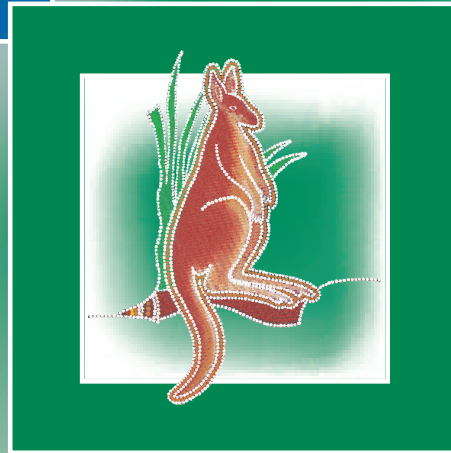
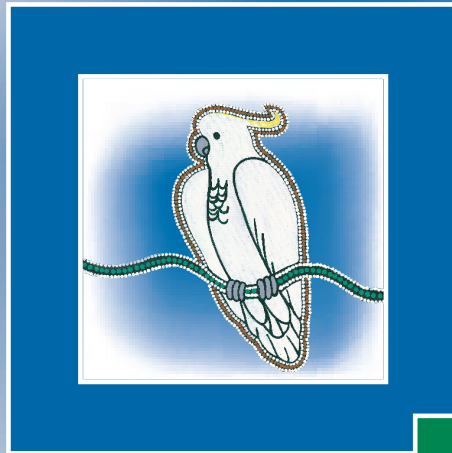
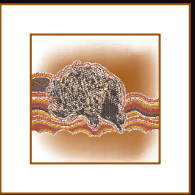
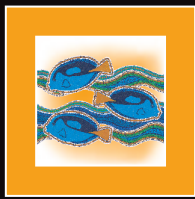


MATH'S MATE

Skill Builder



Blue

Green

J. B. Wright





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3 4 5 6 7 8 9 10 11 12	Math's Mate Yellow	Student Pad - 3rd Ed.	978 1 921535 22 2
	Math's Mate Red	Student Pad - 3rd Ed.	978 1 921535 23 9
	Math's Mate Blue	Student Pad - 3rd Ed.	978 1 921535 24 6
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FORWARD

Why use Skill Builders?

Too often, through the teaching, learning and assessment process, teachers identify weaknesses and gaps in student learning but the constraints of the classroom severely limit remediation opportunities.

The Math's Mate Skill Builder series was prepared in response to requests from teachers and parents who want an easy but effective way to help students who identify skill deficiencies using the Math's Mate Program, and are motivated to do something about them.

The Math's Mate record keeping sheets found at the start of each term in each Student Pad (and in each Teacher Resource Book and CD) enable students to find out what they know and what they still need to learn and practise.

The Skill Builders extensively target through instruction and practice, all skills within the related Math's Mate Program except the problem solving questions. The Problem Solving Hints & Solutions (in each Teacher Resource Book and CD) can be used by teachers to develop students' problem solving skills. The Skill Builders also contain a Glossary of important facts and reference material that will provide instant help when students present with difficulties.

Background to the design of Math's Mate and Skill Builders



MMBlue	1	2	3	4
MMGreen	1	2	3	4

Any question on the Math's Mate sheets is part of a set of 4 similar questions in the term. For example, consider sheets 1, 2, 3 and 4 in MM Blue term 1. Question 10 on each sheet is similar in design, content and degree of difficulty. This grouping of question style is also true of the next set of four sheets and so on. Thus the Math's Mate tests made available in the Teacher Resource Book and CD also reflect this grouping of question style and substance.

Generally too, the Skill Builders can be linked to each set of 4 similar questions. These links are identified in the grid at the title of each skill. The grid shown here for example, with numbers highlighted in black, would relate a skill to questions in the first 4 sheets of MM Blue term 1, the last 4 sheets of MM Blue term 1 and the first 4 sheets of MM Green term 1. Once understood, these links will be helpful to students in their selection of Skill Builders and to you in your allocation of Skill Builders to students.

On each Math's Mate worksheet, questions 1 through to 33 get progressively harder. (Refer - How to use the Skill Builders, page iv)

Suggestions for the preparation and organization of Skill Builders

Skill Builders are available from www.mathsmate.net. Teachers can either direct students to the internet to download and print their own copies or save the entire Skill Builder to disc and photocopy at will. Rather than photocopying Skill Builders one at a time, you may find it helpful to set up a file in a central area that contains perhaps five copies of each Skill Builder. In this way you will save time and be prepared in advance. The Glossary too can be downloaded or photocopied for students as a resource.

How you can help

We are confident that your students will be rewarded for the effort you have made in making these worksheets available to them either via the internet or through hardcopy. As with any program, however, there is always room for improvement and we place great value in feedback from people like yourself. Please, if you have any suggestions at all, contact us.


How to use Math's Mate Skill Builder

1. Determine which Math's Mate questions pose a difficulty

If a student gets one or more incorrect answers (represented by one or more successive unshaded boxes) on their worksheet results sheet, provided at the start of each term in the Math's Mate Student Pad, then that question requires a Skill Builder.

For example, question 21 in Sheets 1, 2, 3 and 4 is not marked, so Skill 21.1 from Skill Builder 21 needs to be handed to the student.

For data builder help go to www.mathsmate.net

MATH'S MATE 

Name: **Paul Wright** Class: **7B**
Teacher: **Miss Bourke**

Worksheet Results

Term 1	Skill Builder 10				Skill Builder 11			
	Sheet 1	Sheet 2	Sheet 3	Sheet 4	Sheet 5	Sheet 6	Sheet 7	Sheet 8
1. [- Whole Numbers to 10]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. [- Whole Numbers to 10]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. [- Whole Numbers to 12]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. [- Whole Numbers to 12]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. [Large Number +,-]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. [Large Number +,-]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. [Decimal +,-]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. [Decimal ×,-]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. [Fraction +,-]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. [Fraction ×,-]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. [Percents]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. [Decimals / Fractions / Percents]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. [Integers]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. [Rates / Ratios]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. [Exponents / Square Roots]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. [Order of Operations]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. [Ordering Number]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. [Multiples / Factors / Primes]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. [Number Patterns]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. [Expressions]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. [Substitution]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. [Equations]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. [Graphs & Functions]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. [Shapes]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25. [Exploring Geometry]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26. [Units of Measurement / Time]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27. [Perimeters / Area / Volume]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28. [Area / Volume]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
29. [Statistics]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30. [Probability]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
31. [Problem Solving 1]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
32. [Problem Solving 2]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
33. [Problem Solving 3]	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Total Correct	20	24	22	26				

2. Find the relevant Skill Builder on the Math's Mate worksheet results sheet

Check across the question that is posing difficulties on the worksheet results sheet to find the list of skills within the Skill Builder that are most relevant to that question.

Obtain a copy of one or all of the skills listed for that question (pages 1 to 316). You can also double check with the grid at the right of each skill title, that the chosen skill is appropriate.

Remember, students should work through the skills in order. The skills, where possible, are arranged in increasing degree of difficulty. Be aware that some skills may require the knowledge of previous skills.

Generally too, when a student has several areas of weakness, they should work on the lowest numbered question first. For example, a student struggling with Q1 and Q11 will need to build skills required for Q1 before they can improve Q11.

21. [Substitution]

Skill 21.1 Substitute a value for a variable into expressions from other skills.

Use the letters with numbers.

Use the order of operations rule: Add (+) and/or subtract (-) from left to right.

Q. If $a = 5$, find the value of $13 - a$

A. $13 - a$ substitute $a = 5$
 $= 13 - 5$
 $= 8$

a) If $p = 2$, find the value of $5 + p$
 $= 5 + 2 = 7$

b) If $f = 3$, find the value of $6 + f$
 $= \dots = \dots$

c) If $c = 4$, find the value of $4 + c$
 $= \dots = \dots$

d) If $m = 5$, find the value of $m + 3$
 $= \dots = \dots$

e) If $g = 7$, find the value of $g + 2$
 $= \dots = \dots$

f) If $z = 6$, find the value of $z + 1$
 $= \dots = \dots$

g) If $x = 3$, find the value of $x + x$
 $= \dots = \dots$

h) If $v = 4$, find the value of $v + v$
 $= \dots = \dots$

i) If $q = 7$, find the value of $q + q$
 $= \dots = \dots$

j) If $t = 5$, find the value of $t + t + t$
 $= \dots = \dots$

k) If $e = 6$, find the value of $e + e + e$
 $= \dots = \dots$

l) If $p = 8$, find the value of $p + p + p$
 $= \dots = \dots$

m) If $j = 9$, find the value of $j + j - 8$
 $= \dots = \dots$

n) If $k = 7$, find the value of $k + k + 6$
 $= \dots = \dots$

o) If $h = 8$, find the value of $4 + h + h$
 $= \dots = \dots$

p) If $m = 8$, find the value of $m + m - 9$
 $= \dots = \dots$

q) If $s = 6$, find the value of $9 + s + s$
 $= \dots = \dots$

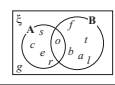
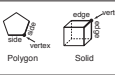
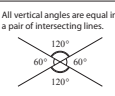
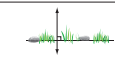
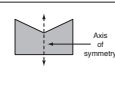
r) If $n = 5$, find the value of $8 + n + n$
 $= \dots = \dots$

page 173 www.mathsmate.net © Math's Mate Blue/Green Skill Builder 21

3. Look up any unknown terms in the Skill Builder glossary

The glossary (pages 317 to 371) is more than just a list of definitions. It contains a wealth of relevant information that may help the students to better understand the question at hand. Weaker students may find that referring to a copy of the glossary, and even building on it, is a helpful strategy for improving their overall mathematical competency.

For example, a student might need to look up the word “variable” before attempting to complete Skill 21.1

SK - UN	unlike terms	• Are <i>terms</i> that contain different <i>variables</i> raised to the different <i>powers</i> . Unlike terms cannot be <i>added</i> or <i>subtracted</i> however they may be <i>multiplied</i> and <i>divided</i> .	Opposite to <i>like terms</i> . 7, 6a and $-4y^3$ are unlike terms. 5w, $\frac{6}{b}$ and $-18w^2$ are unlike terms.
	valid	• Grounded in <i>logic</i> or truth.	If A causes B and B causes C, then it is valid to propose that A may cause C.
	variable	• A letter of the alphabet which stands in for a number. A variable takes the place of: a unknown value or a value which may change (vary) in different situations.	Opposite to a constant. In $y = x + 5$ 5 is constant x and y are variables.
	Venn diagram	• A diagram using circles to show the relationship between <i>sets</i> of objects.	
	vertex	• (pl. <i>vertices</i>) The point at which two <i>sides</i> (of a <i>polygon</i>) or three <i>edges</i> (of a <i>solid</i>) meet.	
	vertical angles	• <i>Angles</i> on opposite sides of a <i>pair</i> of <i>intersecting lines</i> . • Vertical angles are <i>congruent</i> .	All vertical angles are equal in a pair of intersecting lines. 
	vertical line	• A <i>line</i> at <i>right angle</i> to the horizon.	
	vertical symmetry	• A shape has vertical symmetry if an <i>axis of symmetry</i> is vertical.	

4. Complete the relevant Skill Builder

Work through the examples given for that skill, and complete the exercises.

There are many techniques or methods that can be used to teach the same basic skills, even something as simple as adding 7 and 9. It is good for a student to be given a range of alternatives appropriate for each skill but space restrictions make this impossible. These sheets often suggest an approach that may be different to a student’s past experience. If a student feels more comfortable with his current technique, that is fine. In most cases it is the end result that counts.

It is possible to take a very weak student back to a Skill Builder from a lower level if this is necessary. It is also possible to use a higher level book for students to have further practice if required.

5. Correct the relevant Skill Builders from the Skill Builder answer sheets (from page 383)

6. Circle the completed skill numbers on the Math’s Mate worksheet results sheet

16. [Order of Operations]	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8	16.9	16.10	16.11	16.12	16.13	16.14	16.15	16.16	16.17	16.18	16.19	16.20	16.21	16.22	16.23	16.24	16.25	16.26	16.27	16.28	16.29	16.30	16.31	16.32	16.33	16.34	16.35	16.36	16.37	16.38	16.39	16.40	16.41	16.42	16.43	16.44	16.45	16.46	16.47	16.48	16.49	16.50
17. [Exploring Number]	17.1	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.9	17.10	17.11	17.12	17.13	17.14	17.15	17.16	17.17	17.18	17.19	17.20	17.21	17.22	17.23	17.24	17.25	17.26	17.27	17.28	17.29	17.30	17.31	17.32	17.33	17.34	17.35	17.36	17.37	17.38	17.39	17.40	17.41	17.42	17.43	17.44	17.45	17.46	17.47	17.48	17.49	17.50
18. [Multiples / Factors / Primes]	18.1	18.2	18.3	18.4	18.5	18.6	18.7	18.8	18.9	18.10	18.11	18.12	18.13	18.14	18.15	18.16	18.17	18.18	18.19	18.20	18.21	18.22	18.23	18.24	18.25	18.26	18.27	18.28	18.29	18.30	18.31	18.32	18.33	18.34	18.35	18.36	18.37	18.38	18.39	18.40	18.41	18.42	18.43	18.44	18.45	18.46	18.47	18.48	18.49	18.50
19. [Number Patterns]	19.1	19.2	19.3	19.4	19.5	19.6	19.7	19.8	19.9	19.10	19.11	19.12	19.13	19.14	19.15	19.16	19.17	19.18	19.19	19.20	19.21	19.22	19.23	19.24	19.25	19.26	19.27	19.28	19.29	19.30	19.31	19.32	19.33	19.34	19.35	19.36	19.37	19.38	19.39	19.40	19.41	19.42	19.43	19.44	19.45	19.46	19.47	19.48	19.49	19.50
20. [Expressions]	20.1	20.2	20.3	20.4	20.5	20.6	20.7	20.8	20.9	20.10	20.11	20.12	20.13	20.14	20.15	20.16	20.17	20.18	20.19	20.20	20.21	20.22	20.23	20.24	20.25	20.26	20.27	20.28	20.29	20.30	20.31	20.32	20.33	20.34	20.35	20.36	20.37	20.38	20.39	20.40	20.41	20.42	20.43	20.44	20.45	20.46	20.47	20.48	20.49	20.50
21. [Substitution]	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	21.9	21.10	21.11	21.12	21.13	21.14	21.15	21.16	21.17	21.18	21.19	21.20	21.21	21.22	21.23	21.24	21.25	21.26	21.27	21.28	21.29	21.30	21.31	21.32	21.33	21.34	21.35	21.36	21.37	21.38	21.39	21.40	21.41	21.42	21.43	21.44	21.45	21.46	21.47	21.48	21.49	21.50
22. [Equations]	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	22.9	22.10	22.11	22.12	22.13	22.14	22.15	22.16	22.17	22.18	22.19	22.20	22.21	22.22	22.23	22.24	22.25	22.26	22.27	22.28	22.29	22.30	22.31	22.32	22.33	22.34	22.35	22.36	22.37	22.38	22.39	22.40	22.41	22.42	22.43	22.44	22.45	22.46	22.47	22.48	22.49	22.50
23. [Graphs & Functions]	23.1	23.2	23.3	23.4	23.5	23.6	23.7	23.8	23.9	23.10	23.11	23.12	23.13	23.14	23.15	23.16	23.17	23.18	23.19	23.20	23.21	23.22	23.23	23.24	23.25	23.26	23.27	23.28	23.29	23.30	23.31	23.32	23.33	23.34	23.35	23.36	23.37	23.38	23.39	23.40	23.41	23.42	23.43	23.44	23.45	23.46	23.47	23.48	23.49	23.50
24. [Shapes]	24.1	24.2	24.3	24.4	24.5	24.6	24.7	24.8	24.9	24.10	24.11	24.12	24.13	24.14	24.15	24.16	24.17	24.18	24.19	24.20	24.21	24.22	24.23	24.24	24.25	24.26	24.27	24.28	24.29	24.30	24.31	24.32	24.33	24.34	24.35	24.36	24.37	24.38	24.39	24.40	24.41	24.42	24.43	24.44	24.45	24.46	24.47	24.48	24.49	24.50
25. [Exploring Geometry]	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.8	25.9	25.10	25.11	25.12	25.13	25.14	25.15	25.16	25.17	25.18	25.19	25.20	25.21	25.22	25.23	25.24	25.25	25.26	25.27	25.28	25.29	25.30	25.31	25.32	25.33	25.34	25.35	25.36	25.37	25.38	25.39	25.40	25.41	25.42	25.43	25.44	25.45	25.46	25.47	25.48	25.49	25.50
26. [Units of Measurement / Time]	26.1	26.2	26.3	26.4	26.5	26.6	26.7	26.8	26.9	26.10	26.11	26.12	26.13	26.14	26.15	26.16	26.17	26.18	26.19	26.20	26.21	26.22	26.23	26.24	26.25	26.26	26.27	26.28	26.29	26.30	26.31	26.32	26.33	26.34	26.35	26.36	26.37	26.38	26.39	26.40	26.41	26.42	26.43	26.44	26.45	26.46	26.47	26.48	26.49	26.50
27. [Perimeter]	27.1	27.2	27.3	27.4	27.5	27.6	27.7	27.8	27.9	27.10	27.11	27.12	27.13	27.14	27.15	27.16	27.17	27.18	27.19	27.20	27.21	27.22	27.23	27.24	27.25	27.26	27.27	27.28	27.29	27.30	27.31	27.32	27.33	27.34	27.35	27.36	27.37	27.38	27.39	27.40	27.41	27.42	27.43	27.44	27.45	27.46	27.47	27.48	27.49	27.50
28. [Area / Volume]	28.1	28.2	28.3	28.4	28.5	28.6	28.7	28.8	28.9	28.10	28.11	28.12	28.13	28.14	28.15	28.16	28.17	28.18	28.19	28.20	28.21	28.22	28.23	28.24	28.25	28.26	28.27	28.28	28.29	28.30	28.31	28.32	28.33	28.34	28.35	28.36	28.37	28.38	28.39	28.40	28.41	28.42	28.43	28.44	28.45	28.46	28.47	28.48	28.49	28.50

7. Go back and repeat previous Math’s Mate questions

After completing a Skill Builder, students should be encouraged to go back and attempt again those particular questions on the recently completed Math’s Mate sheets.

Dear Parents

As part of their Mathematics program this year, all students have been given a weekly Math's Mate worksheet.

The program is now under way. The diagnostic nature of the worksheets helps students monitor their own progress. After they correct their worksheet and complete the record keeping sheet, over time, your child will be able to identify areas of strength and weakness in their mathematical learning.

If your child is having difficulty with a question for consecutive weeks or believes that their understanding is not at the level they would like, then Skill Builder sheets will be made available to develop each of the skills in the Math's Mate program. Each Skill Builder focuses on and explores, one question from the Math's Mate sheets. Your child is encouraged to make full use of these resources by taking home any sheet that will help consolidate their understanding of a particular skill. Or, for your convenience, all worksheets are available on our website. Simply go to **www.mathsmate.net** and follow the prompts to download the appropriate Skill Builder.

As each question in the Math's Mate is generally more difficult than the last, finishing with the problem solving questions, then it would be advised that, if students are concerned with more than one question, they tackle lower numbered questions first.

The Skill Builders may also help to motivate students to make another attempt at mastering skills that they have found too difficult in the past, given that it will become clear to them that they will be confronted by the same type of question on a regular basis.

While we will be monitoring your child's progress and supporting their skill development in the school environment, it would be appreciated if you would complete the tear off slip at the bottom of this page so that we can be sure that you are aware of our expectations regarding both the Math's Mate worksheets and the availability of Skill Builder worksheets. We ask also that you continue to sign the completed worksheets each week so that we can ensure each student is working independently and regularly but with your support.

We thank you in anticipation of your involvement and remind you that you are encouraged to call and discuss your child's progress at any time.

Yours sincerely

Class Teacher

Principal

Math's Mate Program - Skill Builder Return Slip

Student's Name: Class:

As a parent / guardian I have signed this form to indicate that I am aware of the support Math's Mate Skill Builders can give my child in their mathematical development.

Parent's Signature: Date:

CONTENTS

Forward	iii
How to use Math's Mate Skill Builders	iv
Letter to Parents (sample)	vi
Skill Builders	1
Glossary	317
Math Facts	373
Symbols	
Number Facts	
Algebra Facts	
Measurement Facts	
Geometry Facts	
Answers	383

MM Question	SB Skill No.	[Math's Mate - Mathematical strand] Skill Builder - Skill description	
1.		[+ Whole Numbers to 10]	1
	1.1	Adding whole numbers from 1 to 10.	
	1.2	Adding whole numbers from 1 to 10 from negative numbers.	
2.		[- Whole Numbers to 10]	3
	2.1	Subtracting whole numbers from 1 to 10.	
	2.2	Subtracting whole numbers from 1 to 10 from negative numbers.	
3.		[× Whole Numbers to 12]	5
	3.1	Multiplying whole numbers from 1 to 12	
	3.2	Multiplying whole numbers from 1 to 12 by negative numbers.	
4.		[÷ Whole Numbers to 12]	7
	4.1	Dividing whole numbers from 1 to 12.	
	4.2	Dividing whole numbers from 1 to 12 into negative numbers.	
5.		[Large Number +,-]	9
	5.1	Adding large numbers without carry over.	
	5.2	Subtracting large numbers without carry over.	
	5.3	Adding two large numbers with carry over.	
	5.4	Subtracting large numbers with carry over.	
	5.5	Adding and/or subtracting multiple large numbers with carry over.	
6.		[Large Number ×,÷]	15
	6.1	Multiplying a large number by a power of 10.	
	6.2	Dividing a large number by a power of 10.	
	6.3	Multiplying a large number by a single digit.	
	6.4	Dividing a large number by a single digit.	
	6.5	Multiplying a large number by a multiple of 10.	
	6.6	Dividing a large number by a multiple of 10.	
	6.7	Multiplying a large number by a two-digit number.	
	6.8	Dividing a large number by a two-digit number.	
	6.9	Multiplying a whole number by a large multiple of 10.	
	6.10	Dividing a whole number - answer as a terminating decimal.	
7.		[Decimal +,-]	27
	7.1	Adding decimal numbers.	
	7.2	Subtracting decimal numbers.	
	7.3	Subtracting a decimal number from a whole number.	

MM Question	SB Skill No.	[Math's Mate - Mathematical strand] Skill Builder - Skill description	
8.		[Decimal \times, \div]	33
	8.1	Multiplying a whole number by a decimal number.	
	8.2	Dividing a decimal number by a whole number.	
	8.3	Multiplying a decimal number by a decimal number.	
	8.4	Dividing a decimal number by a decimal number.	
	8.5	Dividing a whole number by a decimal number.	
9.		[Fraction $+, -$]	39
	9.1	Adding fractions with the same denominator.	
	9.2	Subtracting fractions with the same denominator.	
	9.3	Adding mixed numbers with the same denominator.	
	9.4	Subtracting mixed numbers with the same denominator.	
	9.5	Subtracting a fraction or a mixed number from a whole number.	
	9.6	Adding fractions with different denominators - one denominator divides evenly into the other denominator.	
	9.7	Adding fractions with different denominators - the GCF of the denominators is 1 (e.g. 2 and 3, 5 and 6).	
	9.8	Subtracting fractions with different denominators - one denominator divides evenly into the other denominator.	
	9.9	Subtracting fractions with different denominators - the GCF of the denominators is 1 (e.g. 2 and 3, 5 and 6).	
10.		[Fraction \times, \div]	53
	10.1	Multiplying a fraction by a whole number.	
	10.2	Finding a fraction of a quantity.	
	10.3	Dividing a whole number by a fraction.	
	10.4	Multiplying two fractions.	
	10.5	Dividing a fraction by a whole number.	
	10.6	Dividing two fractions.	
11.		[Percents]	65
	11.1	Writing a number out of 100 as a percent.	
	11.2	Finding the remaining percent.	
	11.3	Finding a percent of multiples of 100.	
	11.4	Finding a percent of any number.	
	11.5	Working with percents greater than 100%.	
	11.6	Working with percents to find discounts and sale prices.	
	11.7	Writing one number as a percent of another number.	
	11.8	Calculating profit or loss as a percent of the cost price.	
12.		[Decimals / Fractions / Percents]	75
	12.1	Illustrating fractions and percents.	
	12.2	Simplifying fractions.	
	12.3	Finding equivalent fractions.	
	12.4	Writing a decimal number as a percent.	
	12.5	Writing a percent as a decimal number.	
	12.6	Writing a decimal number as a fraction in simplest form.	
	12.7	Writing a fraction as a terminating decimal.	
	12.8	Writing a percent as a fraction in simplest form.	
	12.9	Writing a fraction as a percent.	
	12.10	Ordering decimal numbers.	
	12.11	Comparing and ordering fractions.	
	12.12	Converting between decimals, fractions and percents.	
	12.13	Comparing decimals, fractions and percents.	
13.		[Integers]	91
	13.1	Comparing and ordering integers.	
	13.2	Comparing integers using 'less than' and 'greater than'.	
	13.3	Modeling integer subtraction on a number line.	
	13.4	Modeling integer subtraction using absolute value.	
	13.5	Modeling integer addition on a number line.	
	13.6	Solving word problems involving two or more integers.	
	13.7	Adding integers.	
	13.8	Subtracting integers.	
	13.9	Multiplying integers.	
	13.10	Dividing integers.	

MM Question	SB Skill No.	[Math's Mate - Mathematical strand] Skill Builder - Skill description	
14.		[Rates / Ratios]	103
	14.1	Simplifying ratios by comparing two numbers.	
	14.2	Simplifying ratios by comparing two quantities.	
	14.3	Solving questions involving distance, time and speed.	
	14.4	Simplifying ratios by comparing three numbers.	
	14.5	Deciding if two ratios form a proportion.	
	14.6	Finding the missing term in a proportion.	
	14.7	Solving word problems involving proportions.	
	14.8	Finding the ratio of two quantities.	
	14.9	Finding other rates.	
15.		[Exponents / Square Roots]	117
	15.1	Expressing powers as products and products as powers.	
	15.2	Squaring whole numbers.	
	15.3	Calculating powers of 10.	
	15.4	Finding square roots of whole numbers.	
	15.5	Evaluating powers of whole numbers.	
	15.6	Finding powers of negative whole numbers.	
16.		[Order of Operations]	123
	16.1	Using 'order of operations' mixing only \times and/or \div , or $+$ and/or $-$	
	16.2	Using 'order of operations' mixing \times , \div , $+$ and/or $-$	
	16.3	Using 'order of operations' mixing () with $+$ and/or $-$	
	16.4	Using 'order of operations' mixing (), \times , \div , $+$, and/or $-$	
	16.5	Using 'order of operations' mixing powers, (), \times , \div , $+$, and/or $-$	
	16.6	Using 'order of operations' involving negative numbers and mixing powers, (), \times , \div , $+$, and/or $-$	
	16.7	Using 'order of operations' mixing square roots, powers, \times , \div , $+$, and/or $-$	
17.		[Exploring Number]	131
	17.1	Comparing whole numbers.	
	17.2	Understanding and finding the place value of a digit in a number.	
	17.3	Writing word numbers in standard form.	
	17.4	Writing whole numbers in word form.	
	17.5	Rounding whole numbers to a given place.	
	17.6	Rounding decimal numbers to a given place.	
	17.7	Recognizing whole numbers and integers.	
	17.8	Writing very large and very small numbers in scientific notation.	
	17.9	Writing numbers in standard form.	
	17.10	Recognizing rational numbers.	
18.		[Multiples / Factors / Primes]	143
	18.1	Finding the multiples of a number.	
	18.2	Finding the common multiples of two numbers.	
	18.3	Finding the least common multiple (LCM) of two numbers.	
	18.4	Finding the factors of a number.	
	18.5	Finding the common factors of two numbers.	
	18.6	Finding the greatest common factor (GCF) of two numbers.	
	18.7	Recognizing prime and composite numbers.	
	18.8	Expressing a number as a product of its prime factors using a factor tree.	
	18.9	Expressing a number as a product of its prime factors using consecutive divisions.	
	18.10	Expressing a number as a product of its prime factors using exponential notation.	
19.		[Number Patterns]	155
	19.1	Completing number patterns by adding the same number.	
	19.2	Completing number patterns by subtracting the same number.	
	19.3	Completing number patterns by adding or subtracting decimal numbers.	
	19.4	Completing number patterns in table format by adding the same number.	
	19.5	Completing number patterns by multiplying by the same number.	
	19.6	Completing number patterns by dividing by the same number.	
	19.7	Completing number patterns by using changing values in the rule.	
	19.8	Completing number patterns involving negative integers by adding or subtracting the same integer.	
	19.9	Finding a term in a number pattern.	
	19.10	Finding a particular term of a sequence given its general rule.	

MM Question	SB Skill No.	[Math's Mate - Mathematical strand] Skill Builder - Skill description	
20.		[Expressions]	167
	20.1	Simplifying expressions by adding and subtracting like terms (coefficient = 1).	
	20.2	Simplifying expressions by adding and subtracting like terms (coefficient ≥ 1).	
	20.3	Finding like terms.	
	20.4	Simplifying expressions by first grouping like terms.	
	20.5	Writing expressions to represent word problems.	
21.		[Substitution]	173
	21.1	Substituting one value into expressions involving + and –	
	21.2	Substituting one value into expressions involving \cdot and \div	
	21.3	Substituting one value into expressions involving +, –, \cdot and \div	
	21.4	Substituting negative values into expressions.	
	21.5	Substituting two values into expressions involving + and –	
	21.6	Substituting two values into expressions involving \cdot and \div	
	21.7	Substituting two values into expressions involving +, –, \cdot and \div	
	21.8	Substituting into expressions involving powers.	
	21.9	Substituting into expressions with brackets.	
	21.10	Substituting into formulae.	
22.		[Equations]	183
	22.1	Finding the missing number in equations involving + and –	
	22.2	Finding the missing number in equations involving \times	
	22.3	Finding the missing number in equations involving fractions.	
	22.4	Finding the missing number in equations involving +, –, \times and/or brackets.	
	22.5	Finding the missing number in equations involving decimals.	
	22.6	Solving one-step equations by using the inverse operations of + and –	
	22.7	Solving one-step equations by using the inverse operations of \cdot and \div	
	22.8	Solving two-step equations by using the inverse operations of +, –, \cdot and \div	
23.		[Graphs & Functions]	199
	23.1	Describing the position of ordered pairs on a coordinate plane.	
	23.2	Using grid references to describe location on a map.	
	23.3	Using coordinates to describe location on a map.	
	23.4	Finding the coordinates of a point on a coordinate plane.	
	23.5	Graphing ordered pairs on a coordinate plane.	
	23.6	Writing linear expressions to represent real-life situations.	
	23.7	Interpreting distance-time graphs and other linear graphs.	
	23.8	Completing a table of values for a linear function.	
	23.9	Graphing linear functions on a coordinate plane.	
24.		[Shapes]	215
	24.1	Measuring angles using a protractor.	
	24.2	Estimating the size of angles.	
	24.3	Recognizing polygons and quadrilaterals.	
	24.4	Classifying and describing the properties of quadrilaterals.	
	24.5	Drawing lines and polygons.	
	24.6	Classifying and describing the properties of 3D shapes.	
	24.7	Classifying angles.	
	24.8	Classifying and describing the properties of triangles.	
	24.9	Working with vertical angles and complementary angles.	
	24.10	Working with supplementary angles.	
	24.11	Finding the size of angles inside a triangle.	
	24.12	Finding the size of angles inside a quadrilateral.	
	24.13	Describing the properties of circles.	

MM Question	SB Skill No.	[Math's Mate - Mathematical strand] Skill Builder - Skill description	
25.		[Exploring Geometry]	231
	25.1	Following directions and using compass bearings to describe location on a map.	
	25.2	Identifying and classifying symmetry in two-dimensional shapes.	
	25.3	Using a scale to calculate distance on a map.	
	25.4	Recognizing basic transformations of two-dimensional shapes.	
	25.5	Drawing translations, reflections and rotations of objects on a grid.	
	25.6	Recognizing congruence of two-dimensional shapes.	
	25.7	Recognizing similarity of two-dimensional shapes.	
	25.8	Recognizing nets of three-dimensional shapes.	
	25.9	Drawing top, side and front views of three-dimensional shapes.	
	25.10	Recognizing the shapes of cross sections through three-dimensional shapes.	
	25.11	Recognizing rotational symmetry in two-dimensional shapes.	
26.		[Units of Measurement / Time]	245
	26.1	Converting customary units of length.	
	26.2	Converting metric units of length.	
	26.3	Converting customary units of mass.	
	26.4	Converting metric units of mass.	
	26.5	Converting customary units of capacity.	
	26.6	Converting metric units of capacity.	
	26.7	Converting units of time.	
	26.8	Finding the elapsed time between two events.	
27.		[Perimeter]	253
	27.1	Finding the perimeter of polygons by measuring their side lengths.	
	27.2	Calculating the perimeter of polygons when all side lengths are given.	
	27.3	Calculating the perimeter of polygons by recognizing congruent sides.	
	27.4	Calculating the perimeter of polygons using real life examples.	
	27.5	Calculating the perimeter of polygons using unit conversions.	
	27.6	Calculating the perimeter of composite shapes.	
	27.7	Calculating an unknown side length when the perimeter of a polygon is given.	
	27.8	Calculating the circumference of circles.	
	27.9	Calculating the perimeter of composite shapes by first finding missing side lengths.	
	27.10	Calculating the perimeter of polygons by using Pythagorean theorem.	
28.		[Area / Volume]	265
	28.1	Calculating the area of polygons by counting squares and triangles on a grid.	
	28.2	Comparing the area of polygons on a square grid.	
	28.3	Estimating the area of irregular shapes on a square grid.	
	28.4	Calculating the area of squares, rectangles and parallelograms.	
	28.5	Calculating the area of triangles.	
	28.6	Calculating the volume of rectangular prisms by counting cubes.	
	28.7	Calculating the volume of square and rectangular prisms.	
	28.8	Calculating the area of composite shapes.	
	28.9	Calculating the area of trapezoids and rhombii.	
	28.10	Calculating the area of circles and composite circular shapes.	
	28.11	Calculating the volume of any prisms.	
29.		[Statistics]	283
	29.1	Interpreting line plots.	
	29.2	Interpreting pictograms.	
	29.3	Interpreting tables.	
	29.4	Interpreting bar graphs.	
	29.5	Interpreting stack graphs.	
	29.6	Calculating the mean and median of sets of data.	
	29.7	Calculating the mode and range of sets of data.	
	29.8	Interpreting line graphs.	
	29.9	Interpreting circle graphs.	
	29.10	Interpreting more complex graphs.	
	29.11	Interpreting stem-and-leaf plots.	

MM Question	SB Skill No.	[Math's Mate - Mathematical strand] Skill Builder - Skill description	
30.		[Probability]	301
	30.1	Describing the degree of likelihood of an event.	
	30.2	Recognizing the likelihood of an event.	
	30.3	Finding the possible outcomes (sample spaces) of an event by completing tables.	
	30.4	Finding the possible outcomes (sample spaces) of an event by completing tree diagrams.	
	30.5	Calculating the probability of a simple event.	
	30.6	Calculating the probability of a simple event using probability scales.	
	30.7	Interpreting Venn diagrams.	
	30.8	Calculating the probability of complementary events.	
	30.9	Calculating the probability of mutually exclusive events.	
	30.10	Finding the possible outcomes of an event by applying the counting principle.	

1. [+ Whole Numbers to 10]

Skill 1.1 Adding whole numbers from 1 to 10.

MMBlue 11 22 33 44
MMGreen 11 22 33 44

EITHER

Regroup into easier numbers

- Break a number up so that you can work with lots of 10

Example: $5 + 8$
 $= 5 + 5 + 3$
 $= 10 + 3$
 $= 13$

OR

Count on

- Start with the largest number and count on the smaller amount.

Example: $8 + 5$
 $\Rightarrow 9, 10, 11, 12, 13$

OR

Use an addition table

- Move down the column and across the row to find the intersection.

+	1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10	11
2	3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12	13
4	5	6	7	8	9	10	11	12	13	14
5	6	7	8	9	10	11	12	13	14	15
6	7	8	9	10	11	12	13	14	15	16
7	8	9	10	11	12	13	14	15	16	17
8	9	10	11	12	13	14	15	16	17	18
9	10	11	12	13	14	15	16	17	18	19
10	11	12	13	14	15	16	17	18	19	20

Example: $8 + 5 = 5 + 8 = 13$

Hint: Addition tables are symmetrical.

Q.

	5	2	7	3	8	6	1	10	9	4
+ 8										

Add 8 to each of the numbers in the top row.

A.

	5	2	7	3	8	6	1	10	9	4
+ 8	13	10	15	11	16	14	9	18	17	12

a)

	5	7	10	9	16	8	3	4	12	11
+ 10	15	17	20							

b)

	3	12	6	8	10	7	4	9	5	11
+ 3										

c)

	23	16	12	18	9	11	20	7	15	24
+ 6										

d)

	32	8	35	7	19	13	11	44	16	10
+ 5										

e)

	14	45	20	86	19	47	15	32	8	23
+ 7										

Skill 1.2 Adding whole numbers from 1 to 10 to negative numbers.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Use a number line.

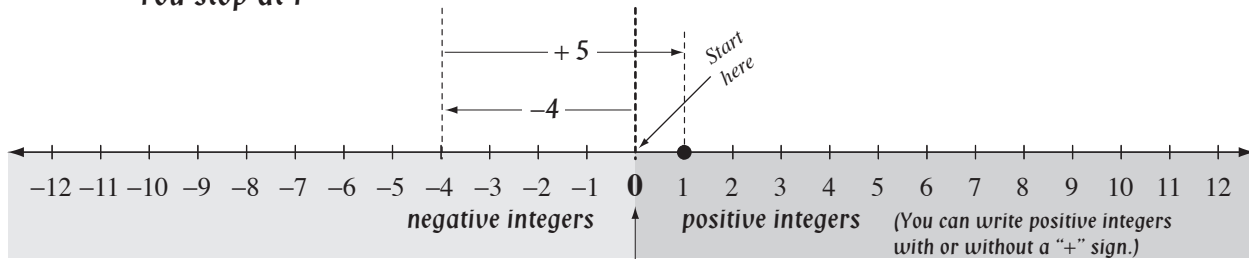
Example: $-4 + 5$ is read as: *negative 4 plus 5*

Start at 0

Move 4 units to the left (negative direction).

Move 5 units to the right (positive direction).

You stop at 1



Q.		-4	-6	12	-10	9	-3	5	-11	-7	8
	+ 5										

Add 5 to each of the numbers on the top row.

A.		-4	-6	12	-10	9	-3	5	-11	-7	8
	+ 5	1	-1	17	-5	14	2	10	-6	-2	13

a)		3	-9	11	-6	7	12	-4	15	8	-10
	+ 2	5									

b)		6	-7	-3	10	9	-5	8	4	11	-12
	+ 4										

c)		11	-2	5	-8	10	-14	7	-19	3	-26
	+ 8										

d)		9	-13	27	-1	46	38	-15	24	12	-30
	+ 6										

e)		35	-8	34	19	-42	26	-13	-20	7	-11
	+ 9										

f)		12	-44	-18	23	86	9	-11	-5	10	-27
	+ 7										

2. [- Whole Numbers to 10]

Skill 2.1 Subtracting whole numbers from 1 to 10.

MMBlue 11 22 33 44
MMGreen 11 22 33 44

EITHER

Break down to easier numbers

- Break a number down so that you can work with lots of 10

Example: $16 - 9$
 $= 15 - 8$
 $= 14 - 7$
 $= 13 - 6$
 $= 12 - 5$
 $= 11 - 4$
 $= 10 - 3$
 $= 7$

Make 16 into 10 by taking 6 from both 16 and 9.

OR

Build up to easier numbers

- Build a number up so that you can work with lots of 10.

Example: $16 - 9$
 Add 1 to 9 to make 10 and another 6 to get to 16.
 $1 + 6 = 7$

OR

Use an addition table

- Move down the column and across the row to find the intersection.

+	1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10	11
2	3	4	5	6	7	8	9	10	11	12
3	4	5	6	7	8	9	10	11	12	13
4	5	6	7	8	9	10	11	12	13	14
5	6	7	8	9	10	11	12	13	14	15
6	7	8	9	10	11	12	13	14	15	16
7	8	9	10	11	12	13	14	15	16	17
8	9	10	11	12	13	14	15	16	17	18
9	10	11	12	13	14	15	16	17	18	19
10	11	12	13	14	15	16	17	18	19	20

Example: $16 - 9 = ?$
 Reword the subtraction by turning it into an addition.
 What number when added to 9 will give 16?
 From the addition table,
 $9 + 7 = 16$
 So $16 - 9 = 7$

Q.

	16	14	17	10	18	13	11	19	15	12
- 9										

Subtract 9 from each of the numbers in the top row.

A.

	16	14	17	10	18	13	11	19	15	12
- 9	7	5	8	1	9	4	2	10	6	3

a)

	5	4	10	7	12	11	8	9	3	6
- 2	3									

b)

	14	17	10	15	12	18	13	16	11	9
- 8										

c)

	14	16	9	23	21	7	15	12	30	28
- 4										

d)

	20	14	23	16	32	25	17	18	11	49
- 7										

Skill 2.2 Subtracting whole numbers from 1 to 10 from negative numbers.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Use a number line.

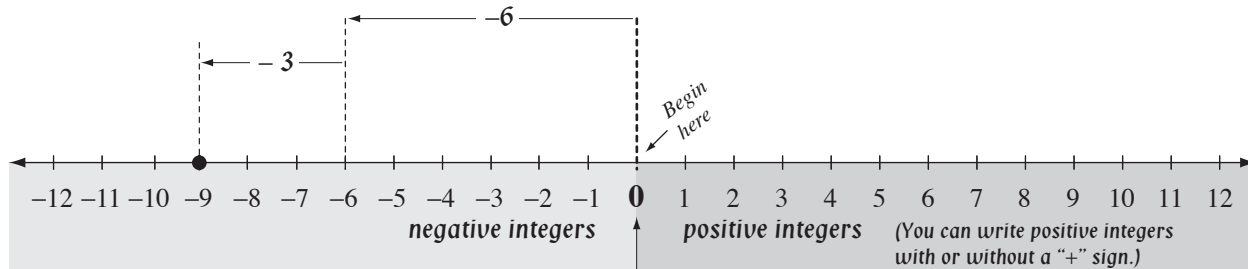
Example: $-6 - 3$ is read as: *negative 6 subtract 3 OR negative 6 minus 3*

Start at 0

Move 6 units to the left (negative direction).

Move 3 units to the left again (negative direction).

You stop at negative 9



Q.		-6	3	9	-7	10	1	5	-4	2	-8	Subtract 3 from each of the numbers on the top row.
	-3											

A.		-6	3	9	-7	10	1	5	-4	2	-8
	-3	-9	0	6	-10	7	-2	2	-7	-1	-11

a)		10	6	-8	15	-11	7	4	-9	2	-13
	-5	5									

b)		-6	7	-3	10	9	-5	8	4	1	-12
	-2										

c)		10	-5	-7	1	-12	9	3	14	-6	8
	-4										

d)		12	-8	19	-5	1	-10	-6	13	17	-4
	-8										

e)		35	24	-8	19	-42	26	3	-20	7	-11
	-6										

f)		15	57	-18	11	-49	-20	4	33	6	72
	-9										

3. [× Whole Numbers to 12]

Skill 3.1 Multiplying whole numbers from 1 to 12.

MMBlue 11 22 33 44
MMGreen 11 22 33 44

Use a multiplication table

- Find one of the numbers to be multiplied across the top row.
- Find the other number to be multiplied down the left hand side column.
- Follow the line of each number until they intersect at their product.

Example: The product of 3 and 9 is 27

$$3 \times 9 = 27$$

$$\text{Since } 3 \times 9 = 9 \times 3 = 27$$

multiplication tables are symmetrical.

Hint: This means you only need to learn half of your times tables.

MULTIPLICATION TABLE

×	1	2	3	4	5	6	7	8	9	10	11	12
1	1	2	3	4	5	6	7	8	9	10	11	12
2	2	4	6	8	10	12	14	16	18	20	22	24
3	3	6	9	12	15	18	21	24	27	30	33	36
4	4	8	12	16	20	24	28	32	36	40	44	48
5	5	10	15	20	25	30	35	40	45	50	55	60
6	6	12	18	24	30	36	42	48	54	60	66	72
7	7	14	21	28	35	42	49	56	63	70	77	84
8	8	16	24	32	40	48	56	64	72	80	88	96
9	9	18	27	36	45	54	63	72	81	90	99	108
10	10	20	30	40	50	60	70	80	90	100	110	120
11	11	22	33	44	55	66	77	88	99	110	121	132
12	12	24	36	48	60	72	84	96	108	120	132	144

Q.

	3	12	9	7	4	5	10	8	6	11
× 9										

Multiply each of the numbers in the top row by 9.

A.

	3	12	9	7	4	5	10	8	6	11
× 9	27	108	81	63	36	45	90	72	48	99

a)

	4	8	11	10	5	6	1	7	9	2
× 4	16									

b)

	1	5	10	7	4	9	12	8	3	6
× 2										

c)

	8	10	2	7	9	3	11	5	6	4
× 10										

d)

	2	4	8	5	7	6	12	9	11	3
× 8										

e)

	10	4	3	6	2	5	7	8	12	9
× 12										

Use a multiplication table

- Find one of the numbers to be multiplied across the top row.
- Find the other number to be multiplied down the left hand side column.
- Follow the line of each number until they intersect at their product.
- Then apply the rule:

When multiplying a positive number by a negative number, the result is always negative, and vice versa.

+	-	=	-
-	+	=	-

Example: The product of negative 3 and 6 is negative 18

$$-3 \times 6 = -18$$

$$\text{Since } -3 \times 6 = 6 \times -3 = -18$$

multiplication tables are symmetrical.

MULTIPLICATION TABLE

×	1	2	3	4	5	6	7	8	9	10	11	12
1	1	2	3	4	5	6	7	8	9	10	11	12
2	2	4	6	8	10	12	14	16	18	20	22	24
3	3	6	9	12	15	18	21	24	27	30	33	36
4	4	8	12	16	20	24	28	32	36	40	44	48
5	5	10	15	20	25	30	35	40	45	50	55	60
6	6	12	18	24	30	36	42	48	54	60	66	72
7	7	14	21	28	35	42	49	56	63	70	77	84
8	8	16	24	32	40	48	56	64	72	80	88	96
9	9	18	27	36	45	54	63	72	81	90	99	108
10	10	20	30	40	50	60	70	80	90	100	110	120
11	11	22	33	44	55	66	77	88	99	110	121	132
12	12	24	36	48	60	72	84	96	108	120	132	144

Q.

	-3	7	9	-11	5	-4	2	-10	-8	12
× 6										

Multiply each of the numbers in the top row by 6.

A.

	-3	7	9	-11	5	-4	2	-10	-8	12
× 6	-18	42	54	-66	30	-24	12	-60	-48	72

Use the rule:
A negative number multiplied by a positive number results in a negative number.

a)

	3	-5	8	-7	-11	6	2	-4	12	9
× 3	9	-15								

b)

	7	-4	-2	3	8	-5	9	1	6	-10
× 5	35									

c)

	-6	2	11	-5	10	8	-4	9	-7	1
× 11										

d)

	-7	3	-1	-2	9	-6	10	5	-8	4
× 4										

e)

	2	-7	9	-5	3	6	-12	10	-4	8
× 7										

f)

	-12	3	8	-4	-7	-9	5	11	10	-6
× 9										

4. [÷ Whole Numbers to 12]

Skill 4.1 Dividing whole numbers from 1 to 12.

MMBlue 11 22 33 44
MMGreen 11 22 33 44

- Reword the division by turning it into a multiplication.
- Use a multiplication table.
- Convert the multiplication back to a division.

Example: How many 6's go into 42?

$$42 \div 6 = ?$$

Reworded: What number multiplied by 6 equals 42?

$$6 \times ? = 42$$

From the multiplication table, $6 \times 7 = 42$

$$\text{So } 42 \div 6 = 7$$

MULTIPLICATION TABLE

×	1	2	3	4	5	6	7	8	9	10	11	12
1	1	2	3	4	5	6	7	8	9	10	11	12
2	2	4	6	8	10	12	14	16	18	20	22	24
3	3	6	9	12	15	18	21	24	27	30	33	36
4	4	8	12	16	20	24	28	32	36	40	44	48
5	5	10	15	20	25	30	35	40	45	50	55	60
6	6	12	18	24	30	36	42	48	54	60	66	72
7	7	14	21	28	35	42	49	56	63	70	77	84
8	8	16	24	32	40	48	56	64	72	80	88	96
9	9	18	27	36	45	54	63	72	81	90	99	108
10	10	20	30	40	50	60	70	80	90	100	110	120
11	11	22	33	44	55	66	77	88	99	110	121	132
12	12	24	36	48	60	72	84	96	108	120	132	144

Q.

	42	60	18	36	30	54	72	24	12	48
÷ 6										

Divide each of the numbers in the top row by 6.

A.

	42	60	18	36	30	54	72	24	12	48
÷ 6	7	10	3	6	5	9	12	4	2	8

a)

	16	28	8	40	24	20	4	32	36	44
÷ 4	4									

b)

	99	66	33	121	44	88	77	110	11	22
÷ 11										

c)

	40	90	120	30	100	10	70	50	80	60
÷ 10										

d)

	56	14	28	70	63	7	21	84	42	77
÷ 7										

e)

	120	48	36	24	144	60	12	96	84	72
÷ 12										

Skill 4.2 Dividing whole numbers from 1 to 12 into negative numbers.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Rerword the division by turning it into a multiplication.
- Use a multiplication table.
- Convert the multiplication back to a division.
- Then apply the rule:

When dividing a negative number
by a positive number,
the result is always negative, and vice versa.

$$\begin{array}{l} + - = - \\ - + = - \end{array}$$

Example: How many 5's go into negative 30?

$$-30 \div 5 = ?$$

Rerworded: What number multiplied by 5 gives
negative 30?

$$5 \times ? = -30$$

From the multiplication table, $5 \times -6 = -30$

$$\text{So } -30 \div 5 = -6$$

MULTIPLICATION TABLE

×	1	2	3	4	5	6	7	8	9	10	11	12
1	1	2	3	4	5	6	7	8	9	10	11	12
2	2	4	6	8	10	12	14	16	18	20	22	24
3	3	6	9	12	15	18	21	24	27	30	33	36
4	4	8	12	16	20	24	28	32	36	40	44	48
5	5	10	15	20	25	30	35	40	45	50	55	60
6	6	12	18	24	30	36	42	48	54	60	66	72
7	7	14	21	28	35	42	49	56	63	70	77	84
8	8	16	24	32	40	48	56	64	72	80	88	96
9	9	18	27	36	45	54	63	72	81	90	99	108
10	10	20	30	40	50	60	70	80	90	100	110	120
11	11	22	33	44	55	66	77	88	99	110	121	132
12	12	24	36	48	60	72	84	96	108	120	132	144

Q.

	-30	-55	-25	15	35	40	50	-45	-20	60
÷ 5										

Divide each of the numbers
in the top row by 5.

Use the rule:

A negative number divided
by a positive number results
in a negative number.

A.

	-30	-55	-25	15	35	40	50	-45	-20	60
÷ 5	-6	-11	-5	3	7	8	10	-9	-4	12

a)

	12	21	-6	30	15	-21	36	-33	3	-24
÷ 3	4									

b)

	5	-30	10	45	-35	40	-25	60	15	-20
÷ 5										

c)

	-44	88	121	-55	22	77	-33	11	-66	99
÷ 11										

d)

	56	72	-8	-40	32	16	64	-24	48	-80
÷ 8										

e)

	66	-48	36	-24	18	60	-12	30	54	-42
÷ 6										

f)

	108	-90	-9	-45	63	36	-72	99	-18	27
÷ 9										

5. [Large Number +,-]

Skill 5.1 Adding large numbers without carry over.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Always keep your working columns in line, aligning units with units, tens with tens, etc.
- Add from right to left.

Q. $1276 + 4520 =$

A. $1276 + 4520 = 5796$

$$\begin{array}{r}
 1\ 2\ 7\ 6 \\
 +\ 4\ 5\ 2\ 0 \\
 \hline
 5\ 7\ 9\ 6
 \end{array}$$

thousands
hundreds
tens
units

Units: $6 + 0 = 6 \Rightarrow 6$ units

Tens: $7 + 2 = 9 \Rightarrow 9$ tens

Hundreds: $2 + 5 = 7 \Rightarrow 7$ hundreds

Thousands: $1 + 4 = 5 \Rightarrow 5$ thousands

a) $5420 + 362 =$

$$\begin{array}{r}
 5\ 4\ 2\ 0 \\
 +\ 3\ 6\ 2 \\
 \hline
 5\ 7\ 8\ 2
 \end{array}$$

b) $1674 + 125 =$

$$\begin{array}{r}
 1\ 6\ 7\ 4 \\
 +\ 1\ 2\ 5 \\
 \hline
 \end{array}$$

c) $2081 + 406 =$

$$\begin{array}{r}
 2\ 0\ 8\ 1 \\
 +\ 4\ 0\ 6 \\
 \hline
 \end{array}$$

d) $2316 + 350 =$

$$\begin{array}{r}
 2\ 3\ 1\ 6 \\
 +\ 3\ 5\ 0 \\
 \hline
 \end{array}$$

e) $1854 + 124 =$

$$\begin{array}{r}
 1\ 8\ 5\ 4 \\
 +\ 1\ 2\ 4 \\
 \hline
 \end{array}$$

f) $3224 + 360 =$

$$\begin{array}{r}
 3\ 2\ 2\ 4 \\
 +\ 3\ 6\ 0 \\
 \hline
 \end{array}$$

g) $2246 + 7401 =$

$$\begin{array}{r}
 2\ 2\ 4\ 6 \\
 +\ 7\ 4\ 0\ 1 \\
 \hline
 \end{array}$$

h) $3517 + 2262 =$

$$\begin{array}{r}
 3\ 5\ 1\ 7 \\
 +\ 2\ 2\ 6\ 2 \\
 \hline
 \end{array}$$

i) $1843 + 3026 =$

$$\begin{array}{r}
 1\ 8\ 4\ 3 \\
 +\ 3\ 0\ 2\ 6 \\
 \hline
 \end{array}$$

j) $7024 + 1721 =$

$$\begin{array}{r}
 7\ 0\ 2\ 4 \\
 +\ 1\ 7\ 2\ 1 \\
 \hline
 \end{array}$$

k) $3251 + 3641 =$

$$\begin{array}{r}
 3\ 2\ 5\ 1 \\
 +\ 3\ 6\ 4\ 1 \\
 \hline
 \end{array}$$

l) $4835 + 2163 =$

$$\begin{array}{r}
 4\ 8\ 3\ 5 \\
 +\ 2\ 1\ 6\ 3 \\
 \hline
 \end{array}$$

Skill 5.2 Subtracting large numbers without carry over.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Always keep your working columns in line, aligning units with units, tens with tens, etc.
- Subtract from right to left.

Q. $2718 - 1403 =$

A. $2718 - 1403 = 1315$

Units: $8 - 3 = 5 \Rightarrow 5$ units

Tens: $1 - 0 = 1 \Rightarrow 1$ ten

Hundreds: $7 - 4 = 3 \Rightarrow 3$ hundreds

Thousands: $2 - 1 = 1 \Rightarrow 1$ thousand

$$\begin{array}{r} 2718 \\ - 1403 \\ \hline 1315 \end{array}$$

thousands
hundreds
tens
units

a) $5899 - 473 =$

5426

$$\begin{array}{r} 5899 \\ - 473 \\ \hline 5426 \end{array}$$

b) $1473 - 302 =$

$$\begin{array}{r} 1473 \\ - 302 \\ \hline \end{array}$$

c) $1384 - 261 =$

$$\begin{array}{r} 1384 \\ - 261 \\ \hline \end{array}$$

d) $8641 - 240 =$

$$\begin{array}{r} 8641 \\ - 240 \\ \hline \end{array}$$

e) $2756 - 304 =$

$$\begin{array}{r} 2756 \\ - 304 \\ \hline \end{array}$$

f) $8792 - 3420 =$

$$\begin{array}{r} 8792 \\ - 3420 \\ \hline \end{array}$$

g) $6207 - 3201 =$

$$\begin{array}{r} 6207 \\ - 3201 \\ \hline \end{array}$$

h) $7493 - 2151 =$

$$\begin{array}{r} 7493 \\ - 2151 \\ \hline \end{array}$$

i) $9867 - 6456 =$

$$\begin{array}{r} 9867 \\ - 6456 \\ \hline \end{array}$$

j) $7085 - 4013 =$

$$\begin{array}{r} 7085 \\ - 4013 \\ \hline \end{array}$$

k) $8782 - 6241 =$

$$\begin{array}{r} 8782 \\ - 6241 \\ \hline \end{array}$$

l) $5694 - 3564 =$

$$\begin{array}{r} 5694 \\ - 3564 \\ \hline \end{array}$$

Skill 5.3 Adding two large numbers with carry over.

MMBlue 1 1 2 2 3 4
MMGreen 1 1 2 2 3 4

- Always keep your working columns in line, aligning units with units, tens with tens, etc.
- Add from right to left.

Q. $4627 + 1398 =$

A. $4627 + 1398 = 6025$

$$\begin{array}{r}
 \overset{1}{4} \ \overset{1}{6} \ \overset{1}{2} \ 7 \\
 + \ 1 \ 3 \ 9 \ 8 \\
 \hline
 6 \ 0 \ 2 \ 5 \\
 \hline
 \end{array}$$

thousands hundreds tens units

Units: $7 + 8 = 15$
 $15 \text{ units} = 1 \text{ ten and } 5 \text{ units} \Rightarrow 5 \text{ units}$
 Carry the 1 ten to the tens column.

Tens: $2 + 9 + \text{carry } 1 = 12$
 $12 \text{ tens} = 1 \text{ hundred and } 2 \text{ tens} \Rightarrow 2 \text{ tens}$
 Carry the 1 hundred to the next column.

Hundreds: $6 + 3 + \text{carry } 1 = 10$
 $10 \text{ hundreds} = 1 \text{ thousand and } 0 \text{ hundred} \Rightarrow 0 \text{ hundred}$
 Carry the 1 thousand to the next column.

Thousands: $4 + 1 + \text{carry } 1 = 6$
 $\Rightarrow 6 \text{ thousands}$

a) $2873 + 651 =$

3524

$$\begin{array}{r}
 \overset{1}{2} \ \overset{1}{8} \ 7 \ 3 \\
 + \ 6 \ 5 \ 1 \\
 \hline
 3 \ 5 \ 2 \ 4 \\
 \hline
 \end{array}$$

b) $7546 + 372 =$

$$\begin{array}{r}
 7 \ 5 \ 4 \ 6 \\
 + \ 3 \ 7 \ 2 \\
 \hline
 \\
 \hline
 \end{array}$$

c) $261 + 1384 =$

$$\begin{array}{r}
 2 \ 6 \ 1 \\
 + \ 1 \ 3 \ 8 \ 4 \\
 \hline
 \\
 \hline
 \end{array}$$

d) $5783 + 2791 =$

$$\begin{array}{r}
 5 \ 7 \ 8 \ 3 \\
 + \ 2 \ 7 \ 9 \ 1 \\
 \hline
 \\
 \hline
 \end{array}$$

e) $3367 + 2945 =$

$$\begin{array}{r}
 3 \ 3 \ 6 \ 7 \\
 + \ 2 \ 9 \ 4 \ 5 \\
 \hline
 \\
 \hline
 \end{array}$$

f) $1592 + 4318 =$

$$\begin{array}{r}
 1 \ 5 \ 9 \ 2 \\
 + \ 4 \ 3 \ 1 \ 8 \\
 \hline
 \\
 \hline
 \end{array}$$

g) $6256 + 2938 =$

$$\begin{array}{r}
 6 \ 2 \ 5 \ 6 \\
 + \ 2 \ 9 \ 3 \ 8 \\
 \hline
 \\
 \hline
 \end{array}$$

h) $2098 + 3147 =$

$$\begin{array}{r}
 2 \ 0 \ 9 \ 8 \\
 + \ 3 \ 1 \ 4 \ 7 \\
 \hline
 \\
 \hline
 \end{array}$$

i) $5437 + 2659 =$

$$\begin{array}{r}
 5 \ 4 \ 3 \ 7 \\
 + \ 2 \ 6 \ 5 \ 9 \\
 \hline
 \\
 \hline
 \end{array}$$

j) $46,723 + 3581 =$

$$\begin{array}{r}
 4 \ 6, \ 7 \ 2 \ 3 \\
 + \ 3 \ 5 \ 8 \ 1 \\
 \hline
 \\
 \hline
 \end{array}$$

k) $31,054 + 6294 =$

$$\begin{array}{r}
 3 \ 1, \ 0 \ 5 \ 4 \\
 + \ 6 \ 2 \ 9 \ 4 \\
 \hline
 \\
 \hline
 \end{array}$$

l) $58,943 + 2387 =$

$$\begin{array}{r}
 5 \ 8, \ 9 \ 4 \ 3 \\
 + \ 2 \ 3 \ 8 \ 7 \\
 \hline
 \\
 \hline
 \end{array}$$

Skill 5.4 Subtracting large numbers with carry over (1).

MMBlue 1 2 3 4
MMGreen 1 2 3 4

- Always keep your working columns in line, aligning units with units, tens with tens, etc.
- Subtract from right to left.
- Whenever a number cannot be subtracted from another number to give a positive result use:

EITHER

Decomposition method - Borrow from a higher place value and give to a lower place value.

Example: $3541 - 194 = 3347$

Units: $1 - 4 = ?$

Borrow 1 ten from the tens column (reduce the 4 tens to 3 tens) and give it as 10 units to the units column to make 11 units.

$11 - 4 = 7$ units

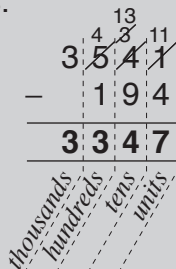
Tens: $3 - 9 = ?$

Borrow 1 hundred from the hundreds column (reduce the 5 hundreds to 4 hundreds) and give it as 10 tens to the tens column to make 13 units.

$13 - 9 = 4$ tens

Hundreds: $4 - 1 = 3$ hundreds

Thousands: $3 - 0 = 3$ thousands



OR

Equal addition method - Each time a number is added to the top it must also be added to the bottom but in different columns.

Example: $3541 - 194 = 3347$

Units: $1 - 4 = ?$

Add 10 units to the 1 and add 10 units (1 ten) to the 9 (bottom number in the tens column)

$11 - 4 = 7$ units

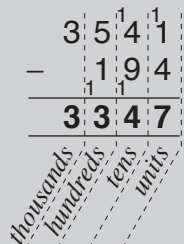
Tens: $4 - (9 + 1) = ?$

Add 10 tens to the 4 and add 10 tens (1 hundred) to the 1 (bottom number in the hundreds column)

$14 - 10 = 4$ tens

Hundreds: $5 - (1 + 1) = 3$ hundreds

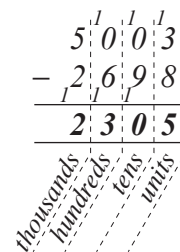
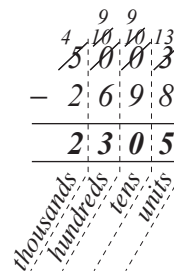
Thousands: $3 - 0 = 3$ thousands



Q. $5003 - 2698 =$

A. $5003 - 2698 = 2305$

Decomposition OR **Equal addition**

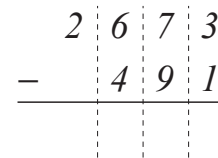
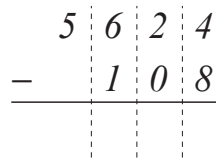
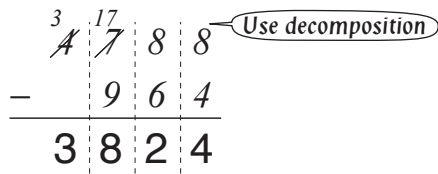


a) $4788 - 964 =$

3824

b) $5624 - 108 =$

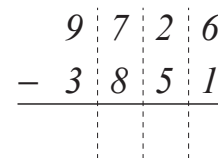
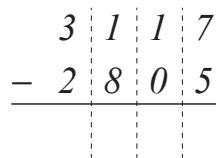
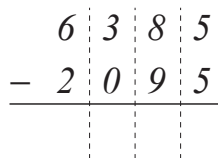
c) $2673 - 491 =$



d) $6385 - 2095 =$

e) $3117 - 2805 =$

f) $9726 - 3851 =$



Skill 5.4 Subtracting large numbers with carry over (2).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

g) $6319 - 254 =$ h) $8536 - 914 =$ i) $4467 - 318 =$

$$\begin{array}{r} 6319 \\ - 254 \\ \hline \end{array}$$

$$\begin{array}{r} 8536 \\ - 914 \\ \hline \end{array}$$

$$\begin{array}{r} 4467 \\ - 318 \\ \hline \end{array}$$

j) $9307 - 2453 =$ k) $4083 - 1957 =$ l) $7062 - 2948 =$

$$\begin{array}{r} 9307 \\ - 2453 \\ \hline \end{array}$$

$$\begin{array}{r} 4083 \\ - 1957 \\ \hline \end{array}$$

$$\begin{array}{r} 7062 \\ - 2948 \\ \hline \end{array}$$

m) $4208 - 657 =$ n) $2009 - 121 =$ o) $3564 - 285 =$

$$\begin{array}{r} 4208 \\ - 657 \\ \hline \end{array}$$

$$\begin{array}{r} 2009 \\ - 121 \\ \hline \end{array}$$

$$\begin{array}{r} 3564 \\ - 285 \\ \hline \end{array}$$

p) $8357 - 489 =$ q) $7231 - 645 =$ r) $6534 - 3977 =$

$$\begin{array}{r} 8357 \\ - 489 \\ \hline \end{array}$$

$$\begin{array}{r} 7231 \\ - 645 \\ \hline \end{array}$$

$$\begin{array}{r} 6534 \\ - 3977 \\ \hline \end{array}$$

s) $45,328 - 8634 =$ t) $31,764 - 5936 =$ u) $72,004 - 4527 =$

$$\begin{array}{r} 45328 \\ - 8634 \\ \hline \end{array}$$

$$\begin{array}{r} 31764 \\ - 5936 \\ \hline \end{array}$$

$$\begin{array}{r} 72004 \\ - 4527 \\ \hline \end{array}$$

v) $63,148 - 7980 =$ w) $52,305 - 4615 =$ x) $28,007 - 3495 =$

$$\begin{array}{r} 63148 \\ - 7980 \\ \hline \end{array}$$

$$\begin{array}{r} 52305 \\ - 4615 \\ \hline \end{array}$$

$$\begin{array}{r} 28007 \\ - 3495 \\ \hline \end{array}$$

- Work from left to right.

Q. $563 + 4027 - 945 =$

A. $563 + 4027 - 945 = 3645$

Complete the addition first
 $563 + 4027 = 4590$
 Then subtract 945 from 4590
 $4590 - 945 = 3645$

		1		
	5	6	3	
+	4	0	2	7
	4	5	9	0
	4	5	9	0
-	9	4	5	
	3	6	4	5
	3	6	4	5

thousands
hundreds
tens
units

a) $1256 + 3875 + 496 =$

5627

b) $883 + 437 + 170 =$

	1	2	5	6
	3	8	7	5
+	4	9	6	
	5	6	2	7

	8	8	3
+			

c) $945 + 34 + 286 + 121 =$

d) $598 + 1763 - 555 =$

	9	4	5
+			

	5	9	8
+			

-	5	5	5

e) $764 + 8359 - 847 =$

f) $1435 + 2957 - 444 =$

	7	6	4
+			

-			

+			

-			

g) $4000 + 10,000 - 11,374 =$

h) $17,000 + 2000 - 13,857 =$

	4	0	0	0
+				

-				

+				

-				

6. [Large Number \times, \div]

Skill 6.1 Multiplying a large number by a power of 10.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

When the multiplication is displayed in a **horizontal line**:

- Add the same number of zeros at the end of the given number as there are zeros in the power of 10.

When the multiplication is displayed in a **vertical algorithm**:

- Move each digit of the given number as many places to the left as there are zeros in the power of 10.
- Add zeros as place holders in the vacated places.

Q. $376 \times 1000 =$

A. $376 \times 1000 = 376,000$ Add 3 zeros

Move 3, 7, 6 three places left

$$\begin{array}{r} 376 \\ \times 1000 \\ \hline 376000 \end{array}$$
Add 3 zeros at the end of 376

a) $318 \times 10 =$

3180

b) $2040 \times 10 =$

20400

c) $9080 \times 10 =$

90800

Add 1 zero

$$\begin{array}{r} 318 \\ \times 10 \\ \hline 3180 \end{array}$$

$$\begin{array}{r} 2040 \\ \times 10 \\ \hline 20400 \end{array}$$

$$\begin{array}{r} 9080 \\ \times 10 \\ \hline 90800 \end{array}$$

d) $238 \times 100 =$

23800

e) $7015 \times 100 =$

701500

f) $4619 \times 100 =$

461900

Add 2 zeros

$$\begin{array}{r} 238 \\ \times 100 \\ \hline 23800 \end{array}$$

$$\begin{array}{r} 7015 \\ \times 100 \\ \hline 701500 \end{array}$$

$$\begin{array}{r} 4619 \\ \times 100 \\ \hline 461900 \end{array}$$

g) $179 \times 1000 =$

179000

h) $412 \times 1000 =$

412000

i) $905 \times 1000 =$

905000

$$\begin{array}{r} 179 \\ \times 1000 \\ \hline 179000 \end{array}$$

$$\begin{array}{r} 412 \\ \times 1000 \\ \hline 412000 \end{array}$$

$$\begin{array}{r} 905 \\ \times 1000 \\ \hline 905000 \end{array}$$

j) $506 \times 1000 =$

506000

k) $803 \times 1000 =$

803000

l) $248 \times 1000 =$

248000

$$\begin{array}{r} 506 \\ \times 1000 \\ \hline 506000 \end{array}$$

$$\begin{array}{r} 803 \\ \times 1000 \\ \hline 803000 \end{array}$$

$$\begin{array}{r} 248 \\ \times 1000 \\ \hline 248000 \end{array}$$

Skill 6.2 Dividing a large number by a power of 10.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Remove as many zeros from the end of the given number as there are zeros in the power of 10.

Hint: If the division is written as a fraction, simply cross off respective zeros from the top and bottom of the fraction.

Q. $850,000 \div 1000 =$

A. $850,000 \div 1000 =$
 $= 850$

OR $850,000 \div 1000$
 $= \frac{850,000}{1000}$
 $= \frac{850,000}{1000}$
 $= 850$

Any division can be written as a fraction.

Simplify by dividing both the numerator and denominator by 1000.

Cross off the respective zeros.

a) $460 \div 10 =$

$= \frac{460}{10}$
 $= \frac{460}{10} = 46$

b) $280 \div 10 =$

$= \frac{280}{10}$
 $= \frac{280}{10} =$

c) $5020 \div 10 =$

$=$
 $=$

d) $8900 \div 100 =$

$= \frac{8900}{100}$
 $= \frac{8900}{100} =$

e) $1500 \div 100 =$

$=$
 $=$

f) $37,000 \div 100 =$

$=$
 $=$

g) $23,000 \div 100 =$

$=$
 $=$

h) $480,000 \div 100 =$

$=$
 $=$

i) $200,500 \div 100 =$

$=$
 $=$

j) $570,000 \div 1000 =$

$=$
 $=$

k) $706,000 \div 1000 =$

$=$
 $=$

l) $309,000 \div 1000 =$

$=$
 $=$

Skill 6.3 Multiplying a large number by a single digit.

- Multiply the number by the single digit working from right to left.
- If there is a 'carry over': First multiply.
Then add on the carry over.

Q. $4019 \times 7 =$

A. $4019 \times 7 = 28,133$

Units: $7 \times 9 = 63$

63 units = 6 tens and 3 units \Rightarrow 3 units
Carry the 6 tens to the next column.

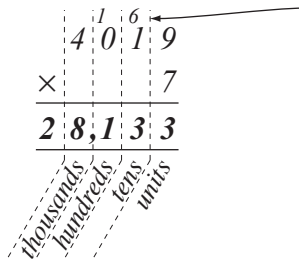
Tens: $7 \times 1 = 7, 7 + 6 = 13$

13 tens = 1 hundred and 3 tens \Rightarrow 3 tens
Carry the 1 hundred to the next column.

Hundreds: $7 \times 0 = 0$

$0 + 1 = 1 \Rightarrow$ 1 hundred

Thousands: $7 \times 4 = 28 \Rightarrow$ 28 thousand

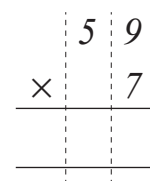
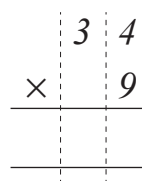
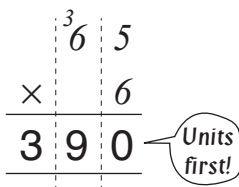


a) $65 \times 6 =$

390

b) $34 \times 9 =$

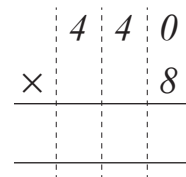
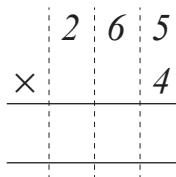
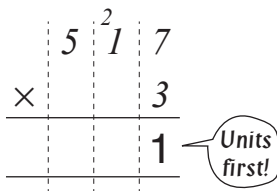
c) $59 \times 7 =$



d) $517 \times 3 =$

e) $265 \times 4 =$

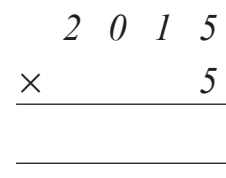
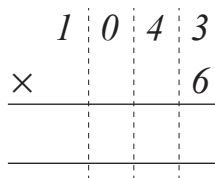
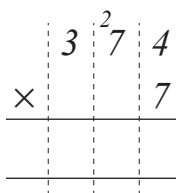
f) $440 \times 8 =$



g) $374 \times 7 =$

h) $1043 \times 6 =$

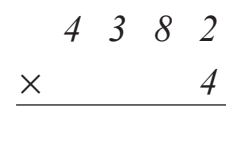
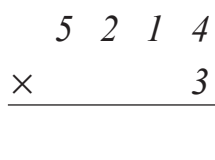
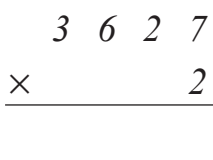
i) $2015 \times 5 =$



j) $3627 \times 2 =$

k) $5214 \times 3 =$

l) $4382 \times 4 =$



Skill 6.4 Dividing a large number by a single digit.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Divide from left to right across the digits one at a time.
- If any result is less than 1: Cross off the number being divided into. 'Carry over' this amount to the next column. Add on the carry. Then try dividing again.

Q. $7168 \div 8 =$

A. $7168 \div 8 = 896$ Divide 8 into 7.

$$\begin{array}{r} 896 \\ 8 \overline{) 7168} \end{array}$$

8 doesn't divide into 7, so 'carry over' the 7 groups of 1000 and make 71 groups of 100.

8 divides into 71 eight times with 7 remainder. Write an 8 above the 1 and carry the remaining 7 groups of 100 to the tens column to make 76 tens.

Divide 8 into 76.

8 divides into 76 nine times and 4 remainder.

Write a 9 above the 6 and carry the remaining 4 groups of tens to the units column to make 48 units.

Divide 8 into 48.

8 divides into 48 six times and 0 remainder.

Write a 6 above the 8.

Read as: 7168 divided by 8

OR How many times can 8 be taken from 7168?

OR How many 8's go into 7168?

a) $468 \div 3 =$

156

$$\begin{array}{r} 156 \\ 3 \overline{) 468} \end{array}$$

b) $356 \div 4 =$

$$\begin{array}{r} 8 \\ 4 \overline{) 356} \end{array}$$

c) $475 \div 5 =$

$$\begin{array}{r} \\ 5 \overline{) 475} \end{array}$$

d) $546 \div 6 =$

$$\begin{array}{r} \\ 6 \overline{) 546} \end{array}$$

e) $296 \div 8 =$

$$\begin{array}{r} \\ 8 \overline{) 296} \end{array}$$

f) $387 \div 9 =$

$$\begin{array}{r} \\ 9 \overline{) 387} \end{array}$$

g) $2214 \div 3 =$

$$\begin{array}{r} 738 \\ 3 \overline{) 2214} \end{array}$$

h) $2046 \div 6 =$

$$\begin{array}{r} \\ 6 \overline{) 2046} \end{array}$$

i) $4085 \div 5 =$

$$\begin{array}{r} \\ 5 \overline{) 4085} \end{array}$$

j) $2364 \div 4 =$

$$\begin{array}{r} \\ 4 \overline{) 2364} \end{array}$$

k) $4347 \div 7 =$

$$\begin{array}{r} \\ 7 \overline{) 4347} \end{array}$$

l) $2392 \div 8 =$

$$\begin{array}{r} \\ 8 \overline{) 2392} \end{array}$$

m) $3608 \div 4 =$

$$\begin{array}{r} \\ 4 \overline{) 3608} \end{array}$$

n) $3725 \div 5 =$

$$\begin{array}{r} \\ 5 \overline{) 3725} \end{array}$$

o) $2268 \div 9 =$

$$\begin{array}{r} \\ 9 \overline{) 2268} \end{array}$$

Skill 6.6 Dividing a large number by a multiple of 10.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Remove as many zeros from the end of the given number as there are zeros in the multiple of 10.
- Divide by the remaining digit working from left to right.

Q. $2280 \div 60 =$

A. $2280 \div 60 =$

$$= \frac{228\cancel{0} \div 10}{6\cancel{0} \div 10}$$

$$= 38$$

$$\begin{array}{r} 38 \\ 6 \overline{) 2280} \end{array}$$

Divide both numbers by 10, by crossing off the zeros.

Complete the division $228 \div 6$
6 divides into 22 three times and 4 remainder.
Write a 3 above the 2 and carry the remaining 4 groups of tens to the units column to make 48 units.

6 divides into 48 eight times and 0 remainder.
Write an 8 above the 8.

a) $5600 \div 20 =$

$$= \frac{560\cancel{0} \div 10}{2\cancel{0} \div 10} = \boxed{280}$$

$$\begin{array}{r} 280 \\ 2 \overline{) 5600} \end{array}$$

b) $4800 \div 30 =$

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

$$\begin{array}{r} \quad \\ 3 \overline{) 4800} \end{array}$$

c) $8160 \div 40 =$

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

$$\begin{array}{r} \quad \\ 4 \overline{) 8160} \end{array}$$

d) $7350 \div 50 =$

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

$$\begin{array}{r} \quad \\ 5 \overline{) \quad \quad} \end{array}$$

e) $9660 \div 60 =$

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

$$\begin{array}{r} \quad \\ 6 \overline{) \quad \quad} \end{array}$$

f) $5240 \div 40 =$

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

$$\begin{array}{r} \quad \\ \quad \overline{) \quad \quad} \end{array}$$

g) $18,000 \div 400 =$

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

$$\begin{array}{r} \quad \\ 4 \overline{) 18000} \end{array}$$

h) $22,000 \div 500 =$

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

$$\begin{array}{r} \quad \\ 5 \overline{) \quad \quad} \end{array}$$

i) $31,000 \div 200 =$

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

$$\begin{array}{r} \quad \\ \quad \overline{) \quad \quad} \end{array}$$

j) $40,500 \div 300 =$

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

$$\begin{array}{r} \quad \\ 3 \overline{) \quad \quad} \end{array}$$

k) $20,400 \div 600 =$

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

$$\begin{array}{r} \quad \\ 6 \overline{) \quad \quad} \end{array}$$

l) $98,700 \div 700 =$

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

$$\begin{array}{r} \quad \\ \quad \overline{) \quad \quad} \end{array}$$

Skill 6.7 Multiplying a large number by a two-digit number (2).

MMBlue 1 1 2 2 3 4
MMGreen 1 1 2 2 3 4

j) $804 \times 75 =$ k) $532 \times 28 =$ l) $926 \times 45 =$

$$\begin{array}{r} 804 \\ \times 75 \\ \hline \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 532 \\ \times 28 \\ \hline \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 926 \\ \times 45 \\ \hline \\ \hline \\ \hline \end{array}$$

m) $1602 \times 19 =$ n) $4086 \times 24 =$ o) $1903 \times 36 =$

$$\begin{array}{r} 1602 \\ \times 19 \\ \hline \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 4086 \\ \times 24 \\ \hline \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 1903 \\ \times 36 \\ \hline \\ \hline \\ \hline \end{array}$$

p) $3015 \times 45 =$ q) $2038 \times 87 =$ r) $5217 \times 23 =$

$$\begin{array}{r} 3015 \\ \times 45 \\ \hline \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 2038 \\ \times 87 \\ \hline \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 5217 \\ \times 23 \\ \hline \\ \hline \\ \hline \end{array}$$

s) $2009 \times 73 =$ t) $3014 \times 46 =$ u) $4268 \times 29 =$

$$\begin{array}{r} 2009 \\ \times 73 \\ \hline \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 3014 \\ \times 46 \\ \hline \\ \hline \\ \hline \end{array}$$

$$\begin{array}{r} 4268 \\ \times 29 \\ \hline \\ \hline \\ \hline \end{array}$$

Skill 6.8 Dividing a large number by a two-digit number (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Work from left to right.
- Break down the division into smaller divisions by dividing into only as many digits as you need to get an answer greater than 1.
- It may be difficult, so guess the number of divisions and multiply your guess to check.
- Subtract your answer from the original number to get the remainder, which must be less than the number you are dividing by.
- Continue in this way by bringing down the next digit to make the next number to divide into.
- Repeat until the result of the subtraction is zero.

Q. $9690 \div 15 =$

A. $9690 \div 15 = \mathbf{646}$

$$\begin{array}{r}
 \overline{) 9690} \\
 \overline{) 96} \\
 \underline{- 90} \\
 69 \\
 \overline{) 69} \\
 \underline{- 60} \\
 90 \\
 \overline{) 90} \\
 \underline{- 90} \\
 0
 \end{array}$$

Start at the left.

9 is too small to divide 15 into, so consider 96.

Divide $96 \div 15 = ?$

6 is a good guess.

Check by multiplying $6 \times 15 = 90$

Subtract $96 - 90 = 6$

Write 6 above the 6.

Bring down the 9.

Divide $69 \div 15 = ?$ (Guess 4)

Check by multiplying $4 \times 15 = 60$

Subtract $69 - 60 = 9$

Write 4 above the 9.

Bring down the 0.

Divide $90 \div 15 = 6$ (No remainder)

Write 6 above the 0.

$$\begin{array}{r}
 \overline{) 9690} \\
 \overline{) 96} \\
 \underline{- 90} \\
 69 \\
 \overline{) 69} \\
 \underline{- 60} \\
 90 \\
 \overline{) 90} \\
 \underline{- 90} \\
 0
 \end{array}$$

OR Work as a short division.

a) $725 \div 25 =$

29

$$\begin{array}{r}
 \overline{) 725} \\
 \overline{) 72} \\
 \underline{- 50} \\
 225 \\
 \overline{) 225} \\
 \underline{- 225} \\
 0
 \end{array}$$

b) $912 \div 16 =$

$$\begin{array}{r}
 \overline{) 912} \\
 \overline{) 91} \\
 \underline{- 80} \\
 112 \\
 \overline{) 112} \\
 \underline{- 96} \\
 162 \\
 \overline{) 162} \\
 \underline{- 160} \\
 2
 \end{array}$$

c) $948 \div 12 =$

$$\begin{array}{r}
 \overline{) 948} \\
 \overline{) 94} \\
 \underline{- 84} \\
 108 \\
 \overline{) 108} \\
 \underline{- 96} \\
 128 \\
 \overline{) 128} \\
 \underline{- 120} \\
 8
 \end{array}$$

d) $2607 \div 11 =$

$$\begin{array}{r}
 \overline{) 2607} \\
 \overline{) 26} \\
 \underline{- 22} \\
 407 \\
 \overline{) 407} \\
 \underline{- 33} \\
 77 \\
 \overline{) 77} \\
 \underline{- 77} \\
 0
 \end{array}$$

e) $3682 \div 14 =$

$$\begin{array}{r}
 \overline{) 3682} \\
 \overline{) 36} \\
 \underline{- 28} \\
 882 \\
 \overline{) 882} \\
 \underline{- 84} \\
 42 \\
 \overline{) 42} \\
 \underline{- 42} \\
 0
 \end{array}$$

f) $4368 \div 12 =$

$$\begin{array}{r}
 \overline{) 4368} \\
 \overline{) 43} \\
 \underline{- 36} \\
 68 \\
 \overline{) 68} \\
 \underline{- 60} \\
 8
 \end{array}$$

Skill 6.8 Dividing a large number by a two-digit number (2).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

g) $5550 \div 15 =$

$$\begin{array}{r} 15 \overline{) 5550} \\ \underline{00} \\ 55 \\ \underline{00} \\ 550 \\ \underline{00} \\ 5500 \\ \underline{00} \\ 5500 \\ \underline{00} \\ 0000 \end{array}$$

h) $8085 \div 11 =$

$$\begin{array}{r} 11 \overline{) 8085} \\ \underline{00} \\ 80 \\ \underline{00} \\ 88 \\ \underline{00} \\ 05 \\ \underline{00} \\ 055 \\ \underline{00} \\ 0550 \\ \underline{00} \\ 0000 \end{array}$$

i) $7680 \div 12 =$

$$\begin{array}{r} 12 \overline{) 7680} \\ \underline{00} \\ 76 \\ \underline{00} \\ 68 \\ \underline{00} \\ 680 \\ \underline{00} \\ 6800 \\ \underline{00} \\ 0000 \end{array}$$

j) $7252 \div 14 =$

$$\begin{array}{r} 14 \overline{) 7252} \\ \underline{00} \\ 72 \\ \underline{00} \\ 55 \\ \underline{00} \\ 52 \\ \underline{00} \\ 520 \\ \underline{00} \\ 0000 \end{array}$$

k) $4224 \div 22 =$

$$\begin{array}{r} 22 \overline{) 4224} \\ \underline{00} \\ 42 \\ \underline{00} \\ 22 \\ \underline{00} \\ 24 \\ \underline{00} \\ 240 \\ \underline{00} \\ 0000 \end{array}$$

l) $5350 \div 25 =$

$$\begin{array}{r} 25 \overline{) 5350} \\ \underline{00} \\ 53 \\ \underline{00} \\ 35 \\ \underline{00} \\ 350 \\ \underline{00} \\ 0000 \end{array}$$

m) $3570 \div 15 =$

$$\begin{array}{r} 15 \overline{) 3570} \\ \underline{00} \\ 35 \\ \underline{00} \\ 27 \\ \underline{00} \\ 270 \\ \underline{00} \\ 0000 \end{array}$$

n) $9030 \div 21 =$

$$\begin{array}{r} 21 \overline{) 9030} \\ \underline{00} \\ 90 \\ \underline{00} \\ 33 \\ \underline{00} \\ 30 \\ \underline{00} \\ 0000 \end{array}$$

o) $3335 \div 23 =$

$$\begin{array}{r} 23 \overline{) 3335} \\ \underline{00} \\ 33 \\ \underline{00} \\ 33 \\ \underline{00} \\ 35 \\ \underline{00} \\ 350 \\ \underline{00} \\ 0000 \end{array}$$

p) $36,864 \div 12 =$

$$\begin{array}{r} 12 \overline{) 36,864} \\ \underline{00} \\ 36 \\ \underline{00} \\ 86 \\ \underline{00} \\ 86 \\ \underline{00} \\ 04 \\ \underline{00} \\ 040 \\ \underline{00} \\ 0000 \end{array}$$

q) $25,795 \div 11 =$

$$\begin{array}{r} 11 \overline{) 25,795} \\ \underline{00} \\ 25 \\ \underline{00} \\ 79 \\ \underline{00} \\ 79 \\ \underline{00} \\ 05 \\ \underline{00} \\ 055 \\ \underline{00} \\ 0000 \end{array}$$

r) $20,650 \div 25 =$

$$\begin{array}{r} 25 \overline{) 20,650} \\ \underline{00} \\ 20 \\ \underline{00} \\ 65 \\ \underline{00} \\ 65 \\ \underline{00} \\ 0000 \end{array}$$

Skill 6.10 Dividing a whole number - answer as a terminating decimal.

MMBlue 11 22 33 44
MMGreen 11 22 33 44

- Line up the decimal point in your answer.
 - Place a decimal point and more zeros at the end of the whole number.
 - Divide into the whole number and continue until you get an exact division with no remainder.
- Hint: When no decimal point is shown it is always placed on the far right of the number.*

Q. $3458 \div 8 =$

A. $3458 \div 8 = 432.25$

Start at the left.

Divide 8 into 3458.00

$$\begin{array}{r} 432.25 \\ 8 \overline{) 3458.00} \end{array}$$

Continue until you get an exact number with no remainder.

a) $1487 \div 2 =$

$$\begin{array}{r} 743.5 \\ 2 \overline{) 1487.0} \end{array}$$

b) $6014 \div 4 =$

$$\begin{array}{r} 1503.5 \\ 4 \overline{) 6014.0} \end{array}$$

c) $2564 \div 5 =$

$$\begin{array}{r} 512.8 \\ 5 \overline{) 2564.0} \end{array}$$

d) $5945 \div 4 =$

$$\begin{array}{r} 1486.25 \\ 4 \overline{) 5945.00} \end{array}$$

e) $3564 \div 8 =$

$$\begin{array}{r} 445.5 \\ 8 \overline{) 3564.0} \end{array}$$

f) $3057 \div 2 =$

$$\begin{array}{r} 1528.5 \\ 2 \overline{) 3057.0} \end{array}$$

g) $1806 \div 5 =$

$$\begin{array}{r} 361.2 \\ 5 \overline{) 1806.0} \end{array}$$

h) $2732 \div 8 =$

$$\begin{array}{r} 341.5 \\ 8 \overline{) 2732.0} \end{array}$$

i) $7263 \div 5 =$

$$\begin{array}{r} 1452.6 \\ 5 \overline{) 7263.0} \end{array}$$

j) $4026 \div 4 =$

$$\begin{array}{r} 1006.5 \\ 4 \overline{) 4026.0} \end{array}$$

k) $7385 \div 2 =$

$$\begin{array}{r} 3692.5 \\ 2 \overline{) 7385.0} \end{array}$$

l) $5862 \div 8 =$

$$\begin{array}{r} 732.75 \\ 8 \overline{) 5862.0} \end{array}$$

m) $9305 \div 2 =$

$$\begin{array}{r} 4652.5 \\ 2 \overline{) 9305.0} \end{array}$$

n) $2189 \div 4 =$

$$\begin{array}{r} 547.25 \\ 4 \overline{) 2189.00} \end{array}$$

o) $9287 \div 5 =$

$$\begin{array}{r} 1857.4 \\ 5 \overline{) 9287.0} \end{array}$$

7. [Decimal +, -]

continues on page 28

Skill 7.1 Adding decimal numbers (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Always keep your working columns in line, aligning the decimal places, units with units, tens with tens, etc.
- Add from right to left.

Q. $43.87 + 9.6 =$

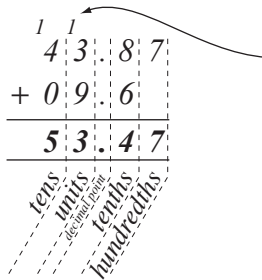
A. $43.87 + 9.6 = 53.47$

Hundredths: $7 + 0 = 7 \Rightarrow 7$ hundredths

Tenths: $8 + 6 = 14 \Rightarrow 4$ tenths
Carry over 10 tenths as 1 unit

Units: $3 + 9 + \text{carry } 1 = 13 \Rightarrow 3$ units
Carry over 10 units as 1 ten

Tens: $4 + 0 + \text{carry } 1 = 5 \Rightarrow 5$ tens



a) $4.82 + 3.09 =$

7.91

$$\begin{array}{r} 4 \ . \ 8 \ 2 \\ + 3 \ . \ 0 \ 9 \\ \hline 7 \ . \ 9 \ 1 \end{array}$$

b) $6.2 + 0.7 =$

$$\begin{array}{r} 6 \ . \ 2 \\ + 0 \ . \ 7 \\ \hline \end{array}$$

c) $51.4 + 3.5 =$

$$\begin{array}{r} 5 \ 1 \ . \ 4 \\ + \quad 3 \ . \ 5 \\ \hline \end{array}$$

d) $78.4 + 25.3 =$

$$\begin{array}{r} 7 \ 8 \ . \ 4 \\ + 2 \ 5 \ . \ 3 \\ \hline \end{array}$$

e) $4.27 + 2.56 =$

$$\begin{array}{r} 4 \ . \ 2 \ 7 \\ + 2 \ . \ 5 \ 6 \\ \hline \end{array}$$

f) $32.6 + 48.3 =$

$$\begin{array}{r} 3 \ 2 \ . \ 6 \\ + 4 \ 8 \ . \ 3 \\ \hline \end{array}$$

g) $6.72 + 0.43 =$

$$\begin{array}{r} 6 \ . \ 7 \ 2 \\ + 0 \ . \ 4 \ 3 \\ \hline \end{array}$$

h) $59.2 + 35.1 =$

$$\begin{array}{r} 5 \ 9 \ . \ 2 \\ + 3 \ 5 \ . \ 1 \\ \hline \end{array}$$

i) $84.3 + 0.9 =$

$$\begin{array}{r} 8 \ 4 \ . \ 3 \\ + \quad 0 \ . \ 9 \\ \hline \end{array}$$

j) $3.52 + 40.08 =$

$$\begin{array}{r} 3 \ . \ 5 \ 2 \\ + \quad \quad \quad \\ \hline \end{array}$$

k) $1.94 + 27.6 =$

$$\begin{array}{r} 1 \ . \ 9 \ 4 \\ + \quad \quad \quad \\ \hline \end{array}$$

l) $51.4 + 3.58 =$

$$\begin{array}{r} 5 \ 1 \ . \ 4 \\ + \quad 3 \ . \ 5 \ 8 \\ \hline \end{array}$$

Skill 7.1 Adding decimal numbers (2).

MMBlue 1 2 3 4
MMGreen 1 2 3 4

m) $9.86 + 0.09 =$

$$\begin{array}{r} 9.86 \\ + 0.09 \\ \hline \end{array}$$

n) $7.54 + 6.3 =$

$$\begin{array}{r} 7.54 \\ + 6.3 \\ \hline \end{array}$$

o) $65.7 + 8 =$

$$\begin{array}{r} 65.7 \\ + 8.0 \\ \hline \end{array}$$

p) $42.08 + 17.95 =$

$$\begin{array}{r} 42.08 \\ + 17.95 \\ \hline \end{array}$$

q) $45.69 + 38.37 =$

$$\begin{array}{r} 45.69 \\ + 38.37 \\ \hline \end{array}$$

r) $64.8 + 9.72 =$

$$\begin{array}{r} 64.8 \\ + 9.72 \\ \hline \end{array}$$

s) $31.54 + 29.8 =$

$$\begin{array}{r} 31.54 \\ + 29.8 \\ \hline \end{array}$$

t) $5.47 + 26.7 =$

$$\begin{array}{r} 5.47 \\ + 26.7 \\ \hline \end{array}$$

u) $9 + 26.82 =$

$$\begin{array}{r} 9 \\ + 26.82 \\ \hline \end{array}$$

v) $0.5 + 49.7 + 6.41 =$

$$\begin{array}{r} 0.5 \\ 49.7 \\ + 6.41 \\ \hline \end{array}$$

w) $38.2 + 0.95 + 7 =$

$$\begin{array}{r} 38.2 \\ 0.95 \\ + 7 \\ \hline \end{array}$$

x) $51.46 + 8 + 4.9 =$

$$\begin{array}{r} 51.46 \\ 8 \\ + 4.9 \\ \hline \end{array}$$

y) $0.8 + 25.6 + 7.59 =$

$$\begin{array}{r} 0.8 \\ 25.6 \\ + 7.59 \\ \hline \end{array}$$

z) $23.5 + 6.974 + 0.69 =$

$$\begin{array}{r} 23.5 \\ 6.974 \\ + 0.69 \\ \hline \end{array}$$

zz) $0.258 + 7.9 + 24.56 =$

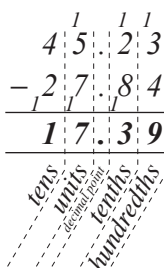
$$\begin{array}{r} 0.258 \\ 7.9 \\ + 24.56 \\ \hline \end{array}$$

Skill 7.2 Subtracting decimal numbers (1).

- Always keep your working columns in line, aligning the decimal places, units with units, tens with tens, etc.
- Subtract from right to left.
- Whenever a number cannot be subtracted from another number to give a positive result then use either the decomposition or equal addition method. (see skill 5.4, page 12)

Q. $45.23 - 27.84 =$

A. $45.23 - 27.84 = 17.39$



Using the **Equal Addition** method

Hundredths: $3 - 4 = ?$

Add 10 hundredths to the 3 and 10 hundredths (1 tenth) to the 8 (bottom number in the tenths column)

$$13 - 4 = 9 \text{ hundredths}$$

Tenths: $2 - (8 + 1) = ?$

Add 10 tenths to the 2 and 10 tenths (1 unit) to the 7 (bottom number in the units column)

$$12 - 9 = 3 \text{ tenths}$$

Units: $5 - (7 + 1) = ?$

Add 10 units to the 5 and 10 units (1 ten) to the 2 (bottom number in the tens column)

$$15 - 8 = 7 \text{ tenths}$$

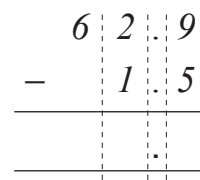
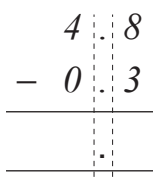
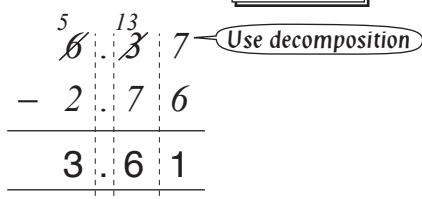
Tens: $4 - (2 + 1) = 1 \text{ ten}$

a) $6.37 - 2.76 =$

3.61

b) $4.8 - 0.3 =$

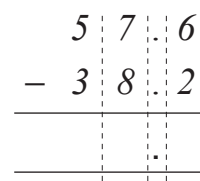
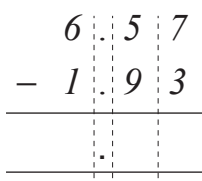
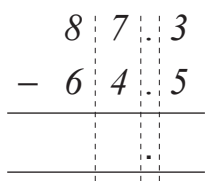
c) $62.9 - 1.5 =$



d) $87.3 - 64.5 =$

e) $6.57 - 1.93 =$

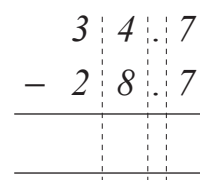
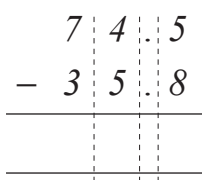
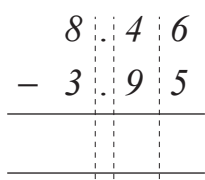
f) $57.6 - 38.2 =$



g) $8.46 - 3.95 =$

h) $74.5 - 35.8 =$

i) $34.7 - 28.7 =$



Skill 7.2 Subtracting decimal numbers (2).

MMBlue 1 2 3 4
MMGreen 1 2 3 4

j) $27.4 - 9.6 =$

$$\begin{array}{r} 27.4 \\ - 9.6 \\ \hline \\ \hline \end{array}$$

k) $8.24 - 0.75 =$

$$\begin{array}{r} 8.24 \\ - 0.75 \\ \hline \\ \hline \end{array}$$

l) $43.8 - 8.9 =$

$$\begin{array}{r} 43.8 \\ - 8.9 \\ \hline \\ \hline \end{array}$$

m) $63.45 - 6.52 =$

$$\begin{array}{r} 63.45 \\ - 6.52 \\ \hline \\ \hline \end{array}$$

n) $28.31 - 9.4 =$

$$\begin{array}{r} 28.31 \\ - 9.4 \\ \hline \\ \hline \end{array}$$

o) $25.4 - 8.63 =$

$$\begin{array}{r} 25.4 \\ - 8.63 \\ \hline \\ \hline \end{array}$$

p) $55.63 - 26.8 =$

$$\begin{array}{r} 55.63 \\ - 26.8 \\ \hline \\ \hline \end{array}$$

q) $37.4 - 6.91 =$

$$\begin{array}{r} 37.4 \\ - 6.91 \\ \hline \\ \hline \end{array}$$

r) $46.2 - 8.37 =$

$$\begin{array}{r} 46.2 \\ - 8.37 \\ \hline \\ \hline \end{array}$$

s) $45.23 - 27.84 =$

$$\begin{array}{r} 45.23 \\ - 27.84 \\ \hline \\ \hline \end{array}$$

t) $34.21 - 18.45 =$

$$\begin{array}{r} 34.21 \\ - 18.45 \\ \hline \\ \hline \end{array}$$

u) $65.62 - 19.84 =$

$$\begin{array}{r} 65.62 \\ - 19.84 \\ \hline \\ \hline \end{array}$$

v) $90.03 - 4.08 =$

$$\begin{array}{r} 90.03 \\ - 4.08 \\ \hline \\ \hline \end{array}$$

w) $80.5 - 4.63 =$

$$\begin{array}{r} 80.5 \\ - 4.63 \\ \hline \\ \hline \end{array}$$

x) $25.46 - 7.59 =$

$$\begin{array}{r} 25.46 \\ - 7.59 \\ \hline \\ \hline \end{array}$$

y) $35.46 - 27.48 =$

$$\begin{array}{r} 35.46 \\ - 27.48 \\ \hline \\ \hline \end{array}$$

z) $66.23 - 19.54 =$

$$\begin{array}{r} 66.23 \\ - 19.54 \\ \hline \\ \hline \end{array}$$

zz) $57.2 - 9.84 =$

$$\begin{array}{r} 57.2 \\ - 9.84 \\ \hline \\ \hline \end{array}$$

Skill 7.3 Subtracting a decimal number from a whole number.

- Always keep your working columns in line, aligning the decimal places, units with units, tens with tens, etc.
- Subtract from right to left.
- Whenever a digit cannot be subtracted from another digit to give a positive result then use either the decomposition or equal addition method. (see skill 5.4, page 12)

Q. $10 - 5.91 =$

A. $10 - 5.91 = 4.09$

$$\begin{array}{r}
 \overset{0}{\cancel{1}}\overset{9}{\cancel{0}}\overset{9}{\cancel{0}}\overset{10}{\cancel{0}} \\
 - 5.91 \\
 \hline
 4.09
 \end{array}$$

tens *units* *tenths* *hundredths*

Using the **Decomposition** method:

Work from right to left until you reach a number you can borrow from, in this case the 1 ten. Restructure the 1 ten to 9 units, 9 tenths and 10 hundredths.

Hundredths: $10 - 1 = 9$ hundredths

Tenths: $9 - 9 = 0$ tenths

Units: $9 - 5 = 4$ units

Tens: $0 - 0 = 0$ tens

a) $3 - 1.27 =$

1.73

b) $8 - 3.7 =$

c) $4 - 2.75 =$

$$\begin{array}{r}
 3 \overset{1}{.} \overset{1}{0} \overset{1}{0} \\
 - 1 \overset{1}{.} \overset{1}{2} \overset{1}{7} \\
 \hline
 1 \overset{1}{.} \overset{1}{7} \overset{1}{3}
 \end{array}$$

Use equal addition

$$\begin{array}{r}
 8 \overset{1}{.} \overset{1}{0} \\
 - 3 \overset{1}{.} \overset{1}{7} \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 4 \overset{1}{.} \overset{1}{0} \overset{1}{0} \\
 - 2 \overset{1}{.} \overset{1}{7} \overset{1}{5} \\
 \hline
 \end{array}$$

d) $4 - 1.61 =$

e) $7 - 3.38 =$

f) $8 - 3.25 =$

$$\begin{array}{r}
 4 \overset{1}{.} \overset{1}{0} \overset{1}{0} \\
 - 1 \overset{1}{.} \overset{1}{6} \overset{1}{1} \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 7 \overset{1}{.} \overset{1}{0} \overset{1}{0} \\
 - 3 \overset{1}{.} \overset{1}{3} \overset{1}{8} \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 8 \overset{1}{.} \overset{1}{0} \overset{1}{0} \\
 - \quad \quad \quad \\
 \hline
 \end{array}$$

g) $13 - 2.54 =$

h) $19 - 3.87 =$

i) $22 - 7.43 =$

$$\begin{array}{r}
 13 \overset{1}{.} \overset{1}{0} \overset{1}{0} \\
 - \quad \quad \quad \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 19 \overset{1}{.} \overset{1}{0} \overset{1}{0} \\
 - \quad \quad \quad \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 22 \overset{1}{.} \overset{1}{0} \overset{1}{0} \\
 - \quad \quad \quad \\
 \hline
 \end{array}$$

j) $7 - 0.357 =$

k) $9 - 0.619 =$

l) $6 - 0.802 =$

$$\begin{array}{r}
 \overset{6}{\cancel{7}}\overset{9}{\cancel{0}}\overset{9}{\cancel{0}}\overset{10}{\cancel{0}} \\
 - 0.357 \\
 \hline
 6.643
 \end{array}$$

Use decomposition

$$\begin{array}{r}
 9 \overset{1}{.} \overset{1}{0} \overset{1}{0} \\
 - \quad \quad \quad \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 6 \overset{1}{.} \overset{1}{0} \overset{1}{0} \\
 - \quad \quad \quad \\
 \hline
 \end{array}$$

8. [Decimal \times, \div]

continues on page 34

Skill 8.1 Multiplying a whole number by a decimal number (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Multiply from right to left, disregarding the decimal point.
- Count the number of places to the right of the decimal point in the question.
- Position the decimal point the same number of places from the right in the answer.

Q. $0.62 \times 4 =$

A. $0.62 \times 4 = 2.48$

$$\begin{array}{r} 0.62 \\ \times 4 \\ \hline 2.48 \end{array}$$

$4 \times 2 = 8$

write 8

$4 \times 6 = 24$

carry 2, write 4

$4 \times 0 + \text{carry } 2 = 2$

write 2

2 decimal places in question so
move decimal point 2 places from right in the answer

a) $0.9 \times 3 =$

2.7

$$\begin{array}{r} 0.9 \\ \times 3 \\ \hline 2.7 \end{array}$$

b) $0.8 \times 2 =$

$$\begin{array}{r} 0.8 \\ \times 2 \\ \hline \end{array}$$

c) $0.7 \times 5 =$

$$\begin{array}{r} 0.7 \\ \times 5 \\ \hline \end{array}$$

d) $0.4 \times 6 =$

$$\begin{array}{r} 0.4 \\ \times 6 \\ \hline \end{array}$$

e) $0.3 \times 7 =$

$$\begin{array}{r} 0.3 \\ \times 7 \\ \hline \end{array}$$

f) $0.6 \times 9 =$

$$\begin{array}{r} 0.6 \\ \times 9 \\ \hline \end{array}$$

g) $5.1 \times 3 =$

$$\begin{array}{r} 5.1 \\ \times 3 \\ \hline \end{array}$$

h) $4.3 \times 6 =$

$$\begin{array}{r} 4.3 \\ \times 6 \\ \hline \end{array}$$

i) $2.7 \times 4 =$

$$\begin{array}{r} 2.7 \\ \times 4 \\ \hline \end{array}$$

j) $3.8 \times 2 =$

$$\begin{array}{r} 3.8 \\ \times 2 \\ \hline \end{array}$$

k) $1.9 \times 5 =$

$$\begin{array}{r} 1.9 \\ \times 5 \\ \hline \end{array}$$

l) $7.3 \times 8 =$

$$\begin{array}{r} 7.3 \\ \times 8 \\ \hline \end{array}$$

Skill 8.1 Multiplying a whole number by a decimal number (2).

MMBlue 1 2 3 4
MMGreen 1 2 3 4

m) $0.24 \times 5 =$

$$\begin{array}{r} \overset{1}{0} . \overset{2}{2} \overset{4}{4} \\ \times \quad \quad 5 \\ \hline 1 . \overset{2}{2} \overset{0}{0} \end{array}$$

n) $0.71 \times 6 =$

$$\begin{array}{r} 0 . 7 1 \\ \times \quad \quad 6 \\ \hline \end{array}$$

o) $1.56 \times 8 =$

$$\begin{array}{r} 1 . 5 6 \\ \times \quad \quad 8 \\ \hline \end{array}$$

p) $2.09 \times 4 =$

$$\begin{array}{r} 2 . 0 9 \\ \times \quad \quad 4 \\ \hline \end{array}$$

q) $3.26 \times 3 =$

$$\begin{array}{r} 3 . 2 6 \\ \times \quad \quad 3 \\ \hline \end{array}$$

r) $4.82 \times 2 =$

$$\begin{array}{r} 4 . 8 2 \\ \times \quad \quad 2 \\ \hline \end{array}$$

s) $14.02 \times 6 =$

$$\begin{array}{r} 1 4 . 0 2 \\ \times \quad \quad 6 \\ \hline \end{array}$$

t) $4 \times 20.15 =$

$$\begin{array}{r} 2 0 . 1 5 \\ \times \quad \quad 4 \\ \hline \end{array}$$

u) $18.02 \times 3 =$

$$\begin{array}{r} \times \\ \hline \end{array}$$

v) $8 \times 10.91 =$

$$\begin{array}{r} \times \\ \hline \end{array}$$

w) $2.008 \times 7 =$

$$\begin{array}{r} \times \\ \hline \end{array}$$

x) $6 \times 0.521 =$

$$\begin{array}{r} \times \\ \hline \end{array}$$

y) $5 \times 3.105 =$

$$\begin{array}{r} \times \\ \hline \end{array}$$

z) $5.312 \times 4 =$

$$\begin{array}{r} \times \\ \hline \end{array}$$

zz) $3 \times 2.041 =$

$$\begin{array}{r} \times \\ \hline \end{array}$$

Skill 8.2 Dividing a decimal number by a whole number.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Line up the decimal point in your answer with the decimal point in the question.
- Divide from left to right.
- Break down the division into smaller divisions.
- If any result is less than 1: Cross off the number being divided into.
'Carry over' this amount to the next column.
Add on the carry.
Then try dividing again.
- Always keep your working columns in line, aligning units with units, tens with tens, etc.

Q. $1.26 \div 9 =$

A. $1.26 \div 9 = 0.14$

$1 \div 9 = ?$ (less than 0) carry 1, write 0
Line up the decimal point.
 $12 \div 9 = 1$ carry 3, write 1
 $36 \div 9 = 4$ write 4

$$\begin{array}{r} 0.14 \\ 9 \overline{) 1.26} \end{array}$$

a) $4.2 \div 6 =$

0.7

b) $2.4 \div 8 =$

c) $1.5 \div 3 =$

÷ from left

$$\begin{array}{r} 0.7 \\ 6 \overline{) 4.2} \end{array}$$

Line up decimal points

$$\begin{array}{r} \\ 8 \overline{) 2.4} \end{array}$$

$$\begin{array}{r} \\ 3 \overline{) 1.5} \end{array}$$

d) $6.5 \div 5 =$

e) $7.2 \div 4 =$

f) $9.8 \div 7 =$

$$\begin{array}{r} \\ 5 \overline{) 6.5} \end{array}$$

$$\begin{array}{r} \\ 4 \overline{) 7.2} \end{array}$$

$$\begin{array}{r} \\ 7 \overline{) 9.8} \end{array}$$

g) $15.3 \div 9 =$

h) $1.11 \div 3 =$

i) $14.5 \div 5 =$

$$\begin{array}{r} \\ 9 \overline{) 15.3} \end{array}$$

$$\begin{array}{r} \\ 3 \overline{) 1.11} \end{array}$$

$$\begin{array}{r} \\ 5 \overline{) 14.5} \end{array}$$

j) $2.66 \div 7 =$

k) $0.96 \div 6 =$

l) $2.72 \div 8 =$

$$\begin{array}{r} \\ 7 \overline{) } \end{array}$$

$$\begin{array}{r} \\ 6 \overline{) } \end{array}$$

$$\begin{array}{r} \\ 8 \overline{) } \end{array}$$

m) $10.4 \div 4 =$

n) $1.47 \div 3 =$

o) $23.4 \div 9 =$

$$\begin{array}{r} \\ \phantom{) } \end{array}$$

$$\begin{array}{r} \\ \phantom{) } \end{array}$$

$$\begin{array}{r} \\ \phantom{) } \end{array}$$

Skill 8.3 Multiplying a decimal number by a decimal number.

- Multiply from right to left, disregarding the decimal point.
- Count the number of places to the right of the decimal point in the question.
- Position the decimal point the same number of decimal places from the right in the answer.
- Use zeros as place holders, if necessary.

Example: $0.02 \times 0.3 = 0.006$

- If the result is less than 1, write a zero in the units place.

Example: By convention 0.37 not .37

Q. $2.5 \times 0.8 =$

A. $2.5 \times 0.8 = 2$

$8 \times 5 = 40$

carry 4, write 0

$8 \times 2 + \text{carry } 4 = 20$

write 20

$$\begin{array}{r} 2.5 \\ \times 0.8 \\ \hline 2.00 \end{array}$$

2 decimal places in question so
move decimal point 2 places from right in the answer

a) $0.8 \times 0.9 =$

0.72

$$\begin{array}{r} 0.8 \\ \times 0.9 \\ \hline 0.72 \end{array}$$

b) $0.3 \times 0.4 =$

$$\begin{array}{r} 0.3 \\ \times 0.4 \\ \hline \end{array}$$

c) $0.5 \times 0.8 =$

$$\begin{array}{r} 0.5 \\ \times 0.8 \\ \hline \end{array}$$

d) $0.7 \times 0.6 =$

$$\begin{array}{r} 0.7 \\ \times 0.6 \\ \hline \end{array}$$

e) $0.9 \times 0.4 =$

$$\begin{array}{r} 0.9 \\ \times 0.4 \\ \hline \end{array}$$

f) $1.2 \times 0.6 =$

$$\begin{array}{r} 1.2 \\ \times 0.6 \\ \hline \end{array}$$

g) $1.4 \times 0.7 =$

$$\begin{array}{r} 1.4 \\ \times 0.7 \\ \hline \end{array}$$

h) $2.3 \times 0.9 =$

$$\begin{array}{r} 2.3 \\ \times 0.9 \\ \hline \end{array}$$

i) $1.6 \times 0.3 =$

$$\begin{array}{r} 1.6 \\ \times 0.3 \\ \hline \end{array}$$

j) $0.5 \times 0.06 =$

0.03

$$\begin{array}{r} 0.5 \\ \times 0.06 \\ \hline 0.030 \end{array}$$

remove unnecessary zero

k) $0.16 \times 0.3 =$

$$\begin{array}{r} 0.16 \\ \times 0.3 \\ \hline \end{array}$$

l) $1.07 \times 0.9 =$

$$\begin{array}{r} 1.07 \\ \times 0.9 \\ \hline \end{array}$$

< 1 so write zero in units place

Skill 8.4 Dividing a decimal number by a decimal number.

- Move the decimal point to the right in the divisor, as many places as you need to make a whole number.
- Then move the decimal point the same number of places to the right in the dividend.
Example: $0.\widehat{5}6 \div 0.\widehat{8} = 5.6 \div 8 = 0.7$
- Add zeros as place holders, if necessary.
Example: $4.9 \div 0.07 = 4.\widehat{90} \div 0.\widehat{07} = 490 \div 7 = 70$
- Line up the decimal point in your answer with the decimal point in the question.
- Divide from left to right.
- Break down the division into smaller divisions.
- If any result is less than 1: Cross off the number being divided into.
‘Carry over’ this amount to the next column.
Add on the carry.
Then try dividing again.
- Always keep your working columns in line, aligning units with units, tens with tens, etc.

Q. $0.63 \div 0.7 =$

A. $0.\widehat{63} \div 0.\widehat{7} =$
 $= 6.3 \div 7$
 $= 0.9$

$$7 \overline{) \begin{array}{r} 0.9 \\ \underline{63} \\ 0 \end{array}}$$

$6 \div 7 = ?$ (less than 0) carry 6, write 0
 Line up the decimal point.
 $63 \div 7 = 9$ write 9

a) $3.\widehat{6} \div 0.\widehat{6} =$

1 place right makes a whole number

$= 36 \div 6 =$

$$3 \overline{) \begin{array}{r} 36 \\ \underline{18} \\ 18 \\ \underline{18} \\ 0 \end{array}}$$

b) $1.4 \div 0.7 =$

$=$ $=$

$$7 \overline{) \begin{array}{r} 14 \\ \underline{14} \\ 0 \end{array}}$$

c) $4.5 \div 0.9 =$

$=$ $=$

$$9 \overline{) \begin{array}{r} 45 \\ \underline{45} \\ 0 \end{array}}$$

d) $7.6 \div 0.2 =$

$=$ $=$

$$2 \overline{) \begin{array}{r} 76 \\ \underline{76} \\ 0 \end{array}}$$

e) $6.9 \div 0.3 =$

$=$ $=$

$$3 \overline{) \begin{array}{r} 69 \\ \underline{69} \\ 0 \end{array}}$$

f) $0.76 \div 0.4 =$

$=$ $=$

$$4 \overline{) \begin{array}{r} 76 \\ \underline{76} \\ 0 \end{array}}$$

g) $0.08 \div 0.4 =$

$=$ $=$

$$4 \overline{) \begin{array}{r} 0.08 \\ \underline{0.08} \\ 0 \end{array}}$$

h) $0.49 \div 0.7 =$

$=$ $=$

$$7 \overline{) \begin{array}{r} 49 \\ \underline{49} \\ 0 \end{array}}$$

i) $6.42 \div 0.6 =$

$=$ $=$

$$6 \overline{) \begin{array}{r} 642 \\ \underline{642} \\ 0 \end{array}}$$

j) $9.\widehat{5} \div 0.\widehat{05} =$

$= 950 \div 5 =$

$$5 \overline{) \begin{array}{r} 950 \\ \underline{45} \\ 50 \\ \underline{50} \\ 0 \end{array}}$$

k) $2.7 \div 0.09 =$

$=$ $=$

$$9 \overline{) \begin{array}{r} 27 \\ \underline{27} \\ 0 \end{array}}$$

l) $7.2 \div 0.08 =$

$=$ $=$

$$8 \overline{) \begin{array}{r} 72 \\ \underline{72} \\ 0 \end{array}}$$

Skill 8.5 Dividing a whole number by a decimal number.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Move the decimal point to the right in the divisor, as many places as you need to make a whole number.
- Then move the decimal point the same number of places to the right in the dividend.
- Add zeros as place holders.

Example: $16 \div 0.4 = 16.\widehat{0} \div 0.\widehat{4} = 160 \div 4 = 40$

- Line up the decimal point in your answer with the decimal point in the question.
- Divide from left to right.
- Break down the division into smaller divisions.
- If any result is less than 1: Cross off the number being divided into.
'Carry over' this amount to the next column.
Add on the carry.
Then try dividing again.
- Always keep your working columns in line, aligning units with units, tens with tens, etc.

Q. $9 \div 0.6 =$ **A.** $9.\widehat{0} \div 0.\widehat{6} =$ 1 place right makes a whole number

add zero as place holder $= 90 \div 6$

$= 15$

$$\begin{array}{r} 15 \\ 6 \overline{) 90} \end{array}$$

$$\begin{array}{r} 9 \div 6 = 1 \\ 30 \div 6 = 5 \end{array}$$

carry 3, write 1
write 5

a) $5 \div 0.5 =$ **b)** $6 \div 0.3 =$ **c)** $6 \div 0.4 =$

$= 50 \div 5 =$ 10 $=$ $=$

$$\begin{array}{r} 10 \\ 5 \overline{) 50} \end{array}$$

$$\begin{array}{r} \\ 3 \overline{) } \end{array}$$

$$\begin{array}{r} \\ \overline{) } \end{array}$$

d) $8 \div 0.1 =$ **e)** $5 \div 0.2 =$ **f)** $4 \div 0.5 =$

$=$ $=$ $=$

$$\begin{array}{r} \\ \overline{) } \end{array}$$

$$\begin{array}{r} \\ \overline{) } \end{array}$$

$$\begin{array}{r} \\ \overline{) } \end{array}$$

g) $9 \div 0.2 =$ **h)** $3 \div 0.06 =$ **i)** $7 \div 0.04 =$

$=$ $=$ $=$

$$\begin{array}{r} \\ \overline{) } \end{array}$$

$$\begin{array}{r} \\ 6 \overline{) } \end{array}$$

$$\begin{array}{r} \\ \overline{) } \end{array}$$

j) $2 \div 0.04 =$ **k)** $5 \div 0.01 =$ **l)** $1 \div 0.25 =$

$=$ $=$ $=$

$$\begin{array}{r} \\ \overline{) } \end{array}$$

$$\begin{array}{r} \\ \overline{) } \end{array}$$

$$\begin{array}{r} \\ \overline{) } \end{array}$$

9. [Fraction +, -]

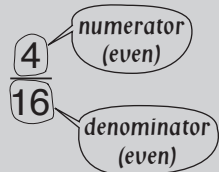
continues on page 40

Skill 9.1 Adding fractions with the same denominator (1).

MMBlue 11 2 2 3 3 4 4
MMGreen 11 2 2 3 3 4 4

Simplifying a fraction

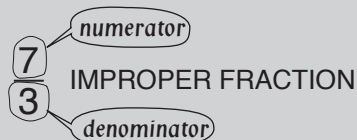
Hint: If the numbers are both even then you can start with dividing by 2.



- Divide both the numerator and the denominator by the same number.

$$\frac{4 \div 2}{16 \div 2} = \frac{2 \div 2}{8 \div 2} = \frac{1}{4}$$

Changing an improper fraction to a mixed number



- Divide the numerator by the denominator.
 $\frac{7}{3} = 7 \div 3 = 2 \text{ remainder } 1$
- Write the result as the whole number and the remainder over the denominator.
 $\frac{7}{3} = 7 \div 3 = 2\frac{1}{3}$

Changing a mixed number to an improper fraction

MIXED NUMBER



- Multiply the whole number by the denominator and then add the result to the numerator.

$$3\frac{2}{5} \quad 3 \times 5 + 2 = 17$$

- Rewrite the total over the denominator.

$$3\frac{2}{5} = \frac{17}{5}$$

- Add the numerators (top numbers of the fractions).
- Do not change the denominators.
- Simplify the resulting fraction and/or change it to a mixed number if necessary.

Q. $\frac{3}{5} + \frac{4}{5} =$

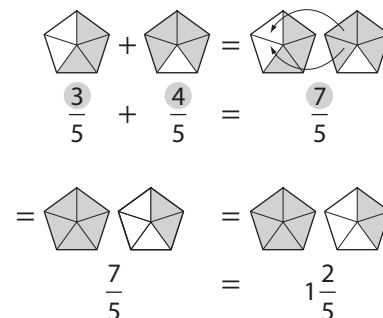
A. $\frac{3}{5} + \frac{4}{5}$ *Add the numerators (top numbers) only*

$$= \frac{3+4}{5}$$

$$= \frac{7}{5}$$

7 ÷ 5 = 1 remainder 2

$$= 1\frac{2}{5}$$



a) $\frac{5}{12} + \frac{4}{12} =$ *Add the numerators (top numbers) only*

$$= \frac{5+4}{12} = \frac{9}{12 \div 3} = \boxed{\frac{3}{4}}$$

b) $\frac{2}{5} + \frac{2}{5} =$

$$= \boxed{\phantom{\frac{3}{4}}}$$

c) $\frac{3}{11} + \frac{5}{11} =$

$$= \boxed{\phantom{\frac{3}{4}}}$$

d) $\frac{2}{7} + \frac{4}{7} =$

$$= \boxed{\phantom{\frac{3}{4}}}$$

e) $\frac{2}{13} + \frac{8}{13} =$

$$= \boxed{\phantom{\frac{3}{4}}}$$

f) $\frac{4}{9} + \frac{1}{9} =$

$$= \boxed{\phantom{\frac{3}{4}}}$$

Skill 9.1 Adding fractions with the same denominator (2).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

g) $\frac{4}{5} + \frac{4}{5} =$

$$= \frac{4+4}{5} = \frac{8}{5}$$

Change to mixed number

$$= 8 \div 5$$

$$= \boxed{1\frac{3}{5}}$$

h) $\frac{5}{7} + \frac{4}{7} =$

$$=$$

$$=$$

$$= \boxed{}$$

i) $\frac{7}{9} + \frac{7}{9} =$

$$=$$

$$=$$

$$= \boxed{}$$

j) $\frac{7}{11} + \frac{9}{11} =$

$$=$$

$$=$$

$$= \boxed{}$$

k) $\frac{10}{3} + \frac{1}{3} =$

$$=$$

$$=$$

$$= \boxed{}$$

l) $\frac{9}{13} + \frac{11}{13} =$

$$=$$

$$=$$

$$= \boxed{}$$

m) $\frac{5}{8} + \frac{7}{8} =$

$$= \frac{5+7}{8} = \frac{12}{8}$$

Simplify

$$= \frac{3}{2}$$

$$= 3 \div 2 =$$

$$= \boxed{}$$

Change to mixed number

n) $\frac{3}{4} + \frac{3}{4} =$

$$=$$

$$=$$

$$= \boxed{}$$

o) $\frac{5}{6} + \frac{5}{6} =$

$$=$$

$$=$$

$$= \boxed{}$$

p) $\frac{1}{8} + \frac{5}{8} =$

$$= \frac{1+5}{8} = \frac{6}{8}$$

$$= \frac{6}{8+2}$$

$$= \boxed{}$$

q) $\frac{1}{15} + \frac{2}{15} =$

$$=$$

$$=$$

$$= \boxed{}$$

r) $\frac{1}{6} + \frac{1}{6} =$

$$=$$

$$=$$

$$= \boxed{}$$

s) $\frac{3}{10} + \frac{2}{10} =$

$$= \boxed{}$$

t) $\frac{5}{12} + \frac{3}{12} =$

$$= \boxed{}$$

u) $\frac{7}{10} + \frac{1}{10} =$

$$= \boxed{}$$

v) $\frac{1}{8} + \frac{3}{8} =$

$$= \boxed{}$$

w) $\frac{5}{12} + \frac{5}{12} =$

$$= \boxed{}$$

x) $\frac{2}{15} + \frac{10}{15} =$

$$= \boxed{}$$

Skill 9.2 Subtracting fractions with the same denominator.

- Subtract the numerators (top numbers of the fractions).
- Do not change the denominators.
- Simplify the resulting fraction and/or change it to a mixed number if necessary.
(see skill 9.1, page 39)

Q. $\frac{5}{8} - \frac{1}{8} =$

A. $\frac{5}{8} - \frac{1}{8}$ *Subtract the numerators (top numbers) only*

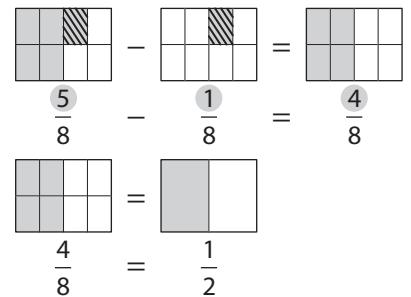
$$= \frac{5-1}{8}$$

$$= \frac{4}{8}$$

Simplify

$$= \frac{4 \div 4}{8 \div 4}$$

$$= \frac{1}{2}$$



a) $\frac{7}{11} - \frac{2}{11}$ *Subtract the numerators (top numbers) only*

$$= \frac{7-2}{11} = \frac{5}{11}$$

b) $\frac{8}{9} - \frac{1}{9} =$

$$= \frac{\quad}{\quad} = \frac{\quad}{\quad}$$

c) $\frac{11}{13} - \frac{9}{13} =$

$$= \frac{\quad}{\quad} = \frac{\quad}{\quad}$$

d) $\frac{11}{5} - \frac{2}{5}$

$$= \frac{11-2}{5} = \frac{9}{5}$$

Change to mixed number

$$= 9 \div 5 = 1\frac{4}{5}$$

e) $\frac{8}{3} - \frac{1}{3} =$

$$= \frac{\quad}{\quad} = \frac{\quad}{\quad}$$

f) $\frac{20}{7} - \frac{2}{7} =$

$$= \frac{\quad}{\quad} = \frac{\quad}{\quad}$$

g) $\frac{7}{12} - \frac{5}{12}$ *Simplify*

$$= \frac{2}{12}$$

$$= \frac{2 \div 2}{12 \div 2} = \frac{\quad}{\quad}$$

h) $\frac{13}{15} - \frac{8}{15} =$

$$= \frac{\quad}{\quad} = \frac{\quad}{\quad}$$

i) $\frac{5}{6} - \frac{1}{6} =$

$$= \frac{\quad}{\quad} = \frac{\quad}{\quad}$$

j) $\frac{9}{14} - \frac{5}{14} =$

$$= \frac{\quad}{\quad} = \frac{\quad}{\quad}$$

k) $\frac{11}{16} - \frac{5}{16} =$

$$= \frac{\quad}{\quad} = \frac{\quad}{\quad}$$

l) $\frac{9}{10} - \frac{1}{10} =$

$$= \frac{\quad}{\quad} = \frac{\quad}{\quad}$$

m) $\frac{11}{18} - \frac{7}{18} =$

$$= \frac{\quad}{\quad} = \frac{\quad}{\quad}$$

n) $\frac{9}{20} - \frac{3}{20} =$

$$= \frac{\quad}{\quad} = \frac{\quad}{\quad}$$

o) $\frac{19}{24} - \frac{7}{24} =$

$$= \frac{\quad}{\quad} = \frac{\quad}{\quad}$$

Skill 9.3 Adding mixed numbers with the same denominator (1).

- Add the whole numbers first.
- Add the fractions. (see skill 9.1, page 39)
- Simplify the resulting fraction and/or change it to a mixed number if necessary. (see skill 9.1, page 39)
- Write the result as a mixed number.

