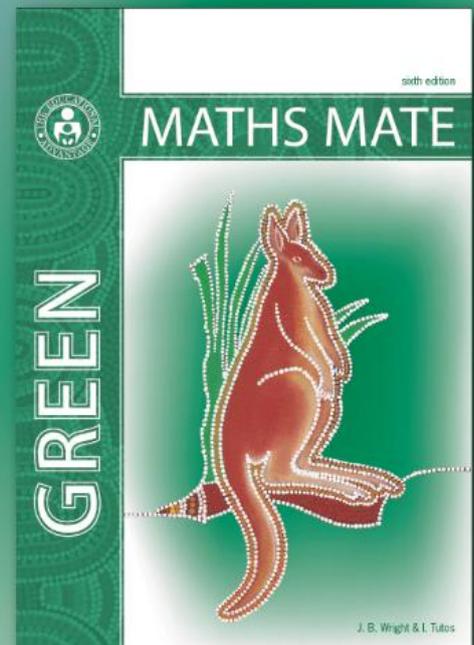
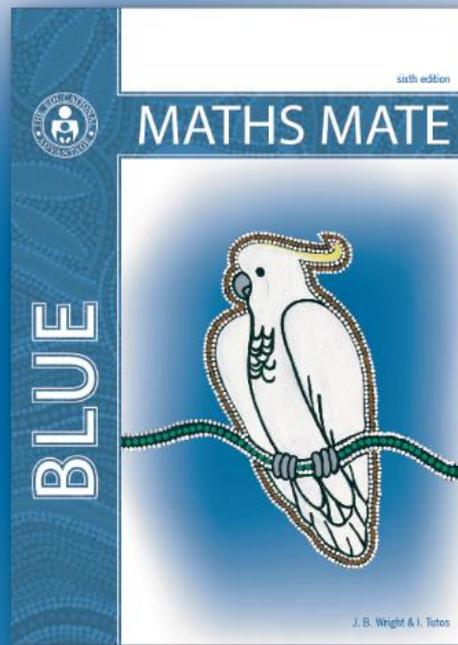


# SKILL BUILDER

sixth edition

# MATHS MATE



J. B. Wright & I. Tutos



**J. B. Wright & I. Tutos**

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**Maths Mate materials available for use**

**STUDENT WORKBOOKS**

**GRADE / YEAR LEVEL INDICATOR**

		AUS 1	2	3	4	5	6	7	8	9	10	11	12
Orange	Student Workbook - 2nd Ed.		[Orange bar]										
Rose	Student Workbook - 2nd Ed.			[Purple bar]									
Yellow	Student Workbook - 5th Ed.			[Yellow bar]									
Red	Student Workbook - 5th Ed.				[Red bar]								
Blue	Student Workbook - 6th Ed.					[Blue bar]							
Green	Student Workbook - 6th Ed.						[Green bar]						
Mauve	Student Workbook - 6th Ed.							[Purple bar]					
9 Gold	Student Workbook - 2nd Ed.								[Gold bar]				
10	Student Workbook - 5th Ed.									[Green bar]			
10 Gold	Student Workbook - 2nd Ed.										[Gold bar]		

**NZ Y2 Y3 Y4 Y5 Y6 Y7 Y8 Y9 Y10 Y11 Y12 Y13**

**TEACHER RESOURCES**

Maths Mate Teacher Resources (for all year levels, PDF format)

**SKILL BUILDERS**

- Skill Builder Orange/Rose - 2nd Ed. PDF format
- Skill Builder Yellow/Red - 5th Ed. PDF format
- Skill Builder Blue/Green - 6th Ed. PDF format
- Skill Builder Mauve/Lime - 6th Ed. PDF format

**TEXTBOOKS**

The textbooks are presented as 12 booklets, each providing about 3 weeks work. Each booklet begins with a low-floor high-ceiling challenge that draws students into the topic of study, allowing them to experience discovery for themselves, no matter their place within a mixed ability classroom. Having gained the students' interest and curiosity, each booklet provides thought-filled lessons that include challenging openers, new skills and exercises. Intriguing puzzles, games and problem solving are carefully interwoven throughout each booklet.

Maths Mate Textbooks are available for purchase through [www.mathsmate.net](http://www.mathsmate.net)

# TEACHER'S GUIDE

## 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 Maths 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 Maths Mate Program, and are motivated to do something about them.