Q. $1\frac{5}{10} + 1\frac{3}{10} =$

A. $1 + 1 + \frac{5}{10} + \frac{3}{10}$

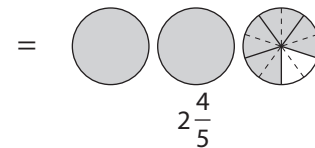
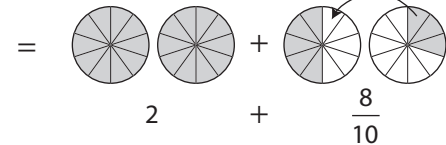
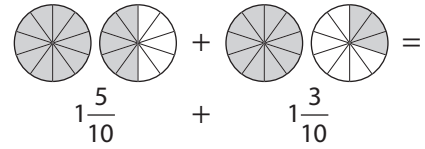
Add the numerators (top numbers) only

$= 2 + \frac{8}{10}$

Simplify

$= 2 + \frac{4}{5}$

$= 2\frac{4}{5}$



a) $2\frac{2}{5} + 1\frac{2}{5} =$
 $= 3 + \frac{4}{5} =$

b) $1\frac{1}{7} + 3\frac{5}{7} =$
 $=$ $=$

c) $3\frac{1}{9} + \frac{4}{9} =$
 $=$ $=$

d) $3\frac{5}{11} + \frac{4}{11} =$
 $=$ $=$

e) $1\frac{2}{9} + 2\frac{5}{9} =$
 $=$ $=$

f) $2\frac{3}{7} + \frac{3}{7} =$
 $=$ $=$

g) $4\frac{1}{8} + \frac{3}{8} =$
 $= 4 + \frac{4}{8}$ *Simplify*
 $= 4 + \frac{1}{2} =$

h) $2\frac{3}{10} + \frac{3}{10} =$
 $=$ $=$

i) $1\frac{2}{9} + 2\frac{1}{9} =$
 $=$ $=$

j) $1\frac{1}{12} + 2\frac{7}{12} =$
 $=$ $=$

k) $2\frac{1}{10} + \frac{4}{10} =$
 $=$ $=$

l) $2\frac{1}{15} + 3\frac{4}{15} =$
 $=$ $=$

Skill 9.3 Adding mixed numbers with the same denominator (2).

$$\text{m) } 1\frac{4}{5} + 2\frac{2}{5} =$$

$$= 3 + \frac{6}{5}$$

Change to mixed number

$$= 3 + 1\frac{1}{5} = \boxed{4\frac{1}{5}}$$

$$\text{n) } 1\frac{2}{3} + 4\frac{2}{3} =$$

=

$$= \underline{\hspace{2cm}} = \boxed{\hspace{1cm}}$$

$$\text{o) } 3\frac{5}{7} + 2\frac{6}{7} =$$

=

$$= \underline{\hspace{2cm}} = \boxed{\hspace{1cm}}$$

$$\text{p) } 2\frac{5}{9} + \frac{5}{9} =$$

=

$$= \underline{\hspace{2cm}} = \boxed{\hspace{1cm}}$$

$$\text{q) } 3\frac{4}{11} + \frac{10}{11} =$$

=

$$= \underline{\hspace{2cm}} = \boxed{\hspace{1cm}}$$

$$\text{r) } 3\frac{8}{9} + \frac{8}{9} =$$

=

$$= \underline{\hspace{2cm}} = \boxed{\hspace{1cm}}$$

$$\text{s) } 3\frac{11}{15} + 2\frac{7}{15} =$$

$$= 5 + \frac{18+3}{15+3}$$

Simplify

$$= 5 + \frac{6}{5}$$

Change to mixed number

$$= 5 + 1\frac{1}{5} = \boxed{6\frac{1}{5}}$$

$$\text{t) } 4\frac{3}{8} + \frac{7}{8} =$$

=

$$= \underline{\hspace{2cm}}$$

$$= \underline{\hspace{2cm}} = \boxed{\hspace{1cm}}$$

$$\text{u) } 2\frac{3}{4} + 3\frac{3}{4} =$$

=

$$= \underline{\hspace{2cm}}$$

$$= \underline{\hspace{2cm}} = \boxed{\hspace{1cm}}$$

$$\text{v) } 1\frac{1}{2} + 4\frac{1}{2} =$$

.....

$$= \boxed{\hspace{1cm}}$$

$$\text{w) } 2\frac{5}{12} + \frac{11}{12} =$$

.....

$$= \boxed{\hspace{1cm}}$$

$$\text{x) } 4\frac{3}{10} + \frac{9}{10} =$$

.....

$$= \boxed{\hspace{1cm}}$$

Skill 9.4 Subtracting mixed numbers with the same denominator (2).

- Subtract the whole numbers first.
- Subtract the fractions. (see skill 9.2, page 41)
- Simplify the resulting fraction if necessary. (see skill 9.1, page 39)

Hint: For subtractions you may need to convert 1 to an equivalent fraction.

Example:

$$1 \text{ (1 whole circle)} = \frac{3}{3} = \frac{5}{5} \text{ (numerator = denominator)}$$

Q. $4\frac{1}{8} - 2\frac{5}{8} =$

A. $4\frac{1}{8} - 2\frac{5}{8}$
 $= 2 + \frac{1}{8} - \frac{5}{8}$
 $= 1 + 1 + \frac{1}{8} - \frac{5}{8}$
 $= 1 + \frac{8}{8} + \frac{1}{8} - \frac{5}{8}$
 $= 1 + \frac{9}{8} - \frac{5}{8}$
 $= 1 + \frac{4}{8}$
 $= 1 + \frac{1}{2} = 1\frac{1}{2}$

$4 - 2 = 2$ and $\frac{1}{8} - \frac{5}{8} = ?$

$\frac{5}{8}$ can not be subtracted from $\frac{1}{8}$ and give a positive answer, so borrow a 1 from the 2.

$1 = \frac{8}{8}$ (see hint)

$\frac{8}{8} + \frac{1}{8} = \frac{8+1}{8} = \frac{9}{8}$

$\frac{9}{8} - \frac{5}{8} = \frac{9-5}{8} = \frac{4}{8}$

Simplify.

j) $4\frac{7}{9} - 1\frac{2}{9} =$

$= 3 + \frac{7}{9} - \frac{2}{9}$ *Subtract the numerators (top numbers) only*

$= 3 + \frac{5}{9} =$

k) $2\frac{7}{8} - 1\frac{5}{8} =$

$=$
 $=$

l) $3\frac{8}{9} - 2\frac{1}{9} =$

$=$
 $=$

m) $4\frac{1}{4} - 1\frac{3}{4} =$

$= 3 + \frac{1}{4} - \frac{3}{4}$

$= 2 + 1 + \frac{1}{4} - \frac{3}{4}$

$= 2 + \frac{4}{4} + \frac{1}{4} - \frac{3}{4}$

$= 2 + \frac{2}{4}$

$= 2 + \frac{1}{2} =$

n) $3\frac{1}{12} - 1\frac{5}{12} =$

$=$
 $=$
 $=$
 $=$
 $=$

o) $4\frac{2}{15} - 2\frac{7}{15} =$

$=$
 $=$
 $=$
 $=$
 $=$

Skill 9.5 Subtracting a fraction or a mixed number from a whole number (2).

- Subtract the whole numbers first.
- Borrow 1 from the whole number and write it as a fraction with the same denominator.
- Subtract the fractions. (see skill 9.2, page 41)

Q. $4 - 1\frac{5}{7} =$

A. $4 - 1\frac{5}{7}$
 $= 3 - \frac{5}{7}$
 $= 2 + 1 - \frac{5}{7}$
 $= 2 + \frac{7}{7} - \frac{5}{7}$
 $= 2 + \frac{2}{7} = 2\frac{2}{7}$

$4 - 1 = 3$ and $3 = 2 + 1$

$1 = \frac{7}{7}$

$\frac{7}{7} - \frac{5}{7} = \frac{7-5}{7} = \frac{2}{7}$

j) $4 - \frac{2}{5} =$

$= 3 + 1 - \frac{2}{5}$
 $= 3 + \frac{5}{5} - \frac{2}{5}$
 $= 3 + \frac{3}{5} = \boxed{}$

k) $3 - \frac{5}{9} =$

$=$
 $=$
 $=$
 $=$
 $= \boxed{}$

l) $2 - \frac{3}{11} =$

$=$
 $=$
 $=$
 $=$
 $= \boxed{}$

m) $4 - 2\frac{2}{3} =$

$= 2 - \frac{2}{3}$
 $= 1 + 1 - \frac{2}{3}$
 $= 1 + \frac{3}{3} - \frac{2}{3}$
 $= 1 + \frac{1}{3} = \boxed{}$

n) $2 - 1\frac{5}{8} =$

$=$
 $=$
 $=$
 $=$
 $= \boxed{}$

o) $5 - 2\frac{3}{10} =$

$=$
 $=$
 $=$
 $=$
 $= \boxed{}$

p) $4 - 1\frac{3}{7} =$

$=$
 $=$
 $=$
 $=$
 $= \boxed{}$

q) $3 - 2\frac{9}{10} =$

$=$
 $=$
 $=$
 $=$
 $= \boxed{}$

r) $5 - 1\frac{11}{12} =$

$=$
 $=$
 $=$
 $=$
 $= \boxed{}$

Skill 9.6 Adding fractions with different denominators - one denominator divides evenly into the other denominator (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

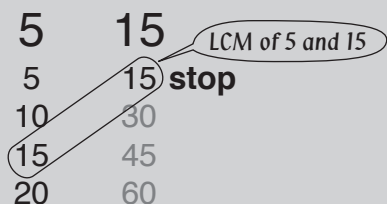
Least Common Multiple (LCM) of two numbers

- Write in ascending order some multiples of the smaller number first.
- Write in ascending order some multiples of the bigger number and stop when you find a multiple that appears in the first list ⇒ Least Common Multiple (LCM).

Hint: The least common multiple is the smallest number that the two numbers divide into.

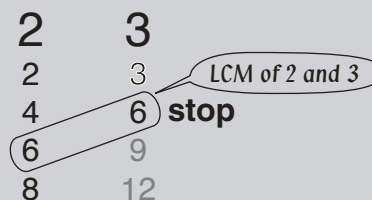
Examples:

One number divides evenly into the other number



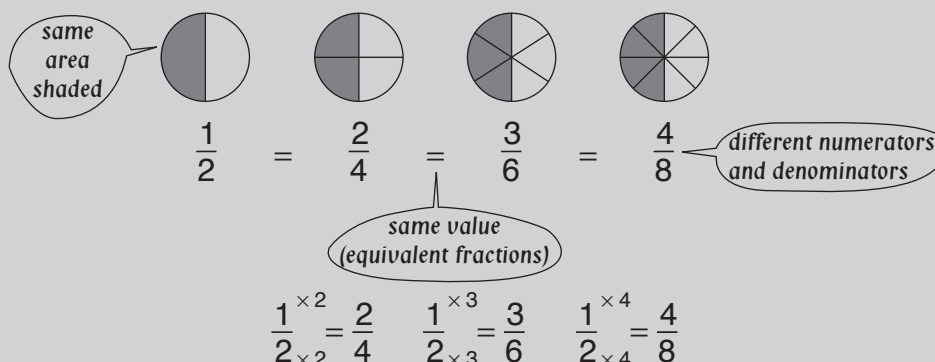
Hint: LCM is the largest number.

Greatest Common Factor (GCF) of the numbers is 1



Hint: LCM is the product of the numbers.

Equivalent Fractions



Equivalent fractions have the same value.

Equivalent fractions are formed by multiplying the numerator and denominator by the same number.

- Find the least common denominator of the fractions, which is the Least Common Multiple (LCM) of the denominators. In this case the LCM is the largest denominator.
- Change the fractions to equivalent fractions with the least common denominator.
- Add the fractions with the same denominators. (see skill 9.1, page 39)
- Simplify the resulting fraction and/or change it to a mixed number if necessary. (see skill 9.1, page 39)

Hint: If unsure which is the LCM of the denominators, use their product as the common denominator.

Examples:

$$\frac{5}{6} + \frac{1}{2} = \frac{5}{6} + \frac{3}{6} = \frac{8}{6} = \frac{4}{3} = 1\frac{1}{3} \quad (\text{LCM of 6 and 2 is 6, because 2 divides evenly into 6})$$

OR

$$\frac{5}{6} + \frac{1}{2} = \frac{10}{12} + \frac{6}{12} = \frac{16}{12} = \frac{4}{3} = 1\frac{1}{3} \quad (\text{common denominator of 6 and 2 is } 6 \times 2 = 12)$$

Skill 9.6 Adding fractions with different denominators - one denominator divides evenly into the other denominator (2).

Q. $\frac{3}{10} + \frac{3}{2} =$

A. $\frac{3}{10} + \frac{3}{2}$ LCM of 10 and 2 is 10

$$= \frac{3}{10} + \frac{3 \times 5}{2 \times 5}$$

$$= \frac{3}{10} + \frac{15}{10}$$

$$= \frac{18}{10}$$

$$= \frac{9}{5} = 1\frac{4}{5}$$

To give the second fraction a denominator of 10, multiply both the numerator and denominator by 5.

Add the fractions.

Simplify.

Change to a mixed number.

a) $\frac{2}{9} + \frac{1}{3} =$ LCM of 9 and 3 is 9

$$= \frac{2}{9} + \frac{1 \times 3}{3 \times 3}$$

$$= \frac{2}{9} + \frac{3}{9} = \boxed{\frac{5}{9}}$$

b) $\frac{3}{8} + \frac{5}{16} =$ LCM of 8 and 16 is 16

$$= \frac{3 \times 2}{8 \times 2} + \frac{5}{16}$$

$$= \frac{6}{16} + \frac{5}{16} = \boxed{\frac{11}{16}}$$

c) $\frac{1}{6} + \frac{2}{3} =$

$$= \frac{1}{6} + \frac{2 \times 2}{3 \times 2} = \frac{1}{6} + \frac{4}{6} = \boxed{\frac{5}{6}}$$

d) $\frac{1}{2} + \frac{3}{8} =$

$$= \frac{1 \times 4}{2 \times 4} + \frac{3}{8} = \frac{4}{8} + \frac{3}{8} = \boxed{\frac{7}{8}}$$

e) $\frac{1}{4} + \frac{1}{8} =$

$$= \frac{1 \times 2}{4 \times 2} + \frac{1}{8} = \frac{2}{8} + \frac{1}{8} = \boxed{\frac{3}{8}}$$

f) $\frac{7}{10} + \frac{3}{20} =$

$$= \frac{7 \times 2}{10 \times 2} + \frac{3}{20} = \frac{14}{20} + \frac{3}{20} = \boxed{\frac{17}{20}}$$

g) $\frac{3}{4} + \frac{1}{12} =$

$$= \frac{3 \times 3}{4 \times 3} + \frac{1}{12}$$

$$= \frac{9}{12} + \frac{1}{12}$$

$$= \frac{10}{12} = \frac{5}{6} = \boxed{\frac{5}{6}}$$

h) $\frac{1}{5} + \frac{3}{10} =$

$$= \frac{1 \times 2}{5 \times 2} + \frac{3}{10} = \frac{2}{10} + \frac{3}{10} = \boxed{\frac{5}{10}} = \boxed{\frac{1}{2}}$$

i) $\frac{1}{6} + \frac{5}{18} =$

$$= \frac{1 \times 3}{6 \times 3} + \frac{5}{18} = \frac{3}{18} + \frac{5}{18} = \boxed{\frac{8}{18}} = \boxed{\frac{4}{9}}$$

j) $\frac{7}{15} + \frac{3}{5} =$

$$= \frac{7}{15} + \frac{3 \times 3}{5 \times 3} = \frac{7}{15} + \frac{9}{15} = \frac{16}{15} = 1\frac{1}{15} = \boxed{1\frac{1}{15}}$$

k) $\frac{5}{6} + \frac{1}{2} =$

$$= \frac{5}{6} + \frac{1 \times 3}{2 \times 3} = \frac{5}{6} + \frac{3}{6} = \frac{8}{6} = 1\frac{2}{6} = 1\frac{1}{3} = \boxed{1\frac{1}{3}}$$

l) $\frac{1}{2} + \frac{7}{12} =$

$$= \frac{1 \times 6}{2 \times 6} + \frac{7}{12} = \frac{6}{12} + \frac{7}{12} = \frac{13}{12} = 1\frac{1}{12} = \boxed{1\frac{1}{12}}$$

Skill 9.7 Adding fractions with different denominators - the GCF of the denominators is 1 (e.g. 2 and 3, 5 and 6).

- Find the least common denominator of the fractions, which is the Least Common Multiple (LCM) of the denominators. In this case the LCM is the product of the denominators. (see skill 9.6, page 48)
- Change the fractions to equivalent fractions with the least common denominator.
- Add the fractions with the same denominators. (see skill 9.1, page 39)
- Simplify the resulting fraction and/or change it to a mixed number if necessary. (see skill 9.1, page 39)

Q. $\frac{1}{3} + \frac{5}{8} =$

A. $\frac{1}{3} + \frac{5}{8}$ LCM of 3 and 8 is 24

$$= \frac{1 \times 8}{3 \times 8} + \frac{5 \times 3}{8 \times 3}$$

$$= \frac{8}{24} + \frac{15}{24}$$

$$= \frac{23}{24}$$

Multiply the numerator and denominator of the first fraction by 8.

Multiply the numerator and denominator of the second fraction by 3.

Add the fractions.

a) $\frac{1}{7} + \frac{2}{3} =$ LCM of 7 and 3 is 21

$$= \frac{1 \times 3}{7 \times 3} + \frac{2 \times 7}{3 \times 7}$$

$$= \frac{3}{21} + \frac{14}{21} = \boxed{\frac{17}{21}}$$

b) $\frac{2}{5} + \frac{1}{6} =$

$$=$$

$$= \boxed{}$$

c) $\frac{2}{7} + \frac{3}{5} =$

$$=$$

$$= \boxed{}$$

d) $\frac{3}{5} + \frac{2}{9} =$

$$=$$

$$= \boxed{}$$

e) $\frac{1}{4} + \frac{2}{3} =$

$$=$$

$$= \boxed{}$$

f) $\frac{2}{3} + \frac{1}{5} =$

$$=$$

$$= \boxed{}$$

g) $\frac{3}{4} + \frac{3}{5} =$

$$=$$

$$= \boxed{}$$

h) $\frac{1}{2} + \frac{4}{5} =$

$$=$$

$$= \boxed{}$$

i) $\frac{2}{3} + \frac{4}{5} =$

$$=$$

$$= \boxed{}$$

Skill 9.8 Subtracting fractions with different denominators - one denominator divides evenly into the other denominator.

- Find the least common denominator of the fractions, which is the Least Common Multiple (LCM) of the denominators. In this case the LCM is the largest denominator.
(see skill 9.6, page 48)
- Change the fractions to equivalent fractions with the least common denominator.
- Subtract the fractions with the same denominators. (see skill 9.2, page 41)
- Simplify the resulting fraction and/or change it to a mixed number if necessary.
(see skill 9.1, page 39)

Hint: If unsure which is the LCM of the denominators, use their product as the common denominator.

Q. $\frac{3}{4} - \frac{3}{20} =$

A. $\frac{3}{4} - \frac{3}{20}$
 $= \frac{3 \times 5}{4 \times 5} - \frac{3}{20}$
 $= \frac{15}{20} - \frac{3}{20}$
 $= \frac{12}{20}$
 $= \frac{3}{5}$

LCM of 4 and 20 is 20

To give the first fraction a denominator of 20, multiply both the numerator and denominator by 5.

Subtract the fractions.

Simplify.

a) $\frac{5}{6} - \frac{2}{3} =$
 $= \frac{5}{6} - \frac{2 \times 2}{3 \times 2}$
 $= \frac{5}{6} - \frac{4}{6} = \frac{1}{6}$

LCM of 6 and 3 is 6

b) $\frac{4}{5} - \frac{3}{20} =$
 $= \frac{4 \times 4}{5 \times 4} - \frac{3}{20}$
 $= \frac{16}{20} - \frac{3}{20}$
 $= \frac{13}{20}$

c) $\frac{7}{8} - \frac{1}{2} =$
 $=$
 $=$
 $=$

d) $\frac{3}{4} - \frac{5}{8} =$
 $=$
 $=$
 $=$

e) $\frac{2}{7} - \frac{2}{21} =$
 $=$
 $=$
 $=$

f) $\frac{3}{10} - \frac{3}{20} =$
 $=$
 $=$
 $=$

g) $\frac{3}{4} - \frac{5}{12} =$
 $= \frac{3 \times 3}{4 \times 3} - \frac{5}{12}$
 $= \frac{9}{12} - \frac{5}{12}$
 $= \frac{4}{12} = \frac{1}{3}$

h) $\frac{5}{6} - \frac{7}{12} =$
 $=$
 $=$
 $=$

i) $\frac{3}{10} - \frac{3}{50} =$
 $=$
 $=$
 $=$

Skill 9.9 Subtracting fractions with different denominators - the GCF of the denominators is 1 (e.g. 2 and 3, 5 and 6).

- Find the least common denominator of the fractions, which is the Least Common Multiple (LCM) of the denominators. In this case the LCM is the product of the denominators. (see skill 9.6, page 48)
- Change the fractions to equivalent fractions with the least common denominator.
- Subtract the fractions with the same denominators. (see skill 9.2, page 41)
- Simplify the resulting fraction and/or change it to a mixed number if necessary. (see skill 9.1, page 39)

Q. $\frac{4}{5} - \frac{2}{3} =$

A. $\frac{4}{5} - \frac{2}{3}$ LCM of 5 and 3 is 15

$$= \frac{4 \times 3}{5 \times 3} - \frac{2 \times 5}{3 \times 5} =$$

$$= \frac{12}{15} - \frac{10}{15}$$

$$= \frac{2}{15}$$

Multiply the numerator and denominator of the first fraction by 3.

Multiply the numerator and denominator of the second fraction by 5.

Subtract the fractions.

a) $\frac{3}{2} - \frac{5}{9} =$ LCM of 2 and 9 is 18

$$= \frac{3 \times 9}{2 \times 9} - \frac{5 \times 2}{9 \times 2}$$

$$= \frac{27}{18} - \frac{10}{18} = \boxed{\frac{17}{18}}$$

b) $\frac{5}{7} - \frac{1}{4} =$

$$=$$

$$= \boxed{\phantom{\frac{\quad}{\quad}}}$$

c) $\frac{4}{5} - \frac{1}{2} =$

$$=$$

$$= \boxed{\phantom{\frac{\quad}{\quad}}}$$

d) $\frac{5}{7} - \frac{2}{3} =$

$$=$$

$$= \boxed{\phantom{\frac{\quad}{\quad}}}$$

e) $\frac{2}{5} - \frac{1}{12} =$

$$=$$

$$= \boxed{\phantom{\frac{\quad}{\quad}}}$$

f) $\frac{3}{5} - \frac{3}{11} =$

$$=$$

$$= \boxed{\phantom{\frac{\quad}{\quad}}}$$

g) $\frac{7}{9} - \frac{3}{4} =$

$$=$$

$$= \boxed{\phantom{\frac{\quad}{\quad}}}$$

h) $\frac{1}{2} - \frac{3}{7} =$

$$=$$

$$= \boxed{\phantom{\frac{\quad}{\quad}}}$$

i) $\frac{2}{3} - \frac{3}{10} =$

$$=$$

$$= \boxed{\phantom{\frac{\quad}{\quad}}}$$

j) $\frac{2}{5} - \frac{3}{8} =$

$$=$$

$$= \boxed{\phantom{\frac{\quad}{\quad}}}$$

k) $\frac{5}{6} - \frac{2}{7} =$

$$=$$

$$= \boxed{\phantom{\frac{\quad}{\quad}}}$$

l) $\frac{7}{9} - \frac{2}{5} =$

$$=$$

$$= \boxed{\phantom{\frac{\quad}{\quad}}}$$

10. [Fraction \times, \div]

continues on page 54

Skill 10.1 Multiplying a fraction by a whole number (1).

MMBlue 11 2 2 3 3 4 4
MMGreen 11 2 2 3 3 4 4

Greatest Common Factor (GCF) of two numbers

- Write all the factors of each number (the factors must divide exactly into the number).
- Find the largest number that appears on both lists.

Hint: The Greatest Common Factor is the largest number that divides evenly into both numbers.

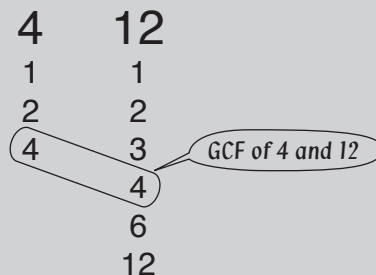
Examples:

Identical numbers



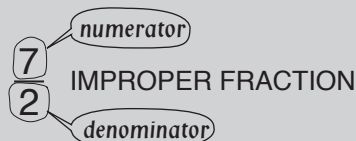
Hint: 5 is the GCF of 5 and 5 because 5 is the largest number that divides into 5 and 5.

One number divides evenly into the other number



Hint: 4 is the GCF of 4 and 12 because 4 is the largest number that divides into 4 and 12.

Changing an improper fraction to a mixed number



- Divide the numerator by the denominator.

$$\frac{7}{2} = 7 \div 2 = 3 \text{ remainder } 1$$

- Write the result as the whole number and the remainder over the denominator.

$$3 \text{ remainder } 1 = 3\frac{1}{2}$$

Cross simplifying a fraction and a whole number

- Simplify the denominator of the fraction and the whole number. This means to divide them by the same number, usually by their Greatest Common Factor.
- Cross out the denominator of the fraction and the whole number.
- Write the result of the division next to each crossed number.
- Multiply the top numbers together.

$$\begin{aligned} \frac{3}{10} \times 5 &= \frac{3}{\cancel{10}^{\div 5}} \times \cancel{5}_{\div 5} && \text{Divide 5 and 10 by 5} \\ &= \frac{3}{2} \times 1 && \begin{matrix} 5 \div 5 = 1 \\ 10 \div 5 = 2 \end{matrix} \\ &= \frac{3}{2} = 1\frac{1}{2} \end{aligned}$$

- Multiply the numerator of the fraction by the whole number.
- Do not change the denominator.
- Simplify the resulting fraction and/or change it to a mixed number if necessary.

EITHER

- Cross simplify where possible before multiplying.

OR

- Simplify at the end.

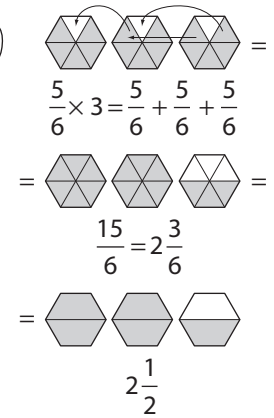
Skill 10.1 Multiplying a fraction by a whole number (2).

MMBlue 11 2 2 3 3 4 4
MMGreen 11 2 2 3 3 4 4

Q. $\frac{5}{6} \times 3 =$

A. $\frac{5}{\cancel{6}^2} \times \frac{1}{\cancel{3}} =$
 $= \frac{5 \times 1}{2}$ *Divide 6 and 3 by 3*
 $= \frac{5}{2}$ *Change to mixed number*
 $= 2\frac{1}{2}$

OR A. $\frac{5}{6} \times 3 =$ *Multiply 5 by 3*
 $= \frac{5 \times 3}{6}$
 $= \frac{15}{6}$
 $= 2\frac{3}{6}$ *Simplify*
 $= 2\frac{1}{2}$



a) $9 \times \frac{2}{5} =$
 $= \frac{9 \times 2}{5} = \frac{18}{5}$ *Change to mixed number*
 $= 18 \div 5 = 3\frac{3}{5}$

b) $\frac{5}{6} \times 5 =$
 $=$
 $=$

c) $3 \times \frac{5}{8} =$
 $=$
 $=$

d) $\frac{4}{5} \times 3 =$
 $=$
 $=$

e) $2 \times \frac{4}{7} =$
 $=$
 $=$

f) $2 \times \frac{2}{9} =$
 $=$
 $=$

g) $8 \times \frac{3}{4} =$
 $= \frac{2}{\cancel{4}^2} \times \frac{3}{\cancel{4}_1} = \frac{2 \times 3}{1} = 6$ *Divide 8 and 4 by 4*

h) $\frac{5}{8} \times 2 =$
 $=$
 $=$

i) $2 \times \frac{5}{12} =$
 $=$
 $=$

j) $6 \times \frac{5}{12} =$
 $=$
 $=$

k) $\frac{3}{7} \times 14 =$
 $=$
 $=$

l) $\frac{3}{4} \times 20 =$
 $=$
 $=$

m) $2 \times \frac{5}{6} =$
 $=$
 $=$

n) $\frac{1}{4} \times 16 =$
 $=$
 $=$

o) $12 \times \frac{3}{4} =$
 $=$
 $=$

Skill 10.2 Finding a fraction of a quantity.

- Replace the word “of” with the multiplication symbol.
- Multiply the fraction by the whole number. (see skill 10.1, page 53)
- Write the unit of measurement in the result.

Hint: To find a fraction of a whole number divide that number by the denominator of the fraction, and then multiply the result by the numerator.

Q. $\frac{5}{9}$ of \$180 =

A. $\frac{5}{9}$ of \$180 =

$$= \frac{5}{9} \times 180$$

Divide 9 and 180 by 9

$$= \frac{5 \times 20}{1}$$

Add the \$ sign

$$= \$100$$

OR A. To find $\frac{5}{9}$ of \$180:

$$180 \div 9 = 20$$

$$20 \times 5 = \$100$$

a) $\frac{3}{7}$ of 35 mL =

$$= \frac{3}{7} \times 35$$

Divide 7 and 35 by 7

$$= \frac{3 \times 5}{1} = \boxed{15 \text{ mL}}$$

b) $\frac{1}{2}$ of 360 kg =

$$= \frac{1}{2} \times 360$$

$$= \quad = \boxed{\text{kg}}$$

c) $\frac{1}{4}$ of \$72 =

$$=$$

$$= \quad = \boxed{\$}$$

d) $\frac{3}{10}$ of 150 L =

$$=$$

$$= \quad = \boxed{\text{L}}$$

e) $\frac{1}{5}$ of 1000 m =

$$=$$

$$= \quad = \boxed{\text{m}}$$

f) $\frac{1}{9}$ of \$45 =

$$=$$

$$= \quad = \boxed{\$}$$

g) $\frac{2}{3}$ of 600 L =

$$=$$

$$= \quad = \boxed{\text{L}}$$

h) $\frac{1}{6}$ of 120 cm =

$$=$$

$$= \quad = \boxed{\text{cm}}$$

i) $\frac{3}{4}$ of 60 m =

$$=$$

$$= \quad = \boxed{\text{m}}$$

j) $\frac{1}{9}$ of 720 g =

$$=$$

$$= \quad = \boxed{\text{g}}$$

k) $\frac{4}{5}$ of 40 mL =

$$=$$

$$= \quad = \boxed{\text{mL}}$$

l) $\frac{3}{8}$ of 80 kg =

$$=$$

$$= \quad = \boxed{\text{kg}}$$

Skill 10.3 Dividing a whole number by a fraction (2).

j) $2 \div \frac{3}{8} =$ Invert fraction

$= 2 \times \frac{8}{3}$

$= \frac{2 \times 8}{3} = \frac{16}{3} = 5 \frac{1}{3}$

k) $4 \div \frac{3}{5} =$

$=$

$=$

l) $2 \div \frac{5}{6} =$

$=$

$=$

m) $3 \div \frac{7}{8} =$

$=$

$=$

n) $5 \div \frac{6}{7} =$

$=$

$=$

o) $6 \div \frac{7}{8} =$

$=$

$=$

p) $6 \div \frac{2}{9} =$ Invert fraction

$= 6 \times \frac{9}{2}$

$= \overset{3}{\cancel{6}} \times \frac{9}{\underset{2}{\cancel{2}}}$ Divide 6 and 2 by 2

$= \frac{3 \times 9}{1} =$

q) $4 \div \frac{2}{5} =$

$=$

$=$

$=$

r) $10 \div \frac{2}{3} =$

$=$

$=$

$=$

s) $8 \div \frac{2}{7} =$

$=$

$=$

t) $9 \div \frac{3}{7} =$

$=$

$=$

$=$

u) $8 \div \frac{4}{11} =$

$=$

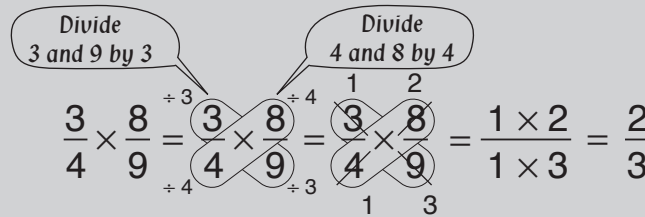
$=$

$=$

Skill 10.4 Multiplying two fractions (1).

Cross simplifying two fractions

- Simplify the numbers in the fractions diagonally (in a cross). This means to divide top and bottom numbers by the same number, usually by their Greatest Common Factor. (see skill 10.1, page 53)
- Cross out the numbers in the fractions diagonally (in a cross).
- Write the result of the division next to each crossed number.
- Multiply the top results together.
- Multiply the bottom results together.



- Multiply the numerators of the fractions.
 - Multiply the denominators of the fractions.
- To simplify:

EITHER

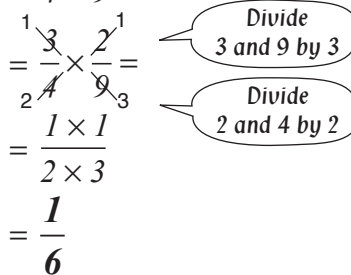
- Cross simplify where possible before multiplying.

OR

- Simplify at the end.

Q. $\frac{3}{4} \times \frac{2}{9} =$

A. $\frac{3}{4} \times \frac{2}{9} =$



OR

A. $\frac{3}{4} \times \frac{2}{9} =$

$$\begin{aligned} &= \frac{3 \times 2}{4 \times 9} \\ &= \frac{6}{36} \end{aligned}$$

Simplify

$$= \frac{1}{6}$$

a) $\frac{1}{4} \times \frac{1}{7} =$

$$= \frac{1 \times 1}{4 \times 7} = \boxed{\frac{1}{28}}$$

b) $\frac{3}{5} \times \frac{3}{4} =$

$$= \dots = \boxed{\phantom{\frac{1}{28}}}$$

c) $\frac{1}{8} \times \frac{3}{4} =$

$$= \dots = \boxed{\phantom{\frac{1}{28}}}$$

d) $\frac{7}{10} \times \frac{1}{2} =$

$$= \dots = \boxed{\phantom{\frac{1}{28}}}$$

e) $\frac{2}{9} \times \frac{4}{5} =$

$$= \dots = \boxed{\phantom{\frac{1}{28}}}$$

f) $\frac{3}{5} \times \frac{4}{7} =$

$$= \dots = \boxed{\phantom{\frac{1}{28}}}$$

g) $\frac{4}{5} \times \frac{1}{3} =$

$$= \dots = \boxed{\phantom{\frac{1}{28}}}$$

h) $\frac{5}{6} \times \frac{1}{2} =$

$$= \dots = \boxed{\phantom{\frac{1}{28}}}$$

i) $\frac{1}{4} \times \frac{3}{11} =$

$$= \dots = \boxed{\phantom{\frac{1}{28}}}$$

Skill 10.4 Multiplying two fractions (2).

j) $\frac{2}{3} \times \frac{1}{2} =$

$$= \frac{\cancel{2}^1 \times \cancel{1}_1}{3 \times 2} \quad \text{Simplify}$$

$$= \frac{1 \times 1}{3 \times 1} = \boxed{\frac{1}{3}}$$

k) $\frac{5}{6} \times \frac{6}{7} =$

$$=$$

$$=$$

$$= \boxed{\phantom{\frac{5}{7}}}$$

l) $\frac{3}{5} \times \frac{2}{3} =$

$$=$$

$$=$$

$$= \boxed{\phantom{\frac{2}{5}}}$$

m) $\frac{7}{9} \times \frac{2}{7} =$

$$=$$

$$=$$

$$= \boxed{\phantom{\frac{2}{9}}}$$

n) $\frac{1}{2} \times \frac{4}{9} =$

$$=$$

$$=$$

$$= \boxed{\phantom{\frac{2}{9}}}$$

o) $\frac{3}{5} \times \frac{1}{6} =$

$$=$$

$$=$$

$$= \boxed{\phantom{\frac{1}{10}}}$$

p) $\frac{3}{4} \times \frac{8}{11} =$

$$=$$

$$=$$

$$= \boxed{\phantom{\frac{6}{11}}}$$

q) $\frac{2}{5} \times \frac{3}{4} =$

$$=$$

$$=$$

$$= \boxed{\phantom{\frac{3}{10}}}$$

r) $\frac{4}{5} \times \frac{1}{2} =$

$$=$$

$$=$$

$$= \boxed{\phantom{\frac{2}{5}}}$$

s) $\frac{7}{9} \times \frac{1}{14} =$

$$=$$

$$=$$

$$= \boxed{\phantom{\frac{1}{18}}}$$

t) $\frac{5}{7} \times \frac{3}{10} =$

$$=$$

$$=$$

$$= \boxed{\phantom{\frac{3}{14}}}$$

u) $\frac{5}{12} \times \frac{6}{7} =$

$$=$$

$$=$$

$$= \boxed{\phantom{\frac{1}{2}}}$$

v) $\frac{3}{10} \times \frac{5}{9} =$

$$=$$

$$=$$

$$= \boxed{\phantom{\frac{1}{6}}}$$

w) $\frac{3}{4} \times \frac{8}{15} =$

$$=$$

$$=$$

$$= \boxed{\phantom{\frac{2}{5}}}$$

x) $\frac{4}{9} \times \frac{3}{16} =$

$$=$$

$$=$$

$$= \boxed{\phantom{\frac{1}{12}}}$$

Skill 10.5 Dividing a fraction by a whole number (1).

- Copy the fraction and write the whole number as an improper fraction with denominator 1.
- Change “divide by” (\div) into “times” (\times).
- Invert the second fraction.
- Multiply the fractions. (see skill 10.4, page 58)

To simplify:

EITHER

- Cross simplify where possible before dividing.

OR

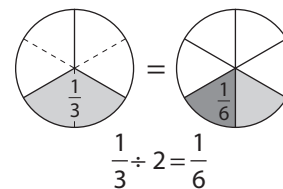
- Simplify at the end.

Q. $\frac{1}{3} \div 2 =$

A. $\frac{1}{3} \div 2 =$
 $= \frac{1}{3} \div \frac{2}{1} =$
 $= \frac{1}{3} \times \frac{1}{2} =$
 $= \frac{1 \times 1}{3 \times 2} =$
 $= \frac{1}{6}$

Invert second fraction

What is one third divided into 2 equal parts?



This can also be thought of as one half of a third.

$\frac{1}{2}$ of $\frac{1}{3} = \frac{1}{2} \times \frac{1}{3} = \frac{1}{6}$

a) $\frac{4}{9} \div 4 =$
 $= \frac{4}{9} \div \frac{4}{1} =$
 $= \frac{4}{9} \times \frac{1}{4} =$
 $= \frac{1 \times 1}{9 \times 1} =$

Divide 4 and 4 by 4

b) $\frac{2}{5} \div 2 =$
 $=$
 $=$
 $=$
 $=$
 $=$

c) $\frac{3}{7} \div 3 =$
 $=$
 $=$
 $=$
 $=$
 $=$

d) $\frac{1}{3} \div 4 =$
 $=$
 $=$
 $=$

e) $\frac{1}{5} \div 6 =$
 $=$
 $=$
 $=$

f) $\frac{1}{7} \div 3 =$
 $=$
 $=$
 $=$

Skill 10.6 Dividing two fractions (1).

- Copy the first fraction and change “divide by” (\div) into “times” (\times).
 - Invert the second fraction.
 - Multiply the fractions. (see skill 10.4, page 58)
- To simplify:

EITHER

- Cross simplify where possible before multiplying. (see skill 10.4, page 58)

OR

- Simplify at the end.

Q. $\frac{2}{9} \div \frac{1}{3} =$

A. $\frac{2}{9} \div \frac{1}{3} =$ *Invert second fraction*

$$= \frac{2}{9} \times \frac{3}{1}$$

$$= \frac{2}{\cancel{9}^3} \times \frac{\cancel{3}^1}{1}$$

Divide 9 and 3 by 3

$$= \frac{2 \times 1}{3 \times 1}$$

$$= \frac{2}{3}$$

OR

A. $\frac{2}{9} \div \frac{1}{3} =$

$$= \frac{2}{9} \times \frac{3}{1}$$

$$= \frac{2 \times 3}{9 \times 1}$$

$$= \frac{6 \div 3}{9 \div 3}$$

Simplify

$$= \frac{2}{3}$$

a) $\frac{3}{4} \div \frac{2}{5} =$

$$= \frac{3}{4} \times \frac{5}{2}$$

$$= \frac{3 \times 5}{4 \times 2} = \frac{15}{8} = \boxed{1\frac{7}{8}}$$

b) $\frac{2}{9} \div \frac{3}{7} =$

$$=$$

$$=$$

$$= \boxed{}$$

c) $\frac{2}{7} \div \frac{3}{5} =$

$$=$$

$$=$$

$$= \boxed{}$$

d) $\frac{2}{3} \div \frac{3}{8} =$

$$=$$

$$= \boxed{}$$

e) $\frac{4}{9} \div \frac{7}{11} =$

$$=$$

$$= \boxed{}$$

f) $\frac{5}{12} \div \frac{2}{7} =$

$$=$$

$$= \boxed{}$$

g) $\frac{2}{3} \div \frac{3}{4} =$

$$=$$

$$= \boxed{}$$

h) $\frac{3}{7} \div \frac{5}{8} =$

$$=$$

$$= \boxed{}$$

i) $\frac{3}{10} \div \frac{2}{9} =$

$$=$$

$$= \boxed{}$$

Skill 10.6 Dividing two fractions (2).

j) $\frac{7}{10} \div \frac{1}{5} =$

$$= \frac{7}{10} \times \frac{5}{1}$$

$$= \frac{7}{\cancel{10}^2} \times \frac{\cancel{5}^1}{1}$$

Divide
10 and 5 by 5

$$= \frac{7 \times 1}{2 \times 1} = \frac{7}{2} = \boxed{}$$

k) $\frac{7}{9} \div \frac{2}{3} =$

=

=

=

$$= \boxed{}$$

l) $\frac{2}{3} \div \frac{1}{6} =$

=

=

=

$$= \boxed{}$$

m) $\frac{1}{4} \div \frac{1}{2} =$

=

=

=

$$= \boxed{}$$

n) $\frac{1}{12} \div \frac{2}{3} =$

=

=

=

$$= \boxed{}$$

o) $\frac{9}{10} \div \frac{2}{5} =$

=

=

=

$$= \boxed{}$$

p) $\frac{5}{6} \div \frac{1}{3} =$

=

=

=

$$= \boxed{}$$

q) $\frac{5}{8} \div \frac{1}{2} =$

=

=

=

$$= \boxed{}$$

r) $\frac{3}{4} \div \frac{5}{16} =$

=

=

=

$$= \boxed{}$$

s) $\frac{4}{5} \div \frac{3}{10} =$

=

=

$$= \boxed{}$$

t) $\frac{5}{12} \div \frac{1}{6} =$

=

=

$$= \boxed{}$$

u) $\frac{7}{10} \div \frac{3}{20} =$

=

=

$$= \boxed{}$$

11. [Percents]

Skill 11.1 Writing a number out of 100 as a percent.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Write the number followed by the percent symbol “%”
Hint: “Percent” means “per hundred” or “of each hundred”.

Q. Write as a percent:
84 out of 100.

A. 84 out of 100 =
= **84%**

a) Write as a percent:
60 out of 100.

60%

b) Write as a percent:
32 out of 100.

c) Write as a percent:
46 out of 100.

d) Write as a percent:
12 out of 100.

e) Write as a percent:
5 out of 100.

f) Write as a percent:
9 out of 100.

g) Write as a percent:
61 out of 100.

h) Write as a percent:
53 out of 100.

i) Write as a percent:
4 out of 100.

j) Write as a percent:
7 out of 100.

k) Write as a percent:
59 out of 100.

l) Write as a percent:
91 out of 100.

m) Write as a percent:
28 out of 100.

n) Write as a percent:
79 out of 100.

Skill 11.2 Finding the remaining percent.

- Subtract the given percents from 100%, to find the remaining percent.

Q. According to a projection for 2020, 39% of the U.S. population will be aged between 0 - 29 and 35% between 30 - 59. What percent of the population will be aged 60 or more?

A. $100\% - 39\% - 35\%$
 $= 100\% - 74\%$
 $= 26\%$

a) Approximately 59% of the athletes at the 2000 Sydney Olympics were male. What percent of the athletes were female?

$100\% - 59\% = 41\%$

b) School is approximately 60% of the calendar year in the Russian Federation. What percent do holidays account for?

$100\% - 60\% = \boxed{}$

c) The green-yellow 18-carat gold is 75% gold and the rest is silver. What percent is silver?

$ = \boxed{}$

d) If 89% of the West Point military academy graduates are male, what percent are females?

$ = \boxed{}$

e) If 78% of the Supreme Court justices are male, what percent are females?

$ = \boxed{}$

f) If the cucumber is 96% water, what percent do the other components make?

$ = \boxed{}$

g) In 2007, 25% of employed women in the U.S. worked in part-time jobs. What percent of women worked in full-time jobs?

$ = \boxed{}$

h) If 37.5% of the adult teeth are incisors and canines, what percent is formed by molars and pre-molars?

$ = \boxed{}$

i) Approximately 60.5% of the world population lives in Asia and 13.5% lives in North and South America. What percent of the population lives in the rest of the world?

$100\% - 60.5\% - 13.5\% = \boxed{}$

j) Approximately 27.2% of the world population is aged between 0 and 14 years and 65.2% between 15 and 64 years. What percent of the population is aged 65 years and over?

$ = \boxed{}$

k) If England occupies 57% and Scotland occupies 34% of Great Britain (the main island of the United Kingdom), what percent is occupied by Wales?

$ = \boxed{}$

l) At the 2008 Beijing Olympics, 39% of the medals won by Germany were gold and 24% were silver. What percent of the medals were bronze?

$ = \boxed{}$

Skill 11.3 Finding a percent of multiples of 100 (1).

- Change the percent to a fraction out of 100.
Example: $40\% = \frac{40}{100}$
- Rewrite the question as a multiplication (change “of” to “ \times ”).
- Change the whole number to a fraction over 1.
Example: $7 = \frac{7}{1}$
- Cross simplify the fractions before multiplying.
(see skill 10.4, page 58)

Hint:

To find $10\% = \frac{1}{10} \Rightarrow$ divide by 10

$5\% =$ half of 10%

$20\% = \frac{1}{5} \Rightarrow$ divide by 5

$25\% = \frac{1}{4} \Rightarrow$ divide by 4

$50\% = \frac{1}{2} \Rightarrow$ divide by 2

OR

- First find 10%.
- Then multiply by the amount needed to make the required percent, i.e. multiply by 3 to get 30%.

Q. 40% of $\$6.00 =$

A. 40% of $\$6.00 =$
 $= 40\%$ of 600 Convert \$ to cents
 $= \frac{40}{100} \times \frac{600}{1}$ Simplify: $\div 100$
 $= 40 \times 6$
 $= 240$ cents
 $= \mathbf{\$2.40}$

OR **A.** $600 \div 10 =$ Find 10%
 $= 60$ cents
 60×4 Multiply by 4 to get 40%
 $= 240$ cents
 $= \mathbf{\$2.40}$

a) 24% of 100 = Divide by 100
 $= \frac{24}{100} \times \frac{100}{1}$ 24

b) 85% of 100 =

c) 69% of 100 =

d) 9% of 100 =

e) 7% of 100 =

f) 50% of 100 =

g) 75% of 400 =
 $= \frac{75}{100} \times \frac{400}{1}$
 $= 75 \times 4 =$

h) 10% of 300 = Divide 300 by 10

i) 30% of 500 = Find 10% first

j) 60% of 200 =

 =

k) 25% of 800 =
 =

l) 70% of 600 =
 =

Skill 11.3 Finding a percent of multiples of 100 (2).

m) 5% of 300 =

$$= \frac{5}{100} \times \frac{300}{1}$$

$$= 5 \times 3 = \boxed{}$$

n) 5% of 500 =
 Find 10%

$$500 \div 10 = 50$$
 5% is half of 10%

$$50 \div 2 = \boxed{}$$

o) 5% of 700 =

$$=$$

$$= \boxed{}$$

p) 50% of 700 =

$$=$$

$$= \boxed{}$$

q) 20% of 200 =

$$=$$

$$= \boxed{}$$

r) 40% of 500 =

$$=$$

$$= \boxed{}$$

s) 80% of 400 =

$$=$$

$$= \boxed{}$$

t) 90% of 300 =

$$=$$

$$= \boxed{}$$

u) 15% of 400 =

$$=$$

$$= \boxed{}$$

v) 50% of \$5.00 =

$$=$$

$$=$$

$$= \boxed{\$ }$$

w) 20% of \$3.00 =

$$=$$

$$=$$

$$= \boxed{\$ }$$

x) 75% of \$6.00 =

$$=$$

$$=$$

$$= \boxed{\$ }$$

y) 5% of \$4.00 =

$$=$$

$$=$$

$$= \boxed{ \text{¢}}$$

z) 40% of \$3.50 =

$$=$$

$$=$$

$$= \boxed{ \text{¢}}$$

zz) 30% of \$4.50 =

$$=$$

$$=$$

$$= \boxed{ \text{¢}}$$

Skill 11.4 Finding a percent of any number (1).

- Change the percent to a fraction out of 100.

Example: $40\% = \frac{40}{100}$

- Rewrite the question as a multiplication (change “of” to “ \times ”).
- Change the whole number to a fraction over 1.

Example: $7 = \frac{7}{1}$

- Cross simplify the fractions before multiplying.
(see skill 10.4, page 58)

Hint:

To find $1\% = \frac{1}{100} \Rightarrow$ divide by 100

$12.5\% = \frac{1}{8} \Rightarrow$ divide by 8

$33\frac{1}{3}\% = \frac{1}{3} \Rightarrow$ divide by 3

$66\frac{2}{3}\% = \frac{2}{3} \Rightarrow$ divide by 3
multiply by 2

OR

- First find 10%.
- Then multiply by the amount needed to make the required percent, i.e. multiply by 3 to get 30%.

Q. $66\frac{2}{3}\%$ of 270 =

A. $66\frac{2}{3}\%$ of 270 =

$$= \frac{2}{3} \times \frac{270}{1} \quad \text{Simplify: } \div 3$$

$$= 2 \times 90$$

$$= \mathbf{180}$$

Substitute $66\frac{2}{3}\%$ with $\frac{2}{3}$

Change “of” to “ \times ”

Change 270 to $\frac{270}{1}$

Multiply $\frac{2}{3}$ by $\frac{270}{1}$

a) 20% of 50 =

$$= \frac{20}{100} \times \frac{50}{1} \quad \text{Simplify: } \div 10, \text{ twice}$$

$$= 2 \times 5 = \mathbf{10}$$

b) 70% of 240 =

$$240 \div 10 = 24 \quad \text{Find 10\% first}$$

$$24 \times 7 = \mathbf{\quad}$$

Multiply by 7 to get 70%

c) 80% of 20 =

$$= \mathbf{\quad}$$

d) 40% of 80 =

$$= \mathbf{\quad}$$

e) 60% of 250 =

$$= \mathbf{\quad}$$

f) 30% of 140 =

$$= \mathbf{\quad}$$

g) 70% of 120 =

$$= \mathbf{\quad}$$

h) 5% of 40 =

$$= \mathbf{\quad}$$

i) 5% of 120 =

$$= \mathbf{\quad}$$

j) 15% of 60 =

10% $60 \div 10 = 6$ Find 10% first

5% $6 \div 2 = 3$ 5% is half of 10%

15% $6 + 3 = \mathbf{\quad}$

k) 35% of 80 =

10% $\mathbf{\quad}$

5% $\mathbf{\quad}$

35% $\mathbf{\quad}$

l) 45% of 120 =

10% $\mathbf{\quad}$

5% $\mathbf{\quad}$

45% $\mathbf{\quad}$

Skill 11.4 Finding a percent of any number (2).

m) 25% of 180 =

$$= \frac{25}{100} \times \frac{180}{1}$$

Simplify: $\div 5$

$$= \frac{90}{2} = \boxed{}$$

Divide by 10

n) 75% of 40 =

$$=$$

$$= \boxed{}$$

o) 75% of 120 =

$$=$$

$$= \boxed{}$$

p) 15% of 40 =

$$= \frac{15}{100} \times \frac{40}{1}$$

Simplify: $\div 10$

$$= \frac{60}{10} = \boxed{}$$

q) 6% of 30 =

$$=$$

$$= \boxed{}$$

r) 8% of 80 =

$$=$$

$$= \boxed{}$$

s) 1% of 300 =

$$= \frac{1}{100} \times \frac{300}{1}$$

$$= \boxed{}$$

t) 1% of 150 =

$$=$$

$$= \boxed{}$$

u) 2% of 50 =

$$=$$

$$= \boxed{}$$

v) 12.5% of 560 =

$$= \frac{1}{8} \times \frac{560}{1}$$

Simplify: $\div 8$

$$= \boxed{}$$

w) 12.5% of 80 =

$$=$$

$$= \boxed{}$$

x) 12.5% of 160 =

$$=$$

$$= \boxed{}$$

y) $33\frac{1}{3}\%$ of 150 =

$$= \frac{1}{3} \times \frac{150}{1}$$

Simplify: $\div 3$

$$= \boxed{}$$

z) $33\frac{1}{3}\%$ of 180 =

$$=$$

$$= \boxed{}$$

A) $33\frac{1}{3}\%$ of 60 =

$$=$$

$$= \boxed{}$$

B) $66\frac{2}{3}\%$ of 90 =

$$= \frac{2}{3} \times \frac{90}{1}$$

$$= \boxed{}$$

C) $66\frac{2}{3}\%$ of 150 =

$$=$$

$$= \boxed{}$$

D) $66\frac{2}{3}\%$ of 210 =

$$=$$

$$= \boxed{}$$

Skill 11.5 Working with percents greater than 100%.

- Change the percent to a fraction out of 100.

Example: $150\% = \frac{150}{100}$

- Rewrite the question as a multiplication (change “of” to “ \times ”).
- Change the whole number to a fraction over 1.

Example: $7 = \frac{7}{1}$

- Cross simplify the fractions before multiplying.
(see skill 10.4, page 58)

OR

- First find 100% or other multiples of 100%.
- Then find the remaining percent.
- Add the results.

Hint:

To find $10\% = \frac{1}{10} \Rightarrow$ divide by 10

$20\% = \frac{1}{5} \Rightarrow$ divide by 5

$200\% = \frac{2}{1} \Rightarrow$ multiply by 2

$300\% = \frac{3}{1} \Rightarrow$ multiply by 3

Q. 350% of $40 =$

A. 350% of $40 =$

OR A. 100% of 40 is 40

$$= \frac{350}{100} \times \frac{40}{1} \quad \text{Simplify: } \div 10, \text{ twice}$$

$$= 35 \times 4$$

$$= \mathbf{140}$$

So 300% is triple that, or 120
 50% of 40 is 20
 So 350% of 40 is
 $120 + 20 = \mathbf{140}$

a) 200% of $60 =$

$$= \frac{200}{100} \times \frac{60}{1} \quad \text{Simplify: } \div 10, \text{ twice}$$

$$= 20 \times 6 = \mathbf{120}$$

b) 300% of $50 =$

$$= \dots = \boxed{}$$

c) 400% of $70 =$

$$= \dots = \boxed{}$$

d) 120% of $80 =$

100% of $80 = 80$ Find 100%

20% of $80 = 16$ Find 20%

Add the results
 $80 + 16 = \boxed{}$

e) 110% of $90 =$

$$= \dots = \boxed{}$$

f) 250% of $30 =$

$$= \dots = \boxed{}$$

g) 250% of $40 =$

$$= \frac{250}{100} \times \frac{40}{1}$$

$$= 25 \times 4 = \boxed{}$$

h) 140% of $50 =$

$$= \dots = \boxed{}$$

i) 220% of $80 =$

$$= \dots = \boxed{}$$

j) 130% of $60 =$

$$= \dots = \boxed{}$$

k) 120% of $70 =$

$$= \dots = \boxed{}$$

l) 350% of $40 =$

$$= \dots = \boxed{}$$

Skill 11.6 Working with percents to find discounts and sale prices.

- Calculate the percent of the given amount. (see skill 11.3, page 67 and skill 11.4, page 69)

To find the **sale price** if a **discount** is applied:

- Subtract this result from the given amount.

To find the **total amount** if a **sales tax** is applied:

- Add this result to the given amount.

Q. If a sales tax of 6% is applied on a purchase of \$200, what is the total amount that must be paid?

A. Sales tax: 6% of 200 =

$$= \frac{6}{100} \times \frac{200}{1}$$

$$= 6 \times 2 = 12$$

Total: $200 + 12 = \mathbf{\$212}$

a) If a \$30 T-shirt is reduced by 15%, what is the discount?

discount: 15% of 30 =

$$= \frac{15}{100} \times \frac{30}{1} = \frac{45}{10} = \mathbf{\$4.50}$$

b) If a \$120 bike is reduced by 25%, what is the discount?

discount:

$$= \mathbf{\$}$$

c) If a \$3000 laptop is reduced by 20%, what is the sale price?

discount: 20% of 3000 =

$$= \frac{20}{100} \times \frac{3000}{1} = 600$$

(Divide by 100)

sale price: $\$3000 - \$600 = \mathbf{\$}$

d) If a \$500 dress is discounted by 40%, what is the sale price?

discount:

$$= \mathbf{\$}$$

e) If a sales tax of 4% is applied on a purchase of \$500, what is the total amount that must be paid?

sales tax: 4% of 500 =

$$= \mathbf{\$}$$

total: $\$500 + \mathbf{\$} = \mathbf{\$}$

f) If a sales tax of 5% is applied on a purchase of \$120, what is the total amount that must be paid?

sales tax:

$$= \mathbf{\$}$$

total: $\mathbf{\$} = \mathbf{\$}$

g) If a sales tax of 6% is applied on a restaurant bill of \$80, what is the total amount that must be paid?

sales tax:

$$= \mathbf{\$}$$

total: $\mathbf{\$} = \mathbf{\$}$

h) If a sales tax of 4% is applied on a purchase of \$60, what is the total amount that must be paid?

sales tax:

$$= \mathbf{\$}$$

total: $\mathbf{\$} = \mathbf{\$}$

Skill 11.7 Writing one number as a percent of another number.

- Form a fraction using the two numbers.

EITHER

- Multiply this fraction by 100%: $\text{fraction} = \text{fraction} \times 100\%$

Hint: 100% equals 1 and does not change the value of the fraction.

- Simplify the resulting fraction and/or change it to a mixed number if necessary. (see skill 9.1, page 39)

OR

- Find an equivalent fraction with the denominator 100, by multiplying or dividing both the numerator and denominator by the same number.
- Write this fraction as a percent. (see skill 12.9, page 84)

Hint: Both numbers must represent the same unit of measurement.

Q. Write as a percent:
23 out of 50.

A. 23 out of 50 = OR

$$= \frac{23}{50} \times 100\%$$

$$= \frac{23}{\cancel{50}^2} \times \frac{100}{1} \% \quad \text{Simplify: } \div 50$$

$$= \frac{23}{1} \times 2$$

$$= 46\%$$

A. 23 out of 50 =

$$= \frac{23 \times 2}{50 \times 2}$$

$$= \frac{46}{100}$$

$$= 46\%$$

a) Write as a percent:
10 out of 40.

$$= \frac{10}{40} \times \frac{100}{1} \% \quad \text{Simplify: } \div 10$$

$$= \frac{100}{4} = 25\%$$

b) Write as a percent:
15 out of 20.

$$= \frac{15}{20} \times \frac{100}{1} \%$$

$$= \quad = \quad$$

c) Write as a percent:
45 out of 50.

$$= \quad = \quad$$

d) Write as a percent:
12 out of 60.

$$\frac{12 \div 12}{60 \div 12} = \frac{1}{5} \quad \text{Simplify: } \div 12$$

$$= \frac{1 \times 20}{5 \times 20} = \frac{20}{100} = \quad \text{Find equivalent fraction}$$

e) Write as a percent:
9 out of 90.

$$= \quad = \quad$$

f) Write as a percent:
300 out of 1500.

$$= \quad = \quad$$

g) Write as a percent:
20 cents out of \$2.00.

$$\text{\$2.00} = 200 \text{ cents} \quad \text{Change \$ to cents}$$

$$\frac{20 \div 2}{200 \div 2} = \frac{10}{100} = \quad$$

h) Write as a percent:
45 min out of 3 hours.

$$= \quad = \quad$$

i) Write as a percent:
15 min out of 2 hours.

$$= \quad = \quad$$

Skill 11.8 Calculating profit or loss as a percent of the cost price.

- Calculate the profit or the loss, as the difference between the selling and the cost price.
- Express the profit or the loss as a percent of the cost price. (see skill 11.7, page 73)

Q. A shop buys jackets in bulk for \$50 each, then sells them for \$95 each. Calculate the profit on each jacket as a percent of the cost price.

A. *profit:* $\$95 - \$50 = \$45$
profit out of cost price: $\$45 \text{ out of } \$50 = \frac{45}{50}$
 $= \frac{45}{50} \times \frac{100}{1}\% = \frac{450}{5}\%$
 $= \mathbf{90\%}$

a) Lorien lost \$40 on a ring costing \$400. What was her loss as a percent of the cost price?

loss: \$40

loss out of cost: \$40 out of \$400 =

$= \frac{40}{400} \times \frac{100}{1}\% = \frac{40}{4}\%$ = 10%

b) The Cycle Center made \$30 profit on a bicycle costing \$150. What was the profit as a percent of the cost price?

profit:

profit out of cost:

=

c) John made \$20 profit on a tool box costing \$100. What was his profit as a percent of the cost price?

profit:

profit out of cost:

=

d) Jason lost \$15 on a book costing \$30. What was his loss as a percent of the cost price?

loss:

loss out of cost:

=

e) Serena bought a car for \$5000. If she later sold it for \$3500, find the loss as a percent of the cost price.

=

f) A shop buys uniforms in bulk for \$75 each, then sells them for \$100 each. Find the profit as a percent of the cost price.

=

g) Tea bought a table for \$400. If she later sold it for \$350, find the loss as a percent of the cost price.

=

h) A painting was bought for \$6000. If it was later sold for \$7500, find the profit as a percent of the cost price.

=

12. [Decimals / Fractions / Percents]

Skill 12.1 Illustrating fractions and percents.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

To recognize a shaded **fraction** of a shape:

- Count the total number of equal parts in which the shape is divided.
- Use this number as the denominator of the fraction.
- Count the number of shaded parts.
- Use this number as the numerator of the fraction.
- Simplify the resulting fraction.
(see skill 9.1, page 39)

To recognize a shaded **percent** of a shape:

- Count the shaded parts.
- Relate the amount shaded to out of 100, by dividing the number of total parts into 100.

Hints: A percent is a fraction out of 100.

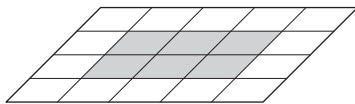
Compare to common fractions:

one half equals 50%

one quarter equals 25%

one tenth equals 10%.

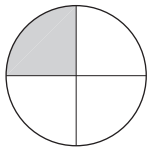
Q. What percent of the shape is shaded?



A. $6 \text{ out of } 20 \text{ parts} =$
 $\times 5 \left(\begin{array}{c} 6 \\ \times 5 \end{array} \right) = 30 \text{ out of } 100 \text{ parts}$
 $= 30\%$

6 out of 20 parts are shaded.
There are 5 lots of 20 in 100
so multiply 6×5 to get the
percent shaded.

a) What fraction of the shape is shaded?

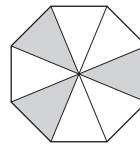


1 out of 4 parts

=

$$\frac{1}{4}$$

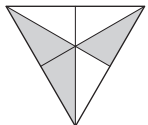
b) What fraction of the shape is shaded?



=

$$\frac{3}{8}$$

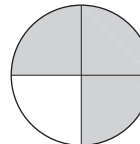
c) What fraction of the shape is shaded?



=

$$\frac{3}{6}$$

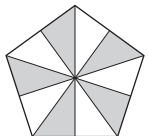
d) What fraction of the shape is shaded?



=

$$\frac{3}{4}$$

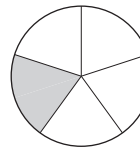
e) What percent of the shape is shaded?



=

$$50\%$$

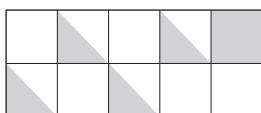
f) What percent of the shape is shaded?



=

$$40\%$$

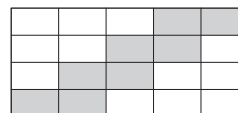
g) What percent of the shape is shaded?



=

$$50\%$$

h) What percent of the shape is shaded?



=

$$58\frac{1}{3}\%$$

Skill 12.2 Simplifying fractions (1).

MMBlue 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

Greatest Common Factor (GCF) of two numbers

- Write all the factors of each number (the factors must divide exactly into the number).
- Find the largest number that appears on both lists.

Hint: The Greatest Common Factor is the largest number that divides evenly in both numbers.

Examples:

Identical numbers

5	5	
1	1	
5	5	GCF of 5 and 5

Hint: 5 is the GCF of 5 and 5 because 5 is the largest number that divides into 5 and 5.

One number divides evenly into the other number

4	12	
1	1	
2	2	
4	3	
4	4	GCF of 4 and 12
	6	
	12	

Hint: 4 is the GCF of 4 and 12 because 4 is the largest number that divides into 4 and 12.

Numbers have other common factors

6	10	
1	1	
2	2	GCF of 6 and 10
3	5	
6	10	

Hint: 2 is the GCF of 6 and 10 because 2 is the largest number that divides into 6 and 10.

- Divide both the numerator and the denominator by their Greatest Common Factor (GCF).
- OR

- Divide both the numerator and the denominator by any common factor.
- Divide again by another common factor, until the common factor of the numerator and the denominator is 1.

Hints: The fraction is in simplest form when it cannot be simplified.

If the numbers are both even then you can start with dividing by 2.

Q. Simplify $\frac{20}{30}$

A. $\frac{20}{30} = \frac{20 \div 10}{30 \div 10} = \frac{2}{3}$ *(GCF of 20 and 30 is 10)* OR **A.** $\frac{20 \div 2}{30 \div 2} = \frac{10 \div 5}{15 \div 5} = \frac{2}{3}$ *(Divide by 2)* *(Divide by 5)*

a) Simplify $\frac{4}{10}$ *(GCF of 4 and 10 is 2)*
 $= \frac{4 \div 2}{10 \div 2} = \frac{2}{5}$

b) Simplify $\frac{3}{6}$
 $= \frac{3 \div 3}{6 \div 3} = \frac{1}{2}$

c) Simplify $\frac{4}{6}$
 $= \frac{4 \div 2}{6 \div 2} = \frac{2}{3}$

d) Simplify $\frac{3}{9}$
 $= \frac{3 \div 3}{9 \div 3} = \frac{1}{3}$

e) Simplify $\frac{2}{8}$
 $= \frac{2 \div 2}{8 \div 2} = \frac{1}{4}$

f) Simplify $\frac{2}{6}$
 $= \frac{2 \div 2}{6 \div 2} = \frac{1}{3}$

Skill 12.2 Simplifying fractions (2).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

g) Simplify $\frac{9}{18}$

= $\frac{\quad}{\quad}$

h) Simplify $\frac{3}{30}$

= $\frac{\quad}{\quad}$

i) Simplify $\frac{12}{15}$

= $\frac{\quad}{\quad}$

j) Simplify $\frac{8}{12}$

= $\frac{\quad}{\quad}$

k) Simplify $\frac{5}{15}$

= $\frac{\quad}{\quad}$

l) Simplify $\frac{15}{20}$

= $\frac{\quad}{\quad}$

m) Simplify $\frac{6}{12}$

= $\frac{\quad}{\quad}$

n) Simplify $\frac{4}{40}$

= $\frac{\quad}{\quad}$

o) Simplify $\frac{10}{30}$

= $\frac{\quad}{\quad}$

p) Simplify $\frac{5}{25}$

= $\frac{\quad}{\quad}$

q) Simplify $\frac{8}{16}$

= $\frac{\quad}{\quad}$

r) Simplify $\frac{14}{21}$

= $\frac{\quad}{\quad}$

s) Simplify $\frac{9}{24}$

= $\frac{\quad}{\quad}$

t) Simplify $\frac{8}{20}$

= $\frac{\quad}{\quad}$

u) Simplify $\frac{24}{30}$

= $\frac{\quad}{\quad}$

v) Simplify $\frac{9}{15}$

= $\frac{\quad}{\quad}$

w) Simplify $\frac{9}{81}$

= $\frac{\quad}{\quad}$

x) Simplify $\frac{25}{35}$

= $\frac{\quad}{\quad}$

y) Simplify $\frac{20}{25}$

= $\frac{\quad}{\quad}$

z) Simplify $\frac{8}{28}$

= $\frac{\quad}{\quad}$

zz) Simplify $\frac{12}{20}$

= $\frac{\quad}{\quad}$

Skill 12.3 Finding equivalent fractions.

- Check if you need to multiply or divide the numerator or denominator of the first fraction to reach the numerator or denominator of the second fraction.
- Do the same operation to the top or the bottom of the fraction.

Example:

$$\frac{4}{5} = \frac{\boxed{?}}{15} \Rightarrow \frac{4 \times 3}{5 \times 3} = \frac{\boxed{12}}{15}$$

$\swarrow \times 3$

So $\frac{4}{5}$ and $\frac{12}{15}$ are equivalent fractions.

Q. Complete the equivalent fractions:

$$\frac{3}{5} = \frac{18}{\boxed{}} = \frac{\boxed{}}{90}$$

A.

$$\frac{3}{5} = \frac{18}{?} \Rightarrow \frac{3 \times 6}{5 \times 6} = \frac{18}{30}$$

and

$$\frac{3}{5} = \frac{?}{90} \Rightarrow \frac{3 \times 18}{5 \times 18} = \frac{54}{90}$$

$\swarrow \times 18$

$$\Rightarrow \frac{3}{5} = \frac{18}{\boxed{30}} = \frac{\boxed{54}}{90}$$

a) Complete the equivalent fractions:

$$\frac{\boxed{35}}{42} = \frac{5}{6}$$

$$\frac{?}{42} = \frac{5}{6} \Rightarrow ? \div 7 = 5 \Rightarrow ? = 35$$

$\swarrow \div 7$

b) Complete the equivalent fractions:

$$\frac{3}{4} = \frac{27}{\boxed{}}$$

$$\frac{3}{4} = \frac{27}{?} \Rightarrow \frac{3 \times 9}{4 \times 9} = \frac{27}{36}$$

c) Complete the equivalent fractions:

$$\frac{2}{5} = \frac{\boxed{}}{35}$$

\Rightarrow

d) Complete the equivalent fractions:

$$\frac{4}{\boxed{}} = \frac{28}{49}$$

\Rightarrow

e) Complete the equivalent fractions:

$$\frac{9}{10} = \frac{\boxed{}}{60}$$

\Rightarrow

f) Complete the equivalent fractions:

$$\frac{48}{60} = \frac{12}{\boxed{}}$$

\Rightarrow

g) Complete the equivalent fractions:

$$\frac{2}{3} = \frac{\boxed{}}{15} = \frac{40}{\boxed{}}$$

\Rightarrow

h) Complete the equivalent fractions:

$$\frac{3}{8} = \frac{12}{\boxed{}} = \frac{\boxed{}}{96}$$

\Rightarrow

i) Complete the equivalent fractions:

$$\frac{3}{\boxed{}} = \frac{6}{8} = \frac{\boxed{}}{64}$$

\Rightarrow

and \Rightarrow

and \Rightarrow

and \Rightarrow

Skill 12.4 Writing a decimal number as a percent.

- Multiply the decimal number by 100, by moving the decimal point two places to the right.
 - Add the percent sign.
- Hint: Zeros can be added at the end of any decimal number: $0.4 = 0.4000$*

Q. Write 0.07 as a percent.

A. $0.07 = 0.\overbrace{07}^{2 \text{ zeros, 2 places to the right}} \times 100\% = 7\%$

a) Write 0.4 as a percent.

$0.4 = 0.\overbrace{40}^{\text{Add a zero}} \times 100\% = \boxed{40\%}$

b) Write 0.2 as a percent.

$\dots = \boxed{}$

c) Write 0.1 as a percent.

$\dots = \boxed{}$

d) Write 0.9 as a percent.

$\dots = \boxed{}$

e) Write 0.7 as a percent.

$\dots = \boxed{}$

f) Write 0.12 as a percent.

$\dots = \boxed{}$

g) Write 0.55 as a percent.

$\dots = \boxed{}$

h) Write 0.48 as a percent.

$\dots = \boxed{}$

i) Write 0.29 as a percent.

$\dots = \boxed{}$

j) Write 0.35 as a percent.

$\dots = \boxed{}$

k) Write 0.04 as a percent.

$\dots = \boxed{}$

l) Write 0.05 as a percent.

$\dots = \boxed{}$

m) Write 0.02 as a percent.

$\dots = \boxed{}$

n) Write 0.38 as a percent.

$\dots = \boxed{}$

o) Write 0.4 as a percent.

$\dots = \boxed{}$

p) Write 0.25 as a percent.

$\dots = \boxed{}$

q) Write 0.125 as a percent.

$\dots = \boxed{}$

r) Write 0.345 as a percent.

$\dots = \boxed{}$

Skill 12.5 Writing a percent as a decimal number.

- Write the percent as a fraction out of 100.
 - Divide the numerator of the fraction by 100, by moving the decimal point two places to the left.
- Hints: *Fractions are divisions.*

*There is a decimal point and zeros which are not written, at the end of any whole number:
27 = 27.00*

Zeros can be used as place holders before any whole number: 27 = 0027.00

Q. Change 8.6% to a decimal.

$$\begin{aligned} \text{A. } 8.6\% &= \frac{8.6}{100} \\ &= 8.6 \div 100 \\ &= \overbrace{00}8.6 \div 100 \quad \text{2 zeros, 2 places to the left} \\ &= \mathbf{0.086} \end{aligned}$$

a) Change 5% to a decimal.

$$5\% = \frac{5}{100} = \overbrace{00}5.0 \div 100 = \boxed{0.05}$$

b) Change 2% to a decimal.

$$2\% = \boxed{}$$

c) Change 88% to a decimal.

$$= \boxed{}$$

d) Change 42% to a decimal.

$$= \boxed{}$$

e) Change 60% to a decimal.

$$= \boxed{}$$

f) Change 40% to a decimal.

$$= \boxed{}$$

g) Change 0.5% to a decimal.

$$= \boxed{}$$

h) Change 1.8% to a decimal.

$$= \boxed{}$$

i) In Mali 72% of people earn less than \$1 each day. Write this percent as a decimal.

$$= \boxed{}$$

j) The August 2007 unemployment figure was 5.7%. Write this percent as a decimal.

$$= \boxed{}$$

k) The percent of Americans between 12 and 17 who play video games is 97%. Write this percent as a decimal.

$$= \boxed{}$$

l) The Sun accounts for 99% of the mass of the solar system. Write this percent as a decimal.

$$= \boxed{}$$

m) The United States has approximately 5% of the world's population. Write this percent as a decimal.

$$= \boxed{}$$

n) In the USA in 2007 McDonald's restaurant business accounted for 2.4% of the total number of restaurants. Write this percent as a decimal.

$$= \boxed{}$$

Skill 12.6 Writing a decimal number as a fraction in simplest form.

- Write the decimal number as the numerator of the fraction.
- Ignore any zeros at the start the number.
- Use the place value of the last digit of the decimal number to determine the size of the denominator.

Example:

units	tenths	hundredths
0	. 0	4

= 4 hundredths = $\frac{4}{100}$

Write the 4 as the numerator

4 in hundredths place, denominator = 100

- Write the fraction in simplest form. This means to divide both the numerator and the denominator by the same number.

Hint: For the denominator, write 1 followed by a zero for each digit after the decimal point.

Example: $0.\underline{04} = \frac{4}{\underline{100}}$

Q. Write 0.6 as a fraction in simplest form.

A. $0.\underline{6} = \frac{6}{10}$

$= \frac{6 \div 2}{10 \div 2}$

$= \frac{3}{5}$

Write 6 as the numerator

1 zero for 1 decimal place

Simplify: $\div 2$

a) Write 0.9 as a fraction.

$0.9 = \textit{nine tenths}$ = $\frac{9}{10}$

b) Write 0.11 as a fraction.

$0.11 = \textit{eleven hundredths}$ =

c) Write 0.3 as a fraction.

=

d) Write 0.1 as a fraction.

=

e) Write 0.06 as a fraction in simplest form.

=

f) Write 0.02 as a fraction in simplest form.

=

g) Write 0.5 as a fraction in simplest form.

=

h) Write 0.28 as a fraction in simplest form.

=

i) Write 0.15 as a fraction in simplest form.

=

j) Write 0.8 as a fraction in simplest form.

=

Skill 12.7 Writing a fraction as a terminating decimal.

When the denominator **is** a power of 10:

- Divide the numerator by the power of 10 by moving the decimal point to the left.

Example: $\frac{15}{100} = 15 \div 100$
 $= 015.0 \div 100$ *(2 zeros, 2 places to the left)*
 $= 0.15$

Hints: Fractions are just divisions.

There is a decimal point and zeros which are not written, at the end of any whole number:
 $27 = 27.00$

Zeros can be used as place holders before any whole number: $27 = 0027.00$

The number of zeros in the denominator shows the number of digits after the decimal point. $\frac{27}{100} = 0.27$

When the denominator **is not** a power of 10:

EITHER

- Multiply both the numerator and denominator by the same number to make the denominator a power of 10. (e.g. 10, 100 or 1000).

Example: $\frac{3}{4} = \frac{3 \times 25}{4 \times 25} = \frac{75}{100} = 0.75$ *(power of 10)*

OR

- Divide the numerator by the denominator.

Example: $\frac{3}{4} = 3 \div 4 = 3.00 \div 4 = 0.75$

$$\begin{array}{r} 0.75 \\ 4 \overline{) 3.00} \\ \underline{3} \\ 0 \\ \underline{0} \\ 0 \\ \underline{0} \\ 0 \end{array}$$

Q. Change $\frac{3}{5}$ to a decimal.

A. $\frac{3}{5} = \frac{3 \times 20}{5 \times 20}$

OR

A. $\frac{3}{5} = 3 \div 5$

$= \frac{60}{100}$ *(Make denominator a power of 10)*

$= 3.0 \div 5$
 $= 0.6$

$= 60 \div 100$
 $= 060.0 \div 100$ *(2 zeros, 2 places to the left)*
 $= 0.60 = 0.6$

$$\begin{array}{r} 0.6 \\ 5 \overline{) 3.0} \\ \underline{3} \\ 0 \\ \underline{0} \\ 0 \end{array}$$

a) Change $\frac{3}{10}$ to a decimal.

$= \frac{3 \times 10}{10 \times 10} = \frac{30}{100}$

$= 030.0 \div 100 = \boxed{0.3}$

b) Change $\frac{7}{20}$ to a decimal.

$= \frac{}{} = \boxed{}$

c) Change $\frac{9}{25}$ to a decimal.

$= \frac{}{} = \boxed{}$

d) Change $\frac{1}{2}$ to a decimal.

$= \frac{}{} = \boxed{}$

e) Change $1\frac{2}{5}$ to a decimal.

$= \frac{}{} = \boxed{}$

f) Change $2\frac{3}{4}$ to a decimal.

$= \frac{}{} = \boxed{}$

g) In 2008 a quarter of the Australian wheat exports went to Indonesia. Write this fraction as a decimal.

$= \frac{}{} = \boxed{}$

h) Approximately 9 out of 10 Nigerians attend church regularly. Write this fraction as a decimal.

$= \frac{}{} = \boxed{}$

i) People can smell one-twentieth as well as a dog. Write this fraction as a decimal.

$= \frac{}{} = \boxed{}$

Skill 12.8 Writing a percent as a fraction in simplest form.

MMBlue 11 22 3 44
MMGreen 11 22 3 44

- Write the percent as a fraction with the denominator of 100.
 - Simplify the fraction by dividing both the numerator and the denominator by the same number.
- Hints: Percent means “per hundred” or “out of a hundred”.*

A percent is another way of writing a fraction out of one hundred.

Example: 25% is said “25 percent” and means 25 out of 100.

Q. U.S. accounts for 24% of the European Union exports. Write this percent as a fraction in simplest form.

$$\begin{aligned} \text{A. } 24\% &= \frac{24}{100} \xrightarrow{\text{Simplify: } \div 4} \\ &= \frac{6}{25} \end{aligned}$$

a) Write 47% as a fraction.

$$47\% = \frac{47}{100}$$

b) Write 9% as a fraction.

$$9\% = \frac{\quad}{\quad}$$

c) Write 15% as a fraction in simplest form.

$$15\% = \frac{15}{100} \xrightarrow{\text{Simplify: } \div 5} = \frac{3}{20}$$

d) Write 30% as a fraction in simplest form.

$$30\% = \frac{\quad}{\quad}$$

e) Write 4% as a fraction in simplest form.

$$4\% = \frac{\quad}{\quad}$$

f) Write 6% as a fraction in simplest form.

$$6\% = \frac{\quad}{\quad}$$

g) The common metal for medals is 84% copper. Write this percent as a fraction in simplest form.

$$84\% = \frac{\quad}{\quad}$$

h) About 14 percent of the U.S. population moves houses every year. Write this percent as a fraction in simplest form.

$$14\% = \frac{\quad}{\quad}$$

i) India is home to 40% of the world’s poor. Write this percent as a fraction in simplest form.

$$40\% = \frac{\quad}{\quad}$$

j) In Belgium, 55% of government ministers are female. Write this percent as a fraction in simplest form.

$$55\% = \frac{\quad}{\quad}$$

k) The average person’s left hand does 56% of the typing. Write this percent as a fraction in simplest form.

$$56\% = \frac{\quad}{\quad}$$

l) The pupil of the eye expands up to 45% when a person looks at something pleasing. Write this percent as a fraction in simplest form.

$$45\% = \frac{\quad}{\quad}$$

Skill 12.9 Writing a fraction as a percent.

MMBlue 11 22 3 44
MMGreen 11 22 3 44

EITHER

- Find the equivalent fraction which has a denominator of 100.
- The numerator of this fraction is the equivalent percent.

Example: $\frac{7}{10} \times \frac{10}{10} = \frac{70}{100} = 70\%$

$$\frac{P}{100} = P\%$$

OR

- Multiply the fraction by $\frac{100}{1}\%$

Example: $\frac{7}{10} = \frac{7}{10} \times \frac{100}{1}\%$ *Simplify: $\div 10$*
 $= 70\%$

$$\text{Fraction} \times \frac{100}{1}\% = \text{Percent}$$

Q. Change $\frac{11}{20}$ to a percent.

A. $\frac{11}{20} = \frac{11 \times 5}{20 \times 5}$
 $= \frac{55}{100}$
 $= 55\%$

OR A. $\frac{11}{20} = \frac{11}{20} \times \frac{100}{1}\%$ *Simplify: $\div 20$*
 $= 11 \times 5\%$
 $= 55\%$

a) Change $\frac{1}{10}$ to a percent.

$$= \frac{1 \times 10}{10 \times 10} = \frac{10}{100} = \boxed{10\%}$$

b) Change $\frac{9}{50}$ to a percent.

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

c) Change $\frac{7}{25}$ to a percent.

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

d) Change $\frac{86}{100}$ to a percent.

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

e) Change $\frac{1}{2}$ to a percent.

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

f) Change $\frac{2}{5}$ to a percent.

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

g) Change $\frac{3}{5}$ to a percent.

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

h) Change $\frac{3}{4}$ to a percent.

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

i) Change $\frac{1}{3}$ to a percent.

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

j) Change $\frac{13}{20}$ to a percent.

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

k) Change $\frac{1}{100}$ to a percent.

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

l) Change $\frac{2}{3}$ to a percent.

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

Skill 12.10 Ordering decimal numbers.

- Line up the decimal numbers at their decimal points.
- Compare digits in the same places, starting from the left, until you find the smallest digit.
Hint: The number with the smallest digit will be the smallest number.
- Look for the second smallest number.
- Continue in this way until you find the largest number.

Q. Place in ascending order:
0.27, 0.07, 0.207, 0.702

		units	tenths	hundredths	thousandths
	U	.	T	H	Th
3rd	0	.	2	7	
smallest 1st	0	.	0	7	
2nd	0	.	2	0	7
largest 4th	0	.	7	0	2

A. 0.07, 0.207, 0.27, 0.702

Find the smallest digits.
Work from left to right.

Units: all 0

Tenths: $0 < 2 < 7$

so 0.07 is the smallest

0.702 is the largest

either 0.207 or 0.27 is the
2nd smallest

Hundredths: $0 < 7$

so 0.207 is the 2nd smallest

0.27 is the 3rd smallest

a) Place in descending order:
0.096, 0.69, 0.609, 0.09

U | T | H | Th

0 | 0 | 9 | 6

0 | 6 | 9 |

the largest number

0 | 6 | 0 | 9

0 | 0 | 9 |

the smallest number

b) Place in ascending order:
0.047, 0.74, 0.407, 0.074

U | T | H | Th

 | | | |

 | | | |

 | | | |

 | | | |

c) Place in ascending order:
0.508, 0.08, 0.085, 0.58

d) Place in descending order:
0.135, 0.53, 0.105, 0.513

e) Place in ascending order:
0.807, 0.07, 0.87, 0.087, 0.708

f) Place in ascending order:
0.364, 0.063, 0.63, 0.34, 0.043

g) Place in descending order:
0.239, 0.209, 0.093, 0.302, 0.3

h) Place in ascending order:
0.156, 0.105, 0.51, 0.016, 0.065

Skill 12.11 Comparing and ordering fractions.

- Find the least common denominator of the fractions, which is the Least Common Multiple (LCM) of the denominators.
- Change the fractions to equivalent fractions with the least common denominator.
- Arrange the fractions in order of the numerators (the smallest fraction has the smallest numerator and so on).

$$\frac{1}{6} < \frac{3}{6} < \frac{5}{6}$$

smallest numerator = smallest fraction (circled around 1/6)
same denominator (circled around the 6s)

Hint: If unsure which is the LCM of the denominators, use their product as the common denominator. When the smaller denominators divide evenly into the biggest denominator, this biggest number becomes the common denominator.

Q. Place in order from smallest to largest:

$$\frac{3}{5}, \frac{1}{2}, \frac{2}{3}$$

A. $\frac{1}{2}, \frac{3}{5}, \frac{2}{3}$

$$\frac{3}{5}, \frac{1}{2}, \frac{2}{3}$$

LCM of 2, 5 and 3
is $2 \times 5 \times 3 = 30$

$$\frac{3 \times 6}{5 \times 6} = \frac{18}{30}$$

$$\frac{1 \times 15}{2 \times 15} = \frac{15}{30}$$

$$\frac{2 \times 10}{3 \times 10} = \frac{20}{30}$$

$$\Rightarrow 15 < 18 < 20, \text{ so } \frac{15}{30} < \frac{18}{30} < \frac{20}{30}$$

$$\text{or } \frac{1}{2} < \frac{3}{5} < \frac{2}{3}$$

a) Which fraction has greater value?

$$\frac{3}{8} \text{ or } \frac{2}{5}$$

LCM of 8 and 5 is 40

$$\frac{3 \times 5}{8 \times 5} = \frac{15}{40} \quad \frac{2 \times 8}{5 \times 8} = \frac{16}{40} \Rightarrow \frac{15}{40} < \frac{16}{40} \Rightarrow \frac{2}{5}$$

2
5

b) Which fraction has greater value?

$$\frac{5}{8} \text{ or } \frac{5}{11}$$

c) Which fraction has greater value?

$$\frac{3}{5} \text{ or } \frac{7}{10}$$

d) Which fraction has greater value?

$$\frac{4}{9} \text{ or } \frac{5}{12}$$

e) Place in order from smallest to largest:

$$\frac{1}{2}, \frac{5}{8}, \frac{3}{5}$$

LCM of 2, 8 and 5
is $8 \times 5 = 40$

$$\frac{1 \times 20}{2 \times 20} = \frac{20}{40} \quad \frac{5 \times 5}{8 \times 5} =$$

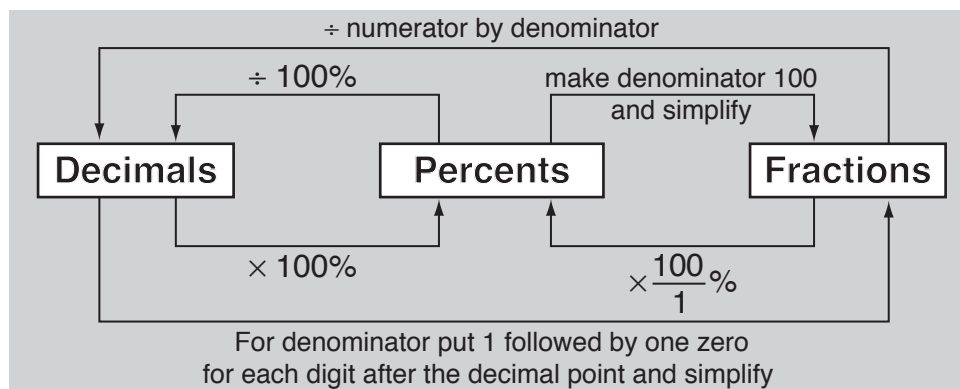
f) Place in order from largest to smallest:

$$\frac{5}{6}, \frac{4}{5}, \frac{9}{10}$$

Skill 12.12 Converting between decimals, fractions and percents (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Convert between decimals, fractions and percents. (see skills 12.4 to 12.9, pages 79 to 84)



Q. Complete the table:

Decimal	Fraction	Percent
	$\frac{13}{50}$	

A. $\frac{13}{50} = \frac{13 \times 2}{50 \times 2} = \frac{26}{100}$ *Make denominator a power of 10*
 $= \overline{26} \div 100$
 $= 0.26$

$\frac{13}{50} = \frac{13}{50} \times \frac{100^2}{1} \%$ *Simplify: $\div 50$*
 $= 13 \times 2\%$
 $= 26\%$

Decimal	Fraction	Percent
0.26	$\frac{13}{50}$	26%

a) Complete the table:

Decimal	Fraction	Percent
0.05	$\frac{1}{20}$	5%

$0.05 = \frac{5^{\div 5}}{100^{\div 5}} \xrightarrow{\text{Simplify: } \div 5} = \frac{1}{20}$

$0.05 = \overline{0.05} \times 100\% = 5\%$

b) Complete the table:

Decimal	Fraction	Percent
		45%

c) Complete the table:

Decimal	Fraction	Percent
0.6		

d) Complete the table:

Decimal	Fraction	Percent
	$\frac{7}{20}$	

Skill 12.12 Converting between decimals, fractions and percents (2).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

e) Complete the table:

Decimal	Fraction	Percent
0.07		

.....

.....

f) Complete the table:

Decimal	Fraction	Percent
		70%

.....

.....

g) Complete the table:

Decimal	Fraction	Percent
0.1		

.....

.....

h) Complete the table:

Decimal	Fraction	Percent
	$\frac{3}{10}$	

.....

.....

i) Complete the table:

Decimal	Fraction	Percent
0.4		

.....

.....

j) Complete the table:

Decimal	Fraction	Percent
		55%

.....

.....

k) Complete the table:

Decimal	Fraction	Percent
		90%

.....

.....

l) Complete the table:

Decimal	Fraction	Percent
	$\frac{17}{50}$	

.....

.....

Skill 12.13 Comparing decimals, fractions and percents (1).

MMBlue 11 22 33 44
MMGreen 11 22 33 44

- Convert the decimals, fractions and percents to the same form, by writing all as decimals, or as fractions, or as percents. (see skill 12.12, page 87)
- Compare the decimals, or the fractions, or the percents.
Hint: The most convenient form is the decimal form. Write the fractions and percents as decimals.

Q. Which is greater?

$\frac{1}{4}$ or 30%

A.

$$\begin{aligned} \frac{1}{4} &= \frac{1 \times 25}{4 \times 25} \\ &= \frac{25}{100} \\ &= \widehat{25} \div 100 \\ &= \mathbf{0.25} \end{aligned}$$

Write the fraction as a decimal

Make denominator a power of 10

Fraction

$$\begin{aligned} 30\% &= \frac{30}{100} \\ &= \widehat{30} \div 100 \\ &= \mathbf{0.3} \end{aligned}$$

Write the percent as a decimal

Percent

0.3 is greater than 0.25, so $30\% > \frac{1}{4}$
30% is greater.

a) Which is greater?
0.07 or 70%

$$70\% = \frac{70}{100} = \widehat{70} \div 100 = 0.7$$

$0.7 > 0.07$

70%

b) Which is greater?
20% or 0.25

.....

c) Which is greater?
 $\frac{9}{10}$ or 9%

.....

d) Which is greater?
 $\frac{4}{5}$ or 45%

.....

e) Which is greater?
 $\frac{1}{10}$ or 1%

.....

f) Which is greater?
 $\frac{2}{5}$ or 25%

.....

g) Which is greater?
0.6 or $\frac{5}{6}$

.....

h) Which is greater?
0.4 or $\frac{1}{4}$

.....

Skill 12.13 Comparing decimals, fractions and percents (2).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4i) Which is greater?
 0.75 or 7.5%

.....

.....

.....

j) Which is greater?
 0.5 or 5%

.....

.....

.....

k) Which is greater?
 $\frac{3}{100}$ or 30%

.....

.....

.....

l) Which is greater?
 $\frac{3}{5}$ or 35%

.....

.....

.....

m) Which is greater?
 $\frac{8}{10}$ or 8%

.....

.....

.....

n) Which is greater?
 $\frac{1}{3}$ or 30%

.....

.....

.....

o) Which is greater?
 0.7 or $\frac{7}{8}$

.....

.....

.....

p) Which is greater?
 0.9 or $\frac{4}{5}$

.....

.....

.....

q) Which is greater?
 $\frac{3}{4}$ or 65%

.....

.....

.....

r) Which is greater?
 $\frac{1}{5}$ or 15%

.....

.....

.....

s) Which is greater?
 0.23 or $\frac{3}{20}$

.....

.....

.....

t) Which is greater?
 0.03 or $\frac{3}{10}$

.....

.....

.....

13. [Integers]

continues on page 92

Skill 13.1 Comparing and ordering integers (1).

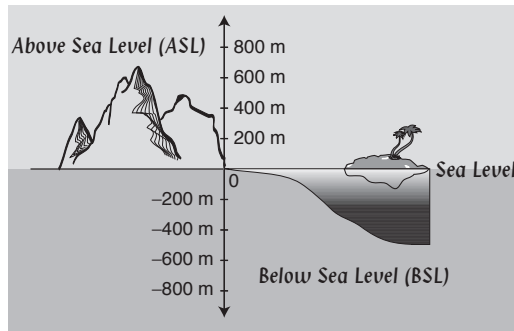
MMBlue 11 22 33 44
MMGreen 11 22 33 44

- Use a number line.

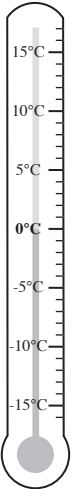
*Hint: Numbers decrease as you move to the left or down and increase as you move to the right or up.
A negative number is always smaller than a positive number.*



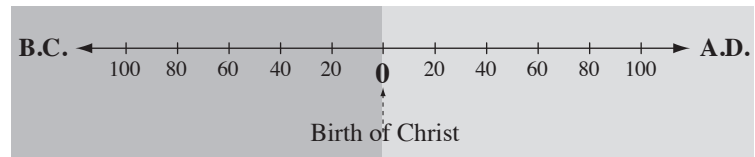
An altitude is lower when further down, below sea level (BSL) and higher when further up, above sea level (ASL).



Temperatures below zero are lower than temperatures above zero.



Years before Christ (B.C.) are prior to his birth at 0 years.
Years after this are A.D. (anno domini).



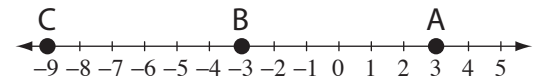
Q. Who won the 2008 Women's Open Golf Tournament?

[In golf the lowest score wins.]

- A) +3 A. Sorenstam
- B) -3 P. Creamer
- C) -9 I. Park

A. C

Find the lowest score to determine the winner.



a) Which of Saturn's moons has the highest temperature?

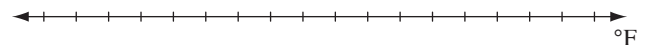
- A) -330°F Enceladus
- B) -328°F Mimas
- C) -305°F Tethys

C



b) Which temperature for oxygen is higher?

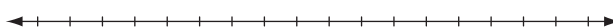
- A) -297°F boiling point
- B) -362°F melting point



c) Who won the 2008 British Open Golf Tournament?

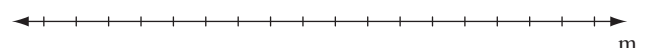
[In golf the lowest score wins.]

- A) -7 P. Harrington
- B) +14 S. Lyle
- C) -2 M. Weir



d) Which body of water is at the lowest altitude?

- A) -28 m Caspian Sea
- B) -408 m Dead Sea
- C) -15 m Lake Eyre

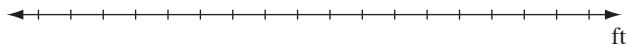


Skill 13.1 Comparing and ordering integers (2).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

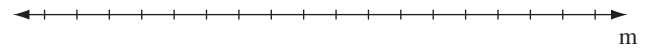
e) Which location has the lowest altitude?

- A) 10 ft above sea level
Amsterdam (Netherlands)
- B) 436 ft below sea level
Qattara Depression (Egypt)
- C) 7970 ft above sea level
Machu Picchu (Peru)



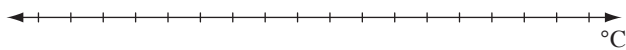
f) Which location has the highest altitude?

- A) 10 m below sea level
Laguna Salada (Mexico)
- B) 7 m below sea level
Lammefjord (Denmark)
- C) 19 m above sea level
Vatican City (Italy)



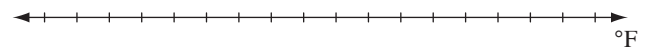
g) Which location recorded the lowest temperature?

- A) -25.6°C Kabul
- B) $+14.1^{\circ}\text{C}$ Christmas Island
- C) -15.2°C La Paz



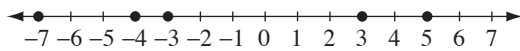
h) Which continent has the lowest recorded temperature?

- A) -81°F North America
- B) -9°F Australia
- C) -67°F Europe



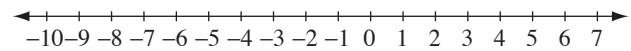
i) Arrange in order from smallest to largest:

$-4, -7, 5, -3, 3$



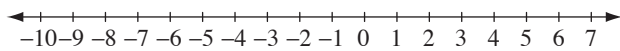
j) Arrange in order from largest to smallest:

$0, 8, -9, 6, -4$



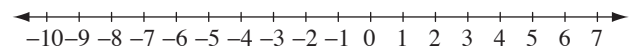
k) Arrange in order from largest to smallest:

$-10, 8, 1, -8, 4$



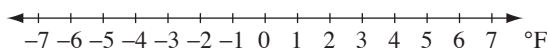
l) Arrange in order from smallest to largest:

$-2, -6, 0, -3, 5$



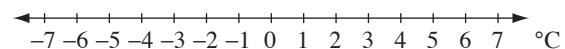
m) Arrange in order from coldest to warmest:

$2^{\circ}\text{F}, -3^{\circ}\text{F}, 4^{\circ}\text{F}, -5^{\circ}\text{F}$



n) Arrange in order from warmest to coldest:

$-1^{\circ}\text{C}, -5^{\circ}\text{C}, 5^{\circ}\text{C}, -3^{\circ}\text{C}$



Skill 13.2 Comparing integers using 'less than' and 'greater than'.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Use a number line.

Hint: A negative number is always smaller than a positive number.

The larger the negative number the lesser the value, e.g. -9 is less than ($<$) -2

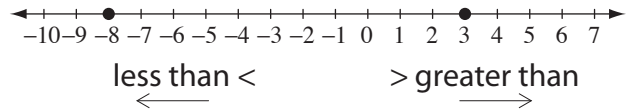
The smaller the negative number the greater the value, e.g. -4 is greater than ($>$) -6

Q. Use $<$ or $>$ to make a true statement.

$$3 \quad \square \quad -8$$

A. $3 > -8$

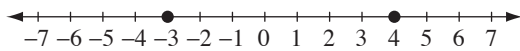
3 is greater than -8



a) Use $<$ or $>$ to make a true statement.

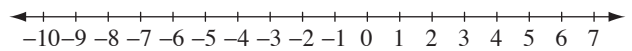
a negative number is less than a positive number

$$-3 \quad \square \quad 4$$



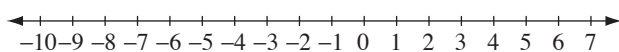
b) Use $<$ or $>$ to make a true statement.

$$-5 \quad \square \quad 0$$



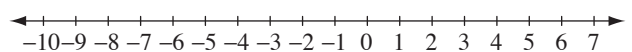
c) Use $<$ or $>$ to make a true statement.

$$-4 \quad \square \quad -9$$



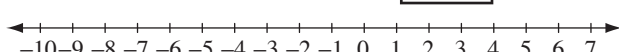
d) Use $<$ or $>$ to make a true statement.

$$-6 \quad \square \quad 3$$



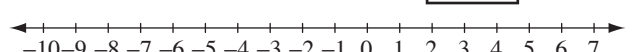
e) Use $<$ or $>$ to make a true statement.

$$2 \quad \square \quad -1$$



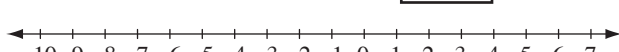
f) Use $<$ or $>$ to make a true statement.

$$-3 \quad \square \quad -7$$



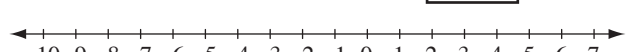
g) Use $<$ or $>$ to make a true statement.

$$-9 \quad \square \quad 0$$



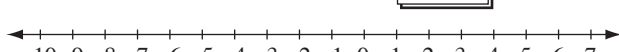
h) Use $<$ or $>$ to make a true statement.

$$3 \quad \square \quad -5$$



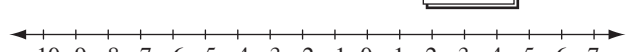
i) Use $<$ or $>$ to make a true statement.

$$4 \quad \square \quad -7$$



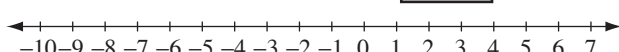
j) Use $<$ or $>$ to make a true statement.

$$-4 \quad \square \quad -2$$



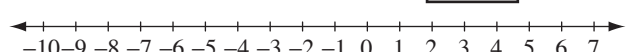
k) Use $<$ or $>$ to make a true statement.

$$-8 \quad \square \quad -5$$



l) Use $<$ or $>$ to make a true statement.

$$-2 \quad \square \quad -4$$

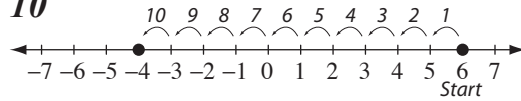
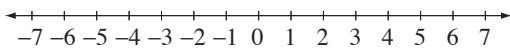


Skill 13.3 Modeling integer subtraction on a number line.

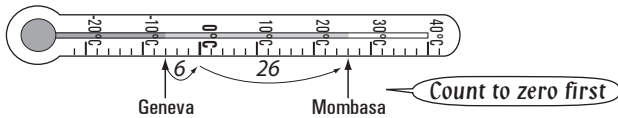
- Determine the value of each mark on the number line.
 - Count the number of spaces between the integers using the number line.
- Hint: Use short cuts such as: counting to zero, counting by tens.*

Q. How many units between 6 and -4 ?

A. 10

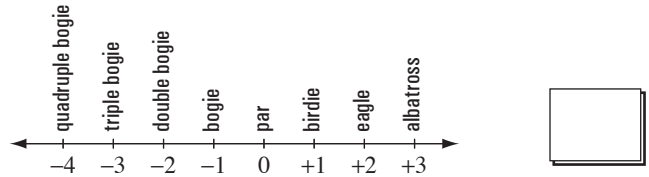


a) How much cooler is it in Geneva than Mombasa?

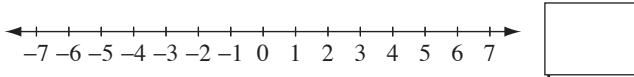


$6 + 26 = \boxed{32} \text{ } ^\circ\text{C}$

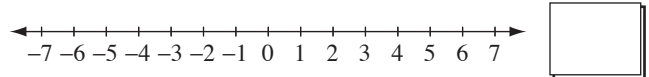
b) If Karrie Webb scores a triple bogie and Greg Norman scores an eagle, what is the difference between their scores?



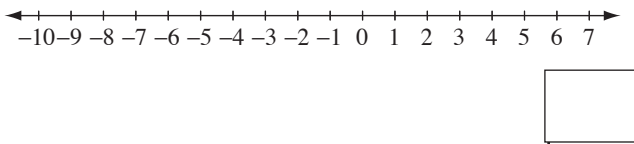
c) How many units between 5 and -4 ?



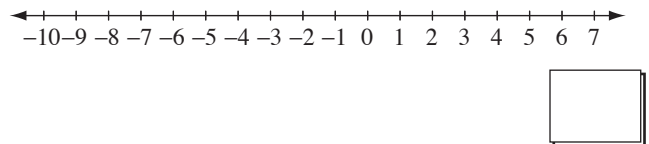
d) How many units between -5 and 3?



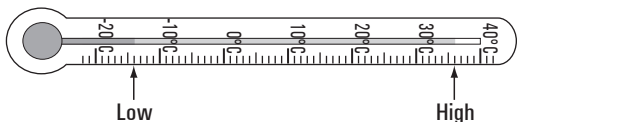
e) How many units between -9 and 2?



f) How many units between 6 and -7 ?

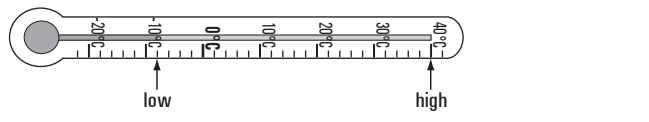


g) What is the difference between the highest and the lowest temperatures recorded in Dunedin, New Zealand?



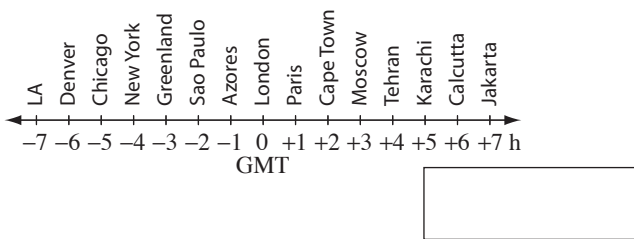
$\dots = \boxed{} \text{ } ^\circ\text{C}$

h) What is the difference between the highest and the lowest temperatures recorded in Rome, Italy?

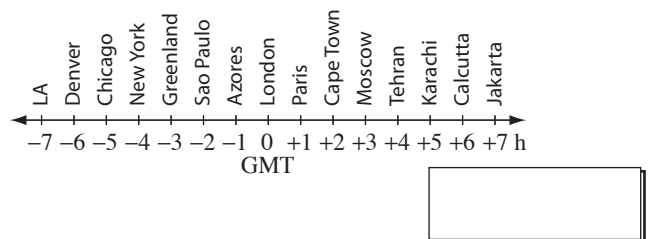


$\dots = \boxed{} \text{ } ^\circ\text{C}$

i) What is the time difference in hours between Denver and Cape Town?



j) What is the time difference in hours between Karachi and New York?

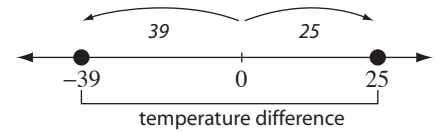


Skill 13.4 Modeling integer subtraction using absolute value.

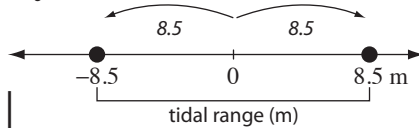
- Visualize the position of the values on a number line.
- Add the absolute values. (see Glossary, page 317)

Q. In Vienna (Austria) the highest recorded temperature is 25°C and the lowest is -39°C . What is the temperature difference?

$$\begin{aligned} \text{A. } & |25| + |-39| \\ &= 25 + 39 \\ &= \mathbf{64^{\circ}\text{C}} \end{aligned}$$



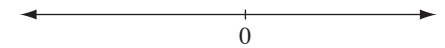
a) The Bay of Fundy, Canada has a high tide of 8.5 m and a low tide of -8.5 m. What is the tidal range for the Bay of Fundy?



$$|8.5| + |-8.5|$$

$$8.5 + 8.5 = \boxed{17 \text{ m}}$$

b) The lowest point in Japan is Lake Hachirogata at -4 m and the highest point is Mt Fujiyama at 3776 m. What is the height difference?



$$= \boxed{\text{m}}$$

c) Sparrow Hills station is the highest station in the Russian metro rail system with an altitude of 220 m above sea level. Park Pobedy is the lowest station at 90 m below sea level. What is their height difference?

$$= \boxed{\text{m}}$$

d) In Reykjavik (Iceland) the highest recorded temperature is 26°C and the lowest is -25°C . What is the temperature difference?

$$= \boxed{^{\circ}\text{C}}$$

e) In Luxembourg the highest recorded temperature is 38°C and the lowest is -23°C . What is the temperature difference?

$$= \boxed{^{\circ}\text{C}}$$

f) In Shanghai (China) the highest recorded temperature is 40°C and the lowest is -12°C . What is the temperature difference?

$$= \boxed{^{\circ}\text{C}}$$

g) The lowest point on the African continent is -156 m at Lake Assal and the highest is 5895 m at Mt Kilimanjaro. What is the height difference?

$$= \boxed{\text{m}}$$

h) The highest point in Europe is 18,481 ft at Mt Elbrus and the lowest is -92 ft in the Caspian Sea. What is the height difference in Europe?

$$= \boxed{\text{ft}}$$

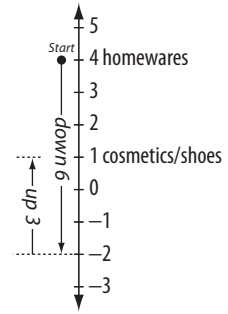
Skill 13.5 Modeling integer addition on a number line.

- Start at the given point on the number line.
- Count up or down the number of spaces as directed.

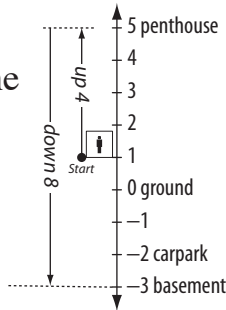
Q. From homewares Marion rides the elevator down 6 levels and up 3 levels. At what level is Marion now?



A. down 6 levels (add -6)
up 3 levels (add +3)
⇒ **cosmetics/shoes**



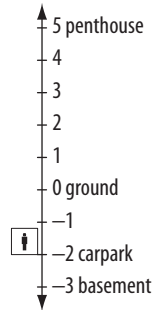
a) From level 1 Hutch rides the elevator up 4 levels and down 8. At what level is Hutch now?



up 4 levels (add +4)

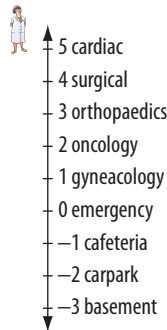
down 8 levels (add -8) ⇒ **basement**

b) From the carpark Kwong rides the elevator down 1 level and up 3 levels. At what level is Kwong now?



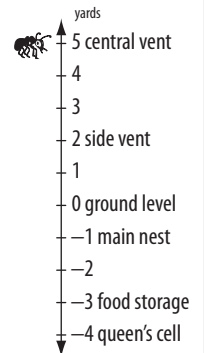
⇒

c) A nurse starts in the cardiac ward, goes down 6 levels and then up 3 levels. Where does she finish?



⇒

d) A termite entered his tower via the central vent, got food and went to the main nest. How far did the termite travel?



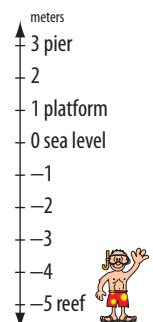
⇒

e) From carpark (A) Todd rides the elevator down 2 levels and up 7 levels. At what level is Todd now?



⇒

f) A snorkeler at the reef surfaces for lunch on the pier and then goes back to the reef. How far does he travel?



⇒

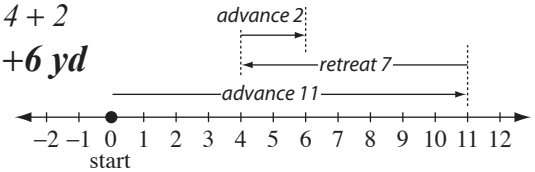
Skill 13.6 Solving word problems involving two or more integers.

- Start at the given point.
- Work in the given order.
- Visualize the position of the values on a number line.

Hint: Positive words: up above over forward advance gained earned later plus
Negative words: down below under backward retreat lost owed earlier minus

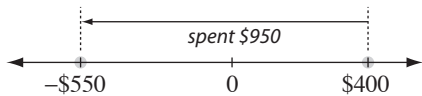
Q. During a football game the ball advanced 11 yd, retreated 7 yd and then advanced 2 yd. Where did the ball finish in relation to its starting point?

A. $Start: 0 + 11 - 7 + 2$
 $= 4 + 2$
 $= +6 \text{ yd}$



a) If Pip had \$400 and spent \$950, what is her bank balance?

$= 400 - 950 = \boxed{-\$550}$



b) Harry owed \$350. If he earned \$420, how much does Harry now have?

$= \dots = \boxed{}$

c) Chan owes \$420. If he earned \$280, what is Chan's bank balance?

$= \dots = \boxed{}$

d) Carbon dioxide boils at -78°C . At 21°C below this, carbon dioxide solidifies. At what temperature does carbon dioxide solidify?

$= \dots = \boxed{}^{\circ}\text{C}$

e) The Persians destroyed the original Acropolis in 480 B.C. Pericles rebuilt it 31 years later. What year was that?

$= \dots = \boxed{}$

f) Tutankhamun reigned for 9 years up until 1323 B.C. What year did Tutenkhamen come to the throne?

$= \dots = \boxed{}$

g) Oxygen boils at -183°C . At 35°C below this, oxygen solidifies. What is the temperature of solid oxygen?

$= \dots = \boxed{}^{\circ}\text{C}$

h) Helium boils at -269°C . At 3°C below this, helium solidifies. At what temperature does helium solidify?

$= \dots = \boxed{}^{\circ}\text{C}$

i) You bought \$1000 worth of stock. After the first year you lost \$480, but after the second year you gained \$220. What is the current value of your stock?

$= \dots = \boxed{}$

j) During a football game the ball advanced 2 yd, retreated 9 yd and then advanced 4 yd. Where did the ball finish in relation to its starting point?

$= \dots = \boxed{} \text{ yd}$

Skill 13.7 Adding integers.

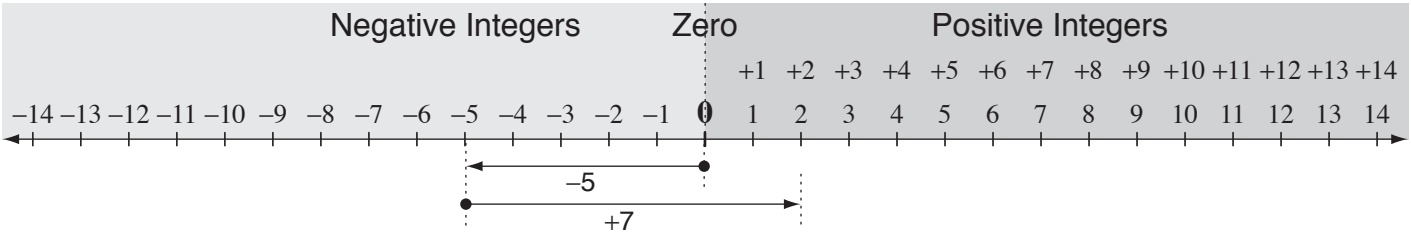
To add two integers with the **same sign**:

- Find their absolute values.
- Determine the sign of the result:
Use “+” if both integers are positive.
Use “-” if both integers are negative.
- **Add** the absolute values.

Hint: Every number has a sign attached to it, so if there is no sign, the number is positive. These signs should not be confused with the operations of addition and subtraction.

- The sign of the result of the addition can also be visualized using a number line.

Hint: ‘-’ means move left or backwards and ‘+’ means move right or forwards.



Q. $-5 + 7 =$

A. $-5 + 7 =$
 $= +(7 - 5)$
 $= 2$

$|-5| = 5, |7| = 7$
Integers have different signs and
 $|7| \geq |-5|$ so use “+”
Subtract $|7|$ and $|-5|$

a) $-2 + (-3) =$

$|-2| = 2, |-3| = 3$
both negative use “-”
 $= -(2 + 3) = -5$
same signs, add

b) $-4 + 3 =$

$|-4| > |3|$, use “-”
different signs, subtract

.....
=

c) $-8 + 6 =$

.....
=

d) $8 + (-5) =$

.....
=

e) $2 + (-6) =$

.....
=

f) $5 + (-3) =$

.....
=

g) $-2 + 4 =$

.....
=

h) $9 + (-2) =$

.....
=

i) $-4 + (-2) =$

.....
=

j) $-8 + 3 =$

.....
=

k) $-2 + (-6) =$

.....
=

l) $-3 + (-6) =$

.....
=

Skill 13.8 Subtracting integers.

- Consider subtracting an integer as adding its opposite.

To add two integers with the **same sign**:

- Find their absolute values.
- Determine the sign of the result:
Use "+" if both integers are positive.
Use "-" if both integers are negative.
- Add** the absolute values.

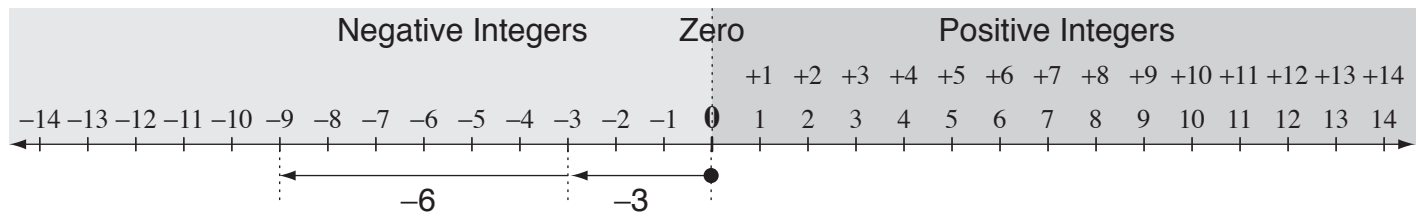
To add two integers with **different signs**:

- Find their absolute values.
- Determine the sign of the result:
Use the sign of the integer with the greater absolute value.
- Subtract** their absolute values.

Hint: Every number has a sign attached to it, so if there is no sign, the number is positive. These signs should not be confused with the operations of addition and subtraction.

- The sign of the result of the subtraction can also be visualized using a number line.

Hint: '-' means move left or backwards and '+' means move right or forwards.



Q. $-3 - 6 =$

start at -3, move backward 6

A. $-3 - 6 =$

$$= -3 + (-6)$$

$$= -(3 + 6)$$

$$= -9$$

Subtract 6 means add -6

$$|-3| = 3, |-6| = 6$$

Both integers negative so use "-"

Integers have same sign so add $|-3|$ and $|-6|$

a) $1 - 7 =$

$$= +1 + (-7)$$

$$= -(7 - 1)$$

$$= \boxed{-6}$$

$|-7| > |1|$, use "-"

subtract 7 means add -7

different signs, subtract

b) $0 - 8 =$

$$=$$

$$=$$

$$= \boxed{}$$

c) $4 - 8 =$

$$=$$

$$=$$

$$= \boxed{}$$

d) $-3 - 5 =$

$$=$$

$$=$$

$$= \boxed{}$$

e) $-6 - 9 =$

$$=$$

$$=$$

$$= \boxed{}$$

f) $2 - (-1) =$

$$=$$

$$=$$

$$= \boxed{}$$

g) $3 - (-4) =$

$$=$$

$$=$$

$$= \boxed{}$$

h) $-8 - (-4) =$

$$=$$

$$=$$

$$= \boxed{}$$

i) $-2 - (-2) =$

$$=$$

$$=$$

$$= \boxed{}$$

Skill 13.9 Multiplying Integers.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Multiply the absolute values.
- Determine the sign of the result:
If the numbers to be multiplied have the:

same sign: $++ = +$
 $-- = +$ positive result

different sign: $+ - = -$
 $- + = -$ negative result

Example: $-9 \times (-3) = 27$
 $-9 \times (-3)$
 $= 27$ (---+)

Example: $9 \times (-3) = -27$
 $9 \times (-3)$
 $= -27$ (+---)

Q. $-4 \times (-7) =$

A. $-4 \times (-7) = 28$
 $-4 \times (-7)$
 $= 28$ (---+)

$|-4| \times |-7| = 28$
 Same signs, both negative
 \Rightarrow positive result.

a) $-6 \times 7 = -42$ (-+--)

b) $-2 \times 6 =$

c) $-8 \times 3 =$

d) $3 \times (-5) =$

e) $2 \times (-9) =$

f) $-8 \times (-8) =$

g) $-8 \times (-5) =$

h) $-9 \times 4 =$

i) $5 \times (-6) =$

j) $7 \times (-8) =$

k) $-4 \times 6 =$

l) $-7 \times 7 =$

m) $3 \times (-9) =$

n) $-7 \times (-4) =$

o) $-6 \times (-3) =$

p) $-4 \times (-4) =$

q) $5 \times (-9) =$

r) $-8 \times (-2) =$

s) $-5 \times (-5) =$

t) $-4 \times 5 =$

u) $-9 \times 9 =$

Skill 13.10 Dividing integers.

- Divide the absolute values.
- Determine the sign of the result:
If the numbers to be divided have the:

same sign: $++ = +$
 $-- = +$ positive result

different sign: $+- = -$
 $-+ = -$ negative result

Example: $-9 \div (-3) = 3$
---+

Example: $9 \div (-3) = -3$
+---

Q. $-30 \div 6 =$

A. $-30 \div 6 = -5$
---+

$|-30| \div |6| = 5$
Different signs,
 \Rightarrow negative result.

a) $12 \div (-4) =$ **b)** $27 \div (-3) =$ **c)** $-54 \div (-9) =$

d) $-72 \div (-12) =$ **e)** $-45 \div 9 =$ **f)** $-32 \div 8 =$

g) $-18 \div 2 =$ **h)** $-24 \div (-8) =$ **i)** $-63 \div 9 =$

j) $25 \div (-5) =$ **k)** $-56 \div (-7) =$ **l)** $-21 \div 7 =$

m) $-45 \div 5 =$ **n)** $-28 \div (-7) =$ **o)** $-54 \div 6 =$

p) $28 \div (-4) =$ **q)** $-35 \div (-7) =$ **r)** $-40 \div (-5) =$

s) $-36 \div 6 =$ **t)** $63 \div (-7) =$ **u)** $-36 \div 9 =$

14. [Rates / Ratios]

Skill 14.1 Simplifying ratios by comparing two numbers.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

EITHER

- Find the largest number that divides evenly into each number of the ratio (Greatest Common Factor).
- Divide each number by the GCF.

Hint: ':' means fraction and is read as 'to'.

$$a : b = \frac{a}{b} \quad \text{Ratio}$$

OR

- Divide each number of the ratio by any factor until the ratio is reduced to simplest form.

Q. Simplify the ratio 32 : 56

A. $\begin{matrix} 32 : 56 \\ \div 8 \quad \swarrow \quad \searrow \quad \div 8 \\ \underline{4 \quad 7} \\ 32 : 56 \\ = 4 : 7 \end{matrix}$ GCF of 32 and 56 is 8 so $\div 8$

OR A. $\begin{matrix} 32 : 56 \\ \div 2 \quad \swarrow \quad \searrow \quad \div 2 \\ \underline{16 \quad 28} \\ 32 : 56 \\ = 16 : 28 \\ \div 2 \quad \swarrow \quad \searrow \quad \div 2 \\ \underline{8 \quad 14} \\ 16 : 28 \\ = 8 : 14 \\ \div 2 \quad \swarrow \quad \searrow \quad \div 2 \\ \underline{4 \quad 7} \\ 8 : 14 \\ = 4 : 7 \end{matrix}$ Simplify: $\div 2$
Simplify: $\div 2$
Simplify: $\div 2$

a) Simplify the ratio 4 : 6

$$= \begin{matrix} 2 & 3 \\ \swarrow & \searrow \\ \underline{4} & \underline{6} \end{matrix} \quad \text{Simplify: } \div 2$$

$$= \boxed{2 : 3}$$

b) Simplify the ratio 6 : 12

$$= \begin{matrix} 6 & 12 \\ \swarrow & \searrow \\ \underline{6} & \underline{12} \end{matrix} \quad \text{Simplify: } \div 6$$

$$= \boxed{\quad : \quad}$$

c) Simplify the ratio 30 : 50

$$= \underline{\quad} : \underline{\quad} = \boxed{\quad : \quad}$$

d) Simplify the ratio 10 : 15

$$= \underline{\quad} : \underline{\quad} = \boxed{\quad : \quad}$$

e) Simplify the ratio 45 : 15

$$= \begin{matrix} 3 & 1 \\ \swarrow & \searrow \\ \underline{45} & \underline{15} \end{matrix} \quad \text{Simplify: } \div 15$$

$$= \boxed{\quad : \quad}$$

f) Simplify the ratio 18 : 24

$$= \underline{\quad} : \underline{\quad} = \boxed{\quad : \quad}$$

g) Simplify the ratio 100 : 70

$$= \underline{\quad} : \underline{\quad} = \boxed{\quad : \quad}$$

h) Simplify the ratio 32 : 8

$$= \underline{\quad} : \underline{\quad} = \boxed{\quad : \quad}$$

i) Simplify the ratio 24 : 96

$$= \underline{\quad} : \underline{\quad} = \boxed{\quad : \quad}$$

j) Simplify the ratio 30 : 54

$$= \underline{\quad} : \underline{\quad} = \boxed{\quad : \quad}$$

k) Simplify the ratio 27 : 36

$$= \underline{\quad} : \underline{\quad} = \boxed{\quad : \quad}$$

l) Simplify the ratio 24 : 16

$$= \underline{\quad} : \underline{\quad} = \boxed{\quad : \quad}$$

m) Simplify the ratio 150 : 45

$$= \underline{\quad} : \underline{\quad} = \boxed{\quad : \quad}$$

n) Simplify the ratio 90 : 240

$$= \underline{\quad} : \underline{\quad} = \boxed{\quad : \quad}$$

Skill 14.2 Simplifying ratios by comparing two quantities.

MMBlue 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Write the quantities of the ratio with the same unit of measurement.

EITHER

- Find the largest number that divides evenly into each quantity of the ratio (Greatest Common Factor).
- Divide each quantity by the GCF.

Hints: The order of the quantities in a ratio matters.

' : ' means fraction and is read as 'to'.

Examples: The ratio of legs to ears in a cat is $4 : 2 = 2 : 1$

The ratio of ears to legs in a cat is $2 : 4 = 1 : 2$

OR

- Divide each quantity of the ratio by any factor until the ratio is reduced to simplest form.

$$a : b = \frac{a}{b} \quad \text{Ratio}$$

Q. Simplify the ratio 10 oz : 2 lb

A. $2 \text{ lb} = 2 \times 16 \text{ oz} = 32 \text{ oz}$ 1 lb = 16 oz

$$10 \text{ oz} : 2 \text{ lb}$$

$$= 10 \text{ oz} : 32 \text{ oz}$$

$\xrightarrow{\div 2} \left(\begin{array}{cc} 5 & 16 \\ 10 & 32 \end{array} \right) \xrightarrow{\div 2}$
GCF of 10 and 32 is 2 so $\div 2$

$$= 5 : 16$$

Ignore the units

a) Simplify the ratio 48 kg : 80 kg

$$= \overset{3}{\cancel{48}} : \overset{5}{\cancel{80}} \quad \text{Simplify: } \div 16 = \boxed{\quad : \quad}$$

b) Simplify the ratio 50 ft : 125 ft

$$= 50 : 125 \quad \text{Simplify: } \div 25 = \boxed{\quad : \quad}$$

c) Simplify the ratio 120 yd : 36 yd

$$= \quad : \quad = \boxed{\quad : \quad}$$

d) Simplify the ratio 150 in. : 175 in.

$$= \quad : \quad = \boxed{\quad : \quad}$$

e) Simplify the ratio \$3.00 : 40 cents

\$1 = 100¢

$\widehat{3.00} \times 100 = 300$ 2 zeros, 2 places right

$$= \overset{15}{\cancel{300}}\text{¢} : \overset{2}{\cancel{40}}\text{¢} \quad \text{Simplify: } \div 20 = \boxed{15 : 2}$$

f) Simplify the ratio 40 s : 2 min

$$= \quad : \quad = \boxed{\quad : \quad}$$

g) Simplify the ratio 6 yd : 6 ft

$$= \quad : \quad = \boxed{\quad : \quad}$$

h) Simplify the ratio \$4.00 : 25 cents

$$= \quad : \quad = \boxed{\quad : \quad}$$

i) Simplify the ratio 6 days : 4 weeks

$$= \quad : \quad = \boxed{\quad : \quad}$$

j) Simplify the ratio 3 ft : 8 in.

$$= \quad : \quad = \boxed{\quad : \quad}$$

Skill 14.3 Solving questions involving distance, time and speed (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

$$\begin{aligned} \text{rate (speed)} &= \frac{\text{distance traveled } (d)}{\text{time taken } (t)} \quad \text{OR} \quad r = \frac{d}{t} \\ \text{distance traveled } (d) &= \text{rate } (r) \cdot \text{time taken } (t) \quad \text{OR} \quad d = rt \\ \text{time taken } (t) &= \frac{\text{distance traveled } (d)}{\text{rate } (r)} \quad \text{OR} \quad t = \frac{d}{r} \end{aligned}$$

- Write the formula for the rate (speed), or distance or time taken to travel.
- Convert the given units into the required units if necessary. (see Math Facts, page 377)
Hints: If the rate (speed) must be calculated in mph, convert the units for distance to miles and the units for time to hours.
Changing from smaller units into larger units, always divide by the conversion factor.
Changing from larger units into smaller units, always multiply by the conversion factor.
- Substitute the known values into the formula.
- Simplify and evaluate.

Q. A jet travels at an average speed of 550 mph. How long would it take to travel 2475 miles?

A. $t = \frac{\text{distance traveled}}{\text{rate}} = \frac{d}{r}$

$$= \frac{2475 \text{ mi}}{550 \text{ mph}} \quad \text{Substitute into the formula}$$

$$= \frac{\overset{99}{\cancel{2475}}}{\underset{22}{\cancel{550}}} \text{ h} \quad \text{Simplify: } \div 25$$

$$= \frac{\overset{9}{\cancel{99}}}{\underset{2}{\cancel{22}}} \text{ h} \quad \text{Simplify: } \div 11$$

$$= 4.5 \text{ h}$$

a) How far will John walk in 45 minutes if he walks at 10 km/h?

$$t = 45 \text{ min} = 0.75 \text{ h} \quad (\text{three quarters of an hour})$$

Use $d = rt$

$$d = 10 \text{ km/h} \cdot 0.75 \text{ h} = \boxed{7.5 \text{ km}}$$

b) A cyclist rides at an average speed of 18 km/h. How long would it take to travel 45 km?

$$t = \frac{45 \text{ km}}{18 \text{ km/h}} \quad \text{Use } t = \frac{d}{r}$$

$$= \frac{\overset{5}{\cancel{45}}}{\underset{2}{\cancel{18}}} \text{ h} \quad \text{Simplify: } \div 9$$

$$= \quad = \quad \boxed{\text{h}}$$

c) The X-15 rocket plane is the fastest aircraft with a maximum speed of 4520 mph, reached in 1967. At this rate how far could it travel in 5 hours?

$$d =$$

$$= \quad = \quad \boxed{\text{mi}}$$

d) An airplane flew from Denver to New York, a distance of 1600 miles. If the plane traveled at an average speed of 500 mph, how long did the trip take?

$$t =$$

$$= \quad = \quad \boxed{\text{h}}$$

Skill 14.3 Solving questions involving distance, time and speed (2).

- e) An airplane flew from Memphis to Pittsburgh, a distance of 660 miles. If the plane traveled 1.1 hours, how fast did it travel?

$$r = \frac{d}{t} = \frac{660 \text{ mi}}{1.1 \text{ h}} = 60 \div 0.1 \text{ mph}$$

Simplify: $\div 11$

$$= 600 \div 1 \text{ mph} = \boxed{\text{mph}}$$

- f) An airplane flew from Houston to Salt Lake City, a distance of 1200 miles. If the plane traveled 2.5 hours, how fast did it travel?

$$r =$$

$$= \boxed{\text{mph}}$$

- g) An emu can run 9 km in 12 minutes. What is its average speed in kilometers per hour?

$$r =$$

$$= \boxed{\text{km/h}}$$

- h) Some species of dolphin can swim 9 miles at 36 mph. How long would it take to swim this distance?

$$t =$$

$$= \boxed{\text{min}}$$

- i) A train travels at an average speed of 48 mph. What distance would it travel in one hour and 15 minutes?

$$d =$$

$$= \boxed{\text{mi}}$$

- j) A satellite orbits the earth at an average speed of 8 km/s. What distance does it travel in 20 minutes?

$$d =$$

$$= \boxed{\text{km}}$$

- k) How far will a salmon swim in 12 minutes if it swims at 45 km/h?

$$d =$$

$$= \boxed{\text{km}}$$

- l) A hot air balloon travels at a speed of 21 km/h. At this rate how far will it travel in 40 minutes?

$$d =$$

$$= \boxed{\text{km}}$$

- m) Earth moves around the sun at an average speed of 65,000 mph. What distance does it move in a quarter of an hour?

$$d =$$

$$= \boxed{\text{mi}}$$

- n) In 1904 the first speeding ticket went to Harry Myers of Dayton, Ohio. Harry drove 12 mph in town. At this rate how far could he travel in 15 minutes?

$$d =$$

$$= \boxed{\text{mi}}$$

Skill 14.4 Simplifying ratios by comparing three numbers.

MMBlue 11 2 2 3 3 4 4
MMGreen 11 2 2 3 3 4 4

EITHER

- Find the largest number that divides evenly into each number of the ratio (Greatest Common Factor).
- Divide each number by the GCF.

OR

- Divide each number of the ratio by any factor until the ratio is reduced to simplest form.

Q. Simplify the ratio

$$24 : 6 : 30$$

A. $\begin{matrix} 24 : 6 : 30 \\ \div 6 \quad \quad \quad \div 6 \\ \hline 4 : 1 : 5 \end{matrix}$ GCF of 24, 6 and 30 is 6 so $\div 6$

OR A. $\begin{matrix} 24 : 6 : 30 \\ \div 2 \quad \quad \quad \div 2 \\ \hline 12 : 3 : 15 \\ \div 3 \quad \quad \quad \div 3 \\ \hline 4 : 1 : 5 \end{matrix}$ Simplify: $\div 2$
Simplify: $\div 3$

a) Simplify the ratio 72 : 16 : 40

$$= \frac{9}{\cancel{72}} : \frac{2}{\cancel{16}} : \frac{5}{\cancel{40}} \xrightarrow{\text{Simplify: } \div 8} = \boxed{9 : 2 : 5}$$

b) Simplify the ratio 4 : 8 : 16

$$= \dots = \boxed{\quad : \quad : \quad}$$

c) Simplify the ratio 3 : 9 : 27

$$= \dots = \boxed{\quad : \quad}$$

d) Simplify the ratio 10 : 30 : 45

$$= \dots = \boxed{\quad : \quad}$$

e) Simplify the ratio 33 : 18 : 15

$$= \dots = \boxed{\quad : \quad}$$

f) Simplify the ratio 18 : 36 : 27

$$= \dots = \boxed{\quad : \quad}$$

g) Simplify the ratio 48 : 18 : 12

$$= \dots = \boxed{\quad : \quad}$$

h) Simplify the ratio 50 : 100 : 30

$$= \dots = \boxed{\quad : \quad}$$

i) Simplify the ratio 36 : 12 : 60

$$= \dots = \boxed{\quad : \quad}$$

j) Simplify the ratio 30 : 45 : 90

$$= \dots = \boxed{\quad : \quad}$$

k) Simplify the ratio 42 : 14 : 21

$$= \dots = \boxed{\quad : \quad}$$

l) Simplify the ratio 40 : 60 : 80

$$= \dots = \boxed{\quad : \quad}$$

Skill 14.5 Deciding if two ratios form a proportion.

- Write the two ratios as equal fractions side by side.
- Cross multiply the numerators and the denominators of the fractions.
- If the two products are equal, then the two ratios are in proportion.

A proportion

$a:b = c:d$ 2 ratios

$$\frac{a}{b} = \frac{c}{d}$$

$$a \cdot d = b \cdot c$$

$$ad = bc$$

Q. Which ratio forms a proportion with $\frac{5}{7}$?

- A) $\frac{10}{35}$ B) $\frac{15}{14}$ C) $\frac{20}{28}$

Cross multiply

A. $\frac{5}{7} = \frac{10}{35} \Rightarrow 5 \cdot 35 = 7 \cdot 10$
 $\Rightarrow 175 = 70 \Rightarrow \text{false}$ **A**

B. $\frac{5}{7} = \frac{15}{14} \Rightarrow 5 \cdot 14 = 7 \cdot 15$
 $\Rightarrow 70 = 105 \Rightarrow \text{false}$ **B**

C. $\frac{5}{7} = \frac{20}{28} \Rightarrow 5 \cdot 28 = 7 \cdot 20$
 $\Rightarrow 140 = 140 \Rightarrow \text{true}$ **C**

The answer is **C**.

a) 5 : 12 is in proportion with 25 : 60
True or false?

$$\frac{5}{12} = \frac{25}{60} \Rightarrow 5 \cdot 60 = 12 \cdot 25$$

$$300 = 300 \Rightarrow \boxed{}$$

b) 4 : 9 is in proportion with 16 : 81
True or false?

$$\Rightarrow \boxed{}$$

c) Which ratio forms a proportion with $\frac{3}{5}$?

- A) $\frac{9}{25}$ B) $\frac{9}{15}$ C) $\frac{18}{25}$

A. $\frac{3}{5} = \frac{9}{25} \Rightarrow 3 \cdot 25 = 5 \cdot 9 \Rightarrow 75 = 45$ (F)

B. $\frac{3}{5} = \frac{9}{15} \Rightarrow$

C. $\Rightarrow \Rightarrow \boxed{}$

d) Which ratio forms a proportion with $\frac{5}{6}$?

- A) $\frac{10}{30}$ B) $\frac{25}{36}$ C) $\frac{35}{42}$

A. \Rightarrow

B. \Rightarrow

C. $\Rightarrow \Rightarrow \boxed{}$

e) Which ratio forms a proportion with $\frac{2}{7}$?

- A) $\frac{8}{28}$ B) $\frac{10}{70}$ C) $\frac{4}{49}$

A. \Rightarrow

B. \Rightarrow

C. $\Rightarrow \Rightarrow \boxed{}$

f) Which ratio forms a proportion with $\frac{7}{9}$?

- A) $\frac{21}{36}$ B) $\frac{49}{81}$ C) $\frac{35}{45}$

A. \Rightarrow

B. \Rightarrow

C. $\Rightarrow \Rightarrow \boxed{}$

Skill 14.6 Finding the missing term in a proportion (1).

MMBlue 1 1 2 2 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Write the proportion as two equal fractions.
- Cross multiply the numerators and the denominators of the fractions.
- Equate the products.
- Solve the equation to find the missing number (x).

A proportion

$a : b = c : d$ 2 ratios

$$\frac{a}{b} = \frac{c}{d}$$

Cross product

$$a \cdot d = b \cdot c$$

$$ad = bc$$

Q. Complete the missing term in the proportion:

$$\boxed{} : 28 = 12 : 7$$

A. $\frac{x}{28} = \frac{12}{7}$

$$\frac{x}{28} = \frac{12}{7}$$

Cross multiply

$$x \cdot 7 = 28 \cdot 12$$

$$7x = 28 \cdot 12$$

$$\frac{1}{7}x = \frac{28 \cdot 12}{7}$$

Simplify: $\div 7$

$$x = 4 \cdot 12$$

$$x = 48$$

a) Complete the missing term in the proportion:

$$3 : \boxed{4} = 12 : 16$$

$$\frac{3}{x} = \frac{12}{16} \Rightarrow 3 \cdot 16 = x \cdot 12$$

$$\frac{1}{12}x = \frac{3 \cdot 16^4}{12}$$

Simplify: $\div 3, \div 4$

$$\Rightarrow x = 4$$

b) Complete the missing term in the proportion:

$$24 : 15 = \boxed{} : 5$$

$$\frac{24}{15} = \frac{x}{5} \Rightarrow 24 \cdot 5 = 15 \cdot x$$

$$\frac{15x}{15} = \frac{24 \cdot 5}{15} \Rightarrow x =$$

c) Complete the missing term in the proportion:

$$3 : 10 = \boxed{} : 90$$

\Rightarrow

$\Rightarrow x =$

d) Complete the missing term in the proportion:

$$\boxed{} : 2 = 45 : 10$$

\Rightarrow

$\Rightarrow x =$

e) Complete the missing term in the proportion:

$$\frac{5}{9} = \frac{35}{\boxed{}}$$

\Rightarrow

$\Rightarrow x =$

f) Complete the missing term in the proportion:

$$\frac{3}{7} = \frac{18}{\boxed{}}$$

\Rightarrow

$\Rightarrow x =$

Skill 14.6 Finding the missing term in a proportion (2).**g)** Complete the missing term in the proportion:

$$\frac{1}{7} = \frac{\boxed{}}{56}$$

 \Rightarrow $\Rightarrow x =$ **h)** Complete the missing term in the proportion:

$$\frac{7}{20} = \frac{\boxed{}}{140}$$

 \Rightarrow $\Rightarrow x =$ **i)** Complete the missing term in the proportion:

$$\frac{24}{40} = \frac{3}{\boxed{}}$$

 \Rightarrow $\Rightarrow x =$ **j)** Complete the missing term in the proportion:

$$\frac{20}{15} = \frac{4}{\boxed{}}$$

 \Rightarrow $\Rightarrow x =$ **k)** Complete the missing term in the proportion:

$$\frac{10}{45} = \frac{\boxed{}}{9}$$

 \Rightarrow $\Rightarrow x =$ **l)** Complete the missing term in the proportion:

$$\frac{64}{80} = \frac{\boxed{}}{10}$$

 \Rightarrow $\Rightarrow x =$ **m)** Complete the missing term in the proportion:

$$\frac{24}{15} = \frac{\boxed{}}{5}$$

 \Rightarrow $\Rightarrow x =$ **n)** Complete the missing term in the proportion:

$$\frac{11}{5} = \frac{\boxed{}}{15}$$

 \Rightarrow $\Rightarrow x =$

Skill 14.7 Solving word problems involving proportions (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

To decide which deal is cheaper:

EITHER

- Find the unit price for each case, by dividing the cost price by the number of units.
- Compare the results.

OR

- Use any other method to make the cost price the same or the number the units the same for both deals.

To solve word problems involving proportions:

EITHER

- Find the unit rate, by dividing the amount by the given number of units.
- Multiply the unit rate by the required number of units.

OR

- Write a proportion using words.
- Replace the words with numbers:
First the given ratio.
Then the ratio of the given quantity to the unknown quantity.
- Find the missing term of the proportion.
(see skill 14.6, page 109)

Q. Which is cheaper per soda can?

- A) \$2.50 for a 6-pack
- B) \$6 for a 12-pack

A. Deal A)

$$\frac{\$2.50}{6 \text{ cans}} = \frac{\$0.42}{1 \text{ can}}$$

$$\Rightarrow \text{unit price} = \$0.42$$

Deal B)

$$\frac{\$6.00}{12 \text{ cans}} = \frac{\$0.50}{1 \text{ can}}$$

$$\Rightarrow \text{unit price} = \$0.50$$

Deal A) is cheaper.

OR

A. Make the same number of cans:

Deal A) double the quantity \Rightarrow
double the cost

\$2.50 for 6 cans \Rightarrow
\$5.00 for 12 cans

Deal B)

\$6.00 for 12 cans \Rightarrow

Deal A) is cheaper.

a) There are 110 calories in 50 g of white bread. How many calories in 80 g?

$$\text{calories} : \text{bread} = \text{calories} : \text{bread}$$

$$110 : 50 = x : 80$$

$$\frac{110}{50} \cdot \frac{x}{80} \Rightarrow 110 \cdot 80 = 50 \cdot x$$

$$x = \frac{110 \cdot 80}{50} = 176$$

x = 176 cal

b) If 5 yd of curtain material costs \$65, how much would 9 yd cost?

$$\text{yd} : \text{dollars} = \text{yd} : \text{dollars}$$

$$\Rightarrow$$

x = \$

c) If 80 concert tickets cost \$360, how much would 30 tickets cost?

80 tickets for \$360

$$\Rightarrow 10 \text{ tickets for } \$360 \div 8 = \$45$$

$$\Rightarrow 30 \text{ tickets for } \$45 \times 3 =$$

\$

d) If 9 pens cost \$22.50, how much would 6 pens cost?

9 pens for \$22.50

$$\Rightarrow$$

= \$

Skill 14.7 Solving word problems involving proportions (2).

MMBlue 11 22 33 44
MMGreen 11 22 33 44

e) There are 300 calories in 4 oz of pork chops. How many calories in 10 oz?

4 oz have 300 cal

⇒ *2 oz*

⇒ *10 oz*

=

f) If 10 lb of minced beef costs \$35, how much would 6 lb cost?

10 lb for

⇒ *2 lb*

⇒

g) If a car travels 180 miles on 8 gallons, how far does it travel on 12 gallons at the same rate?

⇒

⇒

=

⇒

⇒

=

i) Which is cheaper per card?

- A) \$4 for 12 cards
- B) \$6 for 15 cards

Make the same cost

A) $\times 3$
\$4 for 12 cards ⇒ \$12 for 36 cards

B) $\times 2$
\$6 for 15 cards ⇒ \$12 for 30 cards ⇒

j) Which is cheaper per pen?

- A) \$4 for 6 pens
- B) \$5 for 8 pens

Make the same cost

A)

B)

⇒

k) Which is cheaper per ounce?

- A) \$20 for 10 oz
- B) \$40 for 22 oz

A)

B)

⇒

l) Which is cheaper per ounce?

- A) \$16 for 15 oz
- B) \$27 for 25 oz

A)

B)

⇒

m) Which is cheaper per apple?

- A) \$4.80 for 4 apples
- B) \$6.50 for 6 apples

A)

B)

⇒

n) Which is cheaper per yard?

- A) \$25 for 12 yards
- B) \$40 for 17 yards

A)

B)

⇒

Skill 14.8 Finding the ratio of two quantities (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Write the ratio in words.
- Replace the words with numbers.
- Simplify the ratio:

EITHER

- Find the largest number that divides evenly into each quantity of the ratio (Greatest Common Factor) and divide each quantity by the GCF.

Hint: The order of the quantities in a ratio matters.

OR

- Divide each quantity of the ratio by any factor until the ratio is reduced to simplest form.

Q. The common metal for medals is 84% copper, and the rest is zinc. Find the ratio of zinc to copper.

A. $zinc = 100\% - 84\% = 16\%$

$zinc : copper$
 $= 16\% : 84\%$ (Ignore the % sign)
 $= \frac{16}{4} : \frac{84}{4}$ (Simplify: $\div 4$)
 $= 4 : 21$

a) The length of the school year in Egypt is 36 weeks and in Indonesia is 44 weeks. Find the ratio of the length of the school year duration in Indonesia compared to Egypt.

Indonesia : Egypt

$44 : 36$ (Simplify: $\div 4$)
 $\frac{44}{4} : \frac{36}{4}$
 $11 : 9$

b) A computer screen with a diagonal of 24 inches has a length of 20 inches. Find the ratio of the length to the diagonal.

length : diagonal

$20 : 24$

$= \dots = \boxed{\quad : \quad}$

c) The platinum alloy commonly used in the USA is 90% platinum and 10% iridium. Find the ratio of iridium to platinum in the alloy.

iridium : platinum

\dots
 $= \dots = \boxed{\quad : \quad}$

d) In 1978 only 8% of U.S. households had microwave ovens. As of 2006 over 80% have them. Find the ratio of microwave oven ownership in 2006 to 1978.

\dots

\dots

$= \dots = \boxed{\quad : \quad}$

e) The 8-carat gold is 33% gold, 20% silver and the rest is copper. Find the ratio of silver to other components.

\dots

\dots

$= \dots = \boxed{\quad : \quad}$

f) For children aged 2 to 11 years, an airfare is 75% of the full adult airfare. Find the ratio of child to adult airfares.

\dots

\dots

$= \dots = \boxed{\quad : \quad}$

Skill 14.8 Finding the ratio of two quantities (2).

MMBlue 11 22 33 44
MMGreen 11 22 33 44

- g)** The Southern Star Observation Wheel (Melbourne) has a capacity of 20 passengers per capsule and the London Eye has a capacity of 25. Find the ratio of the London Eye passengers per capsule to the Southern Star.

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

- h)** The London Eye has 32 capsules and the Singapore Flyer observation wheel has 28 capsules. Find the ratio of capsules in the Singapore Flyer to capsules in the London Eye.

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

- i)** In 2008, of the 100 seats in the Senate, 84 are held by men. What is the ratio of women to men in the Senate?

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

- j)** Find the ratio of the height of the Statue of Liberty (150 ft) to the height of the Sears Tower, Chicago (1700 ft).

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

- k)** A soccer field is 120 yards long and 80 yards wide. Find the ratio of width to length.

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

- l)** The lowest temperature recorded in the USA is -80°F and in Russia is -90°F . Find the ratio of the lowest temperature in the USA compared to Russia.

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

- m)** The lowest temperature recorded in North America is -81°F and in South America is -27°F . Find the ratio of the lowest temperature in South America compared to North America.

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

- n)** The sensory, language and memory centers are located in the temporal lobe, which is 22% of the total cerebral cortex volume in the brain. Find the ratio of the temporal lobe to the rest of the cortex.

$$= \frac{\quad}{\quad} = \boxed{\quad}$$

Skill 14.9 Finding other rates.

MMBlue 11 22 33 44
MMGreen 11 22 33 44

$$\text{rate} = \frac{\text{amount}}{\text{time}}$$

Rate of change

- Divide the amount by the time taken.
Example: A 300 L bathtub can be filled in 10 minutes.

$$\text{Rate} = \frac{300 \cancel{\text{L}}}{10 \cancel{\text{min}}} = 30 \text{ L/min}$$

$$\text{amount} = \text{rate} \cdot \text{time}$$

Amount

- Multiply the rate by the time taken.
Example: Sam worked 7 h at a rate of \$16/h.

$$\text{Amount (pay)} = 16 \cdot 7 = \$112$$

$$\text{time} = \frac{\text{amount}}{\text{rate}}$$

Time taken

- Divide the amount by the rate.
Example: A Lexmark E232 prints 990 pages at a rate of 22 pages/min (ppm).

$$\text{Time} = \frac{990 \text{ p}}{22 \text{ ppm}} = 45 \text{ min}$$

- Q.** Some species of bamboo can grow 90 feet per year. At this rate how long will they grow in a month?

A. $\text{rate} = 90 \text{ ft per year}$

$$1 \text{ year} = 12 \text{ months}$$

$$\text{rate per month} = 90 \text{ ft} \div 12 = 7.5 \text{ ft}$$

- a)** A Mini Cooper Diesel with a 1.6 L engine emits 104 g/km of the greenhouse gas carbon dioxide (CO₂). How many grams of CO₂ will be emitted during a 400 km trip?

$$\text{amount (g)} = \text{rate (g/km)} \cdot \text{distance (km)}$$

$$= 104 \text{ g/km} \cdot 400 \text{ km} = \boxed{41,600 \text{ g}}$$

- b)** Most of the Lambert Glacier (Antarctica) moves around 150 meters in 4 months. At this rate how much will it move in 6 months?

$$\text{amount} =$$

$$= \dots = \boxed{\text{m}}$$

- c)** The Kudzu climbing plant can grow up to 364 ft per year. What is this rate in feet per week?

$$1 \text{ year} = 52 \text{ weeks}$$

$$\text{rate/wk} = 364 \text{ ft} \div 52 \text{ wk} = \boxed{}$$

- d)** It takes 45 minutes to fill a 180-gallon swimming pool. What is the average rate in gallons per minute?

$$\text{rate} =$$

$$= \dots = \boxed{}$$

- e)** A Dodge Dakota Pickup 2WD automatic has a city consumption of 15 L of gas per 100 km. How much gas does it need for a 20 km trip?

$$\text{amount} =$$

$$= \dots = \boxed{ \text{ L}}$$

- f)** Every glass bottle recycled saves enough energy to light a 100-watt light bulb for 4 hours. How many bottles are needed to light the same bulb for a week?

$$1 \text{ week} =$$

$$\text{bottles} = \boxed{}$$

- g)** A Honda Civic Hybrid automatic has a highway consumption of 45 L of gas per 100 km. How much gas does it need for a 250 km trip?

$$\text{amount} =$$

$$= \dots = \boxed{ \text{ L}}$$

- h)** The annual fuel cost for a Lamborghini Coupe is around \$2490. How much is the cost per month?

$$1 \text{ year} =$$

$$= \dots = \boxed{ \$}$$

15. [Exponents / Square Roots]

Skill 15.1 Expressing powers as products and products as powers.

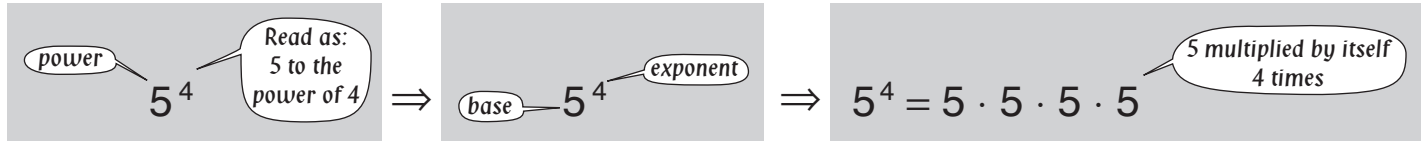
MMBlue 11 22 33 44
MMGreen 11 22 33 44

To write a product as a power:

- Write the factor as the base.
- Count how many times the factor is multiplied by itself and make the result the exponent.

To write a power as a product:

- Multiply the base by itself the same number of times as indicated by the exponent.



Q. Write the power as a product:

$7^4 =$

A. $7^4 =$

$= 7 \cdot 7 \cdot 7 \cdot 7$

7 multiplied by itself 4 times

a) Write the product as a power:

$6 \cdot 6 \cdot 6 \cdot 6 \cdot 6 =$

5 factors of 6 \Rightarrow
6 is the base
5 the exponent

6^5

b) Write the product as a power:

$2 \cdot 2 \cdot 2 =$

c) Write the product as a power:

$5 \cdot 5 =$

d) Write the product as a power:

$4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 =$

e) Write the power as a product:

$8^3 =$

f) Write the power as a product:

$3^4 =$

g) Write the power as a product:

$2^5 =$

h) Write the power as a product:

$9^3 =$

i) Write the product as a power:

$1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 =$

j) Write the product as a power:

$7 \cdot 7 \cdot 7 =$

k) Write the power as a product:

$6^4 =$

l) Write the product as a power:

$2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 =$

Skill 15.2 Squaring whole numbers.

- Multiply the number by itself.

$$1^2$$

= one squared

$$= \begin{array}{|c|} \hline 1 \\ \hline \end{array} 1 = 1 \text{ square}$$

$$= 1 \times 1$$

$$= 1$$

$$2^2$$

= two squared

$$= \begin{array}{|c|c|} \hline & \\ \hline & \\ \hline \end{array} = 4 \text{ squares}$$

$$= 2 \times 2$$

$$= 4$$

$$3^2$$

= three squared

$$= \begin{array}{|c|c|c|} \hline & & \\ \hline & & \\ \hline & & \\ \hline \end{array} = 9 \text{ squares}$$

$$= 3 \times 3$$

$$= 9$$

$$4^2$$

= four squared

$$= \begin{array}{|c|c|c|c|} \hline & & & \\ \hline & & & \\ \hline & & & \\ \hline & & & \\ \hline \end{array} = 16 \text{ squares}$$

$$= 4 \times 4$$

$$= 16$$

Q. $90^2 =$

A. $90^2 =$
 $= 90 \cdot 90$
 $= 8100$

90 multiplied by itself 2 times

$$\begin{array}{r} 8 \\ 90 \\ \times 90 \\ \hline 8100 \end{array}$$

a) $7^2 =$ *7 multiplied by itself 2 times*

$$= 7 \cdot 7 = \boxed{49}$$

b) $3^2 =$

$$= \dots = \boxed{}$$

c) $2^2 =$

$$= \dots = \boxed{}$$

d) $10^2 =$

$$= \dots = \boxed{}$$

e) $5^2 =$

$$= \dots = \boxed{}$$

f) $1^2 =$

$$= \dots = \boxed{}$$

g) $12^2 =$

$$= \dots = \boxed{}$$

h) $11^2 =$

$$= \dots = \boxed{}$$

i) $0^2 =$

$$= \dots = \boxed{}$$

j) $4^2 =$

$$= \dots = \boxed{}$$

k) $9^2 =$

$$= \dots = \boxed{}$$

l) $20^2 =$

$$= \dots = \boxed{}$$

m) $50^2 =$

$$= \dots = \boxed{}$$

n) $30^2 =$

$$= \dots = \boxed{}$$

o) $70^2 =$

$$= \dots = \boxed{}$$

p) $80^2 =$

$$= \dots = \boxed{}$$

q) $40^2 =$

$$= \dots = \boxed{}$$

r) $60^2 =$

$$= \dots = \boxed{}$$

Skill 15.3 Calculating powers of 10.

- Put the same number of zeros in the answer as the exponent.
Example: $10^4 \Rightarrow$ exponent is 4 so the answer ends in 4 zeros
 $10^4 = 10,000$

Q. $10^5 =$

A. $10^5 =$ Exponent 5
 $= 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10$
 $= \mathbf{100,000}$ Answer ends in 5 zeros

a) $10^9 =$ 10 multiplied by itself 9 times
 $= 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10$
 $=$ 1,000,000,000

b) $10^2 =$
 $=$ _____
 $=$

c) $10^7 =$
 $=$ _____
 $=$

d) $10^4 =$
 $=$ _____
 $=$

e) $10^1 =$
 $=$ _____
 $=$

f) $10^5 =$
 $=$ _____
 $=$

g) $10^6 =$
 $=$ _____
 $=$

h) $10^3 =$
 $=$ _____
 $=$

i) $10^8 =$
 $=$ _____
 $=$

j) $10^{10} =$
 $=$ _____
 $=$

Hint: Finding the square root of a number is the reverse of the procedure for squaring a number.

EITHER

- Use trial and error to find the number that, when multiplied by itself, equals the original number.

Example: The square root of 25

$\sqrt{25}$ = the number that when multiplied by itself equals 25

$5 \times 5 = 25$ so

$\sqrt{25} = \sqrt{5 \cdot 5} = 5$

OR

- Arrange that number of tiles in a square.
- Count the number of tiles along one side length.

← 5 →

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Q. $\sqrt{49} =$

A. $\sqrt{49} =$
 $= \sqrt{7 \cdot 7}$
 $= 7$
 The square root of 49 means:
 "what number multiplied by itself equals 49"
 $7 \times 7 = 49$
 $7^2 = 49$

← 7 →

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49

a) $\sqrt{25} =$
 $= \sqrt{5 \cdot 5}$ 5 multiplied by itself $=$ 5
 $=$

b) $\sqrt{9} =$
 $=$
 $=$

c) $\sqrt{36} =$
 $=$
 $=$

d) $\sqrt{4} =$
 $=$
 $=$

e) $\sqrt{16} =$
 $=$
 $=$

f) $\sqrt{100} =$
 $=$
 $=$

g) $\sqrt{144} =$
 $=$
 $=$

h) $\sqrt{121} =$
 $=$
 $=$

i) $\sqrt{64} =$
 $=$
 $=$

j) $\sqrt{900} =$
 $=$
 $=$

k) $\sqrt{4900} =$
 $=$
 $=$

l) $\sqrt{2500} =$
 $=$
 $=$

m) $\sqrt{8100} =$
 $=$
 $=$

n) $\sqrt{3600} =$
 $=$
 $=$

o) $\sqrt{12,100} =$
 $=$
 $=$

Skill 15.5 Evaluating powers of whole numbers.

- Observe the exponent.
- Multiply the number (base) the same number of times by itself as the exponent.
(see skill 15.1, page 117)

Hints: Any number raised to the power of zero (except 0) equals 1.

Example $6^0 = 1$

Any number raised to the power of one equals the number itself.

Example $6^1 = 6$

Q. $5^4 =$

A. $5^4 =$
 $= 5 \cdot 5 \cdot 5 \cdot 5$
 $= 125 \cdot 5$
 $= 625$

5 multiplied by itself
4 times

"5 raised to the power of 4"
means 4 lots of 5 in the equation.

a) $3^5 =$ 3 multiplied by itself
5 times

$= 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$

$= 9 \cdot 9 \cdot 3 = 243$

b) $2^4 =$

$=$

$=$

c) $4^3 =$

$=$

$=$

d) $1^4 =$

$=$

$=$

e) $2^5 =$

$=$

$=$

f) $4^4 =$

$=$

$=$

g) $3^4 =$

$=$

$=$

h) $0^2 =$

$=$

$=$

i) $2^6 =$

$=$

$=$

j) $4^0 =$

$=$

$=$

k) $3^3 =$

$=$

$=$

l) $5^3 =$

$=$

$=$

m) $3^6 =$

$=$

$=$

n) $8^3 =$

$=$

$=$

o) $4^5 =$

$=$

$=$

p) $7^0 =$

$=$

$=$

q) $2^8 =$

$=$

$=$

r) $9^3 =$

$=$

$=$

Skill 15.6 Finding powers of negative whole numbers.

MMBlue 11 22 33 44
MMGreen 11 22 33 44

- Observe the exponent.
- Multiply the number (base) the same number of times by itself as the exponent.
(see skill 15.1, page 117)
- Give the result a sign:

$$\begin{aligned} &\text{even exponent} \\ (-5)^2 &= -5 \cdot (-5) \\ &= +25 \quad \text{positive result} \end{aligned}$$

$$\begin{aligned} &\text{odd exponent} \\ (-5)^3 &= -5 \cdot (-5) \cdot (-5) \\ &= +25 \cdot (-5) \\ &= -125 \quad \text{negative result} \end{aligned}$$

Q. $(-6)^3 =$

A. $(-6)^3 =$ *odd exponent*
 $= -6 \cdot (-6) \cdot (-6)$
 $= 36 \cdot (-6)$
 $= -216$ *negative result*

“-6 raised to the power of 3” means 3 lots of -6 in the equation.

a) $(-3)^4 =$ *even exponent*

$$\begin{aligned} &= -3 \cdot (-3) \cdot (-3) \cdot (-3) \\ &= 9 \cdot 9 \quad \text{positive result} = \boxed{81} \end{aligned}$$

b) $(-2)^4 =$

$$\begin{aligned} &= \dots \\ &= \dots = \boxed{} \end{aligned}$$

c) $(-6)^2 =$

$$\begin{aligned} &= \dots \\ &= \dots = \boxed{} \end{aligned}$$

d) $(-1)^7 =$

$$\begin{aligned} &= \dots \\ &= \dots = \boxed{} \end{aligned}$$

e) $(-3)^3 =$

$$\begin{aligned} &= \dots \\ &= \dots = \boxed{} \end{aligned}$$

f) $(-4)^2 =$

$$\begin{aligned} &= \dots \\ &= \dots = \boxed{} \end{aligned}$$

g) $(-2)^3 =$

$$\begin{aligned} &= \dots \\ &= \dots = \boxed{} \end{aligned}$$

h) $(-5)^2 =$

$$\begin{aligned} &= \dots \\ &= \dots = \boxed{} \end{aligned}$$

i) $(-3)^5 =$

$$\begin{aligned} &= \dots \\ &= \dots = \boxed{} \end{aligned}$$

j) $(-4)^4 =$

$$\begin{aligned} &= \dots \\ &= \dots = \boxed{} \end{aligned}$$

k) $(-1)^9 =$

$$\begin{aligned} &= \dots \\ &= \dots = \boxed{} \end{aligned}$$

l) $(-7)^2 =$

$$\begin{aligned} &= \dots \\ &= \dots = \boxed{} \end{aligned}$$

m) $(-2)^6 =$

$$\begin{aligned} &= \dots \\ &= \dots = \boxed{} \end{aligned}$$

n) $(-12)^2 =$

$$\begin{aligned} &= \dots \\ &= \dots = \boxed{} \end{aligned}$$

o) $(-10)^3 =$

$$\begin{aligned} &= \dots \\ &= \dots = \boxed{} \end{aligned}$$

16. [Order of Operations]

Skill 16.1 Using 'order of operations' mixing only \times and/or \div , or $+$ and/or $-$

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Use the order of operations rules: Multiply (\times) and/or divide (\div) in order from left to right. Add ($+$) and/or subtract ($-$) in order from left to right.

Q. $21 \div 3 \times 4 =$

A. $21 \div 3 \times 4 =$ *work from left to right*
 $= 7 \times 4$ *divide first*
 $= 28$

add first
a) $9 + 13 - 7 =$
 $= 22 - 7 = \boxed{15}$

b) $9 - 5 + 3 =$
 $= \dots = \boxed{}$

c) $6 - 3 + 8 =$
 $= \dots = \boxed{}$

d) $3 + 6 - 5 =$
 $= \dots = \boxed{}$

e) $3 \times 6 \div 9 =$
 $= \dots = \boxed{}$

f) $3 \times 3 \times 2 =$
 $= \dots = \boxed{}$

g) $16 + 7 - 3 =$
 $= \dots = \boxed{}$

h) $32 \div 8 \div 2 =$
 $= \dots = \boxed{}$

i) $36 \div 9 \times 5 =$
 $= \dots = \boxed{}$

j) $2 \times 9 \div 3 =$
 $= \dots = \boxed{}$

k) $2 \times 3 \times 4 =$
 $= \dots = \boxed{}$

l) $27 \div 3 \div 3 =$
 $= \dots = \boxed{}$

m) $19 - 5 + 2 =$
 $= \dots = \boxed{}$

n) $13 - 8 + 6 =$
 $= \dots = \boxed{}$

o) $30 \div 6 \times 7 =$
 $= \dots = \boxed{}$

p) $4 \times 6 \div 2 =$
 $= \dots = \boxed{}$

q) $2 \times 5 \times 7 =$
 $= \dots = \boxed{}$

r) $72 \div 12 \times 3 =$
 $= \dots = \boxed{}$

Skill 16.2 Using 'order of operations' mixing \times , \div , $+$ and/or $-$

- Use the order of operations rules: First multiply (\times) or divide (\div).
Finally add ($+$) or subtract ($-$).

Q. $3 + 24 \div 4 \times 2 =$

A. $3 + 24 \div 4 \times 2 =$
 $= 3 + 6 \times 2$ *divide first*
 $= 3 + 12$
 $= 15$

a) $2 + 3 \times 5 =$ *multiply first*

$= 15 + 2 = \boxed{17}$

b) $6 + 9 \div 3 =$

$= \dots = \boxed{}$

c) $4 \times 3 - 7 =$

$= \dots = \boxed{}$

d) $2 + 7 \times 4 =$

$= \dots = \boxed{}$

e) $14 - 12 \div 2 =$

$= \dots = \boxed{}$

f) $2 \times 5 + 8 =$

$= \dots = \boxed{}$

g) $18 \div 6 - 3 =$

$= \dots = \boxed{}$

h) $9 + 8 \div 4 =$

$= \dots = \boxed{}$

i) $36 - 6 \times 5 =$

$= \dots = \boxed{}$

j) $14 + 21 \div 7 =$

$= \dots = \boxed{}$

k) $5 + 4 \times 9 =$

$= \dots = \boxed{}$

l) $17 - 12 \div 3 =$

$= \dots = \boxed{}$

m) $6 + 15 \div 3 \times 2 =$

$= 6 + 5 \times 2$ *divide first*
 $= 6 + 10 = \boxed{}$

n) $9 \times 5 - 4 \times 6 =$

$= \dots = \boxed{}$

o) $19 + 16 - 4 \times 7 =$

$= \dots = \boxed{}$

p) $21 \div 3 - 15 \div 5 =$

$= \dots = \boxed{}$

q) $28 + 9 - 7 \times 3 =$

$= \dots = \boxed{}$

r) $4 \times 8 - 18 \div 2 =$

$= \dots = \boxed{}$

s) $5 + 48 \div 8 \times 3 =$

$= \dots = \boxed{}$

t) $10 \times 2 - 44 \div 11 =$

$= \dots = \boxed{}$

u) $22 - 3 \times 6 + 9 =$

$= \dots = \boxed{}$

Skill 16.4 Using 'order of operations' mixing (), ×, ÷, +, and/or –

- Use the order of operations rules: First evaluate inside the brackets. Then multiply (×) and/or divide (÷) from left to right. Finally add (+) and/or subtract (–) from left to right.

Q. $12 + 4 \times (3 + 9) =$

A. $12 + 4 \times (3 + 9) =$ *simplify inside the brackets*
 $= 12 + 4 \times 12$ *then multiply*
 $= 12 + 48$
 $= 60$

a) $4 \times (3 + 7) =$ *brackets first*

$= 4 \times 10 =$

b) $3 \times (5 - 2) =$

$=$

c) $8 \div (1 + 3) =$

$=$

d) $18 \div (6 - 3) =$

$=$

e) $(23 - 3) \div 5 =$

$=$

f) $(42 - 6) \div 9 =$

$=$

g) $(12 - 7) \times 4 =$

$=$

h) $6 \times (8 - 3) =$

$=$

i) $5 \times (3 + 8) =$

$=$

j) $14 \div (2 + 5) =$

$=$

k) $28 \div (7 - 3) =$

$=$

l) $9 \times (5 + 7) =$

$=$

m) $9 \div (1 + 2) \times 4 =$

$=$
 $=$

n) $7 \times 8 - (8 - 2) =$

$=$
 $=$

o) $12 - 8 \div (2 + 2) =$

$=$
 $=$

p) $7 + 32 \div (8 - 4) =$

$=$
 $=$

q) $5 + 4 \times (6 + 2) =$

$=$
 $=$

r) $6 + (11 - 4) \times 3 =$

$=$
 $=$

s) $11 - (19 - 3 \times 5) =$

$=$
 $=$

t) $(6 - 3) \times (9 - 4) =$

$=$
 $=$

u) $(7 + 2 \times 8) - 15 =$

$=$
 $=$

Skill 16.5 Using 'order of operations' mixing powers, (), ×, ÷, +, and/or -

- Use the order of operations rules: First evaluate inside the brackets.
Secondly evaluate the powers.
Then multiply (×) and/or divide (÷) from left to right.
Finally add (+) and/or subtract (-) from left to right.

Q. $24 - 4^2 \div 8 =$

A. $24 - 4^2 \div 8 =$ *evaluate the power*
 $= 24 - 16 \div 8$ *then divide*
 $= 24 - 2$
 $= 22$

a) $8 + 9^2 \times 2 =$

$= 8 + 81 \times 2$

$= 8 + 162 = 170$

b) $9 - 2^2 \times 2 =$

$=$

$=$

c) $7 + 2^2 \times 5 =$

$=$

$=$

d) $3 + (9 - 5)^2 =$

$=$

$=$

e) $9 + 5^2 \times 2 =$

$=$

$=$

f) $2 \times (15 - 3)^2 =$

$=$

$=$

g) $(18 - 10)^2 \div 4 =$

$=$

$=$

h) $(12 - 7)^2 =$

$=$

$=$

i) $(8 - 1)^2 =$

$=$

$=$

j) $16 - 2^2 + 3 \times 1 =$

$=$

$=$

k) $27 - 18 \div 3^2 - 2 =$

$=$

$=$

l) $10^2 - (5 - 2) \times 8 =$

$=$

$=$

m) $(6 - 1 \times 2)^2 =$

$=$

$=$

n) $21 \div 3 + (9 - 5)^2 =$

$=$

$=$

o) $24 \div 8 + 2^2 - 4 =$

$=$

$=$

p) $2 \times 6 + 4 \times 5^2 =$

$=$

$=$

q) $32 - (9 + 7) \div 2^2 =$

$=$

$=$

r) $(15 - 9 \div 3)^2 =$

$=$

$=$

Skill 16.7 Using 'order of operations' mixing square roots, powers, \times , \div , $+$ and/or $-$

- Use the order of operations rules: First evaluate inside the brackets.
Secondly evaluate the powers.
Then multiply (\times) and/or divide (\div) from left to right.
Finally add ($+$) and/or subtract ($-$) from left to right.

Q. $\sqrt{25} \times 2^3 - 7 =$

A. $\sqrt{25} \times 2^3 - 7 =$ *evaluate the square root*
 $= 5 \times 8 - 7$ *evaluate the power*
 $= 40 - 7$
 $= 33$

a) $\sqrt{25 + 144} =$

$= \sqrt{169}$

$= \sqrt{13 \times 13} = \boxed{13}$

b) $\sqrt{16 + 9} =$

$=$

$= \boxed{}$

c) $\sqrt{6^2 + 8^2} =$

$=$

$= \boxed{}$

d) $\sqrt{64} \times 2 + 2^2 =$

$=$

$=$

$= \boxed{}$

e) $\sqrt{25} + 16 \div 2^2 =$

$=$

$=$

$= \boxed{}$

f) $\sqrt{81} \div 3^2 + 9 =$

$=$

$=$

$= \boxed{}$

g) $2^3 \times \sqrt{36} - 20 =$

$=$

$=$

$= \boxed{}$

h) $18 - 4^3 \div \sqrt{4} =$

$=$

$=$

$= \boxed{}$

i) $\sqrt{25} \times 2^3 - 7 =$

$=$

$=$

$= \boxed{}$

j) $50 - 3 \times \sqrt{100} + 2^3 =$

$=$

$=$

$= \boxed{}$

k) $3 \times \sqrt{49} + 4 - 2^3 =$

$=$

$=$

$= \boxed{}$

l) $13 + 5^2 \div \sqrt{25} =$

$=$

$=$

$= \boxed{}$

17. [Exploring Number]

Skill 17.1 Comparing whole numbers.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Compare the size of the digits in the same place, one at a time.
- Work from left to right across each number.

Q. Which number is the largest?

- A) 24,706
B) 24,670
C) 24,760

A. C

Tens of thousands and thousands:

All numbers have the same digit in the tens of thousands place (2), and the same digit in the thousands place (4).

Hundreds:

In the hundreds place 7 is greater than 6. So A and C are greater than B.

Tens:

In the tens place 6 is greater than 0. So 24,760 is greater than 24,706.

> means "is greater than"

< means "is less than"

a) $45,804 > 45,480$
True or false?

$8 > 4$

⇒

true

compare the hundreds place

b) $3207 < 3072$
True or false?

⇒

c) $60,198 > 61,980$
True or false?

⇒

d) $9137 < 9317$
True or false?

⇒

e) $52,620 > 52,260$
True or false?

⇒

f) $7548 > 7584$
True or false?

⇒

g) Which number is the largest?

- A) 1805
B) 1850
C) 1800

$5 > 0$

⇒

B

compare the digits in the tens place

h) Which number is the largest?

- A) 30,931
B) 30,391
C) 30,913

⇒

i) Which number is the largest?

- A) 19,054
B) 19,504
C) 19,450

⇒

j) Which number is the largest?

- A) 2380
B) 2083
C) 2308

⇒

k) Which number is the largest?

- A) 62,075
B) 62,570
C) 62,750

⇒

l) Which number is the largest?

- A) 47,091
B) 47,190
C) 47,019

⇒

Skill 17.2 Understanding and finding the place value of a digit in a number (1).

MMBlue 1 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Compare the position of the digit to the position of the decimal point.
Hint: There is a decimal point which is not written, at the end of any whole number.

Place value	tens of thousands	thousands	hundreds	tens	units	tenths	hundredths	thousandths
Value	30,000	6000	100	50	8	$\frac{2}{10}$	$\frac{4}{100}$	$\frac{7}{1000}$
	3	6	1	5	8	2	4	7

↑
Decimal point

Q. What is the value of the underlined digit in the number 36,158.247? **A.** 30,000 Consider the position of the digit 3 to that of the decimal point. 3 is five places to the left so it is in the tens of thousands place. The 3 represents 3 tens of thousands or 30,000

- | | |
|--|--|
| <p>a) In the number 14,058 which digit is in the tens place? <input style="border: 1px solid black; width: 40px; height: 30px; text-align: center;" type="text" value="5"/></p> | <p>b) In the number 9023 which digit is in the units place? <input style="border: 1px solid black; width: 40px; height: 30px;" type="text"/></p> |
| <p>c) In the number 5836 which digit is in the hundreds place? <input style="border: 1px solid black; width: 40px; height: 30px;" type="text"/></p> | <p>d) In the number 24,108 which digit is in the thousands place? <input style="border: 1px solid black; width: 40px; height: 30px;" type="text"/></p> |
| <p>e) In the number 16.253 which digit is in the units place? <input style="border: 1px solid black; width: 40px; height: 30px;" type="text"/></p> | <p>f) In the number 0.017 which digit is in the hundredths place? <input style="border: 1px solid black; width: 40px; height: 30px;" type="text"/></p> |
| <p>g) In the number 45.809 which digit is in the tenths place? <input style="border: 1px solid black; width: 40px; height: 30px;" type="text"/></p> | <p>h) In the number 0.0874 which digit is in the thousandths place? <input style="border: 1px solid black; width: 40px; height: 30px;" type="text"/></p> |
| <p>i) What is the value of the underlined digit in the number 2<u>5</u>9?
<i>5 tens</i> ⇒ <input style="border: 1px solid black; width: 40px; height: 30px; text-align: center;" type="text" value="50"/></p> | <p>j) What is the value of the underlined digit in the number 3<u>2</u>70?
..... ⇒ <input style="border: 1px solid black; width: 40px; height: 30px;" type="text"/></p> |
| <p>k) What is the value of the underlined digit in the number 16,<u>0</u>92?
..... ⇒ <input style="border: 1px solid black; width: 40px; height: 30px;" type="text"/></p> | <p>l) What is the value of the underlined digit in the number 86,<u>9</u>25?
..... ⇒ <input style="border: 1px solid black; width: 40px; height: 30px;" type="text"/></p> |

Skill 17.2 Understanding and finding the place value of a digit in a number (2).

- m) What is the value of the underlined digit in the number $\underline{5}124$?

..... \Rightarrow

- n) What is the value of the underlined digit in the number $73,06\underline{1}$?

..... \Rightarrow

- o) What is the value of the underlined digit in the number $\underline{2}9,603$?

..... \Rightarrow

- p) What is the value of the underlined digit in the number $8\underline{7}14$?

..... \Rightarrow

- q) What is the value of the underlined digit in the number $35.04\underline{3}$?

$4 \text{ hundredths} = \frac{4}{100} =$

- r) What is the value of the underlined digit in the number $5.08\underline{2}$?

$2 \text{ thousandths} =$

- s) What is the value of the underlined digit in the number $0.\underline{9}8$?

..... $=$

- t) What is the value of the underlined digit in the number $1.0\underline{7}6$?

..... $=$

- u) In which number does the digit 4 have greater value? A) 4.65
B) 30.4

A) value 4

B) value 0.4 $4 > 0.4 \Rightarrow$

- v) In which number does the digit 6 have greater value? A) 20,406
B) 1063

A)

B) \Rightarrow

- w) In which number does the digit 1 have greater value? A) 3.15
B) 1.98

A)

B) \Rightarrow

- x) In which number does the digit 9 have greater value? A) 4907
B) 10,892

A)

B) \Rightarrow

- y) In which number does the digit 3 have greater value? A) 8.931
B) 1.375

A)

B) \Rightarrow

- z) In which number does the digit 5 have greater value? A) 0.652
B) 0.526

A)

B) \Rightarrow

Skill 17.3 Writing word numbers in standard form.

- Write the digits in order.
- Write a comma between the thousands place and the hundreds place, and between the millions place and the hundreds of thousands place.
- Write a zero in any place that is left empty.

Hints: The comma is now commonly omitted in 4-digit whole numbers.

Q. Express in numerals:
fifty thousand, six hundred nine

A. 50,609

Tens of Th.	Th.	H	T	U
5	0	6	0	9

First write 50 for the words "fifty thousand"; then write a comma. Write the digit 6 for the hundreds, then write the digit 0, because there are no tens.

Finally write the digit 9 for the units.

a) Express in numerals:
two hundred fifteen

215

b) Express in numerals:
four thousand one hundred fifty

c) Express in numerals:
six thousand eighty-two

d) Express in numerals:
eight thousand one hundred seventeen

e) Express in numerals:
nine hundred two

f) Express in numerals:
three thousand four hundred

g) Express in numerals:
two hundred ninety-eight

h) Express in numerals:
seven thousand three hundred nine

i) Express in numerals:
five hundred thirty

j) Express in numerals:
twelve thousand, six hundred

k) Express in numerals:
seven hundred fourteen

l) Express in numerals:
fourteen thousand, sixty-three

m) Express in numerals:
sixty thousand, five hundred forty

n) Express in numerals:
thirty-one thousand, seven

o) Express in numerals:
four hundred three thousand,
two hundred

p) Express in numerals:
eight hundred thousand, fifty

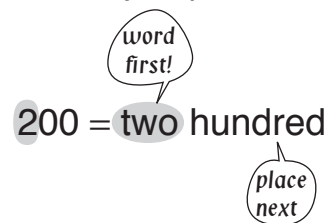
q) Express in numerals:
one million, nine hundred
thousand, twenty-six

r) Express in numerals:
seven million, six hundred
thousand, forty

Skill 17.4 Writing whole numbers in word form (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Start from left and write the word for each digit (unless it is a 0), followed by its place name.



To write 2-digit numbers in words:

- Use a hyphen (-) to separate the word for the tens from the word for the units, for all numbers from 21 to 99; e.g. 67 is written as sixty-seven.

Hint: Some 2-digit numbers have names that do not follow the usual rules. Use the following:

10 ten	50 fifty	90 ninety	14 fourteen	18 eighteen
20 twenty	60 sixty	11 eleven	15 fifteen	19 nineteen
30 thirty	70 seventy	12 twelve	16 sixteen	
40 forty	80 eighty	13 thirteen	17 seventeen	

To write 3-digit numbers in words:

- Describe the number of hundreds first. Always write ‘hundred’ not ‘hundreds’.
- Hints: The word “and” is unnecessary except for the numbers between 100 and 110.*

To write 4-digit numbers in words:

- Describe the number of thousands first. Always write ‘thousand’ not ‘thousands’.
- Hints: The comma is now commonly omitted in writing 4-digit whole numbers.*

To write 5-digit numbers in words:

- Describe the number of thousands by following the rules for 2-digit numbers.

To write 6-digit numbers in words:

- Describe the number of thousands by following the rules for 3-digit numbers.

Q. Write the number 7069 in words.

A. *seven thousand sixty-nine*

Th.	H	T	U
7	0	6	9

7 thousands, 0 hundreds, 6 tens and 9 units become in words:
seven thousand sixty-nine

a) Write the number 318 in words.

three hundred eighteen

b) Write the number 65 in words.

c) Write the number 90 in words.

d) Write the number 413 in words.

e) Write the number 706 in words.

f) Write the number 520 in words.

Skill 17.4 Writing whole numbers in word form (2).MMBlue 1 1 2 2 3 4 4
MMGreen 1 1 2 2 3 3 4 4**g)** Write the number 800 in words.**h)** Write the number 609 in words.**i)** Write the number 570 in words.**j)** Write the number 1600 in words.**k)** Write the number 4200 in words.**l)** Write the number 2004 in words.**m)** Write the number 5007 in words.**n)** Write the number 3012 in words.**o)** Write the number 8040 in words.**p)** Write the number 35,000 in words.**q)** Write the number 86,000 in words.**r)** Write the number 19,000 in words.**s)** Write the number 10,700 in words.**t)** Write the number 24,300 in words.**u)** Write the number 15,090 in words.**v)** Write the number 17,008 in words.**w)** Write the number 903,000 in words.**x)** Write the number 406,000 in words.**y)** Write the number 102,000 in words.**z)** Write the number 905,000 in words.

Skill 17.5 Rounding whole numbers to a given place.

MMBlue 11 22 3 44
MMGreen 11 22 33 44

- Circle the digit to the right of the requested place.
- If this digit is 0, 1, 2, 3 or 4 (< 5) - **round down** - keep the digit in the requested place the same.
5, 6, 7, 8 or 9 (≥ 5) - **round up** - add 1 to the digit in the requested place.
- Keep the number of digits in the answer the same as in the question by using zeros to fill the vacated spaces.

Q. Round 4067 to the nearest hundred.

A. 4100

Th.	H	T	U
4	0	6	7

 \Rightarrow

Th.	H	T	U
4	1	0	0

The digit to the right of the hundreds place is 6.

$6 \geq 5$ so round up.

Add 1 to the 0 in the hundreds place to make 1.

Put zeros in the tens and units places.

a) Round 12,360 to the nearest thousand.

12,360 \Rightarrow 12,000

3 < 5 round down by keeping 2

b) Round 345 to the nearest ten.

\Rightarrow 350

c) Round 2574 to the nearest hundred.

\Rightarrow 2600

d) Round 806 to the nearest ten.

\Rightarrow 810

e) Round 221 to the nearest ten.

\Rightarrow 220

f) Round 34,220 to the nearest thousand.

\Rightarrow 34,000

g) Round 1657 to the nearest hundred.

\Rightarrow 1700

h) Round 71,635 to the nearest thousand.

\Rightarrow 72,000

i) Round 4907 to the nearest ten.

\Rightarrow 4910

j) Round 1449 to the nearest hundred.

\Rightarrow 1500

k) Round 20,506 to the nearest thousand.

\Rightarrow 21,000

l) Round 3650 to the nearest hundred.

\Rightarrow 3700

m) Round 168 to the nearest ten.

\Rightarrow 170

n) Round 5630 to the nearest hundred.

\Rightarrow 5600

Skill 17.6 Rounding decimal numbers to a given place.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

To round a decimal number to the nearest whole number:

- Circle the first digit after the decimal point.
- If this digit is: 0, 1, 2, 3 or 4 (< 5) - **round down** - keep the unit digit unchanged and drop all the digits after the decimal point.
- 5, 6, 7, 8 or 9 (≥ 5) - **round up** - add 1 to the unit digit and drop all the digits after the decimal point.

To round a decimal number to a given place (tenths, hundredths, thousandths):

- Circle the digit to the right of the requested place.
- If this digit is: 0, 1, 2, 3 or 4 (< 5) - **round down** - keep the digit in the requested place unchanged and drop all following digits.
- 5, 6, 7, 8 or 9 (≥ 5) - **round up** - add 1 to the digit in the requested place and drop all following digits.

Q. Round 2.75 to the nearest whole number.

A. 3

Units	Tenths	Hundredths	⇒	Units	Tenths	Hundredths
2	7	5		3	0	0

The first digit after the decimal point is 7.

$7 \geq 5$ so round up.

Add 1 to the 2 in the units place to make 3.

Omit the digits after the decimal point.

a) Round 13.4 to the nearest whole number.

13.4 \Rightarrow 13

4 < 5 round down by keeping 3

b) Round 17.97 to the nearest whole number.

\Rightarrow 18

c) Round 45.85 to the nearest whole number.

\Rightarrow 46

d) Round 2.468 to the nearest whole number.

\Rightarrow 2

e) Round 1.8736 to the nearest thousandth.

1.8736 \Rightarrow 1.874

6 \geq 5 round up by adding 1 to 3

f) Round 18.683 to the nearest hundredth.

\Rightarrow 18.68

g) Round 0.59 to the nearest tenth.

\Rightarrow 0.6

h) Round 9.81 to the nearest tenth.

\Rightarrow 9.8

i) Round 7.843 to the nearest hundredth.

\Rightarrow 7.84

j) Round 0.0856 to the nearest thousandth.

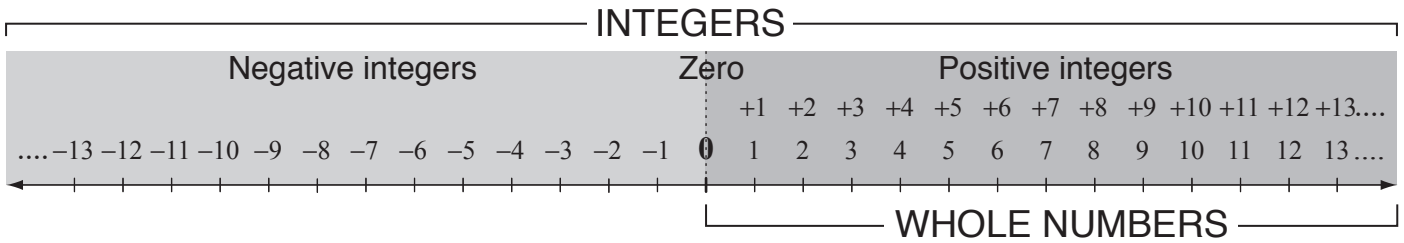
\Rightarrow 0.086

k) Round 0.52 to the nearest tenth.

\Rightarrow 0.5

l) Round 0.1968 to the nearest thousandth.

\Rightarrow 0.197



- Decide if a number is a whole number or an integer, based on their definition and the hints below. (see Glossary)

Hints: *Negative integers, fractions and decimals are not whole numbers.*

Any positive fraction whose numerator is divisible by the denominator is a whole number: $\frac{6}{3} = 2$

Any positive decimal with only zeros after the decimal point is a whole number: $8.00 = 8$

Fractions and decimals are not integers.

Any fraction whose numerator is divisible by the denominator is an integer: $-\frac{5}{1} = -5$

Any decimal with only zeros after the decimal point is an integer: $-3.00 = -3$

- Q.** Choose the whole numbers from this list:

$-19, 8.2, \frac{6}{2}, -\frac{7}{5}, 34, 0$

A. -19 is negative, so not a whole number

8.2 is a decimal, so not a whole number

$\frac{6}{2} = 6 \div 2 = 3$ is a whole number

$-\frac{7}{5}$ is a fraction, so not a whole number

So $\frac{6}{2}, 34, 0$ are whole numbers.

- a)** Choose the whole numbers from this list:

$\textcircled{68}, \frac{9}{5}, -31, 0.24, \textcircled{7}$

68, 7

- b)** Choose the whole numbers from this list:

$7\frac{1}{6}, 52, -100, 3.14, 98$

- c)** Choose the whole numbers from this list:

$\frac{3}{10}, 79, -95, 4.86, 21$

- d)** Choose the whole numbers from this list:

$0.095, \frac{8}{11}, 250, -72, 13$

- e)** Choose the integers from this list:

$-1512, \frac{1}{14}, 54.32, 48, 60$

- f)** Choose the integers from this list:

$21, 1\frac{1}{9}, -4, -3.27, 7500$

- g)** Choose the integers from this list:

$-63, \frac{3}{5}, 0.72, 0, -824$

- h)** Choose the integers from this list:

$\frac{25}{5}, 7.823, -1, -\frac{4}{7}, 110$

- i)** Choose the integers from this list:

$-0.68, \frac{12}{4}, 71, -54, -1039$

- j)** Choose the integers from this list:

$30, -11, \frac{10}{2}, 6.25, 4000$

Skill 17.9 Writing numbers in standard form.

5.81×10^5 Scientific Notation Product of: Number ≥ 1 and < 10 Power of 10 with positive exponent	=	$581,000$ Standard Form Very large
--	---	---

3.47×10^{-4} Scientific Notation Product of: Number ≥ 1 and < 10 Power of 10 with negative exponent	=	0.000347 Standard Form Very small
---	---	--

If the power of 10 is **positive**:

- Move the decimal point to the right as many places as the power of 10.
- Add zeros as place holders if necessary.
Example: $3.1 = 3.1000$

If the power of 10 is **negative**:

- Move the decimal point to the left as many places as the power of 10.
- Add zeros as place holders if necessary.
Example: $4.5 = 00004.5$
- If the result is less than 1, write a zero in the units place.

Q. Write 8.5×10^{-6} in standard form.

A. 8.5×10^{-6} exponent = -6
 $= 0000008.5 \times 10^{-6}$ move decimal point 6 places left
add zeros as place holders
 $= 0.0000085$

a) 2.8×10^9 written in standard form is:

- A) 28,000,000,000
- B) 2,800,000,000
- C) 280,000,000

$2.8 \times 10^9 =$ exponent = +9
 $= 2,800,000,000.00$ 9 places right \Rightarrow B

b) 1.46×10^7 written in standard form is:

- A) 146,000,000
- B) 1,460,000
- C) 14,600,000

$=$ _____ \Rightarrow

c) During an average lifetime, a human eats around 6×10^4 pounds of food. Write this number in standard form.

$=$ _____ $=$

d) Lightning reaches 5×10^5 degrees Fahrenheit. Write this number in standard form.

$=$ _____ $=$

e) The size of a water molecule is 2.78×10^{-10} m. Write this number in standard form.

$=$

f) 9.5×10^{-6} written in standard form is:

- A) 0.0000095
- B) 0.000095
- C) 0.00095

$=$ _____ \Rightarrow

Skill 17.10 Recognizing rational numbers.

A number is **rational** if:

- It can be written as a fraction (ratio) of two integers.

Hints: All integers are rational numbers: $-2, 0, 700, \frac{5}{1}, \frac{25}{5}$

All terminating decimals are rational numbers: $2.16, -5.753469$

All fractions are rational numbers: $-\frac{3}{4}, \frac{12}{85}, \frac{23}{500}$

All square roots of perfect squares are rational numbers: $\sqrt{9}, \sqrt{16}$

Q. Which numbers are rational?

- A) 0.17 B) π
C) $\sqrt{3}$ D) -26

- A.** A) 0.17 is rational (terminating decimal)
B) π is not rational (an infinite non-repeating decimal)
C) $\sqrt{3}$ is not rational (square root of a prime number)
D) -26 is rational (negative integer)
So **A and D** are rational.

a) Choose the rational numbers from the list:

$\sqrt{12}, \left(\frac{1}{3}\right), (7.95), \pi, (-24)$

b) Choose the rational numbers from the list:

$-150, \frac{\pi}{2}, 0.72, \frac{18}{101}, -\sqrt{6}$

c) Choose the rational numbers from the list:

$-\frac{19}{3}, 3.1415, \sqrt{80}, 15, -4$

d) Choose the rational numbers from the list:

$\frac{14}{569}, 98, 3.58904, \sqrt{50}, -79$

e) Which numbers are rational?

- A) $\sqrt{10}$ B) π
C) 3.1415 D) $\frac{7}{8}$

f) Which numbers are rational?

- A) π B) 0.0004
C) $\frac{3}{4}$ D) $\sqrt{20}$

g) Which numbers are rational?

- A) 8.2323 B) $\sqrt{3}$
C) $1\frac{1}{7}$ D) $-\frac{\pi}{4}$

h) Which numbers are rational?

- A) -1 B) $\sqrt{5}$
C) $\frac{\pi}{3}$ D) $\frac{23}{800}$

i) Which is **not** a rational number?

- A) $\sqrt{7}$ B) -360
C) 2.518 D) $-\frac{4}{9}$

j) Which is **not** a rational number?

- A) 0.085 B) -1996
C) $-\frac{\pi}{2}$ D) $\frac{34}{71}$

18. [Multiples / Factors / Primes]

Skill 18.1 Finding the multiples of a number.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Count by the number i.e. add the number to itself continuously.
- OR
- Multiply the number by 1, then 2, 3, 4, 5, etc. to get the multiples in order.

Q. List all the multiples of 5 up to 25.

A. $5 \cdot 1 = 5$
 $5 \cdot 2 = 10$
 $5 \cdot 3 = 15$
 $5 \cdot 4 = 20$
 $5 \cdot 5 = 25$
 $\Rightarrow 5, 10, 15, 20, 25$

a) List all the multiples of 8 up to 32.

$8 + 8 = 16, 16 + 8 = 24, 24 + 8 = 32$

keep adding 8

8, 16, 24, 32

b) List all the multiples of 2 up to 14.

c) List all the multiples of 10 up to 50.

d) List all the multiples of 3 up to 21.

e) List all the multiples of 6 up to 36.

f) List all the multiples of 11 up to 66.

g) List all the multiples of 8 up to 40.

h) List all the multiples of 9 up to 45.

i) List all the multiples of 4 up to 30.

j) List all the multiples of 7 up to 50.

Skill 18.2 Finding the common multiples of two numbers.

- List the multiples of each number.
- Compare the lists to find any numbers the same (common multiples).

Q. List the common multiples of 4 and 5 up to 50.

A. *Multiples of 4:*
4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 52
Multiples of 5:
5, 10, 15, 20, 25, 30, 35, 40, 45, 50
Common multiples of 4 and 5 up to 50:
⇒ **20, 40**

a) List the common multiples of 3 and 6 up to 20.

3, 6, 9, 12, 15, 18 *multiples of 3*

6, 12, 18 *multiples of 6*

6, 12, 18

b) List the common multiples of 4 and 7 up to 30.

.....
.....
.....
.....
.....

c) List the common multiples of 2 and 9 up to 60.

.....
.....
.....
.....

d) List the common multiples of 6 and 8 up to 50.

.....
.....
.....
.....

e) List the common multiples of 4 and 6 up to 32.

.....
.....
.....

f) List the common multiples of 3 and 8 up to 60.

.....
.....
.....

g) List the common multiples of 5 and 8 up to 90.

.....
.....
.....

h) List the common multiples of 7 and 9 up to 100.

.....
.....
.....

Skill 18.3 Finding the least common multiple (LCM) of two numbers.

- List the multiples of each number.
 - Compare the lists and find the lowest matching number (Least Common Multiple, LCM).
- Hints: If one number divides evenly into the other number then the LCM is the larger number.
If two numbers have 1 as their only common factor then the LCM is their product.*

Q. What is the least common multiple (LCM) of 10 and 12?

A. *Multiples of 10:*
10, 20, 30, 40, 50, 60, 70, 80
Multiples of 12:
12, 24, 36, 48, 60, 72, 84
Least Common Multiple (LCM):
60

a) What is the least common multiple (LCM) of 3 and 8?

3, 6, 9, 12, 15, 18, 21, 24, 27 multiples of 3

8, 16, 24, 32 multiples of 8 24

b) What is the least common multiple (LCM) of 4 and 7?

.....

c) What is the least common multiple (LCM) of 2 and 11?

.....

d) What is the least common multiple (LCM) of 5 and 9?

.....

e) What is the least common multiple (LCM) of 3 and 18?

.....

f) What is the least common multiple (LCM) of 4 and 20?

.....

g) What is the least common multiple (LCM) of 6 and 12?

.....

h) What is the least common multiple (LCM) of 6 and 8?

.....

i) What is the least common multiple (LCM) of 8 and 12?

.....

j) What is the least common multiple (LCM) of 9 and 15?

.....

Skill 18.4 Finding the factors of a number.

- To decide if a number is a factor of another number the first number must divide evenly into the second number, with no remainder.
Hint: A number always has at least 2 factors, 1 and the number itself.
- Use trial and error. Be systematic.
Divide 2 into the number. If 2 divides evenly then 2 and the result are factors of the number.
Divide 3 into the number. If 3 divides evenly then 3 and the result are factors of the number.
Divide 4 into the number. If 4 divides evenly then 4 and the result are factors of the number.
Continue until all possibilities are exhausted.

Q. List all the factors of 10 in ascending order.

A. $10 \div 1 = 10$
 $10 \div 2 = 5$
 $10 \div 3 = 3 \text{ remainder } 1$
 $10 \div 4 = 2 \text{ remainder } 2$
 $10 \div 5 = 2$ ← Back to 5 & 2 so possibilities exhausted
 $\Rightarrow 1, 2, 5, 10$

a) Is 2 a factor of 471?

$471 \div 2 = 235 \text{ remainder } 1$

no

b) Is 6 a factor of 282?

$282 \div 6 =$

c) Is 3 a factor of 142?

d) Is 4 a factor of 212?

e) List all the factors of 25 in ascending order.

f) List all the factors of 28 in ascending order.

g) What is the smallest positive integer that has exactly three factors?

h) What is the smallest positive integer that has exactly nine factors?

i) The number 25 has exactly three factors: 1, 5, 25. Find the next number after 25 that has exactly three factors.

j) The number 12 has exactly six factors: 1, 2, 3, 4, 6 and 12. Find the next number after 12 that has exactly six factors.

Skill 18.5 Finding the common factors of two numbers.

MMBlue 11 2 2 3 3 4 4
MMGreen 11 2 2 3 3 4 4

- List the factors of each number.
- Compare the lists and find any matching numbers (Common Factors, CF).

Q. List all the common factors of 18 and 42.

A. Factors of 18:

1, 2, 3, 6, 9, 18

Factors of 42:

1, 2, 3, 6, 7, 14, 21, 42

Common factors of 18 and 42:

1, 2, 3, 6

a) List all the common factors of 8 and 36.

1, 2, 4, 8 *factors of 8*

1, 2, 3, 4, 6, 9, 12, 18, 36 *factors of 36*

1, 2, 4

b) List all the common factors of 12 and 15.

c) List all the common factors of 20 and 44.

d) List all the common factors of 20 and 50.

e) List all the common factors of 27 and 45.

f) List all the common factors of 15 and 50.

g) List all the common factors of 18 and 54.

h) List all the common factors of 28 and 70.

Skill 18.6 Finding the greatest common factor (GCF) of two numbers.

- List the factors of each number.
- Compare the lists and find the greatest matching number (Greatest Common Factor, GCF).

Q. What is the greatest common factor (GCF) of 24 and 60?

A. *Factors of 24:*
1, 2, 3, 4, 6, 8, 12, 24
Factors of 60:
1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60
Greatest common factor (GCF):
⇒ 12

a) What is the greatest common factor (GCF) of 24 and 32?

1, 2, 3, 4, 6, 8, 12, 24 factors of 24

1, 2, 4, 8, 16, 32 factors of 32

8

b) What is the greatest common factor (GCF) of 16 and 26?

.....

c) What is the greatest common factor (GCF) of 30 and 35?

.....

d) What is the greatest common factor (GCF) of 20 and 50?

.....

e) What is the greatest common factor (GCF) of 24 and 48?

.....

f) What is the greatest common factor (GCF) of 45 and 63?

.....

g) What is the greatest common factor (GCF) of 28 and 42?

.....

h) What is the greatest common factor (GCF) of 24 and 54?

.....

i) What is the greatest common factor (GCF) of 12 and 44?

.....

j) What is the greatest common factor (GCF) of 30 and 75?

.....

Skill 18.7 Recognizing prime and composite numbers.

- To decide if a number is prime, find all the factors of the number to determine if it has exactly 2 factors, 1 and itself. (see skill 18.4, page 146)
Hint: 0 and 1 are not prime or composite numbers.
- To decide if a number is composite, find all the factors of the number to determine if it has more than 2 factors.

Q. List the prime numbers between 7 and 14.

A. List the factors of each number:

7 (1,7)	11 (1,11)
8 (1,8), (2,4)	12 (1, 12), (2,6), (3,4)
9 (1,9), (3,3)	13 (1, 13)
10 (1, 10), (2,5)	14 (1,14), (2,7)

Prime numbers (only 2 factors):

⇒ **7, 11, 13**

a) Choose the composite numbers:

0, 1, 2, 3, 4, 5, 6, 7

0 & 1 are not composite; 3, 5 & 7 are prime

2 is the only even prime; 4 & 6 are even

4, 6

b) Choose the composite numbers:

8, 9, 10, 11, 12, 13, 14, 15

c) What is the prime number just before 53?

d) What is the next prime number after 100?

e) What is the next prime number after 41?

f) What is the next prime number after 79?

g) List all the prime numbers between 40 and 50.

.....
.....

h) Choose the composite numbers: 16, 17, 18, 19, 20, 21, 22, 23

.....
.....

i) What is the prime number just before 88?

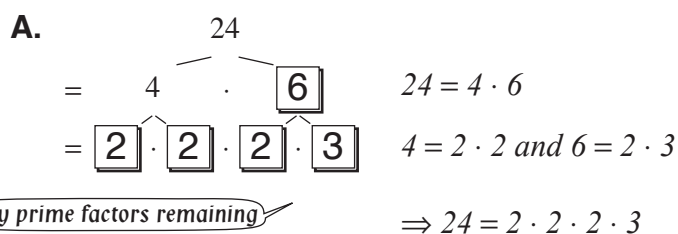
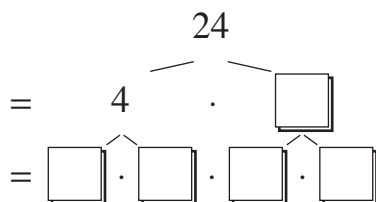
j) What is the next prime number after 90?

Skill 18.8 Expressing a number as a product of its prime factors using a factor tree (1).

MMBlue 11 22 33 44
MMGreen 11 22 33 44

- Write the number as a product of any two factors excluding 1 (not necessarily prime numbers).
- Then write each of these two numbers as a product of any two factors excluding 1.
- Continue in this way until only prime factors remain.

Q. Express 24 as a product of prime numbers by completing the factor tree.

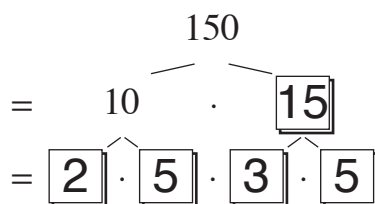


a) Express 150 as a product of prime numbers by completing the factor tree.

150 = 10 · 15

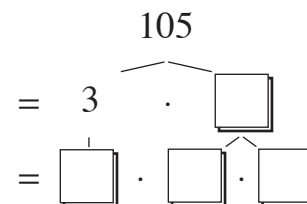
10 = 2 · 5

15 = 3 · 5



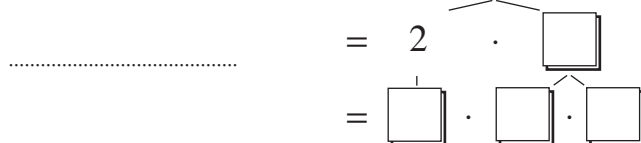
b) Express 105 as a product of prime numbers by completing the factor tree.

105 = 3 ·

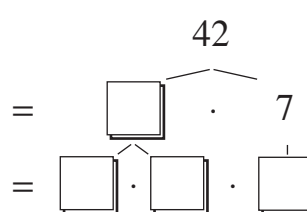


c) Express 68 as a product of prime numbers by completing the factor tree.

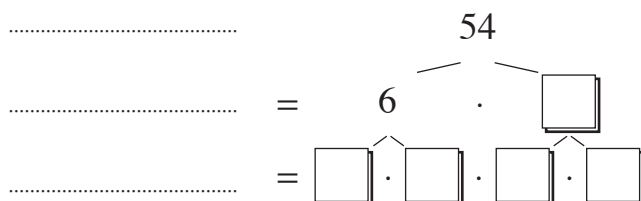
68 =



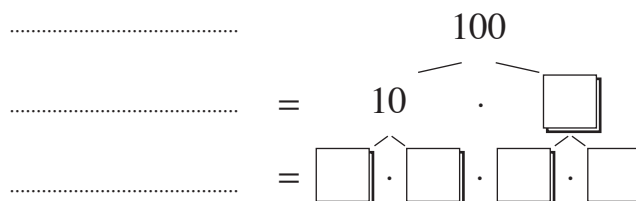
d) Express 42 as a product of prime numbers by completing the factor tree.



e) Express 54 as a product of prime numbers by completing the factor tree.



f) Express 100 as a product of prime numbers by completing the factor tree.



Skill 18.8 Expressing a number as a product of its prime factors using a factor tree (2).

- g)** Express 90 as a product of prime numbers by completing the factor tree.

$$\begin{aligned}
 90 &= \dots\dots\dots \\
 &= \begin{array}{c} 90 \\ \swarrow \quad \searrow \\ 9 \quad \cdot \quad \square \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ \square \quad \cdot \quad \square \quad \cdot \quad \square \quad \cdot \quad \square \end{array} \\
 &= \dots\dots\dots
 \end{aligned}$$

- h)** Express 150 as a product of prime numbers by completing the factor tree.

$$\begin{aligned}
 150 &= \dots\dots\dots \\
 &= \begin{array}{c} 150 \\ \swarrow \quad \searrow \\ 6 \quad \cdot \quad \square \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ \square \quad \cdot \quad \square \quad \cdot \quad \square \quad \cdot \quad \square \end{array} \\
 &= \dots\dots\dots
 \end{aligned}$$

- i)** Express 124 as a product of prime numbers by completing the factor tree.

$$\begin{aligned}
 &\dots\dots\dots \\
 &= \begin{array}{c} 124 \\ \swarrow \quad \searrow \\ 4 \quad \cdot \quad \square \\ \swarrow \quad \searrow \quad \swarrow \\ \square \quad \cdot \quad \square \quad \cdot \quad \square \end{array} \\
 &= \dots\dots\dots
 \end{aligned}$$

- j)** Express 36 as a product of prime numbers by completing the factor tree.

$$\begin{aligned}
 &\dots\dots\dots \\
 &= \begin{array}{c} 36 \\ \swarrow \quad \searrow \\ 3 \quad \cdot \quad \square \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ \square \quad \cdot \quad \square \quad \cdot \quad 4 \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ \square \quad \cdot \quad \square \quad \cdot \quad \square \quad \cdot \quad \square \end{array} \\
 &= \dots\dots\dots
 \end{aligned}$$

- k)** Express 96 as a product of prime numbers by completing the factor tree.

$$\begin{aligned}
 &= \begin{array}{c} 96 \\ \swarrow \quad \searrow \\ 6 \quad \cdot \quad \square \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ \square \quad \cdot \quad \square \quad \cdot \quad 4 \quad \cdot \quad \square \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ \square \quad \cdot \quad \square \quad \cdot \quad \square \quad \cdot \quad \square \quad \cdot \quad \square \end{array} \\
 &= \dots\dots\dots
 \end{aligned}$$

- l)** Express 144 as a product of prime numbers by completing the factor tree.

$$\begin{aligned}
 &= \begin{array}{c} 144 \\ \swarrow \quad \searrow \\ 12 \quad \cdot \quad \square \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ 3 \quad \cdot \quad \square \quad \cdot \quad 3 \quad \cdot \quad \square \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ \square \quad \cdot \quad \square \quad \cdot \quad \square \quad \cdot \quad \square \quad \cdot \quad \square \end{array} \\
 &= \dots\dots\dots
 \end{aligned}$$

- m)** Express 144 as a product of prime numbers by completing the factor tree.

$$\begin{aligned}
 &= \begin{array}{c} 144 \\ \swarrow \quad \searrow \\ 9 \quad \cdot \quad \square \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ \square \quad \cdot \quad \square \quad \cdot \quad 4 \quad \cdot \quad \square \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ \square \quad \cdot \quad \square \quad \cdot \quad \square \quad \cdot \quad \square \quad \cdot \quad \square \end{array} \\
 &= \dots\dots\dots
 \end{aligned}$$

- n)** Express 280 as a product of prime numbers by completing the factor tree.

$$\begin{aligned}
 &= \begin{array}{c} 280 \\ \swarrow \quad \searrow \\ 4 \quad \cdot \quad \square \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ \square \quad \cdot \quad \square \quad \cdot \quad 7 \quad \cdot \quad \square \\ \swarrow \quad \searrow \quad \swarrow \quad \searrow \quad \swarrow \quad \searrow \\ \square \quad \cdot \quad \square \quad \cdot \quad \square \quad \cdot \quad \square \end{array} \\
 &= \dots\dots\dots
 \end{aligned}$$

Skill 18.9 Expressing a number as a product of its prime factors using consecutive divisions.

- Find a prime number that divides evenly into the given number.
- Write this prime number next to the given number.
- Divide and write the result under the given number.
- Continue in this way until the result of the last division equals 1.
- Show all the resulting prime numbers as factors of the original number.

EITHER

- Use divisibility tests. (see Glossary, page 328)

Hints: All even numbers are divisible by 2

All numbers ending in 0 are divisible by 10 (2×5)

OR

- Use a factor tree.

(see skill 18.8, page 150)

Q. Express 84 as a product of its prime factors.

A. $84 \div 2 = 42$ Even numbers divide by 2 $84 \begin{array}{l} 2 \\ 2 \\ 3 \\ 7 \\ 1 \end{array}$

$42 \div 2 = 21$

$21 \div 3 = 7$ 21 divides evenly by 3

$\Rightarrow 84 = 2 \cdot 2 \cdot 3 \cdot 7$

a) Express 110 as a product of its prime factors.

$110 \div 2 = 55$

$55 \div 5 = 11$

110	2
55	5
11	11
1	

$110 = 2 \cdot 5 \cdot 11$

b) Express 65 as a product of its prime factors.

$65 \div$

65	
----	--

$65 =$

c) Express 69 as a product of its prime factors.

69

69	
----	--

$69 =$

d) Express 27 as a product of its prime factors.

27

27	
----	--

$27 =$

e) Express 124 as a product of its prime factors.

124	
-----	--

$124 =$

f) Express 198 as a product of its prime factors.

198	
-----	--

$198 =$

g) Express 81 as a product of its prime factors.

81	
----	--

$81 =$

h) Express 40 as a product of its prime factors.

40	
----	--

$40 =$

Skill 18.10 Expressing a number as a product of its prime factors using exponential notation.

- Express the number as a product of its prime factors. (see skill 18.8, page 150 and skill 18.9, page 152)
- Group like factors in ascending order.
- Use exponential notation to simplify like factors. (see skill 15.1, page 117)

Q. Express 126 as a product of its prime factors using exponential notation.

A. $126 \div 2 = 63$ ← 126 divides evenly by 2
 $63 \div 3 = 21$ ← 21 divides evenly by 3
 $21 \div 3 = 7$
 $126 = 2 \cdot 3 \cdot 3 \cdot 7$
 $\Rightarrow 126 = 2 \cdot 3^2 \cdot 7$

$$\begin{array}{r} 126 \overline{) 2} \\ 63 \overline{) 3} \\ 21 \overline{) 3} \\ 7 \overline{) 7} \\ 1 \end{array}$$

a) Express 136 as a product of its prime factors using exponential notation.

$$\begin{array}{l} 136 = 4 \cdot 34 \\ \dots\dots\dots \\ 4 = 2 \cdot 2 \\ \dots\dots\dots \\ 34 = 2 \cdot 17 \\ \dots\dots\dots \\ 136 = 2 \cdot 2 \cdot 2 \cdot 17 \end{array}$$

$$126 = 2^3 \cdot 17$$

b) Express 200 as a product of its prime factors using exponential notation.

$$200 \overline{) }$$

$$200 =$$

c) Express 360 as a product of its prime factors using exponential notation.

.....

$$360 =$$

d) Express 64 as a product of its prime factors using exponential notation.

.....

$$64 =$$

e) Express 900 as a product of its prime factors using exponential notation.

.....

$$900 =$$

f) Express 576 as a product of its prime factors using exponential notation.

.....

$$576 =$$

19. [Number Patterns]

Skill 19.1 Completing number patterns by adding the same number.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Look at consecutive terms of the pattern.
- Find the number and operation (in this case addition) used to get from one term to the next.
- Define the rule of the pattern.
- Apply this rule to the last given term and find the next two terms of the pattern.

Q. Complete the pattern:

2, 11, 20, 29, ,

A. 2, 11, 20, 29, ,

+9 +9 +9

Rule: Add 9 to each term.

$$29 + 9 = 38$$

$$38 + 9 = 47$$

2, 11, 20, 29, 38, 47

First note that each term in the pattern is increasing. Then find by how much.

a) Complete the pattern:

4, 8, 12, 16, ,

+4 +4 +4 +4 +4

$$16 + 4 = 20, \quad 20 + 4 = 24$$

b) Complete the pattern:

1, 4, 7, 10, 13, ,

+3 +3 +3 +3 +3 +3

c) Complete the pattern:

3, 8, 13, 18, 23, ,

d) Complete the pattern:

3, 5, 7, 9, 11, ,

e) Complete the pattern:

2, 5, 8, 11, ,

f) Complete the pattern:

3, 7, 11, 15, ,

g) Complete the pattern:

3, 11, 19, 27, ,

h) Complete the pattern:

2, 9, 16, 23, ,

i) Complete the pattern:

2, 8, 14, 20, ,

j) Complete the pattern:

5, 14, 23, 32, ,

Skill 19.2 Completing number patterns by subtracting the same number.

MMBlue 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Look at consecutive terms of the pattern.
- Find the number and operation (in this case subtraction) used to get from one term to the next.
- Define the rule of the pattern.
- Apply this rule to the last given term and find the next two terms of the pattern.

Q. Complete the pattern:

45, 36, 27, 18, ,

A. 45, 36, 27, 18, ,

$\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \\ -9 & -9 & -9 & \end{array}$

Rule: Subtract 9 from each term.

$$18 - 9 = 9$$

$$9 - 9 = 0$$

45, 36, 27, 18, 9, 0

First note that each term in the pattern is decreasing. Then find by how much.

a) Complete the pattern:

18, 15, 12, 9, ,

$\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ -3 & -3 & -3 & -3 \end{array}$

$$9 - 3 = 6,$$

$$6 - 3 = 3$$

b) Complete the pattern:

16, 14, 12, 10, 8, ,

$\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ -2 & -2 & -2 & -2 \end{array}$

c) Complete the pattern:

20, 17, 14, 11, 8, ,

d) Complete the pattern:

35, 30, 25, 20, 15, ,

e) Complete the pattern:

30, 26, 22, 18, 14, ,

f) Complete the pattern:

38, 32, 26, 20, ,

g) Complete the pattern:

98, 88, 78, 68, ,

h) Complete the pattern:

38, 31, 24, 17, ,

i) Complete the pattern:

42, 34, 26, 18, ,

j) Complete the pattern:

50, 41, 32, 23, ,

Skill 19.3 Completing number patterns by adding or subtracting decimal numbers.

- Look at consecutive terms of the pattern.
- Find the number and operation used to get from one term to the next.
- Define the rule of the pattern.
- Apply this rule to the last given term and find the next two terms of the pattern.

Q. Complete the pattern:

0.8, 1, 1.2, 1.4, ,

A. 0.8 , 1 , 1.2 , 1.4 , ,

$$+0.2 \quad +0.2 \quad +0.2$$

Rule: Add 0.2 to each term.

$$1.4 + 0.2 = 1.6$$

$$1.6 + 0.2 = 1.8$$

0.8 , 1 , 1.2 , 1.4 , 1.6 , 1.8

First note that each term in the pattern is increasing. Then find by how much.

a) Complete the pattern:

0.2, 0.8, 1.4, 2, ,

$$+0.6 \quad +0.6 \quad +0.6+0.6 \quad +0.6$$

.....
 $2 + 0.6 = 2.6, \quad 2.6 + 0.6 = 3.2$

b) Complete the pattern:

1.8, 1.5, 1.2, 0.9, ,

$$-0.3 \quad -0.3 \quad -0.3 \quad -0.3 \quad -0.3$$

d) Complete the pattern:

1, 1.5, 2, 2.5, ,

c) Complete the pattern:

1.5, 1.7, 1.9, 2.1, 2.3, ,

e) Complete the pattern:

1, 1.4, 1.8, 2.2, 2.6, ,

f) Complete the pattern:

3.1, 2.9, 2.7, 2.5, ,

g) Complete the pattern:

2.9, 2.6, 2.3, 2, ,

h) Complete the pattern:

1, 2.1, 3.2, 4.3, ,

Skill 19.4 Completing number patterns in table format by adding the same number.

- Look at consecutive terms of the pattern.
- Find the number and operation used to get from one term to the next.
- Define the rule of the pattern.
- Apply this rule to the last given term and find the next term of the pattern.

Q. Complete the table:

High-rise buildings

Number of floors	2	3	4	5	6
Number of rooms	4		10	13	

A. 4, ?, 10, 13, ?

+3

Rule: Add 3 to each term.

$$4 + 3 = 7$$

$$13 + 3 = 16$$

4, 7, 10, 13, 16

First note that each term in the pattern is increasing. Then find by how much.

High-rise buildings

Number of floors	2	3	4	5	6
Number of rooms	4	7	10	13	16

a) Complete the table:

Growth (mm)

fingernail	2	4	6	8	10
toenail	0.5	1	1.5	2	2.5

+0.5 +0.5 +0.5 +0.5

$$1.5 + 0.5 = 2, \quad 2 + 0.5 = 2.5$$

b) Complete the table:

Bouquets

White roses	2	4	6	8	10
Red roses	3	6	9		

+3 +3 +3

c) Complete the table:

Food Intake of a baby robin

Number of days	1	2	3	4	5	6
Length of worms (ft)	14	28	42	56		

d) Complete the table:

Calories consumed by children (9 - 13)

Number of calories ($\times 100$)	17	34			85
Number of days	1	2	3	4	5

e) Complete the table:

Rent

Number of bedrooms	1	2	3	4	5
Cost per week (\$)	200		350	425	

f) Complete the table:

Shark teeth regeneration (thousands)

Number of days	10	20	30	40	50	60
Teeth regenerated	3	3.6	4.2	4.8		

g) Complete the table:

Exercise program

Time (min)	10	15	20	25	30
Energy (cal)	240	280	320		

h) Complete the table:

Equilateral triangle

Side length	0.4	0.8	1.2	1.6	2	2.4
Perimeter	1.2	2.4	3.6			

Skill 19.5 Completing number patterns by multiplying by the same number.

MMBlue 11 2 33 44
MMGreen 11 2 33 44

- Look at consecutive terms of the pattern.
- Find the number and operation (in this case multiplication) used to get from one term to the next.
- Define the rule of the pattern.
- Apply this rule to the last given term and find the next two terms of the pattern.

Q. Complete the pattern:

$$\frac{1}{16}, \frac{1}{4}, 1, 4, \boxed{\quad, \quad}$$

A. $\frac{1}{16}, \frac{1}{4}, 1, 4, \underline{\quad}, \underline{\quad}$

$\begin{array}{ccccccc} & \nearrow & & \nearrow & & \nearrow & \\ & \times 4 & & \times 4 & & \times 4 & \\ & \searrow & & \searrow & & \searrow & \end{array}$

First note that each term in the pattern is increasing. Then find by how much.

Rule: Multiply each term by 4
 $4 \times 4 = 16$

$$16 \times 4 = 64$$

$$\frac{1}{16}, \frac{1}{4}, 1, 4, \underline{16}, \underline{64}$$

a) Complete the pattern:

$$2, 6, 18, 54, \boxed{162, 486}$$

$\begin{array}{ccccccc} & \nearrow & & \nearrow & & \nearrow & \\ & \times 3 & & \times 3 & & \times 3 & \\ & \searrow & & \searrow & & \searrow & \end{array}$

$$54 \times 3 = 162, \quad 162 \times 3 = 486$$

b) Complete the pattern:

$$1, 2, 4, 8, \boxed{\quad, \quad}$$

$\begin{array}{ccccccc} & \nearrow & & \nearrow & & \nearrow & \\ & \times 2 & & \times 2 & & \times 2 & \\ & \searrow & & \searrow & & \searrow & \end{array}$

c) Complete the pattern:

$$4, 12, 36, 108, \boxed{\quad, \quad}$$

d) Complete the pattern:

$$5, 15, 45, 135, \boxed{\quad, \quad}$$

e) Complete the pattern:

$$0.25, 0.5, 1, 2, \boxed{\quad, \quad}$$

f) Complete the pattern:

$$\frac{3}{4}, 3, 12, 48, \boxed{\quad, \quad}$$

g) Complete the pattern:

$$\frac{1}{16}, \frac{1}{8}, \frac{1}{4}, \frac{1}{2}, \boxed{\quad, \quad}$$

h) Complete the pattern:

$$\frac{2}{9}, \frac{2}{3}, 2, 6, \boxed{\quad, \quad}$$

i) Complete the pattern:

$$0.02, 0.1, 0.5, 2.5, \boxed{\quad, \quad}$$

j) Complete the pattern:

$$\frac{3}{1000}, \frac{3}{100}, \frac{3}{10}, 3, \boxed{\quad, \quad}$$

Skill 19.6 Completing number patterns by dividing by the same number.

- Look at consecutive terms of the pattern.
- Find the number and operation (in this case division) used to get from one term to the next.
- Define the rule of the pattern.
- Apply this rule to the last given term and find the next two terms of the pattern.

Q. Complete the pattern:

640, 320, 160, 80, ,

A. 640 , 320 , 160 , 80 , ,

$\begin{array}{c} \curvearrowright \\ \div 2 \end{array}$ $\begin{array}{c} \curvearrowright \\ \div 2 \end{array}$ $\begin{array}{c} \curvearrowright \\ \div 2 \end{array}$

Rule: Divide each term by 2.

$$80 \div 2 = 40$$

$$40 \div 2 = 20$$

640 , 320 , 160 , 80 , 40 , 20

First note that each term in the pattern is decreasing. Then find by how much.

a) Complete the pattern:

9375, 1875, 375, 75, ,

$\begin{array}{c} \curvearrowright \\ \div 5 \end{array}$ $\begin{array}{c} \curvearrowright \\ \div 5 \end{array}$ $\begin{array}{c} \curvearrowright \\ \div 5 \end{array}$ $\begin{array}{c} \curvearrowright \\ \div 5 \end{array}$ $\begin{array}{c} \curvearrowright \\ \div 5 \end{array}$

$$75 \div 5 = 15, \quad 15 \div 5 = 3$$

b) Complete the pattern:

128, 64, 32, 16, ,

$\begin{array}{c} \curvearrowright \\ \div 2 \end{array}$ $\begin{array}{c} \curvearrowright \\ \div 2 \end{array}$ $\begin{array}{c} \curvearrowright \\ \div 2 \end{array}$ $\begin{array}{c} \curvearrowright \\ \div 2 \end{array}$ $\begin{array}{c} \curvearrowright \\ \div 2 \end{array}$

c) Complete the pattern:

6250, 1250, 250, 50, ,

d) Complete the pattern:

640, 320, 160, 80, 40, ,

e) Complete the pattern:

1000, 100, 10, 1, 0.1, ,

f) Complete the pattern:

729, 243, 81, 27, ,

g) Complete the pattern:

3.2, 1.6, 0.8, 0.4, ,

h) Complete the pattern:

312.5, 62.5, 12.5, 2.5, ,

i) Complete the pattern:

70,000, 7000, 700, 70, ,

j) Complete the pattern:

512, 128, 32, 8, ,

Skill 19.7 Completing number patterns by using changing values in the rule.

- Look at consecutive terms of the pattern.
- Find the number and operation used to get from one term to the next.
- Define the rule of the pattern.
- Apply this rule to the last given term and find the next two terms of the pattern.

Q. Complete the pattern:

3, 6, 12, 21, 33, ,

A. 3, 6, 12, 21, 33, ,
 $\begin{array}{ccccccc} & \curvearrowright & & \curvearrowright & & \curvearrowright & & \curvearrowright \\ & +3 & & +6 & & +9 & & +12 \end{array}$

Rule: Add 3 then 6 then 9 etc. to each term.

(i.e. consecutive multiples of 3)

$$33 + 15 = 48$$

$$48 + 18 = 66$$

3, 6, 12, 21, 33, 48, 66

First note that each term in the pattern is increasing. Then find by how much.

a) Complete the pattern:

18, 20, 24, 30, 38, 48, 60
 $\begin{array}{ccccccc} & \curvearrowright & & \curvearrowright & & \curvearrowright & & \curvearrowright \\ & +2 & & +4 & & +6 & & +8 & & +10 & & +12 \end{array}$

$$38 + 10 = 48, \quad 48 + 12 = 60$$

b) Complete the pattern:

2, 6, 14, 26, 42, ,
 $\begin{array}{ccccccc} & \curvearrowright & & \curvearrowright & & \curvearrowright & & \curvearrowright \\ & +4 & & +8 & & +12 & & +16 & & +? & & +? \end{array}$

c) Complete the pattern:

49, 46, 40, 31, ,

d) Complete the pattern:

45, 33, 23, 15, 9, ,

e) Complete the pattern:

14, 13, 10, 9, 6, ,

f) Complete the pattern:

1, 3, 7, 9, 13, ,

g) Complete the pattern:

3, 4, 7, 12, 19, ,

h) Complete the pattern:

144, 100, 64, 36, ,

$$144 = 12^2, \quad 100 = 10^2, \quad 64 = 8^2$$

i) Complete the pattern:

1, 9, 25, 49, ,

j) Complete the pattern:

343, 216, 125, 64, ,

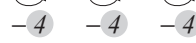
Skill 19.8 Completing number patterns involving negative integers by adding or subtracting the same integer.

- Look at consecutive terms of the pattern.
- Find the number and operation used to get from one term to the next.
- Define the rule of the pattern.
- Apply this rule to the last given term and find the next two terms of the pattern.

Q. Complete the pattern:

3, -1, -5, -9, ,

A. 3, -1, -5, -9, ,



Rule: Subtract 4 from each term.

$-9 - 4 = -13$

$-13 - 4 = -17$

3, -1, -5, -9, -13, -17

First note that each term in the pattern is decreasing. Then find by how much.

a) Complete the pattern:

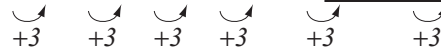
29, 21, 13, 5, -3, -11, -19



$-3 - 8 = -11$, $-11 - 8 = -19$

b) Complete the pattern:

-17, -14, -11, -8, -5, ,



c) Complete the pattern:

-22, -17, -12, -7, -2, ,

d) Complete the pattern:

1, -1, -3, -5, -7, ,

e) Complete the pattern:

10, 6, 2, -2, ,

f) Complete the pattern:

-13, -7, -1, 5, ,

g) Complete the pattern:

17, 8, -1, -10, ,

h) Complete the pattern:

-23, -16, -9, -2, ,

i) Complete the pattern:

7, 3, -1, -5, ,

j) Complete the pattern:

-23, -15, -7, 1, ,

Skill 19.9 Finding a term in a number pattern (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

EITHER

- Find the terms in order until you get to the desired term.

OR

- Draw up a table and match the term numbers with the given terms in the pattern.
- Use observation and trial and error to find a relationship between the term number and its value in the pattern.
- Based on this relationship, find the requested term in the pattern.

Q. Find the 8th term in the pattern:

8, 14, 20, 26, ...

A. 8, 14, 20, 26, ...
 $+6 \quad +6 \quad +6$

Rule: Add 6 to each term.

$$26 + 6 = 32$$

$$32 + 6 = 38$$

$$38 + 6 = 44$$

$$44 + 6 = 50$$

8, 14, 20, 26,, **50**

First note that each term in the pattern is increasing. Then find by how much. Count on.

OR

term number	1	2	3	4	.....	8
pattern	8	14	20	26		?
relationship	$6 \cdot 1 + 2$	$6 \cdot 2 + 2$	$6 \cdot 3 + 2$	$6 \cdot 4 + 2$		$6 \cdot 8 + 2$

Relationship: 6 times the term number + 2

The 8th term of the pattern is $6 \cdot 8 + 2 = 50$

a) Find the 14th term in the pattern:

1, 3, 5, 7, ...

27

term number	1	2	3	4	.....	14
pattern	1	3	5	7		27
relationship	$2 \cdot 1 - 1$	$2 \cdot 2 - 1$	$2 \cdot 3 - 1$	$2 \cdot 4 - 1$		$2 \cdot 14 - 1$

Relationship: 2 times the term number - 1

The 14th term of the pattern is $2 \cdot 14 - 1 = 27$

b) Find the 12th term in the pattern:

2, 3, 4, 5, ...

term number	1	2	3	4	.....	12
pattern	2	3	4	5		?
relationship	$1 + 1$					

Relationship:

The 12th term of the pattern is

c) Find the 20th term in the pattern:

2, 4, 6, 8, 10, ...

term number	1	2	3	4	.....	20
pattern	2	4	6	8		?
relationship						

Relationship:

The 20th term of the pattern is

d) Find the 15th term in the pattern:

5, 10, 15, 20, 25, ...

term number	1	2	3	4	.....	15
pattern	5	10	15	20		?
relationship						

Relationship:

The 15th term of the pattern is

Skill 19.9 Finding a term in a number pattern (2).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

e) Find the 18th term in the pattern:

14, 24, 34, 44, 54, ...

term number	1	2	3	4	.....	18
pattern	14	24	34	44		?
relationship						

Relationship:

.....

The 18th term of the pattern is

.....

f) Find the 10th term in the pattern:

1, 8, 27, 64, ...

term number	1	2	3	4	.....	10
pattern	1	8	27	64		?
relationship						

Relationship:

.....

The 10th term of the pattern is

.....

g) Find the 14th term in the pattern:

5, 7, 9, 11, 13, ...

term number	1	2	3	4	.....	14
pattern	5	7	9	11		?
relationship						

.....

.....

h) Find the 12th term in the pattern:

2, 5, 8, 11, 14, ...

term number	1	2	3	4	.....	12
pattern	2	5	8	11		?
relationship						

.....

.....

i) Find the 11th term in the pattern:

3, 7, 11, 15, 19, ...

term number	1	2	3	4	.....	11
pattern	3	7	11	15		?
relationship						

.....

.....

j) Find the 20th term in the pattern:

12, 14, 16, 18, ...

term number	1	2	3	4	.....	20
pattern	12	14	16	18		?
relationship						

.....

.....

k) Find the 10th term in the pattern:

 $\frac{1}{2}, \frac{1}{4}, \frac{1}{6}, \frac{1}{8}, \dots$

.....

.....

l) Find the 8th term in the pattern:

 $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{16}, \dots$

.....

.....

Skill 19.10 Finding a particular term of a sequence given its general rule.

- Identify the value of n for the requested term of the sequence.
Hint: If the 20th term needs to be found, the value of n is 20.
- Substitute the value of n in the formula for the general rule of the pattern.
- Calculate the value of the particular term of the sequence.

Q. If the general rule of a pattern is $15 + n$ find the 15th term ($n = 15$).

$$\begin{aligned} \text{A. } & 15 + n \\ & = 15 + 15 \quad \text{substitute } n = 15 \\ & = 30 \end{aligned}$$

a) If the general rule of a pattern is $n - 4$ find the 10th term ($n = 10$).

$$\begin{aligned} & n - 4 \\ & \dots\dots\dots \\ & = 10 - 4 = \boxed{6} \end{aligned}$$

b) If the general rule of a pattern is $n + 5$ find the 20th term ($n = 20$).

$$\begin{aligned} & n + 5 \\ & \dots\dots\dots \\ & = \dots\dots\dots = \boxed{} \end{aligned}$$

c) If the general rule of a pattern is $n - 8$ find the 13th term ($n = 13$).

$$\begin{aligned} & \dots\dots\dots \\ & \dots\dots\dots \\ & = \dots\dots\dots = \boxed{} \end{aligned}$$

d) If the general rule of a pattern is $n + 8$ find the 16th term ($n = 16$).

$$\begin{aligned} & \dots\dots\dots \\ & \dots\dots\dots \\ & = \dots\dots\dots = \boxed{} \end{aligned}$$

e) If the general rule of a pattern is $2n + 1$ find the 20th term ($n = 20$).

$$\begin{aligned} & \dots\dots\dots \\ & \dots\dots\dots \\ & = \dots\dots\dots = \boxed{} \end{aligned}$$

f) If the general rule of a pattern is $50 - 5n$ find the 6th term ($n = 6$).

$$\begin{aligned} & \dots\dots\dots \\ & \dots\dots\dots \\ & = \dots\dots\dots = \boxed{} \end{aligned}$$

g) If the general rule of a pattern is $5n + 7$ find the 9th term ($n = 9$).

$$\begin{aligned} & \dots\dots\dots \\ & \dots\dots\dots \\ & = \dots\dots\dots = \boxed{} \end{aligned}$$

h) If the general rule of a pattern is $14 - 2n$ find the 6th term ($n = 6$).

$$\begin{aligned} & \dots\dots\dots \\ & \dots\dots\dots \\ & = \dots\dots\dots = \boxed{} \end{aligned}$$

i) If the general rule of a pattern is $n^2 + 1$ find the 10th term ($n = 10$).

$$\begin{aligned} & \dots\dots\dots \\ & \dots\dots\dots \\ & = \dots\dots\dots = \boxed{} \end{aligned}$$

j) If the general rule of a pattern is $n^2 + 6$ find the 8th term ($n = 8$).

$$\begin{aligned} & \dots\dots\dots \\ & \dots\dots\dots \\ & = \dots\dots\dots = \boxed{} \end{aligned}$$

20. [Expressions]

Skill 20.1 Simplifying expressions by adding and subtracting like terms
(coefficient = 1).

MMBlue 11 22 33 44
MMGreen 11 22 33 44

- Add or subtract, as instructed, all like terms. (see Glossary, page 338)
- In your answer, write the coefficient (number) first followed by the variable (letter).
(see Glossary, pages 321 and 369)

Hint: In the term m , 1 is the coefficient: $m = 1 \cdot m$

Q. Simplify

$$kl + kl + kl - kl + kl$$

A. $kl + kl + kl \rightarrow \cancel{kl} + \cancel{kl}$

$$= 3kl$$

cancel first

a) Simplify
 $n + n + n + n$

coefficient first

$$4n$$

b) Simplify
 $a + a$

c) Simplify
 $u + u$

d) Simplify
 $t + t + t$

e) Simplify
 $w + w + w + w$

f) Simplify
 $z + z + z + z + z$

g) Simplify
 $x - x + x$

h) Simplify
 $b + b + b - b$

i) Simplify
 $e + e - e + e$

j) Simplify
 $k + k + k + k - k - k$

k) Simplify
 $p + p - p - p + p$

l) Simplify
 $c - c + c - c + c + c$

m) Simplify
 $ab + ab$

n) Simplify
 $hi + hi + hi$

o) Simplify
 $fg + fg + fg + fg$

p) Simplify
 $op + op + op + op$

q) Simplify
 $tu + tu + tu + tu + tu$

r) Simplify
 $uv + uv - uv + uv$

s) Simplify
 $ab - ab + ab + ab - ab$

t) Simplify
 $wx + wx - wx + wx + wx$

u) Simplify
 $de + de - de + de - de + de$

Skill 20.2 Simplifying expressions by adding and subtracting like terms
(coefficient ≥ 1).

- Add or subtract the coefficients (numbers) first.
 - Write the variable (letter) next.
- Hint: In the term m , 1 is the coefficient: $m = 1 \cdot m$*

Q. Simplify $7b - 2b + b$

A. $7b - 2b + b$
 $= 5b + b$
 $= 6b$

a) Simplify $3m + 2m$ $5m$ **b)** Simplify $2h + 4h$ **c)** Simplify $3g + 4g$

d) Simplify $3j + j$ **e)** Simplify $z + 5z$ **f)** Simplify $7e - 2e$

g) Simplify $5q - q$ **h)** Simplify $5a - 4a$ **i)** Simplify $3k - k$

j) Simplify $r + 2r + r$
 $= 3r + r$ **k)** Simplify $f + 2f + 4f$
 $=$ **l)** Simplify $3a + a + 2a$
 $=$

m) Simplify $y + y + 5y$
 $=$ **n)** Simplify $4m + 2m + m$
 $=$ **o)** Simplify $h + 5h + 3h$
 $=$

p) Simplify $j - j + 5j$
 $=$ **q)** Simplify $2c + 2c - c$
 $=$ **r)** Simplify $k + 5k - k$
 $=$

s) Simplify $op + 5op$
 $=$ **t)** Simplify $2ij - ij$
 $=$ **u)** Simplify $5de - 3de$
 $=$

Skill 20.3 Finding like terms.

- Look at the combination of letters in all terms.

EITHER

- Find the **like terms**, which use the same combination of letters.

Example: $4c$ and c
 gh and $3gh$

like terms

OR

- Find the **unlike terms**, which do not use the same combination of letters.

Example: $2k$ and $2w$
 $5w$ and w

unlike terms

Hint: The order of the letters in a term does not matter.
 $gh = hg$

Q. Choose the like terms:
 $3y, z, 2z$

A. $3y$ and z - are terms using different letters
 z and $2z$ - are terms using the same combination of letters
 $\Rightarrow z, 2z$

a) Choose the like terms:
 $4f, e, 2f$

$4f, 2f$

b) Choose the like terms:
 $c, 3, 3c$

c) Choose the like terms:
 $h, 2i, 3h$

d) Choose the like terms:
 $b, 3d, 3b$

e) Choose the like terms:
 $f, 3e, 3f$

f) Choose the like terms:
 $m, n, 4n$

g) Choose the like terms:
 $r, 5r, 2s$

h) Choose the like terms:
 $l, 2m, 3m$

i) Choose the like terms:
 $2w, 2x, 4x$

j) Choose the like terms:
 $k, 2jk, 2j, jk$

k) Choose the like terms:
 $ab, 2ab, 3b, 2a$

l) Choose the like terms:
 $2w, 2x, 4x, wx$

m) Choose the like terms:
 $h, 2hi, 4i, hi$

n) Choose the like terms:
 $d, 3de, 3d, 3e$

o) Choose the like terms:
 $5uv, v, 5v, u$

p) Choose the like terms:
 $n, 3o, 2no, no$

q) Choose the like terms:
 $a, 2b, 2ab, 2a$

r) Choose the like terms:
 $3st, s, 4t, st$

Skill 20.4 Simplifying expressions by first grouping like terms.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Group like terms. (see skill 20.3, page 169)
- Read the sign in front of each term.
- Add and/or subtract only the like terms.

Hint: Unlike terms cannot be added or subtracted.

Q. Simplify
 $p + p + q + p + q$

A. $p + p + q + p + q$
 $= p + p + p + q + q$ *group like terms*
 $= 3p + 2q$

a) Simplify
 $s + r + s$

$= s + s + r = \boxed{2s + r}$

b) Simplify
 $d + e + d$

$= \dots = \boxed{}$

c) Simplify
 $h + i + h$

$= \dots = \boxed{}$

d) Simplify
 $a + b + b + a$

$= \dots = \boxed{}$

e) Simplify
 $l + m + l + m$

$= \dots = \boxed{}$

f) Simplify
 $r + r + r + s$

$= \dots = \boxed{}$

g) Simplify
 $p + p + q + p$

$= \dots = \boxed{}$

h) Simplify
 $d + e + e + d$

$= \dots = \boxed{}$

i) Simplify
 $y + z + y + z$

$= \dots = \boxed{}$

j) Simplify
 $y + x + x + y + y$

$= \dots = \boxed{}$

k) Simplify
 $e + f + e + f + e$

$= \dots = \boxed{}$

l) Simplify
 $m + m + n - m + n$

$= \dots = \boxed{}$

m) Simplify
 $t + u + u - t + t$

$= \dots = \boxed{}$

n) Simplify
 $j + k - j - k + k$

$= \dots = \boxed{}$

o) Simplify
 $rs - rs + qr + qr + rs$

$= \dots = \boxed{}$

p) Simplify
 $cd - de + de + de + cd$

$= \dots = \boxed{}$

q) Simplify
 $4h - 2i + h + 3i$

$= \dots = \boxed{}$

r) Simplify
 $5j + 3k - 2j + 2k$

$= \dots = \boxed{}$

Skill 20.5 Writing expressions to represent word problems.

- Write the expression using the variables and/or the numbers mentioned in the word problem.
- Decide about the operation or operations needed in the expression.

Example: $a + b$ (sum of a and b), $4n$ (product of 4 and n), $m - 20$ (20 less than m)

Hint: "Sum, all together, in total, more than" \Rightarrow addition $\Rightarrow +$

"Difference, less than, change" \Rightarrow subtraction $\Rightarrow -$

"Product, times, lots of" \Rightarrow multiplication $\Rightarrow \cdot$

"A fraction (half, third, quarter) of" \Rightarrow division $\Rightarrow \div$

- Q.** Write as an expression:
A number that is equal to 4 less than c
- A.** *less than* $\Rightarrow -$
 $\Rightarrow c - 4$

- a)** Write as an expression:
The sum of n and n

and $\Rightarrow +$ \Rightarrow

- b)** Write as an expression:
The sum of b and b

\Rightarrow

- c)** Write as an expression:
The sum of e and f

\Rightarrow

- d)** Write as an expression:
The number 4 more than j

\Rightarrow

- e)** Write as an expression:
A number that is equal to 3 less than z

\Rightarrow

- f)** Write as an expression:
A number that is equal to 5 less than v

\Rightarrow

- g)** Write as an expression:
A number that is equal to 3 times m

\Rightarrow

- h)** Write as an expression:
A number that is equal to 2 times d

\Rightarrow

- i)** Write as an expression:
A number that is equal to twice as much as h

\Rightarrow

- j)** Write as an expression:
A number that is equal to three times as much as m

\Rightarrow

- k)** A person grows 2 cm every year for y years. How much did he grow?

\Rightarrow

- l)** Write as an expression:
Seven lots of z

\Rightarrow

21. [Substitution]

Skill 21.1 Substituting one value into expressions involving + and -

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Substitute the letters with numbers.
- Use the order of operations rule: Add (+) and/or subtract (-) from left to right.

Q. If $a = 5$, find the value of $13 - a$

A. $13 - a$ ← substitute $a = 5$
 $= 13 - 5$
 $= 8$

a) If $p = 2$, find the value of $5 + p$

$= 5 + 2 = \boxed{7}$

b) If $f = 3$, find the value of $6 + f$

$= \dots = \boxed{}$

c) If $c = 4$, find the value of $4 + c$

$= \dots = \boxed{}$

d) If $m = 5$, find the value of $m + 3$

$= \dots = \boxed{}$

e) If $g = 7$, find the value of $g + 2$

$= \dots = \boxed{}$

f) If $z = 6$, find the value of $z + 1$

$= \dots = \boxed{}$

g) If $x = 3$, find the value of $x + x$

$= \dots = \boxed{}$

h) If $v = 4$, find the value of $v + v$

$= \dots = \boxed{}$

i) If $q = 7$, find the value of $q + q$

$= \dots = \boxed{}$

j) If $t = 5$, find the value of $t + t + t$

$= \dots = \boxed{}$

k) If $e = 6$, find the value of $e + e + e$

$= \dots = \boxed{}$

l) If $p = 8$, find the value of $p + p + p$

$= \dots = \boxed{}$

m) If $j = 9$, find the value of $j + j - 8$

$= \dots = \boxed{}$

n) If $k = 7$, find the value of $k + k + 6$

$= \dots = \boxed{}$

o) If $h = 8$, find the value of $4 + h + h$

$= \dots = \boxed{}$

p) If $m = 8$, find the value of $m + m - 9$

$= \dots = \boxed{}$

q) If $s = 6$, find the value of $9 + s + s$

$= \dots = \boxed{}$

r) If $n = 5$, find the value of $8 + n + n$

$= \dots = \boxed{}$

Skill 21.2 Substituting one value into expressions involving \cdot and $+$

- Substitute the letters with numbers.
- Use the order of operations rule: Multiply (\cdot) and/or divide (\div) from left to right.

Q. If $m = 4$, find the value of $6m$

A. $6m$ \leftarrow substitute $m = 4$
 $= 6 \cdot 4$
 $= 24$

a) If $a = 6$, find the value of $9 \cdot a$

$= 9 \cdot 6$ $=$

b) If $n = 4$, find the value of $3 \cdot n$

$=$

c) If $y = 5$, find the value of $2 \cdot y$

$=$

d) If $w = 7$, find the value of $w \cdot 3$

$=$

e) If $p = 8$, find the value of $4 \cdot p$

$=$

f) If $z = 6$, find the value of $7 \cdot z$

$=$

g) If $a = 3$, find the value of $8a$

$=$

h) If $h = 2$, find the value of $9h$

$=$

i) If $n = 5$, find the value of $7n$

$=$

j) If $m = 32$, find the value of $m \div 4$

$=$

k) If $n = 7$, find the value of $42 \div n$

$=$

l) If $k = 3$, find the value of $36 \div k$

$=$

m) If $d = 9$, find the value of $81 \div d$

$=$

n) If $p = 8$, find the value of $64 \div p$

$=$

o) If $i = 6$, find the value of $42 \div i$

$=$

p) If $m = 7$, find the value of $56 \div m$

$=$

q) If $e = 20$, find the value of $\frac{e}{5}$

$=$

r) If $w = 9$, find the value of $\frac{108}{w}$

$=$

Skill 21.3 Substituting one value into expressions involving +, −, · and ÷

- Substitute the variable (letter) with the given value.
- Use the order of operations rules: First multiply (·) and/or divide (÷) from left to right. Finally add (+) and/or subtract (−) from left to right.

Q. If $q = 8$, find the value of $4q + 2$

A. $4q + 2$ substitute $q = 8$
 $= 4 \cdot 8 + 2$
 $= 32 + 2$
 $= 34$

a) If $w = 6$, find the value of $20 - 3w$

$= 20 - 3 \cdot 6$ Do × first
 $= 20 - 18 = \boxed{2}$

b) If $x = 2$, find the value of $5x + 1$

$=$
 $=$ $=$ $\boxed{}$

c) If $m = 3$, find the value of $2 + 3m$

$=$
 $=$ $=$ $\boxed{}$

d) If $x = 5$, find the value of $12 + 5x$

$=$
 $=$ $=$ $\boxed{}$

e) If $a = 10$, find the value of $15 + 3a$

$=$
 $=$ $=$ $\boxed{}$

f) If $b = 7$, find the value of $2b + 9$

$=$
 $=$ $=$ $\boxed{}$

g) If $s = 3$, find the value of $7 + 11s$

$=$
 $=$ $=$ $\boxed{}$

h) If $v = 4$, find the value of $9v - 8$

$=$
 $=$ $=$ $\boxed{}$

i) If $h = 4$, find the value of $3h - 7$

$=$
 $=$ $=$ $\boxed{}$

j) If $k = 7$, find the value of $35 - 4k$

$=$
 $=$ $=$ $\boxed{}$

k) If $w = 2$, find the value of $8w - 5$

$=$
 $=$ $=$ $\boxed{}$

l) If $u = 5$, find the value of $21 - 3u$

$=$
 $=$ $=$ $\boxed{}$

m) If $e = 9$, find the value of

$\frac{e + 15}{8}$
 $=$
 $=$ $=$ $\boxed{}$

n) If $s = 3$, find the value of

$\frac{s + 4}{7}$
 $=$
 $=$ $=$ $\boxed{}$

o) If $c = 3$, find the value of

$\frac{19 - c}{4}$
 $=$
 $=$ $=$ $\boxed{}$

Skill 21.4 Substituting negative values into expressions.

MMBlue 1 1 2 3 3 4 4
MMGreen 1 1 2 3 3 4 4

- Substitute the variable (letter) with the given value.
- Use the order of operations rules: First multiply (\cdot) and/or divide (\div) from left to right. Finally add ($+$) and/or subtract ($-$) from left to right.
- Determine the sign of the result. (see skills 13.7 to 13.10, pages 98 to 101)

Q. If $z = -5$,
find the value of
 $z - 9$

A. $z - 9$ *substitute $z = -5$*
 $= -5 - 9$
 $= -14$

a) If $e = -12$, find the
value of $19 + e$

$$= 19 + (-12) = \boxed{7}$$

*19 has greatest absolute value
19 is positive $\Rightarrow +7$*

b) If $y = -3$, find the
value of $9y$

$$= \dots = \boxed{}$$

c) If $r = -2$, find the
value of $6r$

$$= \dots = \boxed{}$$

d) If $n = -7$, find the
value of $n + 8$

$$= \dots = \boxed{}$$

e) If $z = -9$, find the
value of $4 - z$

$$= \dots = \boxed{}$$

f) If $h = -6$, find the
value of $8 + h$

$$= \dots = \boxed{}$$

g) If $j = -2$, find the
value of $8 - j$

$$= \dots = \boxed{}$$

h) If $v = -8$, find the
value of $v - 5$

$$= \dots = \boxed{}$$

i) If $b = -5$, find the
value of $7 + b$

$$= \dots = \boxed{}$$

j) If $b = -9$, find the
value of $4b$

$$= \dots = \boxed{}$$

k) If $f = -3$, find the
value of $-7f$

$$= \dots = \boxed{}$$

l) If $i = -6$, find the
value of $-5i$

$$= \dots = \boxed{}$$

m) If $a = -12$, find the
value of $\frac{a}{4}$

$$= \dots = \boxed{}$$

n) If $e = -21$, find the
value of $\frac{e}{3}$

$$= \dots = \boxed{}$$

o) If $c = -32$, find the
value of $\frac{c}{8}$

$$= \dots = \boxed{}$$

p) If $s = -4$, find the
value of $2 + 3s$

$$= \dots = \boxed{}$$

q) If $q = -3$, find the
value of $7q - 5$

$$= \dots = \boxed{}$$

r) If $x = -9$, find the
value of $5 - 2x$

$$= \dots = \boxed{}$$

Skill 21.5 Substituting two values into expressions involving + and -

MMBlue 11 2 2 3 3 4 4
MMGreen 11 2 2 3 3 4 4

- Substitute the variables (letters) with the given values.
- Use the order of operations rule: Add (+) and/or subtract (-) from left to right.
- Determine the sign of the result. (see skills 13.7 to 13.10, pages 98 to 101)

Q. If $h = 5$ and $i = -12$,
find the value of $h + i$

A. $h + i$ *substitute $h = 5$ and $i = -12$*
 $= 5 + (-12)$
 $= -7$

a) If $s = 9$ and $t = 8$,
find the value of $s + t$

$= 9 + 8$ $=$

b) If $m = 3$ and $n = 7$,
find the value of $m + n$

$=$ $=$

c) If $i = 10$ and $j = 4$,
find the value of $i + j$

$=$ $=$

d) If $y = 0$ and $z = 12$,
find the value of $y + z$

$=$ $=$

e) If $k = 14$ and $l = 6$,
find the value of $k - l$

$=$ $=$

f) If $g = 13$ and $h = 7$,
find the value of $g - h$

$=$ $=$

g) If $p = 13$ and $q = 11$,
find the value of $p + q$

$=$ $=$

h) If $n = 5$ and $o = 8$,
find the value of $n - o$

$=$ $=$

i) If $a = 6$ and $b = 14$,
find the value of $a - b$

$=$ $=$

j) If $h = 5$ and $i = -12$,
find the value of $h + i$

$=$ $=$

k) If $v = -8$ and $w = 9$,
find the value of $v - w$

$=$ $=$

l) If $f = -7$ and $g = 3$,
find the value of $f - g$

$=$ $=$

m) If $r = 2$ and $s = -11$,
find the value of $r - s$

$=$ $=$

n) If $a = -5$ and $b = 7$,
find the value of $a - b$

$=$ $=$

o) If $q = 6$ and $r = -16$,
find the value of $q + r$

$=$ $=$

p) If $t = 0$ and $u = 6$,
find the value of $t - u$

$=$ $=$

q) If $v = -14$ and $w = 8$,
find the value of $v + w$

$=$ $=$

r) If $w = 7$ and $x = -9$,
find the value of $w - x$

$=$ $=$

Skill 21.6 Substituting two values into expressions involving \cdot and \div

- Substitute the letters (variables) with the given values.
- Use the order of operations rules: Multiply (\cdot) and/or divide (\div) from left to right.
- Determine the sign of the result. (see skills 13.7 to 13.10, pages 98 to 101)

Q. If $q = 6$ and $r = 8$,
find the value of qr

A. qr — substitute $q = 6$ and $r = 8$
 $= 6 \cdot 8$
 $= 48$

a) If $e = 3$ and $f = 7$,
find the value of $e \cdot f$

$= 3 \cdot 7$ =

b) If $n = 4$ and $o = 2$,
find the value of $n \cdot o$

$=$ =

c) If $b = 10$ and $c = 3$,
find the value of $b \cdot c$

$=$ =

d) If $y = 2$ and $z = 9$,
find the value of yz

$=$ =

e) If $g = 11$ and $h = 4$,
find the value of gh

$=$ =

f) If $l = 3$ and $m = 13$,
find the value of lm

$=$ =

g) If $s = 5$ and $t = 6$,
find the value of st

$=$ =

h) If $w = 5$ and $x = 8$,
find the value of wx

$=$ =

i) If $d = 7$ and $e = 0$,
find the value of de

$=$ =

j) If $w = 30$ and $x = 5$,
find the value of $w \div x$

$=$ =

k) If $v = 45$ and $w = 9$,
find the value of $v \div w$

$=$ =

l) If $u = 22$ and $v = -2$,
find the value of $u \div v$

$=$ =

m) If $a = 54$ and $b = 6$, find
the value of $\frac{a}{b}$

$=$ =

n) If $c = 72$ and $d = 9$, find
the value of $\frac{c}{d}$

$=$ =

o) If $k = 63$ and $l = 7$, find
the value of $\frac{k}{l}$

$=$ =

p) If $l = 0$ and $m = 14$,
find the value of $9lm$

$=$ =

q) If $k = 4$ and $l = -2$,
find the value of $8kl$

$=$ =

r) If $d = 5$ and $e = 3$,
find the value of $7de$

$=$ =

Skill 21.7 Substituting two values into expressions involving +, −, · and ÷

- Substitute the variables (letters) with the given values.
- Use the order of operations rules: First multiply (·) and/or divide (÷) from left to right. Finally add (+) and/or subtract (−) from left to right.
- Determine the sign of the result. (see skills 13.7 to 13.10, pages 98 to 101)

Q. If $m = 8$ and $n = 9$,
find the value of
 $m - 5 - n$

A. $m - 5 - n$ *substitute $m = 8$ and $n = 9$*
 $= 8 - 5 - 9$
 $= 3 - 9$
 $= -6$

a) If $t = 6$ and $u = 7$,
find the value of
 $2t + u$

$= 2 \cdot 6 + 7$
 $= 12 + 7$ *Do × first* $= \boxed{19}$

b) If $d = 8$ and $e = 3$,
find the value of
 $16 - d + e$

$=$
 $=$ $= \boxed{}$

c) If $h = 3$ and $i = 7$,
find the value of
 $11 + h - i$

$=$
 $=$ $= \boxed{}$

d) If $i = 5$ and $j = 6$,
find the value of
 $3ij$

$=$
 $=$ $= \boxed{}$

e) If $a = 3$ and $b = 0$,
find the value of
 $8ab$

$=$
 $=$ $= \boxed{}$

f) If $m = 4$ and $n = 1$,
find the value of
 $3m - n$

$=$
 $=$ $= \boxed{}$

g) If $m = 3$ and $n = 2$,
find the value of
 $4m - 2n$

$=$
 $=$ $= \boxed{}$

h) If $b = 7$ and $c = -5$,
find the value of
 $2bc + 30$

$=$
 $=$ $= \boxed{}$

i) If $g = 2$ and $h = 9$,
find the value of
 $-2gh + 2h$

$=$
 $=$ $= \boxed{}$

j) If $a = 6$ and $b = 3$,
find the value of
 $-4a + 5b$

$=$
 $=$ $= \boxed{}$

k) If $y = 3$ and $z = 2$,
find the value of
 $\frac{9-y}{z}$

$=$
 $=$ $= \boxed{}$

l) If $g = -2$ and $h = 15$,
find the value of
 $\frac{h-7}{g}$

$=$
 $=$ $= \boxed{}$

Skill 21.8 Substituting into expressions involving powers.

MMBlue 11 22 33 44
MMGreen 11 22 33 44

- Substitute the variables (letters) with the given values.
- Use the order of operations rules: First evaluate all powers.
Then multiply (\cdot) and/or divide (\div) from left to right.
Finally add ($+$) and/or subtract ($-$) from left to right.
- Determine the sign of the result. (see skills 13.7 to 13.10, pages 98 to 101)

Q. If $i = 4$,
find the value of
 $2i^2 - i$

A. $2i^2 - i$ *substitute $i = 4$*
 $= 2(4 \cdot 4) - 4$
 $= 2 \cdot 16 - 4$
 $= 32 - 4$
 $= 28$

a) If $x = 5$,
find the value of
 $40 - x^2$

$= 40 - 5 \cdot 5$ *multiply first*
 $= 40 - 25 = \boxed{15}$

b) If $j = 8$,
find the value of
 j^2

$= \dots = \boxed{}$

c) If $m = 3$,
find the value of
 $8 + m^2$

$= \dots = \boxed{}$

d) If $c = 5$,
find the value of
 $4c^2$

$= \dots = \boxed{}$

e) If $d = 7$,
find the value of
 $d^2 - 9$

$= \dots = \boxed{}$

f) If $k = 4$,
find the value of
 $23 - k^2$

$= \dots = \boxed{}$

g) If $z = 6$,
find the value of
 $2z^2 - 32$

$= \dots = \boxed{}$

h) If $y = 10$,
find the value of
 $2y^2 + y$

$= \dots = \boxed{}$

i) If $b = 4$,
find the value of
 $3b^2 + 7$

$= \dots = \boxed{}$

j) If $t = 3$,
find the value of
 $4t^2 + t$

$= \dots = \boxed{}$

k) If $e = 7$,
find the value of
 $-2e^2$

$= \dots = \boxed{}$

l) If $n = 6$,
find the value of
 $\frac{n^2 - 6}{5}$

$= \dots = \boxed{}$

Skill 21.9 Substituting into expressions with brackets.

- Substitute the variables (letters) with the given values.
- Use the order of operations rules: First evaluate inside the brackets.
Then multiply (\cdot) and/or divide (\div) from left to right.
Finally add ($+$) and/or subtract ($-$) from left to right.
- Determine the sign of the result. (see skills 13.7 to 13.10, pages 98 to 101)

Q. If $r = 5$, find the value of $4(r - 2)$

A. $4(r - 2)$ *substitute $r = 5$*
 $= 4(5 - 2)$
 $= 4 \cdot 3$
 $= 12$

a) If $h = 2$, find the value of $3(5 + h)$

$= 3(5 + 2)$ *Do () first*
 $= 3 \cdot 7$ $= \boxed{21}$

b) If $z = 6$, find the value of $4(12 - z)$

$=$
 $=$ $= \boxed{}$

c) If $s = 3$, find the value of $s(7 + s)$

$=$
 $=$ $= \boxed{}$

d) If $a = 7$, find the value of $5(a + 5)$

$=$
 $=$ $= \boxed{}$

e) If $r = 5$, find the value of $4(r - 2)$

$=$
 $=$ $= \boxed{}$

f) If $r = 9$, find the value of $r(2 + r)$

$=$
 $=$ $= \boxed{}$

g) If $q = 2$, find the value of $9(q + 8)$

$=$
 $=$ $= \boxed{}$

h) If $k = 4$, find the value of $k(k - 8)$

$=$
 $=$ $= \boxed{}$

i) If $h = -5$, find the value of $4(h - 2)$

$=$
 $=$ $= \boxed{}$

j) If $f = 9$, find the value of $6(f + 6)$

$=$
 $=$ $= \boxed{}$

k) If $p = 6$, find the value of $p(2 - p)$

$=$
 $=$ $= \boxed{}$

l) If $e = -2$, find the value of $e(e - 7)$

$=$
 $=$ $= \boxed{}$

Skill 21.10 Substituting into formulae.