The Maths Mate record keeping sheets found at the start of each term in each Student Pad (and on the Teacher Resources ~ Record Keeping Sheets, pages 1 to 4) 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 Maths Mate Program except the problem solving questions. The Problem Solving Hints & Solutions (see Teacher Resources ~ Problem Solving Hints & Solutions) 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 Maths Mate and Skill Builders

Blue	1	2	3	4
Green	1	2	3	4

Any question on the Maths Mate sheets is part of a set of 4 similar questions in the term. For example, consider sheets 1, 2, 3 and 4 in Maths Mate 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 Maths Mate tests made available in the Teacher Resources (see Teacher Resources ~ Test Masters, pages 1 to 32 and Test Answers, pages 1 to 32) 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, would relate a skill to questions in the first 4 sheets of MM Blue term 1, the last 4 sheets of MM Blue term 2 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 Maths Mate worksheet, questions 1 through to 33 get progressively harder. (Refer - How to use the Skill Builders, page iv)

### Suggestions for the preparation and organisation of Skill Builders

Teachers can either direct students to their digital copies or print copies of particular pages for students. 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. Students should be reminded that the Glossary is a valuable resource that can be added to. The Glossary too can be 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. 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 MATHS MATE SKILL BUILDERS

## 1. Determine which Maths 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, then that question requires a Skill Builder.

For example, question 13 in Sheets 1, 2, 3 and 4 is not shaded, so Skill 13.1 from Skill Builder 13 needs to be handed to the student.

Term 1	Sheet 1	Sheet 2	Sheet 3	Sheet 4	Skill Builder	Sheet 1	Sheet 2	Sheet 3	Sheet 4	Skill Builder
1. [- Whole Numbers to 10]	10	10	10	10	1.1	10	10	10	10	1.1
2. [- Whole Numbers to 10]	10	10	10	10	2.1	10	10	10	10	2.1
3. [- Whole Numbers to 10]	10	10	10	10	3.1	10	10	10	10	3.1
4. [- Whole Numbers to 12]	10	10	10	10	4.1	10	10	10	10	4.1
5. [Large Number +,-]	10	10	10	10	5.2	10	10	10	10	5.1
6. [Large Number x,-]	10	10	10	10	6.2	10	10	10	10	6.1
7. [Decimal +,-]	10	10	10	10	7.1	10	10	10	10	7.2
8. [Decimal x,-]	10	10	10	10	8.1	10	10	10	10	8.2
9. [Fraction +,-]	10	10	10	10	9.1,2	10	10	10	10	9.1,2
10. [Fraction x,-]	10	10	10	10	10.1	10	10	10	10	10.1
11. [Percentages]	10	10	10	10	11.1	10	10	10	10	11.2
12. [Decimals / Fractions / Percentages]	10	10	10	10	12.1	10	10	10	10	12.2
13. [Integers]	10	10	10	10	13.1	10	10	10	10	13.1
14. [Rates / Ratios]	10	10	10	10	14.1	10	10	10	10	14.2
15. [Indices / Square Roots]	10	10	10	10	15.1	10	10	10	10	15.2
16. [Order of Operations]	10	10	10	10	16.1	10	10	10	10	16.2
17. [Expanding Numbers]	10	10	10	10	17.1	10	10	10	10	17.2
18. [Multiples / Factors / Primes]	10	10	10	10	18.1,2	10	10	10	10	18.3
19. [Number Patterns]	10	10	10	10	19.1	10	10	10	10	19.2
20. [Expressions]	10	10	10	10	20.1	10	10	10	10	20.1
21. [Substitution]	10	10	10	10	21.1	10	10	10	10	21.2
22. [Equations]	10	10	10	10	22.1	10	10	10	10	22.1
23. [Coordinates]	10	10	10	10	23.1	10	10	10	10	23.2
24. [Units of Measurements / Time]	10	10	10	10	24.1	10	10	10	10	24.2
25. [Perimeter]	10	10	10	10	25.1	10	10	10	10	25.1,2
26. [Area / Volume]	10	10	10	10	26.1	10	10	10	10	26.2
27. [Shapes]	10	10	10	10	27.1	10	10	10	10	27.2
28. [Location / Time Information]	10	10	10	10	28.1	10	10	10	10	28.2
29. [Statistics]	10	10	10	10	29.1	10	10	10	10	29.2
30. [Probability]	10	10	10	10	30.1	10	10	10	10	30.2
31. [Problem Solving 1]	10	10	10	10	Skills & Solutions	10	10	10	10	Skills & Solutions
32. [Problem Solving 2]	10	10	10	10	Skills & Solutions	10	10	10	10	Skills & Solutions
33. [Problem Solving 3]	10	10	10	10	Skills & Solutions	10	10	10	10	Skills & Solutions
Total Correct	20	24	22	26						

## 2. Find the relevant Skill Builder on the Maths 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 326). 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, so when a student has several areas of weakness, they should work on the lowest numbered skill builders first. For example, a student struggling with Q9 and Q12 may need to build skills required for Q9 before they can improve Q12.

**13. [Integers]**

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.