MMBlue 11 22 33 44
MMGreen 11 22 33 44

- Substitute the variables (letters) with the given values.
- Use the order of operations rules: First evaluate all powers.
Then multiply (\cdot) and/or divide (\div) from left to right.
Finally add ($+$) and/or subtract ($-$) from left to right.
- Determine the sign of the result. (see skills 13.7 to 13.10, pages 98 to 101)

Q. Use $A = lw$ to find the area (A) of a rectangle where $l = 3$ and $w = 7$

A. $A = lw$ — substitute $l = 3$ and $w = 7$
 $= 3 \cdot 7$
 $= 21$

- a)** Use $F = ma$ to find the force (F) where $m = 5$ and $a = 11$

$$F = 5 \cdot 11 = \boxed{55}$$

- b)** Use $P = 5l$ to find the perimeter (P) of a regular pentagon where $l = 12$

$$P = 5 \cdot 12 = \boxed{}$$

- c)** Use $V = Bh$ to find the volume (V) of a prism where $B = 12$ and $h = 4$

$$V = 12 \cdot 4 = \boxed{}$$

- d)** Use $A = l^2$ to find the area (A) of a square where $l = 9$

$$A = 9^2 = \boxed{}$$

- e)** Use $A = \frac{ab}{2}$ to find the area (A) of a kite where $a = 8$ and $b = 7$

$$A = \frac{8 \cdot 7}{2} = \boxed{}$$

- f)** Use $D = rt$ to find the distance (D) where $r = 55$ and $t = 2$

$$D = 55 \cdot 2 = \boxed{}$$

- g)** Use $A = bh$ to find the area (A) of a parallelogram where $b = 4.5$ and $h = 4$

$$A = 4.5 \cdot 4 = \boxed{}$$

- h)** Use $P = 8l$ to find the perimeter (P) of an octagon where $l = 2.5$

$$P = 8 \cdot 2.5 = \boxed{}$$

- i)** Use $A = \frac{1}{2} h(a + b)$ to find the area (A) of a trapezoid where $h = 4$, $a = 7$ and $b = 3$

$$A = \frac{1}{2} \cdot 4 \cdot (7 + 3) = \boxed{}$$

- j)** Use $V = l^2h$ to find the volume (V) of a square prism where $l = 5$ and $h = 4$

$$V = 5^2 \cdot 4 = \boxed{}$$

- k)** Use $V = l^3$ to find the volume (V) of a cube where $l = 5$

$$V = 5^3 = \boxed{}$$

- l)** Use $A = \pi r^2$ to find the area (A) of a circle where $\pi \approx 3.14$ and $r = 10$

$$A = 3.14 \cdot 10^2 = \boxed{}$$

22. [Equations]

continues on page 184

Skill 22.1 Finding the missing number in equations involving + and - (1).

MMBlue 11 2 2 3 3 4 4
MMGreen 11 2 2 3 3 4 4

EITHER

Use **trial and error**:

- Guess the value of the missing number that will make the equation true (both sides of the equation are equal).
- Substitute this value in the equation.
- Check if the equation is true.
- Write the guessed value as the solution of the equation.

Example:

$$4 + \boxed{?} = 12$$

$$4 + 8 = 12$$

$$12 = 12 \text{ (true)}$$

The equation is true, so **8** is the solution.

OR

Use **inverse operations**:

- Consider the operation used to construct the sum or the difference.
- Get the missing number alone on one side of the equation, by performing the inverse operation to both sides of the equation.
- Evaluate the other side of the equation.

Hints: Addition and subtraction are inverse operations. Adding 4 and then subtracting 4 leaves a number unchanged.

Example: $4 + \boxed{?} = 12$

$$4 + ? - 4 = 12 - 4$$

$$? = 8$$

Q. $15 - \boxed{} = 9$ **A.** $15 - ? = 9$ OR $\textcircled{15} - ? = 9$ If 15 was added to the missing number, then do the inverse operation and subtract 15 from both sides of the equation. Finally, reverse the signs on both sides.

What number subtracted from 15 gives 9? $15 - 6 = 9$ $\cancel{15} - \cancel{15} - ? = 9 - 15$ $-? = -6$ $? = 6$

Guess ? = 6 $9 = 9 \text{ (true)}$ *The solution is 6.*

<p>a) $16 - \boxed{7} = 9$ <i>Use trial and error</i> $16 - ? = 9$ <hr/> $? = 7$</p>	<p>b) $7 + \boxed{} = 15$ $7 + ? = 15$ <hr/> $? =$</p>	<p>c) $\boxed{} + 24 = 30$ $? + 24 = 30$ <hr/> $? =$</p>
<p>d) $14 - \boxed{} = 6$ <hr/> $? =$</p>	<p>e) $13 - \boxed{} = 3$ <hr/> $? =$</p>	<p>f) $8 + \boxed{} = 21$ <hr/> $? =$</p>
<p>g) $\boxed{} + 8 = 20$ <hr/> $? =$</p>	<p>h) $14 + \boxed{} = 21$ <hr/> $? =$</p>	<p>i) $\boxed{} - 8 = 13$ <hr/> $? =$</p>

Skill 22.1 Finding the missing number in equations involving + and - (2).

MMBlue 1 1 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

Operation: +18

Use inverse operations

j) $18 + \boxed{9} = 27$

$$\cancel{18} + ? - \cancel{18} = 27 - 18$$

$$? = 9$$

k) $\boxed{} + 18 = 40$

$$? + \cancel{18} - \cancel{18} = 40 - 18$$

$$? =$$

l) $\boxed{} + 20 = 25$

$$? =$$

m) $\boxed{} + 6 = 23$

n) $4 + \boxed{} = 20$

o) $16 + \boxed{} = 27$

p) $15 + \boxed{} = 29$

q) $\boxed{} + 16 = 34$

r) $\boxed{} + 18 = 38$

s) $\boxed{} - 7 = 18$

t) $\boxed{} - 18 = 15$

u) $\boxed{} - 13 = 14$

v) $\boxed{} - 31 = 4$

w) $12 - \boxed{} = 3$

x) $16 - \boxed{} = 9$

y) $24 - \boxed{} = 9$

z) $\boxed{} - 8 = 16$

zz) $\boxed{} - 8 = 12$

Skill 22.2 Finding the missing number in equations involving \cdot (1).

MMBlue 1 1 22 33 44
MMGreen 1 1 22 33 44

EITHER

Use **trial and error**:

- Guess the value of the missing number that will make the equation true (both sides of the equation are equal).
- Substitute this value in the equation.
- Check if the equation is true.
- Write the guessed value as the solution of the equation.

Example:

$$4 \times \boxed{?} = 12$$

$$4 \times 3 = 12$$

$$12 = 12 \text{ (true)}$$

The equation is true, so **3** is the solution.

OR

Use **inverse operations**:

- Consider the operation used to construct the multiplication or the division.
- Get the missing number alone on one side of the equation, by performing the inverse operation to both sides of the equation.
- Evaluate the other side of the equation.

Hints: Multiplication and division are inverse operations. Multiplying by 4 and then dividing by 4 leaves a number unchanged.

Example: $4 \times \boxed{?} = 12$

$$4 \times ? \div 4 = 12 \div 4$$

$$? = 3$$

Q. $\boxed{} \times 20 = 100$ **A.** $? \times 20 = 100$ *OR* $? \times 20 = 100$ If 20 was multiplied by the missing number, then do the inverse operation and divide by 20 both sides of the equation.

What number multiplied by 20 gives 100? $5 \times 20 = 100$ $? \times \cancel{20} \div \cancel{20} = 100 \div 20$

Guess ? = 5 $100 = 100$ (true) $? = 5$

The solution is 5.

Use trial and error

a) $9 \times \boxed{7} = 63$

$$9 \times ? = 63$$

$$? = 7$$

b) $10 \times \boxed{} = 40$

$$10 \times ? = 40$$

$$? =$$

c) $\boxed{} \times 8 = 64$

$$? =$$

d) $\boxed{} \times 4 = 24$

$$? =$$

e) $4 \times \boxed{} = 20$

$$? =$$

f) $7 \times \boxed{} = 56$

$$? =$$

g) $6 \times \boxed{} = 12$

$$? =$$

h) $\boxed{} \times 7 = 42$

$$? =$$

i) $\boxed{} \times 8 = 72$

$$? =$$

Skill 22.2 Finding the missing number in equations involving \cdot (2).MMBlue 1 2 2 3 3 4 4
MMGreen 1 2 2 3 3 4 4Operation: $\times 6$

Use inverse operations

j) $6 \times \boxed{5} = 30$

Inverse of $\times 6$ is $\div 6$

~~$6 \times ? \div 6 = 30 \div 6$~~

$? = 5$

k) $\boxed{} \times 5 = 60$

~~$? \times 5 \div 5 = 60 \div 5$~~

$? =$

l) $\boxed{} \times 12 = 72$

$? =$

m) $\boxed{} \times 5 = 55$

n) $13 \times \boxed{} = 39$

o) $9 \times \boxed{} = 360$

p) $\boxed{} \times 14 = -28$

q) $-8 \times \boxed{} = -24$

r) $-4 \times \boxed{} = -28$

s) $\boxed{} \times 10 = -30$

t) $-9 \times \boxed{} = -81$

u) $-7 \times \boxed{} = 63$

v) $-9 \times \boxed{} = 18$

w) $\boxed{} \times 5 = -35$

x) $-8 \times \boxed{} = -88$

y) $\boxed{} \times (-3) = -75$

z) $\boxed{} \times (-8) = 16$

zz) $-7 \times \boxed{} = 49$

Skill 22.3 Finding the missing number in equations involving fractions (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

EITHER

Use **trial and error**:

- Guess the value of the missing number that will make the equation true (both sides of the equation are equal).
- Substitute this value in the equation.
- Check if the equation is true.
- Write the guessed value as the solution of the equation.

Hint: “of” means multiplication, so use “×”

Example:

$$\frac{1}{4} \text{ of } \boxed{?} = 3$$

$$\frac{1}{4} \times \overset{3}{\cancel{12}} = 3$$

$$\overset{3}{\cancel{4}} \times 3 = 3 \text{ (true)}$$

The equation is true, so **12** is the solution.

OR

Use **inverse operations**:

- Consider the operation used to construct the division.
- Get the missing number alone on one side of the equation, by performing the inverse operation to both sides of the equation.
- Evaluate the other side of the equation.

Hints: *Multiplication and division are inverse operations. Multiplying by $\frac{1}{4}$ (which is the same as dividing by 4) and then multiplying by 4 leaves a number unchanged.*

Example: $\frac{1}{4} \times \boxed{?} = 3$

$$\overset{1}{\cancel{4}} \times ? \times \cancel{4} = 3 \times 4$$

$$? = 12$$

Q. $\frac{3}{5}$ of $\boxed{} = 21$

A. $\frac{3}{5}$ of ? = 21

OR

$\left(\frac{3}{5}\right)$ of ? = 21

If the missing number has been divided by 5 and then multiplied by 3, then do the inverse operations and multiply by 5 and then divide by 3 both sides of the equation.

What number multiplied by $\frac{3}{5}$ gives 21?

Guess ? = 30

Guess ? = 35

$$\frac{3}{5} \times \overset{6}{\cancel{30}} = 21$$

$$\frac{3}{1} \times 18 = 21 \text{ (false)}$$

$$\frac{3}{5} \times \overset{7}{\cancel{35}} = 21$$

$$\frac{3}{1} \times 21 = 21 \text{ (true)}$$

The solution is **35**.

$$\frac{3}{5} \times ? = 21$$

$$\frac{3}{5} \times ? \times \cancel{5} = 21 \times 5$$

$$3 \times ? = 105$$

$$3 \times ? \div 3 = 105 \div 3$$

$$? = 35$$

Use trial and error

a) $\frac{1}{6}$ of $\boxed{48} = 8$

$$\frac{1}{6} \times ? = 8$$

Guess ? = 48

$$\frac{1}{6} \times \overset{8}{\cancel{48}} = 8 \Rightarrow 8 = 8$$

? = 48

b) $\frac{1}{2}$ of $\boxed{} = 17$

$$\frac{1}{2} \times ? = 17$$

$$\frac{1}{2} \times 34 = 17 \Rightarrow 17 = 17$$

? =

c) $\frac{1}{7}$ of $\boxed{} = 9$

$$\frac{1}{7} \times ? = 9$$

? =

d) $\frac{1}{5} \times \boxed{} = 9$

? =

e) $\frac{1}{9} \times \boxed{} = 10$

? =

f) $\frac{1}{10} \times \boxed{} = 5$

? =

Skill 22.3 Finding the missing number in equations involving fractions (2).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4Operation: $\div 8$

Use inverse operations

g) $\frac{1}{8} \times \boxed{64} = 8$

h) $\frac{1}{4} \times \boxed{} = 48$

i) $\frac{1}{3} \times \boxed{} = 60$

$$\frac{1}{8} \times ? \times 8 = 8 \times 8$$

Inverse of $\div 8$ is $\times 8$

$$? = 64$$

$$? =$$

$$? =$$

j) $\frac{2}{3}$ of $\boxed{} = 10$

k) $\frac{3}{4}$ of $\boxed{} = 15$

l) $\frac{2}{5}$ of $\boxed{} = 12$

m) $\frac{4}{5} \times \boxed{} = 20$

n) $\frac{5}{6} \times \boxed{} = 50$

o) $\frac{2}{7} \times \boxed{} = 12$

p) $\frac{1}{3} \times \boxed{} = -21$

q) $\frac{1}{4} \times \boxed{} = -11$

r) $\frac{1}{5} \times \boxed{} = -12$

s) $\frac{1}{6} \times \boxed{} = -5$

t) $\frac{1}{8} \times \boxed{} = -7$

u) $\frac{1}{9} \times \boxed{} = -3$

Skill 22.4 Finding the missing number in equations involving +, −, · and/or brackets (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

EITHER

Use **trial and error**:

- Guess the value of the missing number that will make the equation true (both sides of the equation are equal).
- Substitute this value in the equation.
- Check if the equation is true.
- Write the guessed value as the solution of the equation.

Example:

$$4 \times \boxed{?} - 13 = 15$$

What number minus 13 gives 15?

$$4 \times ? = 28$$

$$4 \times 7 = 28$$

$$28 = 28 \text{ (true)}$$

The equation is true, so **7** is the solution.

OR

Use **inverse operations**:

- Consider the operation used to construct the equation.
- Get the missing number alone on one side of the equation, by performing the inverse operation to both sides of the equation.
- Evaluate the other side of the equation.

Hints: For simplicity consider the equation inside the brackets, as one number.

Example:

$$4 \times \boxed{?} - 13 = 15$$

$$4 \times ? - \cancel{13} + \cancel{13} = 15 + 13$$

$$4 \times ? \div 4 = 28 \div 4$$

$$? = 7$$

Q. $4 \times (17 - \boxed{}) = 20$ **A.** $4 \times (17 - ?) = 20$ OR $4 \times (17 - ?) \div 4 = 20 \div 4$

What number multiplied by 4 gives 20? $17 - ? = 5$ $17 - ? = 5$ $17 - ? - 17 = 5 - 17$

Guess ? = 12 $17 - 12 = 5$ $5 = 5 \text{ (true)}$ $-? = -12$ $? = 12$

The solution is **12**.

If the bracket has been multiplied by 4, then do the inverse operation and divide by 4 both sides of the equation. Then subtract 17 from both sides. Finally reverse the signs.

Use trial and error

a) $8 + 4 \times \boxed{10} = 48$ **b)** $5 + 6 \times \boxed{} = 47$ **c)** $12 + 4 \times \boxed{} = 44$

$8 + 4 \times ? = 48$ $5 + 6 \times ? = 47$

$4 \times ? = 40$ $6 \times ? = 42$

$? = 10$ $? =$ $? =$

d) $4 \times (9 - \boxed{}) = 16$ **e)** $3 \times (8 - \boxed{}) = 15$ **f)** $7 \times (9 - \boxed{}) = 21$

$4 \times (9 - ?) = 16$

$9 - ? = 4$

$? =$ $? =$ $? =$

Skill 22.4 Finding the missing number in equations involving +, −, · and/or brackets (2).

 MMBlue 1 1 2 2 3 3 4 4
 MMGreen 1 1 2 2 3 3 4 4

Operation: +15

Use inverse operations

g) $15 + 6 \times \boxed{5} = 45$

h) $16 + 2 \times \boxed{} = 40$

i) $21 + 5 \times \boxed{} = 61$

~~$15 + 6 \times ? - 15 = 45 - 15$~~

Inverse of +15 is -15

$6 \times ? \div 6 = 30 \div 6$

$? = 5$

$? =$

$? =$

j) $8 \times (16 - \boxed{}) = 24$

k) $4 \times (13 - \boxed{}) = 16$

l) $8 \times (20 - \boxed{}) = 32$

m) $5 \times \boxed{} - 20 = 25$

n) $6 \times \boxed{} - 36 = 12$

o) $4 \times \boxed{} - 16 = 12$

p) $5 \times \boxed{} + 6 = 51$

q) $7 \times \boxed{} + 12 = 82$

r) $\boxed{} \times 7 + 8 = 50$

s) $36 - 6 \times \boxed{} = 12$

t) $50 - 7 \times \boxed{} = 15$

u) $42 - 10 \times \boxed{} = 22$

Skill 22.5 Finding the missing number in equations involving decimals.

MMBlue 11 22 33 44
MMGreen 11 22 33 44

- Use trial and error or inverse operation to find the missing number. (see skill 22.1, page 183 and skill 22.2, page 185)

Q. $\square + 2.7 = 3.4$

What number added to 2.7 gives 3.4?
Guess ? = 0.7

A. $? + 2.7 = 3.4$ OR $? + 2.7 = 3.4$
 $0.7 + 2.7 = 3.4$ $? + 2.7 - 2.7 = 3.4 - 2.7$
 $3.4 = 3.4$ (true) $? = 0.7$
 The solution is **0.7**

If 2.7 was added to the missing number, then do the inverse operation and subtract 2.7 from both sides of the equation.

a) $\square \times 1.6 = 6.4$ Use trial and error

b) $1.4 + \square = 2.6$

c) $2.8 + \square = 4.4$

Guess ? = 4 $? \times 1.6 = 6.4$

$1.4 + ? = 2.6$

$? = 4$

$? =$

$? =$

d) $3.8 - \square = 3$

e) $2.9 - \square = 0.7$

f) $\square \times 1.3 = 3.9$

$? =$

$? =$

$? =$

Operation: + 4.2

Use inverse operations

g) $4.2 - \square = 2.7$

h) $3.5 - \square = 1.2$

i) $2.8 - \square = 0.6$

Inverse of + 4.2 is - 4.2
 $\cancel{4.2} - ? - \cancel{4.2} = 2.7 - 4.2$

$-? = -1.5$

$? = 1.5$

j) $\square + 2.5 = 4$

k) $3.6 + \square = 5$

l) $\square + 1.2 = 2.1$

m) $1.2 \times \square = 7.2$

n) $1.7 \times \square = 3.4$

o) $1.4 \times \square = 7$

Skill 22.6 Solving one-step equations by using the inverse operations of + and - (1).

MMBlue 11 22 33 44
MMGreen 11 22 33 44

- Consider the operation used to construct the sum or the difference involving the variable.
- Get the variable alone on one side of the equation, by performing the inverse operation to both sides of the equation.
- Evaluate the other side of the equation.

Operation	Inverse Operation	Operation	Inverse Operation
+	-	-	+
$x + 3 = 6$ $x + 3 - 3 = 6 - 3$ $x = 3$		$x - 3 = 6$ $x - 3 + 3 = 6 + 3$ $x = 9$	

Hint: Remember that you must do the same operation to both sides of the equation.

Q. Solve for p : $17 - p = 13$ **A.** $17 - p = 13$ *Operation: + 17*
 $17 - p - 17 = 13 - 17$ *Inverse of + 17 is - 17*
 $-p = -4$ *Reverse sign both sides*
 $p = 4$

a) Solve for t : $t + 6 = 15$ **b)** Solve for y : $y + 5 = 12$ **c)** Solve for r : $3 + r = 11$

Operation: + 6
Inverse of + 6 is - 6

$t + \cancel{6} - \cancel{6} = 15 - 6$ $y + 5 - 5 = 12 - 5$

$t = \boxed{9}$ $y = \boxed{}$ $r = \boxed{}$

d) Solve for a : $a + 10 = 30$ **e)** Solve for x : $8 + x = 17$ **f)** Solve for m : $5 + m = 12$

$a = \boxed{}$ $x = \boxed{}$ $m = \boxed{}$

g) Solve for e : $e + 9 = 12$ **h)** Solve for g : $g + 7 = 11$ **i)** Solve for s : $13 + s = 22$

$e = \boxed{}$ $g = \boxed{}$ $s = \boxed{}$

j) Solve for t : $t - 3 = 6$ **k)** Solve for y : $y - 4 = 9$ **l)** Solve for z : $z - 5 = 2$

$t = \boxed{}$ $y = \boxed{}$ $z = \boxed{}$

Skill 22.6 Solving one-step equations by using the inverse operations of + and - (2).

 MMBLue 1 1 2 2 3 3 4 4
 MMGreen 1 1 2 2 3 3 4 4

m) Solve for x : $x - 12 = 20$

$$x = \boxed{}$$

n) Solve for b : $b - 15 = 8$

$$b = \boxed{}$$

o) Solve for s : $s - 13 = 27$

$$s = \boxed{}$$

p) Solve for a : $14 - a = 6$

$$14 - a - 14 = 6 - 14$$

$$-a = -8$$

$$a = \boxed{8}$$

q) Solve for z : $24 - z = 10$

$$z = \boxed{}$$

r) Solve for s : $18 - s = 7$

$$s = \boxed{}$$

s) Solve for j : $10 - j = 2$

$$j = \boxed{}$$

t) Solve for c : $22 - c = 7$

$$c = \boxed{}$$

u) Solve for e : $16 - e = 9$

$$e = \boxed{}$$

v) Solve for d : $-3 + d = 9$

$$d = \boxed{}$$

w) Solve for v : $-6 + v = 12$

$$v = \boxed{}$$

x) Solve for n : $-8 + n = 7$

$$n = \boxed{}$$

y) Solve for h : $-9 + h = 12$

$$h = \boxed{}$$

z) Solve for k : $-7 + k = 25$

$$k = \boxed{}$$

zz) Solve for m : $-5 + m = 16$

$$m = \boxed{}$$

Skill 22.7 Solving one-step equations by using the inverse operations of \cdot and \div (1).

MMBlue 11 22 33 44
MMGreen 11 22 33 44

- Consider the operation used to construct the expression involving the variable.
- Get the variable alone on one side of the equation, by performing the inverse operation on both sides of the equation.
- Evaluate the other side of the equation.

Hint: Remember that you must do the same operation to both sides of the equation.

Operation	Inverse Operation	Operation	Inverse Operation
\cdot	\div	\div	\cdot
$3x = 6$		$\frac{x}{3} = 6$	
$\frac{3x}{3} = \frac{6}{3}$		$\frac{x}{3} \cdot 3 = 6 \cdot 3$	
$x = 2$		$x = 18$	

Q. Solve for x : $\frac{x}{8} = 6$

A. $\frac{x}{8} = 6$ *Operation: $\div 8$*

Simplify: $8 \div 8 = 1$ $\frac{x}{\cancel{8}} = 6 \cdot \cancel{8}$ *Inverse of $\div 8$ is $\times 8$*
 $x = 48$

Operation: $\cdot 5$

a) Solve for a : $5 \cdot a = 45$

b) Solve for m : $4 \cdot m = 40$

c) Solve for c : $6 \cdot c = 72$

Inverse of $\cdot 5$ is $\div 5$ $\frac{5a}{\cancel{5}} = \frac{45}{\cancel{5}}$ *Simplify: $\div 5$*

$a = \boxed{9}$

$m = \boxed{}$

$c = \boxed{}$

d) Solve for h : $7 \cdot h = 77$

e) Solve for n : $9 \cdot n = 81$

f) Solve for p : $8 \cdot p = 64$

$h = \boxed{}$

$n = \boxed{}$

$p = \boxed{}$

g) Solve for b : $8b = 24$

h) Solve for z : $7z = 28$

i) Solve for l : $9l = 54$

$b = \boxed{}$

$z = \boxed{}$

$l = \boxed{}$

j) Solve for r : $10r = 120$

k) Solve for y : $5y = 75$

l) Solve for u : $4u = 36$

$r = \boxed{}$

$y = \boxed{}$

$u = \boxed{}$

Skill 22.7 Solving one-step equations by using the inverse operations of \cdot and \div (2).

 MMBBlue 11 22 33 44
 MMGreen 11 22 33 44

- m)**
- Solve for
- g
- :
- $15g = -30$
- n)**
- Solve for
- a
- :
- $20a = -100$
- o)**
- Solve for
- s
- :
- $3s = -21$

$$15 \cdot g \div 15 = -30 \div 15$$

$$g = \boxed{-2}$$

$$a = \boxed{}$$

$$s = \boxed{}$$

- p)**
- Solve for
- d
- :
- $10d = -80$
- q)**
- Solve for
- p
- :
- $12p = -36$
- r)**
- Solve for
- h
- :
- $9h = -90$

$$d = \boxed{}$$

$$p = \boxed{}$$

$$h = \boxed{}$$

 Operation: $\div 4$

- s)**
- Solve for
- x
- :
- $\frac{x}{4} = 9$

- t)**
- Solve for
- c
- :
- $\frac{c}{5} = 6$

- u)**
- Solve for
- q
- :
- $\frac{q}{3} = 8$

 Inverse of $\div 4$ is $\cdot 4$

$$\frac{x}{\cancel{4}} \cdot \cancel{4} = 9 \cdot 4$$

$$x = \boxed{}$$

$$c = \boxed{}$$

$$q = \boxed{}$$

- v)**
- Solve for
- n
- :
- $\frac{n}{7} = 3$

- w)**
- Solve for
- r
- :
- $\frac{r}{8} = 12$

- x)**
- Solve for
- j
- :
- $\frac{j}{4} = 15$

$$n = \boxed{}$$

$$r = \boxed{}$$

$$j = \boxed{}$$

- y)**
- Solve for
- b
- :
- $\frac{b}{6} = 12$

- z)**
- Solve for
- e
- :
- $\frac{e}{9} = 10$

- zz)**
- Solve for
- k
- :
- $\frac{k}{2} = 35$

$$b = \boxed{}$$

$$e = \boxed{}$$

$$k = \boxed{}$$

Skill 22.8 Solving two-step equations by using the inverse operations of +, −, ⋅ and ÷ (1).

MMBlue 11 22 33 44
MMGreen 11 22 33 44

- Get the variable alone on one side of the equation, by performing the inverse operations, in order, to both sides of the equation. (see skill 22.6, page 192 and skill 22.7, page 194)
- Evaluate the other side of the equation.

Hint: Remember that you must do the same operation to both sides of the equation.

Q. Solve for v : $9v - 2 = -20$ **A.**

$$9v - 2 = -20 \quad \text{Operation: } -2$$

$$\text{Simplify: } -2 + 2 = 0 \quad 9v - \cancel{2} + \cancel{2} = -20 + 2 \quad \text{Inverse of } -2 \text{ is } +2$$

$$\times 9 \quad 9v = -18 \quad \text{Operation: } \times 9$$

$$\text{Simplify: } 9 \div 9 = 1 \quad \frac{1}{\cancel{9}} \frac{9v}{\cancel{9}} = -\frac{18}{\cancel{9}^2} \quad \text{Inverse of } \times 9 \text{ is } \div 9$$

$$v = -2$$

- a)** Solve for x : $7x + 8 = 50$ **b)** Solve for y : $6y - 9 = 21$ **c)** Solve for a : $3a + 8 = 29$

Operation: + 8
Inverse of + 8 is - 8
 $7x + 8 - 8 = 50 - 8$

Inverse of $\cdot 7$ is $\div 7$
 $7x = 42$
 $\frac{1}{\cancel{7}} \frac{7x}{\cancel{7}} = \frac{42}{\cancel{7}^6}$ Simplify: $\div 7$

$x = \boxed{6}$

$y = \boxed{}$

$a = \boxed{}$

- d)** Solve for d : $4d + 5 = 29$ **e)** Solve for e : $3e - 5 = 25$ **f)** Solve for u : $8u - 10 = 22$

$d = \boxed{}$

$e = \boxed{}$

$u = \boxed{}$

- g)** Solve for x : $2x - 26 = -2$ **h)** Solve for t : $7t - 3 = -24$ **i)** Solve for h : $5h - 6 = -6$

$x = \boxed{}$

$t = \boxed{}$

$h = \boxed{}$

Skill 22.8 Solving two-step equations by using the inverse operations of +, -, · and ÷ (2).

 MMBLue 11 22 33 44
 MMGreen 11 22 33 44

j) Solve for i : $6i - 9 = -21$ **k) Solve for q : $5q - 7 = -32$ **l) Solve for s : $8s - 20 = -4$****

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$$i = \boxed{}$$

$$q = \boxed{}$$

$$s = \boxed{}$$

m) Solve for i : $4i + 12 = -20$ **n) Solve for j : $3j + 5 = -10$ **o) Solve for l : $10l + 4 = -26$****

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$$i = \boxed{}$$

$$j = \boxed{}$$

$$l = \boxed{}$$

p) Solve for x : $9x + 10 = 1$ **q) Solve for z : $4z + 19 = 3$ **r) Solve for c : $6c + 17 = 5$****

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$$x = \boxed{}$$

$$z = \boxed{}$$

$$c = \boxed{}$$

s) Solve for g : $7g + 8 = 1$ **t) Solve for m : $9m + 40 = 4$ **u) Solve for p : $2p + 18 = 6$****

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$$g = \boxed{}$$

$$m = \boxed{}$$

$$p = \boxed{}$$

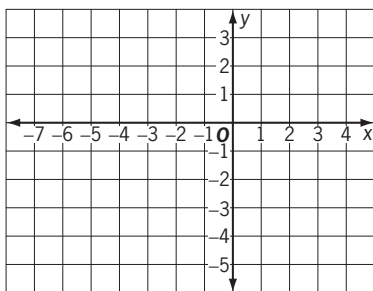
23. [Graphs & Functions]

Skill 23.1 Describing the position of ordered pairs on a coordinate plane.

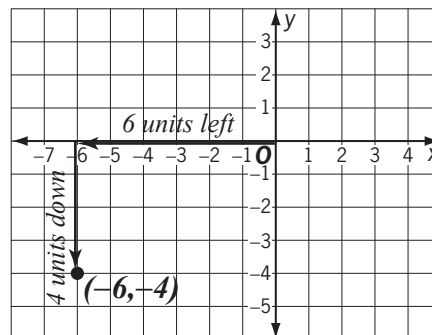
MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Start at the origin (0,0).
- Move left or right by the number of given units. This first number becomes the x -coordinate. Use a “+” sign if you moved to the right and use a “-” if you moved to the left.
- From that point, move up or down by the number of given units. This second number becomes the y -coordinate. Use a “+” sign if you moved up and use a “-” if you moved down.
- Plot the final point on the coordinate plane.

Q. Start at the origin. Move 6 units to the left along the x -axis and then down 4 units. Graph a point. What are the coordinates of the point?



A.

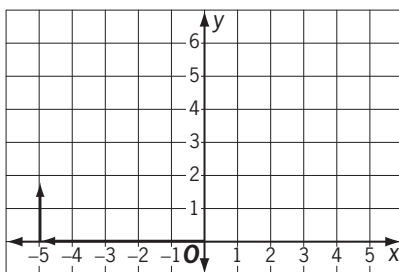


The first coordinate is -6 (6 units left)

The second coordinate is -4 (4 units down)

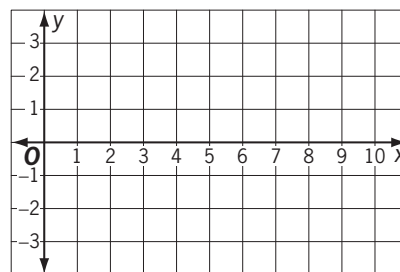
The answer is $(-6, -4)$

a) Start at the origin. Move 5 units to the left along the x -axis and then up 2 units. Graph a point. What are the coordinates of the point?



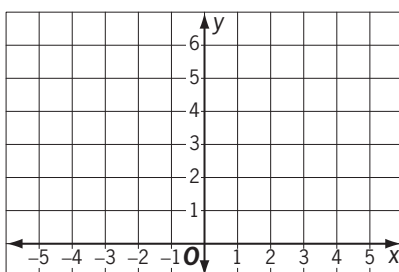
(,)

b) Start at the origin. Move 10 units to the right along the x -axis and then down 3 units. Graph a point. What are the coordinates of the point?



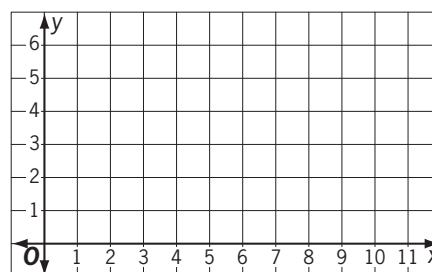
(,)

c) Start at the origin. Move 4 units to the left along the x -axis and then up 5 units. Graph a point. What are the coordinates of the point?



(,)

d) Start at the origin. Move 11 units to the right along the x -axis and then up 6 units. Graph a point. What are the coordinates of the point?



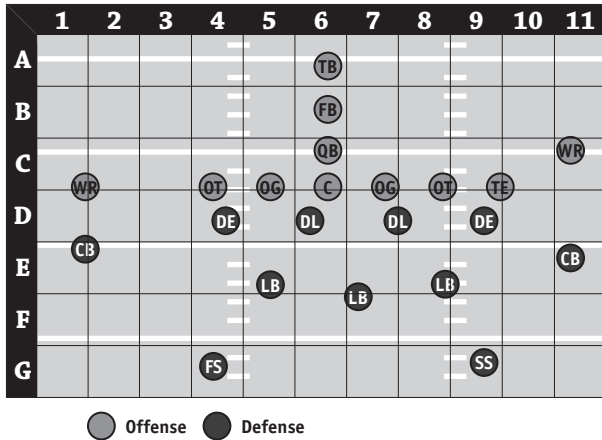
(,)

Skill 23.2 Using grid references to describe location on a map (1).

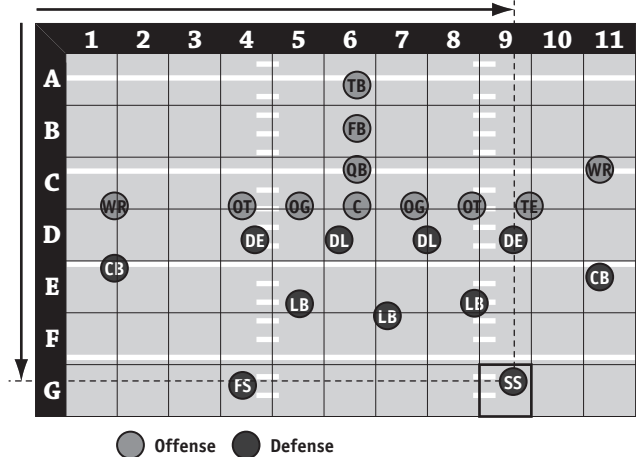
MMBlue 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Locate the object on the grid.
- Starting from the corner of the grid, first read across the horizontal axis to find the number that matches the column of the object.
- Then read along the vertical axis to find the letter that matches the row of the object.
- Write the number followed by the letter to specify the grid reference.

Q. In this starting line up, what is the grid reference of the Strong Safety (SS)?



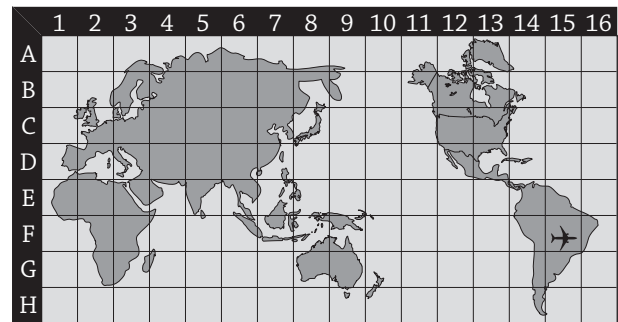
A. The grid reference is **9G**.



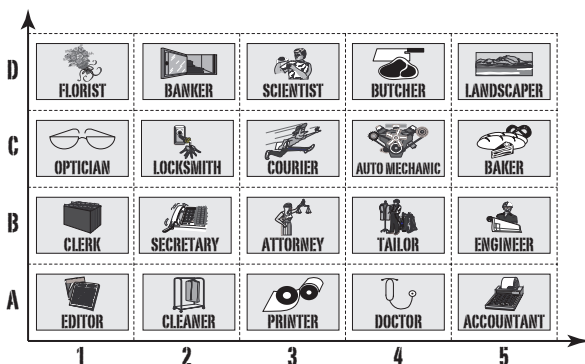
a) In which country would you be in if you were located at 1D?



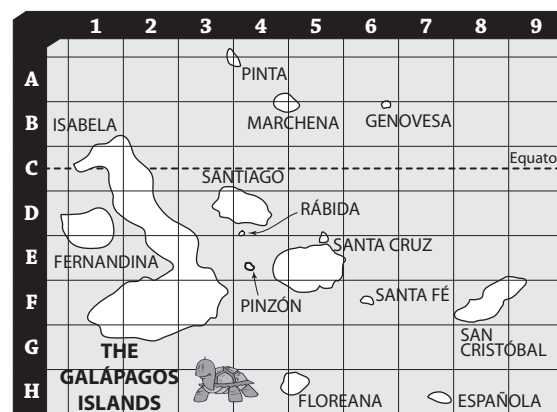
b) Above what continent would you be if your airplane is flying at 15F?



c) Which occupation is listed at 3D?



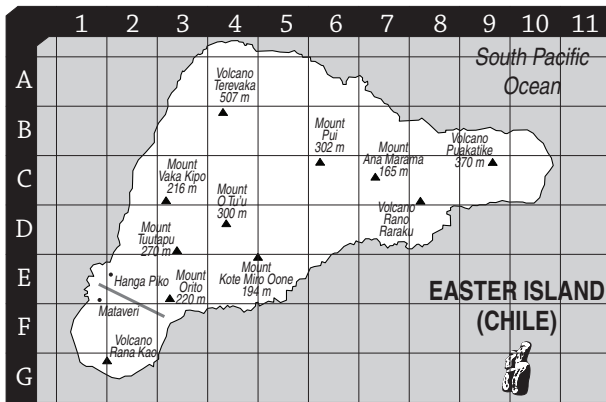
d) On which island would you be in if you were located at 7H?



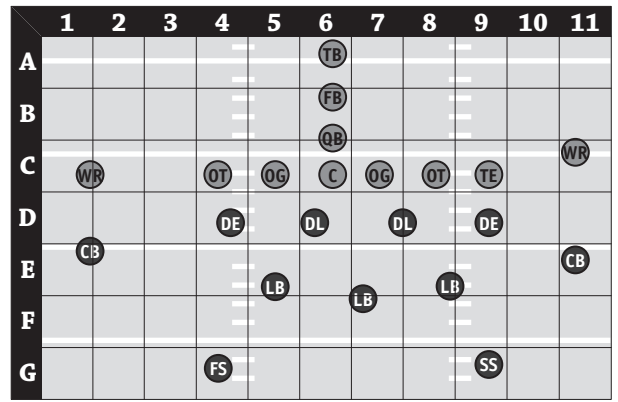
Skill 23.2 Using grid references to describe location on a map (2).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

e) On which mountain would you be if you were located at 3E?

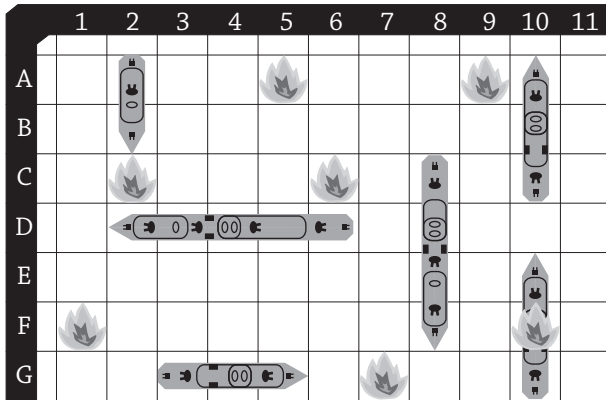


f) In this starting line up, what is the grid reference of the Tight End (TE)?



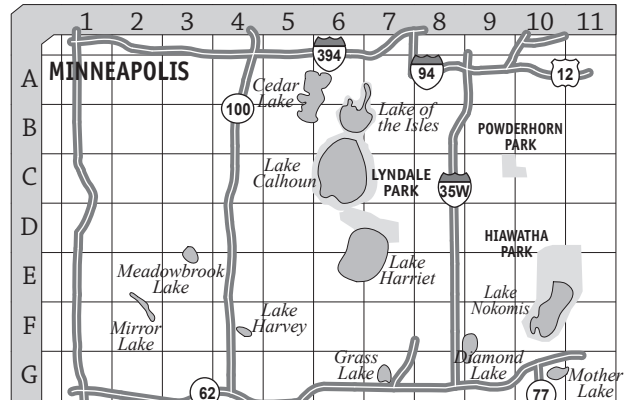
● Offense
● Defense

g) What is the grid reference of an enemy hit on a battleship?

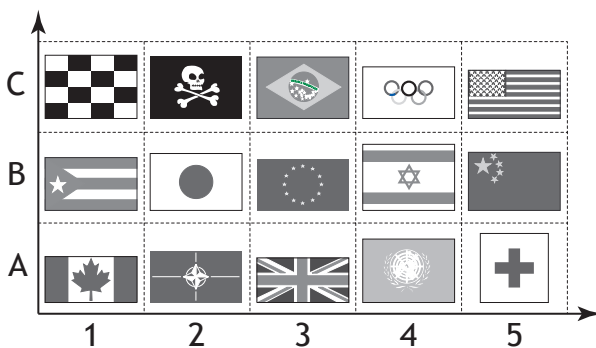


🔥 Enemy hit
🚢 Battleship

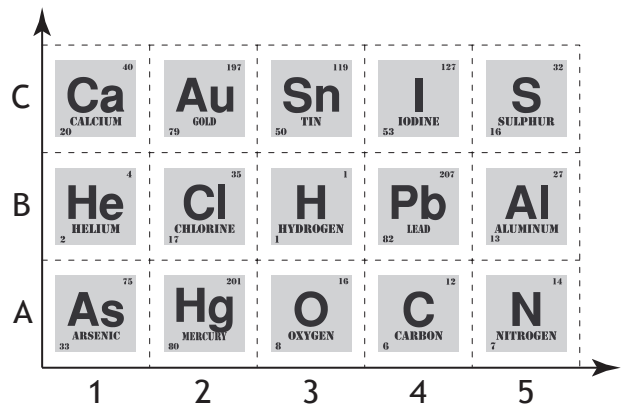
h) What is the grid reference of Grass Lake?



i) What is the grid reference of the American flag?



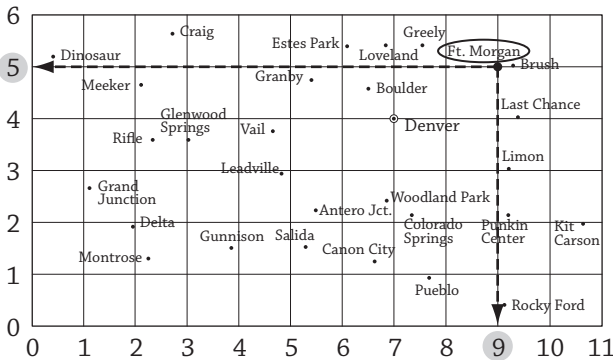
j) What is the grid reference of hydrogen?



- Locate the object on the grid.
- Move vertically from the object until you intersect the horizontal axis (x-axis).
- Write the number you find on the horizontal axis as the x-coordinate of the point (x,).
- Move horizontally from the object until you intersect the vertical axis (y-axis).
- Write the number you find on the vertical axis as the y-coordinate of the point (,y).
- Read the coordinate on the horizontal axis first, then on the vertical axis.

Hint: *x* before *y* in the alphabet is one way to remember this order.

Q. What are the coordinates of Fort Morgan?



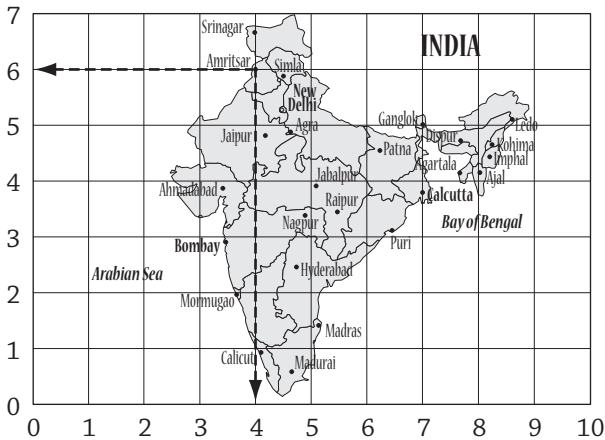
A. Locate Fort Morgan on the map.

Follow the vertical grid line that Ft Morgan is on, down to where it meets the horizontal axis. The x-coordinate is 9.

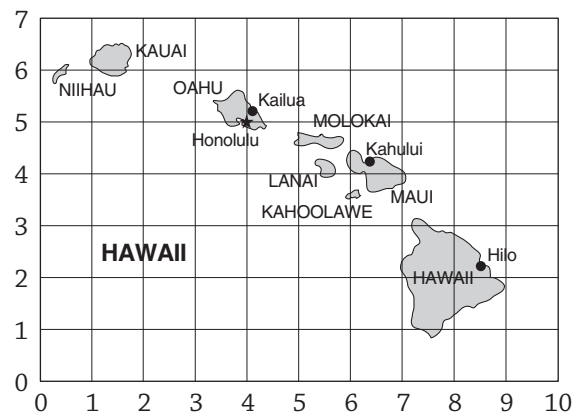
Follow the horizontal grid line that Ft Morgan is on, back to where it meets the vertical axis. The y-coordinate is 5.

The coordinates that describe the location of Ft Morgan are **(9,5)**.

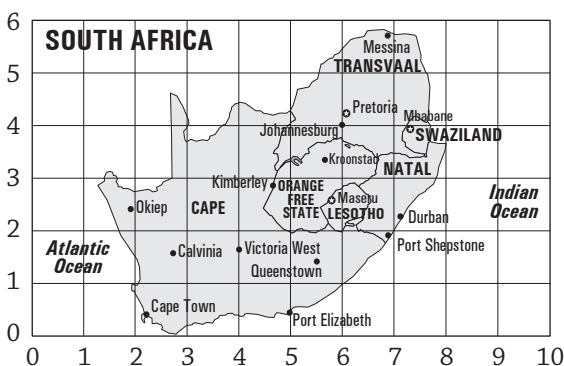
a) What are the coordinates of Amritsar?



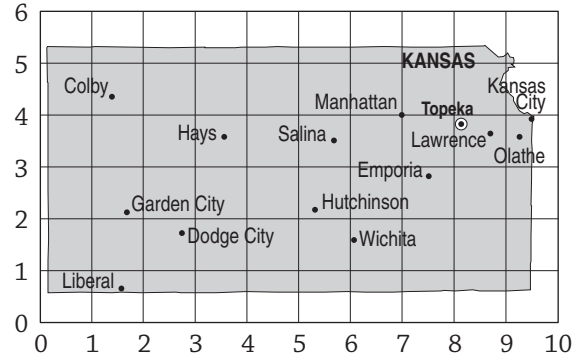
b) What are the coordinates of Honolulu?



c) What are the coordinates of Johannesburg?



d) What are the coordinates of Manhattan?



Skill 23.4 Finding the coordinates of a point on a coordinate plane (1).

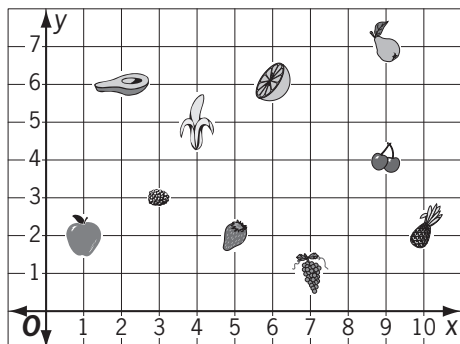
MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Locate the point on the coordinate plane.
- Move vertically from the object until you intersect the horizontal axis (x-axis).
- Write the number you find on the horizontal axis as the x-coordinate of the point (x,).
- Move horizontally from the object until you intersect the vertical axis (y-axis).
- Write the number you find on the vertical axis as the y-coordinate of the point (, y).

Hints: Always write the x-coordinate first.

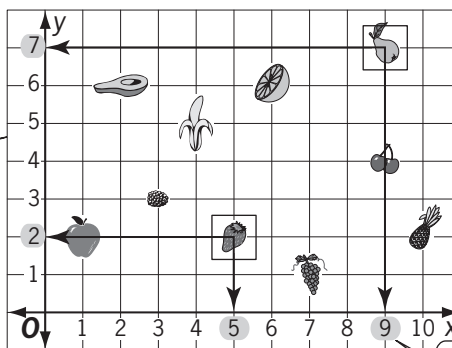
The coordinates of the origin 0 are (0,0).

Q. What are the coordinates of the pear and the strawberry?



coordinate plane

A.



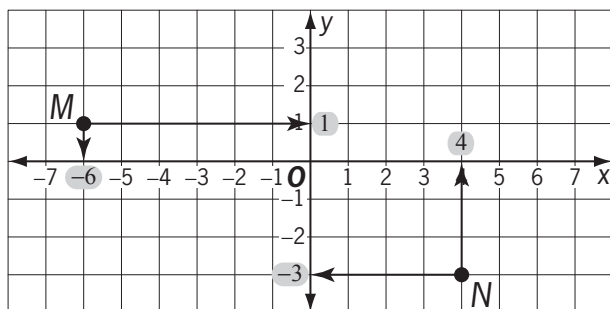
pear (9,7)

strawberry (5,2)

write horizontal coordinate first

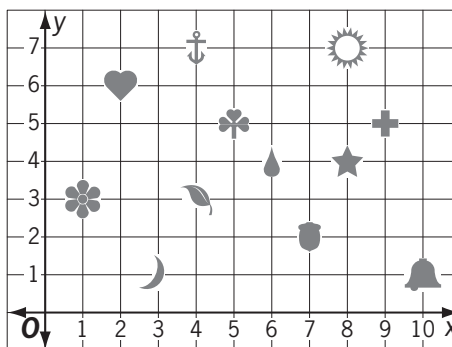
Read as: pear of coordinates 9 and 7

a) What are the coordinates of the points *M* and *N* on this coordinate plane?



$M(-6, 1)$ $N(4, -3)$

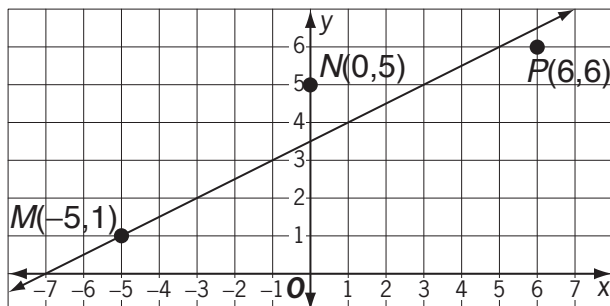
b) What are the coordinates of the sun and the moon?



sun = (8, 7) moon = (3, 1)

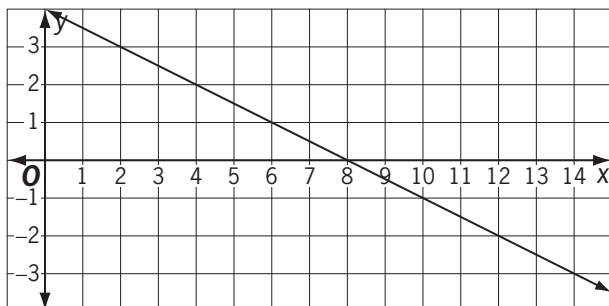
c) Which point lies on the line graphed below?

$M(-5,1)$ $N(0,5)$ $P(6,6)$



d) Which point lies on the line graphed below?

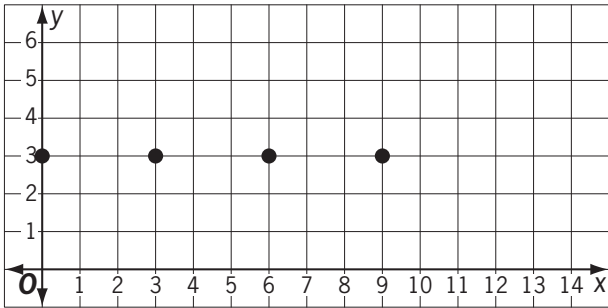
$E(4,-3)$ $F(3,3)$ $G(12,-2)$ $H(0,3)$



Skill 23.4 Finding the coordinates of a point on a coordinate plane (2).

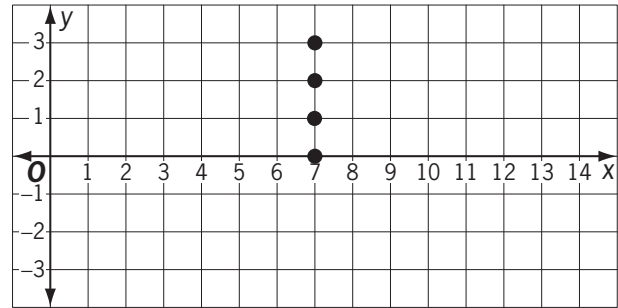
MMBlue 1 2 3 4 4
MMGreen 1 2 3 3 4 4

- e) These dots, if joined, would form a line. A point on this line has an x -coordinate of 12. What is the y -coordinate of this point?



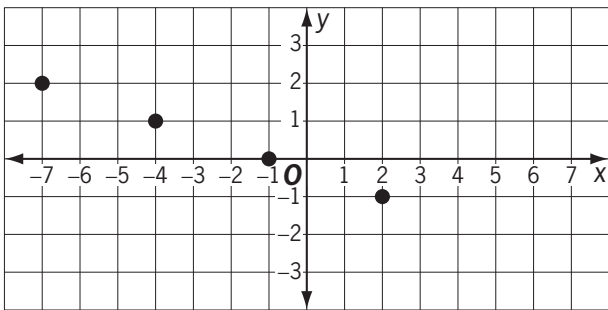
(12,)

- f) These dots, if joined, would form a line. A point on this line has a y -coordinate of -1 . What is the x -coordinate of this point?



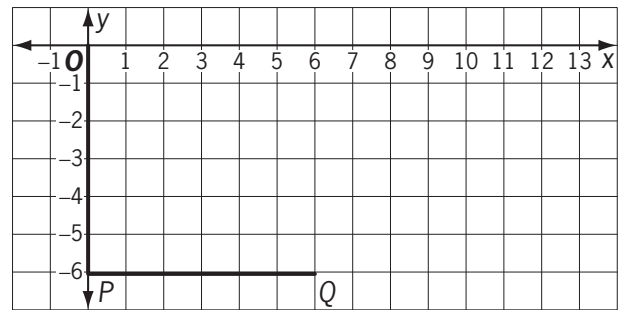
(, -1)

- g) These dots, if joined, would form a line. A point on this line has an x -coordinate of 5. What is the y -coordinate of this point?

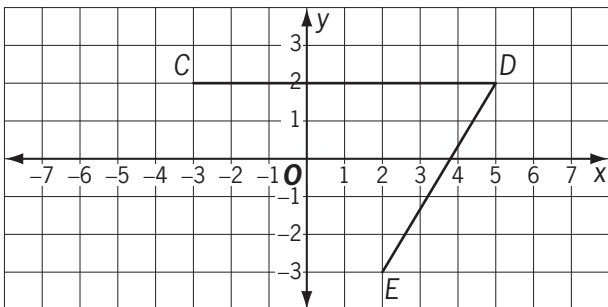


(5,)

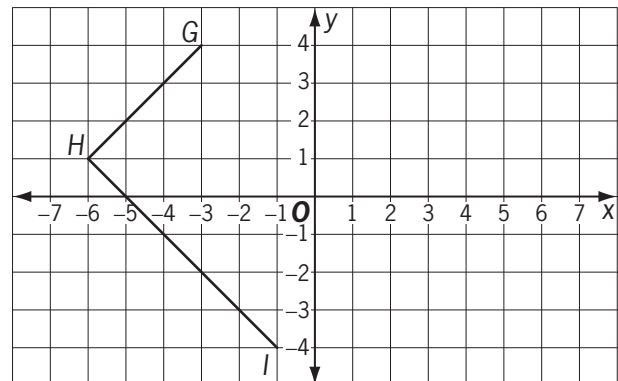
- h) What are the coordinates of point R that will make $OPQR$ a square?



- i) What are the coordinates of point F that will make $CDEF$ a parallelogram?



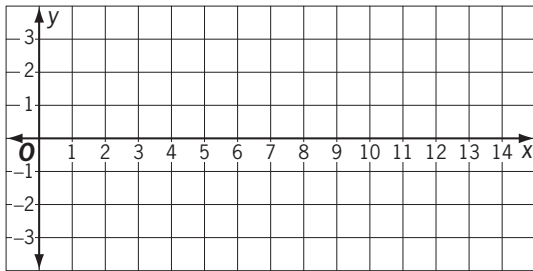
- j) What are the coordinates of point J that will make $GHIJ$ a rectangle?



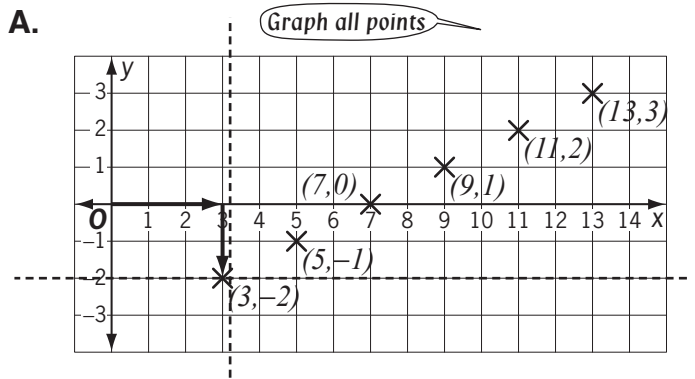
Skill 23.5 Graphing ordered pairs on a coordinate plane.

- Start at the origin (0,0) of the coordinate plane.
- Move across the horizontal axis, or x-axis by the number of units equal to the first coordinate (move to the right if the coordinate is positive and to the left if the coordinate is negative).
- Draw a vertical line passing through this point.
- From the origin, move along the vertical axis, or y-axis by the number of units equal to the second coordinate (move up if the coordinate is positive and down if the coordinate is negative).
- Draw a horizontal line passing through this point.
- Mark the point at the intersection of these two lines.

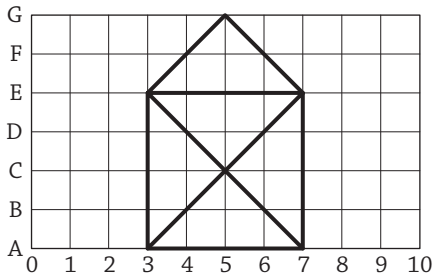
Q. Draw crosses at the following points:
(3,-2), (5,-1), (7,0), (9,1), (11,2), (13,3)



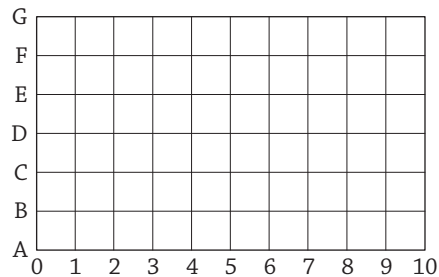
A.



a) Starting at 7A, draw a line to 7E then continue to 3E, 3A, 7A, 3E, 5G, 7E and 3A. What shape have you drawn?

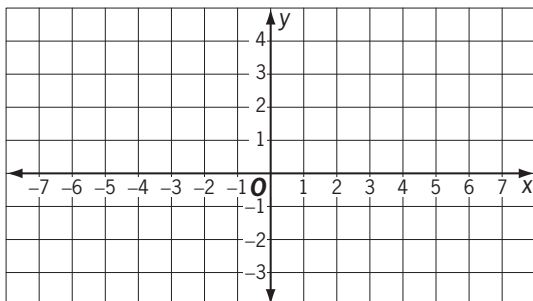


b) Starting at 4E, draw a line to 4F then continue to 9F, 9E, 7E, 7A, 6A, 6E and 4E. What letter have you drawn?



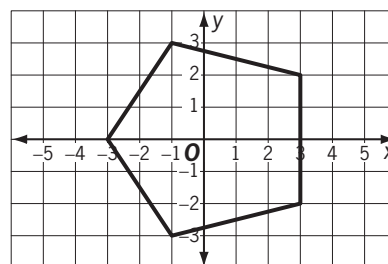
c) Graph the following points on this coordinate plane:

- P* at coordinates (-5,3)
Q at coordinates (-4,-1)
R at coordinates (3,-2)



d) Which set of ordered pairs lie within this pentagon?

- A) (3,3), (-2,-2)
B) (-2,1), (2,-1)
C) (1,-3), (-4,2)



Skill 23.6 Writing linear expressions to represent real-life situations (1).MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Use addition to represent a total or a sum.
- Use subtraction to represent a difference or a remainder.
- Use multiplication to represent a quantity which is a number of times greater or smaller than another quantity.
- Simplify the expression.

Q. A school canteen sells cups of soup for \$2.50 and sandwiches for \$3. Which expression represents the cost of 4 cups of soup and 5 sandwiches?

- A) $4(2.5 + 3)$
 B) $4 \cdot 2.5 + 5 \cdot 3$
 C) $5(2.5 + 3)$

A. 4 cups of soup @ \$2.50 each $\Rightarrow 4 \cdot 2.5$
 5 sandwiches @ \$3.00 each $\Rightarrow 5 \cdot 3$
 \Rightarrow total cost is $4 \cdot 2.5 + 5 \cdot 3$
 The answer is **B**.

a) A printer can print 20 pages per minute. Which expression represents the total number of pages printed in 6 minutes?

- A) $6 \cdot 20$
 B) $6 + 20$
 C) $20 \div 6$

total pages = $6 \cdot 20$ \Rightarrow

b) Suzzie bought a bike for \$90, and then sold it for \$30 less. Which expression represents the selling price?

- A) $90 + 30$
 B) $90 \div 30$
 C) $90 - 30$

selling price = \Rightarrow

c) A Boeing 747 can fly 570 miles per hour. Which expression represents the distance traveled in 5 hours?

- A) $570 + 5$
 B) $570 \cdot 5$
 C) $570 \cdot 747$

distance = \Rightarrow

d) A bike can travel 15 miles per hour. Which expression represents the time, in hours, taken to travel 3 miles?

- A) $15 \div 3$
 B) $3 \div 15$
 C) $15 \cdot 3$

time = \Rightarrow

e) To send a fax it costs \$6 for the first page, and then \$2 for each of the following pages. Which expression represents the total cost to send a 5-page fax?

- A) $6 + 2 \cdot 5$
 B) $(6 + 2) \cdot 5$
 C) $6 + 2 \cdot 4$

cost first page = \$6

cost remaining pages = $\$2 \cdot 4$

total cost = $6 + 2 \cdot 4$ \Rightarrow

f) The first 2 minutes of a phone call cost \$3, and then each minute costs 40 cents. Which expression represents the total cost of a 7 minute call?

- A) $3 \cdot 2 + 0.4 \cdot 5$
 B) $3 + 0.4 \cdot 5$
 C) $3 + 40 \cdot 5$

cost first 2 min =

cost remaining minutes =

total cost = \Rightarrow

Skill 23.6 Writing linear expressions to represent real-life situations (2).

MMBlue 11 22 3 44
MMGreen 11 22 33 44

g) Aquatic Center Tickets

type of ticket	price (\$)
adult	6
child (4 - 15)	4
student	5
pensioner	5

Which expression represents the total cost for 3 adults and 2 children aged six?

- A) $6 \cdot 3 + 4 \cdot 2$
- B) $(6 + 4) \cdot 3$
- C) $(6 + 4) \cdot 2$

cost adult tickets = _____
 cost child tickets = _____
 total cost = _____ \Rightarrow

h) A bus company spends \$30 per hour to run a bus. Fifty students paid \$10 each to travel by bus. If the excursion lasted 6 hours, which expression represents the profit made by the bus company?

- A) $10 \cdot 50 \cdot 6 - 30$
- B) $10 \cdot 50 + 30 \cdot 6$
- C) $10 \cdot 50 - 30 \cdot 6$

profit = _____ \Rightarrow

i) Population - July 2009

continent	population (millions)
The Americas & the Caribbean	915
Europe	736
Asia	4052
Oceania	x

Which expression represents the total population living in these four continents?

- A) $915 + 736 + 4052 + 4x$
- B) $915 + 736 + 4052 + x$
- C) $915 + 736 + 4052 - x$

total population = _____ \Rightarrow

j) Space Shuttle Missions up to August 2009

shuttle	missions
Columbia	28
Challenger	10
Endeavour	25
Discovery	39
Atlantis	x

Which expression represents the total number of missions flown by all shuttles?

- A) $127 + x$
- B) $102 + x$
- C) $102 - x$

total missions = _____ \Rightarrow

k) Donna has x nickels and y dimes in her bag. Which expression represents the total amount in cents she has in her bag?

- A) $5(x + y)$
- B) $10(x + y)$
- C) $5x + 10y$

_____ \Rightarrow

l) Nico drove x miles, and Mia drove y miles. If Nico drove z miles more than Mia, which equation expresses this?

- A) $x = y + z$
- B) $y = x + z$
- C) $z = x + y$

_____ \Rightarrow

Skill 23.7 Interpreting distance-time graphs and other linear graphs (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

To find the time taken to travel when the distance is given:

- Locate the point on the vertical axis, marking the given distance.
- Draw a horizontal line through that point.
- Locate the intersection between this horizontal line and the graph.
- Draw a vertical line through the intersection point until it intersects the horizontal axis.
- Mark and read the value of the time on the horizontal axis at the intersection point.

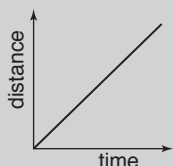
To find the distance traveled:

- Measure the value on the vertical axis, starting from the origin of the axes.

To interpret distance-time graphs:

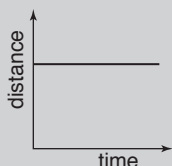
Object moving at a constant rate

It covers the same distance in the same time interval.



Object not moving

Time increasing, but distance not changing.

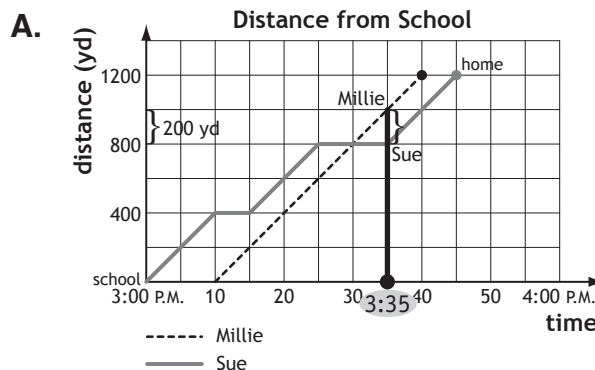
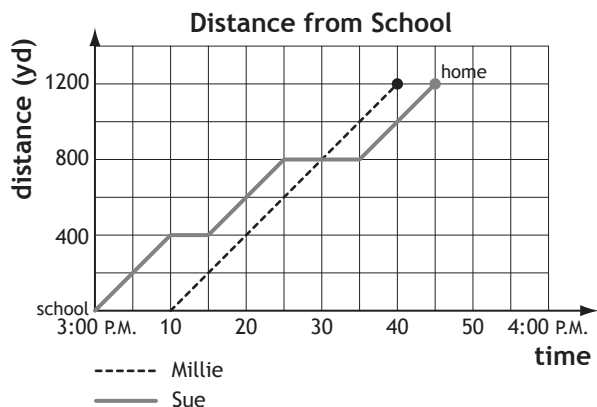


Object moving at a changing rate

At first it travels at a faster rate and then it travels at a gradually slower rate.

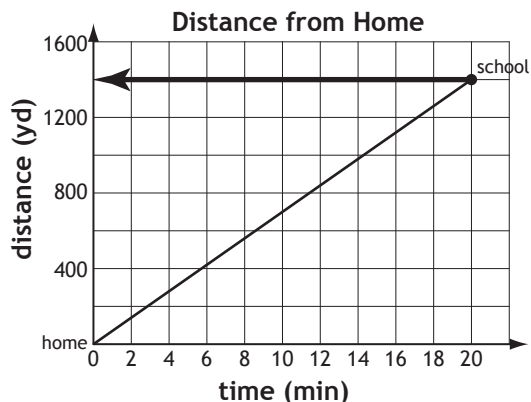


Q. Millie and Sue walk home, leaving school 10 minutes apart. What is the distance between them at 3:35 P.M.?



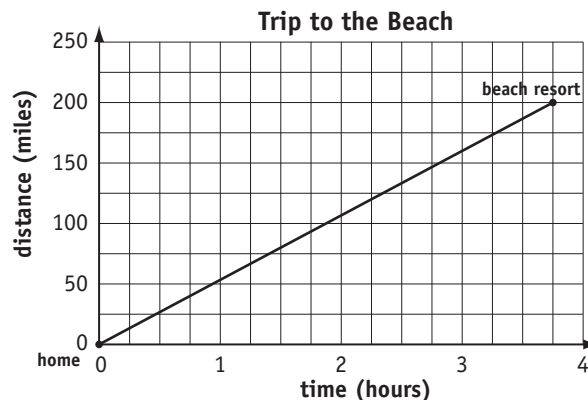
Sue reached 800 yd at 3:35 P.M.
Millie reached 1000 yd at 3:35 P.M.
distance between girls = 1000 yd – 800 yd
= 200 yd

a) This graph shows Grace’s distance from home as she walks to school. How far is the school from home?



distance = yd

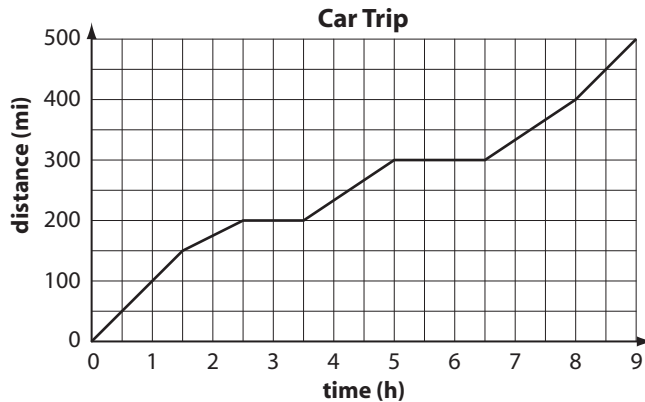
b) Chloe leaves home at 1:00 P.M. At what time does she arrive at the beach resort?



time =

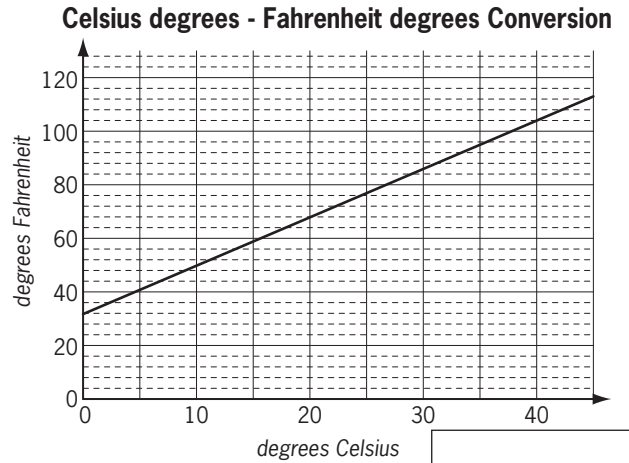
Skill 23.7 Interpreting distance-time graphs and other linear graphs (2).

c) This graph shows the distance traveled by a car over a 9-hour period. For how long does the car stop in total?

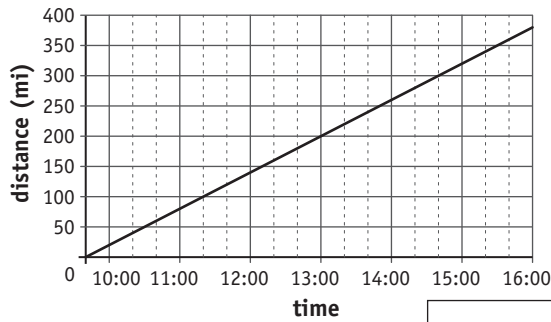


h

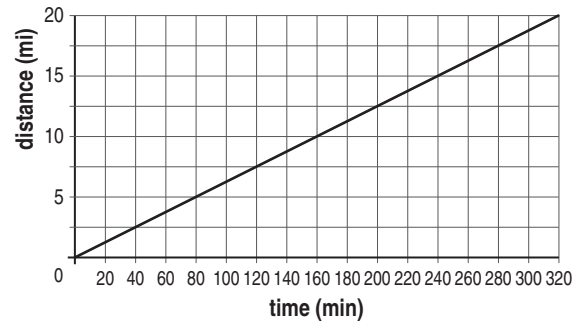
d) Approximately how many degrees Celsius are equivalent to 104 degrees Fahrenheit?



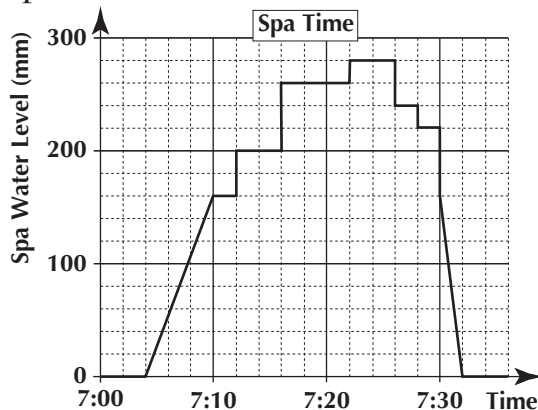
e) This graph shows the distance Felix traveled between 9:40 A.M. and 4:00 P.M. How long in minutes did the car take to travel 200 miles?



f) This graph shows the distance run by Josh at constant speed. How many miles did he cover in 4 hours?

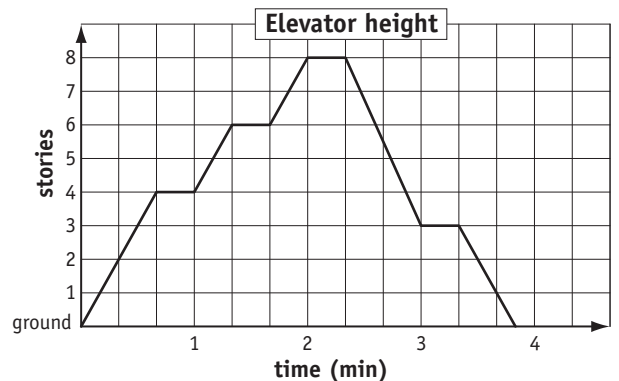


g) At 7:12 Caitlin got into the spa, followed later by Emma and then her younger sister. For how long was Emma in the spa?



min

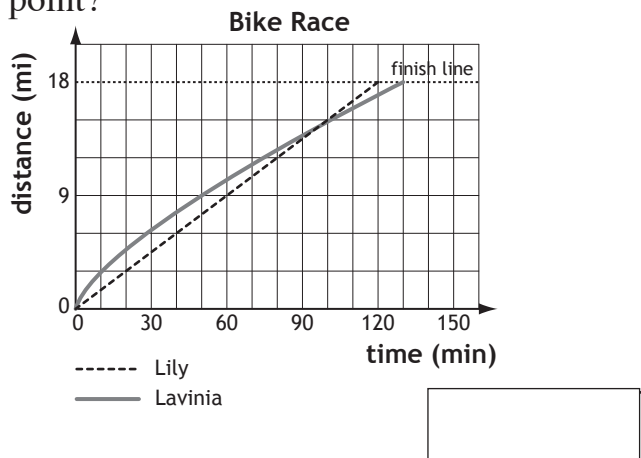
h) This graph shows the height of an elevator in an eight-story building. How many times does the elevator stop on its way to the top?



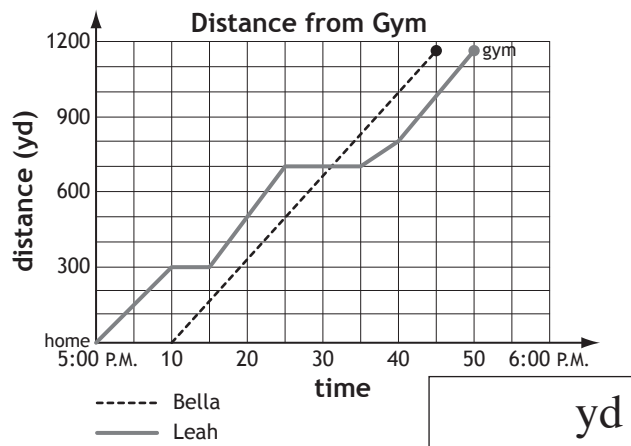
Skill 23.7 Interpreting distance-time graphs and other linear graphs (3).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

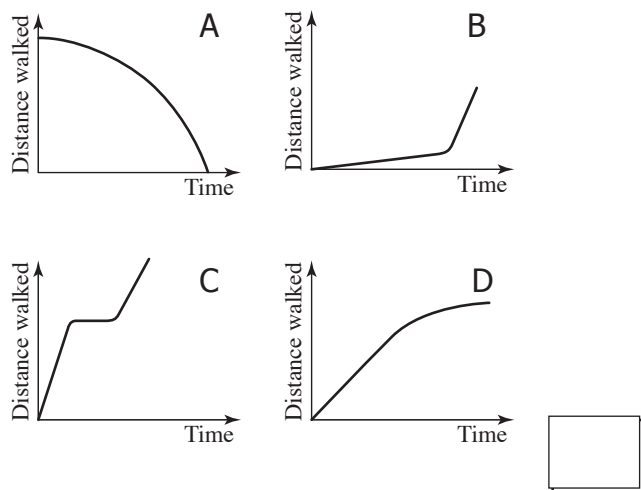
- i) Lily and Lavinia have an 18-mile bike race. Who was winning at the half way point?



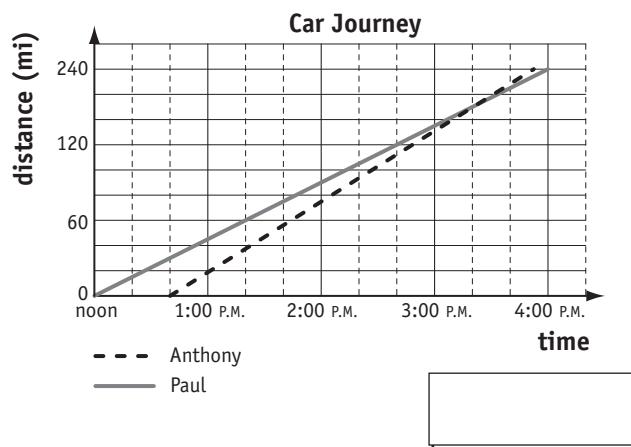
- j) Bella and Leah walk to the gym, leaving home 10 minutes apart. What is the distance between them at 5:40 P.M.?



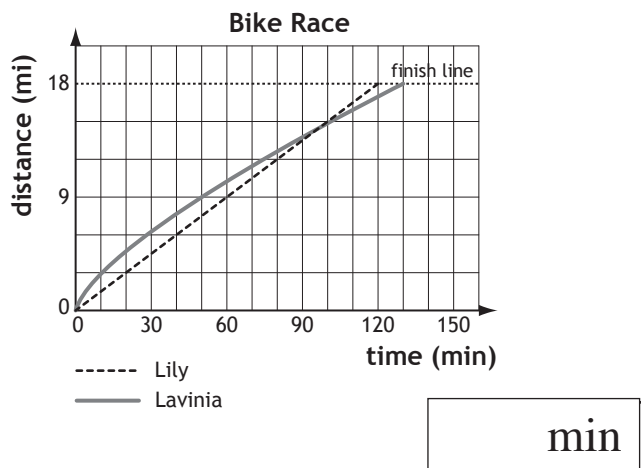
- k) Which graph would best describe Jo's walk if she walked quickly at first and then gradually decreased her speed?



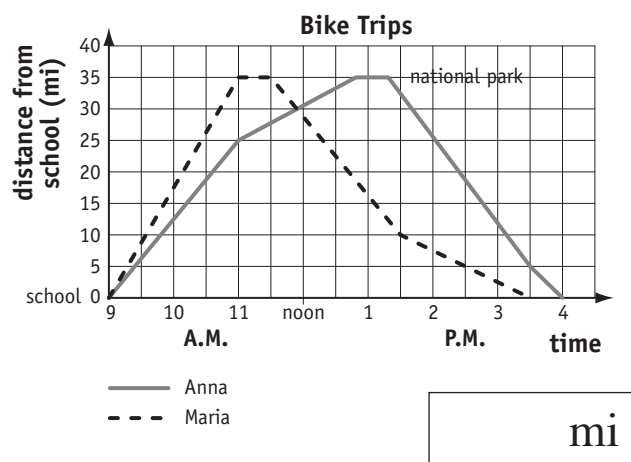
- l) The graph shows the distance traveled by Paul and Anthony by car, on the same journey. At what time does Anthony's car overtake Paul's?



- m) Lily and Lavinia have a bike race. How much longer does Lavinia take to complete the second 9 miles than the first 9 miles?



- n) The graph shows the bike trips of Anna and Maria, from their school to the national park and back. How far from the park do they meet?



Skill 23.8 Completing a table of values for a linear function (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Substitute the variable x with the given values.
- Calculate the values of y .

Q. Complete the table of values for the function rule $y = -2 + x$

x	$-2 + x$	y
0	$-2 + 0 = -2$	-2
1		
2		
3		
4		
5		

A. $y = -2 + x$ Substitute $x = 1$
 $x = 1 \Rightarrow y = -2 + 1 = -1$
 $x = 2 \Rightarrow y = -2 + 2 = 0$
 $x = 3 \Rightarrow y = -2 + 3 = 1$
 $x = 4 \Rightarrow y = -2 + 4 = 2$
 $x = 5 \Rightarrow y = -2 + 5 = 3$

\Rightarrow

x	$-2 + x$	y
0	$-2 + 0 = -2$	-2
1	$-2 + 1 = -1$	-1
2	$-2 + 2 = 0$	0
3	$-2 + 3 = 1$	1
4	$-2 + 4 = 2$	2
5	$-2 + 5 = 3$	3

a) Complete the function table:

Houses sold (x)	Earnings ($2000x$)
1	$2000 \cdot 1 = 2000$
2	$2000 \cdot 2 = 4000$
3	$2000 \cdot 3 = 6000$
4	
5	
6	

b) Complete the function table:

Number of guests (x)	Dinner cost in dollars ($15x$)
4	$15 \cdot 4 = 60$
8	
12	
16	
20	
24	

c) Complete the function table:

No. of days (x)	Records entered ($90x$)
1	$90 \cdot 1 = 90$
2	
3	
4	
5	
6	

d) Complete the function table:

No. of days (x)	Number of T-shirts sold ($16x$)
1	$16 \cdot 1 = 16$
2	
3	
4	
5	
6	

e) Complete the function table:

No. of hours worked (x)	Pay in dollars ($8x$)
2	$8 \cdot 2 = 16$
4	
6	
8	
10	
12	

f) Complete the function table:

No. of seconds (x)	Distance traveled in yards ($18x$)
10	$18 \cdot 10 = 180$
20	
30	
40	
50	
60	

Skill 23.8 Completing a table of values for a linear function (2).MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- g)**
- Complete the table of values for the function rule
- $y = x + 5$

x	$x + 5$	y
0	$0 + 5 = 5$	5
1		
2		
3		
4		
5		

- h)**
- Complete the table of values for the function rule
- $y = 8 - x$

x	$8 - x$	y
3	$8 - 3 = 5$	5
4		
5		
6		
7		
8		

- i)**
- Complete the table of values for the function rule
- $y = 7 + x$

x	$7 + x$	y
0	$7 + 0 = 7$	7
2		
4		
6		
8		
10		

- j)**
- Complete the table of values for the function rule
- $y = x - 4$

x	$x - 4$	y
0	$0 - 4 = -4$	-4
1		
2		
3		
4		
5		

- k)**
- Complete the table of values for the function rule
- $y = 3x$

x	$3x$	y
0	$3 \cdot 0 = 0$	0
1		
2		
3		
4		
5		

- l)**
- Complete the table of values for the function rule
- $y = x - 6$

x	$x - 6$	y
1	$1 - 6 = -5$	-5
2		
3		
4		
5		
6		

- m)**
- Complete the table of values for the function rule
- $y = 100 \div x$

x	$100 \div x$	y
5	$100 \div 5 = 20$	20
10		
20		
25		
50		
100		

- n)**
- Complete the table of values for the function rule
- $y = 2 - x$

x	$2 - x$	y
0	$2 - 0 = 2$	2
1		
2		
3		
4		
5		

Skill 23.9 Graphing linear functions on a coordinate plane (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

To determine the correct equation of a given line:

EITHER

- Choose two points lying on the linear graph.
- Substitute the coordinates of these points in the equation of the line.
- Check if they are both true statements.

OR

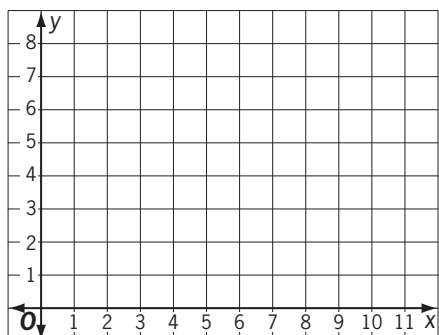
- Check for special properties of the x - or the y -coordinates.

Example: All the points where $x = 4$ means that all points are lying on a vertical line passing through the point $(4,0)$.

To draw the graph of a given equation:

- Choose two different pairs of numbers (x,y) which satisfy the equation.
- Plot these two pairs of coordinates.
- Join the points.

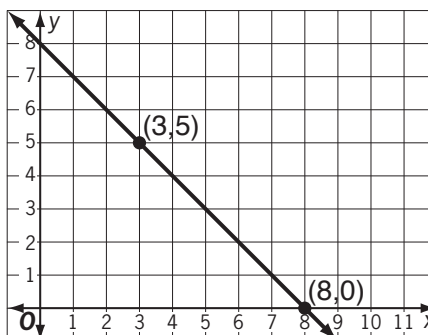
Q. Draw the line through all the points where the x -coordinate and the y -coordinate add to 8.



A. $x + y = 8$

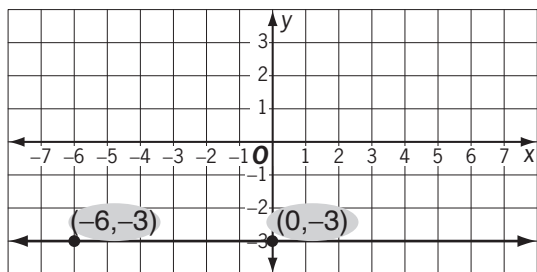
Choose $x = 8$ and $y = 0 \Rightarrow$ the point $(8,0)$

Choose $x = 3$ and $y = 5 \Rightarrow$ the point $(3,5)$



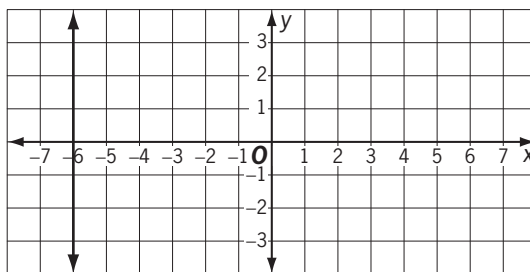
a) This line is best described as:

- A) All points where $x - y = 3$
- B) All points where $x = -3$
- C) All points where $y = -3$



b) This line is best described as:

- A) All points where $y - x = 6$
- B) All points where $x = -6$
- C) All points where $y = -6$



$x - y = 3$ A) $0 - (-3) = 3$ or $3 = 3$ (true) $x = 0$ and $y = -3$

$-3 - (-3) = 3$ or $0 = 3$ (false) $x = -6$ and $y = -3$

$x = -3$ B) $0 = -3$ (false) and $-6 = -3$ (false)

$y = -3$ C) $-3 = -3$ (true)

$-3 = -3$ (true) \Rightarrow

A)

B)

C)

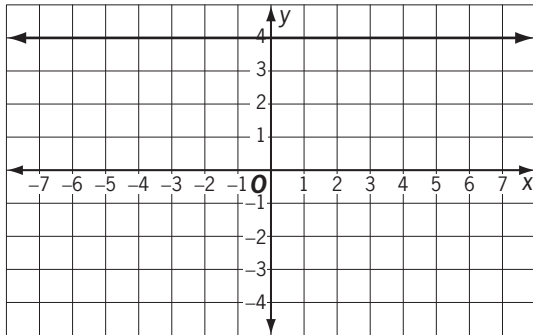
\Rightarrow

Skill 23.9 Graphing linear functions on a coordinate plane (2).

MMBlue 11 22 33 44
MMGreen 11 22 33 44

c) This line is best described as:

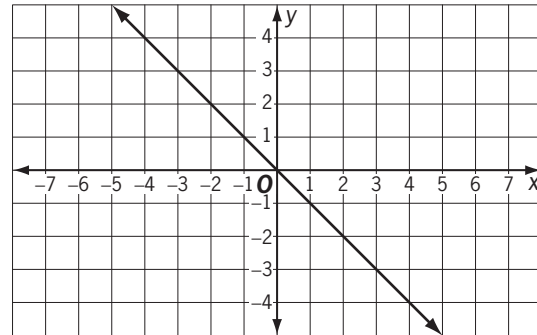
- A) All points where $y = 4$
 B) All points where $x = 4$
 C) All points where $x + y = 4$



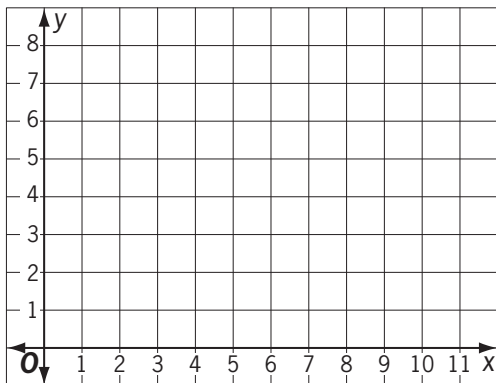
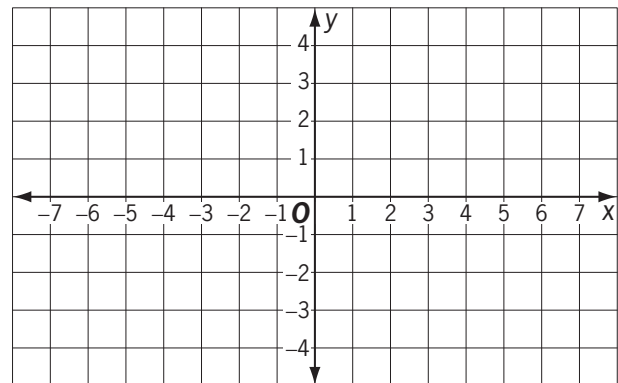
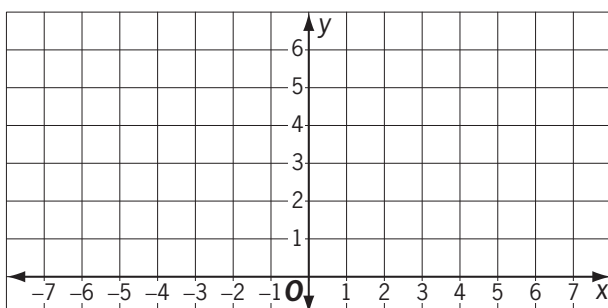
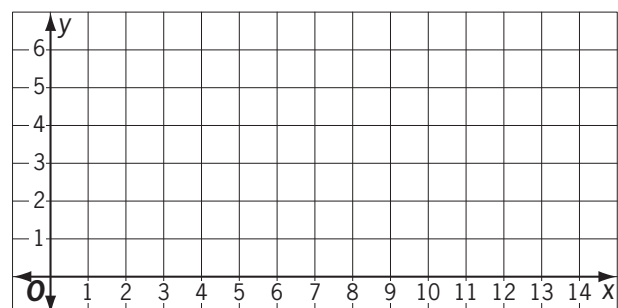
⇒

d) This line is best described as:

- A) All points where $x = 0$
 B) All points where $y = -x$
 C) All points where $y = 0$



⇒

e) Draw the line through all the points where the x -coordinate and the y -coordinate add to 10.f) Draw the line through all the points where the x -coordinate and the y -coordinate add to 1.g) Draw the line through all the points where the y -coordinate is 4 more than the x -coordinate.h) Draw the line through all the points where the x -coordinate is 3 more than the y -coordinate.

24. [Shapes]

continues on page 216

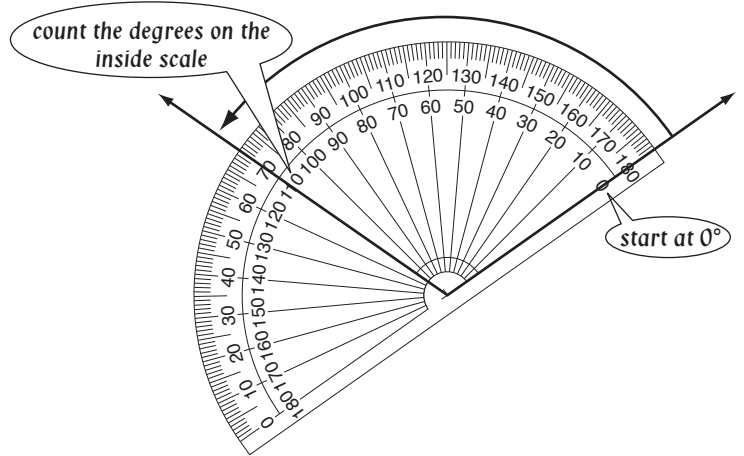
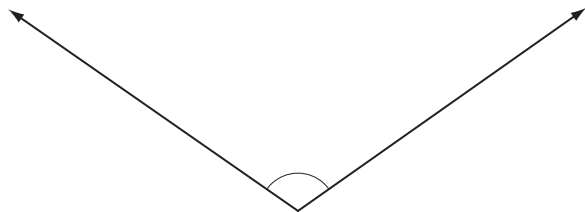
Skill 24.1 Measuring angles using a protractor (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Place the center of the protractor at the vertex (corner) of the angle.
- Align one of the lines forming the angle to pass through 0° on either the inside or outside scale.
- Read the measurement where the other line of the angle crosses the scale on the protractor.

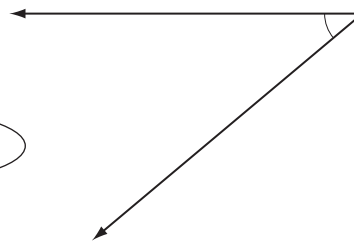
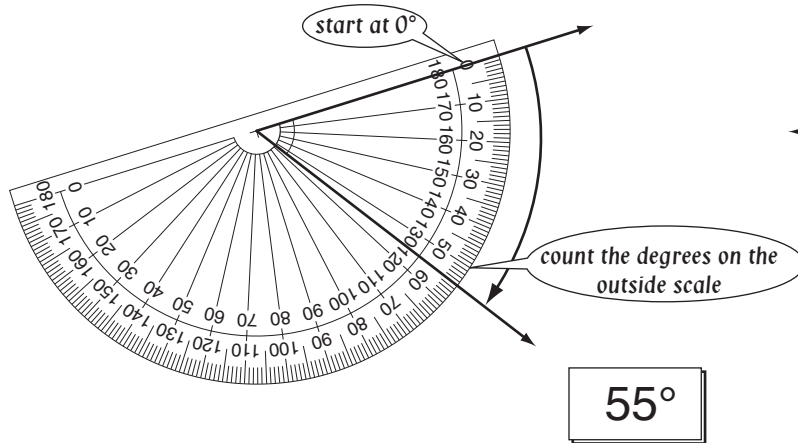
Q. Use a protractor to measure this angle.

A. 110°



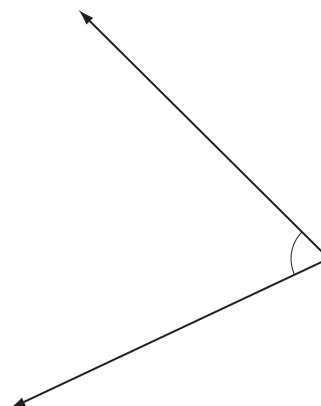
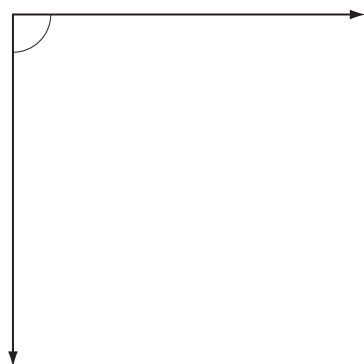
a) Use a protractor to measure this angle.

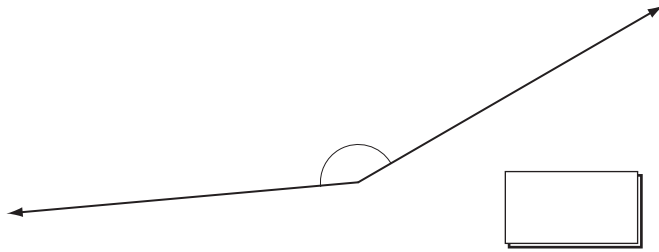
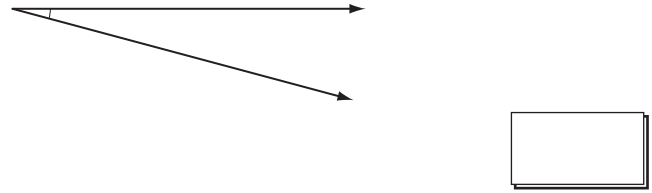
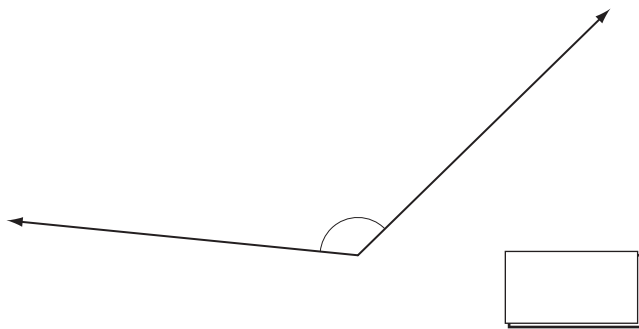
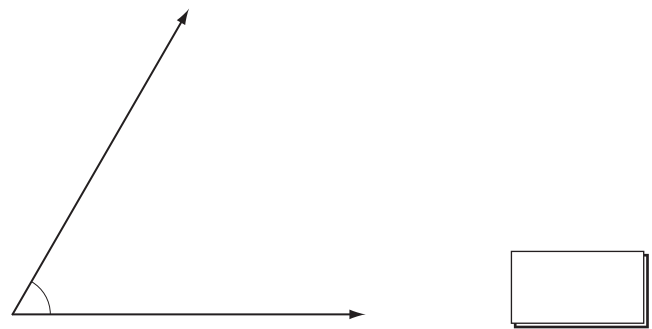
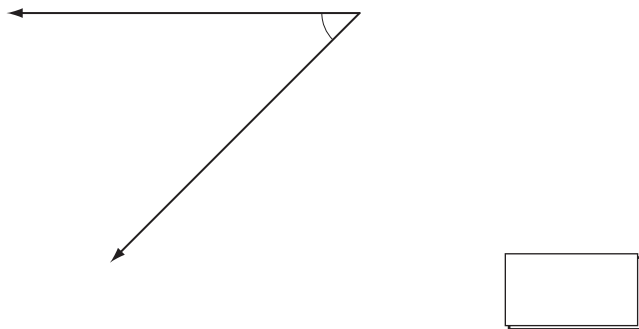
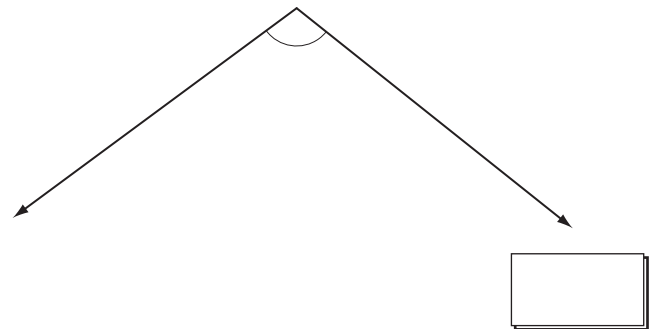
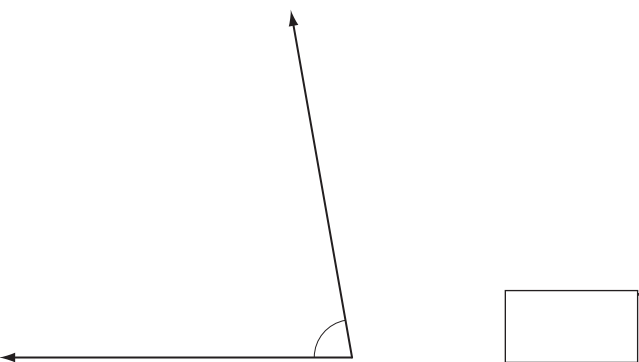
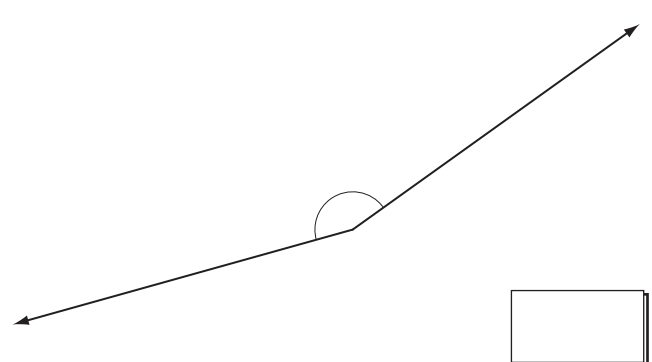
b) Use a protractor to measure this angle.



c) Use a protractor to measure this angle.

d) Use a protractor to measure this angle.



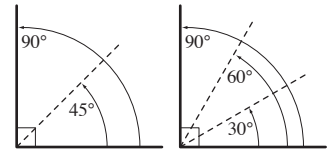
Skill 24.1 Measuring angles using a protractor (2).MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4**e)** Use a protractor to measure this angle.**f)** Use a protractor to measure this angle.**g)** Use a protractor to measure this angle.**h)** Use a protractor to measure this angle.**i)** Use a protractor to measure this angle.**j)** Use a protractor to measure this angle.**k)** Use a protractor to measure this angle.**l)** Use a protractor to measure this angle.

Skill 24.2 Estimating the size of angles (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

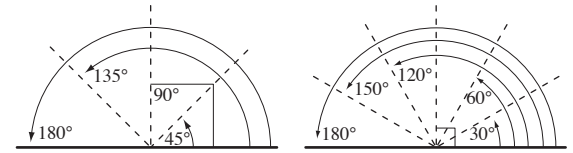
To estimate the size of an acute angle:

- Draw a right angle (90°) overlapping one line of the given angle.
- Divide the right angle into smaller divisions, e.g. halves or thirds.

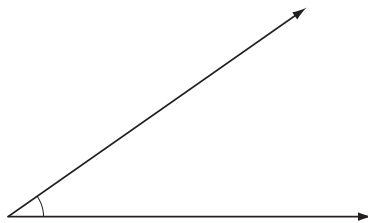


To estimate the size of an obtuse angle:

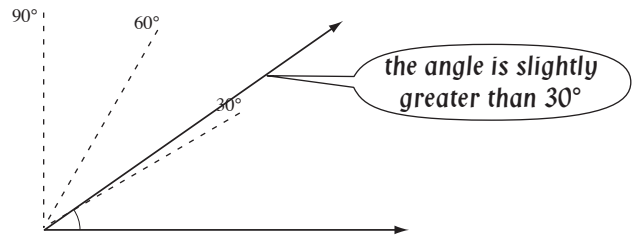
- Draw a straight angle (180°) overlapping one line of the given angle.
- Divide the straight angle into smaller divisions, e.g. quarters or sixths.



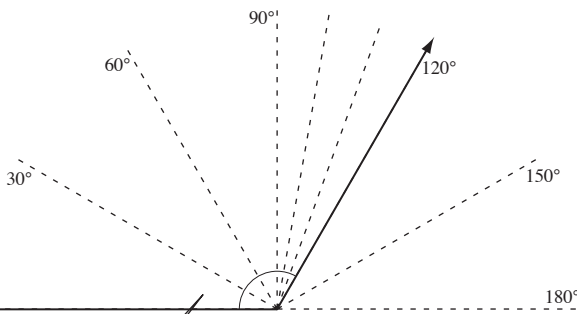
Q. Without measuring, would you estimate that the size of this angle is closer to 35° or to 50° ?



A. 35°



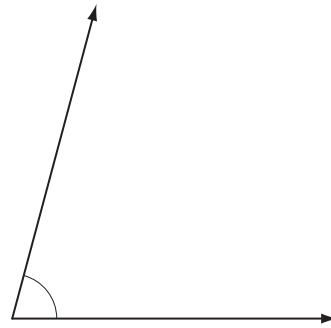
a) Without measuring, would you estimate that the size of this angle is closer to 110° or to 120° ?



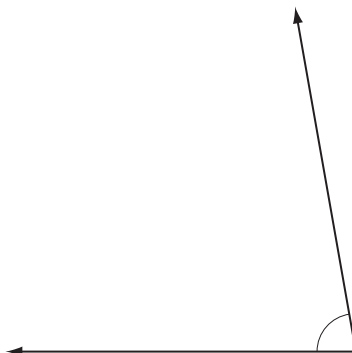
the angle is very close to 120°

120°

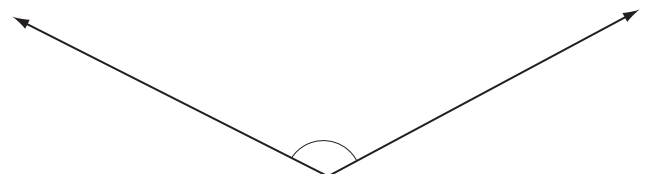
b) Without measuring, would you estimate that the size of this angle is closer to 75° or to 90° ?



c) Without measuring, would you estimate that the size of this angle is closer to 70° or to 80° ?



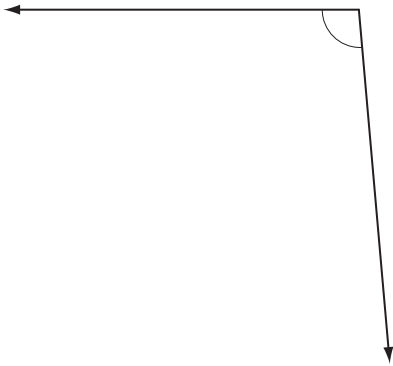
d) Without measuring, would you estimate that the size of this angle is closer to 125° or to 140° ?



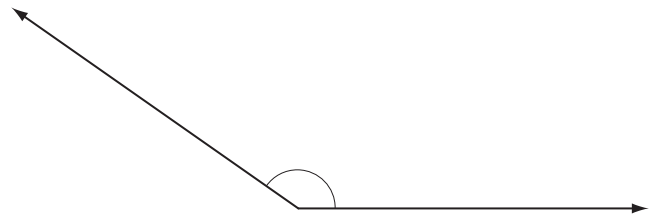
Skill 24.2 Estimating the size of angles (2).

MMBlue 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

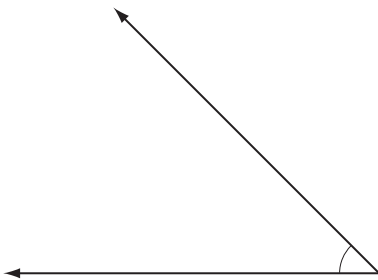
- e) Without measuring, would you estimate that the size of this angle is closer to 95° or to 110° ?



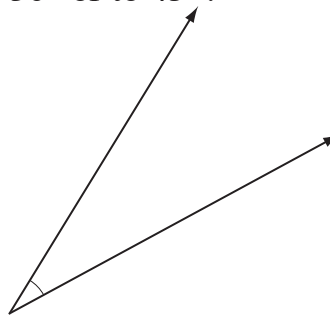
- f) Without measuring, would you estimate that the size of this angle is closer to 135° or to 145° ?



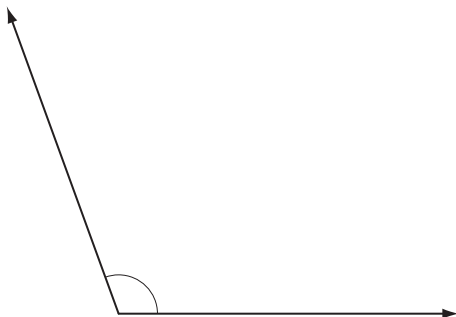
- g) Without measuring, would you estimate that the size of this angle is closer to 45° or to 60° ?



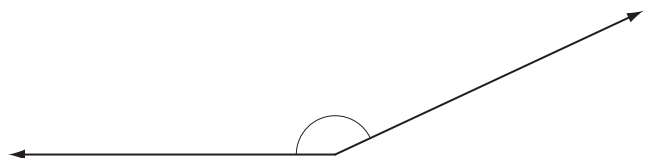
- h) Without measuring, would you estimate that the size of this angle is closer to 30° or to 45° ?



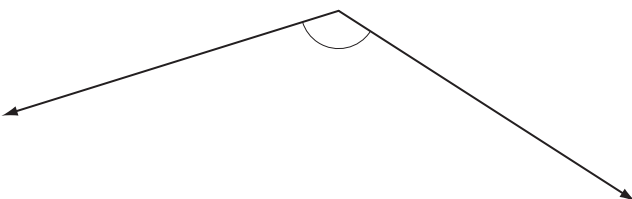
- i) Without measuring, would you estimate that the size of this angle is closer to 95° or to 110° ?



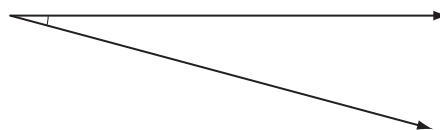
- j) Without measuring, would you estimate that the size of this angle is closer to 155° or to 170° ?



- k) Without measuring, would you estimate that the size of this angle is closer to 130° or to 150° ?



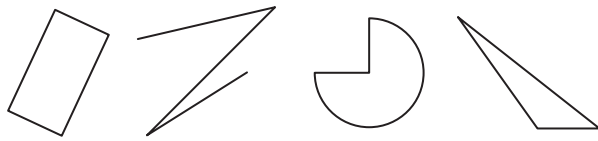
- l) Without measuring, would you estimate that the size of this angle is closer to 5° or to 15° ?



Skill 24.3 Recognizing polygons and quadrilaterals.

- Consider the definition of a polygon. (see Glossary, page 348)
- Consider the definition of a quadrilateral. (see Glossary, page 352)

Q. Circle the shapes that are **not** polygons.

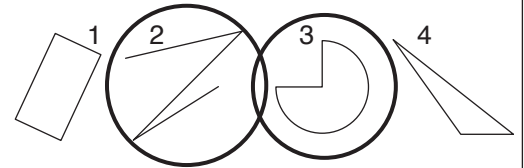


A. 1st shape - closed shape with all sides line segments (polygon)

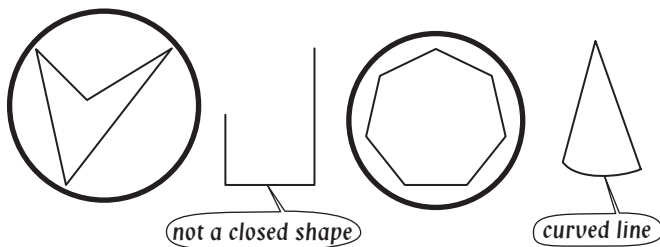
2nd shape - not a closed shape (**not a polygon**)

3rd shape - closed shape with two sides line segments and a curved line (**not a polygon**)

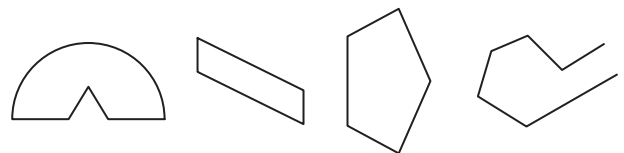
4th shape - closed shape with all sides line segments (polygon)



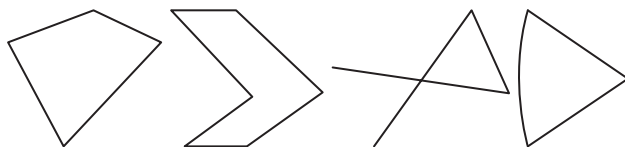
a) Circle the shapes that are polygons.



b) Circle the shapes that are **not** polygons.



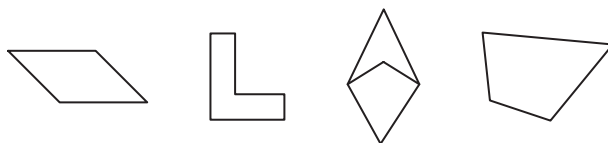
c) Circle the shapes that are polygons.



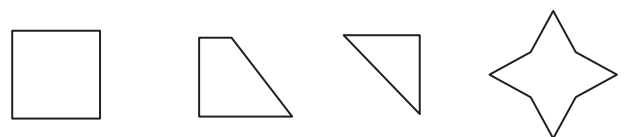
d) Circle the shapes that are **not** polygons.



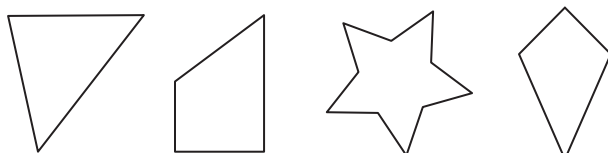
e) Circle the shapes that are quadrilaterals.



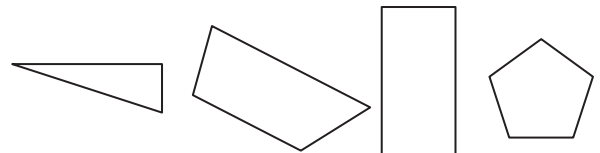
f) Circle the shapes that are quadrilaterals.



g) Circle the shapes that are quadrilaterals.



h) Circle the shapes that are **not** quadrilaterals.



Skill 24.4 Classifying and describing the properties of quadrilaterals.

- Consider the properties of squares, rectangles, rhombi, parallelograms, kites and trapezoids. (see Glossary, page 352)

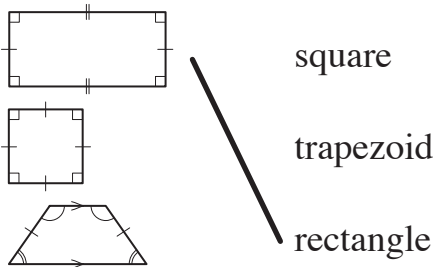
Q. I am a quadrilateral with no parallel sides. I have one pair of opposite angles equal, and my diagonals intersect at right angles. What am I?

- A) a rhombus
- B) a trapezoid
- C) a kite
- D) a square

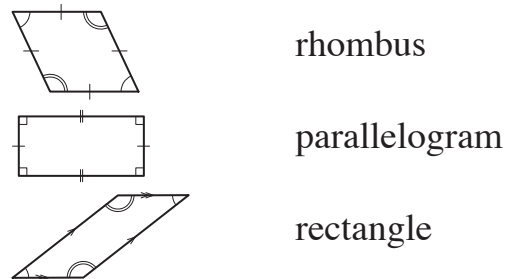
- A.** A) a rhombus has opposite sides parallel \Rightarrow A false
 B) a trapezoid has one pair of opposite sides parallel \Rightarrow B false
 C) a kite has a pair of opposite angles equal and diagonals intersecting at right angles \Rightarrow C true
 D) a square has opposite sides parallel \Rightarrow D false

The answer is **C**.

a) Match each quadrilateral to its name:



b) Match each quadrilateral to its name:



c) I am a 2-dimensional shape with four sides. Both my pairs of opposite sides are parallel. All angles are equal to 90° . What am I?

- A) a trapezoid
- B) a rectangle
- C) a rhombus
- D) a parallelogram



d) I am a quadrilateral with all my sides equal in length. My diagonals intersect at right angles, but are not equal in length. What am I?

- A) a kite
- B) a rectangle
- C) a rhombus
- D) a parallelogram



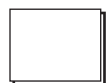
e) I am a 2-dimensional shape with four sides. My diagonals are equal, and all my sides are equal. What am I?

- A) a rhombus
- B) a rectangle
- C) a parallelogram
- D) a square

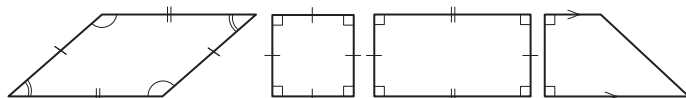


f) I am a quadrilateral with all my angles equal to 90° . My diagonals are equal in length. What am I?

- A) a trapezoid
- B) a parallelogram
- C) a rectangle
- D) a rhombus



g) Circle the shape that is **not** a parallelogram.



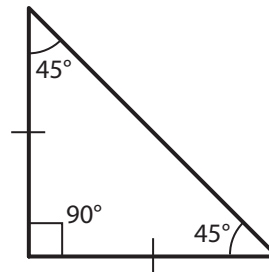
h) Circle the shape that is a rhombus.



Skill 24.5 Drawing lines and polygons.

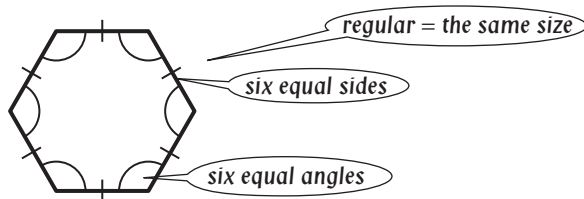
- Consider the definitions of triangles, squares, rectangles, rhombi, parallelograms, kites, trapezoids and regular polygons. (see Glossary)
- Mark:
 - Right angles with a corner (\perp).
 - Congruent angles with similar curved lines (\frown)
(the second pair of congruent angles takes on a pair of curved lines).
 - Congruent sides with a dash ($|$)
(the second pair of congruent lines takes on a pair of dashes).
 - Parallel lines with an arrow ($>$)
(the second pair of parallel lines take on a second pair of arrows).

Q. Draw an isosceles right triangle marking the congruent sides and congruent angles.



One corner marking the right angle (90°).
One dash marking each of the congruent sides.
One curved line marking each of the congruent angles (45°).

a) Draw a regular hexagon marking the congruent sides and congruent angles.



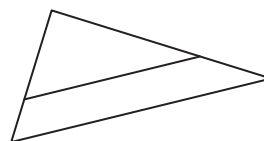
b) Draw a rectangle marking all congruent sides and diagonals.

c) Draw a rhombus marking all congruent sides and perpendicular diagonals.

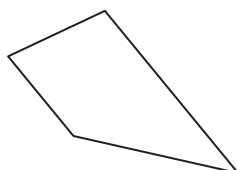
d) Draw an isosceles obtuse triangle marking the congruent sides and congruent angles.

e) Draw a regular pentagon marking the congruent sides and congruent angles.

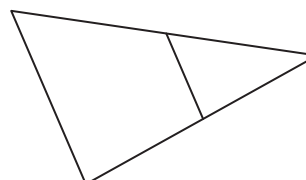
f) Use arrows to show the pair of parallel lines in this diagram.



g) Use arrows to show the pair of parallel lines in this diagram.

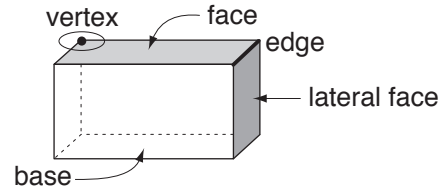


h) Use arrows to show the pair of parallel lines in this diagram.



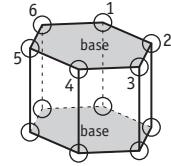
Skill 24.6 Classifying and describing the properties of 3D shapes.

- Count the number of:
 - faces
 - edges
 - vertices (points/corners)

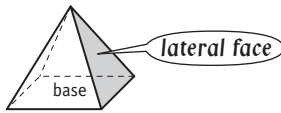


Q. How many vertices are there in a hexagonal prism?

A. Count the vertices, or corners in the prism:
six vertices in one base and
six vertices in the other base
The answer is **12**



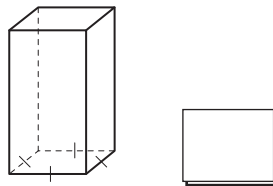
a) The base of a rectangular pyramid is a rectangle. What shape are the lateral faces?



b) The base of a pentagonal prism is a pentagon. What shape are the lateral faces?

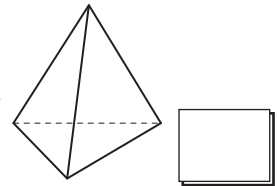
c) What is the name of this solid?

- A) triangular prism
- B) square prism
- C) square pyramid
- D) rectangular prism

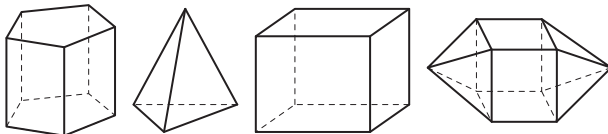


d) What is the name of this solid?

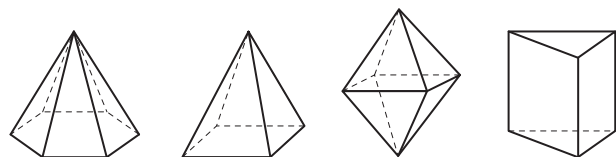
- A) triangular pyramid
- B) square pyramid
- C) rectangular pyramid
- D) triangular prism



e) Circle the shapes that are **not** prisms.



f) Circle the shapes that are **not** pyramids.



g) How many edges are there on a triangular prism?

h) How many edges are there on a cube?

i) How many vertices are there on a pentagonal pyramid?

j) How many faces are there on a square pyramid?

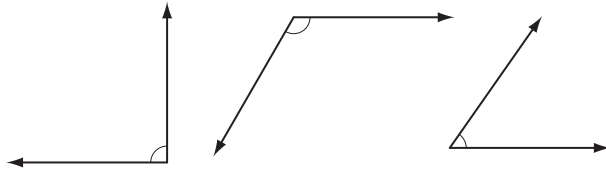
k) Sketch and name the three-dimensional shape that has two square faces and four rectangular faces.

l) Sketch and name the three-dimensional shape that has one rectangular face and four triangular faces.

Skill 24.7 Classifying angles.

- Consider the definitions and properties of a variety of angles. (see Glossary and Math Facts)
Hints: An angle can be classified according to its size (acute, right, obtuse, straight and reflex).
Two angles can be classified according to their position in relation to one another (adjacent, supplementary, complementary or vertical).

Q. Circle the obtuse angle.



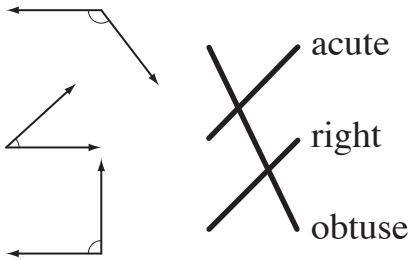
A.

right angle = 90°

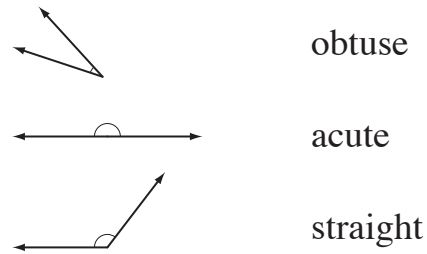
obtuse angle \rightarrow greater than 90°
less than 180°

acute angle \rightarrow less than 90°

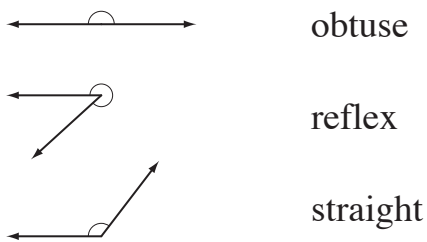
a) Match each angle to its description:



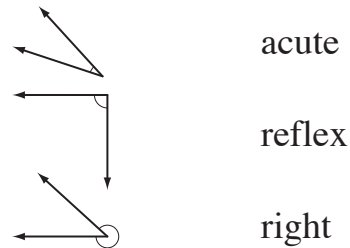
b) Match each angle to its description:



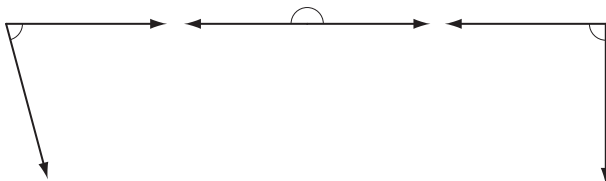
c) Match each angle to its description:



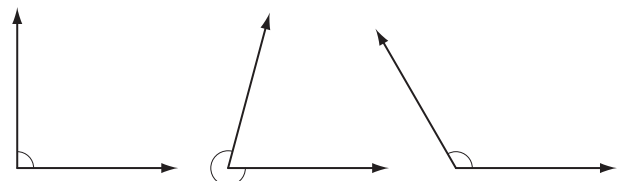
d) Match each angle to its description:



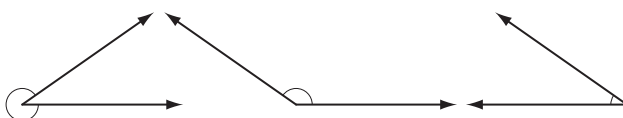
e) Circle the right angle.



f) Circle the reflex angle.



g) Circle the acute angle.



h) Circle the obtuse angle.



Skill 24.8 Classifying and describing the properties of triangles.

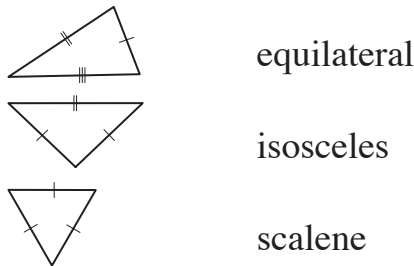
MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Look for equal sides or equal angles.
- Look at the types of angles inside the triangle.

Sides and angles	Triangle type
no equal sides/angles	scalene
two equal sides/angles	isosceles
three equal sides/angles	equilateral

Angles	Triangle type
all acute angles	acute
one right angle	right
one obtuse angle	obtuse

Q. Match each triangle to its description:



A.

no equal sides ⇒ **scalene**

two equal sides ⇒ **isosceles**

three equal sides ⇒ **equilateral**

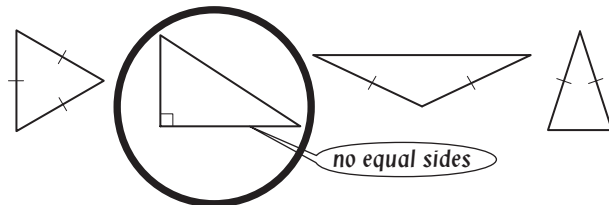
⇒

equilateral

isosceles

scalene

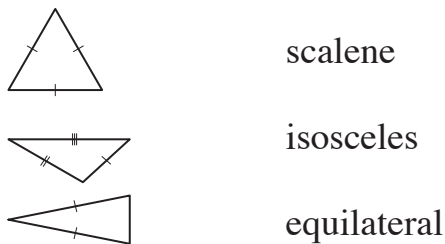
a) Circle the triangle that is **not** isosceles.



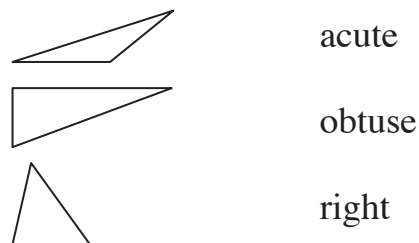
b) Circle the triangle that is obtuse.



c) Match each triangle to its description:



d) Match each triangle to its description:



e) I am a 2-dimensional shape with three sides. I have two of my sides of equal length. What am I?

- A) a square
- B) a right triangle
- C) an isosceles triangle
- D) an equilateral triangle



f) I am a 2-dimensional shape with three sides. I have an obtuse angle. What am I?

- A) an acute triangle
- B) a right triangle
- C) an equilateral triangle
- D) an obtuse triangle



Skill 24.9 Working with vertical angles and complementary angles.

- Use the properties:
 - the sum of complementary angles is 90° .
 - two vertical angles are congruent.

To find the size of an angle when its complementary angle/angles are given:

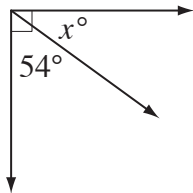
EITHER

- Subtract the given angles from 90° .

OR

- Write an equation involving the unknown angle x° .
- Solve the equation for x° .

Q. Find the value of x° .



A. x° and 54° are complementary: OR

$$x^\circ + 54^\circ = 90^\circ$$

$$x^\circ = 90^\circ - 54^\circ$$

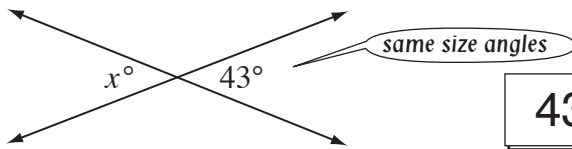
$$= 36^\circ$$

$$x^\circ + 54^\circ = 90^\circ$$

$$x^\circ + 54^\circ - 54^\circ = 90^\circ - 54^\circ$$

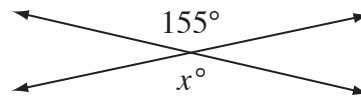
$$x^\circ = 36^\circ$$

a) Find the value of x° .



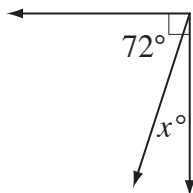
$$43^\circ$$

b) Find the value of x° .



$$\boxed{}$$

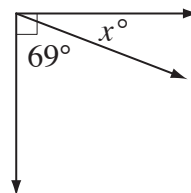
c) Find the value of x° .



$$x^\circ = 90^\circ - 72^\circ$$

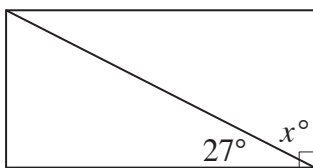
$$x^\circ = \boxed{}$$

d) Find the value of x° .



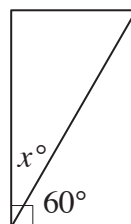
$$x^\circ = \boxed{}$$

e) Find the value of x° .



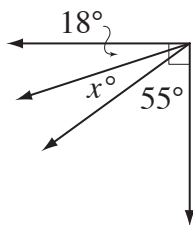
$$x^\circ = \boxed{}$$

f) Find the value of x° .



$$x^\circ = \boxed{}$$

g) Find the value of x° .



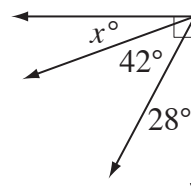
$$x^\circ + 18^\circ + 55^\circ = 90^\circ$$

$$x^\circ + 73^\circ = 90^\circ$$

$$x^\circ + 73^\circ - 73^\circ = 90^\circ - 73^\circ$$

$$x^\circ = \boxed{}$$

h) Find the value of x° .



$$\boxed{}$$

$$\boxed{}$$

$$x^\circ = \boxed{}$$

Skill 24.10 Working with supplementary angles.

- Use the property:
- the sum of supplementary angles is 180° .

To find the size of an angle when its supplementary angle/angles are given:

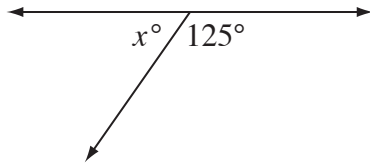
EITHER

- Subtract the given angles from 180° .

OR

- Write an equation involving the unknown angle x° .
- Solve the equation for x° .

Q. Find the value of x° .



A. x° and 125° are supplementary: OR

$$x^\circ + 125^\circ = 180^\circ$$

$$x^\circ = 180^\circ - 125^\circ$$

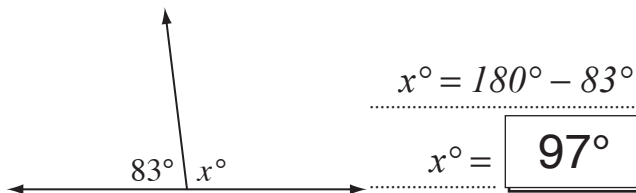
$$= 55^\circ$$

$$x^\circ + 125^\circ = 180^\circ$$

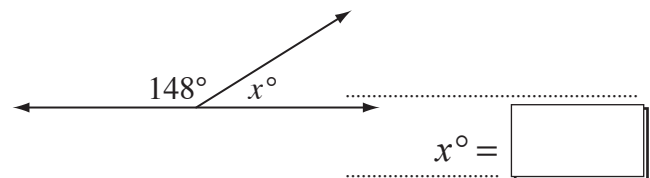
$$x^\circ + 125^\circ - 125^\circ = 180^\circ - 125^\circ$$

$$x^\circ = 55^\circ$$

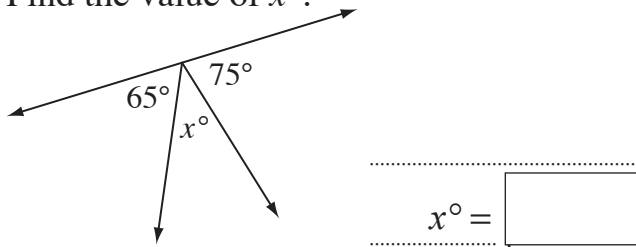
a) Find the value of x° .



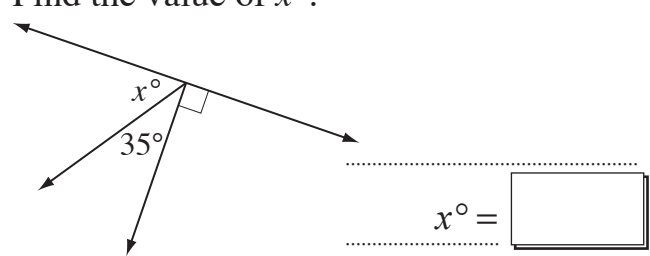
b) Find the value of x° .



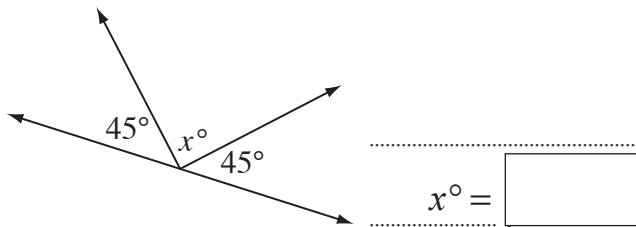
c) Find the value of x° .



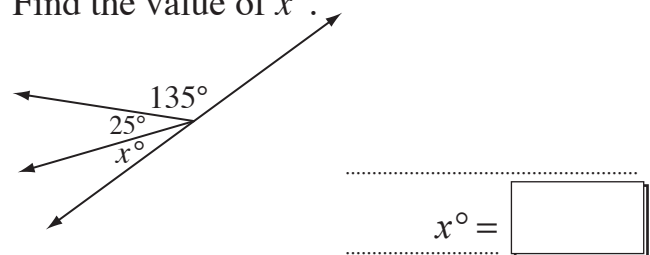
d) Find the value of x° .



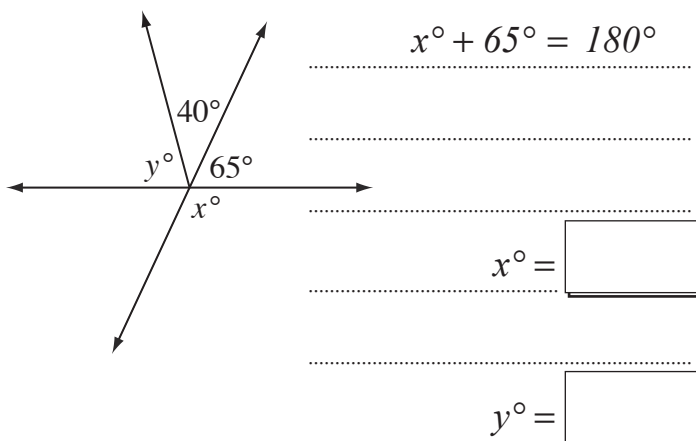
e) Find the value of x° .



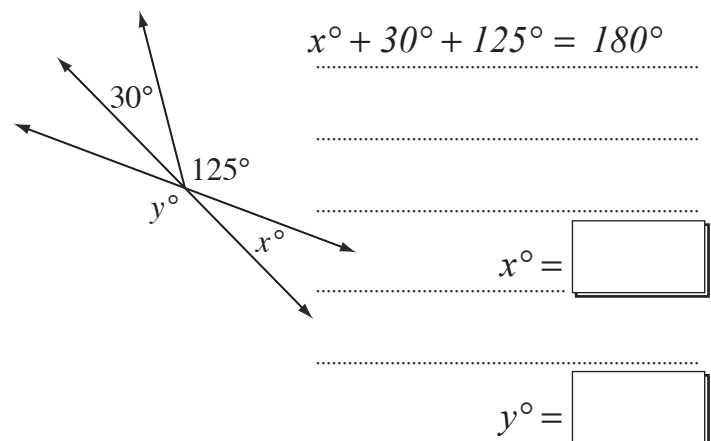
f) Find the value of x° .



g) Find the values of x° and y° .



h) Find the values of x° and y° .



Skill 24.11 Finding the size of angles inside a triangle.

- Use the property:
 - the sum of the interior angles of any triangle is 180° .

To find the size of an angle of a triangle when the other two angles are given:

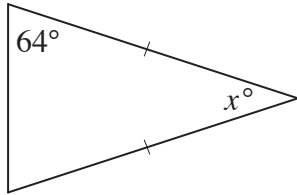
EITHER

- Subtract the sum of the given angles from 180° .

OR

- Write an equation involving the unknown angle x° .
- Solve the equation for x° .

Q. Find the value of x° .

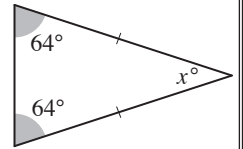


A. *Isosceles triangle* \Rightarrow base angles are equal:

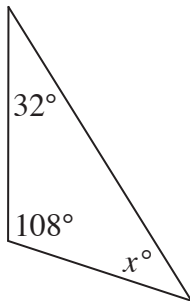
$$\begin{aligned} x^\circ &= 180^\circ - (64^\circ + 64^\circ) \\ &= 180^\circ - 128^\circ \\ &= 52^\circ \end{aligned}$$

OR

$$\begin{aligned} x^\circ + 64^\circ + 64^\circ &= 180^\circ \\ x^\circ + 128^\circ - 128^\circ &= 180^\circ - 128^\circ \\ x^\circ &= 52^\circ \end{aligned}$$



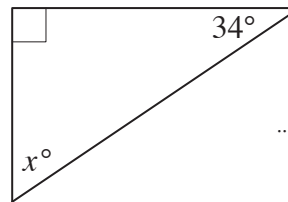
a) Find the value of x° .



$$\begin{aligned} x^\circ &= 180^\circ - (32^\circ + 108^\circ) \\ &= 180^\circ - 140^\circ \end{aligned}$$

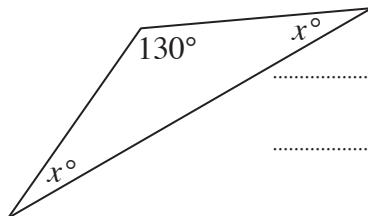
$$x^\circ = \boxed{40^\circ}$$

b) Find the value of x° .



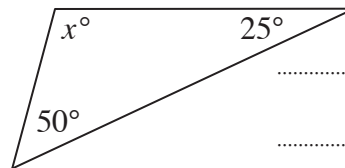
$$x^\circ = \boxed{}$$

c) Find the value of x° .



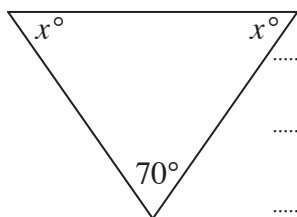
$$x^\circ = \boxed{}$$

d) Find the value of x° .



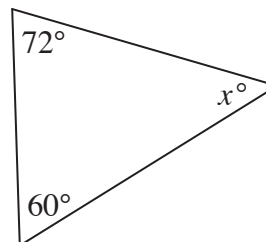
$$x^\circ = \boxed{}$$

e) Find the value of x° .



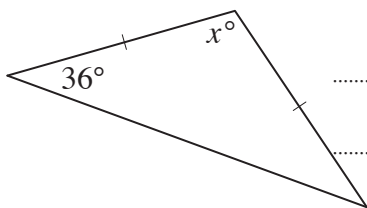
$$x^\circ = \boxed{}$$

f) Find the value of x° .



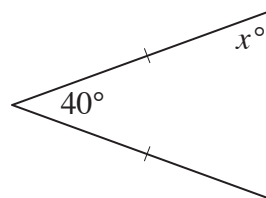
$$x^\circ = \boxed{}$$

g) Find the value of x° .



$$x^\circ = \boxed{}$$

h) Find the value of x° .



$$x^\circ = \boxed{}$$

Skill 24.12 Finding the size of angles inside a quadrilateral.

MMBlue 11 22 33 44
MMGreen 11 22 33 44

- Use the property:
 - the sum of the interior angles of any quadrilateral is 360° .

To find the size of an angle of a quadrilateral when the other three angles are given:

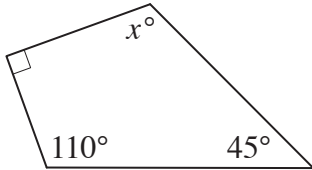
EITHER

- Subtract the sum of the given angles from 360° .

OR

- Write an equation involving the unknown angle x° .
- Solve the equation for x° .

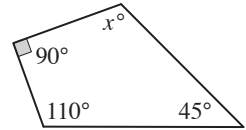
Q. Find the value of x° .



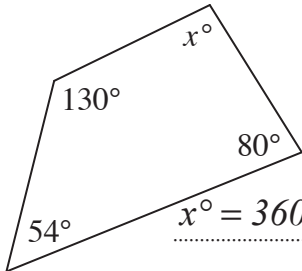
$$\begin{aligned} \mathbf{A.} \quad x^\circ &= 360^\circ - (90^\circ + 110^\circ + 45^\circ) \\ &= 360^\circ - 245^\circ \\ &= \mathbf{115^\circ} \end{aligned}$$

OR

$$\begin{aligned} x^\circ + 90^\circ + 110^\circ + 45^\circ &= 360^\circ \\ x^\circ + 245^\circ - 245^\circ &= 360^\circ - 245^\circ \\ x^\circ &= \mathbf{115^\circ} \end{aligned}$$

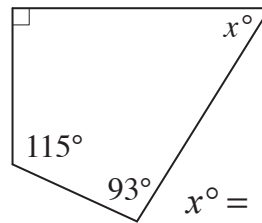


a) Find the value of x° .



$$\begin{aligned} x^\circ &= 360^\circ - (130^\circ + 54^\circ + 80^\circ) \\ &= 360^\circ - 264^\circ = \mathbf{96^\circ} \end{aligned}$$

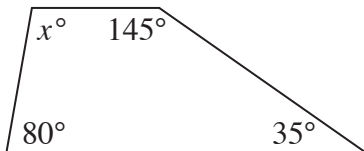
b) Find the value of x° .



$$x^\circ =$$

=

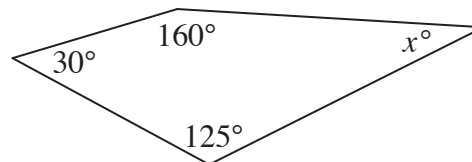
c) Find the value of x° .



$$x^\circ =$$

=

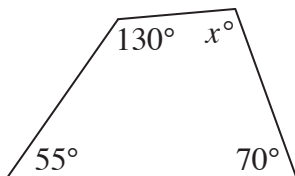
d) Find the value of x° .



$$x^\circ =$$

=

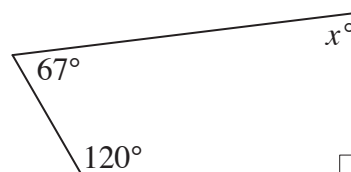
e) Find the value of x° .



$$x^\circ =$$

=

f) Find the value of x° .



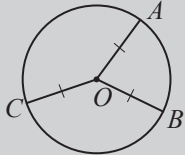
$$x^\circ =$$

=

Skill 24.13 Describing the properties of circles.

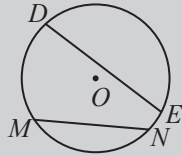
- Consider the definitions and properties of radius (plural radii), chord, diameter, tangent and circumference of a circle. (see Glossary and Math Facts)

Radius - joins the center with any point on the circle

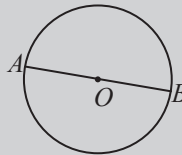


$OA = OB = OC$

Chord - joins any two points on the circle



Diameter - a chord passing through the center

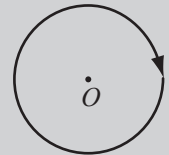


$AB = 2OA$

Tangent - a line touching the circle in one point

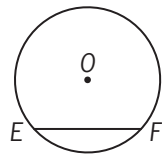


Circumference - the distance around the circle



Q. What is \overline{EF} in this diagram?

- A) diameter
- B) tangent
- C) chord
- D) radius



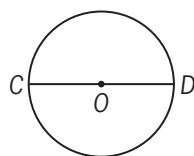
A. \overline{EF} joins two points on the circle & does not pass through the center \Rightarrow **chord**

a) Match each diagram to its description:

b) Match each diagram to its description:

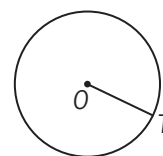
c) What is \overline{CD} in this diagram?

- A) tangent
- B) diameter
- C) radius
- D) circumference

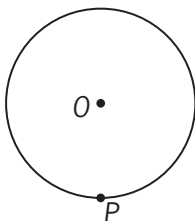


d) What is \overline{OT} in this diagram?

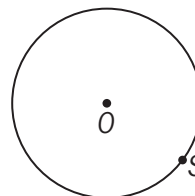
- A) chord
- B) tangent
- C) diameter
- D) radius



e) Draw the diameter passing through P .



f) Draw the radius passing through S .



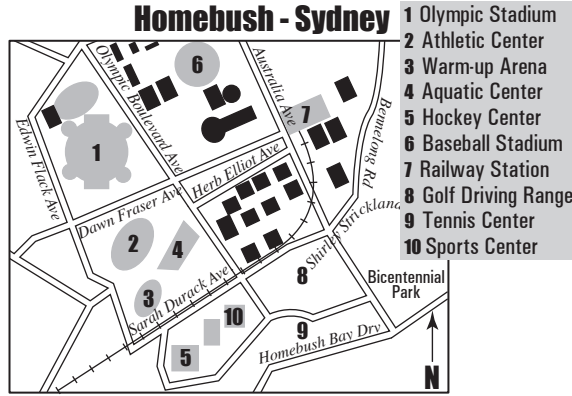
25. [Exploring Geometry]

Skill 25.1 Following directions and using compass bearings to describe location on a map.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

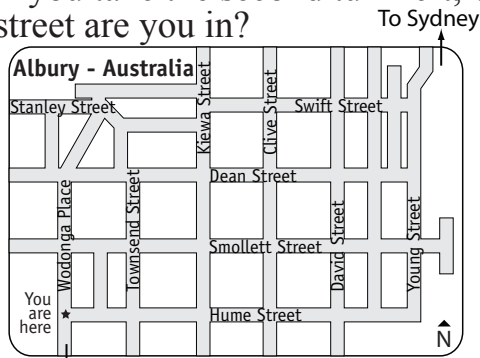
- Follow the directions one at a time.
*Hints: A compass showing North will allow you to find your bearings.
Clockwise from North, "Never Eat Sea Weed" is one way to remember the 4-point compass.*

Q. At Homebush, in which direction is the Olympic Stadium from the Golf Driving Range?



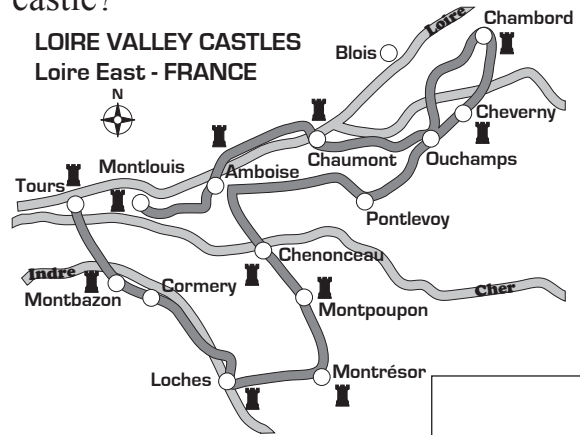
A. NW Focus on the relevant information.

a) From where you are, travel east until you reach David Street. Then walk north. If you take the second turn left, what street are you in?

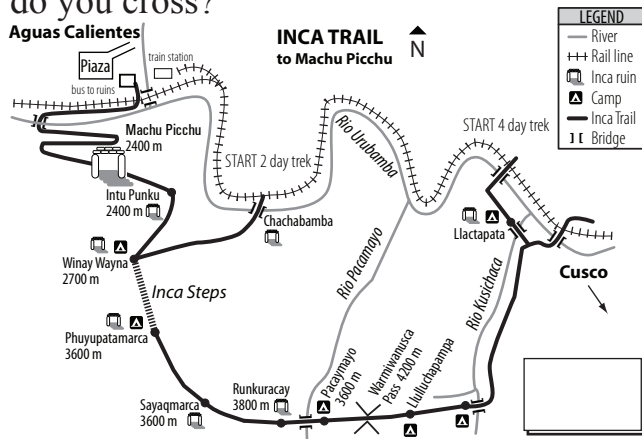


To Melbourne

b) From Montrésor castle, which direction do you have to drive to reach Loches castle?



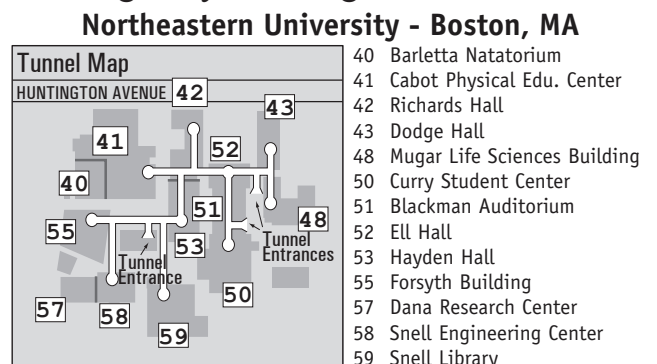
c) From the northern most bridge over Rio Kusichaca you travel south east on the Inca Trail until the T intersection. Then you turn right and follow the Inca Trail to the Inca Steps. How many more bridges do you cross?



LEGEND

- River
- +++ Rail line
- 🏛️ Inca ruin
- ⛑️ Camp
- 🚶 Inca Trail
- ⚖️ Bridge

d) Using the closest tunnel entrance to building 58, take the first turn right, then turn left. Turn right and walk to the end of the tunnel. If you turn left again, which building are you facing?



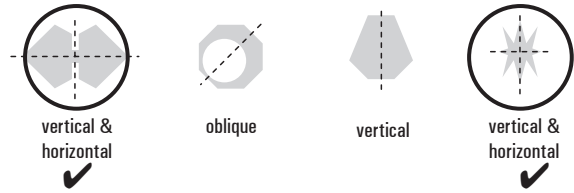
Skill 25.2 Identifying and classifying symmetry in two-dimensional shapes.

- Imagine a line along which the shape can be folded to have one part fit exactly over the other part.

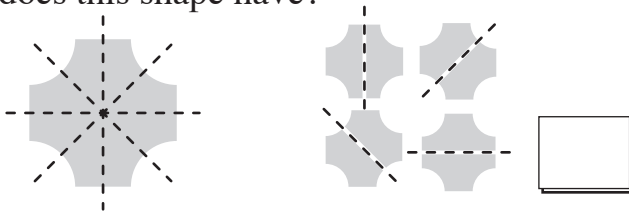
Q. Draw the axes of symmetry for these shapes. Circle the shapes that are both horizontally and vertically symmetrical.



A.



a) Draw all the axes of symmetry for this shape. How many axes of symmetry does this shape have?



b) Draw all the axes of symmetry for this shape. How many axes of symmetry does this shape have?



c) Draw all the axes of symmetry for this shape. How many axes of symmetry does this shape have?



d) Draw all the axes of symmetry for this shape. How many axes of symmetry does this shape have?



e) Draw the axes of symmetry for these shapes. Circle the shapes that have horizontal symmetry.



f) Draw the axes of symmetry for these shapes. Circle the shapes that are both horizontally and vertically symmetrical.



g) Draw the axes of symmetry for these shapes. Circle the shapes that have vertical symmetry.



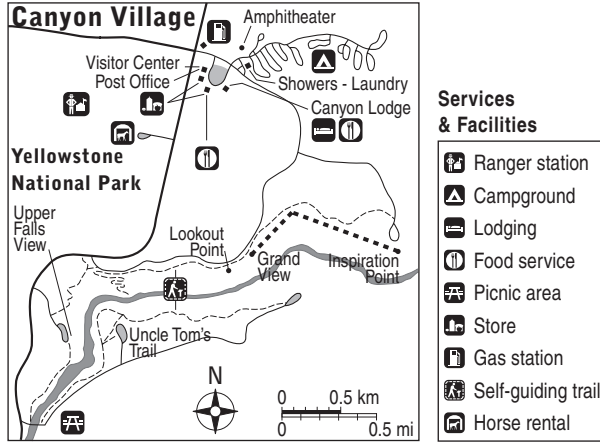
h) Draw the axes of symmetry for these shapes. Circle the shapes that are both horizontally and vertically symmetrical.



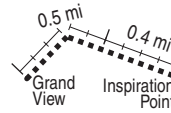
Skill 25.3 Using a scale to calculate distance on a map.

- Place a piece of paper against the scale matching the starting points.
- Slide the paper across the line to be measured, marking the start and end points as you go.
- Add together the scale lengths covered.

Q. You walk from the Inspiration Point to Grand View, along the marked path. What distance did you travel in miles?



A. $0.5 + 0.4 = 0.9 \text{ mi}$



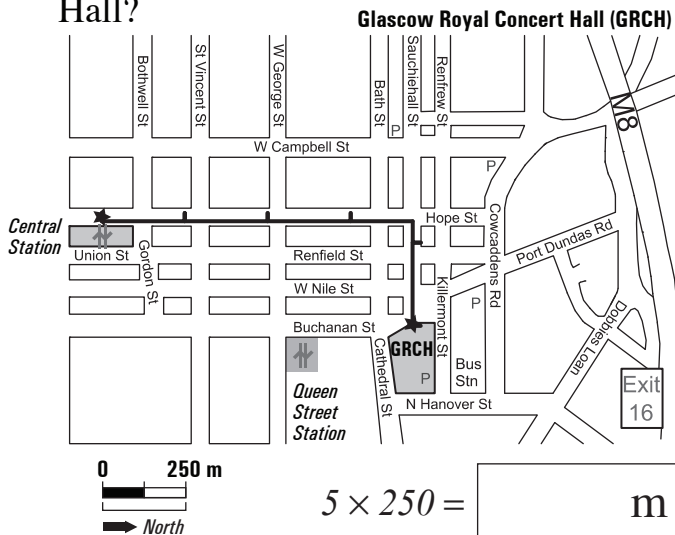
There are 2 distances to be measured.

Mark the start of the first distance and the turning point on paper. Rotate the paper to match the second distance and then mark the end.

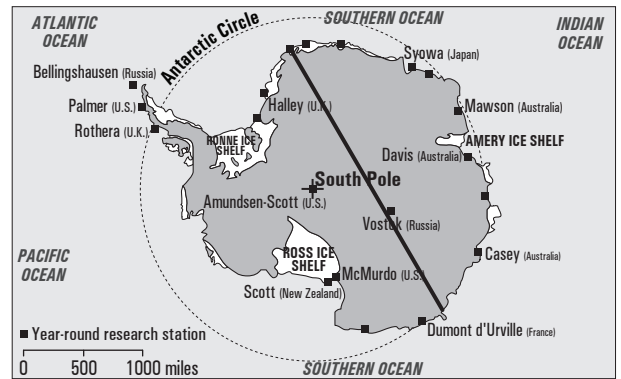
Check the paper against the scale.

Slide the paper along the scale as necessary.

a) How far is it from Central Station, along Hope St. to the Glasgow Royal Concert Hall?



b) Using the scale, what is the marked distance on this map of Antarctica?

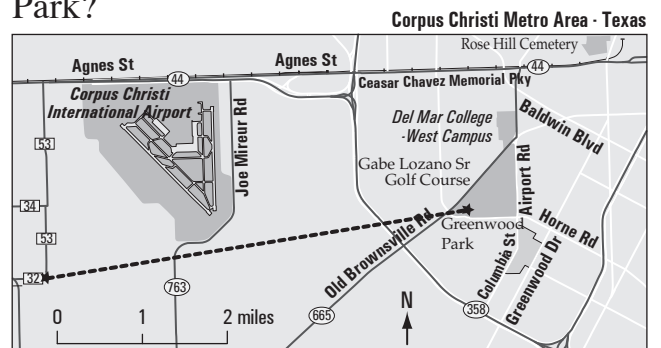


mi

c) A plane flies from Bergen to Copenhagen and then to Stockholm. Using the scale, how far did the plane travel?

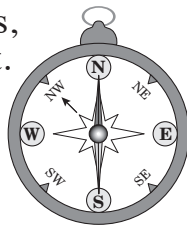


d) Using the scale, what is the marked distance from route 32 to Greenwood Park?

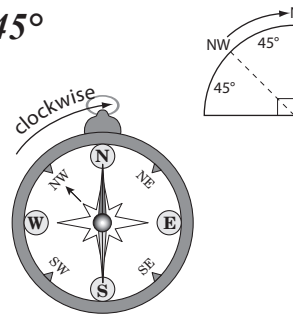


mi

Q. According to the compass, you are facing north-west. How many degrees clockwise must you turn to walk north?



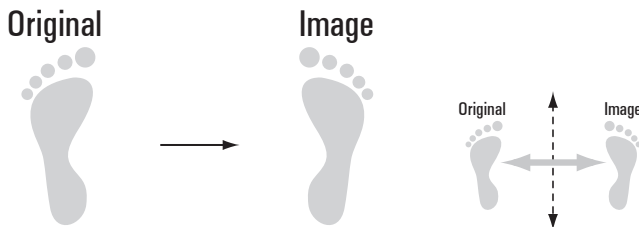
A. 45°



Find the North direction.

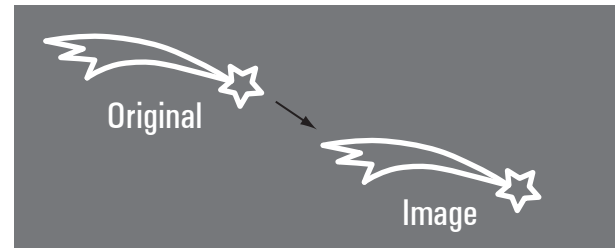
Calculate the number of degrees by picturing a circle.

a) Which transformation (translation, rotation, reflection) has moved this shape to its new position?

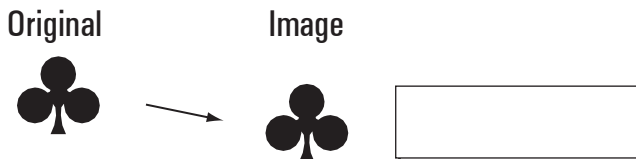


reflection

b) Which transformation (translation, rotation, reflection) has moved this comet to its new position?



c) Which transformation (translation, rotation, reflection) has moved the original shape to its new position?



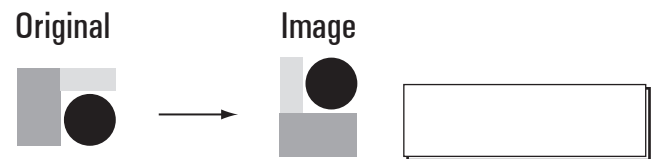
d) Which transformation (translation, rotation, reflection) has moved the original shape to its new position?



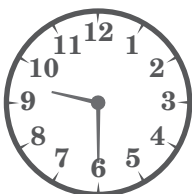
e) Which transformation (translation, rotation, reflection) has moved this shape to its new position?



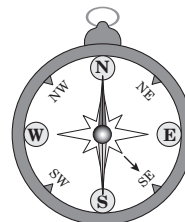
f) Which transformation (translation, rotation, reflection) has moved this shape to its new position?



g) How many degrees must the big hand of this clock turn to show exactly 9:45?



h) According to the compass, you are facing south-east. How many degrees clockwise must you turn to walk west?



Skill 25.5 Drawing translations, reflections and rotations of objects on a grid (1).

Translation (slide)

- Move the shape up (positive, vertically), down (negative, vertically), left (negative, horizontally) or right (positive, horizontally) on the grid, without flipping, turning or changing its size.

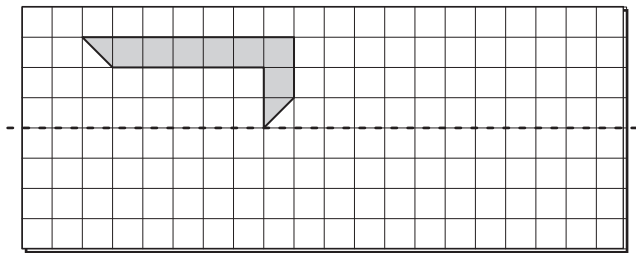
Reflection (like in a mirror)

- Draw a perpendicular line to the mirror line from each vertex of the shape.
- Extend the perpendicular line beyond the mirror line by the same distance.
- Graph and join the reflected points.

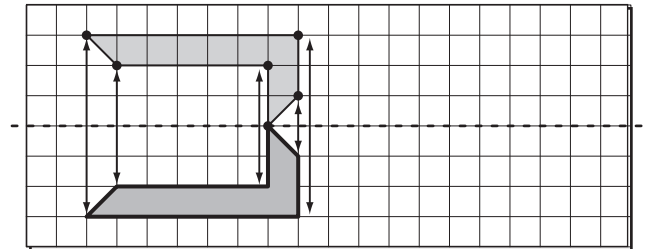
Rotation (turning about a point or center of rotation)

- Rotate each vertex by the given angle, in the given direction.
- Graph and join the rotated points.

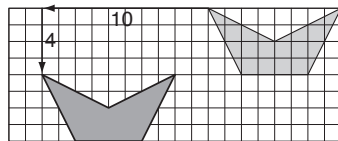
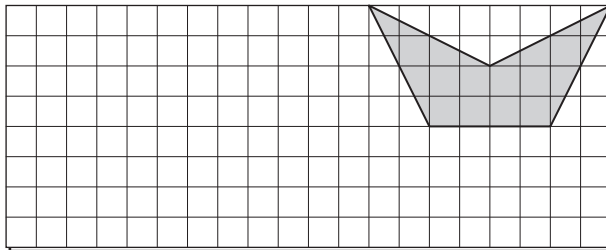
Q. Redraw this shape reflected in the horizontal line.



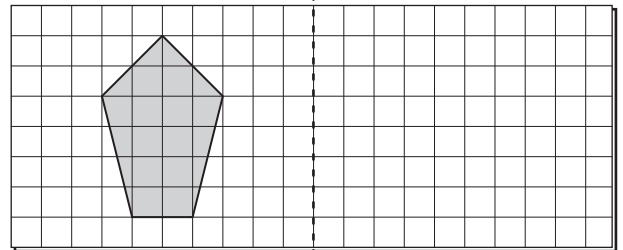
A.



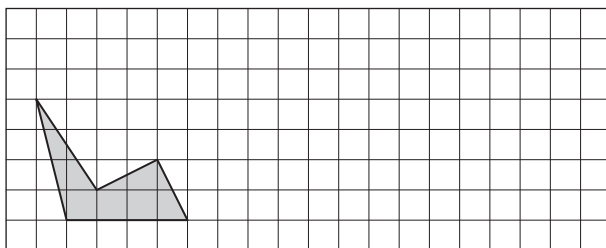
a) Translate this shape 8 units left and 4 units down.



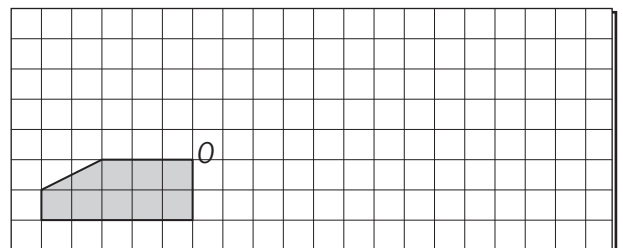
b) Redraw this shape reflected in the vertical line.



c) Translate this shape 3 units up and 10 units right.



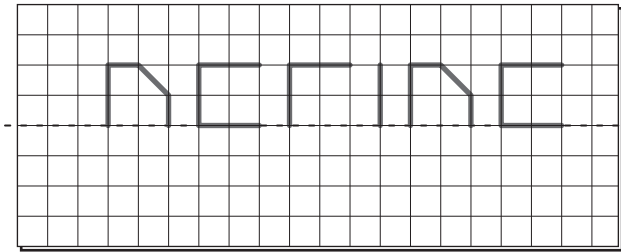
d) Redraw this shape rotated 180° about the point *O*.



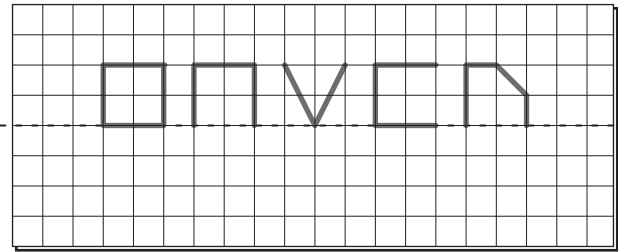
Skill 25.5 Drawing translations, reflections and rotations of objects on a grid (2).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

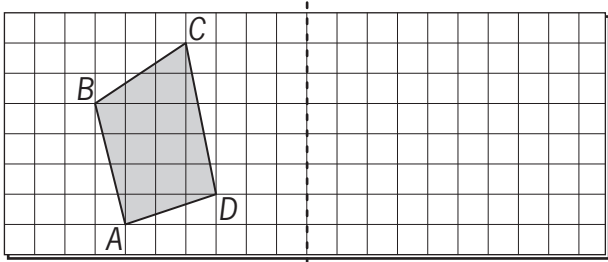
- e) Redraw this diagram reflected in the horizontal line.



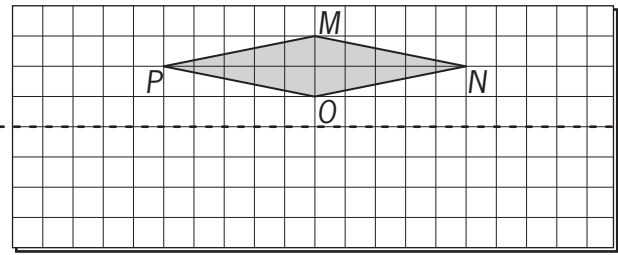
- f) Redraw this diagram reflected in the horizontal line.



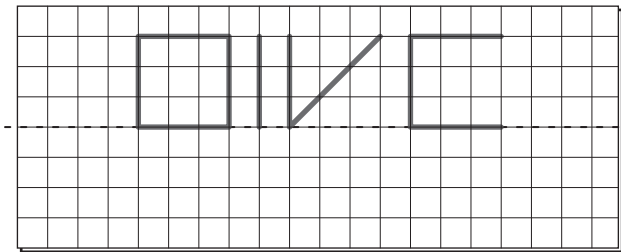
- g) Draw and label the reflection of the quadrilateral $ABCD$ in the vertical line.



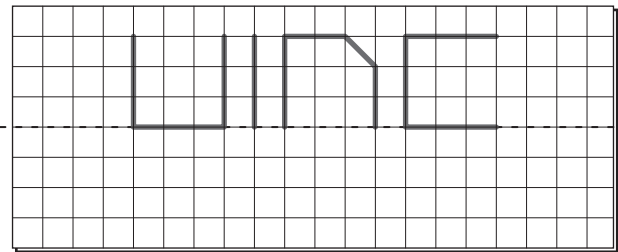
- h) Draw and label the reflection of the rhombus $MNOP$ in the horizontal line.



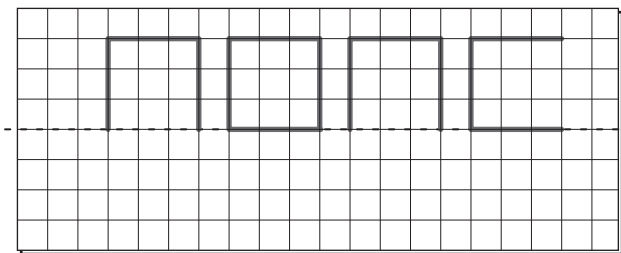
- i) Redraw this diagram reflected in the horizontal line.



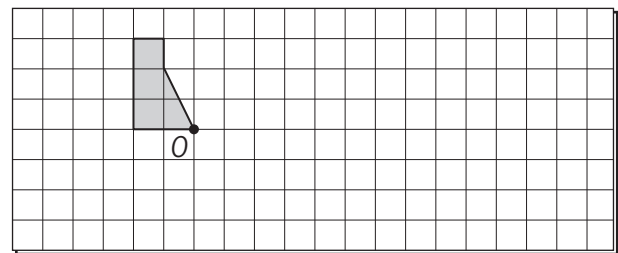
- j) Redraw this diagram reflected in the horizontal line.



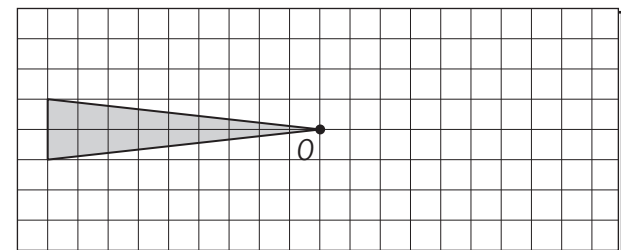
- k) Redraw this diagram reflected in the horizontal line.



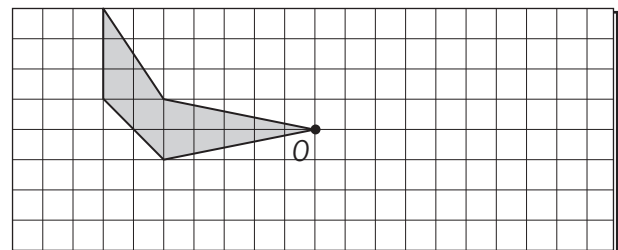
- l) Redraw this shape rotated 180° about the point O .



- m) Redraw this shape rotated 180° about the point O .



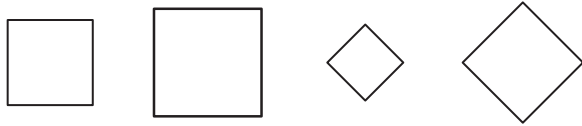
- n) Redraw this shape rotated 180° about the point O .



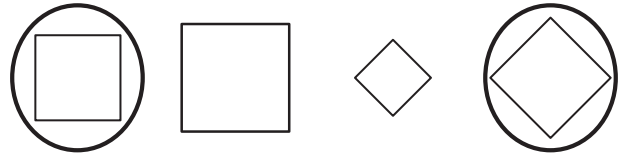
Skill 25.6 Recognizing congruence of two-dimensional shapes.

- Check which shapes are the same shape.
- Check which shapes are the same size.

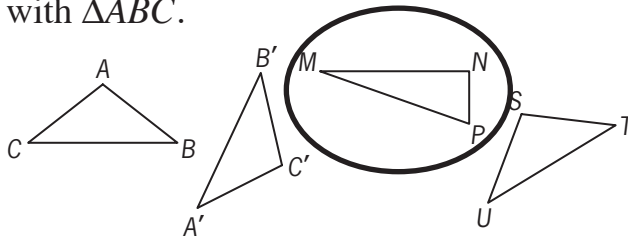
Q. Circle the pair of congruent shapes.



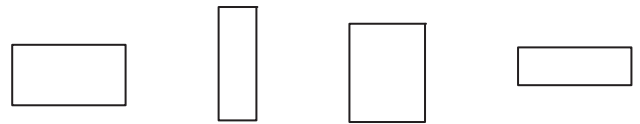
A.



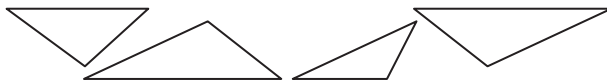
a) Circle the triangle that is **not** congruent with $\triangle ABC$.



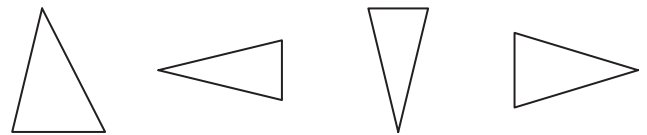
b) Circle the pair of congruent shapes.



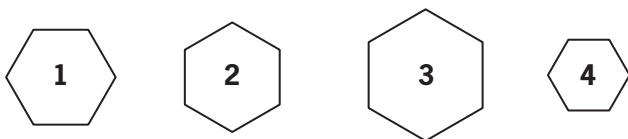
c) Circle the pair of congruent triangles.



d) Circle the pair of congruent triangles.

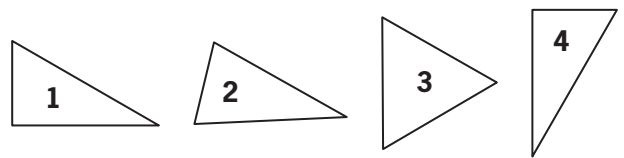


e) Find the pair of congruent hexagons.



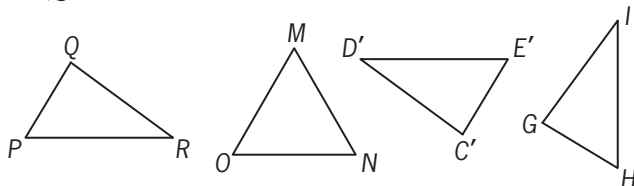
and

f) Find the pair of congruent triangles.

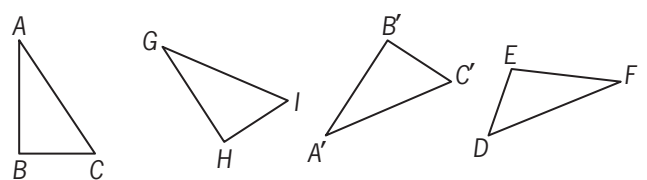


and

g) Which triangle is **not** congruent with $\triangle PQR$?



h) Which triangle is **not** congruent with $\triangle ABC$?

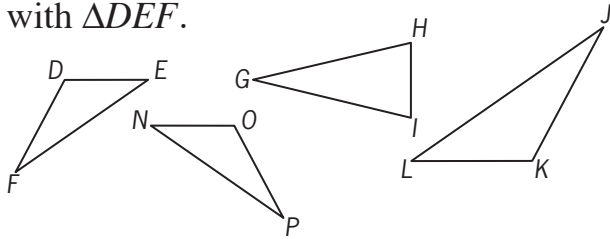


Skill 25.7 Recognizing similarity of two-dimensional shapes.

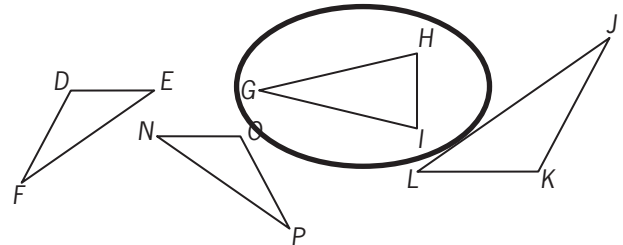
- Check which shapes are the same shape.

Hint: The shapes can be a different size.

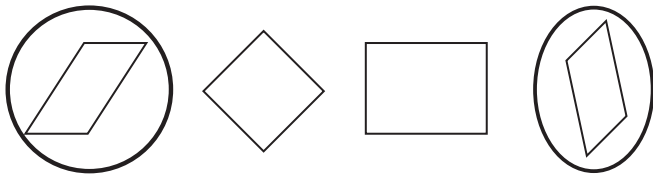
Q. Circle the triangle that is **not** similar with $\triangle DEF$.



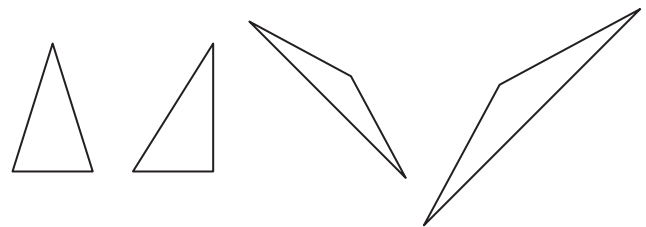
A. $\triangle GHI$ All triangles can be rotated, reflected or enlarged to exactly cover $\triangle DEF$ except for $\triangle GHI$. $\triangle GHI$ looks like an isosceles triangle. $\triangle DEF$ looks like a scalene triangle.



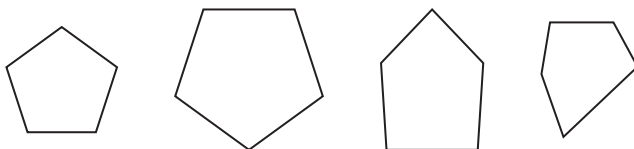
a) Circle the pair of similar shapes.



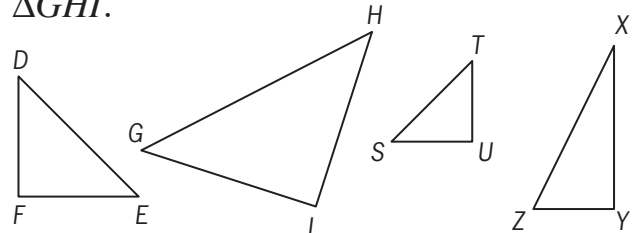
b) Circle the pair of similar triangles.



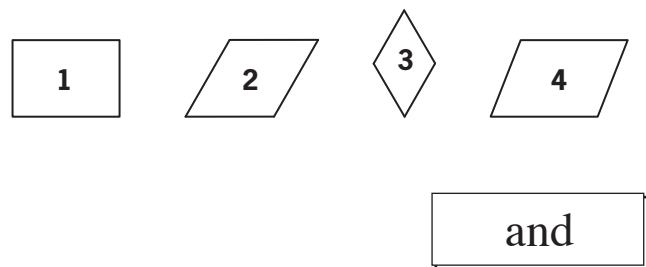
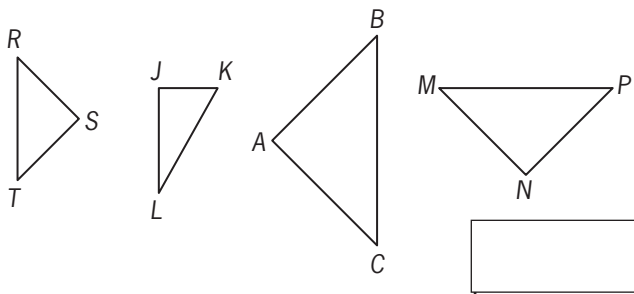
c) Circle the pair of similar shapes.



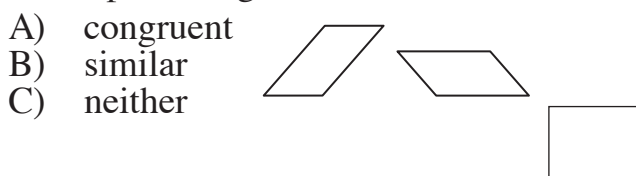
d) Circle the triangle that is **not** similar with $\triangle GHI$.



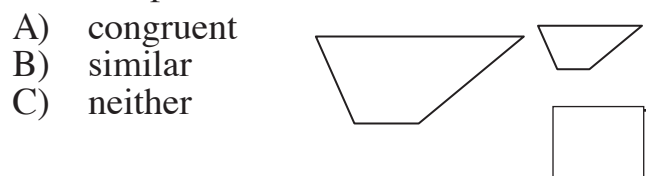
e) Which triangle is **not** similar with $\triangle MNP$? **f)** Find the pair of similar shapes.



g) These parallelograms are:

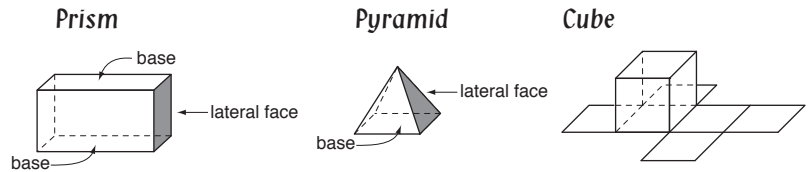


h) These trapezoids are:

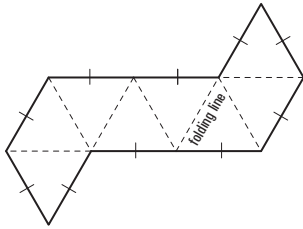


Skill 25.8 Recognizing nets of three-dimensional shapes.

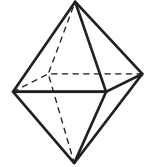
- Identify the shapes in the net.
- Imagine the shape folded. OR Make a model by tracing, cutting out and folding the net.



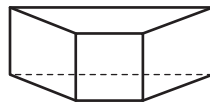
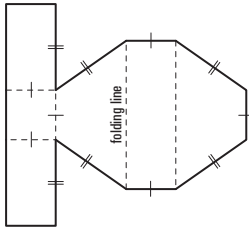
Q. What 3-dimensional shape can this net be used to make?



A. *regular octahedron*

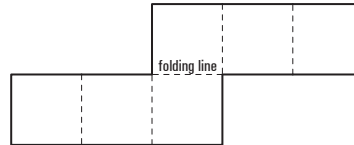


a) What 3-dimensional shape can this net be used to make?

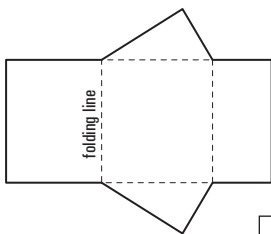


trapezoidal prism

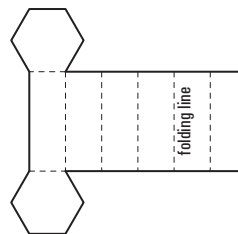
b) What 3-dimensional shape can this net be used to make?



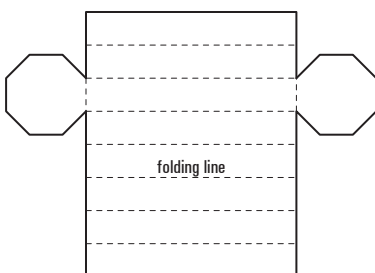
c) What 3-dimensional shape can this net be used to make?



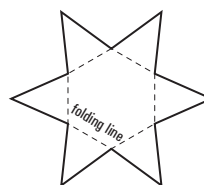
d) What 3-dimensional shape can this net be used to make?



e) What 3-dimensional shape can this net be used to make?



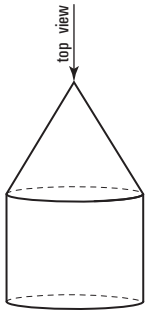
f) What 3-dimensional shape can this net be used to make?



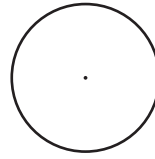
Skill 25.9 Drawing top, side and front views of three-dimensional shapes.

- Imagine what you would see from the stated direction OR
- Make a model and observe the view.

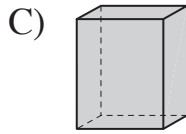
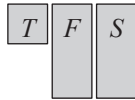
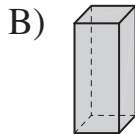
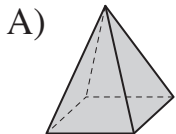
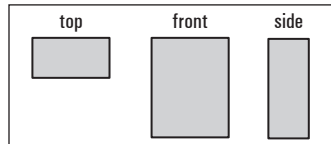
Q. Draw the top view of this solid.



A.



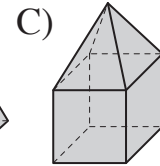
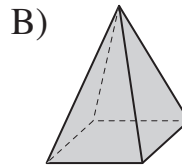
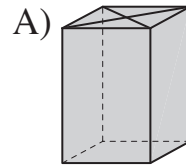
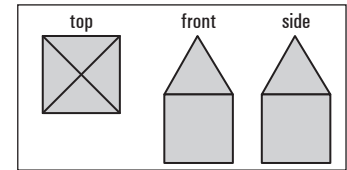
a) Which solid has the top, front and side views shown?



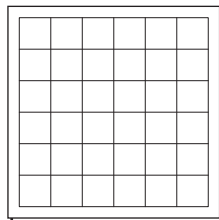
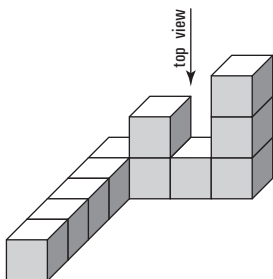
*T F S
as above*



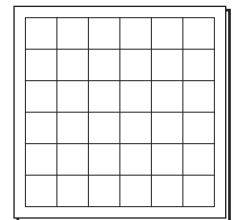
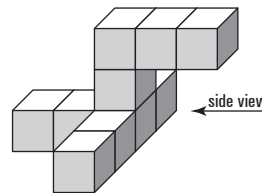
b) Which solid has the top, front and side views shown?



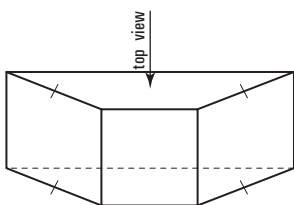
c) Draw the top view of this solid.



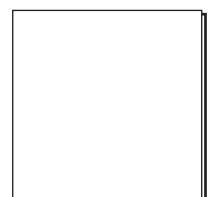
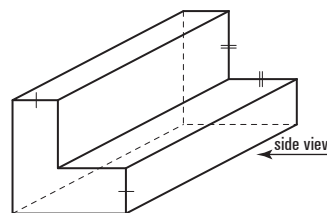
d) Draw the side view of this solid.



e) Draw the top view of this solid.



f) Draw the side view of this solid.

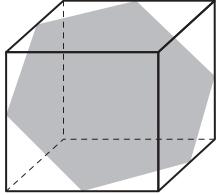


Skill 25.10 Recognizing the shapes of cross sections through three-dimensional shapes (1).

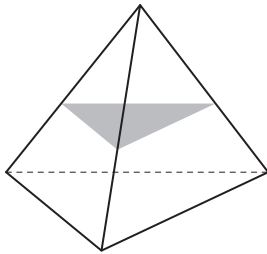
- To name the shape of a cross section through a 3D shape, imagine that you cut the solid through that section, then separate the two parts and look at the shape of the slice.

Q. What shape is the cross section drawn through this cube?

A. *hexagon*

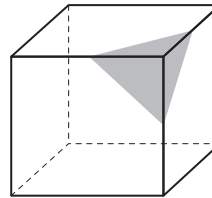


a) What shape is the cross section drawn through this pyramid?

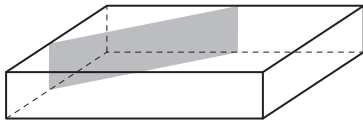


triangle

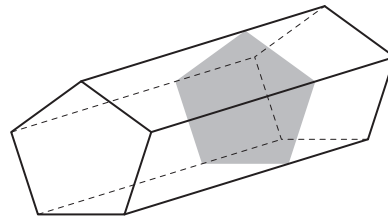
b) What shape is the cross section drawn through this cube?



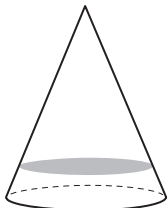
c) What shape is the cross section drawn through this prism?



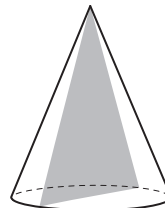
d) What shape is the cross section drawn through this prism?



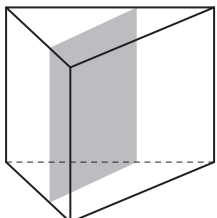
e) What shape is the cross section drawn through this cone?



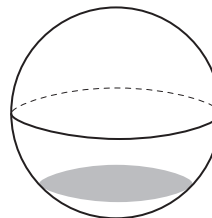
f) What shape is the cross section drawn through this cone?



g) What shape is the cross section drawn through this prism?



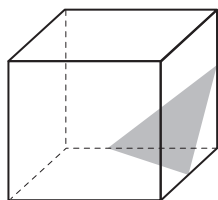
h) What shape is the cross section drawn through this sphere?



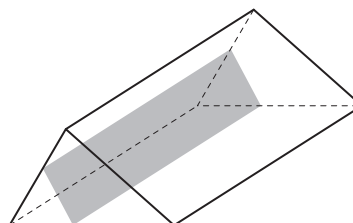
Skill 25.10 Recognizing the shapes of cross sections through three-dimensional shapes (2).

MMBlue 11 22 33 44
MMGreen 11 22 33 44

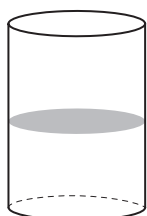
i) What shape is the cross section drawn through this cube?



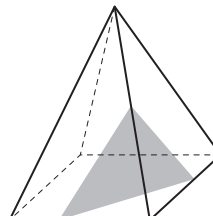
j) What shape is the cross section drawn through this prism?



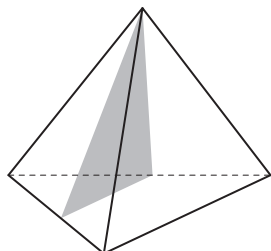
k) What shape is the cross section drawn through this cylinder?



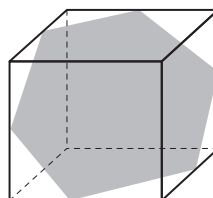
l) What shape is the cross section drawn through this pyramid?



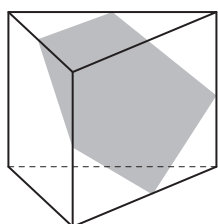
m) What shape is the cross section drawn through this pyramid?



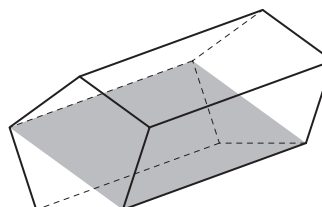
n) What shape is the cross section drawn through this cube?



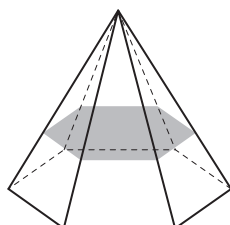
o) What shape is the cross section drawn through this prism?



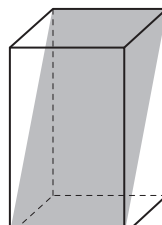
p) What shape is the cross section drawn through this prism?



q) What shape is the cross section drawn through this pyramid?



r) What shape is the cross section drawn through this prism?



Skill 25.11 Recognizing rotational symmetry in two-dimensional shapes.

- Try to visualize the shape during a full turn of 360° and make sure that the shape could cover itself at least once before the full turn is completed.

Q. Which shapes have rotational symmetry.

A)



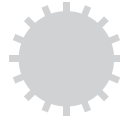
B)



C)



D)



A. A) B) C) D)

Sample rotations of 90° show only A & D get back to their original position before the full, 360° turn.

B)

C)

D)

original position

90°

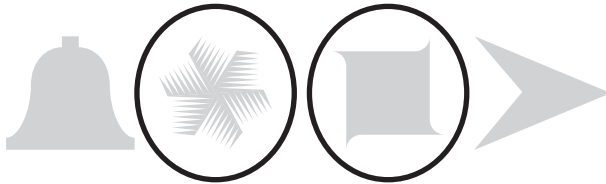
180°

270°

360°
original position

A & D

a) Circle the shapes which have rotational symmetry.



b) Circle the shapes which have rotational symmetry.



c) Circle the shapes which have rotational symmetry.



d) Circle the shapes which have rotational symmetry.



e) Which shapes have rotational symmetry?

A)



B)



C)



D)



f) Which shapes have rotational symmetry?

A)



B)



C)



D)



g) Circle the shape which does **not** have rotational symmetry.



h) Circle the shape which does **not** have rotational symmetry.



26. [Units of Measurement / Time]

Skill 26.1 Converting customary units of length.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Use these conversion factors for customary units of length.

$$1 \text{ mi} = 1760 \text{ yd} = 5280 \text{ ft}$$

$$1 \text{ yd} = 3 \text{ ft} = 36 \text{ in.}$$

$$1 \text{ ft} = 12 \text{ in.}$$

To change from **smaller** units to **larger** units

- Divide by the conversion factor (because you need less).

Example: To change inches to feet \div by 12

To change from **larger** units to **smaller** units

- Multiply by the conversion factor (because you need more).

Example: To change feet to inches \times by 12

Q. $26 \text{ ft} = \boxed{} \text{ yd} \boxed{} \text{ ft}$

A. $26 \text{ ft} = 26 \div 3 \text{ yd}$ ft to yd: $\div 3$
 $= 8 \text{ yd and } 2 \text{ ft remaining}$
 $= 8 \text{ yd } 2 \text{ ft}$

a) $3 \text{ feet} = \boxed{36} \text{ inches}$

$3 \times 12 = 36$ ft to in.: $\times 12$

b) $9 \text{ yards} = \boxed{} \text{ feet}$

yd to ft: $\times 3$

c) $144 \text{ in.} = \boxed{} \text{ ft}$

d) $2 \text{ yd} = \boxed{} \text{ in.}$

e) $33 \text{ ft} = \boxed{} \text{ yd}$

f) $72 \text{ in.} = \boxed{} \text{ yd}$

g) $120 \text{ in.} = \boxed{} \text{ ft}$

h) $60 \text{ ft} = \boxed{} \text{ yd}$

i) $27 \text{ in.} = \boxed{} \text{ ft} \boxed{} \text{ in.}$

j) $10 \text{ ft} = \boxed{} \text{ yd} \boxed{} \text{ ft}$

k) $4 \text{ ft } 9 \text{ in.} = \boxed{} \text{ in.}$

l) $5 \text{ yd } 1 \text{ ft} = \boxed{} \text{ ft}$

Skill 26.2 Converting metric units of length.

- Use these conversion factors for metric units of length.

$$1 \text{ km} = 1000 \text{ m} = 100,000 \text{ cm} = 1,000,000 \text{ mm}$$

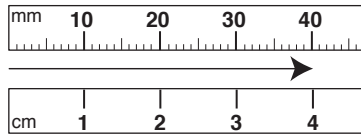
$$1 \text{ m} = 100 \text{ cm} = 1000 \text{ mm}$$

$$1 \text{ cm} = 10 \text{ mm}$$

To change from **smaller** units to **larger** units

- Divide by the conversion factor (because you need less).

Example: To change mm to cm
÷ by 10



To change from **larger** units to **smaller** units

- Multiply by the conversion factor (because you need more).

Example: To change cm to mm
× by 10

Q. $3800 \text{ cm} = \boxed{} \text{ m}$

A. $3800 \text{ cm} = 3800 \div 100 \text{ m}$ *cm to m: ÷ 100*
 $= 38 \text{ m}$

a) $24 \text{ cm} = \boxed{240} \text{ mm}$

cm to mm: × 10

$24 \times 10 = 240$

b) $120 \text{ mm} = \boxed{} \text{ cm}$

mm to cm: ÷ 10

c) $130 \text{ cm} = \boxed{} \text{ mm}$

d) $270 \text{ cm} = \boxed{} \text{ m}$

e) $7000 \text{ m} = \boxed{} \text{ km}$

f) $6.4 \text{ m} = \boxed{} \text{ cm}$

g) $19 \text{ m} = \boxed{} \text{ mm}$

h) $50 \text{ mm} = \boxed{} \text{ cm}$

i) $0.2 \text{ km} = \boxed{} \text{ cm}$

j) $500 \text{ mm} = \boxed{} \text{ m}$

k) $450 \text{ cm} = \boxed{} \text{ m}$

l) $5.1 \text{ m} = \boxed{} \text{ mm}$

Skill 26.3 Converting customary units of mass.

- Use these conversion factors for customary units of mass.

$$1 \text{ ton} = 2000 \text{ lb} = 32,000 \text{ oz}$$

$$1 \text{ lb} = 16 \text{ oz}$$

To change from **smaller** units to **larger** units

- Divide by the conversion factor (because you need less).

Example: To change oz to lb \div by 16

To change from **larger** units to **smaller** units

- Multiply by the conversion factor (because you need more).

Example: To change lb to oz \times by 16

Q. $2 \text{ lb } 12 \text{ oz} = \boxed{} \text{ oz}$

A. $2 \text{ lb } 12 \text{ oz} = 2 \times 16 \text{ oz} + 12 \text{ oz}$ *lb to oz: $\times 16$*
 $= 32 \text{ oz} + 12 \text{ oz}$
 $= 44 \text{ oz}$

a) $4 \text{ tons} = \boxed{8000} \text{ pounds}$

$4 \times 2000 = 8000$ *T to lb: $\times 2000$*

b) $3 \text{ pounds} = \boxed{} \text{ ounces}$

lb to oz: $\times 16$

c) $160 \text{ oz} = \boxed{} \text{ lb}$

d) $12,000 \text{ lb} = \boxed{} \text{ T}$

e) $4.5 \text{ T} = \boxed{} \text{ lb}$

f) $96 \text{ oz} = \boxed{} \text{ lb}$

g) $5 \text{ lb} = \boxed{} \text{ oz}$

h) $3.5 \text{ T} = \boxed{} \text{ lb}$

i) $5500 \text{ lb} = \boxed{} \text{ T } \boxed{} \text{ lb}$

j) $53 \text{ oz} = \boxed{} \text{ lb } \boxed{} \text{ oz}$

k) $1 \text{ lb } 10 \text{ oz} = \boxed{} \text{ oz}$

l) $3 \text{ T } 500 \text{ lb} = \boxed{} \text{ lb}$

Skill 26.4 Converting metric units of mass.

- Use these conversion factors for metric units of mass.

$$1 \text{ tonne} = 1000 \text{ kg} = 1,000,000 \text{ g}$$

$$1 \text{ kg} = 1000 \text{ g}$$

To change from **smaller** units to **larger** units

- Divide by the conversion factor (because you need less).

Example: To change g to kg \div by 1000

To change from **larger** units to **smaller** units

- Multiply by the conversion factor (because you need more).

Example: To change kg to g \times by 1000

Q. $30 \text{ g} = \boxed{} \text{ kg}$

A. $30 \text{ g} = 30 \div 1000 \text{ kg}$ *g to kg: \div 1000*
 $= 0.\overline{030}$ *3 zeros, 3 places to the left*
 $= 0.03 \text{ kg}$

a) $8 \text{ kg} = \boxed{8000} \text{ g}$ *kg to g: \times 1000*
3 zeros, 3 places to the right
 $8 \times 1000 = 8000$

b) $9000 \text{ g} = \boxed{} \text{ kg}$ *g to kg: \div 1000*

c) $260 \text{ g} = \boxed{} \text{ kg}$

d) $3.4 \text{ kg} = \boxed{} \text{ g}$

e) $510 \text{ g} = \boxed{} \text{ kg}$

f) $700 \text{ g} = \boxed{} \text{ kg}$

g) $25.9 \text{ kg} = \boxed{} \text{ g}$

h) $0.9 \text{ kg} = \boxed{} \text{ g}$

i) $80 \text{ g} = \boxed{} \text{ kg}$

j) $0.65 \text{ t} = \boxed{} \text{ kg}$

k) $3800 \text{ kg} = \boxed{} \text{ t}$

l) $12.5 \text{ t} = \boxed{} \text{ kg}$

Skill 26.5 Converting customary units of capacity.

- Use these conversion factors for customary units of capacity.

$$\begin{aligned} 1 \text{ gal} &= 4 \text{ qt} = 8 \text{ pt} = 16 \text{ c} = 128 \text{ fl oz} \\ 1 \text{ qt} &= 2 \text{ pt} = 4 \text{ c} = 32 \text{ fl oz} \\ 1 \text{ pt} &= 2 \text{ c} = 16 \text{ fl oz} \\ 1 \text{ c} &= 8 \text{ fl oz} \end{aligned}$$

To change from **smaller** units to **larger** units

- Divide by the conversion factor (because you need less).

Example: To change fl oz to cups \div by 8

To change from **larger** units to **smaller** units

- Multiply by the conversion factor (because you need more).

Example: To change qt to pt \times by 2

Q. $15 \text{ qt } 1 \text{ pt} = \boxed{} \text{ pt}$

A. $15 \text{ qt } 1 \text{ pt} = 15 \times 2 \text{ pt} + 1 \text{ pt}$ qt to pt: $\times 2$
 $= 30 \text{ pt} + 1 \text{ pt}$
 $= 31 \text{ pt}$

a) $6 \text{ gal} = \boxed{48} \text{ pt}$ gal to qt: $\times 4$
qt to pt: $\times 2$
 $6 \times 4 \times 2 = 24 \times 2 = 48$

b) $13 \text{ qt} = \boxed{} \text{ pt}$ qt to pt: $\times 2$

c) $24 \text{ pt} = \boxed{} \text{ qt}$

d) $16 \text{ pt} = \boxed{} \text{ gal}$

e) $5 \text{ gal} = \boxed{} \text{ qt}$

f) $4 \text{ gal} = \boxed{} \text{ pt}$

g) $180 \text{ pt} = \boxed{} \text{ qt}$

h) $60 \text{ qt} = \boxed{} \text{ gal}$

i) $31 \text{ qt} = \boxed{} \text{ gal } \boxed{} \text{ qt}$

j) $13 \text{ pt} = \boxed{} \text{ qt } \boxed{} \text{ pt}$

k) $3 \text{ gal } 5 \text{ pt} = \boxed{} \text{ pt}$

l) $4 \text{ gal } 2 \text{ qt} = \boxed{} \text{ qt}$

Skill 26.6 Converting metric units of capacity.

MMBlue 1 1 2 2 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Use these conversion factors for metric units of capacity.

$$1 \text{ kL} = 1000 \text{ L} = 1,000,000 \text{ mL}$$

$$1 \text{ L} = 1000 \text{ mL or } 1000 \text{ cm}^3$$

To change from **smaller** units to **larger** units

- Divide by the conversion factor (because you need less).

Example: To change mL to L \div by 1000

To change from **larger** units to **smaller** units

- Multiply by the conversion factor (because you need more).

Example: To change kL to L \times by 1000

Q. $750 \text{ mL} = \boxed{} \text{ L}$

A. $750 \text{ mL} = 750 \div 1000 \text{ L}$ mL to L: \div 1000
 $= 0.\overbrace{750}^{\text{3 zeros, 3 places to the left}}$
 $= 0.75 \text{ L}$

a) $3.7 \text{ L} = \boxed{3700} \text{ mL}$ L to mL: \times 1000
 $3.7 \times 1000 = 3700$

b) $6 \text{ L} = \boxed{} \text{ mL}$ L to mL: \times 1000

c) $22 \text{ L} = \boxed{} \text{ mL}$

d) $8000 \text{ mL} = \boxed{} \text{ L}$

e) $250 \text{ mL} = \boxed{} \text{ L}$

f) $9.4 \text{ L} = \boxed{} \text{ mL}$

g) $0.5 \text{ L} = \boxed{} \text{ mL}$

h) $1.25 \text{ L} = \boxed{} \text{ mL}$

i) $30,000 \text{ mL} = \boxed{} \text{ L}$

j) $15.3 \text{ L} = \boxed{} \text{ mL}$

k) $40 \text{ L} = \boxed{} \text{ mL}$

l) $500 \text{ mL} = \boxed{} \text{ L}$

Skill 26.7 Converting units of time.

- Use these conversion factors for units of time.

$$\begin{array}{rcl}
 1 \text{ week} & = & 7 \text{ days} = 168 \text{ h} = 10,080 \text{ min} = 604,800 \text{ s} \\
 1 \text{ day} & = & 24 \text{ h} = 1440 \text{ min} = 86,400 \text{ s} \\
 1 \text{ h} & = & 60 \text{ min} = 3600 \text{ s} \\
 1 \text{ min} & = & 60 \text{ s}
 \end{array}$$

To change from **smaller** units to **larger** units

- Divide by the conversion factor (because you need less).

Example: To change s to min \div by 60

To change from **larger** units to **smaller** units

- Multiply by the conversion factor (because you need more).

Example: To change h to min \times by 60

Q. 1 week, 6 days = h

A. *1 week 6 days* = $1 \times 7 \text{ days} + 6 \text{ days}$ week to days: $\times 7$
 = 13 days
 $13 \text{ days} \times 24 \text{ h} = 312 \text{ h}$ days to h: $\times 24$

a) $2 \frac{1}{3} \text{ day} =$ h day to h: $\times 24$

$$2 \times 24 + \frac{1}{3} \times 24 = 48 + 8 = 56$$

b) 5 hours = minutes h to min: $\times 60$

c) 4 minutes = seconds

d) 180 s = min

e) $\frac{3}{4} \text{ day} =$ h

f) $2 \frac{1}{2} \text{ h} =$ min

g) $1 \frac{1}{4} \text{ h} =$ min

h) 200 min = h min

i) 144 min = h min

j) 5 min 30 s = s

k) 3 week, 5 days = days

l) 4 h 40 min = min

Skill 26.8 Finding the elapsed time between two events.

- Calculate the time until the next closest hour.
A.M. to P.M.
- Add the time to midday.
- Then add the remaining time.

- P.M. to A.M.
- Add the time to midnight.
- Then add the remaining time.

Q. School starts at 8:50 A.M. and ends at 2:30 P.M. How long is a school day in hours and minutes?

A. $8:50$ to $9:00 = 10$ min
 $9:00$ to $12:00 = 3$ h
 $12:00$ to $2:30 = 2$ h 30 min
 10 min + 3 h + 2 h + 30 min
 = **5 h 40 min**

a) Find the time in hours and minutes between 8:30 A.M. and 3:00 P.M. the same day.

$8:30$ to $9:00 = 30$ min, $9:00$ to $12:00 = 3$ h

$12:00$ to $3:00 = 3$ h

30 min + 3 h + 3 h \Rightarrow

b) The movie begins at 3:15 P.M. and ends at 5:00 P.M. How long is the movie in hours and minutes?

\Rightarrow

c) Mom started cooking at 6:20 P.M. and finished at 7:35 P.M. How long did she cook in hours and minutes?

\Rightarrow

d) Find the time in hours and minutes between 6:30 P.M. and 2:10 A.M. the next day.

\Rightarrow

e) Find the time in hours and minutes between 4:00 A.M. and 2:25 P.M. the same day.

\Rightarrow

f) Find the time in hours and minutes between 09:10 and 16:20 the same day.

\Rightarrow

27. [Perimeter]

Skill 27.1 Finding the perimeter of polygons by measuring their side lengths.

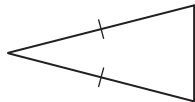
MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Measure each side length of the shape.
- Add together the side lengths.

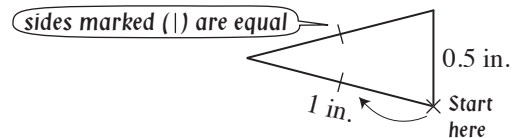
Hint: Sides marked with a dash (|) are of equal length.

Sides marked with two dashes (||) are of equal length etc.

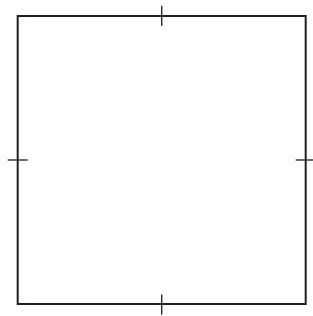
Q. Use a ruler to find the perimeter of the isosceles triangle in inches.



A. $1 \text{ in.} + 1 \text{ in.} + 0.5 \text{ in.}$ Measure the side lengths. Write down the lengths next to each side.
= **2.5 in.**

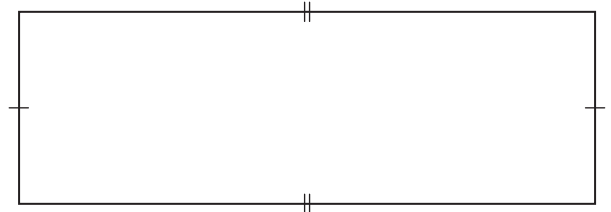


a) Use a ruler to find the perimeter of the square in inches.



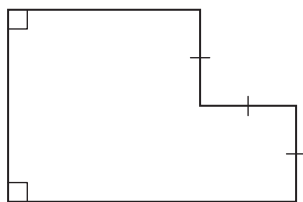
4×1.5 = in.

b) Use a ruler to find the perimeter of the rectangle in inches.



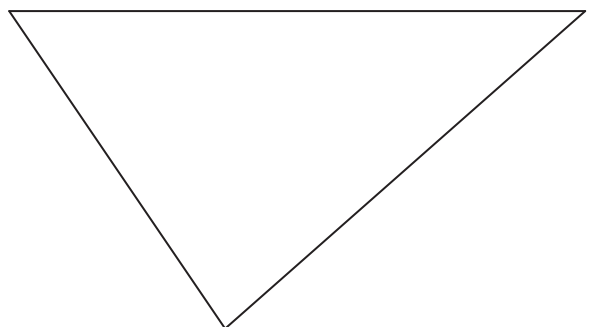
..... = in.

c) Use a ruler to find the perimeter of the polygon in inches.



..... = in.

d) Use a ruler to find the perimeter of the scalene triangle in inches.

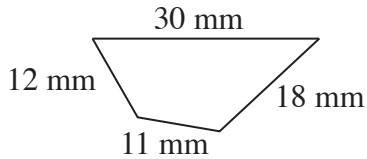


..... = in.

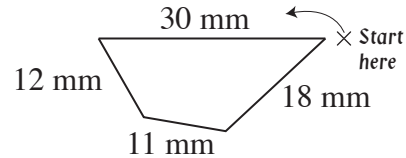
Skill 27.2 Calculating the perimeter of polygons when all side lengths are given.

- Add together the side lengths.

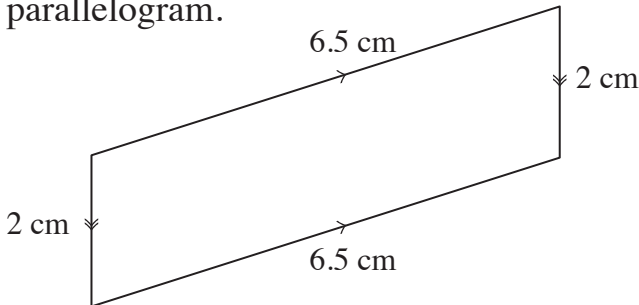
Q. Calculate the perimeter of the quadrilateral.



A. $30\text{ mm} + 12\text{ mm} + 11\text{ mm} + 18\text{ mm}$
 $= 71\text{ mm}$

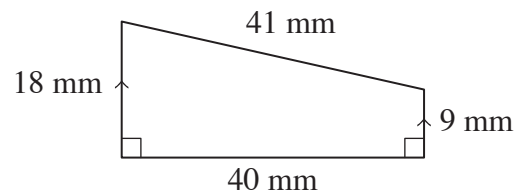


a) Calculate the perimeter of the parallelogram.



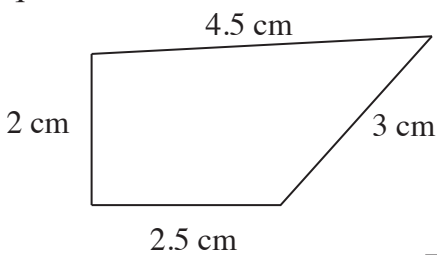
$6.5 + 2 + 6.5 + 2 =$

b) Calculate the perimeter of the trapezoid.



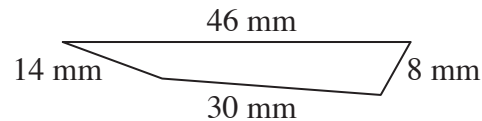
$\dots\dots\dots =$

c) Calculate the perimeter of the quadrilateral.



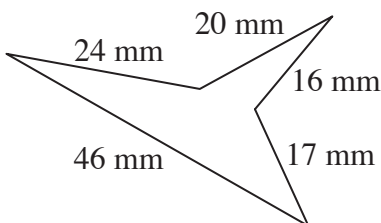
$\dots\dots\dots =$

d) Calculate the perimeter of the quadrilateral.



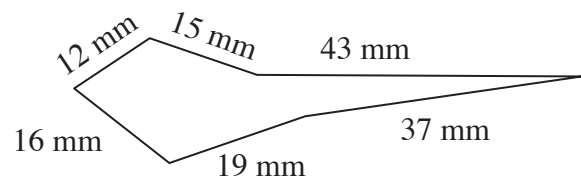
$\dots\dots\dots =$

e) Calculate the perimeter of the polygon.



$\dots\dots\dots =$

f) Calculate the perimeter of the polygon.

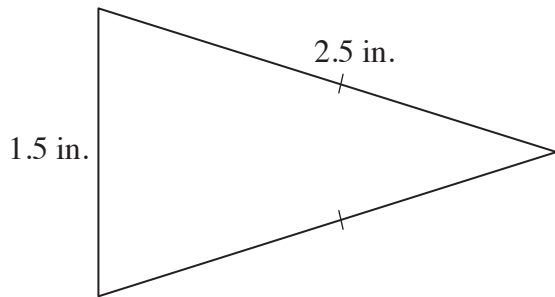


$\dots\dots\dots =$

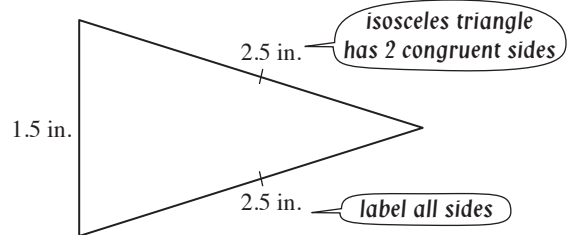
Skill 27.3 Calculating the perimeter of polygons by recognizing congruent sides.

- Determine and label all side lengths.
Hint: Sides marked with a dash (|) are of equal length. Sides marked with two dashes (||) are of equal length etc.
- Add together the side lengths.

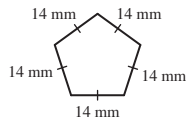
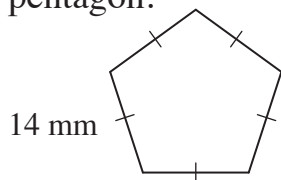
Q. Calculate the perimeter of the isosceles triangle.



A. $1.5 \text{ in.} + 2.5 \text{ in.} + 2.5 \text{ in.}$
 $= 6.5 \text{ in.}$

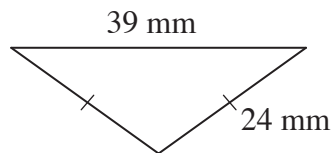


a) Calculate the perimeter of the regular pentagon.



5×14 pentagon - 5 sides = mm

b) Calculate the perimeter of the isosceles triangle.



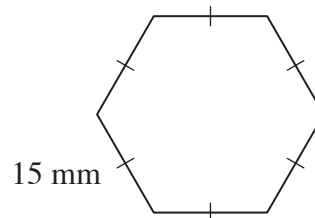
$39 + 24 + 24 =$ mm

c) Calculate the perimeter of the regular octagonal gazebo with side length 4 ft.



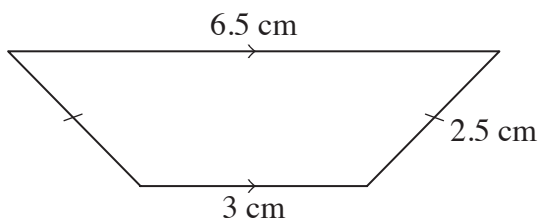
$8 \times 4 =$ ft

d) Calculate the perimeter of the regular hexagon.



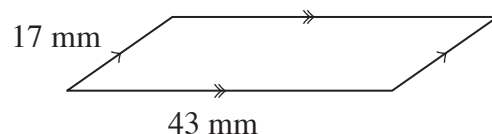
$6 \times 15 =$ mm

e) Calculate the perimeter of the trapezoid.



$6.5 + 3 + 2.5 + 2.5 =$ cm

f) Calculate the perimeter of the parallelogram.

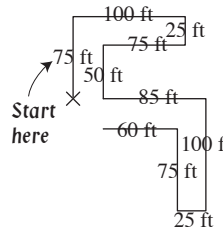
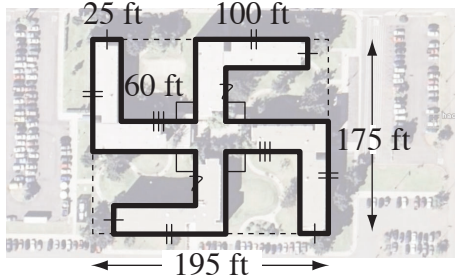


$17 + 43 + 17 + 43 =$ mm

Skill 27.4 Calculating the perimeter of polygons using real-life examples.

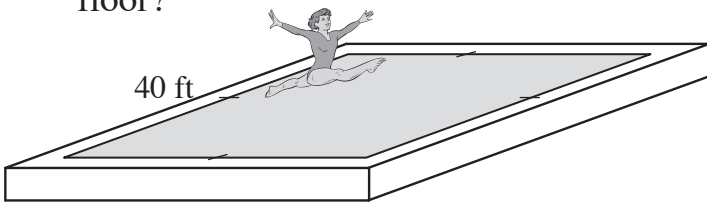
- Determine and label all side lengths.
Hint: Sides marked with a dash (|) are of equal length. Sides marked with two dashes (||) are of equal length etc.
- Add together the side lengths.

Q. What is the perimeter of this Navy building in California? **A.** $(75 + 100 + 25 + 75 + 50 + 85 + 100 + 25 + 75 + 60) \times 2$
 $= 670 \times 2$
 $= 1340 \text{ ft}$



Redraw half the shape.
Write the given side lengths.
Determine the remaining side lengths.
Double your answer.

a) What is the perimeter of the gymnastics floor?



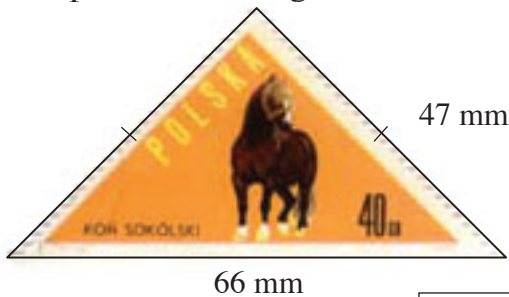
$4 \times 40 = \boxed{160 \text{ ft}}$

b) What is the perimeter of the rectangular Luxio TV screen?



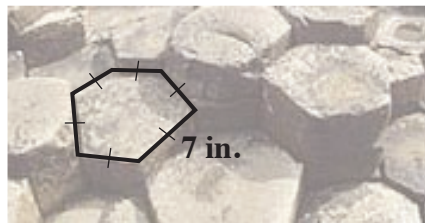
$255 + 455 + 255 + 455 = \boxed{\text{cm}}$

c) What is the perimeter of this Polish stamp valued at 40 groszy?



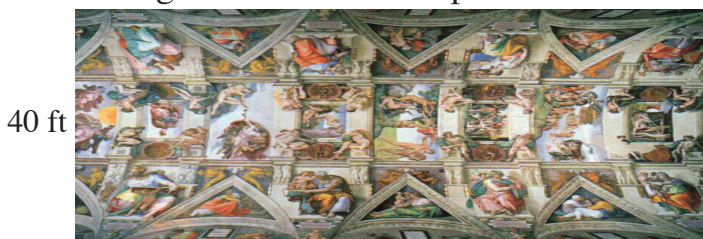
$66 + 47 + 66 + 47 = \boxed{\text{mm}}$

d) What is the perimeter of the upper surface of this regular hexagonal column of basalt seen at the Giant's Causeway in Ireland?



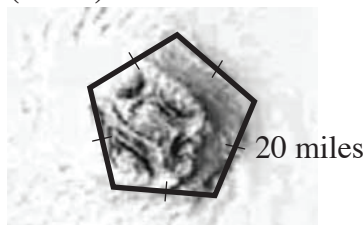
$6 \times 7 = \boxed{\text{in.}}$

e) What is the perimeter of the rectangular ceiling of the Sistine Chapel?



$40 + 130 + 40 + 130 = \boxed{\text{ft}}$

f) What is the perimeter of the eye of the pentagonal vortex of hurricane Isabel (2003)?

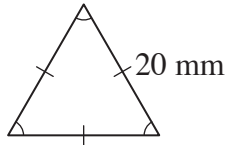


$5 \times 20 = \boxed{\text{mi}}$

Skill 27.5 Calculating the perimeter of polygons using unit conversions.

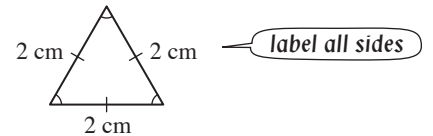
- Convert all measurements to the same unit. (see skill 26.1, page 245 and skill 26.2, page 246)
- Determine and label all side lengths.
*Hint: Sides marked with a dash (|) are of equal length.
Sides marked with two dashes (||) are of equal length etc.*
- Add together the side lengths.

Q. Calculate the perimeter of the equilateral triangle in centimeters.

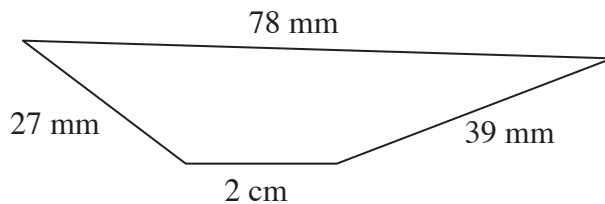


A. $20\text{ mm} = 20 \div 10\text{ cm} = 2\text{ cm}$ (mm to cm: $\div 10$)

$$P = 3 \times 2 = 6\text{ cm}$$

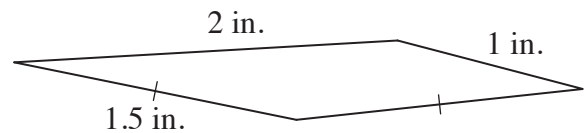


a) Calculate the perimeter of the trapezoid in millimeters.



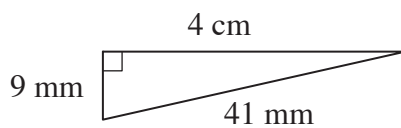
$P =$

b) Calculate the perimeter of the quadrilateral in feet.



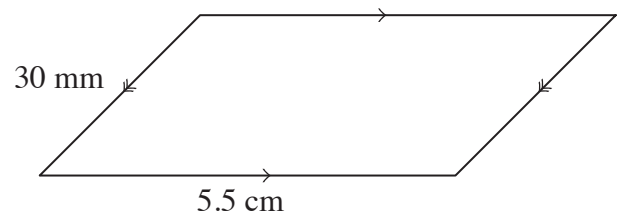
$P =$

c) Calculate the perimeter of the right triangle in millimeters.



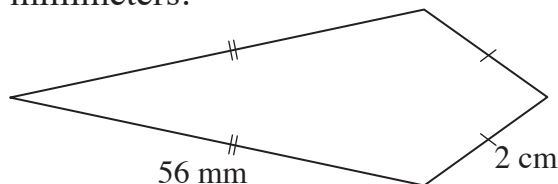
$P =$

d) Calculate the perimeter of the parallelogram in millimeters.



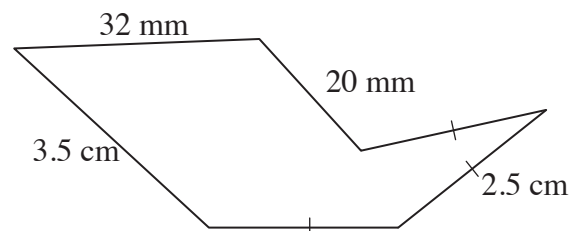
$P =$

e) Calculate the perimeter of the kite in millimeters.



$P =$

f) Calculate the perimeter of this polygon in centimeters.



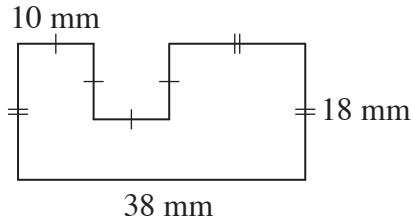
$P =$

Skill 27.6 Calculating the perimeter of composite shapes.

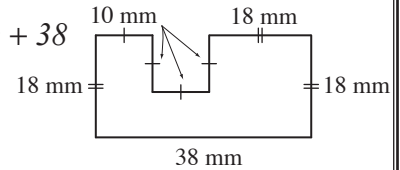
MMBlue 11 22 33 44
MMGreen 11 22 33 44

- Determine and label all side lengths.
Hint: Sides marked with a dash (|) are of equal length. Sides marked with two dashes (||) are of equal length etc.
- Add together the side lengths.

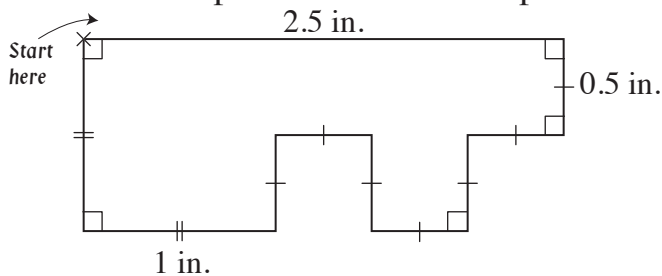
Q. Calculate the perimeter of this shape.



A. $10 + 10 + 10 + 10 + 18 + 18 + 38 + 18$
 $= 40 + 54 + 38$
 $= 132 \text{ mm}$
 OR $(10 \times 4) + (18 \times 3) + 38$
 $= 40 + 54 + 38$
 $= 132 \text{ mm}$



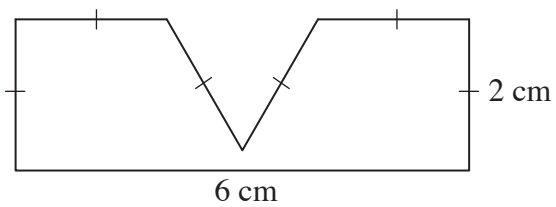
a) Calculate the perimeter of this shape.



$$2.5 + (0.5 \times 7) + (1 \times 2)$$

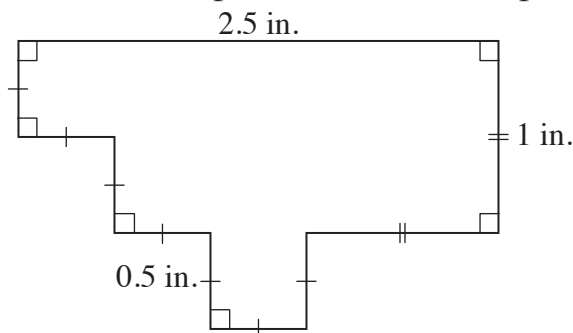
$$= 2.5 + 3.5 + 2 = \boxed{\text{in.}}$$

b) Calculate the perimeter of this shape.



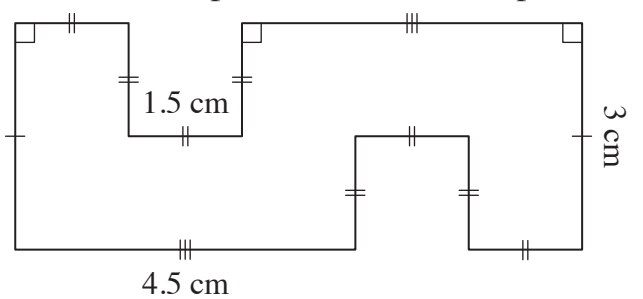
$$= \boxed{\text{cm}}$$

c) Calculate the perimeter of this shape.



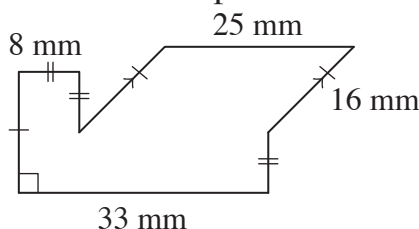
$$= \boxed{\text{in.}}$$

d) Calculate the perimeter of this shape.



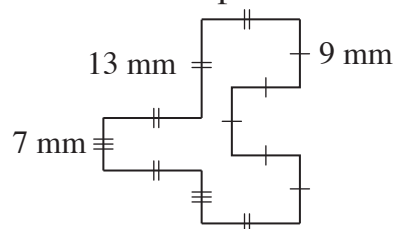
$$= \boxed{\text{cm}}$$

e) Calculate the perimeter of this shape.



$$= \boxed{\text{mm}}$$

f) Calculate the perimeter of this shape.

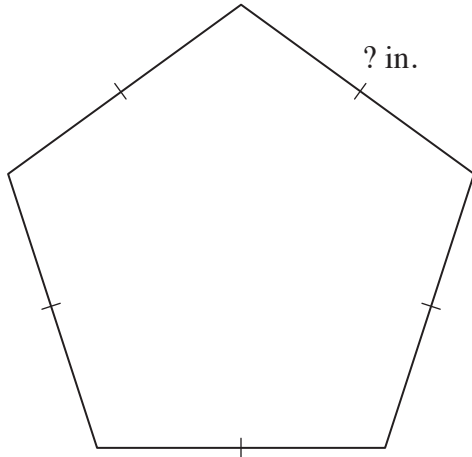


$$= \boxed{\text{mm}}$$

Skill 27.7 Calculating an unknown side length when the perimeter of a polygon is given.

- Add together all the given side lengths.
 - Subtract the total from the perimeter to find the unknown side length.
- OR
- Use algebra.

Q. The perimeter of this regular pentagon is 7.5 in. What is the length of a side?



A. If ? represents the length of a side:

$$P = 7.5 \text{ in.}$$

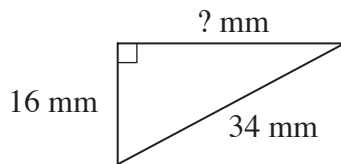
$$P = 5 \times ?$$

$$7.5 = 5 \times ?$$

$$? = \mathbf{1.5 \text{ in.}}$$

Guess ? = 1.5

a) The perimeter of this right triangle is 80 mm. Find the missing side length.



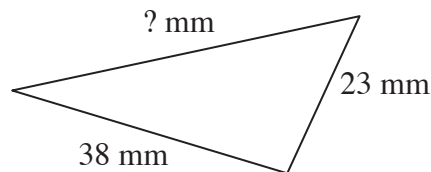
$$P = 16 + 34 + ?$$

Guess ? = 30

$$80 = 50 + ?$$

$$\text{so } ? = \boxed{\text{mm}}$$

b) The perimeter of this scalene triangle is 108 mm. Find the missing side length.

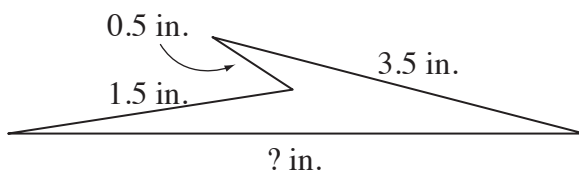


$$P =$$

$$=$$

$$\text{so } ? = \boxed{\text{mm}}$$

c) The perimeter of this quadrilateral is 7.5 in. Find the missing side length.

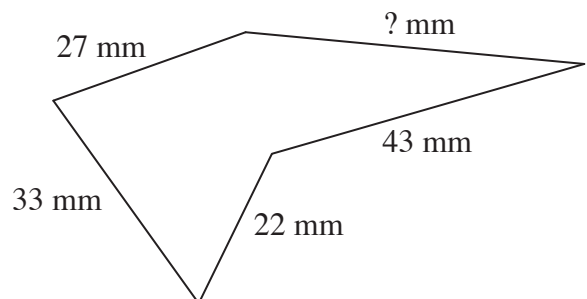


$$P =$$

$$=$$

$$\text{so } ? = \boxed{\text{in.}}$$

d) The perimeter of this polygon is 170 mm. Find the missing side length.



$$P =$$

$$=$$

$$\text{so } ? = \boxed{\text{mm}}$$

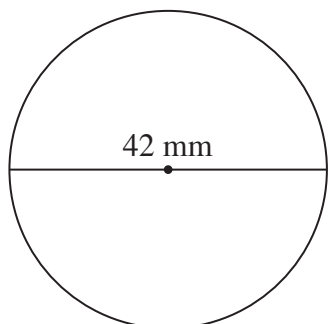
Skill 27.8 Calculating the circumference of circles (1).

MMBlue 11 22 33 44
MMGreen 11 22 33 44

- Substitute the known values into the formula for the circumference.

Hint: You need the radius which is half the diameter.

Q. Using $C = 2\pi r$ where $\pi \approx \frac{22}{7}$, calculate the circumference of the circle.



A. $C = 2\pi r$ where $d = 42$ and $r = 21$ $r = \frac{d}{2}$

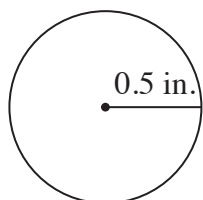
$$= 2 \times \frac{22}{7} \times 21$$

Simplify: $\div 7$

$$= 44 \times 3$$

$$= 132 \text{ mm}$$

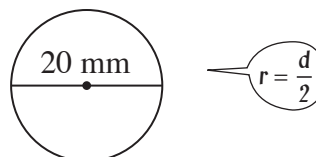
a) Using $C = 2\pi r$ where $\pi \approx 3.14$, calculate the circumference of the circle.



$$C = 2\pi r = 2 \times 3.14 \times 0.5$$

$$= 1 \times 3.14 = \boxed{\text{in.}}$$

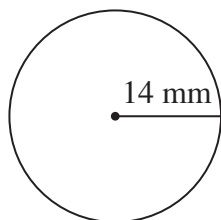
b) Using $C = 2\pi r$ where $\pi \approx 3.14$, calculate the circumference of the circle.



$$C =$$

$$= \boxed{\text{mm}}$$

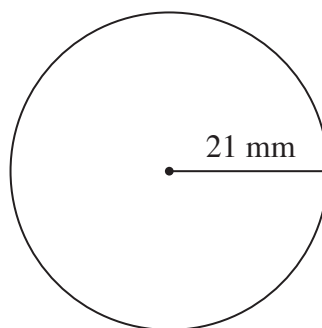
c) Using $C = 2\pi r$ where $\pi \approx \frac{22}{7}$, calculate the circumference of the circle.



$$C =$$

$$= \boxed{\text{mm}}$$

d) Using $C = 2\pi r$ where $\pi \approx \frac{22}{7}$, calculate the circumference of the circle.



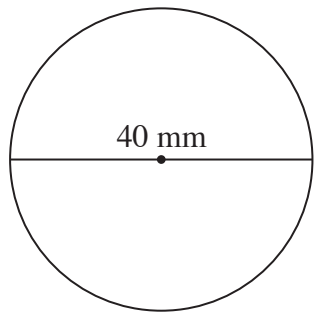
$$C =$$

$$= \boxed{\text{mm}}$$

Skill 27.8 Calculating the circumference of circles (2).

MMBlue 11 22 33 44
MMGreen 11 22 33 44

- e) Using $C = 2\pi r$ where $\pi \approx 3.14$, calculate the circumference of the circle.

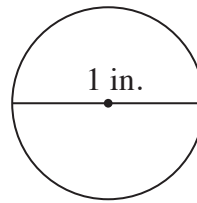


$$r = \frac{d}{2}$$

$$C = 2 \times 3.14 \times 20 \text{ where } d = 40 \text{ and } r = 20$$

$$= 40 \times 3.14 = \boxed{125.6 \text{ mm}}$$

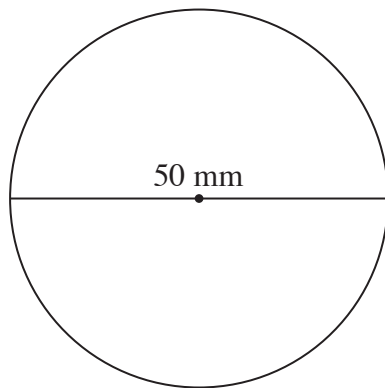
- f) Using $C = 2\pi r$ where $\pi \approx 3.14$, calculate the circumference of the circle.



$$C =$$

$$= \quad = \quad = \boxed{\text{in.}}$$

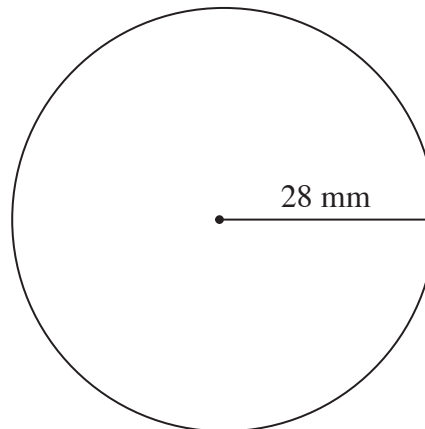
- g) Using $C = 2\pi r$ where $\pi \approx 3.14$, calculate the circumference of the circle.



$$C =$$

$$= \quad = \quad = \boxed{\text{mm}}$$

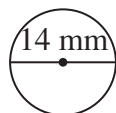
- h) Using $C = 2\pi r$ where $\pi \approx \frac{22}{7}$, calculate the circumference of the circle.



$$C =$$

$$= \quad = \quad = \boxed{\text{mm}}$$

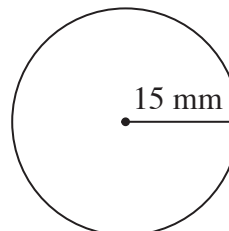
- i) Using $C = 2\pi r$ where $\pi \approx \frac{22}{7}$, calculate the circumference of the circle.



$$C =$$

$$= \quad = \quad = \boxed{\text{mm}}$$

- j) Using $C = 2\pi r$ where $\pi \approx 3.14$, calculate the circumference of the circle.



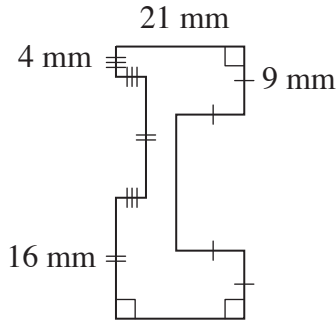
$$C =$$

$$= \quad = \quad = \boxed{\text{mm}}$$

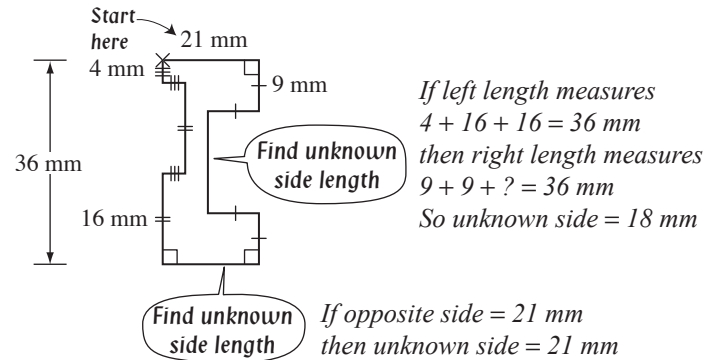
Skill 27.9 Calculating the perimeter of composite shapes by first finding missing side lengths.

- Determine the missing sides by adding or subtracting known sides.
- Label all side lengths.
Hint: Sides marked with a dash (|) are of equal length. Sides marked with two dashes (||) are of equal length etc.
- Add together the side lengths.

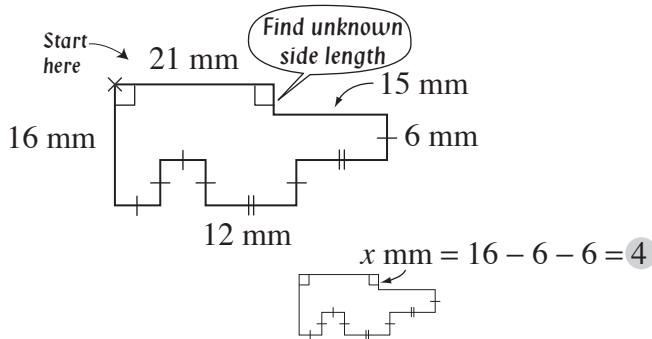
Q. Calculate the perimeter of this shape.



A. $21 + 9 + 9 + 18 + 9 + 9 + 21 + 16 + 4 + 16 + 4 + 4$
 $= 30 + 36 + 30 + 44$
 $= 140 \text{ mm}$



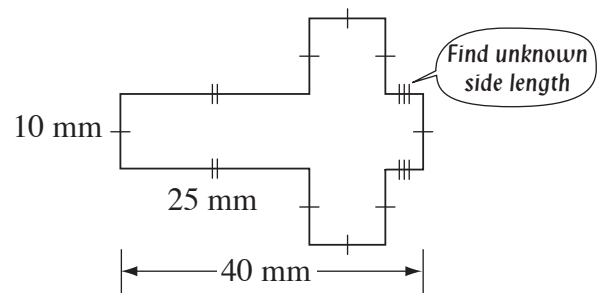
a) Calculate the perimeter of this shape.



$21 + 4 + 15 + 6 + 12 + 6 + 12 + 6 + 6 + 6 + 6 + 16$

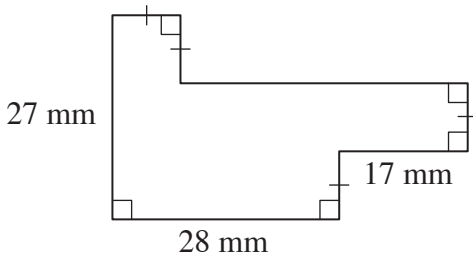
$= 40 + 36 + 40 = \boxed{\text{mm}}$

b) Calculate the perimeter of this shape.



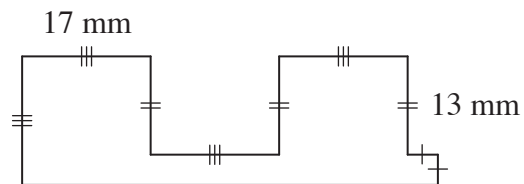
$= \dots = \boxed{\text{mm}}$

c) Calculate the perimeter of this shape.



$= \dots = \boxed{\text{mm}}$

d) Calculate the perimeter of this shape.

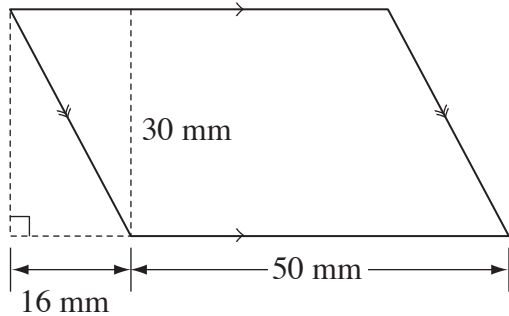


$= \dots = \boxed{\text{mm}}$

Skill 27.10 Calculating the perimeter of polygons by using Pythagorean theorem.

- Mark all the information given.
- Use Pythagorean formula to deduce any unknown side length.
- Add together the side lengths.

Q. Calculate the perimeter of this parallelogram. [Hint: Pythagorean theorem will help.]



A. $c^2 = a^2 + b^2$ where $a = 16$ and $b = 30$

$$c^2 = 16^2 + 30^2$$

$$c^2 = 256 + 900$$

$$c^2 = 1156$$

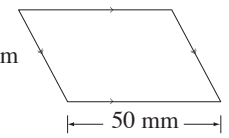
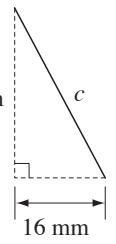
$$c = \sqrt{1156} \quad (1156 = 34 \times 34)$$

$$c = 34$$

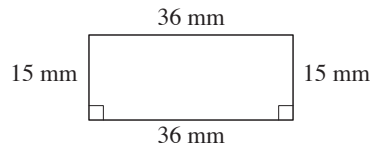
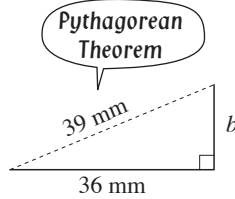
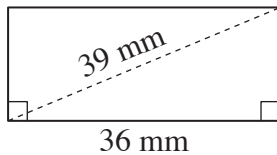
$$P = 34 + 50 + 34 + 50$$

$$= 168 \text{ mm}$$

Pythagorean Theorem



a) Calculate the perimeter of the rectangle. [Hint: Pythagorean theorem will help.]

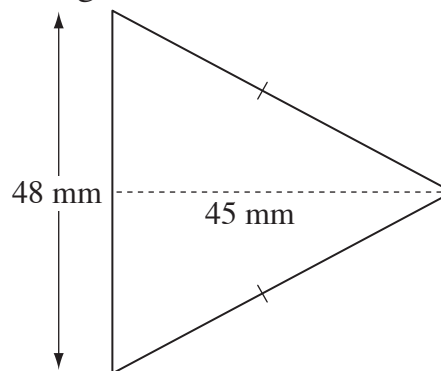


$$39^2 = 36^2 + b^2 \Rightarrow b^2 = 1521 - 1296$$

$$b^2 = 225 \Rightarrow b = \sqrt{225} = 15$$

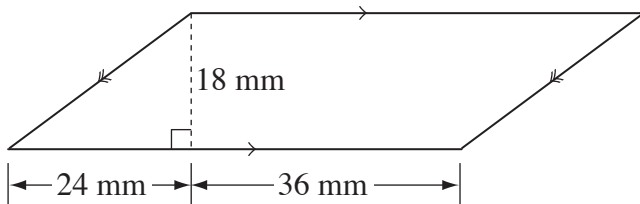
$$P = 36 + 15 + 36 + 15 = \boxed{\text{mm}}$$

b) Calculate the perimeter of this isosceles triangle. [Hint: Pythagorean theorem will help.]



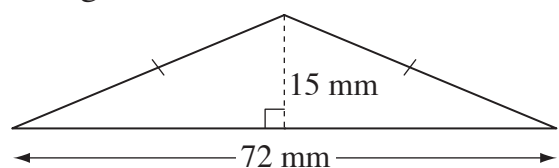
$$P = \quad = \boxed{\text{mm}}$$

c) Calculate the perimeter of this parallelogram. [Hint: Pythagorean theorem will help.]



$$P = \quad = \boxed{\text{mm}}$$

d) Calculate the perimeter of this isosceles triangle. [Hint: Pythagorean theorem will help.]



$$P = \quad = \boxed{\text{mm}}$$

28. [Area / Volume]

continues on page 266

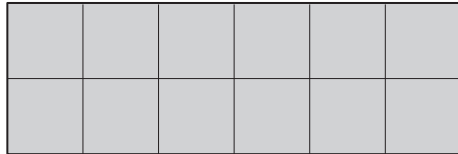
Skill 28.1 Calculating the area of polygons by counting squares and triangles on a square grid (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Count the number of fully shaded squares on the grid.
- If necessary add on the number of half shaded squares (or triangles).
- Look for short cuts in your counting.

Hint: To calculate the area of a rectangular shape it is possible to count the number of squares in a row and then multiply by the number of squares in a column.

Q. Find the area of the rectangle.



Area = 1 cm²

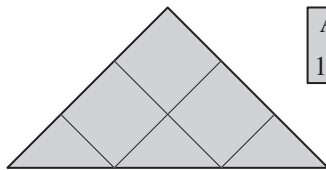
A. 6×2
 $= 12 \text{ cm}^2$

There are 6 squares in a row and 2 squares in a column.

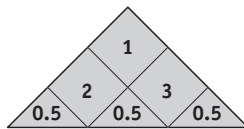
1	2	3	4	5	6
2					

Area = 1 cm²

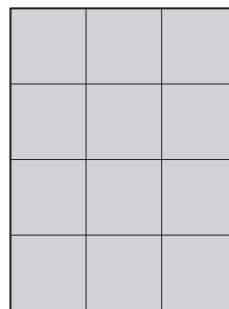
a) Find the area of the triangle.



Area = 1 cm²



b) Find the area of the rectangle.

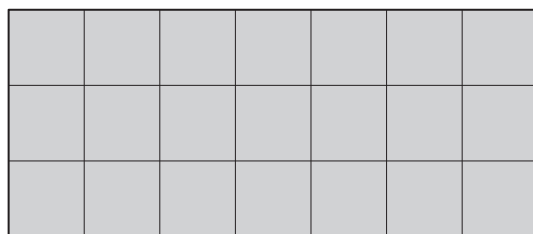


Area = 1 cm²

$3 + 0.5 + 0.5 + 0.5 =$ cm²

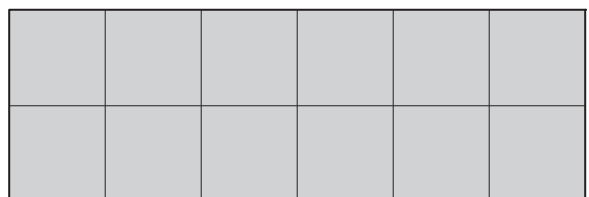
$3 \times 4 =$ cm²

c) Find the area of the rectangle.



Area = 1 cm²

d) Find the area of the rectangle.



Area = 0.25 in.²

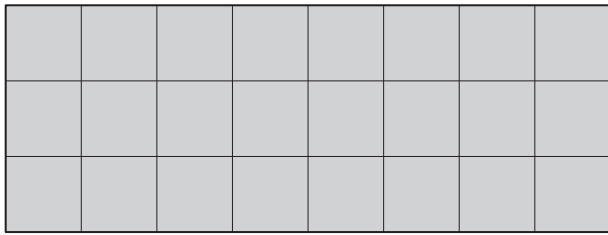
$=$ cm²

$=$ in.²

Skill 28.1 Calculating the area of polygons by counting squares and triangles on a square grid (2).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

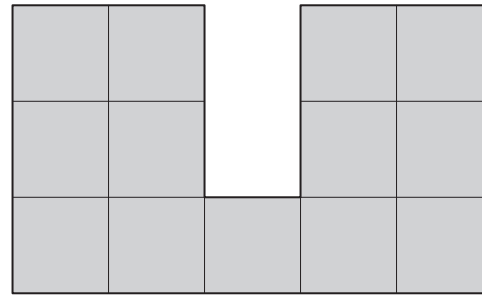
e) Find the area of the rectangle.



Area
= 1 cm²

..... =

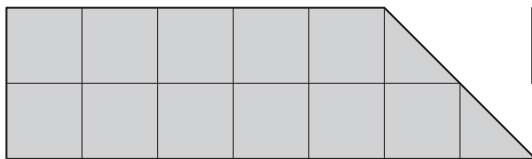
f) Find the area of the polygon.



Area
= 0.25 in.²

..... =

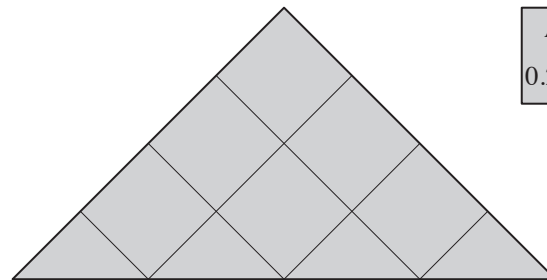
g) Find the area of the trapezoid.



Area
= 1 cm²

..... =

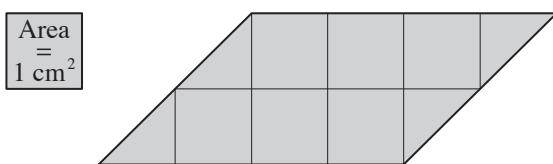
h) Find the area of the triangle.



Area
= 0.25 in.²

..... =

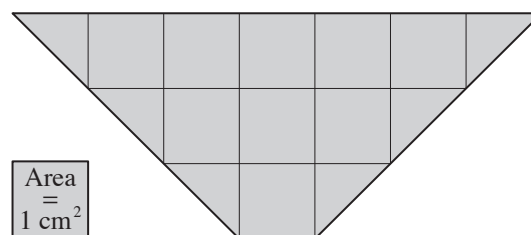
i) Find the area of the parallelogram.



Area
= 1 cm²

..... =

j) Find the area of the trapezoid.



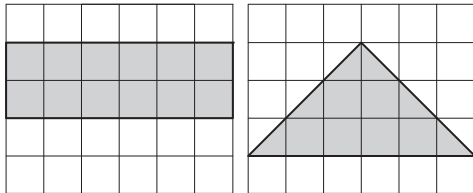
Area
= 1 cm²

..... =

Skill 28.2 Comparing the area of polygons on a square grid (1).

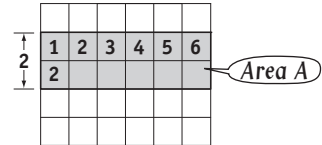
- Break the shape up into rectangles and triangles if necessary.
- Calculate the area of any rectangle by by:
 - Counting the squares OR
 - Multiplying the number of squares in a row by the number of squares in a column.
- Calculate the area of any triangle by halving the area of the rectangle that would enclose it.
- Compare your results.

Q. Do the rectangle and the triangle have the same area?



A. $Area A \neq Area B$
 \Rightarrow **No**

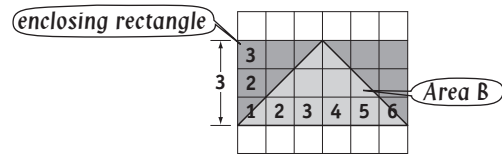
$Area A = 6 \times 2 = 12$ sq. units



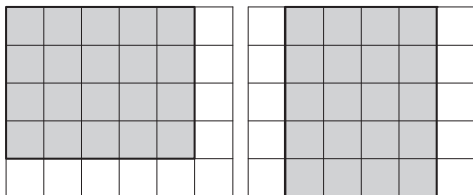
$$Area B = \frac{1}{2} \times 6 \times 3$$

$$= \frac{1}{2} \times 18$$

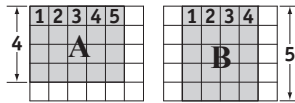
$$= 9 \text{ sq. units}$$



a) Do these rectangles have the same area?



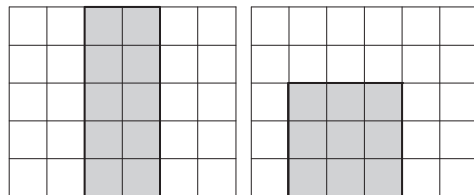
$Area A = 5 \times 4 = 20$



$Area B = 4 \times 5 = 20$

\Rightarrow **yes**

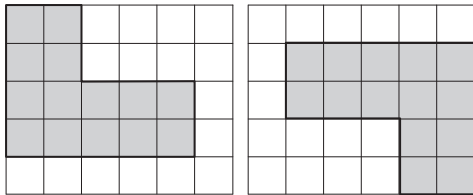
b) Do these rectangles have the same area?



$Area A =$

$Area B =$

c) Do these polygons have the same area?

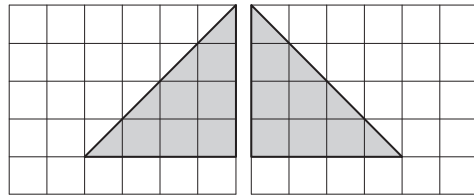


$Area A =$

$Area B =$

\Rightarrow

d) Do these triangles have the same area?



$Area A =$

$Area B =$

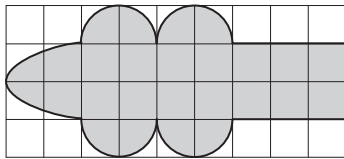
\Rightarrow

Skill 28.3 Estimating the area of irregular shapes on a square grid.

- Break the shape up into workable parts (rectangles/triangles/curved shapes).
- Calculate the area of any rectangle by:
Counting the squares OR
Multiplying the number of squares in a row by the number of squares in a column.
- Calculate the area of any triangle by halving the area of the rectangle that would enclose it.
- Estimate the area of any partly curved shape by making up whole squares from the shaded region.
- Add the results.

Q. Find the area of the shaded shape.

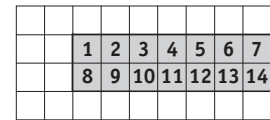
[Round to the nearest whole number.]



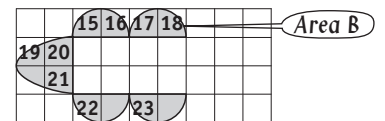
A. $Area A + Area B$ Area A = 14 whole units

$$= 14 + 9$$

$$= 23 \text{ sq. units}$$

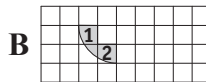
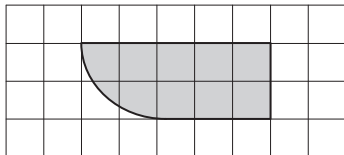


Area B = 9 units
(made up from 12 part units)



a) Find the area of the shaded shape.

[Round to the nearest whole number.]

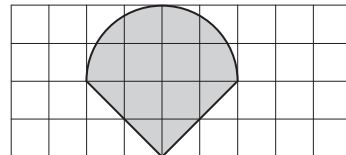


$$Area A = 7 \text{ and } Area B = 2$$

$$Area A + B = 7 + 2 = \boxed{\text{sq. units}}$$

b) Find the area of the shaded shape.

[Round to the nearest whole number.]

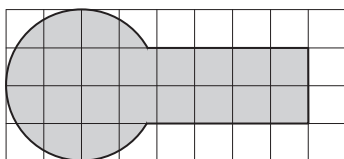


$$Area A = \quad \text{ and } Area B =$$

$$Area A + B = \quad = \boxed{\text{sq. units}}$$

c) Find the area of the shaded shape.

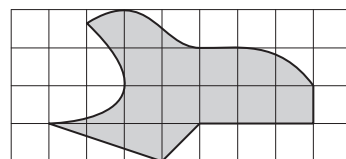
[Round to the nearest whole number.]



$$= \boxed{\text{sq. units}}$$

d) Find the area of the shaded shape.

[Round to the nearest whole number.]



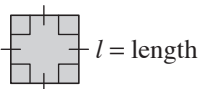
$$= \boxed{\text{sq. units}}$$

Skill 28.4 Calculating the area of squares, rectangles and parallelograms (1).

MMBlue 1 1 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Use the appropriate formula.

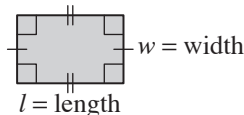
square



$$A = l \times l$$

$$= l^2$$

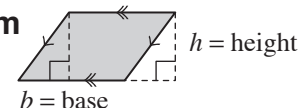
rectangle



$$A = l \times w$$

$$= lw$$

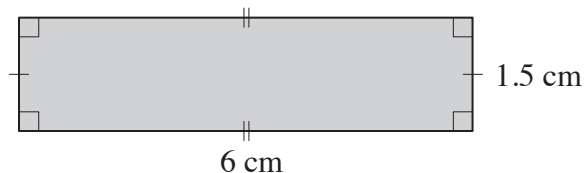
parallelogram



$$A = b \times h$$

$$= bh$$

- Q.** Using $A = lw$ find the area of the rectangle.

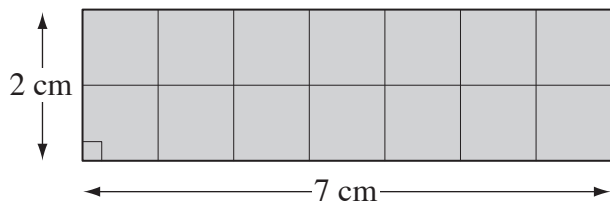


A. $A = lw$ where $l = 6$ and $w = 1.5$

$$= 6 \times 1.5$$

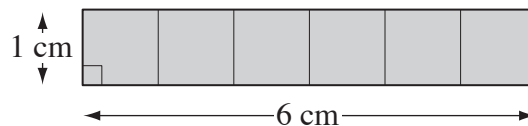
$$= \mathbf{9 \text{ cm}^2}$$

- a)** Using Area = length \times width find the area of this rectangle.



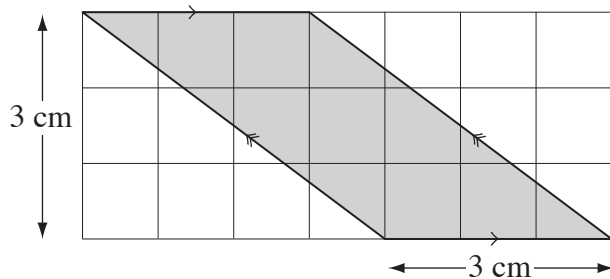
$$A = 7 \times 2 = \boxed{\text{cm}^2}$$

- b)** Using Area = length \times width find the area of this rectangle.



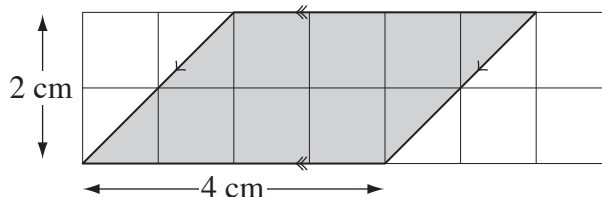
$$A = \boxed{\text{cm}^2}$$

- c)** Using Area = base \times height find the area of this parallelogram.



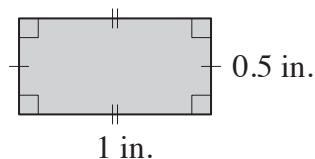
$$A = \boxed{\text{cm}^2}$$

- d)** Using Area = base \times height find the area of this parallelogram.



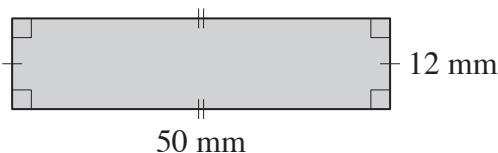
$$A = \boxed{\text{cm}^2}$$

- e)** Using Area = length \times width find the area of this rectangle.



$$A = \boxed{\text{in.}^2}$$

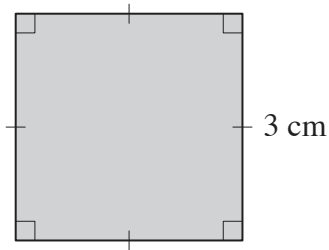
- f)** Using $A = lw$ find the area of the rectangle.



$$A = \boxed{\text{mm}^2}$$

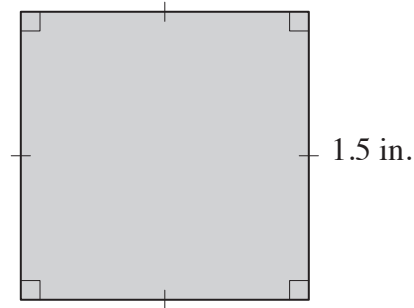
Skill 28.4 Calculating the area of squares, rectangles and parallelograms (2).

- g)** Using $\text{Area} = \text{length} \times \text{length}$ find the area of the square.



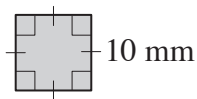
$$A = \dots = \boxed{\text{cm}^2}$$

- h)** Using $\text{Area} = l^2$ find the area of this square.



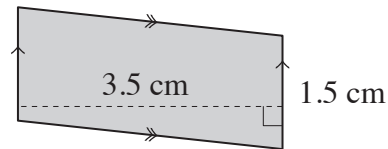
$$A = \dots = \boxed{\text{in.}^2}$$

- i)** Find the area of the square.



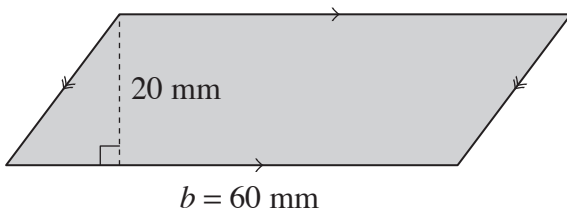
$$A = \dots = \boxed{\text{mm}^2}$$

- j)** Using $\text{Area} = \text{base} \times \text{height}$ find the area of the parallelogram.



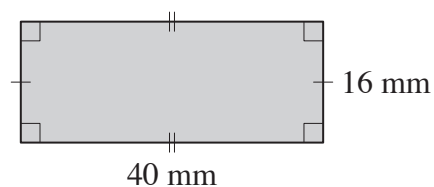
$$A = \dots = \boxed{\text{cm}^2}$$

- k)** Using $\text{Area} = \text{base} \times \text{height}$ find the area of the parallelogram.



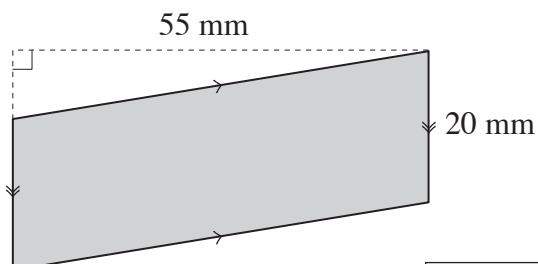
$$A = \dots = \boxed{\text{mm}^2}$$

- l)** Using $A = lw$ find the area of the rectangle.



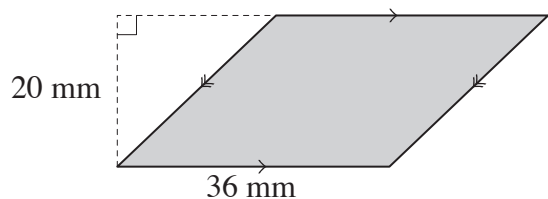
$$A = \dots = \boxed{\text{mm}^2}$$

- m)** Using $A = bh$ find the area of the parallelogram.



$$A = \dots = \boxed{\text{mm}^2}$$

- n)** Find the area of this parallelogram.

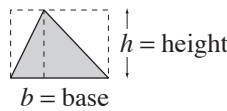


$$A = \dots = \boxed{\text{mm}^2}$$

Skill 28.5 Calculating the area of triangles (1).

- Use the formula.

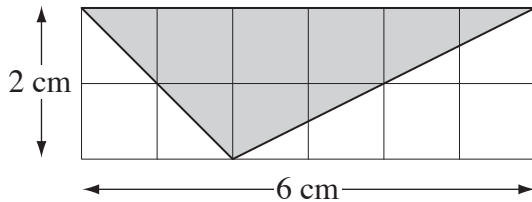
triangle



$$A = \frac{1}{2} \times b \times h$$

$$= \frac{1}{2} bh$$

Q. Using $\text{Area} = \frac{1}{2} \times \text{base} \times \text{height}$ find the area of the triangle.



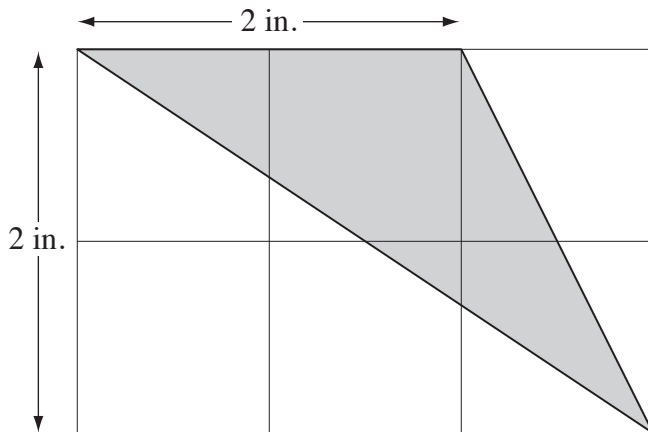
A. $A = \frac{1}{2} bh$ where $b = 6$ and $h = 2$

$$= \frac{1}{2} \times 6 \times 2$$

$$= \frac{1}{2} \times 12$$

$$= \mathbf{6 \text{ cm}^2}$$

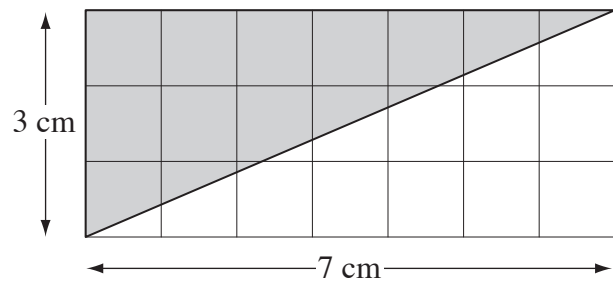
a) Using $\text{Area} = \frac{1}{2} \times \text{base} \times \text{height}$ find the area of the triangle.



$$A = \frac{1}{2} \times 2 \times 2$$

$$= \frac{1}{2} \times 4 = \boxed{\text{in.}^2}$$

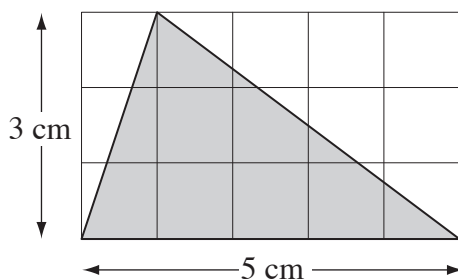
b) Using $\text{Area} = \frac{1}{2} \times \text{base} \times \text{height}$ find the area of the triangle.



$$A =$$

$$= \boxed{\text{cm}^2}$$

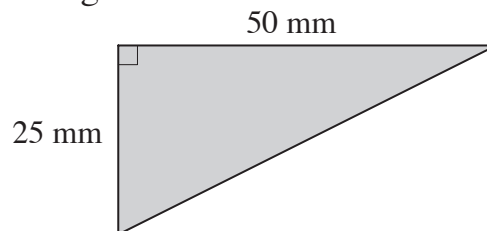
c) Using $\text{Area} = \frac{1}{2} \times \text{base} \times \text{height}$ find the area of the triangle.



$$A =$$

$$= \boxed{\text{cm}^2}$$

d) Using $A = \frac{1}{2} bh$ find the area of the right triangle.

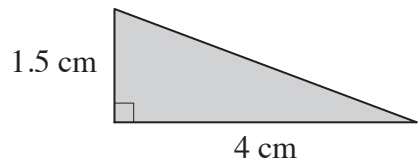


$$A =$$

$$= \boxed{\text{mm}^2}$$

Skill 28.5 Calculating the area of triangles (2).

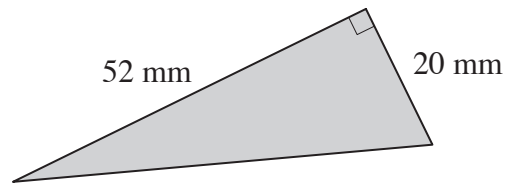
- e) Using Area = $\frac{1}{2} \times \text{base} \times \text{height}$ find the area of the triangle.



$$A =$$

$$= \dots = \boxed{\text{cm}^2}$$

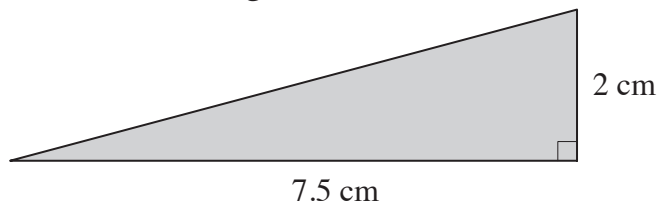
- f) Using Area = $\frac{1}{2} bh$ find the area of the triangle.



$$A =$$

$$= \dots = \boxed{\text{mm}^2}$$

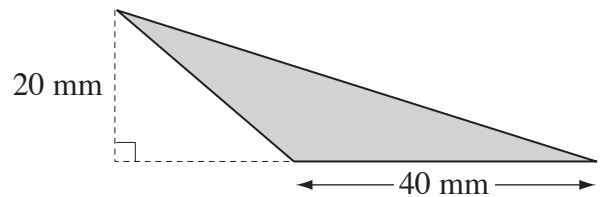
- g) Using Area = $\frac{1}{2} \times \text{base} \times \text{height}$ find the area of the triangle.



$$A =$$

$$= \dots = \boxed{\text{cm}^2}$$

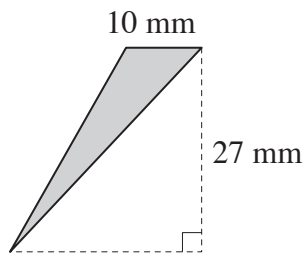
- h) Using Area = $\frac{1}{2} bh$ find the area of the triangle.



$$A =$$

$$= \dots = \boxed{\text{mm}^2}$$

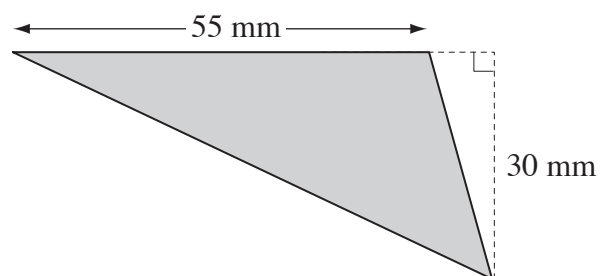
- i) Using Area = $\frac{1}{2} bh$ find the area of the triangle.



$$A =$$

$$= \dots = \boxed{\text{mm}^2}$$

- j) Using Area = $\frac{1}{2} bh$ find the area of the triangle.



$$A =$$

$$= \dots = \boxed{\text{mm}^2}$$

Skill 28.6 Calculating the volume of rectangular prisms by counting cubes (1).

MMBlue 1 1 2 2 3 4 4
MMGreen 1 1 2 3 3 4 4

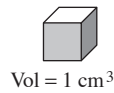
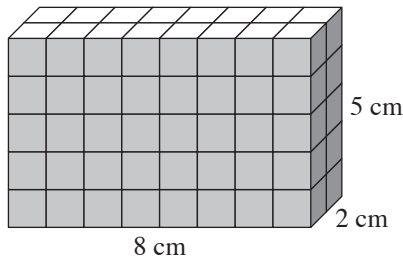
- Count the cubes.

Hint: Count the cubes in one layer and then multiply the result by the total number of layers.

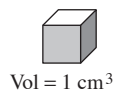
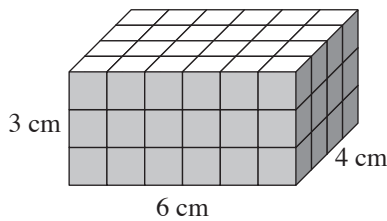
Q. Find the volume of the rectangular prism.

A. $V = 16 \times 5$
 $= 80 \text{ cm}^3$

16 cubes in top layer
5 layers all together

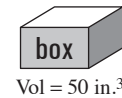
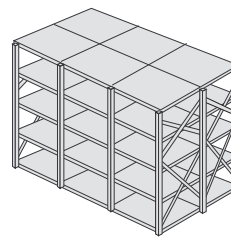


a) Find the volume of the rectangular prism.



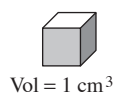
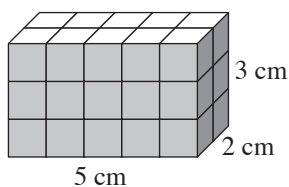
$V = 24 \times 3 = \boxed{\text{cm}^3}$

b) If 24 boxes can fit inside these shelves, find the total volume of the boxes.



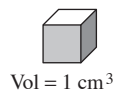
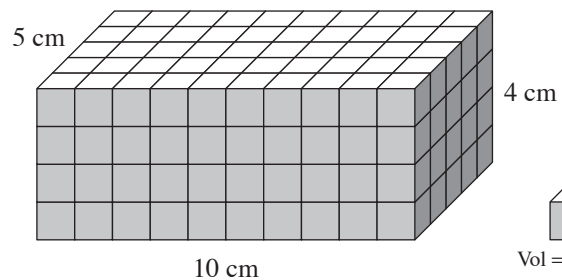
$V = \boxed{\text{in.}^3}$

c) Find the volume of the rectangular prism.



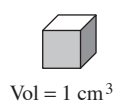
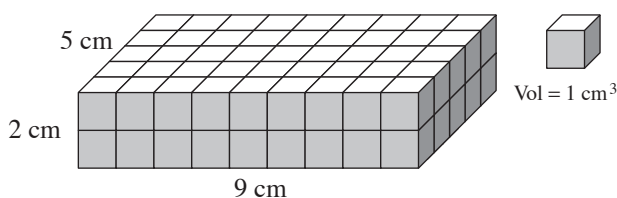
$V = \boxed{\text{cm}^3}$

d) Find the volume of the rectangular prism.



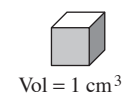
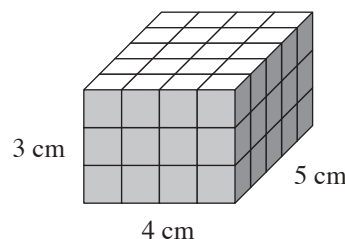
$V = \boxed{\text{cm}^3}$

e) Find the volume of the rectangular prism.



$V = \boxed{\text{cm}^3}$

f) Find the volume of the rectangular prism.

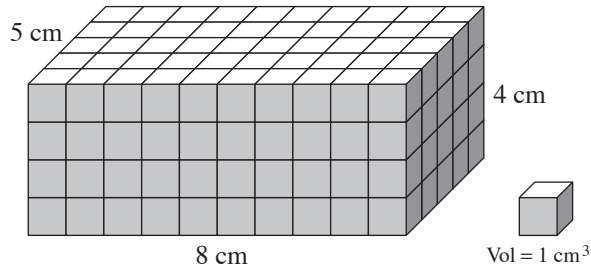


$V = \boxed{\text{cm}^3}$

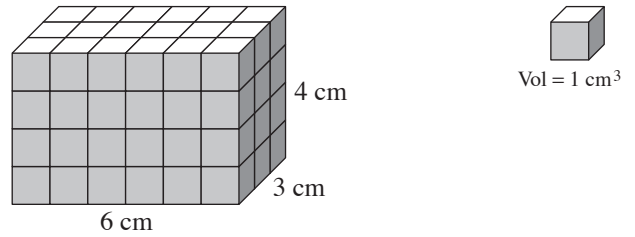
Skill 28.6 Calculating the volume of rectangular prisms by counting cubes (2).

 MMBLue 11 22 3 44
 MMGreen 11 22 3 44

- g)** Find the volume of the rectangular prism. **h)** Find the volume of the rectangular prism.

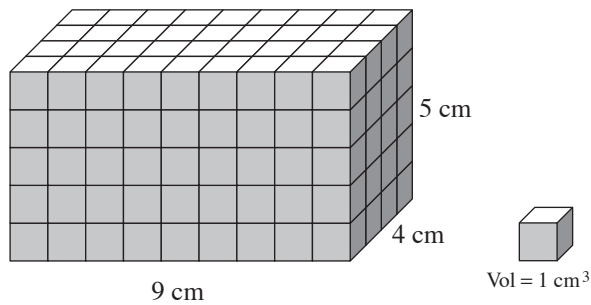


$$V = \dots = \boxed{\text{cm}^3}$$

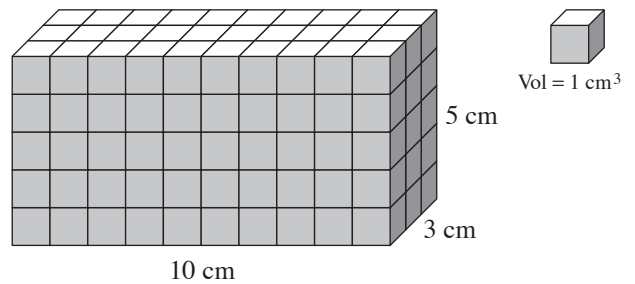


$$V = \dots = \boxed{\text{cm}^3}$$

- i)** Find the volume of the rectangular prism. **j)** Find the volume of the rectangular prism.

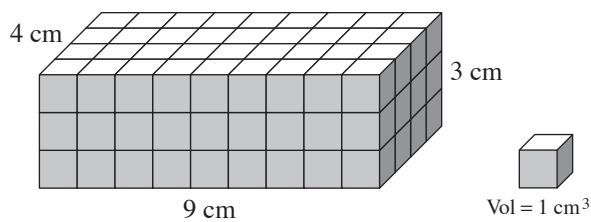


$$V = \dots = \boxed{\text{cm}^3}$$

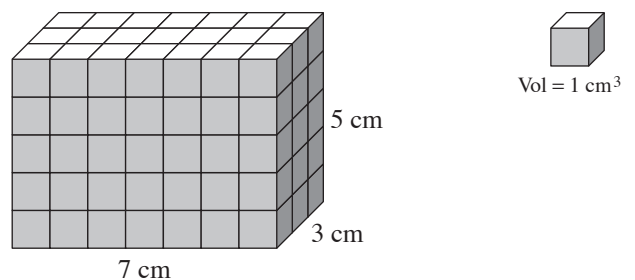


$$V = \dots = \boxed{\text{cm}^3}$$

- k)** Find the volume of the rectangular prism. **l)** Find the volume of the rectangular prism.



$$V = \dots = \boxed{\text{cm}^3}$$



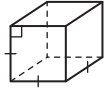
$$V = \dots = \boxed{\text{cm}^3}$$

Skill 28.7 Calculating the volume of square and rectangular prisms (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Use the appropriate formula.

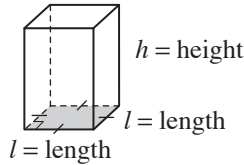
cube



$$V = l \times l \times l$$

$$= l^3$$

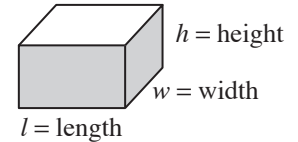
square prism



$$V = l \times l \times h$$

$$= l^2 h$$

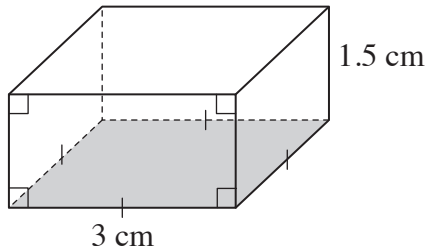
rectangular prism



$$V = l \times w \times h$$

$$= lwh$$

- Q.** Using $V = l^2 h$ find the volume of the square prism.

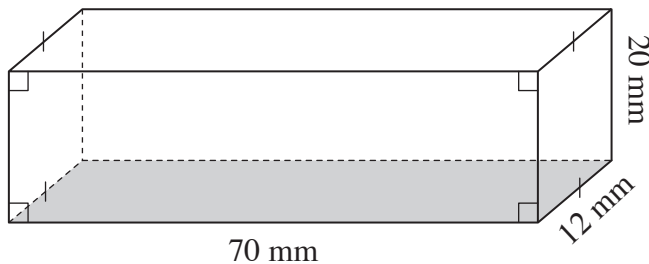


A. $V = 3^2 \times 1.5$

$$= 9 \times 1.5$$

$$= \mathbf{13.5 \text{ cm}^3}$$

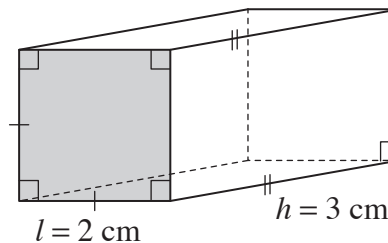
- a)** Using $V = lwh$ find the volume of the rectangular prism.



$$V = 70 \times 12 \times 20$$

$$= 840 \times 20 = \mathbf{16,800 \text{ mm}^3}$$

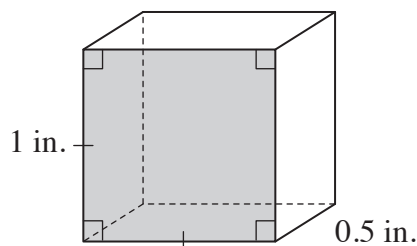
- b)** Using $V = l^2 h$ find the volume of the square prism.



$$V =$$

$$= \quad = \mathbf{\text{cm}^3}$$

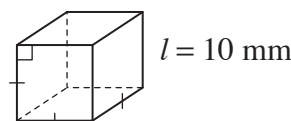
- c)** Using $V = l^2 h$ find the volume of the square prism.



$$V =$$

$$= \quad = \mathbf{\text{in.}^3}$$

- d)** Using $V = l^3$ find the volume of the cube.

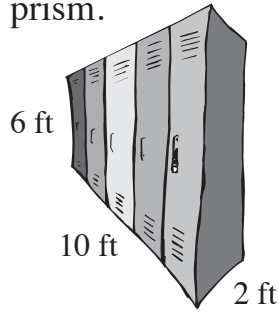


$$V =$$

$$= \quad = \mathbf{\text{mm}^3}$$

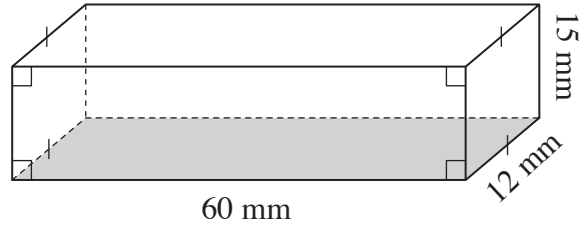
Skill 28.7 Calculating the volume of square and rectangular prisms (2).

- e) Using $V = lwh$ find the volume of the bank of lockers that is a rectangular prism.



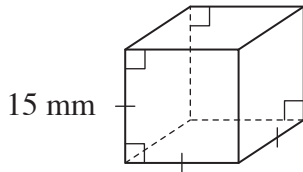
$V =$
.....
= = ft^3

- f) Using $V = lwh$ find the volume of the rectangular prism.



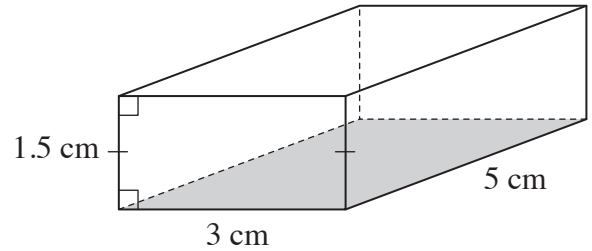
$V =$
.....
= = mm^3

- g) Using $V = l^3$ find the volume of the cube.



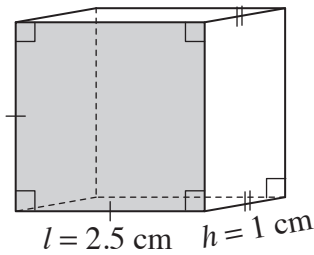
$V =$
.....
= = mm^3

- h) Using $V = lwh$ find the volume of the rectangular prism.



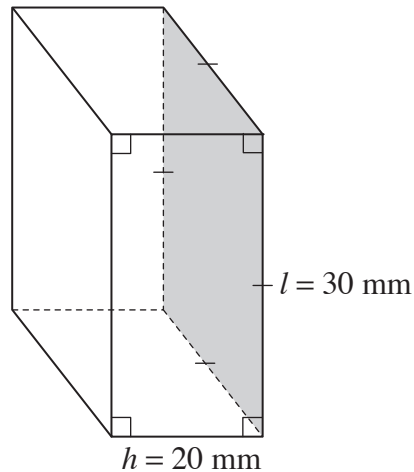
$V =$
.....
= = cm^3

- i) Using $V = l^2h$ find the volume of the square prism.



$V =$
.....
= = cm^3

- j) Using $V = l^2h$ find the volume of the square prism.



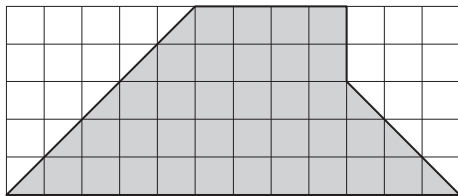
$V =$
.....
= = mm^3

Skill 28.8 Calculating the area of composite shapes (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Break the shape up into workable parts (rectangles/triangles).
- Calculate the area of each part. (see skill 28.4, page 270 and skill 28.6, page 274)
- Add the results.

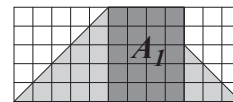
Q. Find the area of the shaded polygon.



A. $A_1 = lw$ where $l = 4$ and $w = 5$

$$= 4 \times 5$$

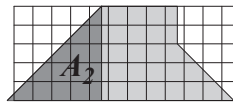
$$= 20$$



$$A_2 = \frac{1}{2}bh$$
 where $b = 5$ and $h = 5$

$$= \frac{1}{2} \times 5 \times 5$$

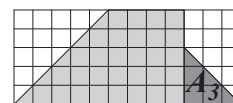
$$= 12.5$$



$$A_3 = \frac{1}{2}bh$$
 where $b = 3$ and $h = 3$

$$= \frac{1}{2} \times 3 \times 3$$

$$= 4.5$$

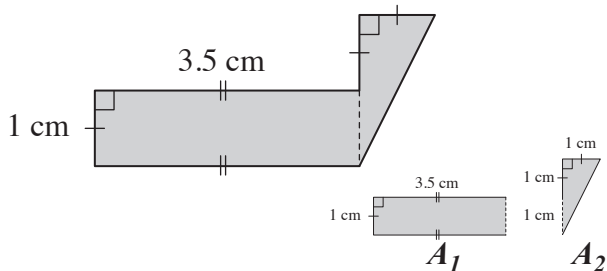


$$A = A_1 + A_2 + A_3$$

$$= 20 + 12.5 + 4.5$$

$$= 37 \text{ sq. units}$$

a) Find the area of the shaded polygon.

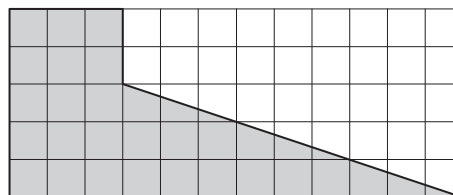


$$A_1 = 1 \times 3.5 = 3.5$$

$$A_2 = \frac{1}{2} \times 1 \times 2 = 1$$

$$A = 3.5 + 1 = \boxed{} \text{ cm}^2$$

b) Find the area of the shaded polygon.

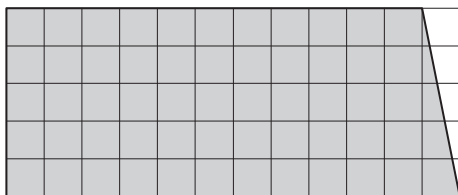


$$A_1 = $$

$$A_2 = $$

$$A = = \boxed{} \text{ sq. units}$$

c) Find the area of the shaded polygon.

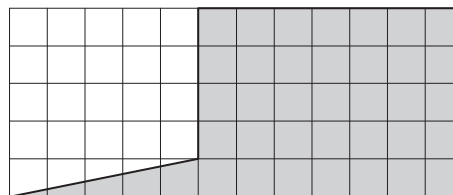


$$A_1 = $$

$$A_2 = $$

$$A = = \boxed{} \text{ sq. units}$$

d) Find the area of the shaded polygon.



$$A_1 = $$

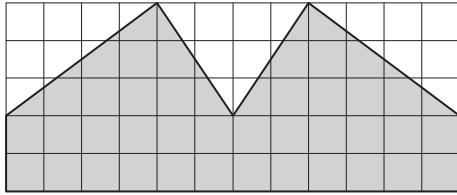
$$A_2 = $$

$$A = = \boxed{} \text{ sq. units}$$

Skill 28.8 Calculating the area of composite shapes (2).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

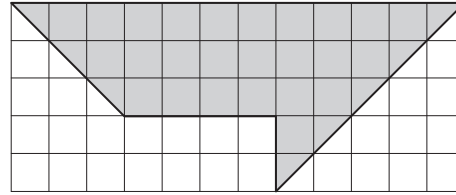
e) Find the area of the shaded polygon.



$A_1 =$ $A_2 =$

$A =$ =

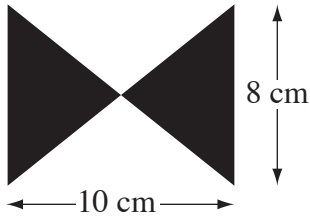
f) Find the area of the shaded polygon.



$A_1 =$ $A_2 =$

$A =$ =

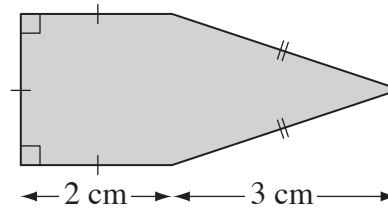
g) Find the area of the bowtie.



$A_1 =$ $A_2 =$

$A =$ =

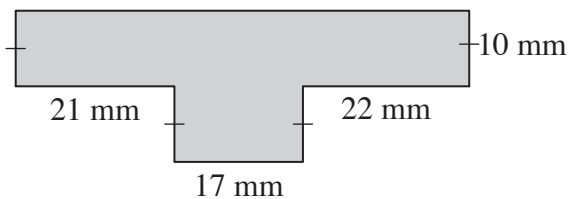
h) Find the area of the polygon.



$A_1 =$ $A_2 =$

$A =$ =

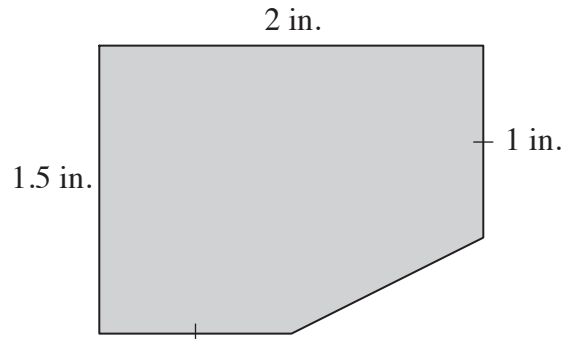
i) Find the area of the shaded polygon.



$A_1 =$ $A_2 =$

$A =$ =

j) Find the area of the polygon.



$A_1 =$ $A_2 =$

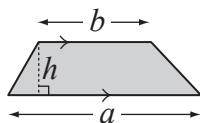
$A =$ =

Skill 28.9 Calculating the area of trapezoids and rhombii.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Use the appropriate formula.

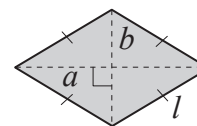
trapezoid



$$A = \frac{1}{2} (\text{base } a + \text{base } b) \times \text{height } h$$

$$= \frac{1}{2} (a + b)h$$

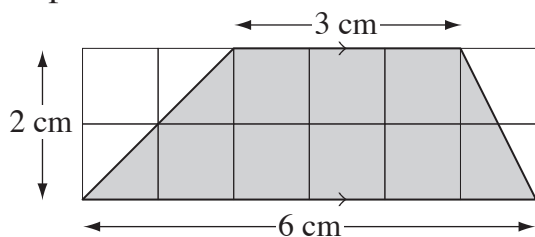
rhombus



$$A = \frac{1}{2} \times \text{diagonal } a \times \text{diagonal } b$$

$$= \frac{1}{2} ab$$

Q. Using $A = \frac{1}{2}(a + b)h$ find the area of the trapezoid.



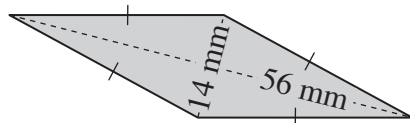
A. $A = \frac{1}{2}(a + b)h$ where $a = 3$, $b = 6$ and $h = 2$

$$= \frac{1}{2} \times (6 + 3) \times 2$$

$$= \frac{1}{2} \times 9 \times 2$$

$$= \mathbf{9 \text{ cm}^2}$$

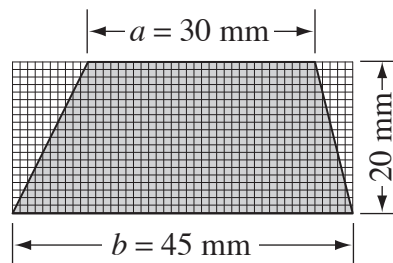
a) Using $A = \frac{1}{2}ab$ find the area of the rhombus.



$$A = \frac{1}{2} \times 14 \times 56$$

$$= 7 \times 56 = \boxed{\text{mm}^2}$$

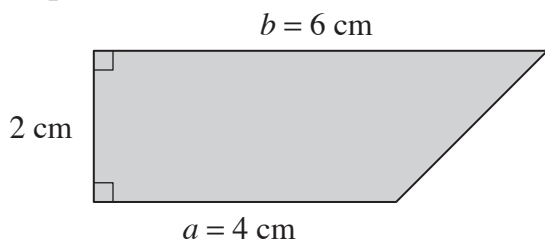
b) Using Area = $\frac{1}{2}(\text{base } a + \text{base } b) \times \text{height}$ find the area of the trapezoid.



$$A =$$

$$= \boxed{\text{mm}^2}$$

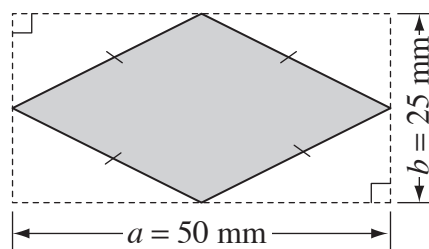
c) Using $A = \frac{1}{2}(a + b)h$ find the area of the trapezoid.



$$A =$$

$$= \boxed{\text{cm}^2}$$

d) Using Area = $\frac{1}{2} \times \text{diagonal } a \times \text{diagonal } b$ find the area of the rhombus.



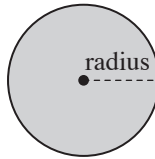
$$A =$$

$$= \boxed{\text{mm}^2}$$

Skill 28.10 Calculating the area of circles and composite circular shapes.

- Use the formula.

circle



$$A = \pi \times \text{radius} \times \text{radius}$$

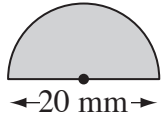
$$= \pi r^2$$

where $\pi \approx 3.14\dots$

or $\approx \frac{22}{7}$

Hint: If you are given the diameter then halve to find the radius: $r = \frac{d}{2}$

- Q.** Using $A = \pi r^2$ and $\pi \approx 3.14$, find the area of the semi-circle.



A. Area of circle = πr^2 where $d = 20$ and $r = 10$

$$= 3.14 \times 10^2$$

$$= 3.14 \times 100$$

$$= 314$$

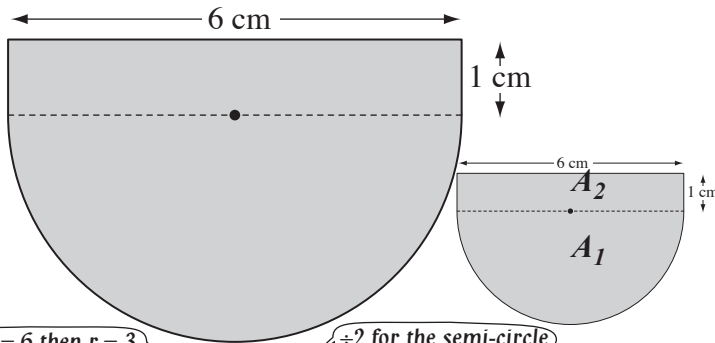
Area of semi-circle

$$= 314 \div 2$$

$$= 157 \text{ mm}^2$$

$r = \frac{d}{2}$

- a)** Using $A = \pi r^2$ and $\pi \approx 3.14$, find the area of the shaded shape.



(If $d = 6$ then $r = 3$)

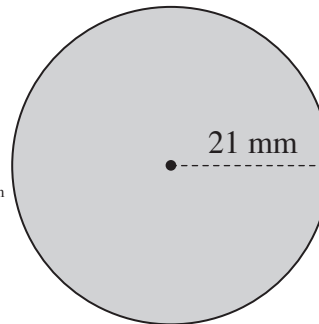
($\div 2$ for the semi-circle)

$$A_1 = 3.14 \times 3 \times 3 \div 2 = 14.13$$

$$A_2 = 6 \times 1 = 6 \text{ and using } A = A_1 + A_2$$

$$A = 14.13 + 6 = \boxed{\text{cm}^2}$$

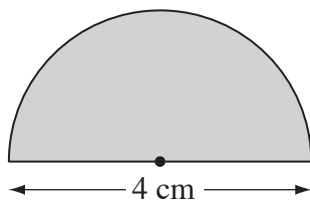
- b)** Using $A = \pi r^2$ and $\pi \approx \frac{22}{7}$, find the area of the circle.



$$A =$$

$$= \boxed{\text{mm}^2}$$

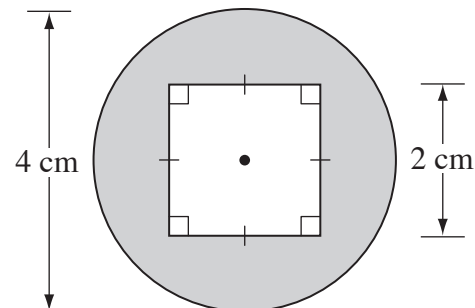
- c)** Using $A = \pi r^2$ and $\pi \approx 3.14$, find the area of the semi-circle.



$$A =$$

$$= \boxed{\text{cm}^2}$$

- d)** Using $A = \pi r^2$ and $\pi \approx 3.14$, find the area of the shaded shape.



$$A_1 =$$

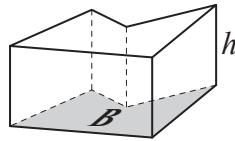
$$A_2 =$$

$$A = \boxed{\text{cm}^2}$$

Skill 28.11 Calculating the volume of any prism.

- Use the general formula.

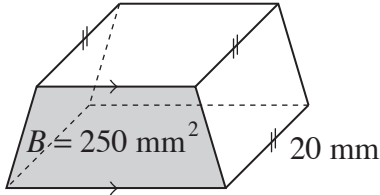
prism



$$V = \text{Area of base} \times \text{height of prism}$$

$$= Bh$$

- Q.** Using $V = Bh$ find the volume of the prism.

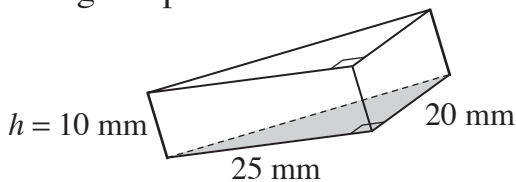


A. $A = Bh$ where $B = 250$ and $h = 20$

$$= 250 \times 20$$

$$= \mathbf{5000 \text{ mm}^3}$$

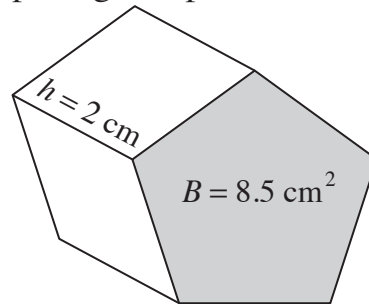
- a)** Using $V = Bh$ find the volume of the triangular prism.



$$B = \frac{1}{2} \times 25 \times 20 = 250$$

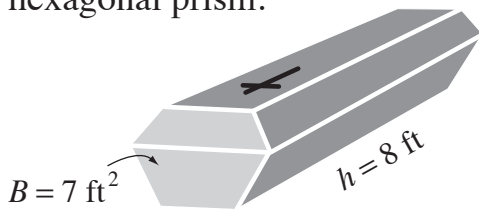
$$V = 250 \times 10 = \boxed{\text{mm}^3}$$

- b)** Using Volume = area of the base \times height of the prism, find the volume of the pentagonal prism.



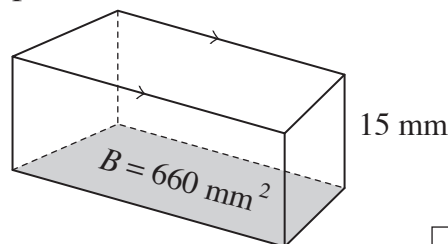
$$V = \boxed{\text{cm}^3}$$

- c)** Using $V = Bh$ find the volume of the hexagonal prism.



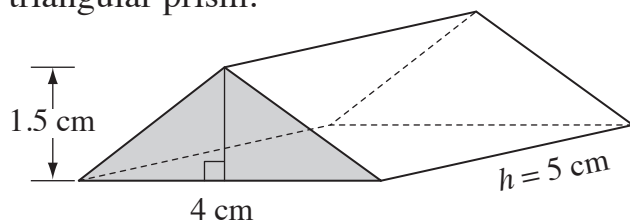
$$V = \boxed{\text{ft}^3}$$

- d)** Using $V = Bh$ find the volume of the prism.



$$V = \boxed{\text{mm}^3}$$

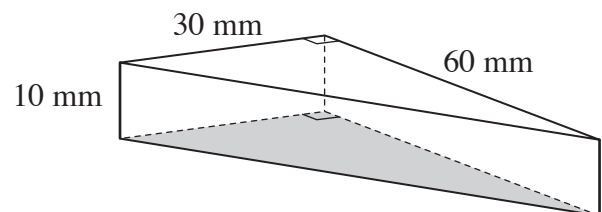
- e)** Using $V = Bh$ find the volume of the triangular prism.



$$B =$$

$$V = \boxed{\text{cm}^3}$$

- f)** Using $V = Bh$ find the volume of the triangular prism.



$$B =$$

$$V = \boxed{\text{mm}^3}$$

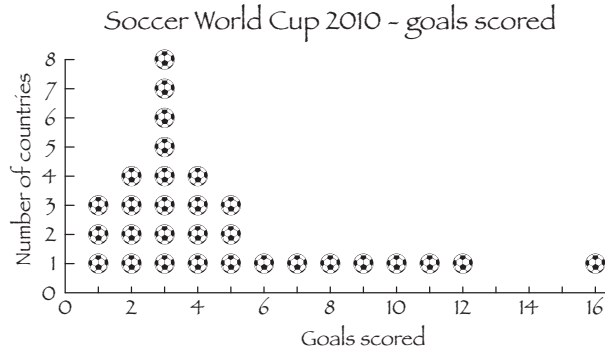
29. [Statistics]

Skill 29.1 Interpreting line plots.

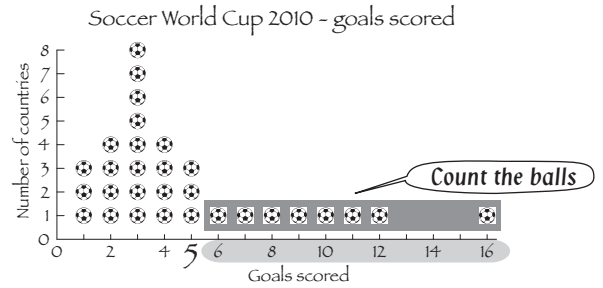
MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

- Hint: Each dot (•), cross (x) or picture shows the position of a sample of the data above a number line.

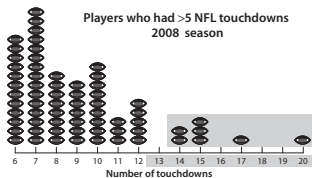
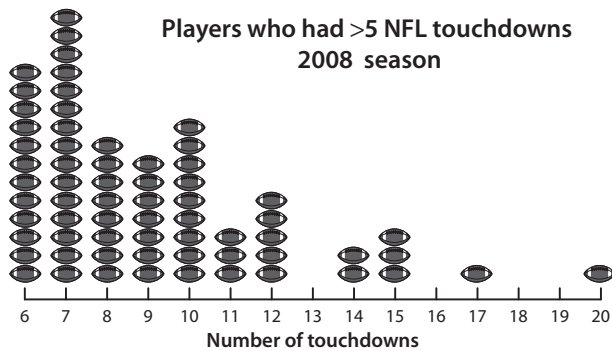
Q. How many countries scored more than 5 goals in the 2010 soccer world cup?



A. $1 + 1 + 1 + 1 + 1 + 1 + 1 + 1$
 $= 8$

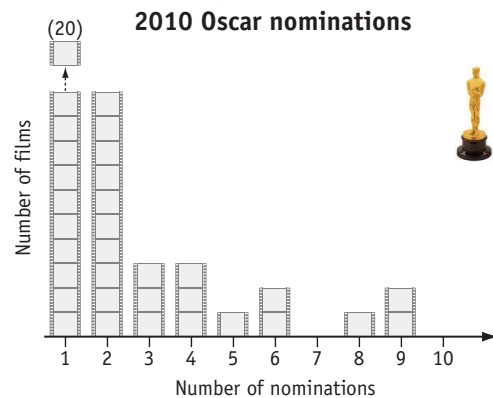


a) How many players had more than 12 NFL touchdowns in 2008?



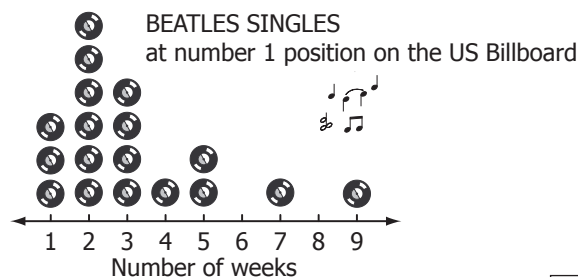
$2 + 3 + 1 + 1 =$

b) In 2010, how many films received four Oscar nominations each?



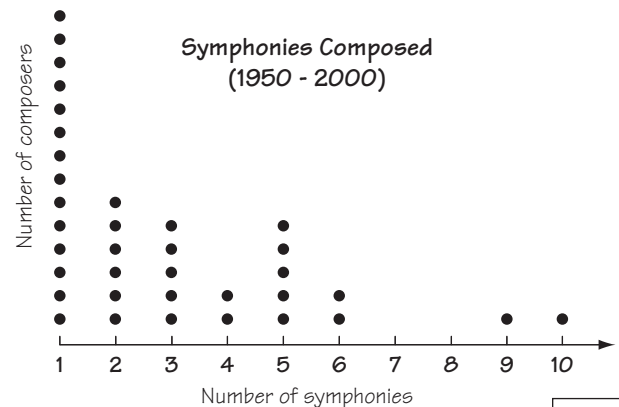
$=$

c) 'Hey Jude' was The Beatles single that held the number one position on the US Billboard for the longest amount of time. For how many weeks was 'Hey Jude' at number one?



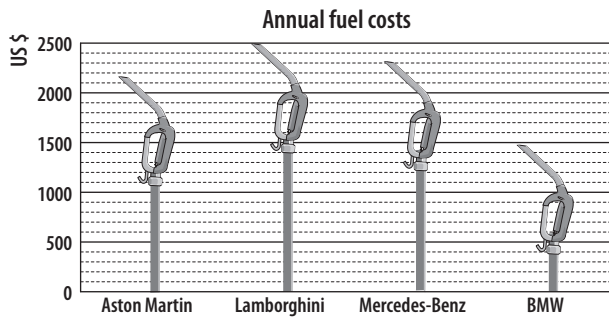
$=$

d) Between 1950 and 2000, how many musicians composed more than four symphonies?

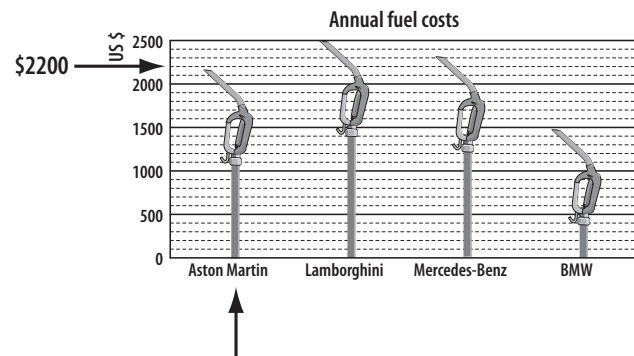


$=$

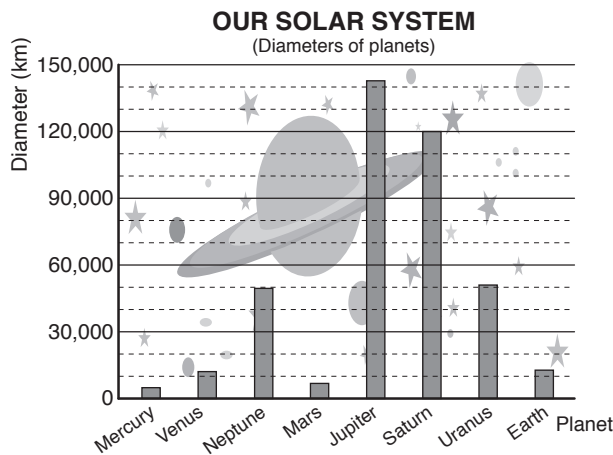
Q. Which car has closest to \$2200 each year in fuel costs?



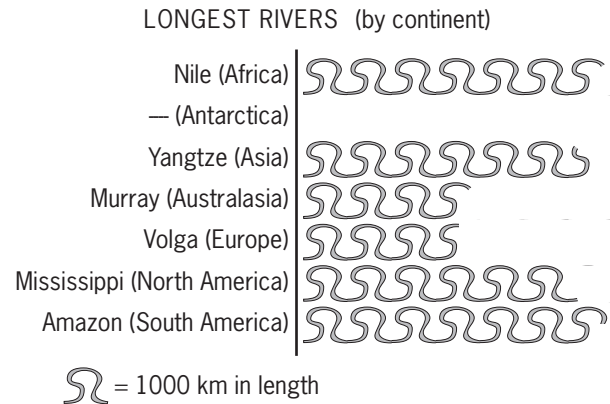
A. *Aston Martin*



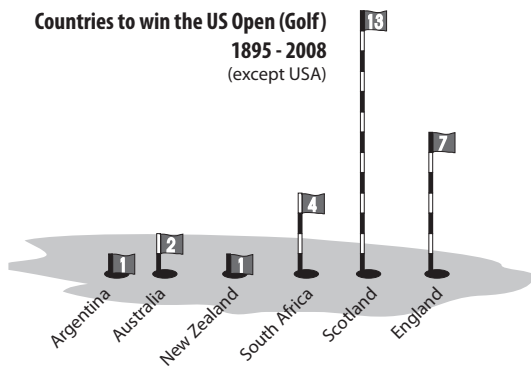
a) Name the planet with the greatest diameter.



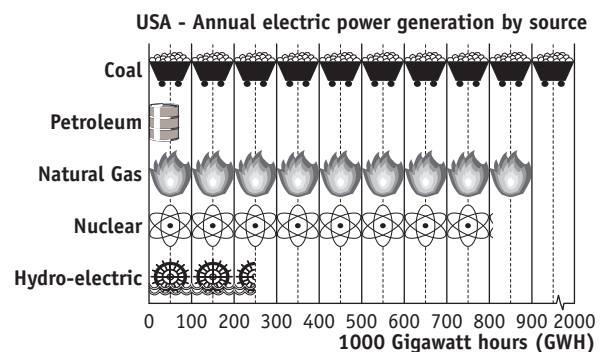
b) Which river is closest to 6000 km in length?



c) Which country has won the US Open half as often as South Africa?



d) Which source of power generates approximately 250,000 GWH of electricity each year?



Skill 29.3 Interpreting tables.

- Read the title and sub-headings.
- Check what each row (across) and column (down) represents.
- To find the information you need, follow a row across to where it meets the relevant column.
- Using the information gathered, perform any calculations necessary.

Q. What percent of girls in grade 6 in Vermont ride a high rise bike with a sissy bar?

A. 1.6%

Percent of girls owning bicycles of different styles by school grade - Vermont

Bike style	School Grade							Total%
	K	1	2	3	4	5	6	
Standard	91.4	83.1	69.1	75.8	73.8	72.6	79	76.8
High rise	8.6	14.7	24.9	20.3	21.8	23.8	16.4	19.4
High rise, sissy bar	0	1.7	5.5	2.2	2.1	1.6	1.6	2.3
Standard and high rise	0	0.6	0.5	1.7	2.3	2.1	3	1.5

Percent of girls owning bicycles of different styles by school grade - Vermont

Bike style	School Grade							Total%
	K	1	2	3	4	5	6	
Standard	91.4	83.1	69.1	75.8	73.8	72.6	79	76.8
High rise	8.6	14.7	24.9	20.3	21.8	23.8	16.4	19.4
High rise, sissy bar	0	1.7	5.5	2.2	2.1	1.6	1.6	2.3
Standard and high rise	0	0.6	0.5	1.7	2.3	2.1	3	1.5

a) Of the birds listed, which bird has a wingspan of 11 feet?

Wing Spans (ft)

barn owl	goose	grey heron	swan	white pelican	condor	stork	albatross
3	6	6	7.5	10	10	11	11.5

b) What percent of boys in grade 6 in Vermont ride a high rise bike with a sissy bar?

Percent of boys owning bicycles of different styles by school grade - Vermont

Bike style	School Grade							Total%
	K	1	2	3	4	5	6	
Standard	86.3	60	47.3	44	44.7	49	48.7	52.2
High rise	13.7	27.4	39.9	45	41	35	28.2	34.2
High rise, sissy bar	0	10.5	10.5	8.5	8.4	8	12.5	8.9
Standard and high rise	0	2.1	2.1	2.5	5.8	7.5	10.6	4.7

c) Which animal has the greatest $\frac{\text{jump height}}{\text{weight}}$ ratio?

How high can they jump?

Animal	Antelope	Human	Cat	Galago	Cuban tree frog	Locust	Flea
Weight (g)	200,000	70,000	2500	300	12.9	3	0.0005
Jump height (cm)	250	60	150	225	65	45	10

d) How many chemicals in sea water have a content of more than one part per thousand?

Principal constituents of seawater

Chemical Constituent	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO ₃)	Sulfate (SO ₄)	Chloride (Cl)	Bromide (Br)	Total dissolved solids (Salinity)
Content (parts per thousand)	0.419	1.304	10.710	0.390	0.145	2.690	19.350	0.070	19.350

e) Which type of coal has the highest percent of carbon?

Coal Type	moisture	carbon	other
lignite	35%	30%	35%
sub-bituminous coal	10%	75%	15%
bituminous coal	5%	80%	15%
anthracite	3%	92%	5%

f) Which activity expends one third of the amount of kilojoules (kJ) per minute as swimming?

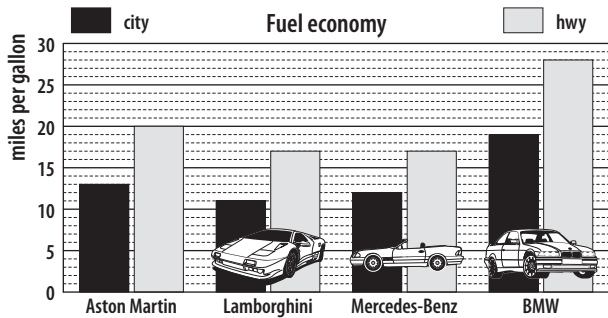
Energy needed (kJ per minute)

sleeping	writing	house work	tennis (doubles)	swimming	cycling	sprinting
4	10	16	21	30	36	42

Skill 29.4 Interpreting bar graphs (1).

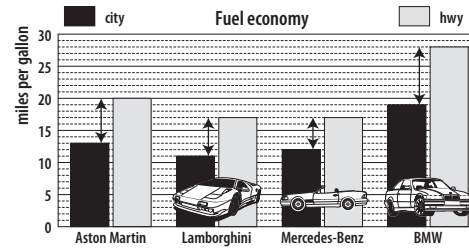
MMBlue 1 1 2 3 3 4 4
MMGreen 1 1 2 3 3 4 4

Q. Which car's fuel economy rate differs the least for city as compared to highway driving?

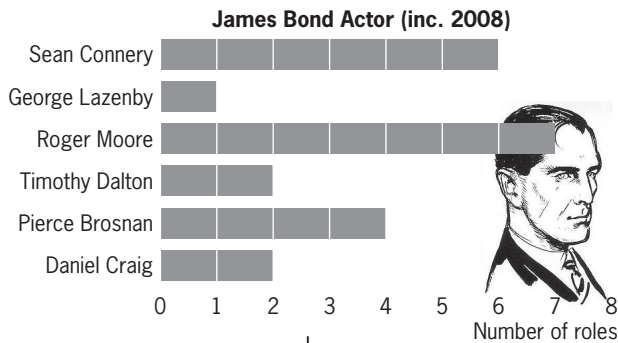


A. Mercedes Benz

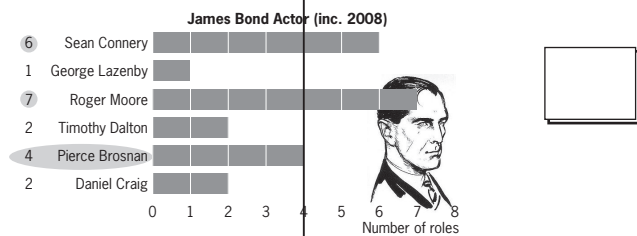
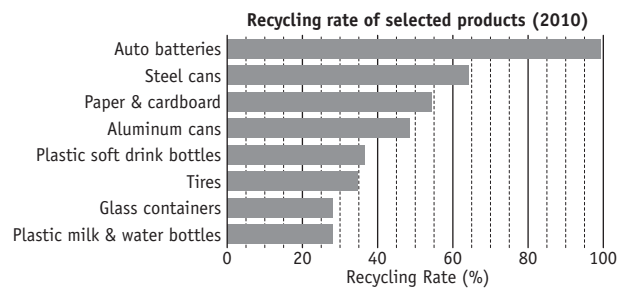
Measure the difference between city and country for each car.



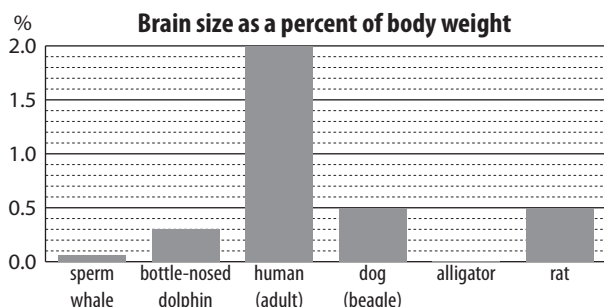
a) How many actors have played James Bond more often than Pierce Brosnan?



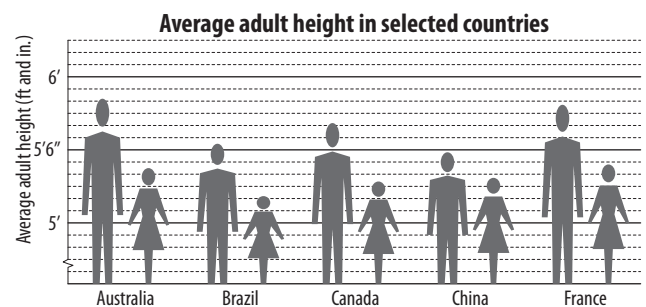
b) How many products in the list had a recycling rate of more than 50% in 2010?



c) Which creature listed below has a brain weighing 0.3% of their body weight?



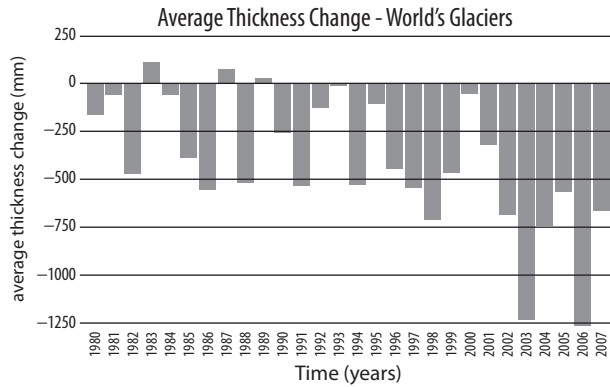
d) Of the countries shown, which has the greatest difference in height between genders?



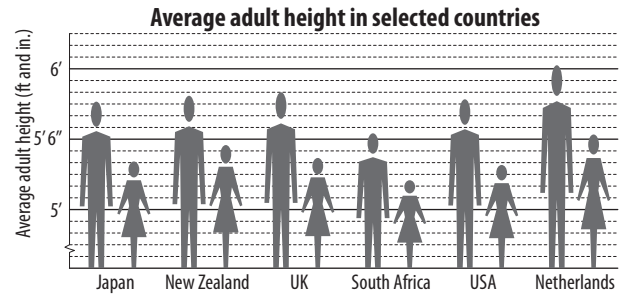
Skill 29.4 Interpreting bar graphs (2).

MMBlue 1 1 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

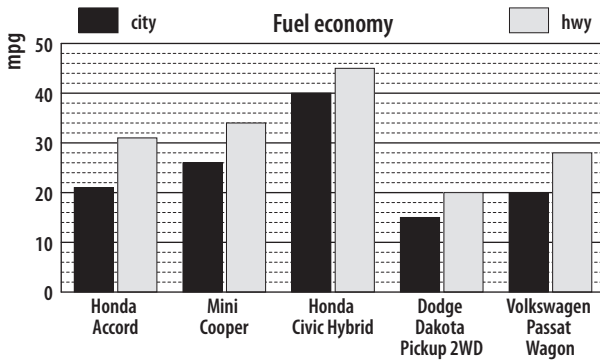
e) In which years did the average thickness of the world's glaciers increase?



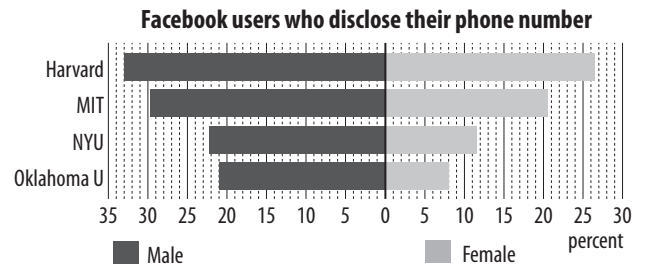
f) What is the average adult height of men in the UK?



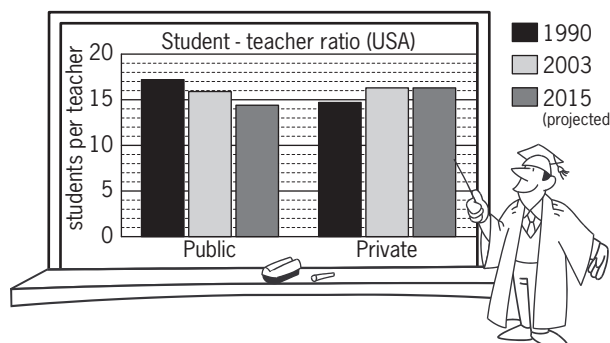
g) Which car's fuel economy rate differs the most for city as compared to highway driving?



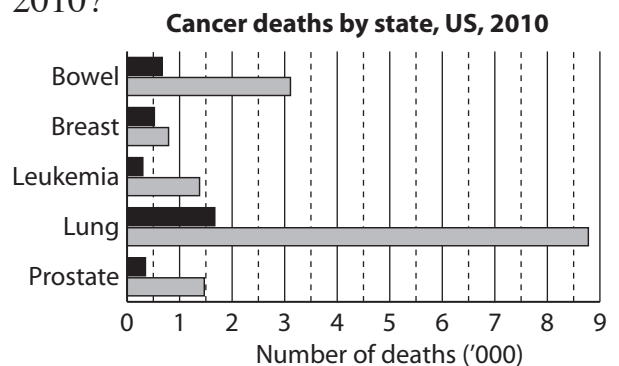
h) Are male or female facebook users more likely to disclose their telephone number?



i) In public schools, in which of the years shown is the student-teacher ratio closest to 16 : 1?



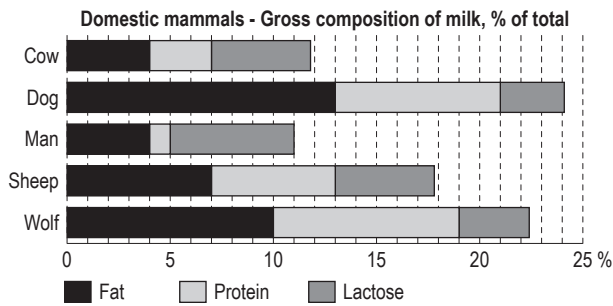
j) Which type of cancer was responsible for closest to 500 deaths in Colorado in 2010?



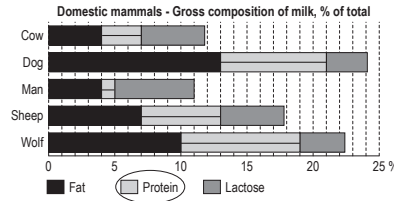
Skill 29.5 Interpreting stack graphs (1).

MMBlue 1 1 2 3 3 4 4
MMGreen 1 1 2 3 3 4 4

Q. Which of the mammals shown has the highest protein content in their milk?



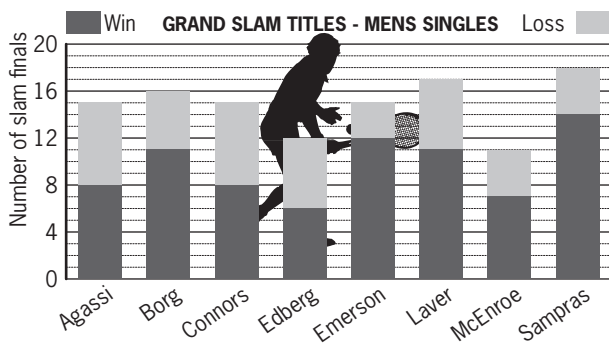
A. *wolf*



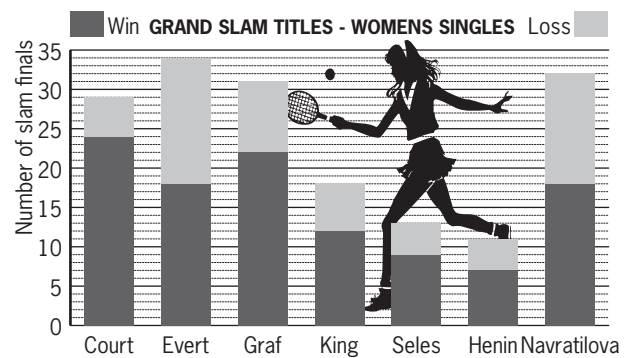
The width of the wolf bar for protein represents 9%.

No other bar for protein content is as long in any other mammal shown.

a) Who had the best ratio of wins to losses in their grand slam singles finals?

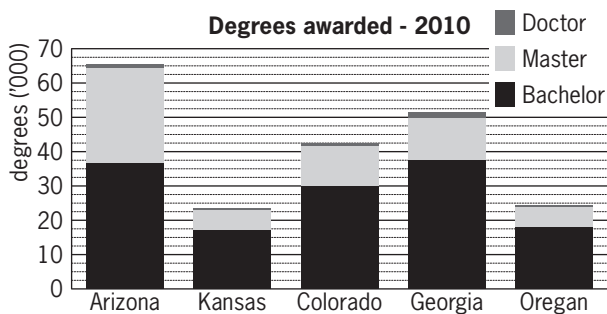


b) Who had the best ratio of wins to losses in their grand slam singles finals?

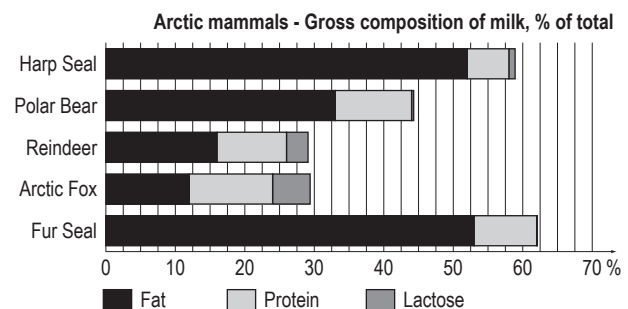


Emerson

c) Which state had the highest percent of master degrees in 2010?

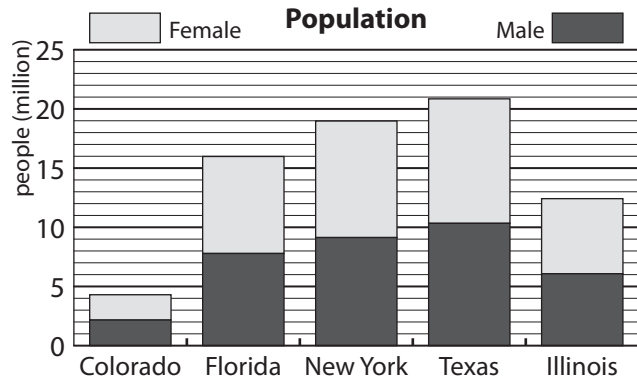


d) Which of the mammals shown has the lowest protein content in their milk?

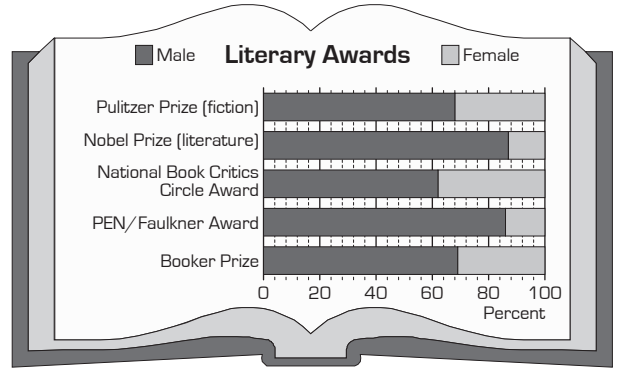


Skill 29.5 Interpreting stack graphs (2).

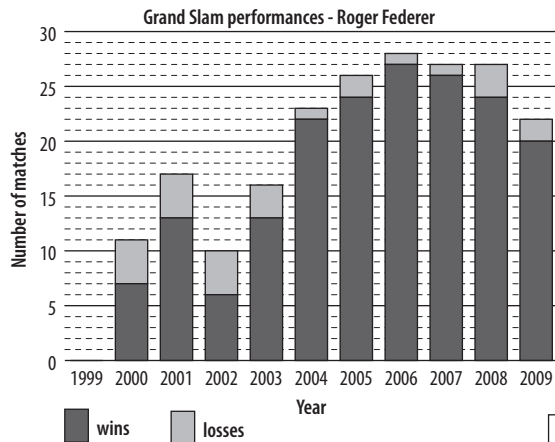
e) Of the states shown below, which has the greatest difference in the number of males and females?



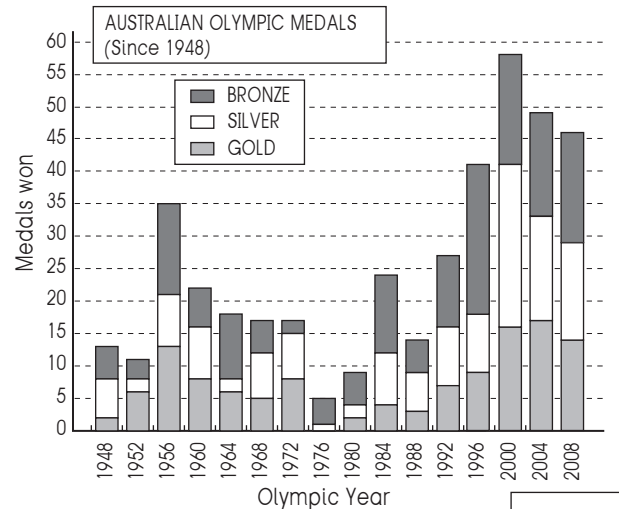
f) For which of the literary awards shown did males make up closest to three fifths of the recipients?



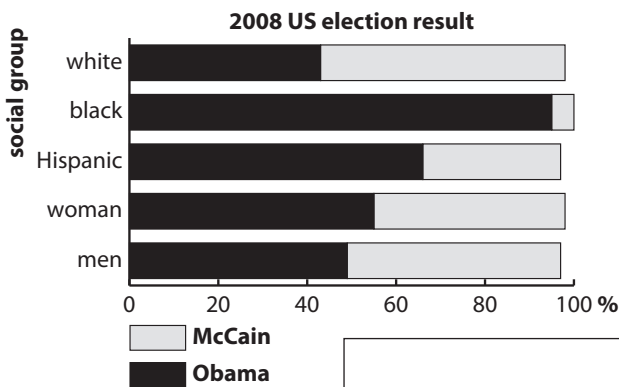
g) Between 2000 and 2009, Roger Federer played in all 4 grand slam tournaments each year. How many grand slam tournaments did Roger Federer win in that time?



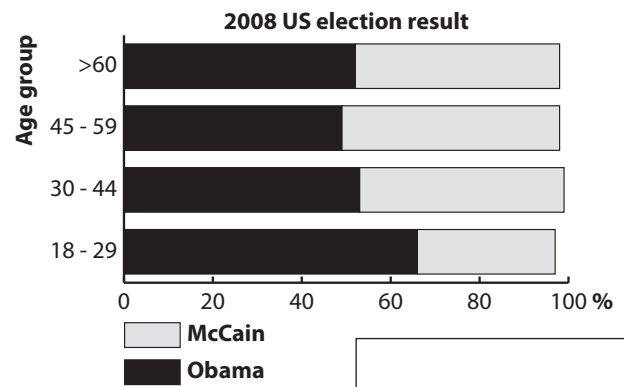
h) Of all the years in which Australia has won more than 15 medals, which year produced the least gold medals?



i) Which social group had the highest percent of their vote going to Obama?



j) Which age group gave equal votes to Obama and McCain?



Skill 29.6 Calculating the mean and median of sets of data (1).

MMBlue 1 1 2 2 3 4 4
MMGreen 1 1 2 2 3 3 4 4

Mean (or average)

- Add all the values in the set.
- Divide the total by the number of values in the set.

Set of data: 5, 1, 5, 3, 2, 1, 5, 2

Mean $1 + 1 + 2 + 2 + 3 + 5 + 5 + 5 = 24$
8 values so $24 \div 8 = 3$

Median (middle value)

- Write all the values in order.
- Odd numbered set - middle value.
- Even numbered set - average of the 2 middle values.

Set of data (even): 5, 1, 5, 3, 2, 1, 5, 2

Ordered set: 1, 1, 2, 2, 3, 5, 5, 5

Median $\frac{2+3}{2} = \frac{5}{2} = 2.5$

Q. This table shows the number of ski runs at selected resorts in Colorado. Find the mean and median of the data.

Resorts in Colorado - ski runs					
33	44	52	76	84	131

A. Mean

$33 + 44 + 52 + 76 + 84 + 131 = 420$

$420 \div 6$

$= 70$

6 values in the set, so divide by 6

Median

33, 44, 52, 76, 84, 131 *order values*

$\frac{52+76}{2} = \frac{128}{2}$ *find middle value*

$= 64$ *average 2 middle values*

a) This table shows the number of stations on some of the monorails in the USA. Find the median of the data.

Monorails of USA (Number of Stations)									
2	2	2	3	4	6	7	8	8	8

2, 2, 2, 3, 4, 6, 7, 8, 8, 8 *middle values*

$Median = \frac{4+6}{2} = \frac{10}{2} = \boxed{}$ *average 2 middle values*

b) This table shows the NASCAR sprint finishes for Carl Edwards between 2005 and 2009 at Pocono raceway. Find the median of the data.

Pocono Raceway NASCAR sprint car series '05 - '09 Finishes - Carl Edwards								
1	1	2	4	9	14	21	25	39

$Median = \boxed{}$

c) This table shows the atomic number of the non-metals in the periodic table of elements. Find the median of the data.

Non-metals • Periodic table of elements

Carbon (C)	Nitrogen (N)	Oxygen (O)	Phosphorus (P)	Sulphur (S)	Selenium (Se)
6	7	8	15	16	34

$Median = \boxed{}$

d) This table shows a 7-day temperature forecast for Vancouver. Find the median high temperature for the interval.

Vancouver 7-day Forecast							Feb 05 2011
THU	FRI	SAT	SUN	MON	TUE	WED	
Hi 47°F	46°F	45°F	43°F	42°F	44°F	43°F	
Lo 37°F	40°F	33°F	37°F	33°F	32°F	34°F	

order values

$Median = \boxed{}$

Skill 29.6 Calculating the mean and median of sets of data (2).

MMBlue 11 2 2 3 3 4 4
MMGreen 11 2 2 3 3 4 4

- e) This table shows the average lifespan of some animals. Find the mean of the data.

ANIMAL LIFESPANS - years

cat	camel	rhinoceros	grizzly bear
12	12	15	25

$$12 + 12 + 15 + 25 = 64$$

4 values in the set, so divide by 4

Mean = $64 \div 4$

=

- f) Ada selects scrabble letters that spell the 7 letter word 'quartz'. Find the mean value of her tiles.

Value of Scrabble tile selection

A	U	R	T	Y	Q	Z
1	1	1	1	4	10	10

Mean =

=

- g) This table shows the number of calories per serving of some carbohydrates. Find the mean of the data.

Carbohydrate Calories per 100 g

Carbohydrate	Calories per 100 g
potatoes	70
macaroni	95
spaghetti	100
pasta	105
rice	140
bread	210

Mean =

=

- h) This table shows the number of stations on some of Europe's monorails. Find the mean of the data.

Europe's monorails (Number of Stations)

2	2	2	2	2	3	3	5	6	20
---	---	---	---	---	---	---	---	---	----

Mean =

=

- i) This table shows the number of petals on some flower species. Find the mean and median of the data.

Number of petals

Lily	Iris	Fuschia	Buttercup	Amaryllis	Narcissus	Delphinium
3	3	4	5	6	6	8

Mean =

Median =

mean =

median =

- j) This table shows the total number of medals won by the USA at the winter Olympics from 1992 to 2010. Find the mean and median of the data.

[Round to the nearest integer.]

United States Winter Olympics Medals

year	1992	1994	1998	2002	2006	2010
medals	11	13	13	34	25	37

Mean =

Median =

mean =

median =

Mode (most common value)

Range

- Write all the values in order.
- Subtract the lowest value from the highest value.

Hint: A set of data can have more than one mode if two or more values repeat the same number of times.

Set of data: 5, 1, 5, 3, 2, 1, 5, 2
Ordered set: 1, 1, 2, 2, 3, 5, 5, 5
Mode 5
Range $5 - 1 = 4$

Q. The number of scrabble tiles available for each letter is shown below. Find the mode and range of the data.

Numbers of Scrabble tiles

Z	Q	X	J	K	Y	W	V	H	F	P	M	C	B	G	D	U	L	S	R	T	N	O	I	A	E
1	1	1	1	1	2	2	2	2	2	2	2	2	2	3	4	4	4	4	6	6	6	8	9	9	12

A. Mode

= 2

Range

$12 - 1$

= 11

Numbers of Scrabble tiles

Z	Q	X	J	K	Y	W	V	H	F	P	M	C	B	G	D	U	L	S	R	T	N	O	I	A	E
1	1	1	1	1	2	2	2	2	2	2	2	2	2	3	4	4	4	4	6	6	6	8	9	9	12

difference between highest and lowest

The value 2 is in the set 9 times

a) This table shows the NASCAR sprint finishes for Jeff Gordon between 2005 and 2009 at Pocono raceway. Find the mode and range of the data.

Pocono Raceway NASCAR sprint car series '05 - '09 Finishes - Jeff Gordon								
1	3	4	4	9	10	13	14	34

The value 4 is in the set 2 times

$Range = 34 - 1 = 33$

mode = range =

b) The values of scrabble tiles are shown below. Find the mode and range of the data.

Values of Scrabble tiles

A	E	I	L	N	O	R	S	T	U	D	G	B	C	M	P	F	H	V	W	Y	K	J	X	Q	Z
1	1	1	1	1	1	1	1	1	1	2	2	3	3	3	3	4	4	4	4	4	5	8	8	10	10

$Range =$

mode = range =

c) This table shows the total number of medals won by the USA at the Winter Olympics. Find the mode and range of the data.

United States Winter Olympics Medals

year	1992	1994	1998	2002	2006	2010
medals	11	13	13	34	25	37

$Range =$

mode = range =

d) This table shows the number of calories per serving of some fruits. Find the mode and range of the data.

Fruit	Calories per 100 g
Apple	47
Orange	40
Banana	95
Grapes	60
Kiwi fruit	49
Pear	40

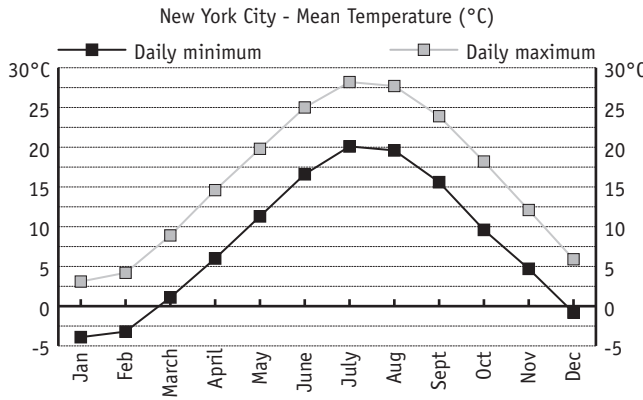
$Range =$

mode = range =

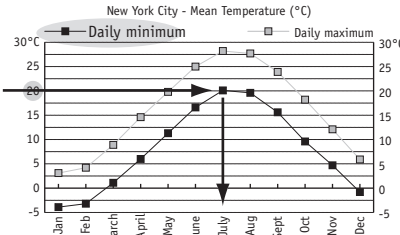
Skill 29.8 Interpreting line graphs (1).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

Q. In which month is the mean daily minimum temperature 20°C?



A. July

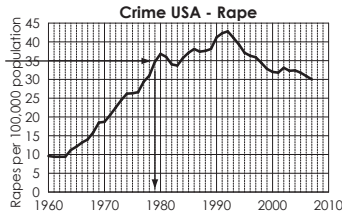
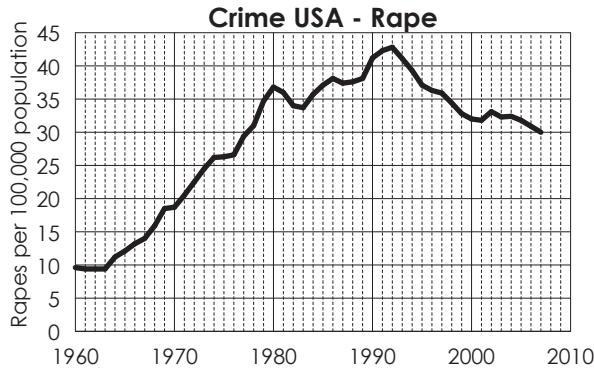


Find the daily minimum graph line.

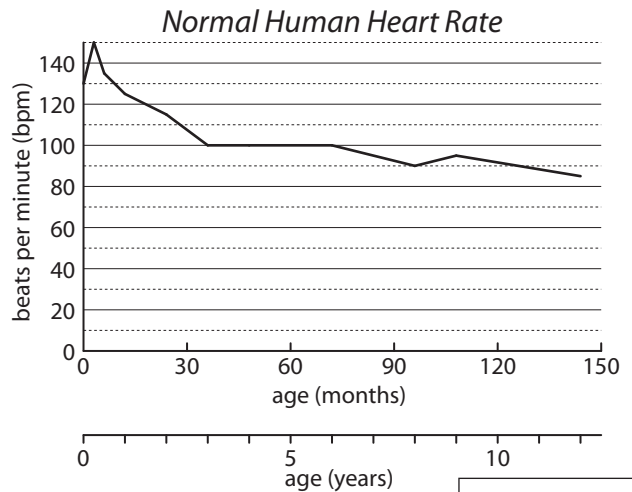
Read across from 20°C to where you reach the line.

Read down to the corresponding month.

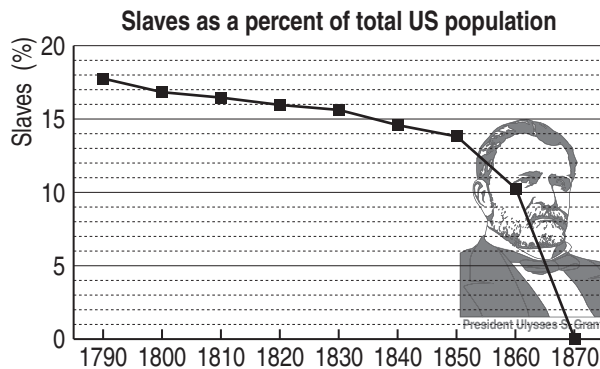
a) In which year in the USA did the number of rapes per 100,000 of the population first reach 35?



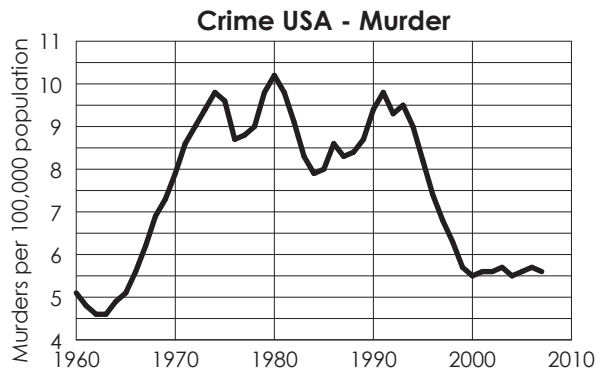
b) For how many years is the normal human heart rate expected to be 100 beats per minute? [Round your answer to the nearest whole number.]



c) Which interval of 10 years has seen the greatest percent decrease in the number of slaves?



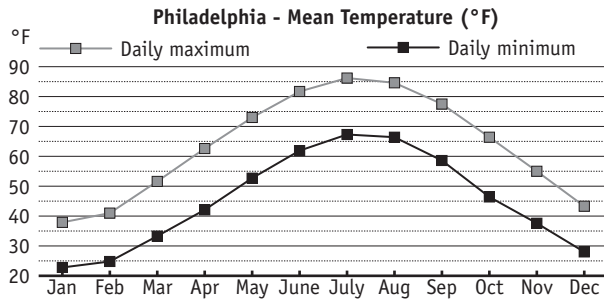
d) How many murders per 100,000 people were registered in 1970?



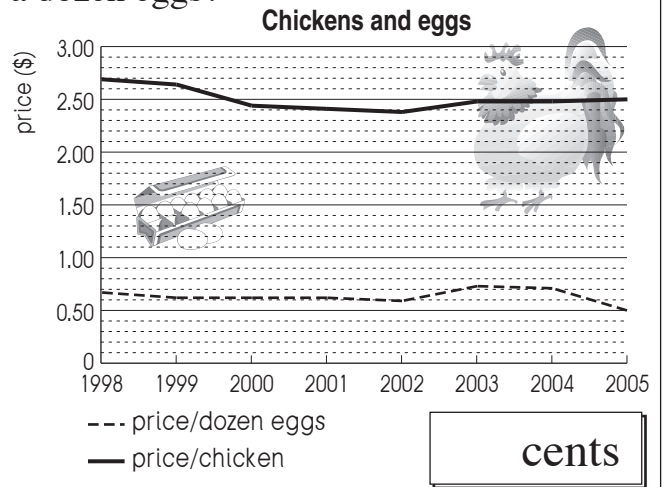
Skill 29.8 Interpreting line graphs (2).

MMBlue 1 1 2 2 3 4 4
MMGreen 1 1 2 2 3 4 4

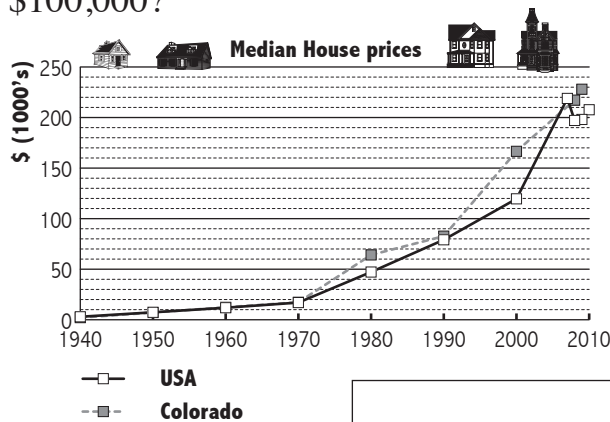
e) For which month is the mean daily maximum temperature closest to 55°F?



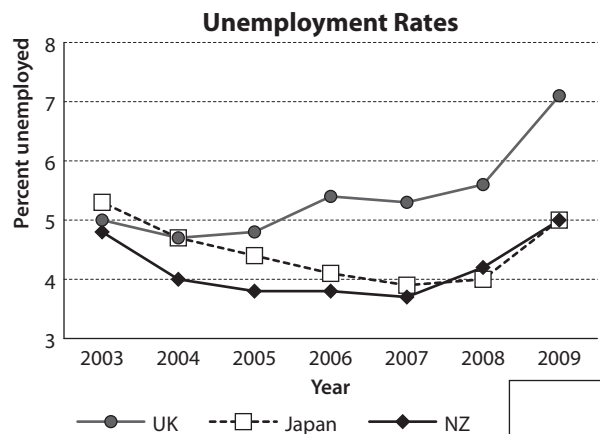
f) Find the difference between the lowest price of a chicken and the lowest price of a dozen eggs?


 cents

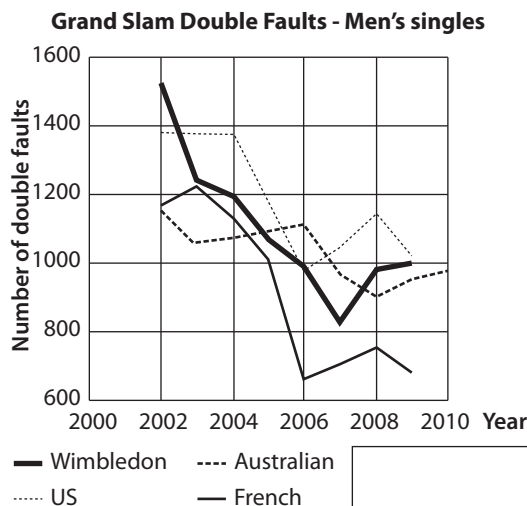
g) In which decade did both the USA and Colorado median house price first exceed \$100,000?



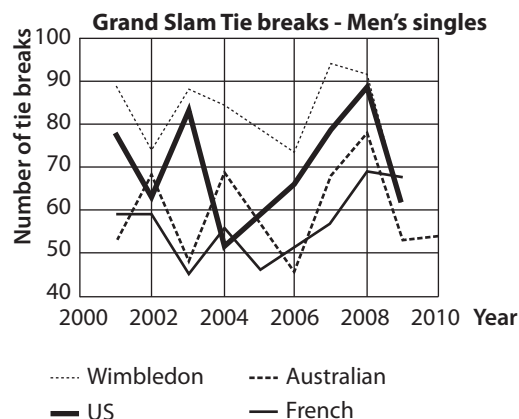
h) In which year was the unemployment rate in Japan and New Zealand the same?



i) Between 2002 and 2010 which grand slam tournament has seen the greatest drop in the number of double faults?

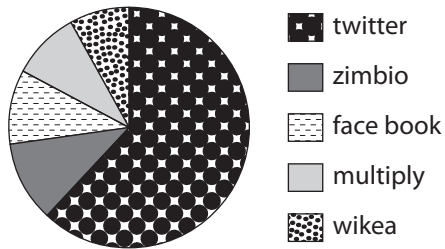


j) For the 4 grand slams, which year had the highest number of tie-breaks overall?

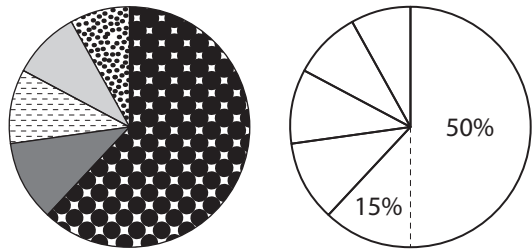


Q. From 2009 to 2010, which community platform had a percent growth closest to 65%?

% Growth from '09 to '10 - top 5 community platforms

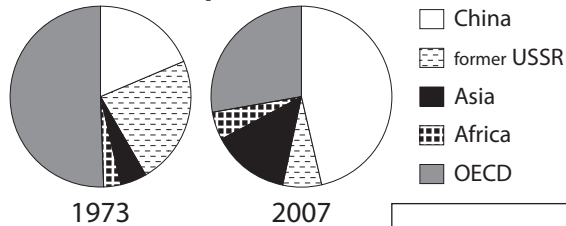


A. *twitter*



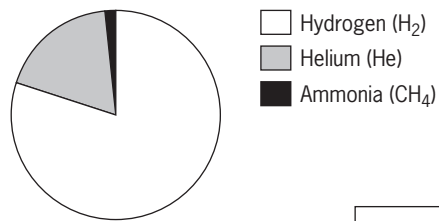
a) Which region has almost halved its share of hard coal production between 1973 and 2007?

Hard coal production

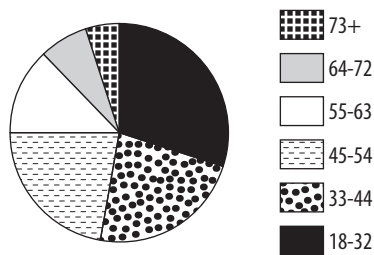


b) Which element makes up about 80% of Neptune's atmosphere?

Atmospheric composition of Neptune

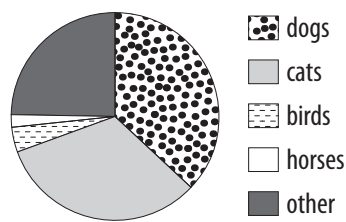


c) Which age group most uses the internet?
US Internet usage 2010 by ages
(% of internet-using population)



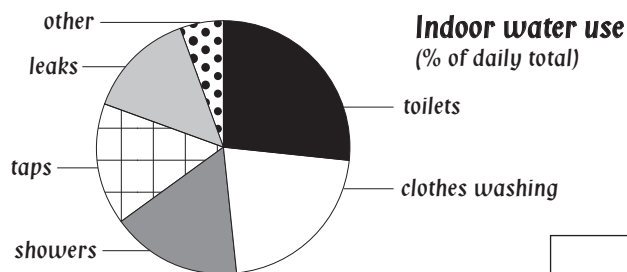
d) Which two animals account for 70% of all pets?

Pet owners' choice



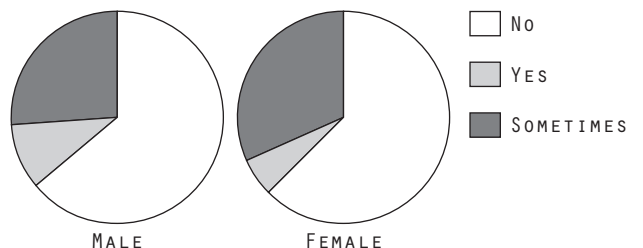
e) Approximately what percent of indoor water usage is accounted for by toilets?

- A) 5%
- B) 15%
- C) 25%
- D) 50%



f) Which response, to accepting a stranger as a friend on facebook, is most similar between males and females?

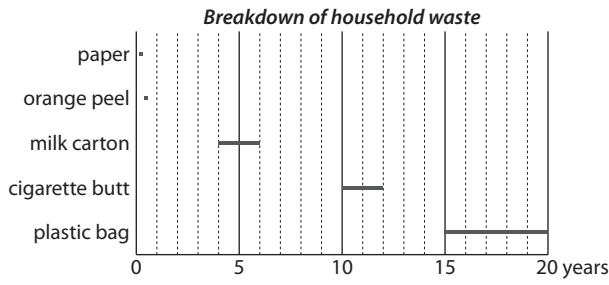
ACCEPTING STRANGERS AS FRIENDS ON FACEBOOK?



Skill 29.10 Interpreting more complex graphs (1).

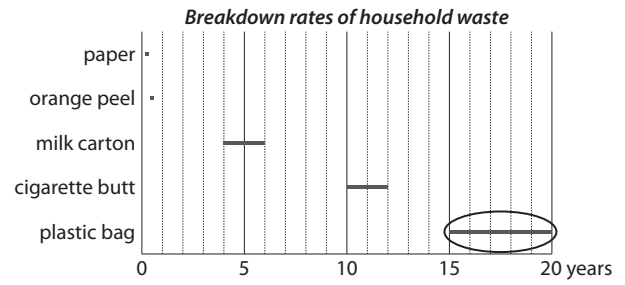
MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

Q. Of the items shown which has the longest breakdown time span?

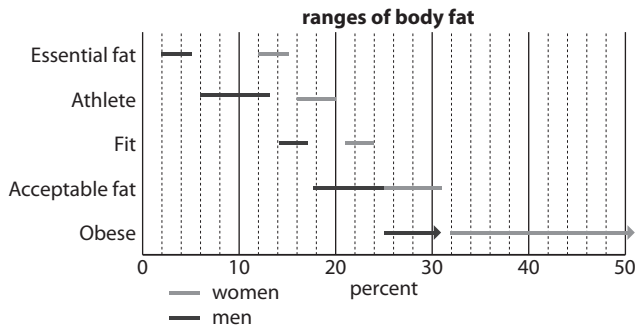


A. *plastic bag*

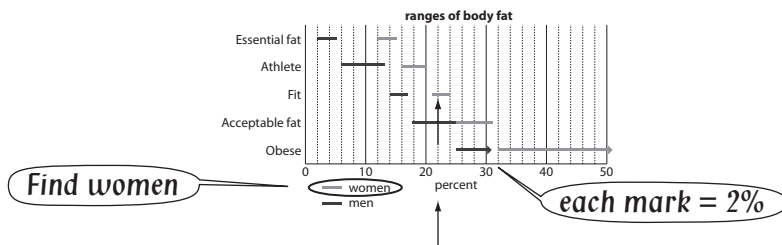
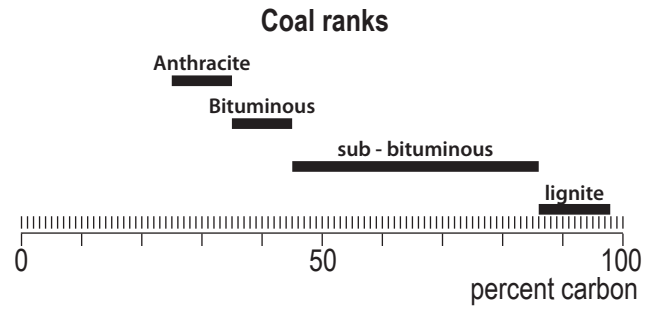
Check the length of each line segment.



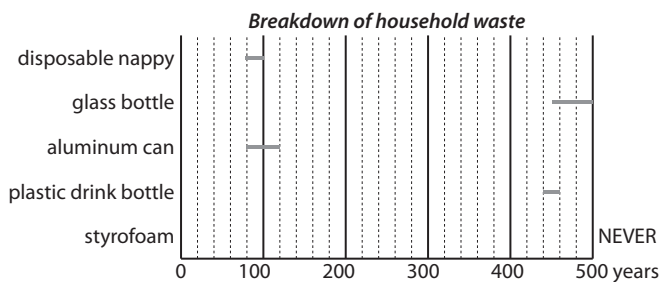
a) If you were a female with 22% body fat, into which category would you fall?



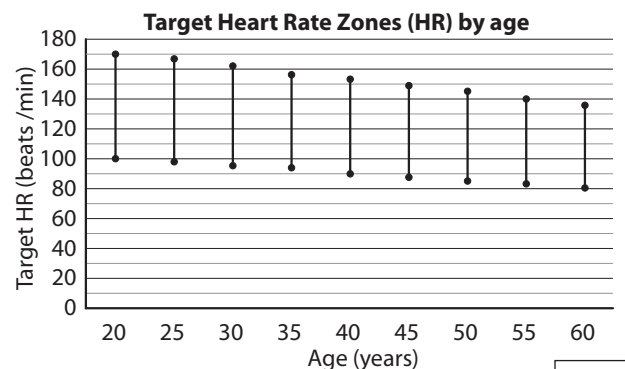
b) A sample of coal contains 38% carbon. To which category does it belong?



c) Apart from styrofoam, which product has the longest breakdown time span?

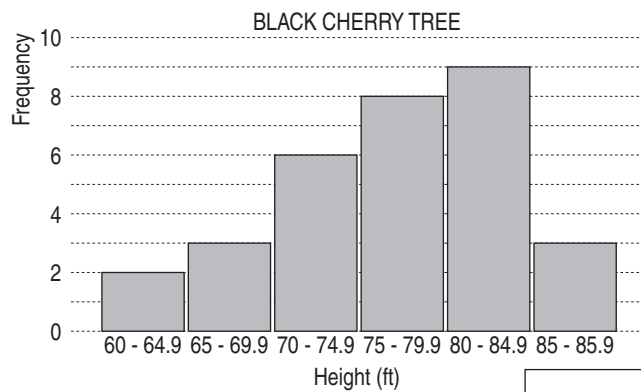


d) For what age is the target heart rate zone between 85 and 145 beats per minute?



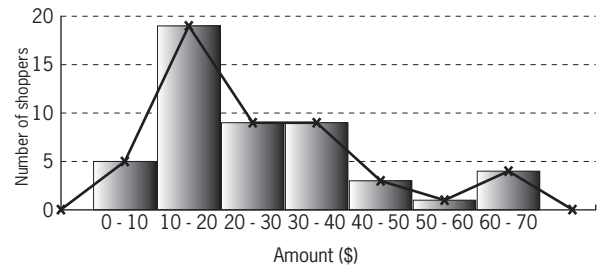
Skill 29.10 Interpreting more complex graphs (2).

e) Of the 31 black cherry trees sampled, how many were greater than 80 feet high?

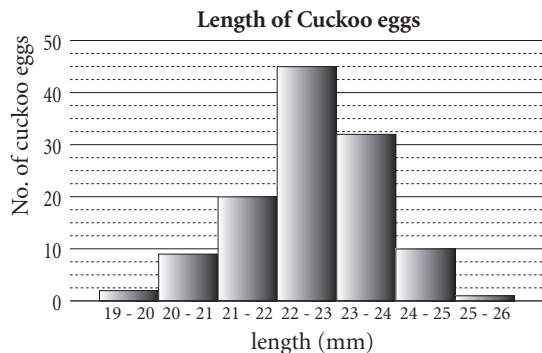


f) Did most shoppers spend more or less than \$20?

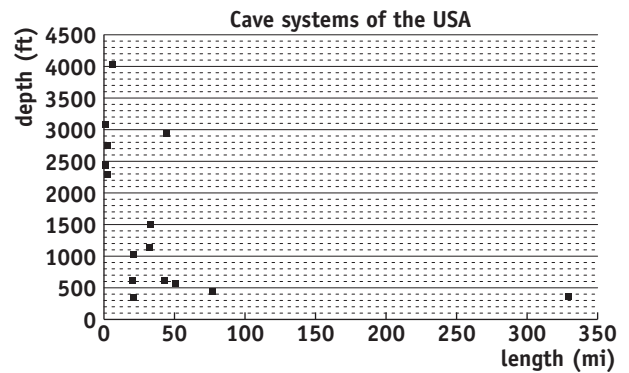
Amount spent in a grocery store by 50 consecutive shoppers



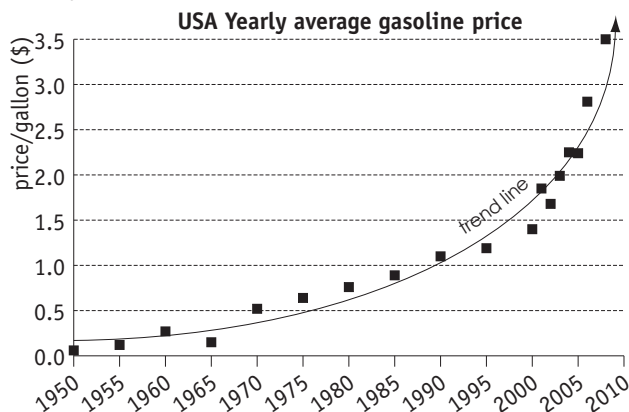
g) Are more cuckoo eggs longer than or shorter than 23 mm?



h) How many cave systems are more than 50 miles in length but less than 500 feet in depth?

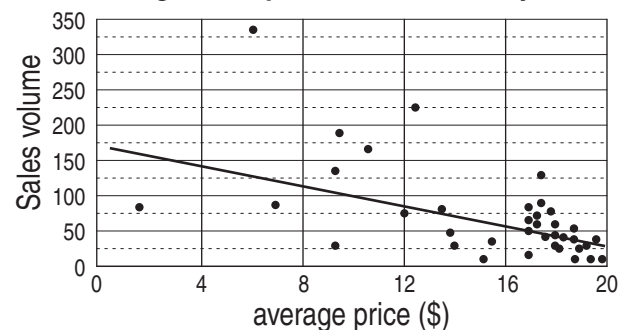


i) Which best describes the trend line?
 A) Gasoline prices decrease each year
 B) Gasoline prices increase each year
 C) Gasoline prices stay the same each year



j) Which best describes the sample?
 A) increased price, decreased sales
 B) increased price, increased sales
 C) decreased price, decreased sales

Average sales price of \$20 books by month



Skill 29.11 Interpreting stem-and-leaf plots (1).

To complete a stem-and-leaf plot from a given set of data:

- Write the values from the data set - each unit digit is a leaf beside its corresponding tens (or hundreds) digit, which is a stem.

Hint:

tens value		units value		hundreds & tens values		units value	
STEM	|	LEAF	=	STEM	|	LEAF	=
0	|	2	= 2	23	|	7	= 237
1	|	5 7	= 15 and 17				

To calculate values from a stem-and-leaf plot:

Median (middle value)

- Count the number of leaves.

If an odd number of leaves:

- Count from the top left leaf until you reach the middle leaf.
- This digit is the unit and must be put with the corresponding stem.

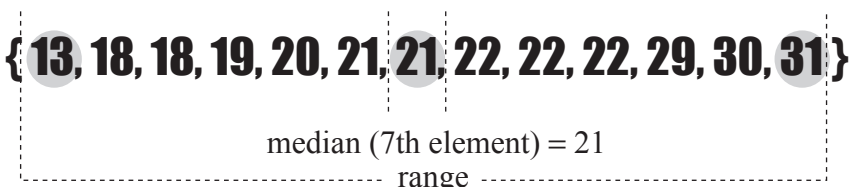
If an even number of leaves:

- Count from the top left leaf until you reach the two middle leaves.
- Read the digits with their corresponding stems.
- Find the average of the 2 middle numbers.

Range

- Subtract the lowest number (top left leaf) from the highest number (bottom right leaf).

Data set of 13 elements:



stem	leaves	lowest value = 13
1	3 8 8 9	median = 21
2	0 1 1 2 2 2 9	
3	0 1	highest value = 31

range = high - low
= 31 - 13
= 18

Q. This stem-and-leaf plot shows the mean annual snowfall for Massachusetts resorts. Find the median of the data.

Stem	Leaf
5	0 5
6	0 0
7	0 0
8	0 3
9	
10	0 0 0
11	0 0

$2|6 = 26$ in.

A. 13 measurements \Rightarrow
median = 7th score
= 80 in.

Stem	Leaf
5	0 5
6	0 0
7	0 0
8	0 3
9	
10	0 0 0
11	0 0

6 values below

middle leaf

6 values above

$2|6 = 26$ in.

Skill 29.11 Interpreting stem-and-leaf plots (2).

- a) Complete the stem-and-leaf plot for the data:
48, 56, 55, 48, 62, 55, 57, 44

Stem	Leaf
4	4 8 8
5	5

3 | 5 = 35

- b) Complete the stem-and-leaf plot for the data showing the results of the women's high jump at the 1968 - 2008 Olympics:
205, 206, 201, 205, 202, 203, 202, 197, 193, 192, 182

Stem	Leaf
18	2

23 | 5 = 235 cm

- c) Find the median and range of the monthly mean temperatures for Richmond, Virginia.

Stem	Leaf
3	6 8
4	0 8
5	0 7 8
6	6
7	0 4 7 8

lowest score = 36

12 scores so middle score halfway between score 6 (57) and score 7 (58)

6 | 3 = 63°F

highest score = 78

median =

range =

median =	range =
----------	---------

- d) This stem-and-leaf plot shows the results of the men's pole vault jump at the 1968 - 2008 Olympics. Find the median of the data.

Stem	Leaf
54	0
55	0 0
56	
57	5 8
58	0
59	0 0 2 5 6

53 | 1 = 531 cm

median =

range =

median =	range =
----------	---------

- e) Find the median and range for these 15 American states that have the lowest number of counties.

Stem	Leaf
0	3 5 5 8
1	0 4 4 5 6 7
2	1 3 4 9 9

1 | 4 = 14 counties

median =

range =

median =	range =
----------	---------

- f) This stem-and-leaf plot shows the water consumption rates per kilogram of body weight for selected livestock. Find the median and range of the data.

Stem	Leaf
7	0
8	0 5 8
9	4
10	0
11	8 9
12	5
13	0
14	
15	
16	0 8 9

12 | 6 = 126 mL

median =

range =

median =	range =
----------	---------

30. [Probability]

Skill 30.1 Describing the degree of likelihood of an event.

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

Q. There are 27 marbles in a bag and 18 of them are green. How many marbles do you have to select to make sure you have a green marble?

A. *Chances of selecting a green marble = 18*
Chances of selecting a different color marble = 27 - 18 = 9
⇒ **10** It is possible to select all 9 other colored marbles before you choose a green marble.

a) There are 6 red, 2 purple and 4 white rulers in a drawer. What is the largest number of rulers you could select from the drawer without taking a white ruler?

red = 6, purple = 2, white = 4

6 red + 2 purple =

b) There are 8 chocolate, 10 milk and 5 cream biscuits in a box. How many biscuits do you have to pick to make sure you have a chocolate biscuit?

..... =

c) Linda has 8 nickels and 12 dimes in her bag. How many coins does she need to take out from her bag to make sure she has 3 dimes?

..... =

d) There are 7 orange, 9 red and 6 white jellybeans in a jar. How many jellybeans do you have to select without looking in order to pick a white jellybean?

..... =

e) There are twenty different pairs of socks in the drawer. How many socks need to be picked up without looking in order to have a pair of matching socks?

..... =

f) Of the 300 songs on an iPod, 185 are pop songs. How many songs do you need to play on a random setting to be sure you will hear a pop song?

..... =

g) Of the 18 movies on Tom's computer, 6 are comedies. How many movies does Tom have to watch on a random setting to be sure he watches a comedy?

..... =

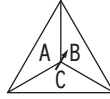
h) How many people do you need to gather to be sure that at least two of them were born on the same day of the week?

..... =

Skill 30.3 Finding the possible outcomes (sample spaces) of an event by completing tables.

- Complete the table to reveal all the possible outcomes (PO) (sample space).
- Count the number of possible outcomes (PO) (sample space).

Q. How many different outcomes are possible when a die is thrown and this spinner is spun? [Complete the table.]



		Die					
		1	2	3	4	5	6
Spinner	A	A,1	A,2				
	B	B,1					
	C	C,1					

A. $PO = 18$

Possible outcomes		Die					
		1	2	3	4	5	6
Spinner	A	A,1	A,2	A,3	A,4	A,5	A,6
	B	B,1	B,2	B,3	B,4	B,5	B,6
	C	C,1	C,2	C,3	C,4	C,5	C,6

Each space represents 1 outcome

a) A zoo has both male and female primates. There are gorillas and chimpanzees. Find the size of the sample space.

[Complete the table.]

Outcomes (sample space)		
male	gorilla	1
male	chimpanzee	2
female	gorilla	3
female	chimpanzee	4

Each row represents 1 outcome

b) How many different outcomes are possible choosing a primary color (red, blue and green) and tossing a coin?

[Complete the table.]

Possible outcomes		Primary color		
		R	G	B
Coin	H	H,R		
	T			

c) How many different outcomes are possible when rolling a die and flipping a coin? [Complete the table.]

Possible outcomes		Die					
		1	2	3	4	5	6
Coin	H	H,1	H,2				
	T	T,1					

d) How many different outcomes are possible when spinning a spinner labeled 1, 2, 3, 4, 5 and flipping a coin?

[Complete the table.]

Possible outcomes		Spinner				
		1	2	3	4	5
Coin	H	H,1				
	T					

e) A car comes in silver, red or purple as a convertible or hardtop. Find the size of the sample space. [Complete the table.]

Outcomes (sample space)	
silver	convertible
silver	
red	

f) A vendor sells vanilla and chocolate ice cream. Customers can have a waffle or sugar cone and either hot fudge or caramel topping. How many different outcomes are possible when ordering an ice cream in a cone with a single topping?

Outcomes (sample space)		
vanilla	waffle	hot fudge
vanilla		caramel
vanilla		

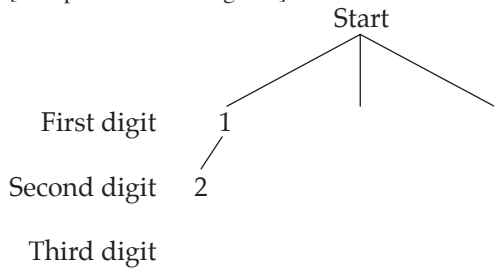
Skill 30.4 Finding the possible outcomes (sample spaces) of an event by completing tree diagrams (1).

MMBlue 1 1 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

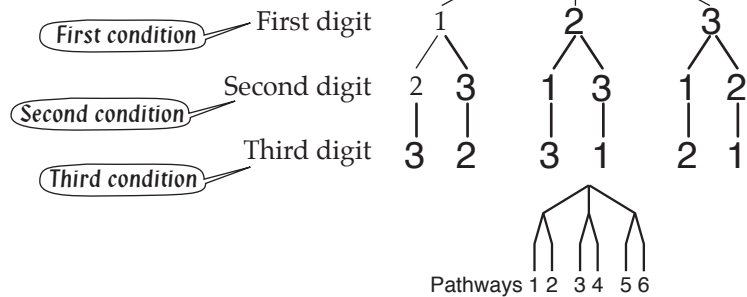
- From the start use the first condition to list all the possible outcomes (PO) on the first set of branches.
- From each of the first outcomes create enough branches to list all the possible outcomes of the second condition.
- Continue in this way until the tree diagram is completed.
- Count the number of pathways from the start to the end of each branch line.
The number of pathways equals the total number of possible outcomes (sample space).

Q. How many different 3-digit numbers can be made using the digits 1, 2 and 3 if the digits can be used only once?

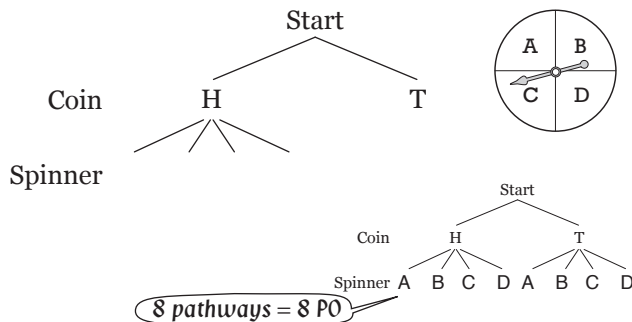
[Complete the tree diagram.]



A. Possible outcomes (PO)
= 123, 132, 213, 231, 312, 321
= 6



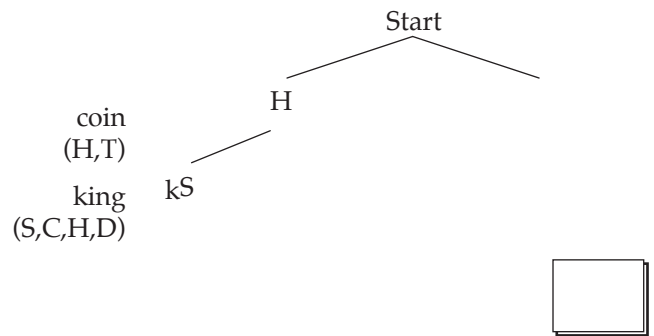
a) How many different outcomes are possible when flipping a coin and spinning this spinner? [Complete the tree diagram.]



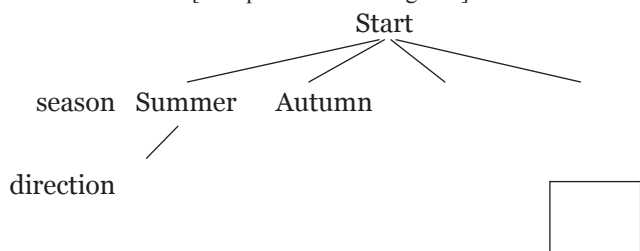
PO = HA, HB, HC, HD, TA, TB, TC, TD =

b) How many different outcomes are possible when flipping a coin and cutting a king from any of the 4 suits in a pack of cards?

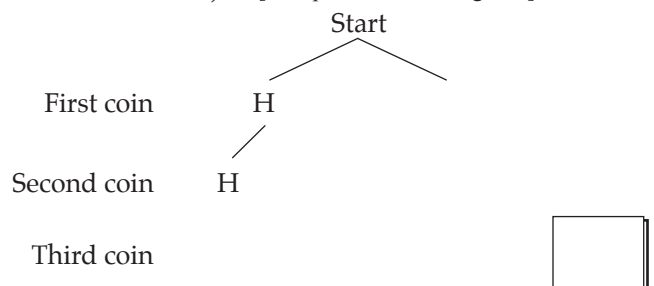
[Complete the tree diagram.]



c) How many different outcomes are possible when choosing a season of the year and one of the 4 point compass directions? [Complete the tree diagram.]



d) How many different outcomes are possible when flipping 3 coins (assuming order matters)? [Complete the tree diagram.]

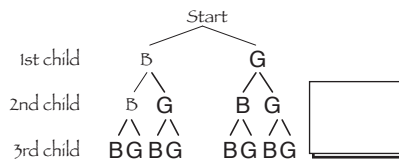
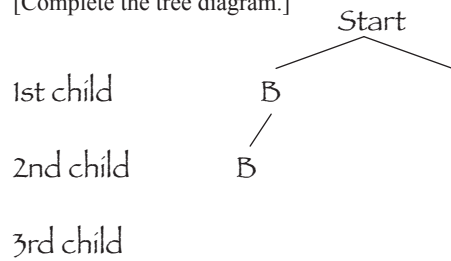


Skill 30.4 Finding the possible outcomes (sample spaces) of an event by completing tree diagrams (2).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

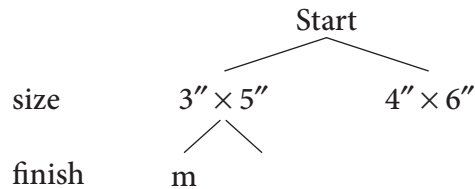
- e)** How many different gender combinations are possible if a couple have 3 children and order matters?

[Complete the tree diagram.]



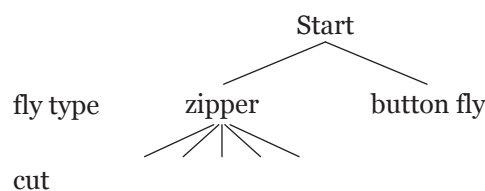
- f)** Photos can be printed in various sizes (3" × 5" or 4" × 6") and finishes (matte or gloss) with single or double prints an option. How many choices are possible?

[Complete the tree diagram.]

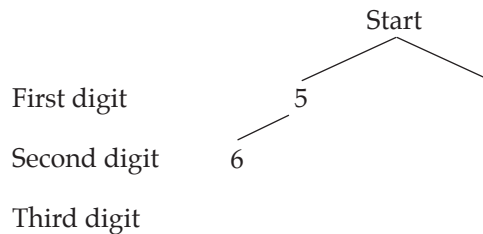


- g)** Jeans come with 2 fly types (zipper or button fly) and 5 cuts (boot cut, stove pipe, straight leg, skinny and flared). How many choices of jeans are possible?

[Complete the tree diagram.]

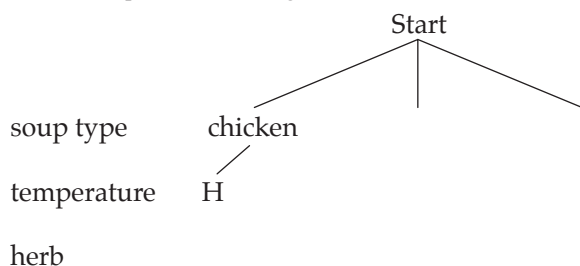


- h)** How many different 3-digit numbers less than 700 can be made using the digits 5, 6, 7 and 8 if the digits can be used only once? [Complete the tree diagram.]



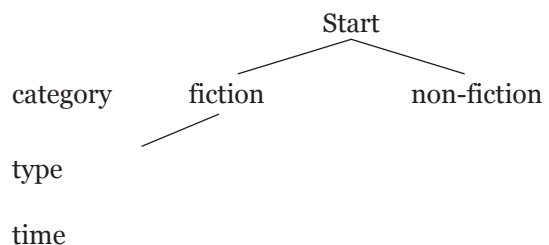
- i)** There are 3 kinds of soup on the menu: chicken, vegetable and pumpkin. They may be served hot or cold and always with a condiment of parsley or basil. How many choices are possible?

[Complete the tree diagram.]



- j)** On a library visit Tara must decide whether to loan a fiction or non-fiction item in one of the available formats (book, movie, tape, large print) for 2 weeks or 4 weeks. How many different options does Tara have?

[Complete the tree diagram.]



Skill 30.5 Calculating the probability of a simple event (2).

- c) When a die is rolled, what is the probability of rolling an even number?

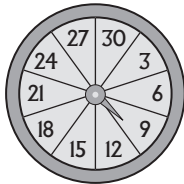


FO =

PO =

$Pr(\text{even number}) = \frac{FO}{PO} = \quad = \boxed{\quad}$

- e) A spinner is divided into 10 equal parts. When it is spun once, what is the probability of spinning an odd number?



FO =

PO =

$Pr(\text{odd number}) = \frac{FO}{PO} = \quad = \boxed{\quad}$

- g) A 52 card deck of playing cards is shuffled, and one card is dealt from the top of the deck. What is the probability that it will be a King?

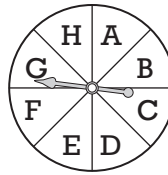


FO =

PO =

$Pr(\text{king}) = \frac{FO}{PO} = \quad = \boxed{\quad}$

- d) When a spinner is spun, what is the probability of spinning a G?

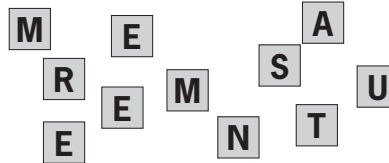


FO =

PO =

$Pr(\text{spinning a G}) = \frac{FO}{PO} = \quad = \boxed{\quad}$

- f) If a letter tile is chosen at random, find the probability of choosing letter M.



FO =

PO =

$Pr(\text{letter M}) = \frac{FO}{PO} = \quad = \boxed{\quad}$

- h) A day is randomly selected from the month of November. What is the probability that it will be a federal holiday?

November						
SUN	MON	TUE	WED	THU	FRI	SAT
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

× federal holiday

FO =

PO =

$Pr(\text{holiday}) = \frac{FO}{PO} = \quad = \boxed{\quad}$

Skill 30.5 Calculating the probability of a simple event (3).

- i) A bag contains 20 keys, one of which opens the door to the prize car. One key is randomly selected from the bag. What is the probability of selecting the winning key?

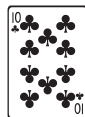


$FO =$

$PO =$

$Pr(\text{winning key}) = \frac{FO}{PO} =$ =

- j) A 52 card deck of playing cards is shuffled, and one card is dealt from the top of the deck. What is the probability that it will be a club?



$FO =$

$PO =$

$Pr(\text{club}) =$ = =

- k) A 52 card deck of playing cards is shuffled, and one card is dealt from the top of the deck. What is the probability that it will be a red card?

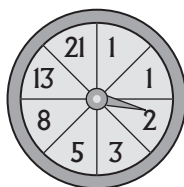


$FO =$

$PO =$

$Pr(\text{red card}) =$ = =

- l) A spinner is divided into 8 equal parts. When it is spun once, what is the probability of spinning an even number?

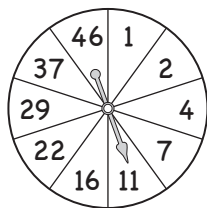


$FO =$

$PO =$

$Pr(\text{even number}) =$ = =

- m) When the spinner is spun once, what is the probability of spinning a prime number?

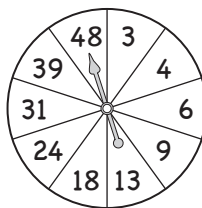


$FO =$

$PO =$

$Pr(\text{prime number}) =$ = =

- n) When the spinner is spun once, what is the probability of spinning a composite number?



$FO =$

$PO =$

$Pr(\text{composite number}) =$ = =

Skill 30.5 Calculating the probability of a simple event (4).

o) There are 8 pennies, 10 nickels, 6 dimes and 12 quarters in a piggy bank. If a coin is selected at random, what is the probability that a dime will be drawn?

.....

.....

.....

=

p) Ten balls numbered 1 to 10 are mixed together, and then one ball is drawn. Find the probability that a number less than 5 is drawn.

.....

.....

.....

=

q) There are 7 tomato soup cans, 3 chicken soup cans, 5 vegetable soup cans and 3 pumpkin soup cans in the cupboard. If a can is chosen at random, what is the probability that it is a chicken soup can?

.....

.....

.....

=

r) Mia has a bag that contains 7 blue, 5 white, 12 green and 6 yellow marbles. If Mia is randomly selecting a marble, what is the probability that she chooses a green marble?

.....

.....

.....

=

Q. Which event is most unlikely to happen?

- A) choosing a spade from a deck of 52 playing cards
- B) rolling a '4' on a standard die
- C) selecting a white marble from a bag of 8 black and 2 white marbles

A. Consider each alternative:

- a) 13 spades in 52 cards = $\frac{13}{52} = \frac{1}{4}$ Simplify: ÷ 13
- b) 1 four on a 6 sided die = $\frac{1}{6}$ Least likely
- c) 2 white marbles out of 10 = $\frac{2}{10} = \frac{1}{5}$ Simplify: ÷ 2

⇒ The answer is **B**.

s) Which event is most unlikely to happen?

- A) rolling a '6' on a standard die
- B) drawing a diamond from a deck of 52 playing cards
- C) predicting 'boy' for an unborn baby

.....

.....

.....

=

t) Which event is most likely to happen?

- A) choosing 'false' as the answer
- B) selecting the winner in a 10 horse race
- C) scoring the only touchdown in a game of football

.....

.....

.....

=

Skill 30.5 Calculating the probability of a simple event (5).

MMBlue 1 1 2 2 3 3 4 4
MMGreen 1 1 2 2 3 3 4 4

u) Which event is most likely to happen?

- A) winning the jackpot in a lottery
- B) rolling an odd number on a die
- C) selecting a consonant from the word GEOMETRY

.....

.....

..... =

v) Which event is most likely to happen?

- A) turning 'heads' on a tossed coin
- B) serving an ace ten times in a row
- C) rolling a number greater than 1 on a standard die

.....

.....

..... =

w) Which event is most unlikely to happen?

- A) marking a 'cross' playing tic-tac-toe
- B) selecting an even number from the numbers 1 to 8
- C) throwing a 13 on a hookey board marked 1 to 13

.....

.....

..... =

x) Which event does **not** have a 50% chance of success?

- A) drawing a red card from a deck of 52 playing cards
- B) throwing a bullseye on a dartboard
- C) marking a 'nought' in tic-tac-toe

.....

.....

..... =

y) Which event is most likely to happen?

- A) selecting 'red' from the 7 colors of the rainbow
- B) moving a pawn at the start of a chess game
- C) randomly hitting a key on a keyboard and it being the 'tab' key

.....

.....

..... =

z) Which event is most likely to happen?

- A) choosing a prime number from the numbers 2 to 7
- B) winning a car in a raffle
- C) selecting a vowel from the word PROBABILITY

.....

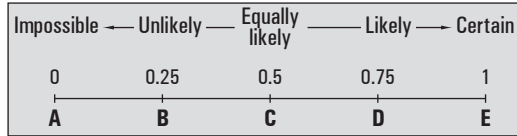
.....

..... =

Skill 30.6 Calculating the probability of a simple event using probability scales.

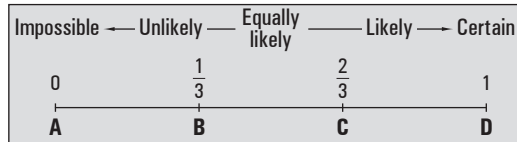
- Divide the number of favorable outcomes (FO) by the number of possible outcomes (PO).
(see skill 30.5, page 306)

Q. ‘A coin is tossed and tails comes up.’
Which letter A to E best represents the probability of the event?



A. $FO = 1$ (tails)
 $PO = 2$ (heads or tails) possible outcomes
 $Pr(\text{event}) = \frac{FO}{PO}$
 $= \frac{1}{2} = 0.5$
 The answer is **C**.

a) ‘A blue tile will be drawn from a box containing 8 black tiles and 4 blue tiles.’
Which letter A to D best represents the probability of the event?

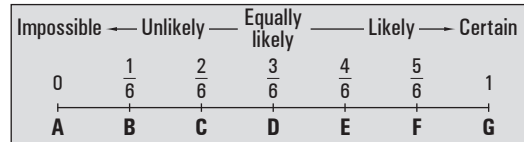


$FO = 4$ $PO = 12$

$$\frac{FO}{PO} = \frac{4 \div 4}{12 \div 4} \Rightarrow \boxed{}$$

simplify: $\div 4$

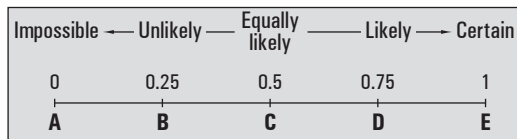
b) ‘A die is rolled and a 6 comes up.’
Which letter A to G best represents the probability of the event?



$FO =$ $PO =$

$$\frac{FO}{PO} = \Rightarrow \boxed{}$$

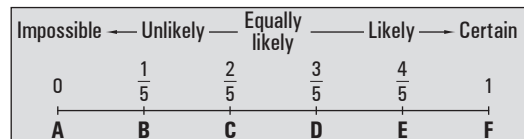
c) ‘A caramel candy will be drawn from a box with 12 caramel and 4 milk candies.’
Which letter A to E best represents the probability of the event?



$FO =$ $PO =$

$$= \Rightarrow \boxed{}$$

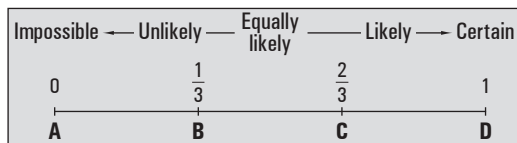
d) ‘A 5-sided pencil is rolled and the logo, printed on 1 side, comes up.’
Which letter A to F best represents the probability of the event?



$FO =$ $PO =$

$$= \Rightarrow \boxed{}$$

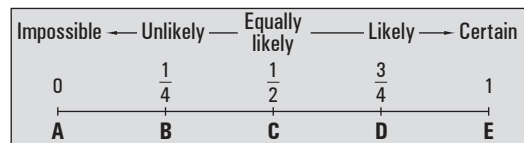
e) ‘A red marble will be drawn from a bag containing 3 red and 6 blue marbles.’
Which letter A to D best represents the probability of the event?



$FO =$ $PO =$

$$= \Rightarrow \boxed{}$$

f) ‘A club is drawn from a deck of 52 playing cards.’
Which letter A to E best represents the probability of the event?



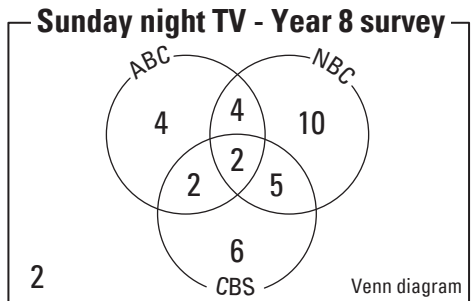
$FO =$ $PO =$

$$= \Rightarrow \boxed{}$$

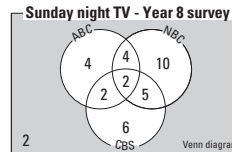
Skill 30.7 Interpreting Venn diagrams.

- Count the total number of possible outcomes.
- Shade the areas inside the Venn diagram that fit the description for favorable outcomes.
- Use the formula for the probability of an event.

Q. What is the probability that a student selected at random from the Year 8 class did not watch any Sunday night TV?

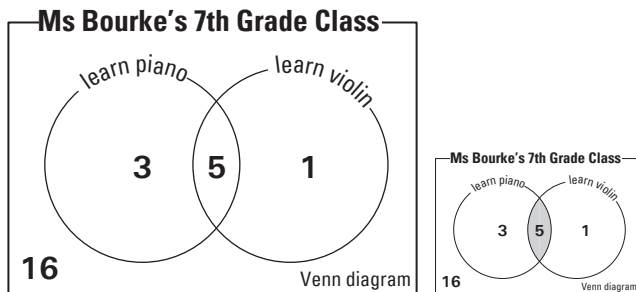


A. $FO = 2$ possible outcomes
 $PO = 4 + 4 + 2 + 2 + 10 + 5 + 6 + 2$
 $= 35$
 $Pr(event) = \frac{FO}{PO} = \frac{2}{35}$



Students who do not watch TV are shown in the shaded area. Students who do watch TV are shown in the white area.

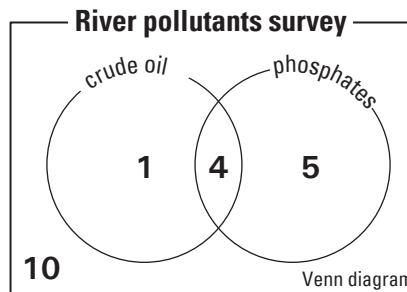
a) What is the probability that a student chosen at random from Ms Bourke's class learns both piano and violin?



$FO = 5$ $PO = 16 + 3 + 5 + 1 = 25$

$Pr(event) = \frac{FO}{PO} = \frac{5}{25} = \frac{1}{5}$

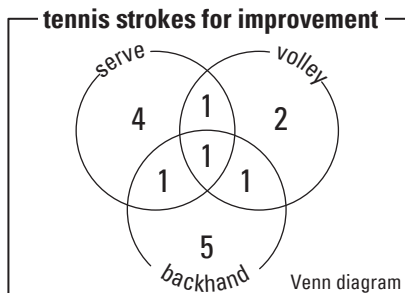
b) What is the probability that a surveyed river, visited at random, contained only phosphate pollutants?



$FO =$ $PO =$

$Pr(event) = \frac{FO}{PO} = \frac{5}{10} = \frac{1}{2}$

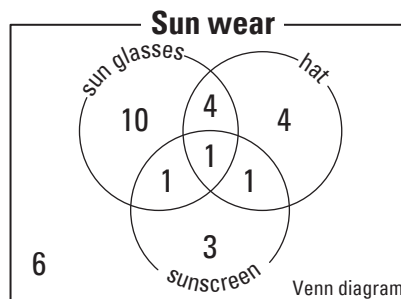
c) What is the probability that a tennis player chosen at random named the serve as the stroke that needs improvement?



$FO =$ $PO =$

$Pr(event) = \frac{FO}{PO} = \frac{4}{10} = \frac{2}{5}$

d) What is the probability that a person chosen at random did not wear sunscreen?



$FO =$ $PO =$

$Pr(event) = \frac{FO}{PO} = \frac{10 + 4 + 3 - 4 - 1 - 1 - 1}{10 + 4 + 3 - 4 - 1 - 1 - 1} = \frac{16}{10} = \frac{8}{5}$

Skill 30.8 Calculating the probability of complementary events.

- Identify and calculate the probability of the event. $\Pr(\text{event}) = \frac{\text{number of favorable outcomes}}{\text{number of possible outcomes}} = \frac{\text{FO}}{\text{PO}}$
- Identify the complementary events.
- To calculate the probability of the complementary event, subtract the probability of the event from 1: $\Pr(\text{complementary event}) = 1 - \Pr(\text{event})$

Hints: The complement of the event “the plane will be on time” is “the plane will not be on time”.
Winning - not winning, voting “yes” - voting “no” are examples of complementary events.

Q. A box contains 10 blue, 2 green and 6 white ribbons. If a ribbon is selected at random, find the probability that it is not a green ribbon.

A. *Event = green*
Complementary event = not a green

$$\Pr(\text{green}) = \frac{2}{18}$$

$$\Pr(\text{not green}) = 1 - \frac{2}{18}$$

$$= \frac{18}{18} - \frac{2}{18} = \frac{16}{18} = \frac{8}{9}$$

a) The probability of an earthquake of 7.5 magnitude occurring in San Francisco in any year is 2%. What is the probability of there being no earthquake in San Francisco next year? [Give the answer as a percent.]

$$\Pr(\text{earthquake}) = 2\%$$

$$\Pr(\text{no earthquake}) = 100\% - 2\% = \boxed{}$$

b) The cookie jar contains 12 cookies of which 4 are burnt. What is the probability of Leah choosing a cookie that is not burnt?

$$\Pr(\text{burnt}) =$$

$$\Pr(\text{not burnt}) = \boxed{}$$

c) A bag contains gold and silver discs. The probability of choosing a gold disc is $\frac{2}{5}$. What is the probability of not choosing a gold disc?

$$\Pr(\text{gold}) =$$

$$\Pr(\text{not gold}) = \boxed{}$$

d) Ten balls numbered 1 to 10 are mixed together, and then one ball is drawn. Find the probability that the number drawn is not a perfect square (i.e. 1, 4 or 9).

$$\Pr(\text{perfect square}) =$$

$$\Pr(\text{not perfect square}) = \boxed{}$$

e) A ballot box contains 20 independent, 12 conservative and 18 labor votes. If one vote is picked at random, what is the probability that it is not labor?

$$ \boxed{}$$

f) In the USA, 53% of students are in elementary school and 24% are in post-secondary education. What is the probability that a student selected at random is not in either area of education? [Give the answer as a percent.]

$$ \boxed{}$$

Skill 30.9 Calculating the probability of mutually exclusive events.

- Find the probability of each event.

$$\Pr(\text{event}) = \frac{\text{number of favorable outcomes}}{\text{number of possible outcomes}} = \frac{\text{FO}}{\text{PO}}$$

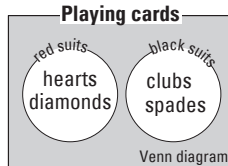
- Add the probabilities of each event in order to find the probability of both events occurring.

$$\Pr(A \text{ and } B) = \Pr(A) + \Pr(B)$$

- Simplify the fraction where necessary.

Hint: Mutually exclusive events cannot occur at the same time.

Example: A card selected from a pack of playing cards can either be red or black, not both.



- Q.** A bag contains 3 dimes, 1 nickel and 8 quarters. If a coin is selected at random, find the probability that it is a dime or a quarter.

A. $\Pr(D) = \frac{3}{12}$
 $\Pr(Q) = \frac{8}{12}$
 $\Pr(D \text{ or } Q) = \Pr(D) + \Pr(Q)$
 $= \frac{3}{12} + \frac{8}{12}$
 $= \frac{11}{12}$

- a)** What is the probability of drawing a red card or a club from a pack of cards?

$$\Pr(\text{red}) = \frac{26}{52} \quad \Pr(\text{club}) = \frac{13}{52}$$

$$\Pr(\text{red or club}) = \Pr(\text{red}) + \Pr(\text{club})$$

$$= \frac{26}{52} + \frac{13}{52} = \frac{39}{52} = \frac{3}{4}$$

- b)** When a die is rolled, what is the probability of rolling a 5 or a 6?



$$\Pr(5) = \quad \Pr(6) =$$

$$\Pr(5 \text{ or } 6) = \Pr(5) + \Pr(6)$$

$$= \quad =$$

- c)** In the lucky dip box there are 5 lolly bags, 4 marble bags and 3 sand bags. If a bag is selected at random, find the probability that it is a lolly or a marble bag.

$$\Pr(\text{lolly bag}) = \quad \Pr(\text{marble bag}) =$$

$$= \quad =$$

- d)** When a die is rolled, what is the probability of rolling an odd number or an even number?

$$= \quad =$$

Skill 30.10 Finding the possible outcomes of an event by applying the counting principle.

- Multiply the number of possibilities in event 1 by the number of possibilities in event 2.
Hint: The counting principle can be extended to 3 or more events.

Q. Maria chose one chemistry class, one math class, one history class and one English class. According to the schedule she has 2 different chemistry classes, 4 different math classes, 3 different history classes, and 3 different English classes to choose from. If no scheduling conflicts exist, how many different four-course selections can Maria make?

A. *Number of 4-course selections*
 $= 2 \times 4 \times 3 \times 3$
 $= 72$

a) How many different 3-digit numbers can be made from the digits 4, 5, 6, 7 and 8, if a digit can appear just once?

$N = 5 \times 4 \times 3 = \boxed{60}$

5 digits in 1st position, 4 digits in 2nd position, 3 digits in 3rd position

b) In how many ways can a family of five stand in a line for a photograph?

$N = \dots = \boxed{}$

c) A dime and a six-sided die are tossed. How many results are possible?

$N = \dots = \boxed{}$

d) How many 4-digit numbers can be formed with the digits 1, 2, 3 and 4 if no digit can be used more than once?

$N = \dots = \boxed{}$

e) Two dimes and one five-sided die are tossed. How many results are possible?

$N = \dots = \boxed{}$

f) In how many ways can six books be arranged on a shelf?

$N = \dots = \boxed{}$

g) How many possible outfits can be created with 3 different dresses, 5 different vests and 2 different pairs of shoes?

$N = \dots = \boxed{}$

h) Using one of each kind of ingredient, how many hamburger combinations can be made with 3 different kinds of bread, 6 different fillings and 2 different sauces?

$N = \dots = \boxed{}$

i) In how many ways can a coach select two emergencies from a total of five players?

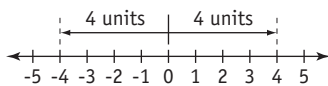
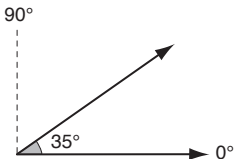
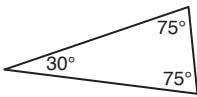

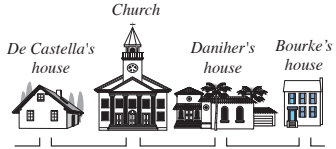
$N = \dots = \boxed{}$

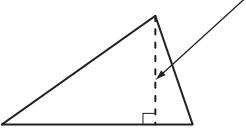


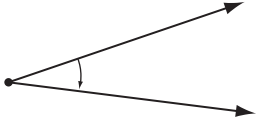


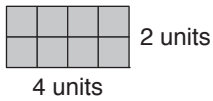
j) In how many ways can any 4 of the vowels be arranged assuming they are not repeated?

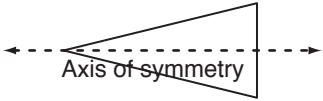

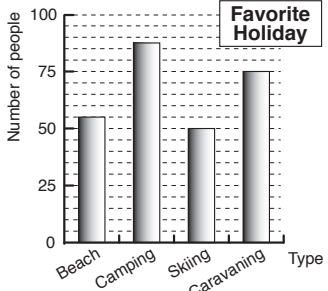
$N = \dots = \boxed{}$

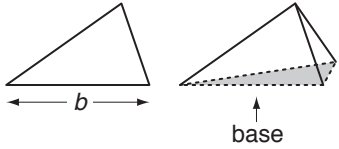
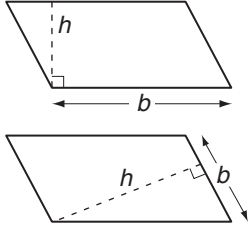
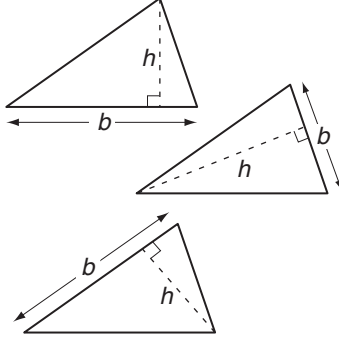


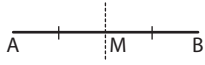


GLOSSARY

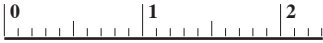
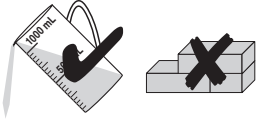

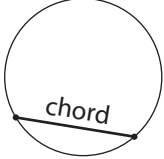
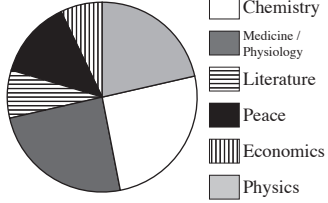

ab - qb


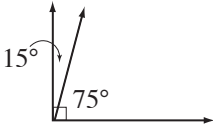
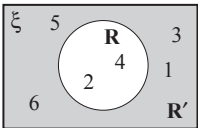
TERMS	DEFINITIONS	EXAMPLES
absolute value	<ul style="list-style-type: none"> The numerical value of a <i>number</i> without regard to its <i>sign</i>. The <i>distance</i> from a number to the <i>origin</i>. 	<p>The absolute value of 4 is 4. $|4| = 4$ The absolute value of -4 is 4. $|-4| = 4$</p>  <p>A number line from -5 to 5 with tick marks at every integer. The origin (0) is marked. Two arrows point from 0 to 4 and from 0 to -4, both labeled "4 units".</p>
accuracy	<ul style="list-style-type: none"> A measure of how close the result of a measuring comes to the true value. 	<p>3.14 is a fairly accurate estimation of π.</p>
acute angle	<ul style="list-style-type: none"> An <i>angle</i> measuring less than 90°. 	 <p>A diagram showing an acute angle of 35°. A horizontal ray is labeled 0° at its vertex. A vertical dashed ray is labeled 90° at its vertex. A solid ray is drawn between them, forming a 35° angle.</p>
acute triangle	<ul style="list-style-type: none"> A <i>triangle</i> in which all <i>angles</i> measure less than 90°. 	 <p>A scalene triangle with interior angles labeled 30°, 75°, and 75°.</p>
add (+)	<ul style="list-style-type: none"> To join together. 	<p>If you add 1 black cow and 2 white cows, there are $1 + 2 = 3$ cows all together.</p>  <p>Three cow illustrations: one black cow in the middle, and two white cows on either side.</p>
addition	<ul style="list-style-type: none"> The <i>operation</i> of finding the total or sum of two or more numbers to make one number. The result is called the <i>sum</i> or <i>total</i>. 	<p>Adding 15 and 6 we reach a total (sum) of 21. $15 + 6 = 21$</p>
adjacent	<ul style="list-style-type: none"> Immediately next to. 	<p>The Daniher's live adjacent to the Bourke's.</p>  <p>A diagram showing four buildings in a row: De Castella's house, Church, Daniher's house, and Bourke's house. Brackets below the houses indicate that Daniher's house and Bourke's house are adjacent.</p>
algebra	<ul style="list-style-type: none"> A branch of Mathematics where numbers are represented by letters or symbols, called <i>variables</i>. 	<p>$x + x = 6$, so x equals 3 $\clubsuit \div 3 = 12$, so \clubsuit equals 36</p>

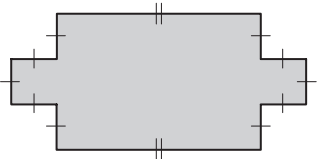

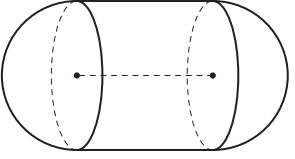
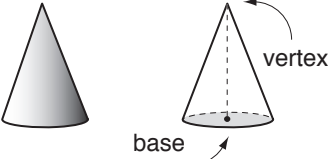
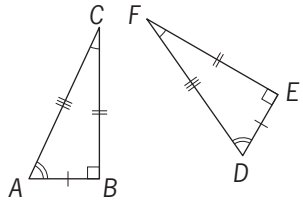

<p>altitude</p>	<ul style="list-style-type: none"> The <i>perpendicular segment</i> between the <i>base</i> of a geometric figure and its <i>top</i> whether that top is an <i>opposite vertex</i>, an <i>apex</i> or another base. <p>The <i>length</i> of the altitude is the <i>height</i>.</p>	<p>altitude of a triangle</p> 
<p>A.M. (Ante Meridiem)</p>	<ul style="list-style-type: none"> The <i>time</i> from midnight to midday (morning). 	
<p>analogue clock</p>	<ul style="list-style-type: none"> A clock or watch that has rotating hands and shows <i>12 hour time</i>. 	
<p>angle</p>	<ul style="list-style-type: none"> The amount of turning between two straight <i>lines</i> that are fixed at a <i>point</i>. An angle is measured in <i>degrees</i>. 	
<p>annual</p>	<ul style="list-style-type: none"> Happening <i>once a year</i>. 	
<p>anticlockwise</p>	<ul style="list-style-type: none"> Moving in the <i>opposite direction</i> to the hands on a clock. 	
<p>approximate</p>	<ul style="list-style-type: none"> Very close to the actual size. To <i>estimate</i> by <i>rounding off</i>. 	<p>If you have \$24.85 in your wallet, you can say you have approximately \$25.00</p>
<p>area</p>	<ul style="list-style-type: none"> The amount of surface covered by a <i>2D shape</i>. Area is measured in <i>square units</i>, e.g. square centimeters (cm²) or square meters (m²). 	<p>The area of a rectangle is calculated by multiplying length (<i>l</i>) by width (<i>w</i>):</p> $A = lw$ $= 4 \times 2$ $= 8$ <p>Area = 8 square units</p> 
<p>arithmetic sequence</p>	<ul style="list-style-type: none"> A sequence in which the difference between any two consecutive terms is the same. 	<p>20, 30, 40, 50, .....is an arithmetic sequence.</p>

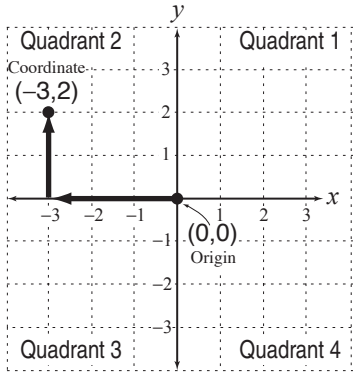
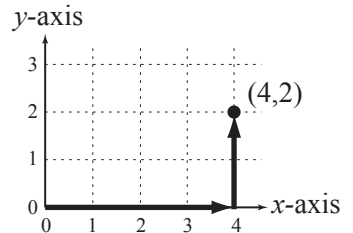
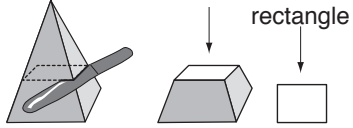
<p>ascending order</p>	<ul style="list-style-type: none"> • Arranged from smallest to largest. • Becoming larger, greater or higher. 	<p>3, 5 and 7 are in ascending order.</p>															
<p>associative property (of addition and multiplication)</p>	<ul style="list-style-type: none"> • Rule: When <i>adding</i> or <i>multiplying</i>, no matter how the numbers are grouped, the answers will always be the same. 	$a + (b + c) = (a + b) + c$ $1 + (3 + 4) = (1 + 3) + 4$ $8 = 8$ <p style="text-align: right;">“+”</p> $a \cdot (b \cdot c) = (a \cdot b) \cdot c$ $1 \cdot (3 \cdot 4) = (1 \cdot 3) \cdot 4$ $12 = 12$ <p style="text-align: right;">“•”</p>															
<p>average</p>	<ul style="list-style-type: none"> • Or <i>mean</i>, is the total of all scores divided by how many scores there are. • The number that could be used to replace every number in a set of numbers without changing the <i>sum</i> for the <i>set</i>. 	<p>The average of 5, 7 and 9 is 7. $5 + 7 + 9 = 21$ and $21 \div 3 = 7$ So $7 + 7 + 7 = 21$</p>															
<p>average speed</p>	<ul style="list-style-type: none"> • See <i>speed</i>. 																
<p>axis of symmetry</p>	<ul style="list-style-type: none"> • (pl. axes) See <i>line of symmetry</i>. 																
<p>back-to-back stem-and-leaf plot</p>	<ul style="list-style-type: none"> • A diagram displaying <i>data</i> by <i>place value</i>. • See <i>stem-and-leaf plot</i>. 	<p>Data A: 5, 18, 18, 19, 19, 21 Data B: 5, 17, 17, 18, 20, 21, 30,</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>(B) Leaf</th> <th>Stem</th> <th>Leaf (A)</th> </tr> </thead> <tbody> <tr> <td>5</td> <td>0</td> <td>5</td> </tr> <tr> <td>8 7 7</td> <td>1</td> <td>8 8 9 9</td> </tr> <tr> <td>1 0</td> <td>2</td> <td>1</td> </tr> <tr> <td>0</td> <td>3</td> <td></td> </tr> </tbody> </table>	(B) Leaf	Stem	Leaf (A)	5	0	5	8 7 7	1	8 8 9 9	1 0	2	1	0	3	
(B) Leaf	Stem	Leaf (A)															
5	0	5															
8 7 7	1	8 8 9 9															
1 0	2	1															
0	3																
<p>backwards</p>	<ul style="list-style-type: none"> • Away from your front. • In reverse of the usual way. 																
<p>balance (money)</p>	<ul style="list-style-type: none"> • The amount of money remaining in a bank account after all transactions have been completed. 	<p>The bank account held \$32. After \$12 was withdrawn the balance of the account was \$20.</p>															
<p>bar graph</p>	<ul style="list-style-type: none"> • A graph using <i>columns</i> to show quantities or numbers so they can be easily compared. 	<p>Camping is the favorite holiday.</p> 															

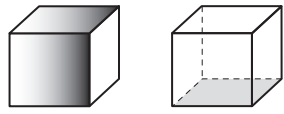
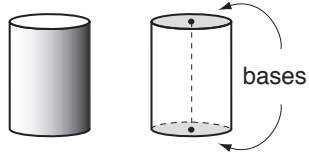
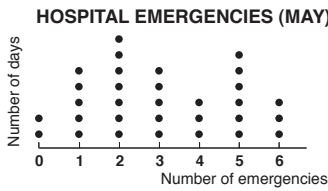

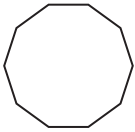
<p>base</p>	<ul style="list-style-type: none"> • A <i>line</i> or surface on which a figure stands. 	
<p>base of a parallelogram</p>	<ul style="list-style-type: none"> • The base (<i>b</i>) of a <i>parallelogram</i> is the <i>length</i> of any of its <i>sides</i>. 	
<p>base of a triangle</p>	<ul style="list-style-type: none"> • The base (<i>b</i>) of a <i>triangle</i> is the <i>length</i> of any of its <i>sides</i>. 	
<p>between</p>	<ul style="list-style-type: none"> • At a place bounded by two or more places. 	<p>The child is between her parents.</p> 
<p>bi</p>	<ul style="list-style-type: none"> • (or di) Prefix meaning two. 	<p>A bicycle has 2 wheels.</p> 
<p>bisect</p>	<ul style="list-style-type: none"> • To split into two <i>equal</i> parts. 	<p>$\overline{AM} \cong \overline{MB}$</p> 
<p>brackets ()</p>	<ul style="list-style-type: none"> • A <i>pair</i> of symbols used to enclose a mathematical <i>expression</i>. 	<p>$(12 - 4) \div 2 = 4$ Brackets group 12 take away 4.</p>
<p>calculate</p>	<ul style="list-style-type: none"> • To find the exact value of mathematical operations. 	<p>$3 + 5 + 6 = 14$</p> 
<p>calendar</p>	<ul style="list-style-type: none"> • A <i>time</i> chart that tells us what <i>day</i>, <i>week</i>, <i>month</i> and <i>year</i> it is. 	

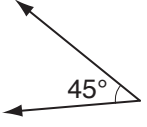
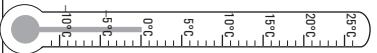


<p>calibration</p>	<ul style="list-style-type: none"> • A mark on a <i>scale</i>. 															
<p>cancel</p>	<ul style="list-style-type: none"> • To strike out an <i>equal term</i> on each side of an <i>equation</i>. 	<p>$x - 3 = 6$ cancel -3 by adding 3 to both sides of the equation</p> <p>$x \cancel{-3} \cancel{+3} = 6 + 3 \quad -3 + 3 = 0$</p> <p>$x = 9$</p>														
<p>capacity</p>	<ul style="list-style-type: none"> • Or <i>volume</i>, is the measure of the amount of liquid a container can hold. 	<p>A jug has capacity because it can hold liquid, a brick does not.</p> 														
<p>Cartesian plane</p>	<ul style="list-style-type: none"> • See <i>coordinate plane</i>. 															
<p>chance</p>	<ul style="list-style-type: none"> • The likelihood that a particular result or <i>outcome</i> will occur. 	<p>The chance of rolling a 2 with a standard die is 1 in 6.</p> 														
<p>chord</p>	<ul style="list-style-type: none"> • A <i>line segment</i> on the <i>interior</i> of a <i>circle</i>. A chord has both end points on the <i>circumference</i> of the circle. 															
<p>circle graph</p>	<ul style="list-style-type: none"> • A <i>graph</i> that represents <i>data</i> as a <i>sector</i> of a <i>circle</i>. 	<p>Nobel Prizes Won by the UK up to 2004 (Total of 98)</p>  <table border="1"> <thead> <tr> <th>Category</th> <th>Color/Pattern</th> </tr> </thead> <tbody> <tr> <td>Chemistry</td> <td>White</td> </tr> <tr> <td>Medicine / Physiology</td> <td>Dark Grey</td> </tr> <tr> <td>Literature</td> <td>Horizontal Lines</td> </tr> <tr> <td>Peace</td> <td>Black</td> </tr> <tr> <td>Economics</td> <td>Vertical Lines</td> </tr> <tr> <td>Physics</td> <td>Light Grey</td> </tr> </tbody> </table>	Category	Color/Pattern	Chemistry	White	Medicine / Physiology	Dark Grey	Literature	Horizontal Lines	Peace	Black	Economics	Vertical Lines	Physics	Light Grey
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<p>closest</p>	<ul style="list-style-type: none"> • Nearest to. 	<p>The son is closest to the mother.</p> 														
<p>coefficient</p>	<ul style="list-style-type: none"> • The number which multiplies a <i>variable</i>. 	<p>3 is the coefficient of $3x$ 6 is the coefficient of $6y^4$</p>														


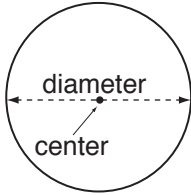


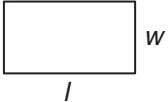
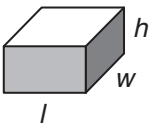

<p>column</p>	<ul style="list-style-type: none"> • A <i>vertical</i> line of <i>data</i> in a table. 	<p>Medal Tally - Beijing Olympics 2008</p> <table border="1"> <thead> <tr> <th>COUNTRY</th> <th>Gold</th> <th>Silver</th> <th>Bronze</th> </tr> </thead> <tbody> <tr> <td>China</td> <td>51</td> <td>21</td> <td>28</td> </tr> <tr> <td>United States</td> <td>36</td> <td>38</td> <td>36</td> </tr> <tr> <td>Russia</td> <td>23</td> <td>21</td> <td>28</td> </tr> <tr> <td>Great Britain</td> <td>19</td> <td>13</td> <td>15</td> </tr> <tr> <td>Germany</td> <td>16</td> <td>10</td> <td>15</td> </tr> <tr> <td>Australia</td> <td>14</td> <td>15</td> <td>17</td> </tr> </tbody> </table> <p style="text-align: center;">↑</p>	COUNTRY	Gold	Silver	Bronze	China	51	21	28	United States	36	38	36	Russia	23	21	28	Great Britain	19	13	15	Germany	16	10	15	Australia	14	15	17
COUNTRY	Gold	Silver	Bronze																											
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Germany	16	10	15																											
Australia	14	15	17																											
<p>combinations</p>	<ul style="list-style-type: none"> • A selection of objects from a collection. Order is irrelevant. 	<p>A class committee is a combination of 2 boys and 2 girls chosen from a total of 12 boys and 15 girls.</p>																												
<p>common factor</p>	<ul style="list-style-type: none"> • A <i>whole number</i> that is a <i>factor</i> of two or more non-zero whole numbers. 	<p>The common factors of 18 and 24 are 1, 2, 3 and 6.</p>																												
<p>common multiple</p>	<ul style="list-style-type: none"> • A <i>whole number</i> that is a <i>multiple</i> of two or more non-zero <i>whole numbers</i>. 	<p>The common multiples of 5 and 6 are 30, 60, 90,</p>																												
<p>commutative property (of addition and multiplication)</p>	<ul style="list-style-type: none"> • Rule: When <i>adding</i> or <i>multiplying</i>, no matter how the numbers are ordered, the answers will always be the same. 	<p> $a + b = b + a$ $1 + 3 = 3 + 1$ $4 = 4$ </p> <p style="text-align: right;">“+”</p> <p> $a \cdot b = b \cdot a$ $3 \cdot 4 = 4 \cdot 3$ $12 = 12$ </p> <p style="text-align: right;">“•”</p>																												
<p>compass</p>	<ul style="list-style-type: none"> • An instrument that shows <i>direction</i>. 																													
<p>complement of an angle</p>	<ul style="list-style-type: none"> • An <i>angle</i> that, when added to the first angle, makes a <i>right angle</i> (or 90° in total). 	<p>75° is the complement of 15°, because $75^\circ + 15^\circ = 90^\circ$</p> 																												
<p>complementary event</p>	<ul style="list-style-type: none"> • The <i>opposite</i> of an event. The <i>set</i> of all outcomes that are not included in the <i>event</i>. 	<p>If the event is “raining” then the complement event is “not raining”.</p> <p>If the event is to roll a die and $R = \{2, 4\}$ is the result, then the complement of event R is R'.</p> <p>$R' = \{1, 3, 5, 6\}$</p> 																												
<p>composite number</p>	<ul style="list-style-type: none"> • A <i>positive integer</i> that has <i>factors</i> other than just 1 and the number itself. 	<p>12 is a composite number. $12 = 1 \times 12 = 2 \times 6 = 3 \times 4$ The factors of 12 are: 1, 2, 3, 4, 6, 12</p>																												

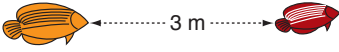

<p>composite shapes</p>	<ul style="list-style-type: none"> • A combination of two or more <i>2D</i> shapes into one figure. 	 <p>The above diagram is the composite of 3 rectangular shapes.</p> 
<p>composite solids</p>	<ul style="list-style-type: none"> • A combination of two or more <i>3D</i> shapes into one object. 	
<p>cone</p>	<ul style="list-style-type: none"> • A <i>solid</i> with one circular base and one <i>vertex</i>. 	
<p>congruent shapes</p>	<ul style="list-style-type: none"> • Have exactly the same size and shape. 	<p>Triangles <i>ABC</i> and <i>DEF</i> are congruent.</p>  <p>Sides Corresponding sides are congruent: $\overline{AB} \cong \overline{DE}, \overline{BC} \cong \overline{EF}, \overline{AC} \cong \overline{DF}$</p> <p>Angles Corresponding angles are congruent: $\angle A \cong \angle D, \angle B \cong \angle E, \angle C \cong \angle F$</p>
<p>consecutive numbers</p>	<ul style="list-style-type: none"> • Numbers that follow each other. 	<p>4 and 5 are consecutive numbers.</p> 
<p>constant term</p>	<ul style="list-style-type: none"> • A <i>term</i> that has a fixed value and does not contain a <i>variable</i>. 	<p>In $y = x + 5$ 5 is constant <i>x</i> and <i>y</i> are variables.</p> <p>The speed of light in a vacuum (<i>c</i>) is a constant.</p> $c = 299,792,458 \text{ m/s}$

<p>conversion factor</p>	<ul style="list-style-type: none"> The amount by which you <i>multiply</i> or <i>divide</i> a number to change it to a different <i>unit of measurement</i>. 	<p>1 yd = 3 ft The conversion factor for changing yards to feet is 3.</p>
<p>convert</p>	<ul style="list-style-type: none"> Change from a <i>unit</i> to another. 	<p>25 kg can be converted to 25,000 g.</p>
<p>coordinate plane</p>	<ul style="list-style-type: none"> A <i>plane</i> divided into four <i>quadrants</i> by a <i>horizontal line</i> called the <i>x-axis</i> and a <i>vertical line</i> called the <i>y-axis</i>. 	
<p>coordinates</p>	<ul style="list-style-type: none"> An <i>ordered pair</i> of numbers that locate a <i>point</i> on a <i>coordinate plane</i>. The <i>first</i> number tells you how far from the <i>origin</i> to move along the <i>x-axis</i>. The <i>second</i> tells you how far from the origin to move along the <i>y-axis</i>. They are written in <i>brackets</i> with a comma in between. 	<p>(4,2) are the coordinates of a point located 4 units to the right and 2 units upward from the origin (0,0).</p> 
<p>counting number</p>	<ul style="list-style-type: none"> Any of the <i>whole numbers</i> from zero onwards. 	<p>0, 1, 2, 3, 4, 5..... are counting numbers.</p>
<p>cross multiply</p>	<ul style="list-style-type: none"> To simplify a <i>proportion</i>, written as two <i>equal fractions</i> OR To <i>multiply</i> each <i>numerator</i> by the <i>denominator</i> of the fraction across from it. 	$a : b = c : d$ $\frac{a}{b} \times \frac{c}{d}$ $a \cdot d = b \cdot c$ $ad = bc$
<p>cross-section</p>	<ul style="list-style-type: none"> The <i>shape</i> of the <i>face</i> that results when an object is cut through. 	
<p>cross simplify</p>	<ul style="list-style-type: none"> To <i>divide</i> the <i>diagonal numbers</i> (when <i>multiplying two fractions</i>) by the same number to reduce their value before multiplying. 	$\frac{3}{4} \times \frac{8}{9} = \frac{\overset{+3}{\cancel{3}}}{\underset{+4}{4}} \times \frac{\overset{+4}{\cancel{8}}}{\underset{+3}{\cancel{9}}} = \frac{1}{4} \times \frac{2}{3} = \frac{2}{12} = \frac{1}{6}$


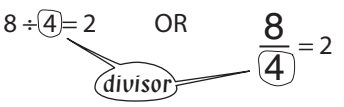
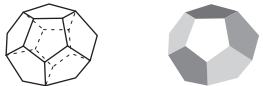
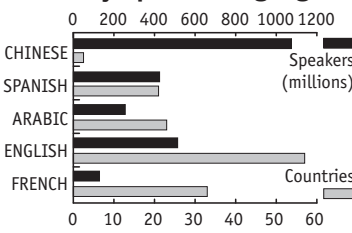

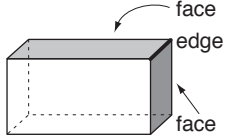

cube	<ul style="list-style-type: none"> A <i>solid</i> with six identical <i>square</i> faces. 																	
cubed	<ul style="list-style-type: none"> A number cubed is the third <i>power</i> of the number. 	5 cubed = $5^3 = 5 \times 5 \times 5 = 125$																
cubic unit	<ul style="list-style-type: none"> A unit of <i>volume</i> expressed in cubic form. 	The volume of a solid is measured in the appropriate cubic units, e.g. cm^3 or m^3 .																
cylinder	<ul style="list-style-type: none"> A <i>solid</i> with two <i>parallel</i> circular <i>bases</i> of the same size. 																	
data	<ul style="list-style-type: none"> Collection of information that can include facts, numbers or measurements. 	<p>HOSPITAL EMERGENCIES (MAY)</p>  <table border="1"> <caption>HOSPITAL EMERGENCIES (MAY)</caption> <thead> <tr> <th>Number of emergencies</th> <th>Number of days</th> </tr> </thead> <tbody> <tr><td>0</td><td>1</td></tr> <tr><td>1</td><td>3</td></tr> <tr><td>2</td><td>4</td></tr> <tr><td>3</td><td>2</td></tr> <tr><td>4</td><td>1</td></tr> <tr><td>5</td><td>3</td></tr> <tr><td>6</td><td>2</td></tr> </tbody> </table>	Number of emergencies	Number of days	0	1	1	3	2	4	3	2	4	1	5	3	6	2
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0	1																	
1	3																	
2	4																	
3	2																	
4	1																	
5	3																	
6	2																	
day	<ul style="list-style-type: none"> A <i>unit</i> of <i>time</i> equal to 24 <i>hours</i>. 	<p>A day starts and ends at midnight.</p> 																
daylight saving time	<ul style="list-style-type: none"> Use of fictitious time in the summer months that prolongs light in the evening hours. 	During daylight saving clocks are one hour ahead of real time.																
deca	<ul style="list-style-type: none"> Prefix meaning ten. 	Decathlon is an athletics contest with ten events.																
decade	<ul style="list-style-type: none"> A <i>unit</i> of <i>time</i> equal to 10 <i>years</i>. 	2001 to 2010 make a decade.																
decagon	<ul style="list-style-type: none"> A shape with 10 <i>sides</i>. 																	
decimal number	<ul style="list-style-type: none"> A number based on the ten <i>place value</i> system where a <i>decimal point</i> separates the <i>units</i> and <i>tenths</i>. 	<p>The decimal number 4.3 represents:</p> <p>4 - ones 3 - tenths OR 4 and 3 tenths.</p>																


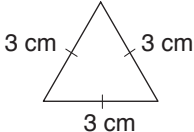

decimal place	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">units</td> <td style="text-align: center;">tenths</td> <td style="text-align: center;">hundredths</td> <td style="text-align: center;">thousandths</td> </tr> <tr> <td style="text-align: center;">0</td> <td style="text-align: center;">.</td> <td style="text-align: center;">7</td> <td style="text-align: center;">6</td> </tr> <tr> <td></td> <td></td> <td style="text-align: center;">3</td> <td></td> </tr> </table>	units	tenths	hundredths	thousandths	0	.	7	6			3		<p>7 is in the tenths place. 6 is in the hundredths place. 3 is in the thousandths place.</p>
units	tenths	hundredths	thousandths											
0	.	7	6											
		3												
decimal point (.)	<ul style="list-style-type: none"> A point that separates the <i>units</i> and <i>tenths</i> in a <i>decimal number</i>. 	<p>2.5 is a decimal number where the 2 and the 5 are separated by a decimal point.</p>												
decrease	<ul style="list-style-type: none"> To make smaller. 	<p>8 must decrease by 5 to become 3.</p>												
deduct	<ul style="list-style-type: none"> To take away. 	<p>If you deduct 1 from 3 there are 2 left. $3 - 1 = 2$</p>												
degree (°)	<ul style="list-style-type: none"> A <i>unit</i> used to measure the amount of turn in an <i>angle</i>. 	<p>Angle measures 45°.</p> 												
degrees Celsius (°C)	<ul style="list-style-type: none"> A <i>unit</i> used to measure temperature on the Celsius scale, used in the metric system. The Celsius (or centigrade) thermometer was invented by Swedish astronomer Anders Celsius in 1742. 	<p>0°C = freezing point of water 100°C = boiling point of water 37°C = human body temperature</p> 												
degrees Fahrenheit (°F)	<ul style="list-style-type: none"> A <i>unit</i> used to measure <i>temperature</i> on the Fahrenheit scale. The mercury thermometer and the Fahrenheit scale were invented by the Dutch instrument maker Gabriel Fahrenheit in 1724. 	<p>32°F = freezing point of water 212°F = boiling point of water 98.6°F = human body temperature</p> 												
denominator	<ul style="list-style-type: none"> The number below the fraction bar in a <i>fraction</i>. The number of equal parts in one whole. 	<p>Considering fifths, 5 parts would make a whole.</p> 												
deposit (money)	<ul style="list-style-type: none"> To pay an amount of money into a bank account. 	<p>A deposit of \$15 into a bank account with a balance of \$25 will increase the account balance to \$40.</p>												
descending order	<ul style="list-style-type: none"> Arranged from largest to smallest. Becoming smaller, lesser or lower. 	<p>8, 6 and 2 are in descending order.</p>												


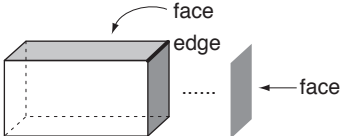
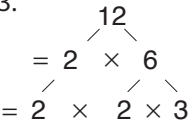
diagonal	<ul style="list-style-type: none"> A straight <i>line</i> inside a <i>polygon</i> joining any two <i>vertices</i> that are not next to each other. 	
diameter of a circle	<ul style="list-style-type: none"> A <i>segment</i> that passes through the <i>center</i> of a <i>circle</i> and has both endpoints on the circle. The diameter of a circle is twice the length of its <i>radius</i>. 	
die	<ul style="list-style-type: none"> (pl. dice) A numbered <i>cube</i> that is used in games. A standard die has 1 to 6 pips (dots) on each <i>face</i> with <i>opposite</i> faces adding to 7. 	
difference	<ul style="list-style-type: none"> The result when a number is <i>subtracted</i> from another number. The amount by which one number is bigger or smaller than another number. 	The difference between 5 and 3 is 2. $5 - 3 = 2$
digit	<ul style="list-style-type: none"> Any of the first ten <i>whole numbers</i> from 0 to 9. 	There are 10 digits: 0, 1, 2, 3, 4, 5, 6, 7, 8 or 9
digit sum	<ul style="list-style-type: none"> The <i>sum</i> of the <i>digits</i> in a number. 	124 has a digit sum of 7. $1 + 2 + 4 = 7$
digital clock	<ul style="list-style-type: none"> A clock that uses only numbers to show the <i>time</i>. (No hands!) 	
dimension	<ul style="list-style-type: none"> A measure of size. A <i>two-dimensional</i> shape (2D shape) has <i>length</i> and <i>width</i>. A <i>three-dimensional</i> shape (3D shape) has <i>length</i>, <i>width</i> and <i>height</i>. 	<p>2D shape </p> <p>3D shape </p>
direction	<ul style="list-style-type: none"> The way something is placed, pointing or moving. 	North, east, south, west, up, down, sideways, backwards and forwards. 
discount (money)	<ul style="list-style-type: none"> An amount subtracted from the regular price of an item to get the sale price. 	When \$80 track shoes are on sale at 25% off \Rightarrow discount = 25% of \$80 = \$20.

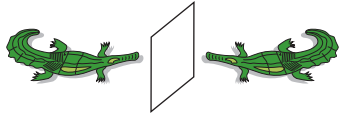

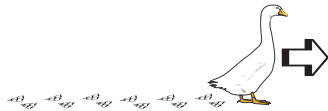


distance	<ul style="list-style-type: none"> The <i>length</i> between two <i>points</i>. 	<p>The distance between the fish is 3 meters.</p> 
distributive property <small>(of multiplication over addition and subtraction)</small>	<ul style="list-style-type: none"> Rule: You can <i>multiply a sum</i> (or a <i>difference</i>) by multiplying the number outside the brackets by each term of the sum (or the difference). 	$a(b + c) = ab + ac$ $2 \times (4 + 3) = 2 \times 4 + 2 \times 3 \quad \text{"+"}$ $14 = 14$ $a(b - c) = ab - ac$ $2 \times (4 - 3) = 2 \times 4 - 2 \times 3 \quad \text{"-"}$ $2 = 2$
divide (\div)	<ul style="list-style-type: none"> To share into groups. 	<p>6 cows are divided into 2 groups: $6 \div 2 = 3$ in each group</p> 
dividend	<ul style="list-style-type: none"> The first number written in a division. It is the number being divided. In a <i>fraction</i> the dividend is the <i>numerator</i>. 	<p>In the division: $144 \div 9 = 16$ the number 144 is called the dividend.</p>
divisible	<ul style="list-style-type: none"> Can be divided without a <i>remainder</i>. 	<p>$20 \div 2 = 10$ with 0 remainder. So 20 is divisible by 2 and 10.</p>
divisibility tests	<ul style="list-style-type: none"> Checks performed to help find the <i>factors</i> of a number. 	

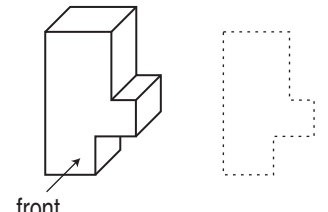
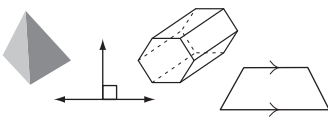

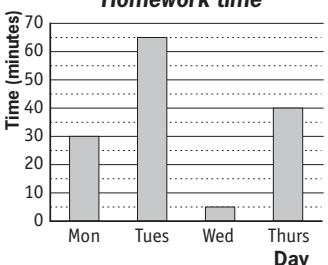
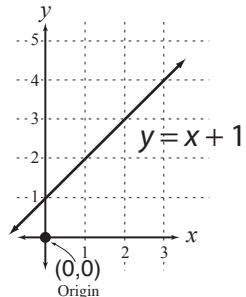
Divisibility tests (factor tricks)	Examples
2 is a factor of all even numbers.	Numbers that end with 0, 2, 4, 6 and 8, e.g. 754, 120
3 is a factor of all numbers with a digit sum that is divisible by 3.	252 has 3 as a factor because $2 + 5 + 2 = 9$ and 9 is divisible by 3.
4 is a factor of all numbers where the last two digits are divisible by 4.	1532 has 4 as a factor because 32 is divisible by 4.
5 is a factor of all numbers whose last digit is a 5 or a 0.	120 and 4935 both have 5 as a factor.
6 is a factor of all numbers that have both 2 and 3 as factors.	102 has 6 as a factor because 2 and 3 are both factors.
9 is a factor of all numbers with a digit sum that is divisible by 9.	1764 has 9 as a factor because $1 + 7 + 6 + 4 = 18$ and 18 is divisible by 9.
For 11 to be a factor of a number, the difference between the sum of the even placed digits and the sum of the odd placed digits must be divisible by 11.	81,917 has 11 as a factor because $1 + 1 = 2$ $8 + 9 + 7 = 24$ and $24 - 2 = 22$ which is divisible by 11.
For 10, 100, 1000 to be a factor of a number, that number must end in one 0 or two 0's or three 0's, etc.	270 has 10 as a factor, 1400 has 100 as a factor etc.

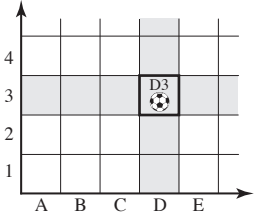



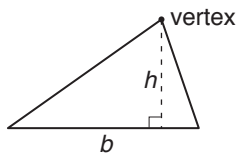
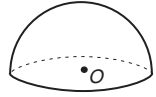

<p>division</p>	<ul style="list-style-type: none"> The <i>operation</i> of sharing or grouping a number into <i>equal</i> parts. 	<p>The division $6 \div 2 = 3$ means: How many groups of 2 can 6 be divided into? OR How many groups of 2 can be taken from 6 before none remain? \Rightarrow 3 groups of 2.</p> 																		
<p>divisor</p>	<ul style="list-style-type: none"> The <i>second</i> number written in a <i>division</i>. It is the number that will divide the <i>dividend</i>. In a <i>fraction</i> the divisor is the <i>denominator</i>. 	<p>$8 \div 4 = 2$ OR $\frac{8}{4} = 2$</p> 																		
<p>dodecahedron</p>	<ul style="list-style-type: none"> A regular <i>solid</i> in which all twelve <i>faces</i> are <i>regular pentagons</i>. 																			
<p>double</p>	<ul style="list-style-type: none"> <i>Twice</i> as much. <i>Multiplied</i> by two. 	<p>Double 4 is: $4 + 4 = 8$ OR $4 \times 2 = 8$.</p>																		
<p>double bar graph</p>	<ul style="list-style-type: none"> A <i>bar graph</i> that shows two sets of <i>data</i> on the same graph. 	<p>Officially Spoken Languages</p>  <table border="1"> <caption>Officially Spoken Languages Data</caption> <thead> <tr> <th>Language</th> <th>Speakers (millions)</th> <th>Countries</th> </tr> </thead> <tbody> <tr> <td>CHINESE</td> <td>~1200</td> <td>~1</td> </tr> <tr> <td>SPANISH</td> <td>~400</td> <td>~20</td> </tr> <tr> <td>ARABIC</td> <td>~300</td> <td>~25</td> </tr> <tr> <td>ENGLISH</td> <td>~350</td> <td>~60</td> </tr> <tr> <td>FRENCH</td> <td>~100</td> <td>~30</td> </tr> </tbody> </table>	Language	Speakers (millions)	Countries	CHINESE	~1200	~1	SPANISH	~400	~20	ARABIC	~300	~25	ENGLISH	~350	~60	FRENCH	~100	~30
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FRENCH	~100	~30																		
<p>east</p>	<ul style="list-style-type: none"> A <i>compass direction</i>. 	<p>The sun rises in the east.</p> 																		
<p>edges of a solid</p>	<ul style="list-style-type: none"> The <i>segment</i> (line part) where two <i>faces</i> of a <i>solid</i> meet. 	<p>A rectangular prism has 12 edges.</p> 																		
<p>eighth</p>	<ul style="list-style-type: none"> The position after <i>seventh</i>. 	<p>1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th.....</p>																		
<p>elapsed time</p>	<ul style="list-style-type: none"> The amount of <i>time</i> between the start time and the finish time. 	<p>The amount of elapsed time from 2:15 P.M. to 3:00 P.M. is 45 minutes.</p>																		
<p>ellipse</p>	<ul style="list-style-type: none"> A curved shape that looks like a squashed <i>circle</i>. 	<p>The approximate orbit of the Earth around the Sun is an ellipse.</p> 																		

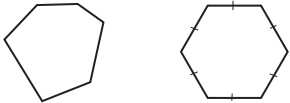
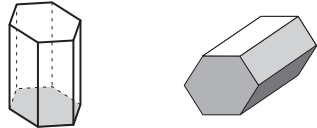


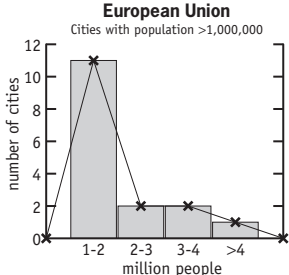

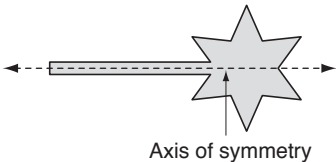
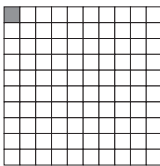
enlargement	<ul style="list-style-type: none"> To reproduce and make bigger. 	<p>The second object is an enlargement of the first.</p> 
equal (=)	<ul style="list-style-type: none"> Exactly the same in value or size. 	$7 + 2 = 9$ 100 centimeters is equal to 1 meter: $100 \text{ cm} = 1 \text{ m}$
equation	<ul style="list-style-type: none"> A mathematical sentence formed by placing an <i>equals</i> sign (=) between two <i>expressions</i>. 	$6 \times 2 = 9 + 3$ $4x - 5 = 0$ $2y^2 - 2 = 0$ are examples of equations.
equilateral triangle	<ul style="list-style-type: none"> A <i>triangle</i> with all three <i>sides</i> of equal <i>length</i>. 	
equivalent fractions	<ul style="list-style-type: none"> <i>Fractions</i> that represent the same number. 	$\frac{2}{16}$ and $\frac{8}{64}$ are equivalent fractions. They both equal $\frac{1}{8}$.
error	<ul style="list-style-type: none"> The variation of a measurement. It may be contributed to by the <i>precision</i> of the instrument or the <i>accuracy</i> of the measured value. 	“My measuring may be off by 1%!”
estimate	<ul style="list-style-type: none"> To make a close guess based on <i>rounding</i>. 	$48 + 21 = ?$ By rounding to $50 + 20$, the estimation of the sum is 70.
evaluate	<ul style="list-style-type: none"> To work out the value. 	Evaluate: $7 \times 3 - 10 = 21 - 10$ $= 11$
even numbers	<ul style="list-style-type: none"> A <i>whole number</i> that can be <i>divided</i> by two. Even numbers end with 0, 2, 4, 6 or 8. 	134 is an even number. 134 ✓ 431 is not an even number. 431 ✗
event	<ul style="list-style-type: none"> A <i>set</i> of possible <i>outcomes</i> resulting from a particular <i>experiment</i>. Any <i>subset</i> of a <i>sample space</i>. 	A die is rolled - Event = {5, 6} i.e. either a 5 or a 6 may result 
expand	<ul style="list-style-type: none"> To <i>multiply</i> out parts of an <i>expression</i> thereby removing the <i>brackets</i>. 	Using $a = 1, b = 4, c = 3$, $a(b + c) = ab + ac$ $1 \times (4 + 3) = 1 \times 4 + 1 \times 3$ $= 7$

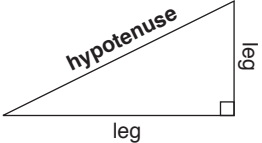

<p>expense (money)</p>	<ul style="list-style-type: none"> The cost involved. 	<p>You buy 3 CDs at \$15 each. Your expense is \$45.</p>
<p>experiment</p>	<ul style="list-style-type: none"> A controlled, repeatable process carried out in the study of <i>probability</i>. 	<p>Tossing a coin is an experiment.</p> 
<p>exponent</p>	<ul style="list-style-type: none"> A number placed to the upper right of a base number, showing how many times the base number is multiplied by itself. 	<p>$7^4 = 7 \times 7 \times 7 \times 7 = 2401$ The exponent is 4. It is read as 'seven to the power of four'.</p>
<p>exponential notation</p>	<ul style="list-style-type: none"> Quantities in the form of a <i>base</i> number and an <i>exponent</i>. Exponential notation indicates what <i>power</i> is to be used and makes it easier to use multiple <i>factors</i>. 	<p>$3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3$ can be more easily written using exponential notation as 3^7.</p>
<p>expression</p>	<ul style="list-style-type: none"> A <i>sequence</i> of numbers and/or <i>variables</i> (letters) connected by <i>operation</i> signs. 	<p>$42 \div 3 - 10$ $x + 2y$ $2x^2 - 2$ } are examples of expressions</p>
<p>faces of a solid</p>	<ul style="list-style-type: none"> <i>Polygons</i> that join on their <i>edges</i> to form a <i>solid</i>. 	<p>A rectangular prism has 6 rectangular faces.</p> 
<p>factor</p>	<ul style="list-style-type: none"> When <i>whole numbers</i>, other than zero, are multiplied together, each number is a factor of the <i>product</i>. OR A whole number that divides exactly into another number. See <i>divisibility tests</i>. To write a number as a <i>product</i> of its <i>factors</i>. To write an <i>expression</i> as a product of two or more expressions. 	<p>Because $1 \times 12 = 12$ $2 \times 6 = 12$ and $3 \times 4 = 12$</p> <p>1, 2, 3, 4, 6 and 12 are all factors of 12.</p> <p>Factor: $3x + 15 = 3(x + 5)$ because $3 = 3 \times 1$ and $15 = 3 \times 5$</p>
<p>factor tree</p>	<ul style="list-style-type: none"> A diagram that shows all possible <i>factors</i> on the different branches of a 'tree'. It is used to find the <i>prime factors</i> of a number. 	<p>The prime factors of 12 are 2 and 3.</p> 
<p>favorable outcome</p>	<ul style="list-style-type: none"> The result that you are hoping or testing for. 	<p>A die is rolled. Event = {numbers >2} Fav. outcomes = {3,4,5,6}</p>

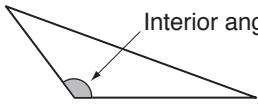
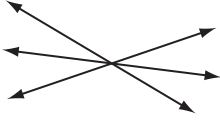

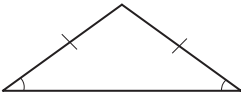

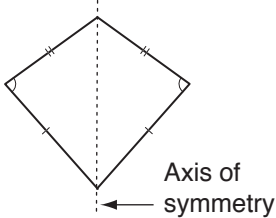
fifth	<ul style="list-style-type: none"> The position after <i>fourth</i>. 	1st, 2nd, 3rd, 4th, 5th
finite	<ul style="list-style-type: none"> With limits. Able to be counted. 	There are a finite number (12) of months in the year.
first	<ul style="list-style-type: none"> Placed before anything else. 	The first athlete to cross the finish line won the gold medal.
flip	<ul style="list-style-type: none"> To turn across a line so the result is a mirror image. See <i>reflection</i>. 	
fluid ounce (fl oz)	<ul style="list-style-type: none"> A <i>unit of capacity</i>. 16 fluid <i>ounces</i> equal 1 pint. 	There are about 34 fluid ounces in one liter.
foot (ft)	<ul style="list-style-type: none"> A <i>unit of length</i> equal to 12 <i>inches</i>. 	The tallest man ever recorded was Robert Wadlow of Illinois, who at his death was 8 foot 11 inches tall (8'11").
formula	<ul style="list-style-type: none"> (pl. formulae) A mathematical <i>rule</i>, usually an <i>equation</i>, describing a relationship between two or more quantities. For example, the formula describing the area of a circle is $A = \pi r^2$ where A is the symbol for the area and r is the symbol for the <i>radius</i>. 	<p>Find the area of a circle of radius 10 cm, using $\pi \approx 3.14$</p> <p>Use the formula $A = \pi r^2$ and substitute $r = 10$</p> $A = 3.14 \times 10^2$ $= 3.14 \times 100$ $= 314 \text{ cm}^2$
fortnight	<ul style="list-style-type: none"> A <i>unit of time</i> equal to 2 whole <i>weeks</i> or 14 <i>days</i>. 	
forwards	<ul style="list-style-type: none"> In the <i>direction</i> of your front. The usual way. 	
fourth	<ul style="list-style-type: none"> The position after <i>third</i>. 	1st, 2nd, 3rd, 4th
fraction	<ul style="list-style-type: none"> Part of a group. Part of a whole. A number in the form $\frac{a}{b}$ ($b \neq 0$) where a is the <i>numerator</i> and b is the <i>denominator</i>. Fractions can be <i>proper fractions</i> or <i>improper fractions</i>. 	<p>5 out of 8 dots are circled.</p>  $\frac{5}{8}$ <p>1 half of a whole orange.</p>  $\frac{1}{2}$


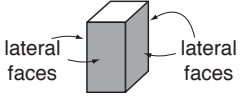
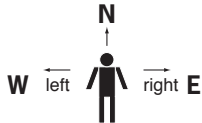
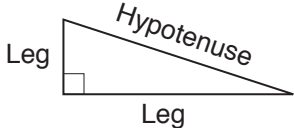
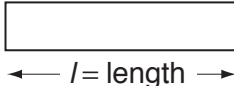
frequency (f)	<ul style="list-style-type: none"> How often a particular item occurs in a set of <i>data</i>. 	<p style="text-align: center;">TRAFFIC SURVEY</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Vehicle</th> <th>Tally</th> <th>Frequency</th> </tr> </thead> <tbody> <tr> <td>car</td> <td> III</td> <td>8</td> </tr> <tr> <td>truck</td> <td> </td> <td>1</td> </tr> <tr> <td>bus</td> <td> </td> <td>2</td> </tr> </tbody> </table> <p>"The most frequent vehicle to pass by was a car."</p>	Vehicle	Tally	Frequency	car	III	8	truck		1	bus		2
Vehicle	Tally	Frequency												
car	III	8												
truck		1												
bus		2												
frequency table	<ul style="list-style-type: none"> Lists items and uses <i>tallies</i> to show the number of times each <i>event</i> or category occurs for a set of <i>data</i>. 	<p style="text-align: center;"><i>Number of household phones for the class</i></p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>No. of phones</th> <th>Tally</th> <th>Frequency</th> </tr> </thead> <tbody> <tr> <td>1</td> <td> I</td> <td>6</td> </tr> <tr> <td>2</td> <td> </td> <td>3</td> </tr> <tr> <td>3</td> <td> </td> <td>5</td> </tr> </tbody> </table>	No. of phones	Tally	Frequency	1	I	6	2		3	3		5
No. of phones	Tally	Frequency												
1	I	6												
2		3												
3		5												
front view	<ul style="list-style-type: none"> What you see of an object looking from a frontal perspective. <i>Three-dimensional</i> objects have 3 views: front, top and side. 													
function (f)	<ul style="list-style-type: none"> A relationship or correspondence in which values of one <i>variable</i> determine the values of another: $f(x) = \text{rule}$ or $y = \text{rule}$. 	$f(x) = x^2 - 4$ or $y = x^2 - 4$ See rule and <i>linear function</i> .												
gallon (gal)	<ul style="list-style-type: none"> A <i>unit of measurement</i> for <i>capacity</i>. 8 <i>pints</i> equal 1 gallon. 	Gas is sold by the gallon.												
geometry	<ul style="list-style-type: none"> A branch of Mathematics studying the properties and relations of <i>lines</i>, surfaces and <i>solids</i>. 													
gram (g)	<ul style="list-style-type: none"> A <i>unit of measurement</i> for <i>mass</i> equal to 1000 <i>milligrams</i>. 	250 g of butter. 												
graph	<ul style="list-style-type: none"> A diagram that shows a collection of <i>data</i>. 	<p style="text-align: center;">Homework time</p> 												
graph of a function	<ul style="list-style-type: none"> The picture obtained by plotting all the points of the <i>function</i>. 													

greater than (>)	<ul style="list-style-type: none"> An <i>inequality symbol</i> showing which is bigger. 	$10 > 2$ means 10 is greater than 2.
greatest common factor (GCF)	<ul style="list-style-type: none"> The largest number that is a <i>factor</i> of all the given numbers. 	Factors of 12: 1, 2, 3, 4, 6, 12 Factors of 30: 1, 2, 3, 5, 6, 10, 15, 30 The GCF of 12 and 30 is 6.
grid reference	<ul style="list-style-type: none"> A pair of letters and/or numbers that describe <i>location</i> within a grid. See also <i>coordinates</i>. 	The grid reference for the ball is D3. 
half	<ul style="list-style-type: none"> (pl. halves) One of two <i>equal</i> parts expressed as a fraction. 	One half is one of 2 parts of one whole pizza: 
hedron	<ul style="list-style-type: none"> (pl. hedra) Face. 	Polyhedron - A solid object that has multiple (poly) faces. 
height	<ul style="list-style-type: none"> The <i>vertical</i> distance from top to bottom. 	The height of the Taj Mahal is 76 m 
height of a triangle	<ul style="list-style-type: none"> The height (<i>h</i>) is the <i>length</i> of the <i>altitude</i> drawn to the <i>base</i> of the <i>triangle</i>. 	
hemisphere	<ul style="list-style-type: none"> One half of a <i>sphere</i>. 	
hepta	<ul style="list-style-type: none"> Prefix meaning seven. 	See <i>heptagon</i> .
heptagon	<ul style="list-style-type: none"> A <i>polygon</i> with 7 sides. 	 Heptagon Regular heptagon
hexa	<ul style="list-style-type: none"> Prefix meaning six. 	See <i>hexagon</i> .

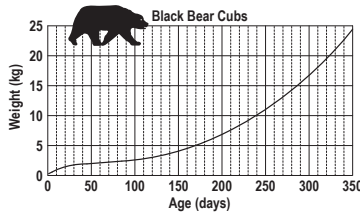
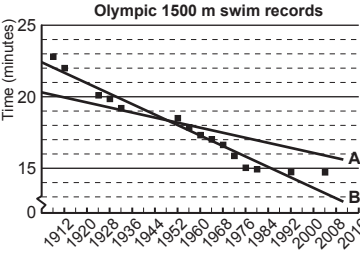
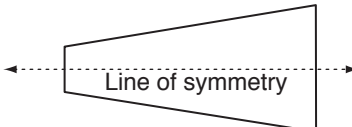
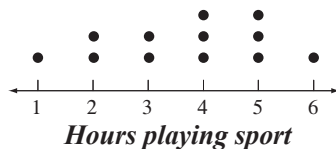
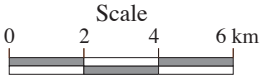
<p>hexagon</p>	<ul style="list-style-type: none"> • A <i>polygon</i> with 6 sides. 	 <p>Hexagon Regular hexagon</p>														
<p>hexagonal prism</p>	<ul style="list-style-type: none"> • A <i>three-dimensional</i> shape. Two identical <i>bases</i> are <i>hexagons</i>. Six <i>faces</i> are <i>rectangles</i>. 															
<p>hexagonal pyramid</p>	<ul style="list-style-type: none"> • A <i>three-dimensional</i> shape. The <i>base</i> is a <i>hexagon</i>. Six <i>faces</i> are <i>triangles</i>. 															
<p>hexahedron</p>	<ul style="list-style-type: none"> • A <i>regular solid</i>. Six <i>faces</i> are <i>square</i> (<i>cube</i>). 															
<p>histogram</p>	<ul style="list-style-type: none"> • A <i>vertical bar graph</i> used to represent the <i>frequency</i> of individual scores. 															
<p>horizontal line</p>	<ul style="list-style-type: none"> • <i>Parallel</i> to the horizon. 															
<p>horizontal symmetry</p>	<ul style="list-style-type: none"> • A shape has horizontal symmetry if an <i>axis of symmetry</i> is horizontal. 															
<p>hour (h)</p>	<ul style="list-style-type: none"> • A <i>unit of time</i> equal to 60 <i>minutes</i>. 	<p>One hour is the amount of time between 1 o'clock and 2 o'clock.</p>														
<p>hundreds</p>	<ul style="list-style-type: none"> • The <i>place value</i> between <i>tens</i> and <i>thousands</i>. 	<p>1825.763 has 8 hundreds.</p> <table border="1"> <tr> <td>thousands</td> <td>hundreds</td> <td>tens</td> <td>units</td> <td>tenths</td> <td>hundredths</td> <td>thousandths</td> </tr> <tr> <td>1</td> <td>8</td> <td>2</td> <td>5</td> <td>7</td> <td>6</td> <td>3</td> </tr> </table>	thousands	hundreds	tens	units	tenths	hundredths	thousandths	1	8	2	5	7	6	3
thousands	hundreds	tens	units	tenths	hundredths	thousandths										
1	8	2	5	7	6	3										
<p>hundredth</p>	<ul style="list-style-type: none"> • One part out of 100 parts of one whole. 															




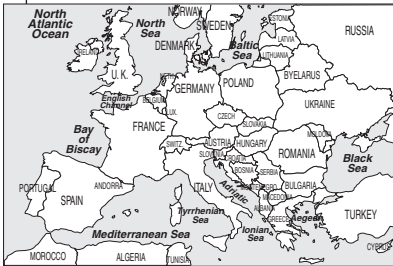

<p>hundredths</p>	<ul style="list-style-type: none"> The <i>place value</i> between <i>tenths</i> and <i>thousandths</i>. 	<p>1825.763 has 6 hundredths.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">thousands</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">hundreds</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">tens</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">units</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">tenths</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">hundredths</td> <td style="writing-mode: vertical-rl; transform: rotate(180deg);">thousandths</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">8</td> <td style="text-align: center;">2</td> <td style="text-align: center;">5</td> <td style="text-align: center;">7</td> <td style="text-align: center;">6</td> <td style="text-align: center;">3</td> </tr> </table>	thousands	hundreds	tens	units	tenths	hundredths	thousandths	1	8	2	5	7	6	3
thousands	hundreds	tens	units	tenths	hundredths	thousandths										
1	8	2	5	7	6	3										
<p>hypotenuse</p>	<ul style="list-style-type: none"> The length of the side <i>opposite</i> the <i>right angle</i> of a <i>right triangle</i>. The longest side of a right triangle. 															
<p>icosahedron</p>	<ul style="list-style-type: none"> A <i>regular solid</i> in which all twenty <i>faces</i> are <i>equilateral triangles</i>. 															
<p>identity element (for addition)</p>	<p>Rule: The <i>sum</i> of any number and zero equals that number.</p> <ul style="list-style-type: none"> Zero is the identity element for <i>addition</i>. 	<p>$a + 0 = a$ OR $0 + a = a$ $3 + 0 = 3$ $0 + 3 = 3$</p>														
<p>identity element (for multiplication)</p>	<p>Rule: The <i>product</i> of any number and one equals that number.</p> <ul style="list-style-type: none"> One is the identity element for addition. 	<p>$a \cdot 1 = a$ OR $1 \cdot a = a$ $3 \cdot 1 = 3$ $1 \cdot 3 = 3$</p>														
<p>improper fraction</p>	<ul style="list-style-type: none"> Any <i>fraction</i> in which the <i>numerator</i> is greater than or equal to the <i>denominator</i>. 	<p>$\frac{9}{8}$ the numerator is 9 the denominator is 8. $9 \geq 8$ so $\frac{9}{8}$ is an improper fraction.</p>														
<p>inch (in.)</p>	<ul style="list-style-type: none"> A <i>unit of length</i>. 	<p>Your thumb is about one inch wide.</p>														
<p>increase</p>	<ul style="list-style-type: none"> To make larger or grow in size. 	<p>8 must increase by 5 to get to 13.</p>														
<p>inequality</p>	<ul style="list-style-type: none"> A mathematical sentence that shows the relative size of two objects or <i>expressions</i>. Uses the <i>inequality symbols</i>: $<$, $>$, \leq or \geq 	<p>$12 > x$ is an inequality. 12 is greater than x.</p>														
<p>inequality symbols</p>	<ul style="list-style-type: none"> Symbols that tell us how the two objects or <i>expressions</i> in a mathematical sentence are not <i>equal</i>. 	<p>$<$, $>$, \leq and \geq are inequality symbols.</p>														
<p>infinite (∞)</p>	<ul style="list-style-type: none"> Has no limits. Unable to be counted. The symbol for infinity is (∞). 	<p>There are an infinite number of integers: -3, -2, -1, 0, 1, 2, 3</p>														




integer (Z)	<ul style="list-style-type: none"> Any <i>negative number</i>, zero or <i>positive number</i>. 	<p>$-3, -2, -1, 0, 1, 2, 3$ are integers.</p> <p>3.5 and $5\frac{2}{3}$ are not integers.</p>																			
interior angle	<ul style="list-style-type: none"> An <i>angle</i> inside a <i>polygon</i>. 																				
intersecting lines	<ul style="list-style-type: none"> <i>Lines</i> that meet at a <i>point</i>. 																				
inverse of an operation	<ul style="list-style-type: none"> The <i>opposite</i> operation. Operations that undo each other. 	<p>$+$ is opposite $-$</p> <p>\times is opposite \div</p>																			
<table border="1"> <thead> <tr> <th>Operation</th> <th>Inverse Operation</th> <th>Operation</th> <th>Inverse Operation</th> <th>Operation</th> <th>Inverse Operation</th> <th>Operation</th> <th>Inverse Operation</th> </tr> </thead> <tbody> <tr> <td>$+$</td> <td>$-$</td> <td>$-$</td> <td>$+$</td> <td>\times</td> <td>\div</td> <td>\div</td> <td>\times</td> </tr> </tbody> </table>	Operation	Inverse Operation	Operation	Inverse Operation	Operation	Inverse Operation	Operation	Inverse Operation	$+$	$-$	$-$	$+$	\times	\div	\div	\times	<table border="1"> <tbody> <tr> <td> $x + 3 = 6$ $x + 3 - 3 = 6 - 3$ $x = 3$ </td> <td> $x - 3 = 6$ $x - 3 + 3 = 6 + 3$ $x = 9$ </td> <td> $3x = 6$ $\frac{3x}{3} = \frac{6}{3}$ $x = 2$ </td> <td> $\frac{x}{3} = 6$ $\frac{x}{3} \times 3 = 6 \times 3$ $x = 18$ </td> </tr> </tbody> </table>	$x + 3 = 6$ $x + 3 - 3 = 6 - 3$ $x = 3$	$x - 3 = 6$ $x - 3 + 3 = 6 + 3$ $x = 9$	$3x = 6$ $\frac{3x}{3} = \frac{6}{3}$ $x = 2$	$\frac{x}{3} = 6$ $\frac{x}{3} \times 3 = 6 \times 3$ $x = 18$
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$+$	$-$	$-$	$+$	\times	\div	\div	\times														
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invest (money)	<ul style="list-style-type: none"> To put some form of money at risk to make a <i>profit</i>. 	It is common to invest in shares.																			
investment (money)	<ul style="list-style-type: none"> The act of laying out some form of money in an enterprise to make a <i>profit</i>. 																				
irrational number	<ul style="list-style-type: none"> A <i>real number</i> that can be written as an infinite non-repeating decimal, but not as a <i>fraction</i>. Not a <i>rational number</i>. 	<p>$\pi, \varphi, e, \sqrt{2}, \sqrt{3}, \sqrt{5}, 2.6293045632\dots$</p> <p>$\cos 30^\circ$</p> <p>$\tan 60^\circ$</p>																			
isosceles triangle	<ul style="list-style-type: none"> A <i>triangle</i> with two sides of equal length. 																				
kilogram (kg)	<ul style="list-style-type: none"> A <i>unit of weight</i> equal to 1000 <i>grams</i>. 	My father weighs 75 kg.																			
kilometer (km)	<ul style="list-style-type: none"> A <i>unit of distance</i> equal to 1000 <i>meters</i>. 	<p>The distance from Denver to Las Vegas is 1220 km.</p> 																			
kite	<ul style="list-style-type: none"> A <i>quadrilateral</i> where one <i>diagonal</i> is an <i>axis of symmetry</i>. 																				

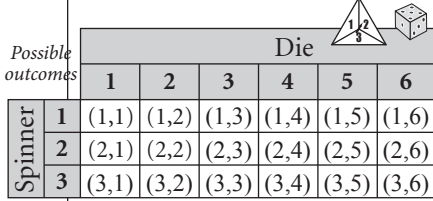


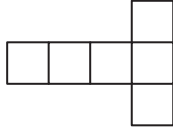


largest to smallest	<ul style="list-style-type: none"> Ranking in order from the biggest to the littlest. 	
lateral area	<ul style="list-style-type: none"> The <i>sum</i> of the area of the <i>lateral faces</i> of a solid. 	A rectangular prism has 4 lateral faces.
lateral faces	<ul style="list-style-type: none"> The <i>vertical</i> surfaces on a solid. 	A rectangular prism has 4 lateral faces. 
leap year	<ul style="list-style-type: none"> A <i>year</i> with 366 <i>days</i> that falls every <i>fourth</i> year and includes the 29th of February as the extra day. 	A leap year is divisible by 4. 2012 is a leap year.
least common denominator	<ul style="list-style-type: none"> The <i>least common multiple</i> of the <i>denominators</i> of two or more <i>fractions</i>. 	The least common denominator of $\frac{2}{3}$ and $\frac{4}{5}$ is the least common multiple of 3 and 5, which is 15.
least common multiple (LCM)	<ul style="list-style-type: none"> The smallest of the common <i>multiples</i> of two or more non-zero <i>whole numbers</i>. 	The least common multiple of 6 and 9 is the smallest of their common multiples 18, 36, 54 ..., so the LCM of 6 and 9 is 18.
left	<ul style="list-style-type: none"> The <i>direction</i> to the <i>west</i> of your body if you are facing <i>north</i>. 	
leg	<ul style="list-style-type: none"> Either of the two <i>perpendicular sides</i> of a <i>right triangle</i>. 	
length	<ul style="list-style-type: none"> The <i>distance</i> from one end to the other. How long a shape is. 	
less than (<)	<ul style="list-style-type: none"> An <i>inequality symbol</i> showing which is smaller. 	$2 < 10$ means that 2 is less than 10.
like terms	<ul style="list-style-type: none"> <i>Terms</i> that contain the same <i>variables</i> raised to the same <i>power</i>. Only the number parts of like terms can be different. Like terms may be added, subtracted, multiplied or divided. <i>Unlike terms</i> may not be added or subtracted. However, they may be multiplied and divided. 	<ul style="list-style-type: none"> $7, \frac{6}{9}$ and -18 are like terms. $6a, a$ and $-3a$ are like terms. $xy^2, 5xy^2$ and $-3xy^2$ are like terms. $7, 6a$ and $-4y^3$ are not like terms. $5w, \frac{6}{w}$ and $-18w^2$ are not like terms.



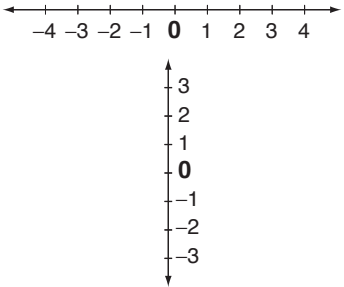
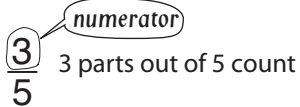

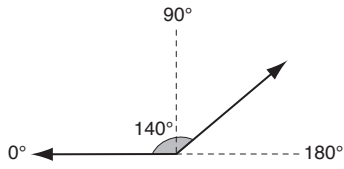
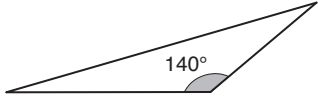

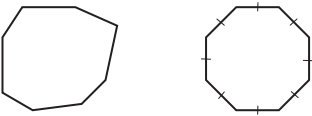


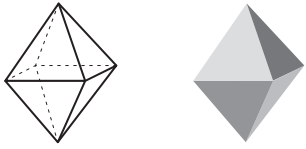
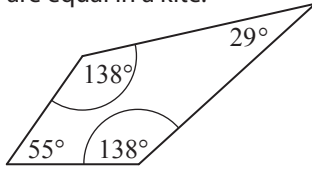
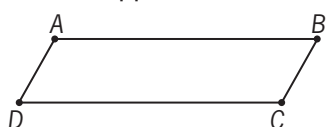

<p>line graph</p>	<ul style="list-style-type: none"> • A <i>graph</i> in which <i>points</i> representing <i>data</i> pairs are connected by <i>line segments</i>. It shows how quantities change over <i>time</i>. 	
<p>line of best fit</p>	<ul style="list-style-type: none"> • A straight or curved <i>line</i> which is most closely to all the <i>data</i> points in a <i>scatter plot</i> and gives the best <i>approximation</i> to the trend of the <i>set</i> of data. • A line which goes through the “middle” of the data points so that the <i>sums</i> of the distances from the points above and below the line, to the line, are <i>approximately equal</i>. 	<p>Line B is a line of best fit, being closest to all the data points.</p> 
<p>line of symmetry</p>	<ul style="list-style-type: none"> • A <i>line</i> that divides a shape so that one <i>side</i> is a mirror image of the other. Both sides match exactly when folded. 	
<p>line plot</p>	<ul style="list-style-type: none"> • A <i>graph</i> showing the frequency of data, using a <i>number line</i>. • The number line has all the numbers in the <i>sample</i>. Each observation is marked with a point above the <i>line</i>. 	<p>A dot plot showing how many hours are dedicated to sport by 12 people.</p> 
<p>linear equation</p>	<ul style="list-style-type: none"> • An algebraic <i>expression</i> in which the <i>variable</i> is in the first <i>power</i>. It can be solved for <i>x</i> and the value of <i>x</i> for which the <i>equation</i> is true is called the <i>solution</i>. <p>The <i>graph</i> of a linear equation is always a straight <i>line</i>.</p> <ul style="list-style-type: none"> • See <i>linear function</i>. 	<p>$4x - 2 = x$ is a linear equation.</p>
<p>linear function</p>	<ul style="list-style-type: none"> • A <i>function</i> in which the <i>variable</i> is only in the first <i>power</i> and has no <i>products</i>. It can be represented by an <i>equation</i> in the form of $y = ax + b$ where <i>a</i> and <i>b</i> are <i>real numbers</i>. <p>The <i>graph</i> of this function is a straight line.</p>	<p>Used to describe things like the movement of a car traveling at a constant speed.</p> <p>$y = x + 4$ $y = -4$ $3x - 4y = 0.5$ are linear functions.</p>
<p>linear scale</p>	<ul style="list-style-type: none"> • A <i>scale</i> shown on a line. <p>Compares the dimensions on a map to real life.</p>	<p>Every cm on the map represents 2 km in real life.</p> 

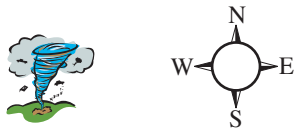
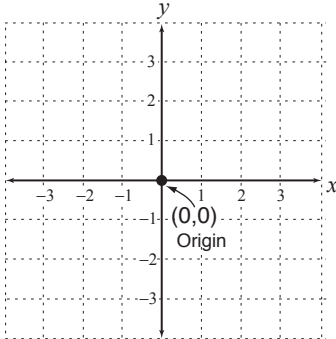


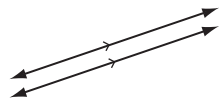
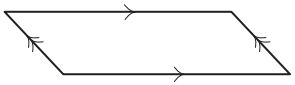
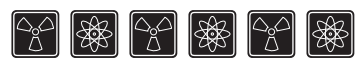
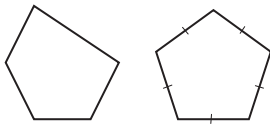
<p>liter (L)</p>	<ul style="list-style-type: none"> • A <i>unit of capacity</i> equal to 1000 milliliters. 	<p>1 liter of milk.</p> 												
<p>location</p>	<ul style="list-style-type: none"> • The exact place, where something is situated. 													
<p>longest</p>	<ul style="list-style-type: none"> • Having the biggest <i>length</i>. 	<p>The record length for the reticulated python of S-E Asia is 10 m. The specimen was found in Celebes, Indonesia in 1912.</p> 												
<p>loss (money)</p>	<ul style="list-style-type: none"> • A reduction in the value of an investment. • Expenses > Revenue 	<p>Revenue from a business activity is \$20. If the expenses are \$25 then the loss would be \$5.</p>												
<p>magic square</p>	<ul style="list-style-type: none"> • A square grid filled with numbers • The <i>sum</i> of the numbers in every <i>row</i>, <i>column</i> and <i>diagonal</i> is the same. 	<table border="1" style="display: inline-table; margin-right: 10px;"> <tr><td>4</td><td>9</td><td>2</td></tr> <tr><td>3</td><td>5</td><td>7</td></tr> <tr><td>8</td><td>1</td><td>6</td></tr> </table> <p>Rows: $4 + 9 + 2 = 15$ $3 + 5 + 7 = 15$ $8 + 1 + 6 = 15$ Columns: $4 + 3 + 8 = 15$ $9 + 5 + 1 = 15$ $2 + 7 + 6 = 15$ Diagonals: $4 + 5 + 6 = 15$ $2 + 5 + 8 = 15$</p>	4	9	2	3	5	7	8	1	6			
4	9	2												
3	5	7												
8	1	6												
<p>map</p>	<ul style="list-style-type: none"> • A diagram of a region showing its position in the world. 	<p style="text-align: center;">Europe</p> 												
<p>mass</p>	<ul style="list-style-type: none"> • The amount of matter that an object contains. It is measured in <i>units</i> like pounds (lb) and ounces (oz) or grams (g) and kilograms (kg) in the metric system. Often called weight, but not the same. 	<p>The mass of the packet of butter is 18 oz. The weight of an object changes according to the gravity. A packet of butter would be weightless in space, even though it still has the same mass as on earth.</p>												
<p>maximum</p>	<ul style="list-style-type: none"> • The highest value. 	<p>The maximum speed in a residential area is 25 miles per hour.</p> 												
<p>mean</p>	<ul style="list-style-type: none"> • Or <i>average</i>, is the total of all scores divided by how many scores there are. • To calculate the mean: <ol style="list-style-type: none"> 1) <i>Add</i> up the values. 2) <i>Divide</i> the total by the number of values. 	<table style="border-collapse: collapse;"> <tr> <td style="padding-right: 20px;">4</td> <td>$24 \div 4 = 6$</td> </tr> <tr> <td>6</td> <td>The average</td> </tr> <tr> <td>5</td> <td>or mean of</td> </tr> <tr> <td></td> <td>4, 6, 5 and 9 is 6.</td> </tr> <tr> <td style="border-top: 1px solid black; border-bottom: 3px double black;">+ 9</td> <td></td> </tr> <tr> <td style="border-bottom: 3px double black;">24</td> <td></td> </tr> </table>	4	$24 \div 4 = 6$	6	The average	5	or mean of		4, 6, 5 and 9 is 6.	+ 9		24	
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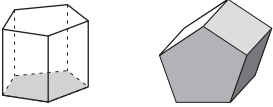

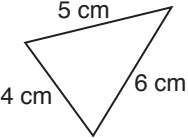
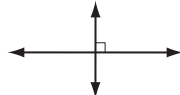
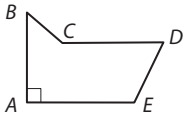











median	<ul style="list-style-type: none"> The middle value of an ordered <i>set</i> of values. If there is an <i>even number</i> of values then the median is the <i>average</i> of the two middle numbers. 	Data: 2, 5, <u>6</u> , 8, 9 Median is 6 Data: 2, 3, <u>5</u> , <u>6</u> , 8, 8 Average the two middle values: $5 + 6 = 11$ $11 \div 2 = 5.5$ Median is 5.5
meter (m)	<ul style="list-style-type: none"> A <i>unit of length equal</i> to 100 centimeters. 	Track distances are measured in meters.
mile (mi)	<ul style="list-style-type: none"> A <i>unit of length equal</i> to 1,760 yards. 	Distance is measured in miles.
milliliter (mL)	<ul style="list-style-type: none"> A <i>unit of capacity</i>. 1000 milliliters is <i>equal</i> to 1 <i>liter</i>. 	Medicines are measured in mL.
millimeter (mm)	<ul style="list-style-type: none"> A <i>unit of length</i>. 1000 millimeters is <i>equal</i> to 1 <i>meter</i>. 	Timber length is measured in millimeters.
million	<ul style="list-style-type: none"> A thousand thousands. 	
minimum	<ul style="list-style-type: none"> The lowest value. 	The minimum temperature reached yesterday was 60°F.
minus (-)	<ul style="list-style-type: none"> Another word for <i>subtract</i>. To take away. 	\$20 minus \$5 is \$15. $20 - 5 = 15$
minute (min)	<ul style="list-style-type: none"> A <i>unit of time equal</i> to 60 <i>seconds</i>. 	One minute has 60 seconds.
mixed number	<ul style="list-style-type: none"> The <i>sum</i> of a <i>whole number</i> and a <i>fraction</i> less than one. 	$3\frac{5}{7}$ is a mixed number.
mode	<ul style="list-style-type: none"> The most frequent score in a set of <i>data</i>. 	Data: 2, 3, 5, 7, 7, 7, 8, 8, 9 The mode is 7 as 7 occurs three times.
month	<ul style="list-style-type: none"> A <i>unit of time equal</i> to 28, 29, 30 or 31 <i>days</i>. 	There are 12 months in a year starting with January. 
morning	<ul style="list-style-type: none"> The early part of the <i>day</i> ending at 12 noon. 	
multiple	<ul style="list-style-type: none"> A multiple of a <i>whole number</i> is the <i>product</i> of that number with any non-zero whole number. 	The multiples of 2 are 2, 4, 6, 8, 10, $2 \times 1 = 2$ $2 \times 2 = 4$ $2 \times 3 = 6$ etc.


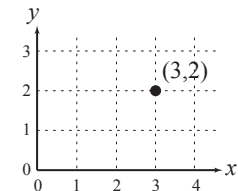
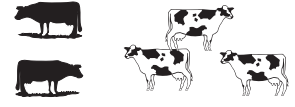

<p>multiple events</p>	<ul style="list-style-type: none"> • More than one <i>event</i>, where their individual results are totally unaffected by whether or not the other event does or does not occur. 	
<p>multiplication</p>	<ul style="list-style-type: none"> • An <i>operation</i> where a number is added to itself a number of times. 	<p>$2 + 2 + 2 + 2 + 2 = 10$ or $5 \times 2 = 10$</p> 
<p>multiply (×)</p>	<ul style="list-style-type: none"> • To find the <i>total</i> of a number of identical groups. 	<p>Three lots of 2 cows is 6. $3 \times 2 = 6$ or $2 + 2 + 2 = 6$</p> 
<p>mutually exclusive events</p>	<ul style="list-style-type: none"> • Two <i>events</i> that have no outcomes in common. 	<p>A 6 sided die is rolled once. Event A: Roll a 2 Event B: Roll a 3</p> <p>Events A and B are mutually exclusive since they both can not happen at the same time.</p> <p>Addition rule for mutually exclusive events: $P(A \text{ or } B) = P(A) + P(B)$</p>
<p>natural number (N)</p>	<ul style="list-style-type: none"> • A counting number from 1 to <i>infinity</i>. 	<p>1, 2, 3, 4, 5,∞</p>
<p>negative number</p>	<ul style="list-style-type: none"> • A number that is <i>less than zero</i>. 	<p>-1, -2, -3, -4, -5, are negative numbers.</p>
<p>net</p>	<ul style="list-style-type: none"> • The pattern cut out to form a <i>3D</i> shape. 	<p>Possible net of a cube.</p> 
<p>ninth</p>	<ul style="list-style-type: none"> • The <i>position</i> after <i>eighth</i>. 	<p>1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th.....</p>
<p>nona</p>	<ul style="list-style-type: none"> • Prefix meaning nine. 	<p>See <i>nonagon</i>.</p>
<p>nonagon</p>	<ul style="list-style-type: none"> • A <i>polygon</i> with 9 sides. 	 <p>Nonagon Regular nonagon</p>
<p>north</p>	<ul style="list-style-type: none"> • A <i>compass direction</i>. 	

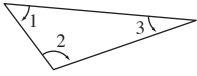









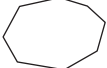





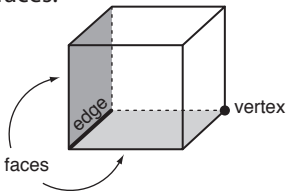
north-east	<ul style="list-style-type: none"> • A <i>compass direction</i>. 	
north-west	<ul style="list-style-type: none"> • A <i>compass direction</i>. 	
number line	<ul style="list-style-type: none"> • An evenly marked <i>line</i> that shows position of numbers. • <i>Points</i> are marked with numbers in <i>ascending order</i> from left to right (horizontal number line) or from bottom to top (vertical number line). • Zero represents the <i>origin</i> of a number line. 	
number sentence	<ul style="list-style-type: none"> • A sentence using numbers and operations instead of words. 	<p>"Mary had four cats and two dogs. How many pets did she have?"</p> <p>Number sentence: $4 + 2 = 6$</p>
numeral	<ul style="list-style-type: none"> • A symbol used to represent a number. 	<p>Arabic numerals: 1, 2, 3, 4, 5</p> <p>Roman numerals: I, II, III, IV, V</p>
numerator	<ul style="list-style-type: none"> • The number above the fraction bar in a <i>fraction</i>. • The number of parts that are counted. 	
oblique line	<ul style="list-style-type: none"> • A line at an <i>angle</i> to the horizon. 	
obtuse angle	<ul style="list-style-type: none"> • An <i>angle</i> measuring greater than 90° and less than 180°. 	
obtuse triangle	<ul style="list-style-type: none"> • A triangle with one <i>angle</i> measuring greater than 90° and less than 180°. 	
octa	<ul style="list-style-type: none"> • Prefix meaning eight. 	<p>An octopus has 8 legs.</p> 
octagon	<ul style="list-style-type: none"> • A <i>polygon</i> with 8 sides. 	 <p>Octagon Regular octagon</p>



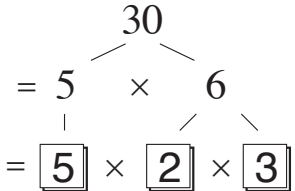
<p>octahedron</p>	<ul style="list-style-type: none"> • A <i>solid</i> with eight <i>faces</i>. • A regular octahedron has faces that are all <i>equilateral triangles</i>. 	
<p>odd numbers</p>	<ul style="list-style-type: none"> • A <i>whole number</i> that is not <i>divisible</i> by 2. 	<p>Odd numbers end with 1, 3, 5, 7 or 9.</p>
<p>of</p>	<ul style="list-style-type: none"> • Seen in context like ‘a <i>fraction of</i> a number’, it means to <i>multiply</i>. 	<p>A quarter of 100 means $\frac{1}{4}$ of 100, or $\frac{1}{4} \times 100 = 25$</p>
<p>once</p>	<ul style="list-style-type: none"> • On one occasion. 	<p>Just this time!</p>
<p>operation</p>	<ul style="list-style-type: none"> • A mathematical process performed according to certain <i>rules</i>. 	<p>There are four basic operations in arithmetic:</p> <p>addition $3 + 12$ subtraction $3 - 1$ multiplication 1×5 division $6 \div 3$</p> <p>There are many complex operations like: $\sin 30^\circ, \sqrt{9}$ and $\log_{10} 100, 5^4$.</p>
<p>opposite angles</p>	<ul style="list-style-type: none"> • Angles across from each other in a shape. 	<p>One pair of opposite angles are equal in a kite.</p> 
<p>opposite sides</p>	<ul style="list-style-type: none"> • Sides across from each other in a shape. 	<p>Side \overline{AB} is opposite to side \overline{CD} Side \overline{AD} is opposite to side \overline{BC}</p> 
<p>opposites</p>	<ul style="list-style-type: none"> • Two <i>numbers</i> with the same <i>absolute value</i> but different <i>signs</i>. 	<p>The opposite of +4 is -4.</p>
<p>order</p>	<ul style="list-style-type: none"> • Placing a group in a special arrangement. 	<p>The aliens are arranged in order of height.</p> 
<p>order of operations</p>	<ul style="list-style-type: none"> • The order of doing <i>operations</i> is: <ol style="list-style-type: none"> 1) <i>Simplify</i> inside all <i>brackets</i>. 2) <i>Evaluate powers</i> and <i>square roots</i>. 3) Calculate \times and \div from left to right. 4) Calculate $+$ and $-$ from left to right. 	<p>Calculate $4 + 3^2 \times (6 - 2)$ by</p> <ol style="list-style-type: none"> 1) $4 + 3^2 \times (6 - 2)$ 2) $= 4 + 3^2 \times 4$ 3) $= 4 + 9 \times 4$ 4) $= 4 + 36$ $= 40$



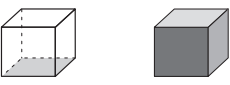
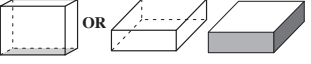

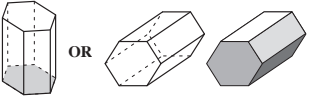
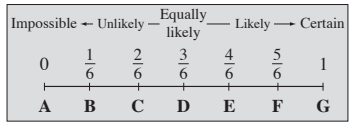

ordinal numbers	<ul style="list-style-type: none"> A <i>whole number</i> that shows position. 	1st, 2nd, 3rd, 4th, 5th..... are ordinal numbers.
orientation	<ul style="list-style-type: none"> Position relative to <i>direction</i>. 	<p>The tornado is coming from the west.</p> 
origin	<ul style="list-style-type: none"> The point of <i>coordinates</i> (0,0) on a <i>coordinate plane</i>. 	
ounce (oz)	<ul style="list-style-type: none"> A <i>unit of mass</i>. 16 ounces equal 1 <i>pound</i>. 	<p>An ounce of gold.</p> 
outcome	<ul style="list-style-type: none"> Result of an event. 	<p>The outcome (result) of tossing a coin was to turn up a head.</p>
pair	<ul style="list-style-type: none"> Two together. 	
palindrome	<ul style="list-style-type: none"> A number with 2 or more digits that reads the same <i>forwards</i> and <i>backwards</i>. 	44 or 6116 are palindromic numbers.
parallel lines	<ul style="list-style-type: none"> <i>Lines</i> in the same <i>plane</i> that never cross over. They are marked with matching arrows. 	
parallelogram	<ul style="list-style-type: none"> A special <i>quadrilateral</i>. <i>Opposite sides</i> are <i>parallel lines</i>. <i>Opposite sides</i> are equal in length. 	
pattern	<ul style="list-style-type: none"> Numbers or objects that are arranged following a <i>rule</i>. 	
penta	<ul style="list-style-type: none"> Prefix meaning five. 	See <i>pentagon</i> .
pentagon	<ul style="list-style-type: none"> A <i>polygon</i> with 5 sides. 	 <p>Pentagon Regular pentagon</p>

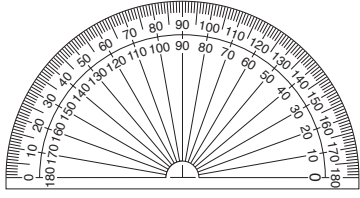
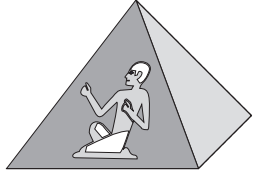


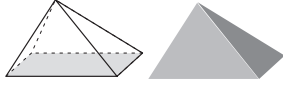




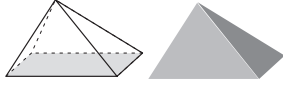




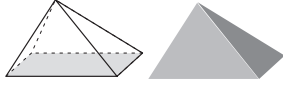


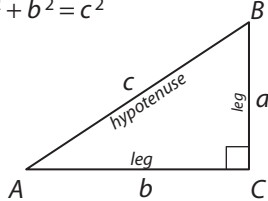
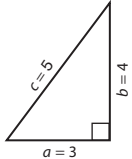
pentagonal prism	<ul style="list-style-type: none"> • A <i>three-dimensional</i> shape. Two identical, <i>parallel bases</i> are <i>pentagons</i>. Five <i>faces</i> are <i>rectangles</i>. 							
pentagonal pyramid	<ul style="list-style-type: none"> • A <i>three-dimensional</i> shape. <i>Base</i> is a <i>pentagon</i>. Five <i>faces</i> are <i>triangles</i>. 							
per	<ul style="list-style-type: none"> • For each. • Can be written as a forward slash (/). 	20 miles per hour or 20 mph means 20 miles traveled for each hour.						
percent	<ul style="list-style-type: none"> • Out of 100 • ‘<i>Per</i>’ means for each, ‘<i>cent</i>’ means 100. 	$59\% = \frac{59}{100} = 0.59$						
perfect square	<ul style="list-style-type: none"> • Any number that is the result of multiplying two <i>rational numbers</i> together. 	0, 1, 4, 9, 16, 25, $\frac{1}{25}$, $\frac{4}{9}$ etc. are all perfect squares.						
perimeter	<ul style="list-style-type: none"> • The <i>distance</i> around the outside of a <i>shape</i>. 	Add the length of all sides. Perimeter = 4 + 5 + 6 = 15 cm 						
perpendicular lines	<ul style="list-style-type: none"> • Lines on a <i>plane</i> that <i>intersect</i> to form a <i>right angle</i>. 							
perpendicular sides	<ul style="list-style-type: none"> • Sides on a <i>shape</i> that are at <i>right angles</i> to each other. 	\overline{AB} is perpendicular to \overline{AE} . 						
perspective	<ul style="list-style-type: none"> • The appearance of objects affected by size and <i>position</i>. 							
pi (π)	<ul style="list-style-type: none"> • The <i>ratio</i> of the <i>circumference</i> of a <i>circle</i> to its <i>diameter</i>. The diameter of a circle wraps around the circle approximately 3.14 times. 	3.14 or $\frac{22}{7}$ is the approximate value of π . Pi is an infinite number. $\pi = 3.14159\ 26535\ 89793\dots$						
pictograph	<ul style="list-style-type: none"> • A <i>graph</i> that uses pictures or symbols to represent <i>data</i>. 	<p>Toy Sales in Winter  = 50 toys</p> <table border="1"> <tr> <td>June</td> <td></td> </tr> <tr> <td>July</td> <td></td> </tr> <tr> <td>Aug.</td> <td></td> </tr> </table>	June		July		Aug.	
June								
July								
Aug.								

<p>pint (pt)</p>	<ul style="list-style-type: none"> • A <i>unit of capacity</i>. • 16 <i>fluid ounces</i> equal 1 pint. 	<p>Milk can be bought by the pint.</p>																						
<p>place holder</p>	<ul style="list-style-type: none"> • Minds a spot in a number. 	<p>Zeros are used as place holders in long multiplication algorithms.</p> $\begin{array}{r} 34 \\ \times 21 \\ \hline 734 \\ 680 \\ \hline 714 \end{array}$ <p>Zero is a place holder</p>																						
<p>place value</p>	<ul style="list-style-type: none"> • Value according to position in a number. 	<p>954 5 is in the tens place 5 has a value of 50.</p> <table border="1"> <thead> <tr> <th>millions</th> <th>hundreds of thousands</th> <th>tens of thousands</th> <th>thousands</th> <th>hundreds</th> <th>tens</th> <th>units</th> <th>decimal point</th> <th>tenths</th> <th>hundredths</th> <th>thousandths</th> </tr> </thead> <tbody> <tr> <td>1,000,000</td> <td>100,000</td> <td>10,000</td> <td>1000</td> <td>100</td> <td>10</td> <td>1</td> <td>•</td> <td>$\frac{1}{10}$</td> <td>$\frac{1}{100}$</td> <td>$\frac{1}{1000}$</td> </tr> </tbody> </table>	millions	hundreds of thousands	tens of thousands	thousands	hundreds	tens	units	decimal point	tenths	hundredths	thousandths	1,000,000	100,000	10,000	1000	100	10	1	•	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$
millions	hundreds of thousands	tens of thousands	thousands	hundreds	tens	units	decimal point	tenths	hundredths	thousandths														
1,000,000	100,000	10,000	1000	100	10	1	•	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$														
<p>plane</p>	<ul style="list-style-type: none"> • A flat surface. 																							
<p>plot (or graph)</p>	<ul style="list-style-type: none"> • To mark a <i>point</i> on a <i>coordinate plane</i>. 	<p>The point of coordinate (3,2)</p> 																						
<p>plus (+)</p>	<ul style="list-style-type: none"> • Another word for <i>addition</i>. To add. 	<p>2 cows plus 3 cows gives you 5 cows.</p> <p>$2 + 3 = 5$</p> 																						
<p>P.M. (Post Meridiem)</p>	<ul style="list-style-type: none"> • The <i>time</i> from midday to midnight. 	<p>Every night Jimmy starts reading at 9 P.M.</p> 																						
<p>point</p>	<ul style="list-style-type: none"> • A position in space represented by a dot. 	<p>• P</p>																						

<p>polygon</p>	<ul style="list-style-type: none"> • A closed <i>two-dimensional</i> shape for which all sides are line segments. 3 or more <i>sides</i> and <i>angles</i>. 	<p>'Poly' means many and 'gon' means angle. Example: A triangle has 3 angles.</p>	
<p>polygon (many angles)</p>	<p>regular polygon (all sides and all angles are equal)</p>	<p>Number of Sides</p>	<p>Number of Interior angles</p>
<p><u>Triangle</u> 3 angles</p> 	<p><u>Equilateral triangle</u></p> 	<p>3</p>	<p>3</p>
<p><u>Quadrilateral</u> 4 angles</p> 	<p><u>Square</u></p> 	<p>4</p>	<p>4</p>
<p><u>Pentagon</u> 5 angles</p> 	<p><u>Regular pentagon</u></p> 	<p>5</p>	<p>5</p>
<p><u>Hexagon</u> 6 angles</p> 	<p><u>Regular hexagon</u></p> 	<p>6</p>	<p>6</p>
<p><u>Heptagon</u> 7 angles</p> 	<p><u>Regular heptagon</u></p> 	<p>7</p>	<p>7</p>
<p><u>Octagon</u> 8 angles</p> 	<p><u>Regular octagon</u></p> 	<p>8</p>	<p>8</p>
<p><u>Nonagon</u> 9 angles</p> 	<p><u>Regular nonagon</u></p> 	<p>9</p>	<p>9</p>
<p><u>Decagon</u> 10 angles</p> 	<p><u>Regular decagon</u></p> 	<p>10</p>	<p>10</p>
<p>polyhedron</p>	<ul style="list-style-type: none"> • A <i>three-dimensional</i> shape. Four or more <i>faces</i>. Described by their <i>faces</i>, <i>edges</i> and <i>vertices</i>. 	<p>'Poly' means many and 'hedron' means faces. Example: A hexahedron has 6 faces.</p> 	
<p>population</p>	<ul style="list-style-type: none"> • The entire <i>set</i> under consideration in a statistical analysis. 	<p>The population of a country is every person who lives in that country.</p>	
<p>position</p>	<ul style="list-style-type: none"> • Where something is in relation to things around it. 	<p>In, on, under, behind, next to.</p>	
<p>positive numbers</p>	<ul style="list-style-type: none"> • A number that is <i>greater than zero</i>. 	<p>+1, +2, +3, +4, +5, are positive numbers.</p>	

<p>possible outcomes</p>	<ul style="list-style-type: none"> • The total number of result options. 	<p>When you toss a coin there are 2 possible results: heads or tails.</p>
<p>pound (lb)</p>	<ul style="list-style-type: none"> • A <i>unit of mass equal to 16 ounces</i>. 	<p>Butter is bought by the pound.</p> 
<p>power</p>	<ul style="list-style-type: none"> • An <i>expression</i>, such as 4^3, in which the base (4) is <i>multiplied</i> by itself a number of times equal to the <i>exponent</i> (3). 	<p>4^3 or 4 to the power of 3 is $4 \times 4 \times 4 = 64$</p>
<p>precision of an instrument</p>	<ul style="list-style-type: none"> • Considered to be the size of the smallest <i>unit</i> on the <i>scale</i> of the instrument. 	<p>The ruler has a precision of 0.1 cm</p> 
<p>previous</p>	<ul style="list-style-type: none"> • The one before. 	<p>If the current year is 2011, the previous year was 2010.</p>
<p>prime factor</p>	<ul style="list-style-type: none"> • A <i>factor</i> that is also a <i>prime number</i>. <i>Factor trees</i> can help to determine a number's prime factors. 	<p>The prime factors of 30 are 2, 3 and 5.</p> 
<p>prime factorization</p>	<ul style="list-style-type: none"> • Writing a <i>whole number</i> as the <i>product</i> of its <i>prime factors</i>. 	<p>Prime factorization of 30: $30 = 2 \times 3 \times 5$</p>
<p>prime number</p>	<ul style="list-style-type: none"> • A <i>whole number</i> that has exactly two <i>factors</i>, 1 and itself. • 1 is not a prime number. 	<p>59 is a prime number as its only factors are 1 and 59.</p> <p>The prime numbers between 0 and 100 are: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89 and 97.</p>

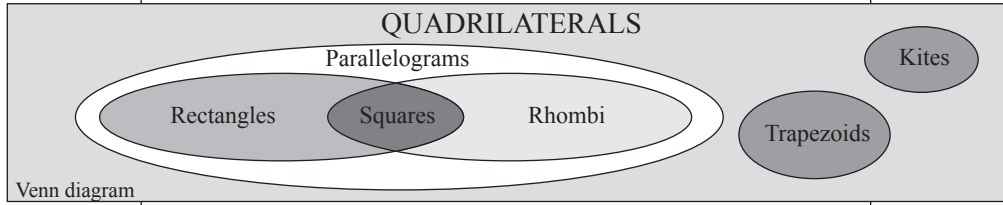
prism	<ul style="list-style-type: none"> A <i>three-dimensional</i> shape. Two <i>parallel bases</i> are the same. 				
prism	Properties	Number of			Examples
		Faces	Edges	Vertices	
Triangular Prism	Bases are triangles Lateral faces are rectangles	5	9	6	
Square Prism	Bases are squares Lateral faces are rectangles	6	12	8	
Rectangular Prism	Bases are rectangles Lateral faces are rectangles	6	12	8	
Pentagonal Prism	Bases are pentagons Lateral faces are rectangles	7	15	10	
Hexagonal Prism	Bases are hexagons Lateral faces are rectangles	8	18	12	
probability	<ul style="list-style-type: none"> The likelihood that an event will happen, measured as a <i>fraction</i> of the total of possible outcomes. See <i>chance</i>. 	The probability of spinning the number 5 is $\frac{1}{8}$.			
probability scale	<ul style="list-style-type: none"> A measure, from 0 (no chance) to 1 (will happen), of the likelihood of an event occurring. 				
product	<ul style="list-style-type: none"> The result when two or more numbers are <i>multiplied</i>. 	The product of 4 and 5 is 20: $4 \times 5 = 5 \times 4 = 20$			
profit (money)	<ul style="list-style-type: none"> What is gained, less any <i>expenses</i>. Profit = Revenue – Expense. 	Revenue from a business activity is \$20. If the expenses are \$15 then the profit would be \$5.			
proper fraction	<ul style="list-style-type: none"> Any <i>fraction</i> in which the <i>numerator</i> is <i>less than</i> the <i>denominator</i>. 	$\frac{5}{8}$ the numerator is 5 the denominator is 8. $5 < 8$ so $\frac{5}{8}$ is a proper fraction. 			
proportion	<ul style="list-style-type: none"> A comparative <i>ratio</i>, showing that two ratios are equivalent. 	$\frac{2}{3} = \frac{6}{9}$ is a proportion. 2 : 3 is the same ratio as 6 : 9 2 : 3 is in proportion with 6 : 9			

<p>protractor</p>	<ul style="list-style-type: none"> • A <i>semi-circular</i> tool used to measure <i>degrees</i>. There are 180° on a protractor. 																																		
<p>pyramid</p>	<ul style="list-style-type: none"> • A <i>three-dimensional</i> shape. One <i>base</i> is a <i>polygon</i>. All other <i>faces</i> are <i>triangles</i> that meet at one point called <i>vertex</i>. A pyramid is named for the shape of its base. 																																		
<p>pyramid</p>	<table border="1"> <thead> <tr> <th rowspan="2">Properties</th> <th colspan="3">Number of</th> <th rowspan="2">Examples</th> </tr> <tr> <th>Faces</th> <th>Edges</th> <th>Vertices</th> </tr> </thead> <tbody> <tr> <td>Triangular Pyramid</td> <td>4</td> <td>6</td> <td>4</td> <td></td> </tr> <tr> <td>Square Pyramid</td> <td>5</td> <td>8</td> <td>5</td> <td></td> </tr> <tr> <td>Rectangular Pyramid</td> <td>5</td> <td>8</td> <td>5</td> <td></td> </tr> <tr> <td>Pentagonal Pyramid</td> <td>6</td> <td>10</td> <td>6</td> <td></td> </tr> <tr> <td>Hexagonal Pyramid</td> <td>7</td> <td>12</td> <td>7</td> <td></td> </tr> </tbody> </table>	Properties	Number of			Examples	Faces	Edges	Vertices	Triangular Pyramid	4	6	4		Square Pyramid	5	8	5		Rectangular Pyramid	5	8	5		Pentagonal Pyramid	6	10	6		Hexagonal Pyramid	7	12	7		
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Hexagonal Pyramid	7	12	7																																
<p>Pythagorean theorem</p>	<ul style="list-style-type: none"> • Rule: $a^2 + b^2 = c^2$ For any <i>right triangle</i>, the square of the length of the <i>hypotenuse</i> (<i>c</i>) equals the sum of the squares of the lengths of the legs (<i>a</i> and <i>b</i>). 	<p>$a^2 + b^2 = c^2$</p>  <p>$3^2 + 4^2 = 5^2$ $9 + 16 = 25$</p> 																																	
<p>Pythagorean triples</p>	<ul style="list-style-type: none"> • A set of 3 <i>positive integers</i> that make <i>Pythagorean theorem</i> true. 	<p>$a^2 + b^2 = c^2$ $3^2 + 4^2 = 5^2$ $9 + 16 = 25$ so triples include 3,4,5 6,8,10 5,12,13 7,24,25 8,15,17 9,40,41, 20,21,29 etc.</p>																																	

quadrilateral

• A *polygon* with 4 *sides*.

'Quad' means 4 and 'lateral' means side.



quadrilateral	Sides	Interior angles	Diagonals	Axes of symmetry	Diagram
Square	4 sides of equal length	4 right angles	2 diagonals equal in length and bisecting at right angles	4	
Rectangle	Opposite sides of equal length	4 right angles	2 diagonals equal in length and bisecting each other	2	
Trapezoid	2 opposite sides parallel		2 diagonals	0	
Rhombus	4 sides of equal length and opposite sides parallel	Opposite angles equal	2 diagonals bisecting at right angles	2	
Parallelogram	Opposite sides of equal length and parallel	Opposite angles equal	2 diagonals bisecting each other	0	
Kite	4 sides, two each of equal length	One pair of opposite angles equal	2 diagonals bisecting each other	1	

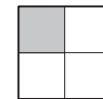
quart (qt)

• A *unit* of *capacity* equal to 2 *pints*.

Also defined as one quarter of a gallon.

quarter

• One of four *equal* parts of a group or object.
• Written as the *fraction* $\frac{1}{4}$.



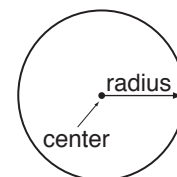
radical ($\sqrt{\quad}$)


• The symbol used to represent square roots.


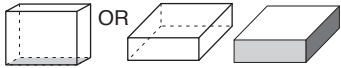
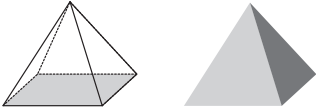
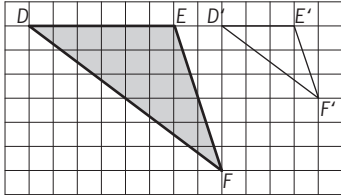
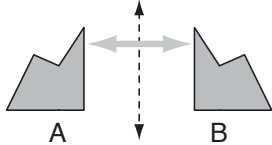
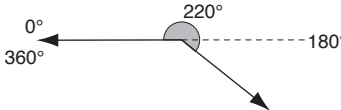
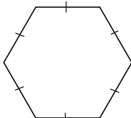
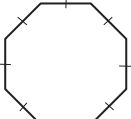
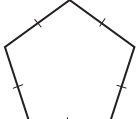
$\sqrt{64} = 8$

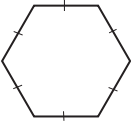
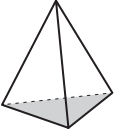





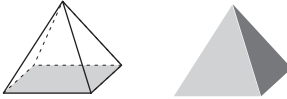
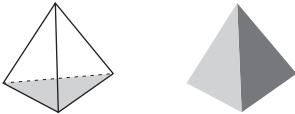
radius of a circle

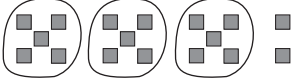

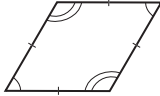
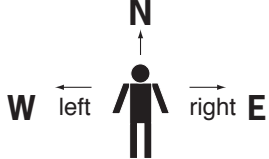

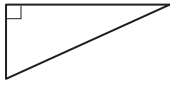
• (pl. **radii**) The distance from the *center* to any *point* on the *circle*.

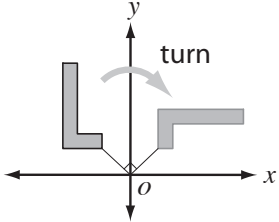

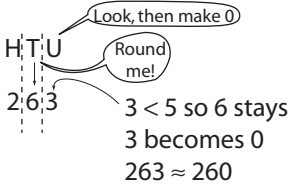
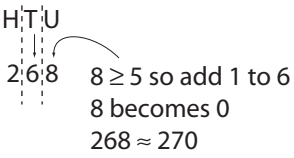


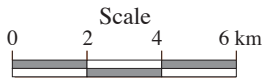



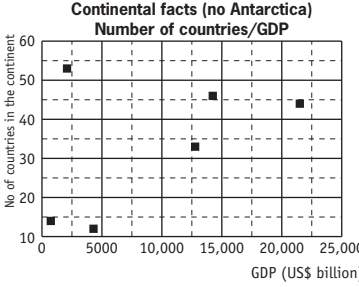
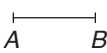
<p>random sample</p>	<ul style="list-style-type: none"> • A selection taken from a group without method or conscious choice. 	<p>Drawing out of a hat is a random selection.</p> 
<p>range</p>	<ul style="list-style-type: none"> • The <i>difference</i> between the greatest and the smallest value. 	<p>For the data: 21, 24, 25, 27, 27 and 28 the range is $28 - 21 = 7$</p>
<p>rate</p>	<ul style="list-style-type: none"> • The <i>ratio</i> of two measures that have different <i>units</i>. 	<p>When running, calories burn at a rate of 14 cal/min.</p>
<p>ratio</p>	<ul style="list-style-type: none"> • The ratio of a number (<i>a</i>) to a non-zero number (<i>b</i>) is the result when <i>a</i> is <i>divided</i> by <i>b</i>. The ratio of <i>a</i> to <i>b</i> can be written as: $\frac{a}{b}$, <i>a</i> : <i>b</i> or '<i>a</i> to <i>b</i>'. A ratio is made by comparing quantities using the same <i>unit</i> e.g. parts, buckets or liters. 	<p>If the ratio of cordial to water is 3 : 1 then that would mean 3 parts cordial to 1 part water! Agh, the order of the ratio matters.</p> <p>Map scales are an example of a ratio. See also <i>ratio scale</i> and <i>scale</i>.</p>
<p>ratio scale</p>	<ul style="list-style-type: none"> • A <i>scale</i> written as a <i>ratio</i>. Compares the dimensions on a <i>map</i> or model (first number) to real life (second number). 	<p>If the scale on a map is 1 : 10,000 1 cm represents 10,000 cm. 1 cm represents 100 m. Every cm on the drawing represents 100 m in real life.</p>
<p>rational number (Q)</p>	<ul style="list-style-type: none"> • A <i>real number</i> that can be written as a non repeating or non terminating decimal but not as a <i>fraction</i>. • Not an <i>irrational number</i>. 	<p>$-2\frac{3}{7}$, 3.010101..., $\frac{4}{10}$, 0.56, $\sqrt{\frac{4}{9}}$</p>
<p>real number (R)</p>	<ul style="list-style-type: none"> • Any number on the <i>number line</i>. • Includes all <i>rational</i> and <i>irrational numbers</i>. <p style="text-align: center;">R REAL NUMBERS</p>	
<p>IRRATIONAL π, ϕ, e, $\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$, 2.6293045632.... $\cos 30^\circ$</p>	<p style="text-align: center;">Q RATIONAL</p> <p>$-2\frac{3}{7}$, 3.010101..., $\frac{4}{10}$, 0.56, $\sqrt{\frac{4}{9}}$</p>	<p style="text-align: center;">Z Integers</p> <p>..., -3, -2, -1, 0, 1, 2, 3, ...</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p style="text-align: center;">N Natural (Whole Numbers)</p> <p>0, 1, 2, 3, 4, 5, 6, ...</p> </div>
<p>reciprocal</p>	<ul style="list-style-type: none"> • One of two numbers whose <i>product</i> is 1. • Also called the multiplicative <i>inverse</i>. 	<p>The reciprocal of $\frac{3}{5}$ is $\frac{5}{3}$.</p> <p>$\frac{3}{5} \times \frac{5}{3} = 1$</p>

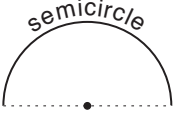
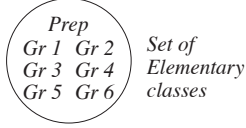

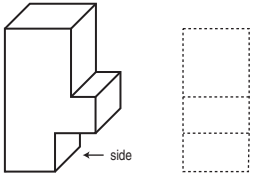

rectangle	<ul style="list-style-type: none"> A special <i>parallelogram</i>. Four <i>right angles</i>. 	
rectangular prism	<ul style="list-style-type: none"> A <i>three-dimensional</i> shape. Six rectangular faces. 	
rectangular pyramid	<ul style="list-style-type: none"> A <i>three-dimensional</i> shape. One <i>rectangular base</i>. All the other <i>faces</i> are <i>triangles</i>. 	
reduction	<ul style="list-style-type: none"> Make smaller or decrease. 	<p>$\triangle DEF$ was reduced to $\triangle D'E'F'$ by a scale factor of 2.</p> 
reflection	<ul style="list-style-type: none"> A movement that <i>flips</i> a figure across a <i>line</i> so that the figure is in the mirror image <i>position</i>. 	<p>Shape B is a reflection of shape A.</p> 
reflex angle	<ul style="list-style-type: none"> An <i>angle</i> measuring greater than 180° and less than 360°. 	
regular hexagon	<ul style="list-style-type: none"> A <i>polygon</i> with six sides of equal length and six equal angles. 	 Regular hexagon
regular octagon	<ul style="list-style-type: none"> A <i>polygon</i> with eight sides of equal length and eight equal angles. 	 Regular octagon
regular pentagon	<ul style="list-style-type: none"> A <i>polygon</i> with five sides of equal length and five equal angles. 	 Regular pentagon








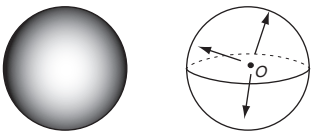
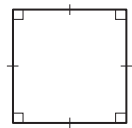
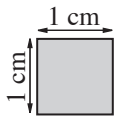
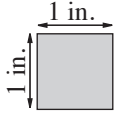
regular polygon	<ul style="list-style-type: none"> A shape with all <i>sides</i> and all <i>angles equal</i>. 	<p>A regular hexagon has 6 equal sides and 6 equal angles.</p>  <p>Regular hexagon</p>				
regular prism	<ul style="list-style-type: none"> A <i>three-dimensional</i> shape with <i>bases</i> that are <i>regular polygons</i> and all the other faces that are rectangles. 	<p>A regular hexagonal prism has regular hexagons as its bases.</p>				
regular pyramid	<ul style="list-style-type: none"> A <i>three-dimensional</i> shape with only one <i>base</i> which is a <i>regular polygon</i> and all the other <i>faces</i> that are <i>isosceles triangles</i>. The base gives the pyramid its name, e.g. regular ‘triangular’ pyramid. 	<p>This regular triangular pyramid has an equilateral triangle as its base.</p> 				
regular solid	<ul style="list-style-type: none"> A <i>three-dimensional</i> shape that encloses a part of space, with all faces being <i>regular polygons</i>. 					
regular solid	<p>Properties All faces are regular polygons</p>	<p><i>In any polyhedron: $E = F + V - 2$</i></p> <p>Number of</p> <table border="1"> <thead> <tr> <th>Faces</th> <th>Edges</th> <th>Vertices</th> </tr> </thead> </table>	Faces	Edges	Vertices	Examples
Faces	Edges	Vertices				
Tetrahedron	All faces are equilateral triangles	<table border="1"> <tbody> <tr> <td>4</td> <td>6</td> <td>4</td> </tr> </tbody> </table>	4	6	4	
4	6	4				
Hexahedron	All faces are squares	<table border="1"> <tbody> <tr> <td>6</td> <td>12</td> <td>8</td> </tr> </tbody> </table>	6	12	8	
6	12	8				
Octahedron	All faces are equilateral triangles	<table border="1"> <tbody> <tr> <td>8</td> <td>12</td> <td>6</td> </tr> </tbody> </table>	8	12	6	
8	12	6				
Dodecahedron	All faces are regular pentagons	<table border="1"> <tbody> <tr> <td>12</td> <td>30</td> <td>20</td> </tr> </tbody> </table>	12	30	20	
12	30	20				
Icosahedron	All faces are equilateral triangles	<table border="1"> <tbody> <tr> <td>20</td> <td>38</td> <td>20</td> </tr> </tbody> </table>	20	38	20	
20	38	20				
regular square pyramid	<ul style="list-style-type: none"> A <i>pyramid</i> whose <i>base</i> is a <i>square</i> and whose <i>height</i> intersects the base at its center. All 4 <i>slant heights</i> and 4 vertical edges are congruent. 					
regular tetrahedron	<ul style="list-style-type: none"> A <i>triangular pyramid</i> whose four <i>faces</i> are equal <i>equilateral triangles</i>. 					

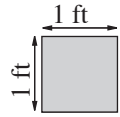
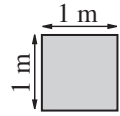
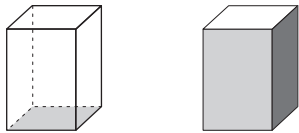
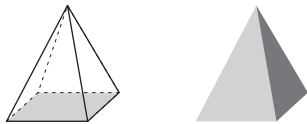
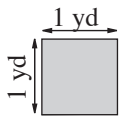
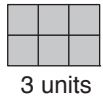
remainder	<ul style="list-style-type: none"> The amount left over when one number cannot be <i>divided</i> exactly by another. 	$17 \div 5 = 3$ with 2 remainder. 
repeating decimal	<ul style="list-style-type: none"> A <i>decimal</i> that has a repeating <i>digit</i> or a repeating pattern of digits. A repeating digit is marked with a bar (—). A repeating pattern of two decimals with a bar (—). 	$\frac{2}{9} = 0.22222222 = 0.\overline{2}$ $\frac{1}{6} = 0.16666666 = 0.1\overline{6}$ are repeating decimals, where 2 and 6 are the repeating digits respectively. $\frac{1}{11} = 0.09090909 = 0.\overline{09}$ is a repeating decimal, where 09 is the repeating pattern of digits.
reversible	<ul style="list-style-type: none"> Able to be turned in the <i>opposite</i> way. 	The process of freezing the water is reversible: water \rightarrow ice \rightarrow water
revolution	<ul style="list-style-type: none"> A complete turn. An <i>angle</i> measuring 360°. 	
rhombus	<ul style="list-style-type: none"> (pl. rhombi) A special <i>parallelogram</i>. Four <i>equal sides</i>. <i>Opposite angles equal</i>. 	
right	<ul style="list-style-type: none"> The <i>direction</i> to the <i>east</i> of your body if you are facing <i>north</i>. 	
right angle	<ul style="list-style-type: none"> An <i>angle</i> measuring exactly 90°. It is marked with a corner. 	
right triangle	<ul style="list-style-type: none"> A <i>triangle</i> with one <i>right angle</i>. 	
Roman numerals	<ul style="list-style-type: none"> Number system invented by the ancient Romans. 	I = 1 V = 5 X = 10 L = 50 C = 100 D = 500 M = 1000


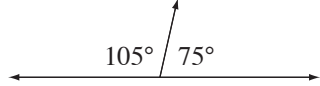
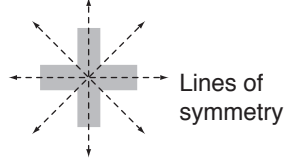
<p>rotation</p>	<ul style="list-style-type: none"> • A movement that turns a shape about a fixed <i>point</i> (the center of rotation) by a given <i>angle</i> (the angle of rotation). 	<p>The center of rotation is the origin O and the angle of rotation is 90°.</p> 																												
<p>rotational symmetry</p>	<ul style="list-style-type: none"> • A shape has rotational symmetry if a <i>rotation</i> of 180° or less produces an image that fits exactly on the original shape. 	<p>This shape has rotational symmetry, because after a rotation of 120° it looks identical to the original.</p> 																												
<p>round</p>	<ul style="list-style-type: none"> • To <i>approximate</i> a number to a given <i>place value</i>. <p>Look at the next <i>digit</i> after the given place value you are rounding to.</p> <p>If this digit is less than 5, keep the digit in the given place value the same.</p> <p>If this digit is greater than or equal to 5, add 1 to the digit in the given place value. Then make the <i>digit</i> you were looking at, zero.</p>	<p>Round 263 to the nearest 10:</p>  <p>Round 268 to the nearest 10:</p> 																												
<p>row of a table</p>	<ul style="list-style-type: none"> • A <i>horizontal</i> line of <i>data</i> in a table. 	<p>Medal Tally - Beijing Olympics 2008</p> <table border="1"> <thead> <tr> <th>COUNTRY</th> <th>Gold</th> <th>Silver</th> <th>Bronze</th> </tr> </thead> <tbody> <tr> <td>China</td> <td>51</td> <td>21</td> <td>28</td> </tr> <tr> <td>United States</td> <td>36</td> <td>38</td> <td>36</td> </tr> <tr> <td>Russia</td> <td>23</td> <td>21</td> <td>28</td> </tr> <tr> <td>Great Britain</td> <td>19</td> <td>13</td> <td>15</td> </tr> <tr> <td>Germany</td> <td>16</td> <td>10</td> <td>15</td> </tr> <tr> <td>Australia</td> <td>14</td> <td>15</td> <td>17</td> </tr> </tbody> </table>	COUNTRY	Gold	Silver	Bronze	China	51	21	28	United States	36	38	36	Russia	23	21	28	Great Britain	19	13	15	Germany	16	10	15	Australia	14	15	17
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<p>sample</p>	<ul style="list-style-type: none"> • A selection taken from a group or <i>population</i>. 	<p>See <i>random sample</i>.</p>																												
<p>sample space</p>	<ul style="list-style-type: none"> • The <i>set</i> of all possible <i>outcomes</i> of an <i>experiment</i>. 	<p>A coin is flipped - Sample space = {HH, HT, TH, TT}</p> <table border="1"> <tr> <td colspan="2" rowspan="2">Possible outcomes (sample space)</td> <td colspan="2">Coin 1</td> </tr> <tr> <td>H</td> <td>T</td> </tr> <tr> <td rowspan="2">Coin 2</td> <td>H</td> <td>H,H</td> <td>H,T</td> </tr> <tr> <td>T</td> <td>T,H</td> <td>T,T</td> </tr> </table>	Possible outcomes (sample space)		Coin 1		H	T	Coin 2	H	H,H	H,T	T	T,H	T,T															
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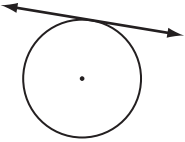

<p>scale</p>	<ul style="list-style-type: none"> • A key on a <i>scale drawing</i>/map that tells how the drawing's <i>dimensions</i> and life size dimensions are related. <p>Can be written as:</p> <p>1) A <i>ratio scale</i> with the first number referring to the map distance and the second number referring to the real distance.</p> <p>OR</p> <p>2) A <i>linear scale</i> with a set of marks on a line.</p>	<p>On a map with a ratio scale of 1 : 10,000 1 cm represents 10,000 cm or 100 m. Every centimeter on the drawing represents 100 m in real life.</p>  <p>On a map with this linear scale, every highlighted segment represents 2 km in real life.</p>
<p>scale drawing</p>	<ul style="list-style-type: none"> • Changing the size of an object but not the shape. 	<p>A life size staple. </p> <p>The staple scaled by 50%. </p>
<p>scale factor</p>	<ul style="list-style-type: none"> • The amount used to <i>enlarge</i>, <i>reduce</i> or find the original size of an object. 	<p>To make an object 2 times bigger or 200% of the original size, enlarge the object by a scale factor 2 : 1 To do this multiply each dimension by the fraction $\frac{2}{1}$.</p> <p>To make an object 2 times smaller or 50% of the original size, reduce the object by a scale factor 1 : 2 To do this multiply each dimension by the fraction $\frac{1}{2}$.</p>
<p>scalene triangle</p>	<ul style="list-style-type: none"> • A <i>triangle</i> in which all three sides are a different length. 	
<p>scatter plot</p>	<ul style="list-style-type: none"> • A <i>graph</i> in which two sets of data are plotted as ordered pairs in a <i>coordinate plane</i>. 	<p>Continental facts (no Antarctica) Number of countries/GDP</p> 
<p>second (s)</p>	<ul style="list-style-type: none"> • A very short unit of <i>time</i>. 	<p>There are 60 seconds in 1 minute.</p>
<p>second</p>	<ul style="list-style-type: none"> • The <i>position</i> after <i>first</i>. 	<p>1st, 2nd.....</p>
<p>segment</p>	<ul style="list-style-type: none"> • Two <i>points</i> and all points on the <i>line</i> between the two points. Part of a line. 	<p>Segment \overline{AB} </p>

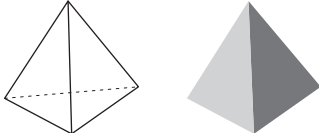

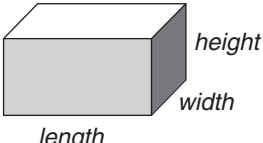
semicircle	<ul style="list-style-type: none"> • Half of a circle. 	
sequence of numbers	<ul style="list-style-type: none"> • A list of numbers that follows a certain <i>rule</i>. Each number is called a <i>term</i>. 	<p>35, 30, 25, 20, ...</p> <p>In this sequence of numbers, the next three are 15, 10 and 5.</p>
set { }	<ul style="list-style-type: none"> • A collection of items. Members of a set are called <i>elements</i>. 	<p>There are 7 elements in the set.</p> 
seventh	<ul style="list-style-type: none"> • The <i>position</i> after <i>sixth</i>. 	<p>1st, 2nd, 3rd, 4th, 5th, 6th, 7th.....</p>
shortest	<ul style="list-style-type: none"> • Having the smallest <i>length</i>. 	<p>Sam is the shortest in the class.</p>
side	<ul style="list-style-type: none"> • One of the lines that form a <i>polygon</i>. 	
side view	<ul style="list-style-type: none"> • What you see of an object looking from a <i>side perspective</i>. • <i>Three-dimensional</i> objects have 3 views: front, top and side. 	
sign	<ul style="list-style-type: none"> • The <i>positive</i> or <i>negative</i> indicator attached to any <i>real number</i> that is <i>greater than</i> or <i>less than</i> zero respectively. 	<p>+ positive sign</p> <p>- negative sign</p>
similar shapes	<ul style="list-style-type: none"> • Shapes that are identical but not necessarily in size. 	<p>These stars are similar.</p> 
simplest form of a fraction	<ul style="list-style-type: none"> • A <i>fraction</i> is in simplest form when the only number that divides into both the <i>numerator</i> and the <i>denominator</i> is 1. 	<p>The simplest form of $\frac{6}{9}$ is $\frac{2}{3}$</p> <p>(Divide 6 and 9 by 3. 2 and 3 can only be divided by 1 so they can not be reduced.)</p>
simplify	<ul style="list-style-type: none"> • To reduce to the <i>simplest form</i>. 	<p>To simplify the ratio 14 : 6 divide both sides by 2.</p> <p>14 : 6 simplified is 7 : 3.</p>
sixth	<ul style="list-style-type: none"> • The <i>position</i> after <i>fifth</i>. 	<p>1st, 2nd, 3rd, 4th, 5th, 6th.....</p>

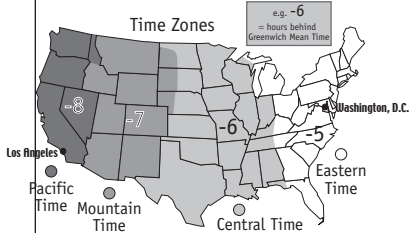
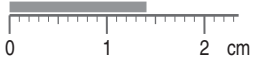
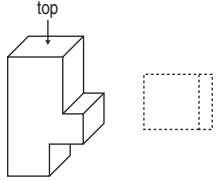
size	<ul style="list-style-type: none"> • How big an object is. 	<p>The size of the wave is 2 m.</p> 
slide	<ul style="list-style-type: none"> • Move without changing <i>direction</i>. • See <i>translation</i>. 	
smallest to largest	<ul style="list-style-type: none"> • Ranking in order from the littlest to the biggest. 	
solid	<ul style="list-style-type: none"> • A <i>three-dimensional</i> shape that encloses a part of space. 	
south	<ul style="list-style-type: none"> • A <i>compass direction</i>. 	
south-east	<ul style="list-style-type: none"> • A <i>compass direction</i>. 	
south-west	<ul style="list-style-type: none"> • A <i>compass direction</i>. 	
speed	<ul style="list-style-type: none"> • The <i>rate</i> at which an object moves. <p>Speed is worked out by dividing the distance traveled by the time taken.</p> <p>We call this average speed $r = \frac{d}{t}$</p>	<p>The average speed for a car which travels 150 miles in 3 hours is:</p> $r = \frac{\text{distance}}{\text{time}} = \frac{150}{3} = 50 \text{ mph}$
sphere	<ul style="list-style-type: none"> • A <i>set of points</i> in space of equal distance from the central point. 	
square	<ul style="list-style-type: none"> • A <i>rectangle</i> with all <i>sides</i> of equal length. 	
square centimeter (cm²)	<ul style="list-style-type: none"> • A <i>unit of area</i> equal to 1 <i>centimeter</i> by 1 <i>centimeter</i>. 	
square inch (in.²)	<ul style="list-style-type: none"> • A <i>unit of area</i> equal to 1 <i>inch</i> by 1 <i>inch</i>. 	

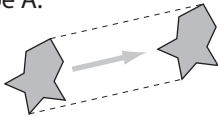
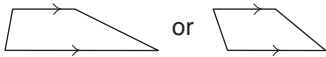
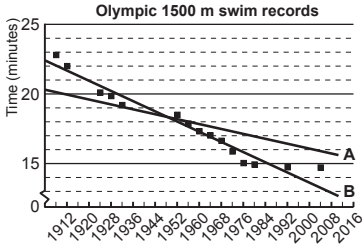


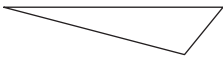
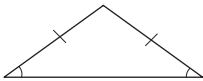

square foot (ft²)	<ul style="list-style-type: none"> A <i>unit of area equal to 1 foot by 1 foot.</i> 	
square meter (m²)	<ul style="list-style-type: none"> A <i>unit of area equal to 1 meter by 1 meter.</i> 	
square number	<ul style="list-style-type: none"> A number that results from multiplying another number by itself. 	<p>9, 6.25 and $\frac{4}{9}$ are all square numbers.</p> <p>$9 = 3 \times 3$ $6.25 = 2.5 \times 2.5$ $\frac{4}{9} = \frac{2}{3} \times \frac{2}{3}$</p>
square prism	<ul style="list-style-type: none"> A <i>three-dimensional shape.</i> Two identical square <i>bases.</i> All the other faces are <i>rectangles.</i> 	
square pyramid	<ul style="list-style-type: none"> A <i>three-dimensional shape.</i> One square <i>base.</i> All the other faces are <i>triangles.</i> 	
square root of a number ($\sqrt{\quad}$)	<ul style="list-style-type: none"> A <i>number which, when multiplied by itself, gives the original number.</i> Finding the square root of a number is the <i>inverse operation</i> of squaring that number. 	<p>$\sqrt{900} = 30$ Square root of 900 is 30, because $30 \times 30 = 900$ or $30^2 = 900$</p>
square yard (yd²)	<ul style="list-style-type: none"> A <i>unit of area equal to 1 yard by 1 yard.</i> 	
square units	<ul style="list-style-type: none"> A <i>unit of area equal to the area of a square with side lengths of 1 unit.</i> 	<p>$A = lw$ $= 3 \times 2$ $= 6$</p> <p>Area = 6 square units</p> 
squared	<ul style="list-style-type: none"> Multiplied by itself. A number raised to the second <i>power.</i> 	<p>4 squared is written as 4^2 $4^2 = 4 \times 4 = 16$</p>
statistics	<ul style="list-style-type: none"> Numerical facts systematically collected, organized and analyzed. 	<p>Data is collected from a sample of the population, organized into a graph and interpreted to summarize some characteristic.</p>

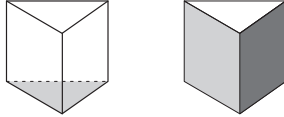
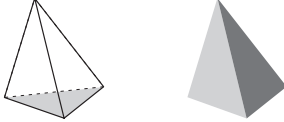

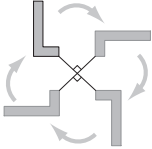
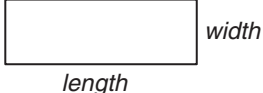

<p>stem-and-leaf plot</p>	<ul style="list-style-type: none"> • A diagram displaying <i>data</i> by <i>place value</i>. The data is in order from lowest to highest. 													
<p>Data set of 13 elements: { 13, 18, 18, 19, 20, 21, 21, 22, 22, 22, 29, 30, 31 }</p> <p style="text-align: center;">mode = 22 median (7th element) = 21 range</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>stem</th> <th>leaves</th> <th>lowest value = 13</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>3 8 8 9</td> <td>median = 21</td> </tr> <tr> <td>2</td> <td>0 1 1 2 2 2 9</td> <td>mode = 22</td> </tr> <tr> <td>3</td> <td>0 1</td> <td>highest value = 31</td> </tr> </tbody> </table> <div style="margin-left: auto; margin-right: auto;"> <p>range = high - low</p> <p>= 31 - 13</p> <p>= 18</p> <p>mean = 286 ÷ 13</p> <p>= 22</p> </div>			stem	leaves	lowest value = 13	1	3 8 8 9	median = 21	2	0 1 1 2 2 2 9	mode = 22	3	0 1	highest value = 31
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<p>straight angle</p>	<ul style="list-style-type: none"> • An <i>angle</i> measuring 180°. 													
<p>substitute</p>	<ul style="list-style-type: none"> • To replace a number or function with another. Often used in <i>algebra</i> when a <i>variable</i> (letter) is replaced by a number. 	<p>If $x = 4$, the value of $x + x$ is found by replacing the letter x with 4: $4 + 4 = 8$</p>												
<p>subtract</p>	<ul style="list-style-type: none"> • To take away or <i>minus</i>. 	<p>If you subtract 10 from 15 you are left with 5: $15 - 10 = 5$</p>												
<p>sum</p>	<ul style="list-style-type: none"> • The result when two or more numbers are added. 	<p>The sum of 20 and 6 is 26: $20 + 6 = 6 + 20 = 26$</p>												
<p>supplement of an angle</p>	<ul style="list-style-type: none"> • An <i>angle</i> that, when added to an <i>adjacent</i> angle, makes a <i>straight angle</i> (or 180° in total). 	<p>75° is the supplement of 105°, because $75^\circ + 105^\circ = 180^\circ$</p> 												
<p>survey</p>	<ul style="list-style-type: none"> • A method of collecting a <i>sample</i> of <i>data</i> by getting people's responses. 	<p>TV ratings are determined by surveying viewers.</p>												
<p>symmetry</p>	<ul style="list-style-type: none"> • A shape has a <i>line of symmetry</i> when a line can be drawn through the shape so that one side of the shape is the mirror image of the other. 	<p>There are 3 kinds of symmetry: horizontal symmetry vertical symmetry rotational symmetry</p> 												

<p>table</p>	<ul style="list-style-type: none"> • <i>Data organized in columns and rows.</i> 	<p>Medal Tally - Beijing Olympics 2008</p> <table border="1"> <thead> <tr> <th>COUNTRY</th> <th>Gold</th> <th>Silver</th> <th>Bronze</th> </tr> </thead> <tbody> <tr> <td>China</td> <td>51</td> <td>21</td> <td>28</td> </tr> <tr> <td>United States</td> <td>36</td> <td>38</td> <td>36</td> </tr> <tr> <td>Russia</td> <td>23</td> <td>21</td> <td>28</td> </tr> <tr> <td>Great Britain</td> <td>19</td> <td>13</td> <td>15</td> </tr> <tr> <td>Germany</td> <td>16</td> <td>10</td> <td>15</td> </tr> <tr> <td>Australia</td> <td>14</td> <td>15</td> <td>17</td> </tr> </tbody> </table>	COUNTRY	Gold	Silver	Bronze	China	51	21	28	United States	36	38	36	Russia	23	21	28	Great Britain	19	13	15	Germany	16	10	15	Australia	14	15	17
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<p>table of values</p>	<ul style="list-style-type: none"> • A list of numbers that are used to <i>substitute</i> one <i>variable</i> (x) in a <i>function</i>, to find the <i>value</i> of the other variable (y). 	<p>$y = x + 4$</p> <table border="1"> <thead> <tr> <th>x</th> <th>$y = x + 4$</th> <th>y</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>$1 + 4 = 5$</td> <td>5</td> </tr> <tr> <td>2</td> <td>$2 + 4 = 6$</td> <td>6</td> </tr> <tr> <td>3</td> <td>$3 + 4 = 7$</td> <td>7</td> </tr> <tr> <td>4</td> <td>$4 + 4 = 8$</td> <td>8</td> </tr> <tr> <td>5</td> <td>$5 + 4 = 9$</td> <td>9</td> </tr> <tr> <td>6</td> <td>$6 + 4 = 10$</td> <td>10</td> </tr> </tbody> </table>	x	$y = x + 4$	y	1	$1 + 4 = 5$	5	2	$2 + 4 = 6$	6	3	$3 + 4 = 7$	7	4	$4 + 4 = 8$	8	5	$5 + 4 = 9$	9	6	$6 + 4 = 10$	10							
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5	$5 + 4 = 9$	9																												
6	$6 + 4 = 10$	10																												
<p>tangent to a circle</p>	<ul style="list-style-type: none"> • A <i>line</i> that touches the <i>circle</i> at a <i>point</i> without crossing over. 																													
<p>tax</p>	<ul style="list-style-type: none"> • A financial charge imposed by the state often calculated as a <i>percent</i>. 	<p>If a sales tax of 6% is applied on a purchase of \$100, the total amount that must be paid is \$106.</p>																												
<p>temperature</p>	<ul style="list-style-type: none"> • How hot or cold a thing is. • Temperature is measured in <i>degrees Fahrenheit</i> ($^{\circ}\text{F}$) or <i>degrees Celsius</i> ($^{\circ}\text{C}$) with a <i>thermometer</i>. 	<p>212 $^{\circ}\text{F}$ is the temperature at which water boils.</p>																												
<p>tens</p>	<ul style="list-style-type: none"> • The <i>place value</i> between the <i>units</i> and <i>hundreds</i>. 	<p>1825.763 has 2 tens.</p> <table border="1"> <thead> <tr> <th>thousands</th> <th>hundreds</th> <th>tens</th> <th>units</th> <th>tenths</th> <th>hundredths</th> <th>thousandths</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>8</td> <td>2</td> <td>5</td> <td>7</td> <td>6</td> <td>3</td> </tr> </tbody> </table>	thousands	hundreds	tens	units	tenths	hundredths	thousandths	1	8	2	5	7	6	3														
thousands	hundreds	tens	units	tenths	hundredths	thousandths																								
1	8	2	5	7	6	3																								
<p>tenth</p>	<ul style="list-style-type: none"> • One part out of 10 parts of one whole. 																													
<p>tenths</p>	<ul style="list-style-type: none"> • The <i>place value</i> after the decimal point between the <i>units</i> and <i>hundredths</i>. 	<p>1825.763 has 7 tenths.</p> <table border="1"> <thead> <tr> <th>thousands</th> <th>hundreds</th> <th>tens</th> <th>units</th> <th>tenths</th> <th>hundredths</th> <th>thousandths</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>8</td> <td>2</td> <td>5</td> <td>7</td> <td>6</td> <td>3</td> </tr> </tbody> </table>	thousands	hundreds	tens	units	tenths	hundredths	thousandths	1	8	2	5	7	6	3														
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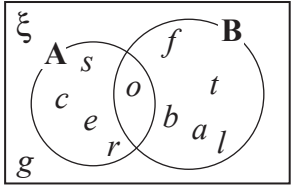
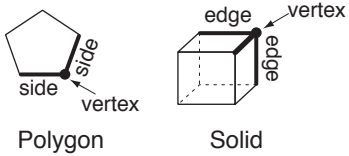
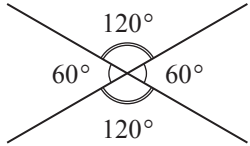
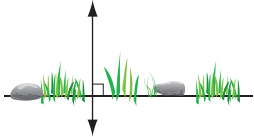
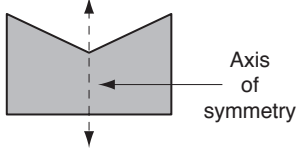
<p>term</p>	<ul style="list-style-type: none"> Any part of an expression separated by “+” or “-” signs. A term can be a: <ol style="list-style-type: none"> constant (number) single letter or variable product of a number and a variable product of a number and two or more variables <div style="display: flex; justify-content: space-around; margin-top: 10px;"> <div style="border: 1px solid black; padding: 5px; width: 45%;"> $a + a + a + a + a = \text{Five lots of } a$ $= 5 \cdot a$ $= 5a$ <p>We simplify the writing by removing the "." sign. We read this as "five a".</p> </div> <div style="border: 1px solid black; padding: 5px; width: 45%;"> $a = \text{One lot of } a$ $= 1 \cdot a$ $= 1a$ $= a$ <p>We simplify the writing by removing the "1" and the "." sign. We read this as "a".</p> </div> </div>	<p>a) $7, \frac{1}{3}$ or -18</p> <p>b) a, b or $-c$</p> <p>c) $7a, \frac{1}{b}, -18g$ or $3x^2$</p> <p>d) $7ab, 5mn^3$ or $-3jk^2$</p> <p>A term that has both numerals and variables is always written with the number before the variable.</p> <p>If there is more than one variable in the term then they are usually written in alphabetical order.</p>														
<p>terminating decimal</p>	<ul style="list-style-type: none"> A decimal whose digits end. Every terminating decimal can be written as a fraction with a denominator of 10, 100 or 1000 etc. 	$0.765 = \frac{765}{1000}$														
<p>tetrahedron</p>	<ul style="list-style-type: none"> A triangular pyramid. <p>See also regular tetrahedron.</p>															
<p>thermometer</p>	<ul style="list-style-type: none"> An instrument used to measure temperature. 															
<p>third</p>	<ul style="list-style-type: none"> The position after second. 	<p>1st, 2nd, 3rd.....</p>														
<p>thousands</p>	<ul style="list-style-type: none"> The place value between hundreds and tens of thousands. 	<p>1825.763 has 1 thousand.</p> <table border="1" style="width: 100%; text-align: center; border-collapse: collapse;"> <thead> <tr> <th>thousands</th> <th>hundreds</th> <th>tens</th> <th>units</th> <th>tenths</th> <th>hundredths</th> <th>thousandths</th> </tr> </thead> <tbody> <tr> <td style="background-color: #cccccc;">1</td> <td style="background-color: #cccccc;">8</td> <td style="background-color: #cccccc;">2</td> <td style="background-color: #cccccc;">5</td> <td>• 7</td> <td>6</td> <td style="background-color: #cccccc;">3</td> </tr> </tbody> </table>	thousands	hundreds	tens	units	tenths	hundredths	thousandths	1	8	2	5	• 7	6	3
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1	8	2	5	• 7	6	3										
<p>thousandth</p>	<ul style="list-style-type: none"> One part out of 1000 parts of one whole. 	<p>One gram is a thousandth of a kilogram.</p>														
<p>thousandths</p>	<ul style="list-style-type: none"> The place value after hundredths. 	<p>1825.763 has 3 thousandths.</p> <table border="1" style="width: 100%; text-align: center; border-collapse: collapse;"> <thead> <tr> <th>thousands</th> <th>hundreds</th> <th>tens</th> <th>units</th> <th>tenths</th> <th>hundredths</th> <th>thousandths</th> </tr> </thead> <tbody> <tr> <td style="background-color: #cccccc;">1</td> <td style="background-color: #cccccc;">8</td> <td style="background-color: #cccccc;">2</td> <td style="background-color: #cccccc;">5</td> <td>• 7</td> <td>6</td> <td style="background-color: #cccccc;">3</td> </tr> </tbody> </table>	thousands	hundreds	tens	units	tenths	hundredths	thousandths	1	8	2	5	• 7	6	3
thousands	hundreds	tens	units	tenths	hundredths	thousandths										
1	8	2	5	• 7	6	3										
<p>three-dimensional (3D)</p>	<ul style="list-style-type: none"> Able to be measured in three directions namely length, width and height. 															

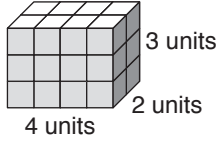

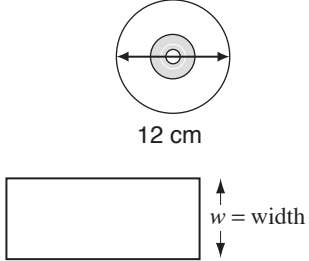
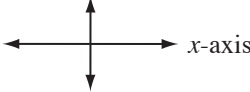
<p>time</p>	<ul style="list-style-type: none"> The continuum from past to present to future. 	<p>The time is 9:25 A.M.</p>
<p>time zone</p>	<ul style="list-style-type: none"> Regions of different <i>times</i> around the world. Based on Greenwich Mean Time (GMT), each 15° of longitude away from Greenwich, England represents 1 hour of time. 	<p>Washington, D.C. time is 3 hours ahead of Los Angeles time.</p> 
<p>tip</p>	<ul style="list-style-type: none"> Optional payment given in addition to a required payment, usually to express appreciation for excellent service. 	<p>The tip added an extra 5% to the cost of the meal.</p>
<p>tolerance</p>	<ul style="list-style-type: none"> The greatest <i>range</i> of variation that can be allowed. The amount of acceptable <i>error</i>. 	<p>See <i>tolerance interval</i>.</p>
<p>tolerance interval</p>	<ul style="list-style-type: none"> To calculate the tolerance interval, add and subtract one <i>half</i> of the <i>precision</i> of the measuring instrument. 	<p>The ruler has a precision of 0.1 cm. The tolerance interval in this measurement is: 1.4 ± 0.05 cm or from 1.35 to 1.45 cm</p> 
<p>ton (T)</p>	<ul style="list-style-type: none"> A <i>unit of measurement for mass equal to 2000 pounds</i>. 	<p>The elephant can weigh 5 tons.</p>
<p>tonne (t)</p>	<ul style="list-style-type: none"> A <i>unit of measurement for mass equal to 1000 kilograms</i>. 	<p>The humpback whale can weigh 58 tonnes.</p>
<p>top view</p>	<ul style="list-style-type: none"> What you see of an object looking from a <i>top perspective</i>. <i>Three-dimensional</i> objects have 3 views: front, top and side. 	
<p>total</p>	<ul style="list-style-type: none"> The whole lot. The <i>sum</i> of two or more quantities. 	<p>The total of 2 and 7 and 3 is 12: $2 + 7 + 3 = 12$</p>
<p>transformation</p>	<ul style="list-style-type: none"> A movement of a shape in a <i>coordinate plane</i>. Types of transformations are <i>translations</i>, <i>reflections</i> and <i>rotations</i>. 	<p>See <i>translation</i>, <i>reflection</i> and <i>rotation</i></p>

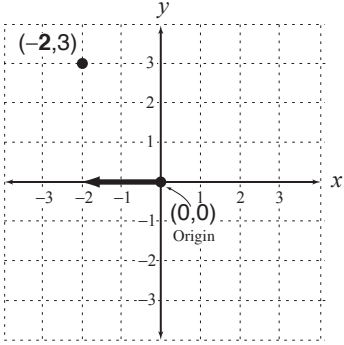
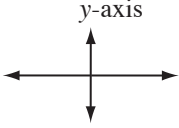
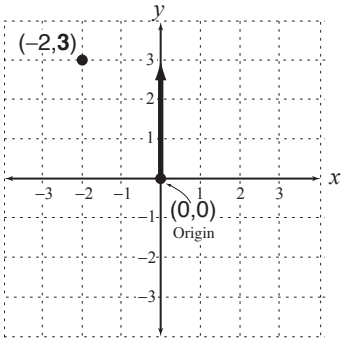
<p>translation</p>	<ul style="list-style-type: none"> • A movement that <i>slides</i> a shape. Each <i>point</i> of the shape is moved the same distance, in the same direction, to produce a shape that is <i>congruent</i> to the original one. 		<p>Shape B is a translation of shape A.</p> 
<p>trapezoid</p>	<ul style="list-style-type: none"> • A <i>quadrilateral</i>. Two <i>opposite sides</i> are <i>parallel</i>. 		
<p>tree diagram</p>	<ul style="list-style-type: none"> • A tree diagram displays all the possible <i>outcomes</i> of an <i>event</i>. 		<p>Event: Tossing 2 coins</p> <pre> / \ / \ / \ / \ / \ / \ 1st coin H T / \ / \ / \ / \ / \ / \ / \ / \ / \ / \ / \ / \ / \ / \ 2nd coin H T </pre> <p>When tossing 2 coins there are 4 possible outcomes (branches): HH, HT, TH, TT - sample space</p>
<p>trend line</p>	<ul style="list-style-type: none"> • A straight or curved <i>line</i> which is closest to all the <i>data points</i> in a <i>scatter plot</i> and gives the best approximation to the trend of the <i>set</i> of data. • A line which goes through the ‘middle’ of the data points so that the <i>sums</i> of the distances from the points above and below the line, to the line, are <i>approximately equal</i>. 		<p>Line B is a trend line, being closest to all the data points.</p> 
<p>tri</p>	<ul style="list-style-type: none"> • Prefix meaning three. 		<p>A tricycle has 3 wheels.</p> 
<p>trial and error</p>	<ul style="list-style-type: none"> • To try repeatedly and learn from mistakes. 		<p>This sum can be solved using trial and error.</p> $\begin{array}{r} \text{TWO} \\ + \text{TWO} \\ \hline \text{FOUR} \end{array}$
<p>triangle</p>	<ul style="list-style-type: none"> • A <i>polygon</i> with 3 straight <i>sides</i>. 		
<p>triangle</p>	<p><i>Interior angles</i></p>	<p><i>Sides</i></p>	<p><i>Diagram</i></p>
<p><i>Right triangle</i></p>	<p>1 right angle</p>		
<p><i>Scalene triangle</i></p>	<p>0 equal angles</p>	<p>0 sides of equal length</p>	
<p><i>Isosceles triangle</i></p>	<p>2 equal angles</p>	<p>2 sides of equal length</p>	
<p><i>Equilateral triangle</i></p>	<p>3 equal angles</p>	<p>3 sides of equal length</p>	

<p>triangular prism</p>	<ul style="list-style-type: none"> • A <i>three-dimensional</i> shape. Two identical triangular <i>bases</i>. Three rectangular faces. 																						
<p>triangular pyramid</p>	<ul style="list-style-type: none"> • A <i>three-dimensional</i> shape. One triangular <i>base</i>. The other three faces are <i>triangles</i>. 																						
<p>triple</p>	<ul style="list-style-type: none"> • Multiply by three. 	<p>Children $\times 3 =$ triplets!</p> 																					
<p>turn</p>	<ul style="list-style-type: none"> • To <i>rotate</i> about a point. 																						
<p>twenty-four hour time</p>	<ul style="list-style-type: none"> • Time told in 24 hour lots using 4 <i>digits</i>. 	<p>Nine thirty A.M. is 0930 or 09:30 Two thirty P.M. is 1430 or 14:30</p>																					
<p>twice</p>	<ul style="list-style-type: none"> • Two times. 	<p>Sam has \$5 and Jo has \$10. Jo has twice as much as Sam.</p>																					
<p>two-dimensional (2D)</p>	<ul style="list-style-type: none"> • Able to be measured in 2 <i>directions</i> (<i>length</i> and <i>width</i>). 																						
<p>two-way table</p>	<ul style="list-style-type: none"> • A table that shows the combinations of possible outcomes and their values. 	<p>Possible outcomes when spinning a spinner labeled 1, 2, 3, 4 and flipping a coin</p>  <table border="1"> <tr> <td colspan="2" rowspan="2"></td> <td colspan="4">Spinner</td> </tr> <tr> <td>1</td> <td>2</td> <td>3</td> <td>4</td> </tr> <tr> <td rowspan="2">Coin</td> <td>H</td> <td>H,1</td> <td>H,2</td> <td>H,3</td> <td>H,4</td> </tr> <tr> <td>T</td> <td>T,1</td> <td>T,2</td> <td>T,3</td> <td>T,4</td> </tr> </table>			Spinner				1	2	3	4	Coin	H	H,1	H,2	H,3	H,4	T	T,1	T,2	T,3	T,4
		Spinner																					
		1	2	3	4																		
Coin	H	H,1	H,2	H,3	H,4																		
	T	T,1	T,2	T,3	T,4																		
<p>unit</p>	<ul style="list-style-type: none"> • One. 	<p>The unit of measurement for length is meter (m).</p>																					
<p>units</p>	<ul style="list-style-type: none"> • The <i>place value</i> before the decimal point between the <i>tens</i> and <i>tenths</i>. 	<p>1825.763 has 5 units.</p> <table border="1"> <tr> <td>thousands</td> <td>hundreds</td> <td>tens</td> <td>units</td> <td>tenths</td> <td>hundredths</td> <td>thousandths</td> </tr> <tr> <td>1</td> <td>8</td> <td>2</td> <td>5</td> <td>7</td> <td>6</td> <td>3</td> </tr> </table>	thousands	hundreds	tens	units	tenths	hundredths	thousandths	1	8	2	5	7	6	3							
thousands	hundreds	tens	units	tenths	hundredths	thousandths																	
1	8	2	5	7	6	3																	

units of measurement	• Standard amount or quantity.		See <i>cubic unit</i> and <i>square unit</i> .
metric units	<i>Abbreviation</i>	<i>Examples</i>	<i>Used for measuring.....</i>
• millimeter	mm	thickness of a plank of wood	LENGTH distance - length, width, height, diameter, perimeter
• centimeter	cm	width of a photo frame	
• meter	m	length of a lap of a stadium	
• kilometer	km	distance between two cities	
• gram	g	weight of an egg	MASS weight - people, animals, objects
• kilogram	kg	weight of a bag of apples	
• tonne	t	weight of an elephant	
• milliliter	mL	liquid in a can	CAPACITY (Liquid Volume) quantity - liquids
• liter	L	liquid in a bucket	
• square centimeter	cm ²	area of a Math book cover	AREA surface - objects, territories (countries, continents, oceans)
• square meter	m ²	area of the gym floor	
• square kilometer	km ²	area of Texas	
• cubic centimeter	cm ³	volume of water in a fish tank	VOLUME quantity - air, water
• cubic meter	m ³	volume of air in a warehouse	
customary units	<i>Abbreviation</i>	<i>Examples</i>	<i>Used for measuring.....</i>
• inch	in.	thickness of a plank of wood	LENGTH
• foot	ft	width of a photo frame	
• yard	yd	length of a lap of a stadium	
• mile	mi	distance between two cities	
• ounce	oz	weight of an egg	MASS
• pound	lb	weight of a bag of apples	
• ton	T	weight of an elephant	
• pint	pt	liquid in a can	CAPACITY (Liquid Volume)
• quart	qt	liquid in a bucket	
• gallon	gal	liquid in a car tank	
• square inch	in. ²	area of a Math book cover	AREA
• square foot	ft ²	area of a room	
• square yard	yd ²	area of a gym floor	

<p>unlike terms</p>	<ul style="list-style-type: none"> • Are <i>terms</i> that contain different <i>variables</i> raised to the different <i>powers</i>. Unlike terms cannot be <i>added</i> or <i>subtracted</i> however they may be <i>multiplied</i> and <i>divided</i>. 	<p>Opposite to <i>like terms</i>. $7, 6a$ and $-4y^3$ are not like terms. $5w, \frac{6}{w}$ and $-18w^2$ are not like terms.</p>
<p>valid</p>	<ul style="list-style-type: none"> • Grounded in <i>logic</i> or truth. 	<p>If A causes B and B causes C then it is valid to propose that A may cause C.</p>
<p>variable</p>	<ul style="list-style-type: none"> • A letter of the alphabet which stands in for a number. A variable takes the place of: an unknown value or a value which may change (vary) in different situations. 	<p>Opposite to a <i>constant</i>. In $y = x + 5$ 5 is constant x and y are variables.</p>
<p>Venn diagram</p>	<ul style="list-style-type: none"> • A diagram using circles to show the relationship between <i>sets</i> of objects. 	
<p>vertex</p>	<ul style="list-style-type: none"> • (pl. vertices) The point at which two <i>sides</i> (of a <i>polygon</i>) or three <i>edges</i> (of a <i>solid</i>) meet. 	
<p>vertical angles</p>	<ul style="list-style-type: none"> • <i>Angles</i> on opposite sides of a <i>pair</i> of <i>intersecting lines</i>. • Vertical angles are <i>congruent</i>. 	<p>All vertical angles are equal in a pair of intersecting lines.</p> 
<p>vertical line</p>	<ul style="list-style-type: none"> • A <i>line</i> at a <i>right angle</i> to the horizon. 	
<p>vertical symmetry</p>	<ul style="list-style-type: none"> • A shape has vertical symmetry if an <i>axis of symmetry</i> is vertical. 	

volume	<ul style="list-style-type: none"> The amount of space that a <i>solid</i> occupies. Volume is measured in <i>cubic units</i>. e.g. cubic centimeters (cm^3) or cubic meters (m^3). 	<p>Volume of a rectangular prism is calculated by multiplying length by width by height:</p> $V = lwh$ $= 4 \times 2 \times 3$ $= 24$ <p>Volume = 24 cubic units</p> 
week	<ul style="list-style-type: none"> A <i>unit of time</i> equal to 7 days; Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday. 	<p>Roger was on holidays for one week (seven days).</p>
weight	<ul style="list-style-type: none"> The heaviness of an object. Equals the <i>mass</i> of an object times the force of gravity. This means that weight changes with any change in gravity. 	<p>A 3 kg brick weighs: 3 kg on Earth, about 0.5 kg on the moon, 0 kg in outer space.</p>
west	<ul style="list-style-type: none"> A <i>compass direction</i>. 	<p>The sun sets in the west.</p> 
whole numbers	<ul style="list-style-type: none"> The <i>counting numbers</i> from zero to <i>infinity</i>. 	<p>0, 1, 2, 3, 4, 5, are whole numbers.</p>
width	<ul style="list-style-type: none"> How wide an object is. The sideways <i>dimension</i>. 	<p>The width of the CD is 12 cm.</p> 
x-axis	<ul style="list-style-type: none"> The <i>horizontal axis</i>. 	

<p>x-coordinate</p>	<ul style="list-style-type: none"> The <i>first</i> number in an ordered pair. <p>The position of a <i>point</i> along the <i>x-axis</i>.</p>	<p>The <i>x</i>-coordinate of the ordered pair $(-2,3)$ is -2.</p> 
<p>yard (yd)</p>	<ul style="list-style-type: none"> A <i>unit of length</i> equal to 3 feet. 	<p>A yard is approximately the length of your outstretched arms.</p>
<p>y-axis</p>	<ul style="list-style-type: none"> The <i>vertical axis</i>. 	
<p>y-coordinate</p>	<ul style="list-style-type: none"> The <i>second</i> number in an ordered pair. <p>The position of a <i>point</i> along the <i>y-axis</i>.</p>	<p>The <i>y</i>-coordinate of the ordered pair $(-2,3)$ is 3.</p> 
<p>year</p>	<ul style="list-style-type: none"> A <i>unit of time</i> equal to 365 days. (366 in a leap year). 	<p>1st of January to the 31st of December.</p>






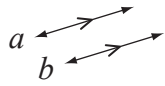



MATH FACTS

SYMBOLS

Number

+	plus or add
–	minus or subtract
\times, \cdot	multiplied by, times, lots of
\div	divided by, into groups of
=	equals, is equal to
\neq	is not equal to
\approx	is approximately equal to
<	is less than, $4 < 6$
>	is greater than, $8 > 5$
\leq	is less than or equal to
\geq	is greater than or equal to
()	brackets, a grouping symbol
%	percent, $12\% = \frac{12}{100}$
.	decimal point as in 7.9
–3	negative 3
6^3	6 raised to the 3 rd power, $6 \times 6 \times 6$
$\sqrt{9}$	square root of 9
$\frac{4}{7}$	fraction, $4 \div 7$, four sevenths
$a:b$ or $\frac{a}{b}$	ratio of a to b
$2.\bar{4}$ or $2.\bar{13}$	repeating decimal
$|a|$	absolute value of a

Geometry

π (pi)	≈ 3.14 or $\frac{22}{7}$
$^\circ$	degree (a right angle measures 90°)
\cong	is congruent to,  \cong 
\sim	is similar to,  \sim 
\parallel	is parallel to
\perp	is perpendicular to
$\triangle ABC$	triangle with vertices A , B and C
	right angle
\overleftrightarrow{AD}	line AD
\overline{BC}	segment BC
	parallel lines (line a is parallel to line b)
	congruent segments
	equal angles
	equal side lengths

Algebra

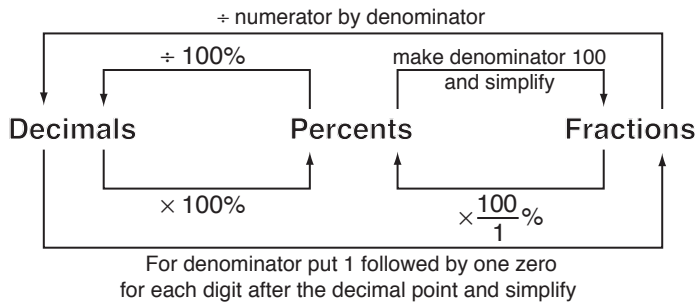
$3x$	3 times x , 3 lots of x , $3 \cdot x$, $3x$
x^2	x raised to the 2 nd power, $x \cdot x$
$-x$	opposite of x
$\frac{1}{x}$	reciprocal of x
(x,y)	coordinates in a coordinate plane

NUMBER FACTS (1)

Place Value

millions	hundreds of thousands	tens of thousands	thousands	hundreds	tens	units	↓ decimal point	tenths	hundredths	thousandths
1,000,000	100,000	10,000	1000	100	10	1		$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$

Decimals / Fractions / Percents



Fraction	Decimal	Percent
$\frac{1}{1}$	1	100%
$\frac{1}{2}$	0.5	50%
$\frac{1}{3}$	$0.\bar{3}$	33.33%
$\frac{2}{3}$	$0.\bar{6}$	66.66%
$\frac{1}{4}$	0.25	25%
$\frac{3}{4}$	0.75	75%
$\frac{1}{5}$	0.2	20%
$\frac{2}{5}$	0.4	40%
$\frac{3}{5}$	0.6	60%
$\frac{4}{5}$	0.8	80%
$\frac{1}{8}$	0.125	12.5%
$\frac{1}{9}$	$0.\bar{1}$	11.11%

0

Subtraction $a - 0 = a$

Multiplication $a \cdot 0 = 0$ and $0 \cdot a = 0$

Division $0 \div a = 0$

1

Multiplication $a \cdot 1 = a$ and $1 \cdot a = a$

Division $a \div 1 = a$

Prime numbers < 100

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89 and 97

Perfect squares of numbers 0 to 30

0, 1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144, 169, 196, 225, 256, 289, 324, 361, 400, 441, 484, 529, 576, 625, 676, 729, 784, 841 and 900

NUMBER FACTS (2)

Real Numbers \mathbb{R}

IRRATIONAL

$\pi, \phi, e, \sqrt{2}, \sqrt{3}, \sqrt{5},$
 $2.6293045632\dots$
 $\cos 30^\circ$

 \mathbb{Q}

RATIONAL

$-2\frac{3}{7}, 3.010101\dots,$
 $\frac{4}{10}, 0.56, \sqrt{\frac{4}{9}}$

 \mathbb{Z}

Integers

$\dots, -3, -2, -1, 0, 1, 2, 3, \dots$

 \mathbb{N}

Natural (Whole Numbers)
 $0, 1, 2, 3, 4, 5, 6, \dots$

Operation terminology

Addition: sum, all together, in total, more than

Subtraction: difference, less than, change

Multiplication: product, times, lots of

Division: a fraction (half, third, quarter) of,
quotient

Sign rules

$$++ = +$$

$$-- = +$$

$$+- = -$$

$$-+ = -$$

Order of operations

- 1) Simplify inside all brackets first.
- 2) Evaluate powers and square roots.
- 3) Do all multiplications or divisions in order from left to right.
- 4) Do all additions or subtractions in order from left to right.

Ratios and Proportions

$$a : b = \frac{a}{b}$$

$$a : b = c : d$$

$$\frac{a}{b} \times \frac{c}{d}$$

$$a \times d = b \times c$$

$$ad = bc$$

ALGEBRA FACTS

Identity Properties

Additive identity $a + 0 = 0 + a = a$

Multiplicative identity $a \cdot 1 = 1 \cdot a = a$

Commutative Properties

Addition $a + b = b + a$

Multiplication $a \cdot b = b \cdot a$

Associative Properties

Addition $(a + b) + c = a + (b + c)$

Multiplication $(a \cdot b) \cdot c = a \cdot (b \cdot c)$

Distributive Properties

$$a(b + c) = ab + ac$$

$$a(b - c) = ab - ac$$

Inverse operation rules

Operation	Inverse Operation	Operation	Inverse Operation	Operation	Inverse Operation	Operation	Inverse Operation
+	-	-	+	×	÷	÷	×
$x + 3 = 6$		$x - 3 = 6$		$3x = 6$		$\frac{x}{3} = 6$	
$x + 3 - 3 = 6 - 3$		$x - 3 + 3 = 6 + 3$		$\frac{3x}{3} = \frac{6}{3}$		$\frac{x}{3} \times 3 = 6 \times 3$	
$x = 3$		$x = 9$		$x = 2$		$x = 18$	

Inverse properties

Addition $a + (-a) = -a + a = 0$

Multiplication $a \cdot \frac{1}{a} = \frac{1}{a} \cdot a = 1, a \neq 0$

MEASUREMENT FACTS (1)

CONVERSIONS - Customary

Length

$$\begin{aligned} 12 \text{ inches (in.)} &= 1 \text{ foot (ft)} \\ 3 \text{ ft} &= \left. \begin{array}{l} \\ \\ \end{array} \right\} 1 \text{ yard (yd)} \\ 36 \text{ in.} &= \left. \begin{array}{l} \\ \\ \end{array} \right\} \\ 5280 \text{ ft} &= \left. \begin{array}{l} \\ \\ \end{array} \right\} 1 \text{ mile (mi)} \\ 1760 \text{ yd} &= \left. \begin{array}{l} \\ \\ \end{array} \right\} \end{aligned}$$

Mass

$$\begin{aligned} 16 \text{ ounces (oz)} &= 1 \text{ pound (lb)} \\ 2000 \text{ lb} &= 1 \text{ ton} \end{aligned}$$

Liquid Capacity

$$\begin{aligned} 8 \text{ fluid ounces (fl oz)} &= 1 \text{ cup (c)} \\ 2 \text{ c} &= 1 \text{ pint (pt)} \\ 2 \text{ pt} &= 1 \text{ quart (qt)} \\ 4 \text{ qt} &= 1 \text{ gallon (gal)} \end{aligned}$$

Temperature - degrees Fahrenheit (°F)

$$\begin{aligned} 32^\circ\text{F} &= \text{freezing point of water} \\ 98.6^\circ\text{F} &= \text{human body temperature} \\ 212^\circ\text{F} &= \text{boiling point of water} \end{aligned}$$

Area

$$\begin{aligned} 144 \text{ square inch (in.}^2\text{)} &= 1 \text{ square foot (ft}^2\text{)} \\ 9 \text{ ft}^2 &= 1 \text{ square yard (yd}^2\text{)} \end{aligned}$$

CONVERSIONS - Metric

Length

$$\begin{aligned} 10 \text{ millimeters (mm)} &= 1 \text{ centimeter (cm)} \\ 100 \text{ cm} &= \left. \begin{array}{l} \\ \\ \end{array} \right\} 1 \text{ meter (m)} \\ 1000 \text{ mm} &= \left. \begin{array}{l} \\ \\ \end{array} \right\} \\ 1000 \text{ m} &= 1 \text{ kilometer (km)} \end{aligned}$$

Mass

$$\begin{aligned} 1000 \text{ milligrams (mg)} &= 1 \text{ gram (g)} \\ 1000 \text{ g} &= 1 \text{ kilogram (kg)} \\ 1000 \text{ kg} &= 1 \text{ tonne (t)} \end{aligned}$$

Liquid Capacity

$$\begin{aligned} 1000 \text{ milliliters (mL)} &= \left. \begin{array}{l} \\ \\ \end{array} \right\} 1 \text{ liter (L)} \\ 1000 \text{ cm}^3 &= \left. \begin{array}{l} \\ \\ \end{array} \right\} \\ 1000 \text{ L} &= 1 \text{ kiloliter (kL)} \end{aligned}$$

Temperature - degrees Celsius (°C)

$$\begin{aligned} 0^\circ\text{C} &= \text{freezing point of water} \\ 37^\circ\text{C} &= \text{human body temperature} \\ 100^\circ\text{C} &= \text{boiling point of water} \end{aligned}$$

Area

$$\begin{aligned} 100 \text{ square mm (mm}^2\text{)} &= 1 \text{ square cm (cm}^2\text{)} \\ 10,000 \text{ cm}^2 &= 1 \text{ square meter (m}^2\text{)} \\ 1,000,000 \text{ m}^2 &= 1 \text{ square km (km}^2\text{)} \end{aligned}$$

Volume

$$\begin{aligned} 1000 \text{ cubic mm (mm}^3\text{)} &= 1 \text{ cubic cm (cm}^3\text{)} \\ 1,000,000 \text{ cm}^3 &= 1 \text{ cubic meter (m}^3\text{)} \end{aligned}$$

MEASUREMENT FACTS (2)

Time

$$60 \text{ seconds (s)} = 1 \text{ minute (min)}$$

$$60 \text{ minutes (min)} = 1 \text{ hour (h)}$$

$$24 \text{ hours} = 1 \text{ day}$$

$$7 \text{ days} = 1 \text{ week}$$

$$4 \text{ weeks (approx.)} = 1 \text{ month}$$

$$365 \text{ or } 366 \text{ days} =$$

$$52 \text{ weeks (approx.)} = \left. \begin{array}{l} 365 \text{ or } 366 \text{ days} = \\ 12 \text{ months} = \end{array} \right\} 1 \text{ year}$$

$$12 \text{ months} =$$

$$10 \text{ years} = 1 \text{ decade}$$

$$100 \text{ years} = 1 \text{ century}$$

Conversion factors: metric \leftrightarrow customary

Length

$$1 \text{ inch} \approx 2.54 \text{ centimeters}$$

$$1 \text{ kilometer} \approx 0.62 \text{ miles}$$

Mass

$$1 \text{ ounce} \approx 28 \text{ grams}$$

$$1 \text{ kilogram} \approx 2.2 \text{ pounds}$$

Liquid Capacity

$$1 \text{ liter} \approx 1.06 \text{ quarts}$$

Liquid Capacity

$$1 \text{ milliliter (mL)} = 1 \text{ cubic centimeter (cm}^3\text{)}$$

$$1000 \text{ liter (L)} = 1 \text{ cubic meter (m}^3\text{)}$$

METRIC PREFIXES

$$\text{giga (G)} = 1 \text{ billion} = 1,000,000,000$$

$$\text{mega (M)} = 1 \text{ million} = 1,000,000$$

$$\text{kilo (k)} = 1 \text{ thousand} = 1000$$

$$\text{hecto (h)} = 1 \text{ hundred} = 100$$

$$\text{deca (da)} = 1 \text{ ten} = 10$$

$$\text{micro } (\mu) = 1 \text{ millionth} = \frac{1}{1,000,000}$$

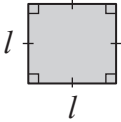
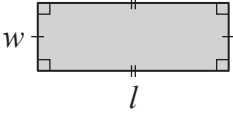
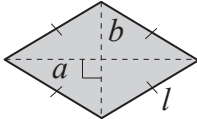
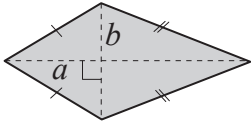
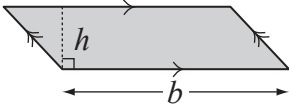
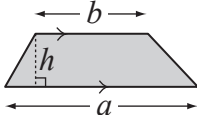
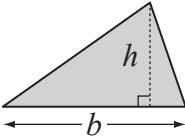

$$\text{milli (m)} = 1 \text{ thousandth} = \frac{1}{1000}$$

$$\text{centi (c)} = 1 \text{ hundredth} = \frac{1}{100}$$

$$\text{deci (d)} = 1 \text{ tenth} = \frac{1}{10}$$

MEASUREMENT FACTS (3)

2D shapes - Formulae

Name	Shape	Perimeter	Area
Square		$P = 4 \times l$ $= 4l$	$A = l \times l$ $= l^2$
Rectangle		$P = 2l + 2w$ $= 2(l + w)$	$A = l \times w$ $= lw$
Rhombus		$P = 4 \times l$ $= 4l$	$A = \frac{a \times b}{2}$ $= \frac{1}{2}ab$
Kite		$P = \text{Sum of all sides}$	$A = \frac{a \times b}{2}$ $= \frac{1}{2}ab$
Parallelogram		$P = \text{Sum of all sides}$	$A = b \times h$ $= bh$
Trapezoid		$P = \text{Sum of all sides}$	$A = \frac{1}{2}(a + b)h$
Triangle		$P = \text{Sum of all sides}$	$A = \frac{b \times h}{2}$ $= \frac{1}{2}bh$
Circle		$C = 2\pi r$	$A = \pi r^2$ where $\pi \approx 3.14$ or $\frac{22}{7}$

Prefixes

poly - many
equi - equal
hedra - face
gon - angle
lateral - side

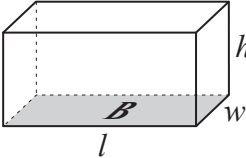
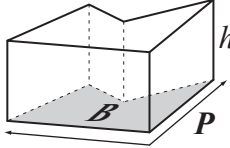
mono - one
bi or **di** - two
tri - three
quad or **tetra** - four
penta - five
hexa - six
hepta - seven
octa - eight
nona - nine
deca - ten

Abbreviations

l length
w width
h height
b base length
P perimeter
r radius
C circumference
A area

MEASUREMENT FACTS (4)

3D shapes - Formulae

Name	Shape	Volume
Rectangular Prism		$V = lwh$ or $= Bh$
Prism - (All)		$V = Bh$

Abbreviations

l length

w width

h height

b base length

r radius

A area

P perimeter

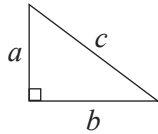
V volume

B base area

C circumference

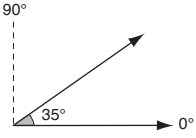
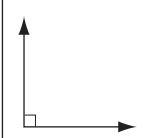
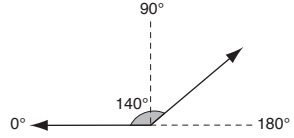
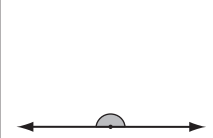
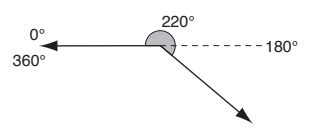
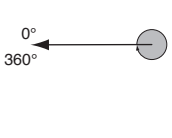
Pythagorean theorem

$$a^2 + b^2 = c^2$$



GEOMETRY FACTS

Angle Types

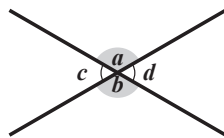
Acute $< 90^\circ$	Right 90°	Obtuse more than 90° less than 180°	Straight 180°	Reflex more than 180° less than 360°	Revolution 360°
					

Properties of angles

Vertically Opposite Angles

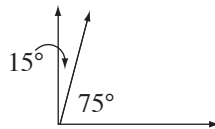
Are equal

$$\angle a = \angle b, \angle c = \angle d$$



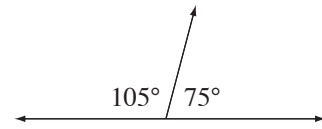
Complementary Angles

Add to 90°



Supplementary Angles

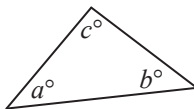
Add to 180°



Properties of angles in a triangle

The sum of interior angles of a triangle is 180° .

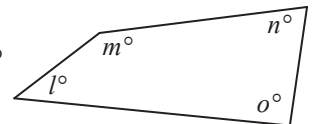
$$a^\circ + b^\circ + c^\circ = 180^\circ$$



Properties of angles in a quadrilateral

The sum of interior angles of a quadrilateral is 360° .

$$l^\circ + m^\circ + n^\circ + o^\circ = 360^\circ$$



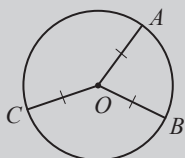
Triangle types

Sides and angles	Triangle type
no equal sides/angles	scalene
two equal sides/angles	isosceles
three equal sides/angles	equilateral

Angles	Triangle type
all acute angles	acute
one right angle	right
one obtuse angle	obtuse

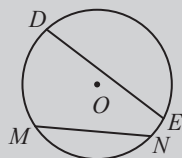
Properties of circles

Radius - joins the center with any point on the circle

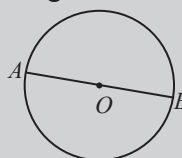


$$OA = OB = OC$$

Chord - joins any two points on the circle

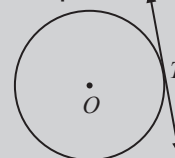


Diameter - a chord passing through the center

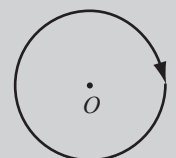


$$AB = 2OA$$

Tangent - a line touching the circle in one point



Circumference - the distance around the circle



ANSWERS

1. [+ Whole Numbers to 10] page 1

- Skill 1.1** a) 15, 17, 20, 19, 26, 18, 13, 14, 22, 21
b) 6, 15, 9, 11, 13, 10, 7, 12, 8, 14
c) 29, 22, 18, 24, 15, 17, 26, 13, 21, 30
d) 37, 13, 40, 12, 24, 18, 16, 49, 21, 15
e) 21, 52, 27, 93, 26, 54, 22, 39, 15, 30
- Skill 1.2** a) 5, -7, 13, -4, 9, 14, -2, 17, 10, -8
b) 10, -3, 1, 14, 13, -1, 12, 8, 15, -8
c) 19, 6, 13, 0, 18, -6, 15, -11, 11, -18
d) 15, -7, 33, 5, 52, 44, -9, 30, 18, -24
e) 44, 1, 43, 28, -33, 35, -4, -11, 16, -2
f) 19, -37, -11, 30, 93, 16, -4, 2, 17, -20

2. [- Whole Numbers to 10] page 3

- Skill 2.1** a) 3, 2, 8, 5, 10, 9, 6, 7, 1, 4
b) 6, 9, 2, 7, 4, 10, 5, 8, 3, 1
c) 10, 12, 5, 19, 17, 3, 11, 8, 26, 24
d) 13, 7, 16, 9, 25, 18, 10, 11, 4, 42
- Skill 2.2** a) 5, 1, -13, 10, -16, 2, -1, -14, -3, -18
b) -8, 5, -5, 8, 7, -7, 6, 2, -1, -14
c) 6, -9, -11, -3, -16, 5, -1, 10, -10, 4
d) 4, -16, 11, -13, -7, -18, -14, 5, 9, -12
e) 29, 18, -14, 13, -48, 20, -3, -26, 1, -17
f) 6, 48, -27, 2, -58, -29, -5, 24, -3, 63

3. [× Whole Numbers to 12] page 5

- Skill 3.1** a) 16, 32, 44, 40, 20, 24, 4, 28, 36, 8
b) 2, 10, 20, 14, 8, 18, 24, 16, 6, 12
c) 80, 100, 20, 70, 90, 30, 110, 50, 60, 40
d) 16, 32, 64, 40, 56, 48, 96, 72, 88, 24
e) 120, 48, 36, 72, 24, 60, 84, 96, 144, 108
- Skill 3.2** a) 9, -15, 24, -21, -33, 18, 6, -12, 36, 27
b) 35, -20, -10, 15, 40, -25, 45, 5, 30, -50
c) -66, 22, 121, -55, 110, 88, -44, 99, -77, 11
d) -28, 12, -4, -8, 36, -24, 40, 20, -32, 16
e) 14, -49, 63, -35, 21, 42, -84, 70, -28, 56
f) -108, 27, 72, -36, -63, -81, 45, 99, 90, -54

4. [÷ Whole Numbers to 12] page 7

- Skill 4.1** a) 4, 7, 2, 10, 6, 5, 1, 8, 9, 11
b) 9, 6, 3, 11, 4, 8, 7, 10, 1, 2
c) 4, 9, 12, 3, 10, 1, 7, 5, 8, 6
d) 8, 2, 4, 10, 9, 1, 3, 12, 6, 11
e) 10, 4, 3, 2, 12, 5, 1, 8, 7, 6
- Skill 4.2** a) 4, 7, -2, 10, 5, -7, 12, -11, 1, -8
b) 1, -6, 2, 9, -7, 8, -5, 12, 3, -4
c) -4, 8, 11, -5, 2, 7, -3, 1, -6, 9
d) 7, 9, -1, -5, 4, 2, 8, -3, 6, -10
e) 11, -8, 6, -4, 3, 10, -2, 5, 9, -7
f) 12, -10, -1, -5, 7, 4, -8, 11, -2, 3

5. [Large Number +, -] page 9

- Skill 5.1** a) 5782, b) 1799, c) 2487, d) 2666, e) 1978, f) 3584
g) 9647, h) 5779, i) 4869, j) 8745, k) 6892, l) 6998
- Skill 5.2** a) 5426, b) 1171, c) 1123, d) 8401, e) 2452, f) 5372
g) 3006, h) 5342, i) 3411, j) 3072, k) 2541, l) 2130
- Skill 5.3** a) 3524, b) 7918, c) 1645, d) 8574, e) 6312, f) 5910
g) 9194, h) 5245, i) 8096, j) 50,304, k) 37,348, l) 61,330

- Skill 5.4** a) 3824, b) 5516, c) 2182, d) 4290, e) 312, f) 5875, g) 6065
h) 7622, i) 4149, j) 6854, k) 2126, l) 4114, m) 3551
n) 1888, o) 3279, p) 7868, q) 6586, r) 2557, s) 36,694
t) 25,828, u) 67,477, v) 55,168, w) 47,690, x) 24,512

- Skill 5.5** a) 5627, b) 1490, c) 1386, d) 1806, e) 8276, f) 3948
g) 2626, h) 5143

6. [Large Number ×, ÷] page 15

- Skill 6.1** a) 3180, b) 20,400, c) 90,800, d) 23,800, e) 701,500
f) 461,900, g) 179,000, h) 412,000, i) 905,000, j) 506,000
k) 803,000, l) 248,000
- Skill 6.2** a) 46, b) 28, c) 502, d) 89, e) 15, f) 370, g) 230, h) 4800
i) 2005, j) 570, k) 706, l) 309
- Skill 6.3** a) 390, b) 306, c) 413, d) 1551, e) 1060, f) 3520, g) 2618
h) 6258, i) 10,075, j) 7254, k) 15,642, l) 17,528
- Skill 6.4** a) 156, b) 89, c) 95, d) 91, e) 37, f) 43, g) 738, h) 341
i) 817, j) 591, k) 621, l) 299, m) 902, n) 745, o) 252
- Skill 6.5** a) 6860, b) 4500, c) 12,380, d) 17,300, e) 19,080, f) 16,110
g) 130,800, h) 88,800, i) 112,600, j) 103,000, k) 288,400
l) 695,600, m) 150,000, n) 84,000, o) 120,000
- Skill 6.6** a) 280, b) 160, c) 204, d) 147, e) 161, f) 131, g) 45, h) 44
i) 155, j) 135, k) 34, l) 141
- Skill 6.7** a) 4674, b) 5952, c) 1610, d) 12,155, e) 18,607, f) 22,032
g) 17,472, h) 19,768, i) 13,248, j) 60,300, k) 14,896
l) 41,670, m) 30,438, n) 98,064, o) 68,508, p) 135,675
q) 177,306, r) 119,991, s) 146,657, t) 138,644, u) 123,772
- Skill 6.8** a) 29, b) 57, c) 79, d) 237, e) 263, f) 364, g) 370, h) 735
i) 640, j) 518, k) 192, l) 214, m) 238, n) 430, o) 145
p) 3072, q) 2345, r) 826
- Skill 6.9** a) 38,880, b) 107,400, c) 27,520, d) 152,160, e) 98,560
f) 243,350, g) 291,200, h) 1,170,700, i) 2,582,400
- Skill 6.10** a) 743.5, b) 1503.5, c) 512.8, d) 1486.25, e) 445.5
f) 1528.5, g) 361.2, h) 341.5, i) 1452.6, j) 1006.5, k) 3692.5
l) 732.75, m) 4652.5, n) 547.25, o) 1857.4

7. [Decimal +, -] page 27

- Skill 7.1** a) 7.91, b) 6.9, c) 54.9, d) 103.7, e) 6.83, f) 80.9, g) 7.15
h) 94.3, i) 85.2, j) 43.6, k) 29.54, l) 54.98, m) 9.95, n) 13.84
o) 73.7, p) 60.03, q) 84.06, r) 74.52, s) 61.34, t) 32.17
u) 35.82, v) 56.61, w) 46.15, x) 64.36, y) 33.99, z) 31.164
zz) 32.718
- Skill 7.2** a) 3.61, b) 4.5, c) 61.4, d) 22.8, e) 4.64, f) 19.4, g) 4.51
h) 38.7, i) 6, j) 17.8, k) 7.49, l) 34.9, m) 56.93, n) 18.91
o) 16.77, p) 28.83, q) 30.49, r) 37.83, s) 17.39, t) 15.76
u) 45.78, v) 85.95, w) 75.87, x) 17.87, y) 7.98, z) 46.69
zz) 47.36
- Skill 7.3** a) 1.73, b) 4.3, c) 1.25, d) 2.39, e) 3.62, f) 4.75, g) 10.46
h) 15.13, i) 14.57, j) 6.643, k) 8.381, l) 5.198

8. [Decimal ×, ÷] page 33

- Skill 8.1** a) 2.7, b) 1.6, c) 3.5, d) 2.4, e) 2.1, f) 5.4, g) 15.3, h) 25.8
i) 10.8, j) 7.6, k) 9.5, l) 58.4, m) 1.2, n) 4.26, o) 12.48
p) 8.36, q) 9.78, r) 9.64, s) 84.12, t) 80.6, u) 54.06, v) 87.28
w) 14.056, x) 3.126, y) 15.525, z) 21.248, zz) 6.123
- Skill 8.2** a) 0.7, b) 0.3, c) 0.5, d) 1.3, e) 1.8, f) 1.4, g) 1.7, h) 0.37
i) 2.9, j) 0.38, k) 0.16, l) 0.34, m) 2.6, n) 0.49, o) 2.6
- Skill 8.3** a) 0.72, b) 0.12, c) 0.4, d) 0.42, e) 0.36, f) 0.72, g) 0.98
h) 2.07, i) 0.48, j) 0.03, k) 0.048, l) 0.963

8. [Decimal \times, \div] cont

- Skill 8.4** a) 6, b) 2, c) 5, d) 38, e) 23, f) 1.9, g) 0.2, h) 0.7, i) 10.7
j) 190, k) 30, l) 90
- Skill 8.5** a) 10, b) 20, c) 15, d) 80, e) 25, f) 8, g) 45, h) 50, i) 175
j) 50, k) 500, l) 4

9. [Fraction $+, -$] page 39

- Skill 9.1** a) $\frac{3}{4}$, b) $\frac{4}{5}$, c) $\frac{8}{11}$, d) $\frac{6}{7}$, e) $\frac{10}{13}$, f) $\frac{5}{9}$, g) $1\frac{3}{5}$, h) $1\frac{2}{7}$, i) $1\frac{5}{9}$
j) $1\frac{5}{11}$, k) $3\frac{2}{3}$, l) $1\frac{7}{13}$, m) $1\frac{1}{2}$, n) $1\frac{1}{2}$, o) $1\frac{2}{3}$, p) $\frac{3}{4}$, q) $\frac{1}{5}$
r) $\frac{1}{3}$, s) $\frac{1}{2}$, t) $\frac{2}{3}$, u) $\frac{4}{5}$, v) $\frac{1}{2}$, w) $\frac{5}{6}$, x) $\frac{4}{5}$
- Skill 9.2** a) $\frac{5}{11}$, b) $\frac{7}{9}$, c) $\frac{2}{13}$, d) $1\frac{4}{5}$, e) $2\frac{1}{3}$, f) $2\frac{4}{7}$, g) $\frac{1}{6}$, h) $\frac{1}{3}$, i) $\frac{2}{3}$
j) $\frac{2}{7}$, k) $\frac{3}{8}$, l) $\frac{4}{5}$, m) $\frac{2}{9}$, n) $\frac{3}{10}$, o) $\frac{1}{2}$
- Skill 9.3** a) $3\frac{4}{5}$, b) $4\frac{6}{7}$, c) $3\frac{5}{9}$, d) $3\frac{9}{11}$, e) $3\frac{7}{9}$, f) $2\frac{6}{7}$, g) $4\frac{1}{2}$, h) $2\frac{3}{5}$
i) $3\frac{1}{3}$, j) $3\frac{2}{3}$, k) $2\frac{1}{2}$, l) $5\frac{1}{3}$, m) $4\frac{1}{5}$, n) $6\frac{1}{3}$, o) $6\frac{4}{7}$, p) $3\frac{1}{9}$
q) $4\frac{3}{11}$, r) $4\frac{7}{9}$, s) $6\frac{1}{5}$, t) $5\frac{1}{4}$, u) $6\frac{1}{2}$, v) 6, w) $3\frac{1}{3}$, x) $5\frac{1}{5}$
- Skill 9.4** a) $1\frac{2}{5}$, b) $1\frac{5}{7}$, c) $2\frac{2}{3}$, d) $1\frac{5}{7}$, e) $2\frac{5}{9}$, f) $\frac{6}{11}$, g) $1\frac{3}{5}$, h) $2\frac{1}{3}$
i) $2\frac{5}{6}$, j) $3\frac{5}{9}$, k) $1\frac{1}{4}$, l) $1\frac{7}{9}$, m) $2\frac{1}{2}$, n) $1\frac{2}{3}$, o) $1\frac{2}{3}$
- Skill 9.5** a) $1\frac{7}{9}$, b) $3\frac{3}{10}$, c) $2\frac{5}{6}$, d) $2\frac{3}{7}$, e) $1\frac{1}{5}$, f) $1\frac{5}{11}$, g) $2\frac{1}{8}$, h) $\frac{7}{8}$
i) $1\frac{7}{12}$, j) $3\frac{3}{5}$, k) $2\frac{4}{9}$, l) $1\frac{8}{11}$, m) $1\frac{1}{3}$, n) $\frac{3}{8}$, o) $2\frac{7}{10}$, p) $2\frac{4}{7}$
q) $\frac{1}{10}$, r) $3\frac{1}{12}$
- Skill 9.6** a) $\frac{5}{9}$, b) $\frac{11}{16}$, c) $\frac{5}{6}$, d) $\frac{7}{8}$, e) $\frac{3}{8}$, f) $\frac{17}{20}$, g) $\frac{5}{6}$, h) $\frac{1}{2}$, i) $\frac{4}{9}$
j) $1\frac{1}{15}$, k) $1\frac{1}{3}$, l) $1\frac{1}{12}$
- Skill 9.7** a) $\frac{17}{21}$, b) $\frac{17}{30}$, c) $\frac{31}{35}$, d) $\frac{37}{45}$, e) $\frac{11}{12}$, f) $\frac{13}{15}$, g) $1\frac{7}{20}$, h) $1\frac{3}{10}$
i) $1\frac{7}{15}$
- Skill 9.8** a) $\frac{1}{6}$, b) $\frac{13}{20}$, c) $\frac{3}{8}$, d) $\frac{1}{8}$, e) $\frac{4}{21}$, f) $\frac{3}{20}$, g) $\frac{1}{3}$, h) $\frac{1}{4}$, i) $\frac{6}{25}$
- Skill 9.9** a) $\frac{17}{18}$, b) $\frac{13}{28}$, c) $\frac{3}{10}$, d) $\frac{1}{21}$, e) $\frac{19}{60}$, f) $\frac{18}{55}$, g) $\frac{1}{36}$, h) $\frac{1}{14}$
i) $\frac{11}{30}$, j) $\frac{1}{40}$, k) $\frac{23}{42}$, l) $\frac{17}{45}$

10. [Fraction \times, \div] page 53

- Skill 10.1** a) $3\frac{3}{5}$, b) $4\frac{1}{6}$, c) $1\frac{7}{8}$, d) $2\frac{2}{5}$, e) $1\frac{1}{7}$, f) $\frac{4}{9}$, g) 6, h) $1\frac{1}{4}$
i) $\frac{5}{6}$, j) $2\frac{1}{2}$, k) 6, l) 15, m) $1\frac{2}{3}$, n) 4, o) 9
- Skill 10.2** a) 15 mL, b) 180 kg, c) \$18, d) 45 L, e) 200 m, f) \$5
g) 400 L, h) 20 cm, i) 45 m, j) 80 g, k) 32 mL, l) 30 kg
- Skill 10.3** a) 5, b) 8, c) 7, d) 10, e) 9, f) 11, g) 18, h) 20, i) 28, j) $5\frac{1}{3}$
k) $6\frac{2}{3}$, l) $2\frac{2}{5}$, m) $3\frac{3}{7}$, n) $5\frac{5}{6}$, o) $6\frac{6}{7}$, p) 27, q) 10, r) 15
s) 28, t) 21, u) 22
- Skill 10.4** a) $\frac{1}{28}$, b) $\frac{9}{20}$, c) $\frac{3}{32}$, d) $\frac{7}{20}$, e) $\frac{8}{45}$, f) $\frac{12}{35}$, g) $\frac{4}{15}$, h) $\frac{5}{12}$, i) $\frac{3}{44}$
j) $\frac{1}{3}$, k) $\frac{5}{7}$, l) $\frac{2}{5}$, m) $\frac{2}{9}$, n) $\frac{2}{9}$, o) $\frac{1}{10}$, p) $\frac{6}{11}$, q) $\frac{3}{10}$, r) $\frac{2}{5}$
s) $\frac{1}{18}$, t) $\frac{3}{14}$, u) $\frac{5}{14}$, v) $\frac{1}{6}$, w) $\frac{2}{5}$, x) $\frac{1}{12}$
- Skill 10.5** a) $\frac{1}{9}$, b) $\frac{1}{5}$, c) $\frac{1}{7}$, d) $\frac{1}{12}$, e) $\frac{1}{30}$, f) $\frac{1}{21}$, g) $\frac{1}{20}$, h) $\frac{1}{28}$, i) $\frac{2}{11}$
j) $\frac{1}{24}$, k) $\frac{1}{35}$, l) $\frac{1}{72}$, m) $\frac{2}{27}$, n) $\frac{5}{24}$, o) $\frac{2}{33}$, p) $\frac{3}{16}$, q) $\frac{3}{10}$, r) $\frac{7}{60}$
- Skill 10.6** a) $1\frac{7}{8}$, b) $\frac{14}{27}$, c) $\frac{10}{21}$, d) $1\frac{7}{9}$, e) $\frac{44}{63}$, f) $1\frac{11}{24}$, g) $\frac{8}{9}$, h) $\frac{24}{35}$
i) $1\frac{7}{20}$, j) $3\frac{1}{2}$, k) $1\frac{1}{6}$, l) 4, m) $\frac{1}{2}$, n) $\frac{1}{8}$, o) $2\frac{1}{4}$, p) $2\frac{1}{2}$
q) $1\frac{1}{4}$, r) $2\frac{2}{5}$, s) $2\frac{2}{3}$, t) $2\frac{1}{2}$, u) $4\frac{2}{3}$

11. [Percents] page 65

- Skill 11.1** a) 60%, b) 32%, c) 46%, d) 12%, e) 5%, f) 9%, g) 61%
h) 53%, i) 4%, j) 7%, k) 59%, l) 91%, m) 28%, n) 79%
- Skill 11.2** a) 41%, b) 40%, c) 25%, d) 11%, e) 22%, f) 4%, g) 75%
h) 62.5%, i) 26%, j) 7.6%, k) 9%, l) 37%
- Skill 11.3** a) 24, b) 85, c) 69, d) 9, e) 7, f) 50, g) 300, h) 30, i) 150
j) 120, k) 200, l) 420, m) 15, n) 25, o) 35, p) 350, q) 40
r) 200, s) 320, t) 270, u) 60, v) \$2.50, w) \$0.60, x) \$4.50
y) 20 ¢, z) 140 ¢, zz) 135 ¢
- Skill 11.4** a) 10, b) 168, c) 16, d) 32, e) 150, f) 42, g) 84, h) 2, i) 6
j) 9, k) 28, l) 54, m) 45, n) 30, o) 90, p) 6, q) 1.8, r) 6.4
s) 3, t) 1.5, u) 1, v) 70, w) 10, x) 20, y) 50, z) 60, A) 20
B) 60, C) 100, D) 140
- Skill 11.5** a) 120, b) 150, c) 280, d) 96, e) 99, f) 75, g) 100, h) 70
i) 176, j) 78, k) 84, l) 140
- Skill 11.6** a) \$4.50, b) \$30, c) \$2400, d) \$300, e) \$520, f) \$126
g) \$84.80, h) \$62.40
- Skill 11.7** a) 25%, b) 75%, c) 90%, d) 20%, e) 10%, f) 20%, g) 10%
h) 25%, i) 12.5%
- Skill 11.8** a) 10%, b) 20%, c) 20%, d) 50%, e) 30%, f) 33.3%
g) 12.5%, h) 25%

12. [Dec. / Frac. / Percents] page 75

- Skill 12.1** a) $\frac{1}{4}$, b) $\frac{3}{8}$, c) $\frac{1}{2}$ or $\frac{3}{6}$, d) $\frac{3}{4}$, e) 50%, f) 20%, g) 30%, h) 40%
- Skill 12.2** a) $\frac{2}{5}$, b) $\frac{1}{2}$, c) $\frac{2}{3}$, d) $\frac{1}{3}$, e) $\frac{1}{4}$, f) $\frac{1}{3}$, g) $\frac{1}{2}$, h) $\frac{1}{10}$, i) $\frac{4}{5}$, j) $\frac{2}{3}$
k) $\frac{1}{3}$, l) $\frac{3}{4}$, m) $\frac{1}{2}$, n) $\frac{1}{10}$, o) $\frac{1}{3}$, p) $\frac{1}{5}$, q) $\frac{1}{2}$, r) $\frac{2}{3}$, s) $\frac{3}{8}$, t) $\frac{2}{5}$
u) $\frac{4}{5}$, v) $\frac{3}{5}$, w) $\frac{1}{9}$, x) $\frac{5}{7}$, y) $\frac{4}{5}$, z) $\frac{2}{7}$, zz) $\frac{3}{5}$
- Skill 12.3** a) $\frac{35}{42} = \frac{5}{6}$, b) $\frac{3}{4} = \frac{27}{36}$, c) $\frac{2}{5} = \frac{14}{35}$, d) $\frac{4}{7} = \frac{28}{49}$, e) $\frac{9}{10} = \frac{54}{60}$
f) $\frac{48}{60} = \frac{12}{15}$, g) $\frac{2}{3} = \frac{10}{15} = \frac{40}{60}$, h) $\frac{3}{8} = \frac{12}{32} = \frac{36}{96}$, i) $\frac{3}{4} = \frac{6}{8} = \frac{48}{64}$
- Skill 12.4** a) 40%, b) 20%, c) 10%, d) 90%, e) 70%, f) 12%, g) 55%
h) 48%, i) 29%, j) 35%, k) 4%, l) 5%, m) 2%, n) 38%, o) 40%
p) 25%, q) 12.5%, r) 34.5%
- Skill 12.5** a) 0.05, b) 0.02, c) 0.88, d) 0.42, e) 0.6, f) 0.4, g) 0.005
h) 0.018, i) 0.72, j) 0.057, k) 0.97, l) 0.99, m) 0.05, n) 0.024
- Skill 12.6** a) $\frac{9}{10}$, b) $\frac{11}{100}$, c) $\frac{3}{10}$, d) $\frac{1}{10}$, e) $\frac{3}{50}$, f) $\frac{1}{50}$, g) $\frac{1}{2}$, h) $\frac{7}{25}$, i) $\frac{3}{20}$, j) $\frac{4}{5}$
- Skill 12.7** a) 0.3, b) 0.35, c) 0.36, d) 0.5, e) 1.4, f) 2.75, g) 0.25, h) 0.9
i) 0.05
- Skill 12.8** a) $\frac{47}{100}$, b) $\frac{9}{100}$, c) $\frac{3}{20}$, d) $\frac{3}{10}$, e) $\frac{1}{25}$, f) $\frac{3}{50}$, g) $\frac{21}{25}$, h) $\frac{7}{50}$, i) $\frac{2}{5}$
j) $\frac{11}{20}$, k) $\frac{14}{25}$, l) $\frac{9}{20}$
- Skill 12.9** a) 10%, b) 18%, c) 28%, d) 86%, e) 50%, f) 40%, g) 60%
h) 75%, i) 33.3%, j) 65%, k) 1%, l) 66.6%
- Skill 12.10** a) 0.69, 0.609, 0.096, 0.09 b) 0.047, 0.074, 0.407, 0.74
c) 0.08, 0.085, 0.508, 0.58 d) 0.53, 0.513, 0.135, 0.105
e) 0.07, 0.087, 0.708, 0.807, 0.87
f) 0.043, 0.063, 0.34, 0.364, 0.63
g) 0.302, 0.3, 0.239, 0.209, 0.093
h) 0.016, 0.065, 0.105, 0.156, 0.51
- Skill 12.11** a) $\frac{2}{5}$, b) $\frac{5}{8}$, c) $\frac{7}{10}$, d) $\frac{4}{9}$, e) $\frac{1}{2}$, $\frac{3}{5}$, $\frac{5}{8}$ f) $\frac{9}{10}$, $\frac{5}{6}$, $\frac{4}{5}$
- Skill 12.12** a) $\frac{1}{20} = 5\%$, b) $0.45 = \frac{45}{100} = \frac{9}{20}$, c) $\frac{6}{10} = \frac{3}{5} = 60\%$, d) $0.35 = 35\%$
e) $\frac{7}{100} = 7\%$, f) $0.7 = \frac{7}{10}$, g) $\frac{1}{10} = 10\%$, h) $0.3 = 30\%$
i) $\frac{4}{10} = \frac{2}{5} = 40\%$, j) $0.55 = \frac{55}{100} = \frac{11}{20}$, k) $0.9 = \frac{9}{10}$, l) $0.34 = 34\%$
- Skill 12.13** a) 70%, b) 0.25, c) $\frac{9}{10}$, d) $\frac{4}{5}$, e) $\frac{1}{10}$, f) $\frac{2}{5}$, g) $\frac{5}{6}$, h) 0.4, i) 0.75
j) 0.5, k) 30%, l) $\frac{3}{5}$, m) $\frac{8}{10}$, n) $\frac{1}{3}$, o) $\frac{7}{8}$, p) 0.9, q) $\frac{3}{4}$, r) $\frac{1}{5}$
s) 0.23, t) $\frac{3}{10}$

13. [Integers]**page 91**

- Skill 13.1** a) C, b) A, c) A, d) B, e) B, f) C, g) A, h) A
i) -7, -4, -3, 3, 5 j) 8, 6, 0, -4, -9 k) 8, 4, 1, -8, -10
l) -6, -3, -2, 0, 5 m) -5°F, -3°F, 2°F, 4°F
n) 5°C, -1°C, -3°C, -5°C
- Skill 13.2** a) < b) < c) > d) < e) > f) > g) < h) > i) > j) < k) < l) >
- Skill 13.3** a) 32°C, b) 5, c) 9, d) 8, e) 11, f) 13, g) 50°C, h) 48°C, i) 8 h
j) 9 h
- Skill 13.4** a) 17 m, b) 3780 m, c) 310 m, d) 51°C, e) 61°C, f) 52°C
g) 6051 m, h) 18,573 ft
- Skill 13.5** a) basement, b) ground, c) oncology, d) 6 yd
e) homewares, f) 16 m
- Skill 13.6** a) -\$550, b) \$70, c) -\$140, d) -99°C, e) 449 B.C.
f) 1332 B.C., g) -218°C, h) -272°C, i) \$740, j) -3 yd
- Skill 13.7** a) -5, b) -1, c) -2, d) 3, e) -4, f) 2, g) 2, h) 7, i) -6, j) -5
k) -8, l) -9
- Skill 13.8** a) -6, b) -8, c) -4, d) -8, e) -15, f) 3, g) 7, h) -4, i) 0
- Skill 13.9** a) -42, b) -12, c) -24, d) -15, e) -18, f) 64, g) 40, h) -36
i) -30, j) -56, k) -24, l) -49, m) -27, n) 28, o) 18, p) 16
q) -45, r) 16, s) 25, t) -20, u) -81
- Skill 13.10** a) -3, b) -9, c) 6, d) 6, e) -5, f) -4, g) -9, h) 3, i) -7, j) -5
k) 8, l) -3, m) -9, n) 4, o) -9, p) -7, q) 5, r) 8, s) -6, t) -9
u) -4

14. [Rates / Ratios]**page 103**

- Skill 14.1** a) 2 : 3, b) 1 : 2, c) 3 : 5, d) 2 : 3, e) 3 : 1, f) 3 : 4, g) 10 : 7
h) 4 : 1, i) 1 : 4, j) 5 : 9, k) 3 : 4, l) 3 : 2, m) 10 : 3, n) 3 : 8
- Skill 14.2** a) 3 : 5, b) 2 : 5, c) 10 : 3, d) 6 : 7, e) 15 : 2, f) 1 : 3, g) 3 : 1
h) 16 : 1, i) 3 : 14, j) 9 : 2
- Skill 14.3** a) 7.5 km, b) 2.5 h, c) 22,600 mi, d) 3.2 h, e) 600 mph
f) 480 mph, g) 45 km/h, h) 15 min, i) 60 mi, j) 9600 km
k) 9 km, l) 14 km, m) 16,250 mi, n) 3 mi
- Skill 14.4** a) 9 : 2 : 5, b) 1 : 2 : 4, c) 1 : 3 : 9, d) 2 : 6 : 9, e) 11 : 6 : 5
f) 2 : 4 : 3, g) 8 : 3 : 2, h) 5 : 10 : 3, i) 3 : 1 : 5, j) 2 : 3 : 6
k) 6 : 2 : 3, l) 2 : 3 : 4
- Skill 14.5** a) true, b) false, c) B, d) C, e) A, f) C
- Skill 14.6** a) 3 : 4 = 12 : 16 b) 24 : 15 = 8 : 5 c) 3 : 10 = 27 : 90
d) 9 : 2 = 45 : 10 e) $\frac{5}{9} = \frac{35}{63}$ f) $\frac{3}{7} = \frac{18}{42}$ g) $\frac{1}{7} = \frac{8}{56}$ h) $\frac{7}{20} = \frac{49}{140}$
i) $\frac{24}{40} = \frac{3}{5}$ j) $\frac{20}{15} = \frac{4}{3}$ k) $\frac{10}{45} = \frac{2}{9}$ l) $\frac{64}{80} = \frac{8}{10}$ m) $\frac{24}{15} = \frac{8}{5}$
n) $\frac{11}{5} = \frac{33}{15}$
- Skill 14.7** a) 176 cal, b) \$117, c) \$135, d) \$15, e) 750 cal, f) \$21
g) 270 mi, h) 384 cal, i) A, j) B, k) B, l) A, m) B, n) A
- Skill 14.8** a) 11 : 9, b) 5 : 6, c) 1 : 9, d) 10 : 1, e) 1 : 4, f) 3 : 4, g) 5 : 4
h) 7 : 8, i) 4 : 21, j) 3 : 34, k) 2 : 3, l) 8 : 9, m) 1 : 3
n) 11 : 39
- Skill 14.9** a) 41,600 g, b) 225 m, c) 7 ft/week, d) 4 gal/min, e) 3 L
f) 42, g) 112.5 L, h) \$207.50

15. [Exponents / Square Roots]**page 117**

- Skill 15.1** a) 6⁵, b) 2³, c) 5², d) 4⁶, e) 8 · 8 · 8, f) 3 · 3 · 3 · 3
g) 2 · 2 · 2 · 2 · 2, h) 9 · 9 · 9, i) 1⁷, j) 7³, k) 6 · 6 · 6 · 6, l) 2⁸
- Skill 15.2** a) 49, b) 9, c) 4, d) 100, e) 25, f) 1, g) 144, h) 121, i) 0, j) 16
k) 81, l) 400, m) 2500, n) 900, o) 4900, p) 6400, q) 1600
r) 3600
- Skill 15.3** a) 1,000,000,000, b) 100, c) 10,000,000, d) 10,000, e) 10
f) 100,000, g) 1,000,000, h) 1000, i) 100,000,000
j) 10,000,000,000
- Skill 15.4** a) 5, b) 3, c) 6, d) 2, e) 4, f) 10, g) 12, h) 11, i) 8, j) 30, k) 70
l) 50, m) 90, n) 60, o) 110

- Skill 15.5** a) 243, b) 16, c) 64, d) 1, e) 32, f) 256, g) 81, h) 0, i) 64, j) 1
k) 27, l) 125, m) 729, n) 512, o) 1024, p) 1, q) 256, r) 729

- Skill 15.6** a) 81, b) 16, c) 36, d) -1, e) -27, f) 16, g) -8, h) 25, i) -243
j) 256, k) -1, l) 49, m) 64, n) 144, o) -1000

16. [Order of Operations]**page 123**

- Skill 16.1** a) 15, b) 7, c) 11, d) 4, e) 2, f) 18, g) 20, h) 2, i) 20, j) 6
k) 24, l) 3, m) 16, n) 11, o) 35, p) 12, q) 70, r) 18
- Skill 16.2** a) 17, b) 9, c) 5, d) 30, e) 8, f) 18, g) 0, h) 11, i) 6, j) 17
k) 41, l) 13, m) 16, n) 21, o) 7, p) 4, q) 16, r) 23, s) 23
t) 16, u) 13
- Skill 16.3** a) 3, b) 7, c) 8, d) 8, e) 5, f) 16, g) 7, h) 4, i) 9, j) 12, k) 18
l) 7, m) 15, n) 9, o) 8, p) 0, q) 14, r) 10
- Skill 16.4** a) 40, b) 9, c) 2, d) 6, e) 4, f) 4, g) 20, h) 30, i) 55, j) 2, k) 7
l) 108, m) 12, n) 50, o) 10, p) 15, q) 37, r) 27, s) 7
t) 15, u) 8
- Skill 16.5** a) 170, b) 1, c) 27, d) 19, e) 59, f) 288, g) 16, h) 25, i) 49
j) 15, k) 23, l) 76, m) 16, n) 23, o) 3, p) 112, q) 28, r) 144
- Skill 16.6** a) -10, b) -6, c) 13, d) 29, e) 59, f) 65, g) 200, h) -3, i) -47
j) -5, k) 2, l) 12
- Skill 16.7** a) 13, b) 5, c) 10, d) 20, e) 9, f) 10, g) 28, h) -14, i) 33, j) 28
k) 17, l) 18

17. [Exploring Number]**page 131**

- Skill 17.1** a) true, b) false, c) false, d) true, e) true, f) false, g) B, h) A
i) B, j) A, k) C, l) B
- Skill 17.2** a) 5, b) 3, c) 8, d) 4, e) 6, f) 1, g) 8, h) 7, i) 50, j) 200
k) 6000, l) 900, m) 5000, n) 1, o) 20,000, p) 700, q) 0.04
r) 0.002, s) 0.9, t) 0.07, u) A, v) B, w) B, x) A, y) B, z) B
- Skill 17.3** a) 215, b) 4150, c) 6082, d) 8117, e) 902, f) 3400, g) 298
h) 7309, i) 530, j) 12,600, k) 714, l) 14,063, m) 60,540
n) 31,007, o) 403,200, p) 800,050, q) 1,900,026
r) 7,600,040
- Skill 17.4** a) three hundred eighteen, b) sixty-five, c) ninety
d) four hundred thirteen, e) seven hundred six
f) five hundred twenty, g) eight hundred
h) six hundred nine, i) five hundred seventy
j) one thousand six hundred
k) four thousand two hundred, l) two thousand four
m) five thousand seven, n) three thousand twelve
o) eight thousand forty, p) thirty-five thousand
q) eighty-six thousand, r) nineteen thousand
s) ten thousand, seven hundred
t) twenty-four thousand, three hundred
u) fifteen thousand, ninety, v) seventeen thousand, eight
w) nine hundred three thousand
x) four hundred six thousand, y) one hundred two thousand
z) nine hundred five thousand
- Skill 17.5** a) 12,000, b) 350, c) 2600, d) 810, e) 220, f) 34,000
g) 1700, h) 72,000, i) 4910, j) 1400, k) 21,000, l) 3700
m) 170, n) 5600
- Skill 17.6** a) 13, b) 18, c) 46, d) 2, e) 1.874, f) 18.68, g) 0.6, h) 9.8
i) 7.84, j) 0.086, k) 0.5, l) 0.197
- Skill 17.7** a) 68, 7 b) 52, 98 c) 79, 21 d) 250, 13 e) -1512, 48, 60
f) 21, -4, 7500 g) -63, 0, -824 h) $\frac{25}{5}$, -1, 110
i) $\frac{12}{4}$, 71, -54, -1039 j) 30, -11, $\frac{10}{2}$, 4000
- Skill 17.8** a) 1.3×10^7 , b) A, c) 1.2411×10^{12} , d) 4.6×10^7
e) 1×10^{-3} , f) 2×10^{-4}
- Skill 17.9** a) B, b) C, c) 60,000, d) 500,000, e) 0.00000000278, f) A
- Skill 17.10** a) $\frac{1}{3}$, 7.95, -24 b) -150, 0.72, $\frac{18}{101}$ c) $-\frac{19}{3}$, 3.1415, 15, -4
d) $\frac{14}{569}$, 98, 3.58904, -79 e) C and D, f) B and C
g) A and C, h) A and D, i) A, j) C

18. [Multiples / Factors / Primes] page 143

- Skill 18.1** a) 8, 16, 24, 32, b) 2, 4, 6, 8, 10, 12, 14
c) 10, 20, 30, 40, 50, d) 3, 6, 9, 12, 15, 18, 21
e) 6, 12, 18, 24, 30, 36, f) 11, 22, 33, 44, 55, 66
g) 8, 16, 24, 32, 40, h) 9, 18, 27, 36, 45
i) 4, 8, 12, 16, 20, 24, 28, j) 7, 14, 21, 28, 35, 42, 49
- Skill 18.2** a) 6, 12, 18, b) 28, c) 18, 36, 54, d) 24, 48, e) 12, 24
f) 24, 48, g) 40, 80, h) 63
- Skill 18.3** a) 24, b) 28, c) 22, d) 45, e) 18, f) 20, g) 12, h) 24, i) 24
j) 45
- Skill 18.4** a) no, b) yes, c) no, d) yes, e) 1, 5, 25, f) 1, 2, 4, 7, 14, 28,
g) 4, h) 36, i) 49, j) 18
- Skill 18.5** a) 1, 2, 4, b) 1, 3, c) 1, 2, 4, d) 1, 2, 5, 10, e) 1, 3, 9
f) 1, 5, g) 1, 2, 3, 6, 9, 18, h) 1, 2, 7, 14
- Skill 18.6** a) 8, b) 2, c) 5, d) 10, e) 24, f) 9, g) 14, h) 6, i) 4, j) 15
- Skill 18.7** a) 4, 6, b) 8, 9, 10, 12, 14, 15, c) 47, d) 101, e) 43, f) 83
g) 41, 43, 47, h) 16, 18, 20, 21, 22, i) 83, j) 97

- Skill 18.8** a)
$$150 = 10 \cdot 15 = 2 \cdot 5 \cdot 3 \cdot 5$$
- b)
$$105 = 3 \cdot 35 = 3 \cdot 5 \cdot 7$$
- c)
$$68 = 2 \cdot 34 = 2 \cdot 2 \cdot 17$$
- d)
$$42 = 6 \cdot 7 = 2 \cdot 3 \cdot 7$$
- e)
$$54 = 6 \cdot 9 = 2 \cdot 3 \cdot 3 \cdot 3$$
- f)
$$100 = 10 \cdot 10 = 2 \cdot 5 \cdot 2 \cdot 5$$
- g)
$$90 = 9 \cdot 10 = 3 \cdot 3 \cdot 2 \cdot 5$$
- h)
$$150 = 6 \cdot 25 = 2 \cdot 3 \cdot 5 \cdot 5$$
- i)
$$124 = 4 \cdot 31 = 2 \cdot 2 \cdot 31$$
- j)
$$36 = 3 \cdot 12 = 3 \cdot 3 \cdot 2 \cdot 2$$
- k)
$$96 = 6 \cdot 16 = 2 \cdot 3 \cdot 4 \cdot 4 = 2 \cdot 3 \cdot 2 \cdot 2 \cdot 2 \cdot 2$$
- l)
$$144 = 12 \cdot 12 = 3 \cdot 4 \cdot 3 \cdot 4 = 3 \cdot 2 \cdot 2 \cdot 3 \cdot 2 \cdot 2$$
- m)
$$144 = 9 \cdot 16 = 3 \cdot 3 \cdot 4 \cdot 4 = 3 \cdot 3 \cdot 2 \cdot 2 \cdot 2 \cdot 2$$
- n)
$$280 = 4 \cdot 70 = 2 \cdot 2 \cdot 7 \cdot 10 = 2 \cdot 2 \cdot 7 \cdot 2 \cdot 5$$

- Skill 18.9** a) $110 = 2 \cdot 5 \cdot 11$, b) $65 = 5 \cdot 13$, c) $69 = 3 \cdot 23$
d) $27 = 3 \cdot 3 \cdot 3$, e) $124 = 2 \cdot 2 \cdot 31$, f) $198 = 2 \cdot 3 \cdot 3 \cdot 11$
g) $81 = 3 \cdot 3 \cdot 3 \cdot 3$, h) $40 = 2 \cdot 2 \cdot 2 \cdot 5$
- Skill 18.10** a) $136 = 2^3 \cdot 17$, b) $200 = 2^3 \cdot 5^2$, c) $360 = 2^3 \cdot 3^2 \cdot 5$
d) $64 = 2^6$, e) $900 = 2^2 \cdot 3^2 \cdot 5^2$, f) $576 = 2^6 \cdot 3^2$

19. [Number Patterns] page 155

- Skill 19.1** a) 20, 24, b) 16, 19, c) 28, 33, d) 13, 15, e) 14, 17, f) 19, 23
g) 35, 43, h) 30, 37, i) 26, 32, j) 41, 50
- Skill 19.2** a) 6, 3, b) 6, 4, c) 5, 2, d) 10, 5, e) 10, 6, f) 14, 8, g) 58, 48
h) 10, 3, i) 10, 2, j) 14, 5
- Skill 19.3** a) 2.6, 3.2, b) 0.6, 0.3, c) 2.5, 2.7, d) 3, 3.5, e) 3, 3.4
f) 2.3, 2.1, g) 1.7, 1.4, h) 5.4, 6.5

- Skill 19.4** a) 2, 2.5, b) 12, 15, c) 70, 84, d) 51, 68, e) 275, 500
f) 5.4, 6, g) 360, 400, h) 4.8, 6, 7.2
- Skill 19.5** a) 162, 486, b) 16, 32, c) 324, 972, d) 405, 1215, e) 4, 8
f) 192, 768, g) 1, 2, h) 18, 54, i) 12.5, 62.5, j) 30, 300
- Skill 19.6** a) 15, 3, b) 8, 4, c) 10, 2, d) 20, 10, e) 0.01, 0.001, f) 9, 3
g) 0.2, 0.1, h) 0.5, 0.1, i) $7 \frac{7}{10}$, j) $2 \frac{1}{2}$
- Skill 19.7** a) 48, 60, b) 62, 86, c) 19, 4, d) 5, 3, e) 5, 2, f) 15, 19
g) 28, 39, h) 16, 4, i) 81, 121, j) 27, 8
- Skill 19.8** a) -11, -19, b) -2, 1, c) 3, 8, d) -9, -11, e) -6, -10, f) 11, 17
g) -19, -28, h) 5, 12, i) -9, -13, j) 9, 17
- Skill 19.9** a) 27, b) 13, c) 40, d) 75, e) 184, f) 1000, g) 31, h) 35, i) 43
j) $50 \frac{1}{20}$, l) $\frac{1}{256}$
- Skill 19.10** a) 6, b) 25, c) 5, d) 24, e) 41, f) 20, g) 52, h) 2, i) 101, j) 70

20. [Expressions] page 167

- Skill 20.1** a) $4n$, b) $2a$, c) $2u$, d) $3t$, e) $4w$, f) $5z$, g) x , h) $2b$, i) $2e$, j) $2k$
k) p , l) $2c$, m) $2ab$, n) $3hi$, o) $4fg$, p) $4op$, q) $5tu$, r) $2uv$, s) ab
t) $3wx$, u) $2de$
- Skill 20.2** a) $5m$, b) $6h$, c) $7g$, d) $4j$, e) $6z$, f) $5e$, g) $4q$, h) a, i) $2k$, j) $4r$
k) $7f$, l) $6a$, m) $7y$, n) $7m$, o) $9h$, p) $5j$, q) $3c$, r) $5k$, s) $6op$
t) ij , u) $2de$
- Skill 20.3** a) $4f$, $2f$, b) c , $3c$, c) h , $3h$, d) b , $3b$, e) f , $3f$, f) n , $4n$, g) r , $5r$
h) $2m$, $3m$, i) $2x$, $4x$, j) $2jk$, jk , k) ab , $2ab$, l) $2x$, $4x$
m) $2hi$, hi , n) d , $3d$, o) v , $5v$, p) $2no$, no , q) a , $2a$, r) $3st$, st
- Skill 20.4** a) $2s + r$, b) $2d + e$, c) $2h + i$, d) $2a + 2b$, e) $2l + 2m$
f) $3r + s$, g) $3p + q$, h) $2d + 2e$, i) $2y + 2z$, j) $2x + 3y$
k) $3e + 2f$, l) $m + 2n$, m) $t + 2u$, n) k , o) $2qr + rs$, p) $2cd + de$
q) $5h + i$, r) $3j + 5k$
- Skill 20.5** a) $2n$, b) $2b$, c) $e + f$, d) $j + 4$, e) $z - 3$, f) $v - 5$, g) $3m$, h) $2d$
i) $2h$, j) $3m$, k) $2y$, l) $7z$

21. [Substitution] page 173

- Skill 21.1** a) 7, b) 9, c) 8, d) 8, e) 9, f) 7, g) 6, h) 8, i) 14, j) 15, k) 18
l) 24, m) 10, n) 20, o) 20, p) 7, q) 21, r) 18
- Skill 21.2** a) 54, b) 12, c) 10, d) 21, e) 32, f) 42, g) 24, h) 18, i) 35, j) 8
k) 6, l) 12, m) 9, n) 8, o) 7, p) 8, q) 4, r) 12
- Skill 21.3** a) 2, b) 11, c) 11, d) 37, e) 45, f) 23, g) 40, h) 28, i) 5, j) 7
k) 11, l) 6, m) 3, n) 1, o) 4
- Skill 21.4** a) 7, b) -27, c) -12, d) 1, e) 13, f) 2, g) 10, h) -13, i) 2
j) -36, k) 21, l) 30, m) -3, n) -7, o) -4, p) -10, q) -26, r) 23
- Skill 21.5** a) 17, b) 10, c) 14, d) 12, e) 8, f) 6, g) 24, h) -3, i) -8
j) -7, k) -17, l) -10, m) 13, n) -12, o) -10, p) -6, q) -6
r) 16
- Skill 21.6** a) 21, b) 8, c) 30, d) 18, e) 44, f) 39, g) 30, h) 40, i) 0, j) 6
k) 5, l) -11, m) 9, n) 8, o) 9, p) 0, q) -64, r) 105
- Skill 21.7** a) 19, b) 11, c) 7, d) 90, e) 0, f) 11, g) 8, h) -40, i) -18, j) -9
k) 3, l) -4
- Skill 21.8** a) 15, b) 64, c) 17, d) 100, e) 40, f) 7, g) 40, h) 210, i) 55
j) 39, k) -98, l) 6
- Skill 21.9** a) 21, b) 24, c) 30, d) 60, e) 12, f) 99, g) 90, h) -16, i) -28
j) 90, k) -24, l) 18
- Skill 21.10** a) 55, b) 60, c) 48, d) 81, e) 28, f) 110, g) 18, h) 20, i) 20
j) 100, k) 125, l) 314

22. [Equations]

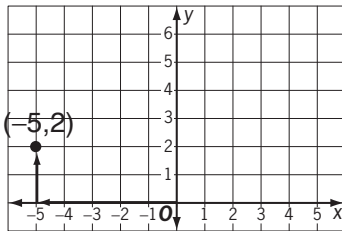
page 183

- Skill 22.1** a) 7, b) 8, c) 6, d) 8, e) 10, f) 13, g) 12, h) 7, i) 21, j) 9, k) 22
l) 5, m) 17, n) 16, o) 11, p) 14, q) 18, r) 20, s) 25, t) 33
u) 27, v) 35, w) 9, x) 7, y) 15, z) 24, zz) 20
- Skill 22.2** a) 7, b) 4, c) 8, d) 6, e) 5, f) 8, g) 2, h) 6, i) 9, j) 5, k) 12, l) 6
m) 11, n) 3, o) 40, p) -2, q) 3, r) 7, s) -3, t) 9, u) -9, v) -2
w) -7, x) 11, y) 25, z) -2, zz) -7
- Skill 22.3** a) 48, b) 34, c) 63, d) 45, e) 90, f) 50, g) 64, h) 192, i) 180
j) 15, k) 20, l) 30, m) 25, n) 60, o) 42, p) -63, q) -44, r) -60
s) -30, t) -56, u) -27
- Skill 22.4** a) 10, b) 7, c) 8, d) 5, e) 3, f) 6, g) 5, h) 12, i) 8, j) 13, k) 9
l) 16, m) 9, n) 8, o) 7, p) 9, q) 10, r) 6, s) 4, t) 5, u) 2
- Skill 22.5** a) 4, b) 1.2, c) 1.6, d) 0.8, e) 2.2, f) 3, g) 1.5, h) 2.3, i) 2.2
j) 1.5, k) 1.4, l) 0.9, m) 6, n) 2, o) 5
- Skill 22.6** a) 9, b) 7, c) 8, d) 20, e) 9, f) 7, g) 3, h) 4, i) 9, j) 9, k) 13
l) 7, m) 32, n) 23, o) 40, p) 8, q) 14, r) 11, s) 8, t) 15, u) 7
v) 12, w) 18, x) 15, y) 21, z) 32, zz) 21
- Skill 22.7** a) 9, b) 10, c) 12, d) 11, e) 9, f) 8, g) 3, h) 4, i) 6, j) 12
k) 15, l) 9, m) -2, n) -5, o) -7, p) -8, q) -3, r) -10, s) 36
t) 30, u) 24, v) 21, w) 96, x) 60, y) 72, z) 90, zz) 70
- Skill 22.8** a) 6, b) 5, c) 7, d) 6, e) 10, f) 4, g) 12, h) -3, i) 0, j) -2
k) -5, l) 2, m) -8, n) -5, o) -3, p) -1, q) -4, r) -2, s) -1
t) -4, u) -6

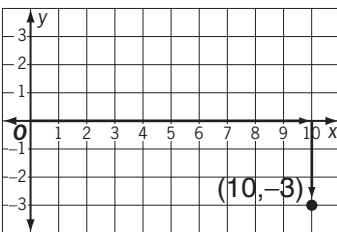
23. [Graphs & Functions]

page 199

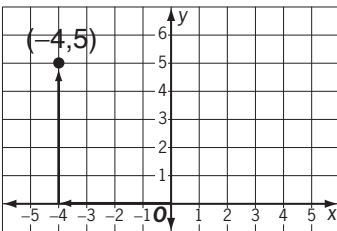
- Skill 23.1** a) (-5,2)



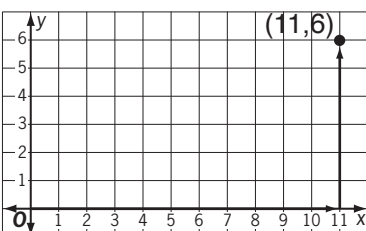
- b) (10,-3)



- c) (-4,5)



- d) (11,6)

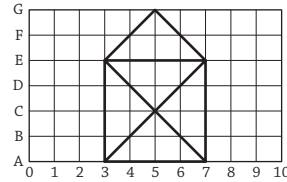


- Skill 23.2** a) Egypt, b) South America, c) scientist, d) Española
e) Mount Orto, f) 9C, g) 10F, h) 7G, i) 5C, j) 3B

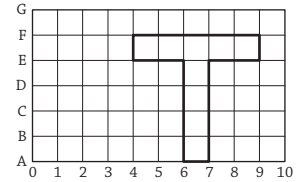
- Skill 23.3** a) (4,6), b) (4,5), c) (6,4), d) (7,4)

- Skill 23.4** a) M(-6,1) N(4,-3), b) sun = (8,7) moon = (3,1), c) M, d) G
e) (12,3), f) (7,-1), g) (5,-2), h) (6,0), i) (-6,-3), j) (2,-1)

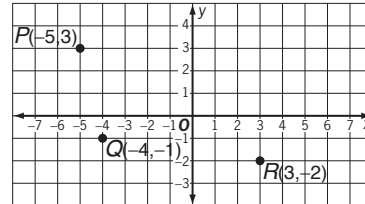
- Skill 23.5** a) house,



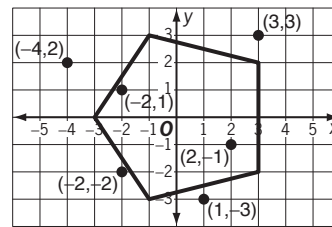
- b) T



- c)



- d) B



- Skill 23.6** a) A, b) C, c) B, d) B, e) C, f) B, g) A, h) C, i) B, j) B, k) C
l) A

- Skill 23.7** a) 1400 yd, b) 4:45 P.M., c) 2.5 h, d) 40°C, e) 200 min
f) 15 miles, g) 14 min, h) 2, i) Lavinia, j) 200 yd, k) D
l) 3:20 P.M., m) 30 min, n) 5 mi

- Skill 23.8** a)

Houses sold (x)	Earnings (2000x)
1	$2000 \cdot 1 = 2000$
2	$2000 \cdot 2 = 4000$
3	$2000 \cdot 3 = 6000$
4	$2000 \cdot 4 = 8000$
5	$2000 \cdot 5 = 10,000$
6	$2000 \cdot 6 = 12,000$

- b)

No. of guests (x)	Dinner cost in dollars (15x)
4	$15 \cdot 4 = 60$
8	$15 \cdot 8 = 120$
12	$15 \cdot 12 = 180$
16	$15 \cdot 16 = 240$
20	$15 \cdot 20 = 300$
24	$15 \cdot 24 = 360$

- c)

No. of days (x)	Records entered (90x)
1	$90 \cdot 1 = 90$
2	$90 \cdot 2 = 180$
3	$90 \cdot 3 = 270$
4	$90 \cdot 4 = 360$
5	$90 \cdot 5 = 450$
6	$90 \cdot 6 = 540$

- d)

No. of days (x)	Number of T-shirts sold (16x)
1	$16 \cdot 1 = 16$
2	$16 \cdot 2 = 32$
3	$16 \cdot 3 = 48$
4	$16 \cdot 4 = 64$
5	$16 \cdot 5 = 80$
6	$16 \cdot 6 = 96$

- e)

No. of hours worked (x)	Pay in dollars (8x)
2	$8 \cdot 2 = 16$
4	$8 \cdot 4 = 32$
6	$8 \cdot 6 = 48$
8	$8 \cdot 8 = 64$
10	$8 \cdot 10 = 80$
12	$8 \cdot 12 = 96$

- f)

No. of s (x)	Distance traveled in yards (18x)
10	$18 \cdot 10 = 180$
20	$18 \cdot 20 = 360$
30	$18 \cdot 30 = 540$
40	$18 \cdot 40 = 720$
50	$18 \cdot 50 = 900$
60	$18 \cdot 60 = 1080$

- g)

x	x + 5	y
0	$0 + 5 = 5$	5
1	$1 + 5 = 6$	6
2	$2 + 5 = 7$	7
3	$3 + 5 = 8$	8
4	$4 + 5 = 9$	9
5	$5 + 5 = 10$	10

- h)

x	8 - x	y
3	$8 - 3 = 5$	5
4	$8 - 4 = 4$	4
5	$8 - 5 = 3$	3
6	$8 - 6 = 2$	2
7	$8 - 7 = 1$	1
8	$8 - 8 = 0$	0

Skill 23.8

i)

x	7+x	y
0	7+0=7	7
2	7+2=9	9
4	7+4=11	11
6	7+6=13	13
8	7+8=15	15
10	7+10=17	17

j)

x	x-4	y
0	0-4=-4	-4
1	1-4=-3	-3
2	2-4=-2	-2
3	3-4=-1	-1
4	4-4=0	0
5	5-4=1	1

k)

x	3x	y
0	3·0=0	0
1	3·1=3	3
2	3·2=6	6
3	3·3=9	9
4	3·4=12	12
5	3·5=15	15

l)

x	x-6	y
1	1-6=-5	-5
2	2-6=-4	-4
3	3-6=-3	-3
4	4-6=-2	-2
5	5-6=-1	-1
6	6-6=0	0

m)

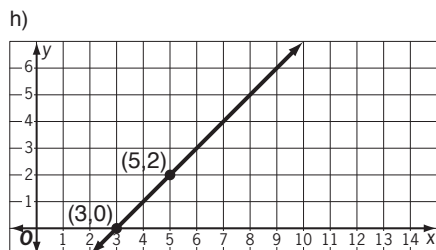
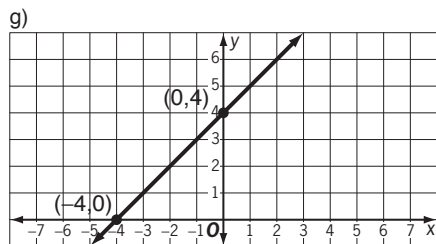
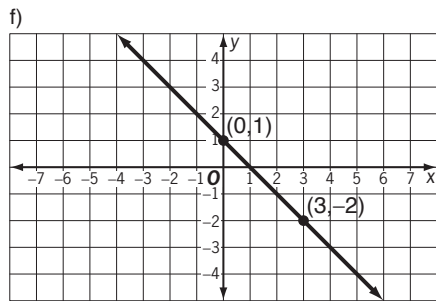
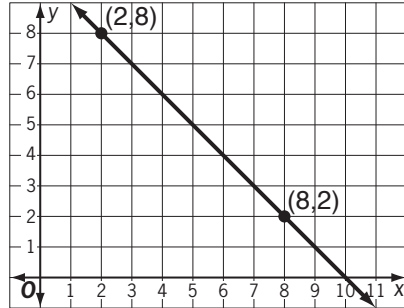
x	100÷x	y
5	100÷5=20	20
10	100÷10=10	10
20	100÷20=5	5
25	100÷25=4	4
50	100÷50=2	2
100	100÷100=1	1

n)

x	2-x	y
0	2-0=2	2
1	2-1=1	1
2	2-2=0	0
3	2-3=-1	-1
4	2-4=-2	-2
5	2-5=-3	-3

Skill 23.9

a) C, b) B, c) A, d) B
e)



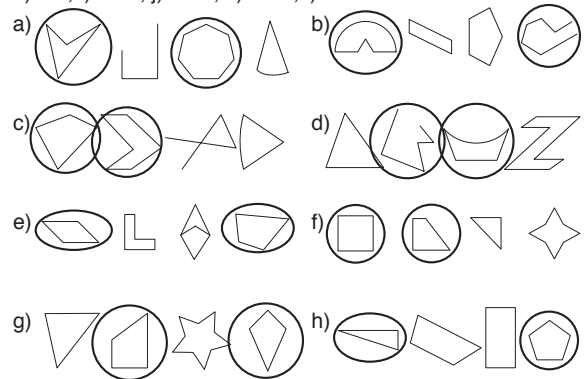
Skill 24.1

a) 55°, b) 40°, c) 90°, d) 70°, e) 155°, f) 15°, g) 130°
h) 60°, i) 45°, j) 105°, k) 80°, l) 160°

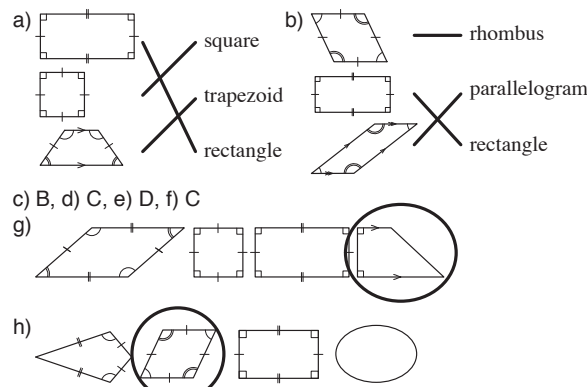
Skill 24.2

a) 120°, b) 75°, c) 80°, d) 125°, e) 95°, f) 145°, g) 45°
h) 30°, i) 110°, j) 155°, k) 130°, l) 15°

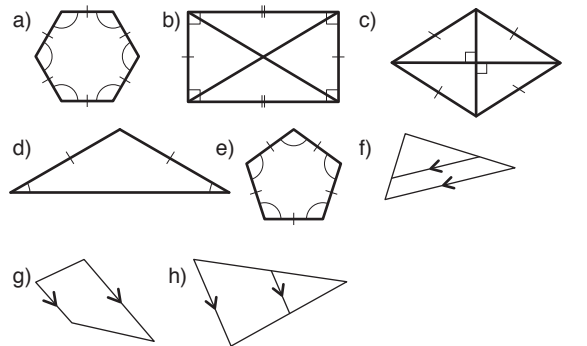
Skill 24.3



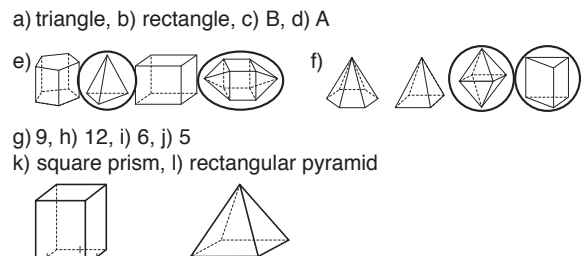
Skill 24.4



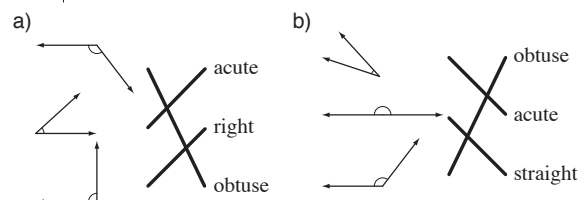
Skill 24.5

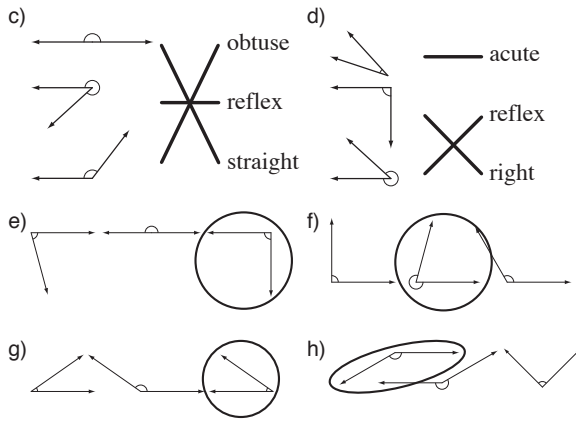


Skill 24.6

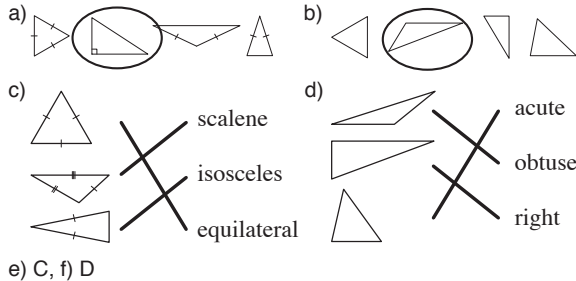


Skill 24.7





Skill 24.8



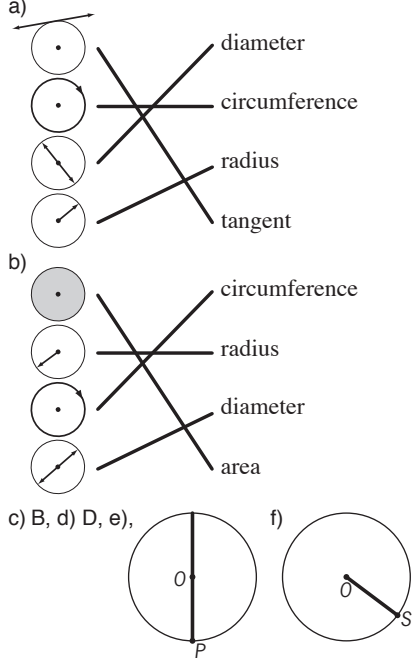
Skill 24.9 a) 43°, b) 155°, c) 18°, d) 21°, e) 63°, f) 30°, g) 17°, h) 20°

Skill 24.10 a) 97°, b) 32°, c) 40°, d) 55°, e) 90°, f) 20°
g) $x^\circ = 115^\circ$, $y^\circ = 75^\circ$, h) $x^\circ = 25^\circ$, $y^\circ = 155^\circ$

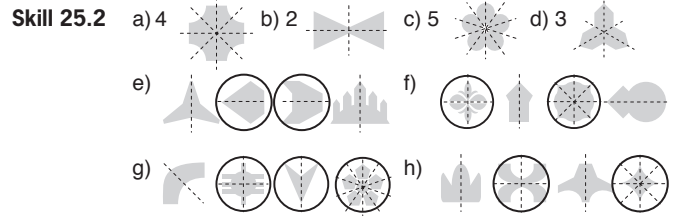
Skill 24.11 a) 40°, b) 56°, c) 25°, d) 105°, e) 55°, f) 48°, g) 108°, h) 70°

Skill 24.12 a) 96°, b) 62°, c) 100°, d) 45°, e) 105°, f) 83°

Skill 24.13



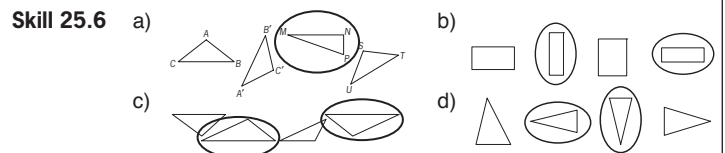
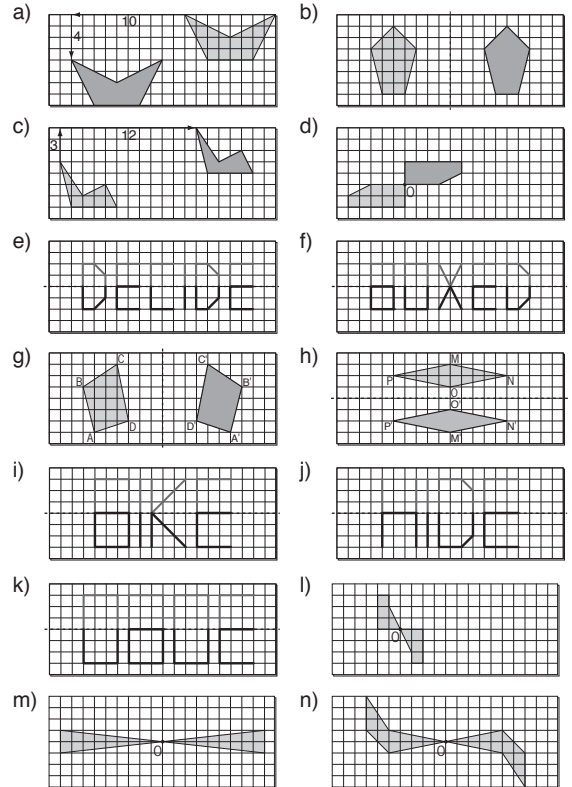
Skill 25.1 a) Dean Street, b) west, c) 2, d) Dodge Hall



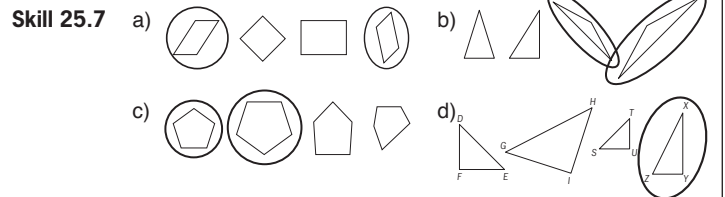
Skill 25.3 a) 1250 m, b) 2500 mi, c) 750 mi, d) 5 mi

Skill 25.4 a) reflection, b) translation, c) translation, d) reflection
e) reflection, f) rotation, g) 90°, h) 135°

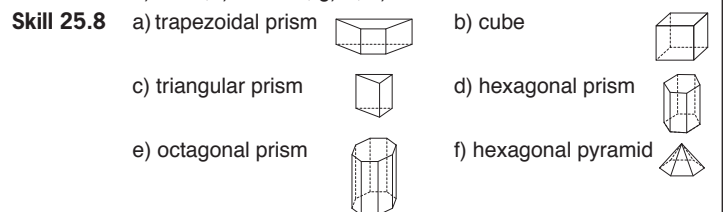
Skill 25.5







e) 1 and 2, f) 1 and 4, g) $\triangle MNO$, h) $\triangle DEF$



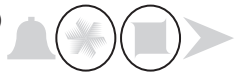





e) $\triangle JKL$, f) 2 and 3, g) A, h) B



25. [Exploring Geometry] cont

Skill 25.9 a) C, b) C, c) , d) , e) , f) 

Skill 25.10 a) triangle, b) triangle, c) rectangle, d) pentagon, e) circle
f) triangle, g) rectangle, h) circle, i) triangle, j) rectangle
k) circle, l) triangle, m) triangle, n) hexagon, o) pentagon
p) rectangle, q) hexagon, r) rectangle

Skill 25.11 a)  b) 
c)  d) 
e) A, B & D, f) A, B, C & D
g)  h) 

26. [Units of Measurement / Time] page 245

Skill 26.1 a) 36 in., b) 27 ft, c) 12 ft, d) 72 in., e) 11 yd, f) 2 yd
g) 10 ft, h) 20 yd, i) 2 ft 3 in., j) 3 yd 1 ft, k) 57 in., l) 16 ft

Skill 26.2 a) 240 mm, b) 12 cm, c) 1300 mm, d) 2.7 m, e) 7 km
f) 640 cm, g) 19,000 mm, h) 5 cm, i) 20,000 cm, j) 0.5 m
k) 4.5 m, l) 5100 mm

Skill 26.3 a) 8000 pounds, b) 48 ounces, c) 10 lb, d) 6 T, e) 9000 lb
f) 6 lb, g) 80 oz, h) 7000 lb, i) 2 T 1500 lb, j) 3 lb 5 oz
k) 26 oz, l) 6500 lb

Skill 26.4 a) 8000 g, b) 9 kg, c) 0.26 kg, d) 3400 g, e) 0.51 kg
f) 0.7 kg, g) 25,900 g, h) 900 g, i) 0.08 kg, j) 650 kg
k) 3.8 t, l) 12,500 kg

Skill 26.5 a) 48 pt, b) 26 pt, c) 12 qt, d) 2 gal, e) 20 qt, f) 32 pt
g) 90 qt, h) 15 gal, i) 7 gal 3 qt, j) 6 qt 1 pt, k) 29 pt, l) 18 qt

Skill 26.6 a) 3700 mL, b) 6000 mL, c) 22,000 mL, d) 8 L, e) 0.25 L
f) 9400 mL, g) 500 mL, h) 1250 mL, i) 30 L, j) 15,300 mL
k) 40,000 mL, l) 0.5 L

Skill 26.7 a) 56 h, b) 300 minutes, c) 240 seconds, d) 3 min, e) 18 h
f) 150 min, g) 75 min, h) 3 h 20 min, i) 2 h 24 min
j) 330 s, k) 26 days, l) 280 min

Skill 26.8 a) 6 h 30 min, b) 1 h 45 min, c) 1 h 15 min, d) 7 h 40 min
e) 10 h 25 min, f) 7 h 10 min

27. [Perimeter] page 253

Skill 27.1 a) 6 in., b) 8 in., c) 5 in., d) 7.5 in.

Skill 27.2 a) 17 cm, b) 108 mm, c) 12 cm, d) 98 mm, e) 123 mm
f) 142 mm

Skill 27.3 a) 70 mm, b) 87 mm, c) 32 ft, d) 90 mm, e) 14.5 cm
f) 120 mm

Skill 27.4 a) 160 ft, b) 1420 cm, c) 160 mm, d) 42 in., e) 340 ft
f) 100 mi

Skill 27.5 a) 164 mm, b) 0.5 ft, c) 90 mm, d) 170 mm, e) 152 mm
f) 16.2 cm

Skill 27.6 a) 8 in., b) 18 cm, c) 8 in., d) 27 cm, e) 130 mm, f) 124 mm

Skill 27.7 a) 30 mm, b) 47 mm, c) 2 in., d) 45 mm

Skill 27.8 a) 3.14 in., b) 62.8 mm, c) 88 mm, d) 132 mm, e) 125.6 mm
f) 3.14 in., g) 157 mm, h) 176 mm, i) 44 mm, j) 94.2 mm

Skill 27.9 a) 116 mm, b) 140 mm, c) 144 mm, d) 170 mm

Skill 27.10 a) 102 mm, b) 150 mm, c) 180 mm, d) 150 mm

28. [Area / Volume] page 265

Skill 28.1 a) 4.5 cm², b) 12 cm², c) 21 cm², d) 3 in.², e) 24 cm²
f) 3.25 in.², g) 12 cm², h) 2 in.², i) 8 cm², j) 12 cm²

Skill 28.2 a) yes, b) no, c) yes, d) yes, e) yes, f) no, g) yes, h) yes
i) yes, j) no, k) yes, l) no

Skill 28.3 a) 9 sq. units, b) 10 sq. units, c) 21 sq. units, d) 14 sq. units

Skill 28.4 a) 14 cm², b) 6 cm², c) 9 cm², d) 8 cm², e) 0.5 in.²
f) 600 mm², g) 9 cm², h) 2.25 in.², i) 100 mm², j) 5.25 cm²
k) 1200 mm², l) 640 mm², m) 1100 mm², n) 720 mm²,

Skill 28.5 a) 2 in.², b) 10.5 cm², c) 7.5 cm², d) 625 mm², e) 3 cm²
f) 520 mm², g) 7.5 cm², h) 400 mm², i) 135 mm²
j) 825 cm²

Skill 28.6 a) 72 cm³, b) 1200 in.³, c) 30 cm³, d) 200 cm³, e) 90 cm³
f) 60 cm³, g) 160 cm³, h) 72 cm³, i) 180 cm³, j) 150 cm³
k) 108 cm³, l) 105 cm³

Skill 28.7 a) 16,800 mm³, b) 12 cm³, c) 0.5 in.³, d) 1000 mm³
e) 120 ft³, f) 10,800 mm³, g) 3375 mm³, h) 22.5 cm³
i) 6.25 cm³, j) 18,000 mm³

Skill 28.8 a) 4.5 cm², b) 28.5 sq. units, c) 57.5 sq. units
d) 37.5 sq. units, e) 42 sq. units, f) 29 sq. units
g) 40 cm², h) 7 cm², i) 770 mm², j) 2.75 in.²

Skill 28.9 a) 392 mm², b) 750 mm², c) 10 cm², d) 625 mm²

Skill 28.10 a) 20.13 cm², b) 1386 mm², c) 6.28 cm², d) 8.56 cm²

Skill 28.11 a) 2500 mm³, b) 17 cm³, c) 56 ft³, d) 9900 mm³, e) 15 cm³
f) 9000 mm³

29. [Statistics] page 283

Skill 29.1 a) 7, b) 3, c) 9, d) 9

Skill 29.2 a) Jupiter, b) Mississippi, c) Australia, d) hydro-electric

Skill 29.3 a) stork, b) 12.5%, c) flea, d) 5, e) anthracite, f) writing

Skill 29.4 a) 2, b) 3, c) bottle-nosed dolphin, d) Australia
e) 1983, 1987 and 1989, f) 5' 10", g) Honda Accord, h) male
i) 2003, j) breast cancer

Skill 29.5 a) Emerson, b) Court, c) Arizona, d) harp seal, e) New York
f) National Book Critics Circle Award, g) 15, h) 1984
i) black, j) 45 - 59

Skill 29.6 a) 5, b) 9, c) 11.5, d) 44°F, e) 16, f) 4, g) 120, h) 4.7
i) mean = 5, median = 5, j) mean = 22, median = 19

Skill 29.7 a) mode = 4, range = 33, b) mode = 1, range = 9
c) mode = 13, range = 26, d) mode = 40, range = 55

Skill 29.8 a) 1979, b) 3 yr, c) 1860 - 1870, d) 8, e) November
f) 190 cents, g) 1990 - 2000, h) 2009, i) French, j) 2008

Skill 29.9 a) OECD, b) hydrogen, c) 18 - 32, d) dogs & cats, e) C, f) no

Skill 29.10 a) fit, b) bituminous, c) glass bottle, d) 50, e) 12, f) more
g) shorter, h) 2, i) B, j) A

Skill 29.11 a)

Stem	Leaf
4	4 8 8
5	5 5 6 7
6	2

 3|5 = 35
b)

Stem	Leaf
18	2
19	2 3 7
20	1 2 2 3 5 5 6

 23|5 = 235 cm

c) median = 57.5, range = 42, d) median = 580, range = 56
e) median = 15, range = 26, f) median = 118, range = 99

Skill 30.1 a) 8, b) 16, c) 11, d) 17, e) 21, f) 116, g) 13, h) 8

Skill 30.2 a) A, b) B, c) B, d) C, e) A, f) D

Skill 30.3 a) 4

Outcomes (sample space)	
male	gorilla
male	chimpanzee
female	gorilla
female	chimpanzee

b) 6

Possible outcomes	Coin	Primary colour		
		R	G	B
	H	H,R	H,G	H,B
	T	T,R	T,G	T,B

c) 12

Possible outcomes	Coin	Die					
		1	2	3	4	5	6
	H	H,1	H,2	H,3	H,4	H,5	H,6
	T	T,1	T,2	T,3	T,4	T,5	T,6

d) 10

Possible outcomes	Coin	Spinner				
		1	2	3	4	5
	H	H,1	H,2	H,3	H,4	H,5
	T	T,1	T,2	T,3	T,4	T,5

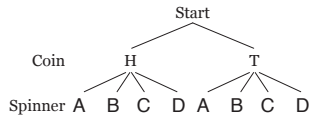
e) 6

Outcomes (sample space)	
silver	convertible
silver	hardtop
red	convertible
red	hardtop
purple	convertible
purple	hardtop

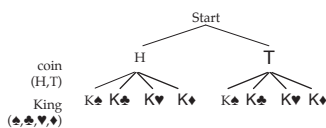
f) 8

Outcomes (sample space)		
vanilla	waffle	hot fudge
vanilla	waffle	caramel
vanilla	sugar	hot fudge
vanilla	sugar	caramel
chocolate	waffle	hot fudge
chocolate	waffle	caramel
chocolate	sugar	hot fudge
chocolate	sugar	caramel

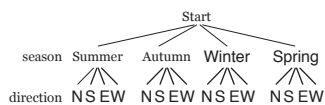
Skill 30.4 a) 8



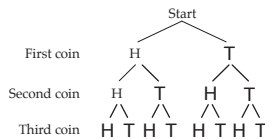
b) 8



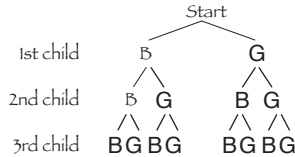
c) 16



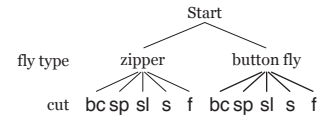
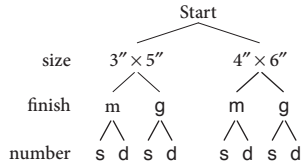
d) 8



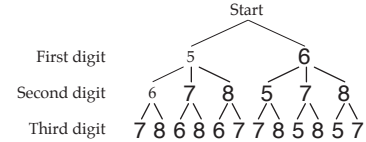
e) 8



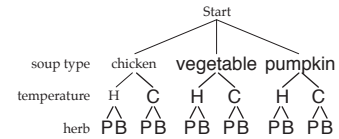
f) 8



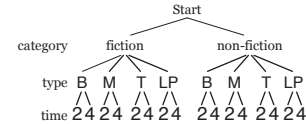
h) 12



i) 12



j) 16



Skill 30.5 a) $\frac{6}{13}$, b) $\frac{1}{2}$ or 0.5, c) $\frac{1}{2}$ or 0.5, d) $\frac{1}{8}$ or 0.125, e) $\frac{1}{2}$ or 0.5
 f) $\frac{2}{11}$, g) $\frac{1}{13}$, h) $\frac{1}{15}$, i) $\frac{1}{20}$ or 0.05, j) $\frac{1}{4}$ or 0.25, k) $\frac{1}{2}$ or 0.5
 l) $\frac{1}{4}$ or 0.25, m) $\frac{1}{2}$ or 0.5, n) $\frac{7}{10}$, o) $\frac{1}{6}$ or 0.16, p) $\frac{2}{5}$ or 0.4
 q) $\frac{1}{6}$, r) $\frac{2}{5}$, s) A, t) A, u) C, v) C, w) C, x) B, y) B, z) A

Skill 30.6 a) B, b) B, c) D, d) B, e) B, f) B

Skill 30.7 a) $\frac{1}{5}$, b) $\frac{1}{4}$, c) $\frac{7}{15}$, d) $\frac{4}{5}$

Skill 30.8 a) 98%, b) $\frac{2}{3}$, c) $\frac{3}{5}$ or 0.6, d) $\frac{7}{10}$ or 0.7, e) $\frac{16}{25}$ or 0.64
 f) 23%

Skill 30.9 a) $\frac{3}{4}$ or 0.75, b) $\frac{1}{3}$ or 0.3, c) $\frac{3}{4}$ or 0.75, d) 1

Skill 30.10 a) 60, b) 120, c) 12, d) 24, e) 20, f) 720, g) 30, h) 36, i) 10
 j) 120