Q. Who won the 2010 Women's British Open Golf Tournament? (Hint: In golf the lowest score wins.)  
A) +5 K. Webb  
B) -10 K. Hull  
C) -11 Y. Tseng  
A. C Find the lowest score to determine the winner.

a) Which of Saturn's moons has the highest temperature?  
A) -201°C Enceladus  
B) -200°C Mimas  
C) -187°C Tethys  
C

b) Which temperature for oxygen is higher?  
A) -183°C boiling point  
B) -218°C melting point

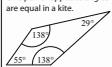
c) Who won the 2010 British Open Golf Tournament? (Hint: In golf the lowest score wins.)  
A) -16 L. Oosthuizen  
B) +3 P. Senior  
C) -2 R. Allenby

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

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

The glossary (pages 327 to 378) 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 “operation” before attempting to complete Skill 13.1

<b>once</b>	• On one occasion.	Just this time!
<b>operation</b>	• A mathematical process performed according to certain <i>rules</i> .	There are four basic operations in arithmetic: addition $3 + 12$ subtraction $3 - 1$ multiplication $1 \times 5$ division $6 \div 3$ There are many complex operations like: sine $30^\circ$ , $\sqrt{9}$ and $\log_{10} 100, 5^4$ .
<b>opposite angles</b>	• Angles across from each other in a shape.	One pair of opposite angles are equal in a kite. 
<b>opposite sides</b>	• Sides across from each other in a shape.	Side $\overline{AB}$ is opposite to side $\overline{CD}$ Side $\overline{AD}$ is opposite to side $\overline{BC}$ 
<b>opposites</b>	• Two <i>numbers</i> with the same <i>absolute value</i> but different <i>signs</i> .	The opposite of +4 is -4.
<b>order</b>	• Placing a group in a special arrangement.	The aliens are arranged in order of height. 
<b>order of operations</b>	• The order of doing <i>operations</i> is: 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.	Calculate $4 + 3 \times (6 - 2)$ by 1) $4 + 3 \times (6 - 2)$ 2) $4 + 3 \times 4$ 3) $4 + 9 \times 4$ 4) $4 + 36$ = 40
<b>ordered pair</b>	• See <i>coordinates</i> .	
<b>ordinal numbers</b>	• A <i>whole number</i> that shows position.	1st, 2nd, 3rd, 4th, 5th.... are ordinal numbers.
<b>orientation</b>	• Position relative to <i>direction</i> .	The tornado is coming from the west. 

page 352 © Maths Mate Blue/Green Skill Builder Glossary

### 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 387)

### 6. Circle the completed skill numbers on the Maths Mate worksheet results sheet



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
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
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
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
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
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
23. [Coordinates]	23.1	23.2	23.3	23.4	23.5	23.6	23.7	23.8	23.9	23.10	23.11	23.12
24. [Units of Measurement / Time]	24.1	24.2	24.3	24.4	24.5	24.6	24.7	24.8	24.9	24.10	24.11	24.12
25. [Perimeter]	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.8	25.9	25.10	25.11	25.12

### 7. Go back and repeat previous Maths Mate questions

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

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MM	SB	[Maths Mate - Mathematical strand]	
Question	Skill No.	Skill Builder - Skill description	
<b>1.</b>		<b>[+ Whole Numbers to 10]</b> .....	<b>1</b>
	1.1	Adding whole numbers from 1 to 10.	
	1.2	Adding whole numbers from 1 to 10 to negative numbers.	
<b>2.</b>		<b>[- Whole Numbers to 10]</b> .....	<b>3</b>
	2.1	Subtracting whole numbers from 1 to 10.	
	2.2	Subtracting whole numbers from 1 to 10 from negative numbers.	
<b>3.</b>		<b>[× Whole Numbers to 12]</b> .....	<b>5</b>
	3.1	Multiplying whole numbers from 1 to 12.	
	3.2	Multiplying whole numbers from 1 to 12 by negative numbers.	
<b>4.</b>		<b>[÷ Whole Numbers to 12]</b> .....	<b>7</b>
	4.1	Dividing whole numbers from 1 to 12.	
	4.2	Dividing whole numbers from 1 to 12 into negative numbers.	
<b>5.</b>		<b>[Large Number +, -]</b> .....	<b>9</b>
	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.	
<b>6.</b>		<b>[Large Number ×, ÷]</b> .....	<b>15</b>
	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.	
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	6.10	Dividing a whole number - answer as a terminating decimal.	
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	7.3	Subtracting a decimal number from a whole number.	

MM Question	SB Skill No.	[Maths Mate - Mathematical strand] Skill Builder - Skill description	
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	8.3	Multiplying a decimal number by a power of 10.	
	8.4	Dividing a decimal number by a power of 10.	
	8.5	Multiplying a decimal number by another decimal number.	
	8.6	Dividing a decimal number by another decimal number.	
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MM	SB	[Maths Mate - Mathematical strand]	
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# 1. [+ Whole Numbers to 10]

Skill 1.1 Adding whole numbers from 1 to 10.

Blue 11 22 33 44  
Green 11 22 33 44

EITHER

**Regroup into easier numbers**

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

$$\begin{aligned} \text{Example: } 5 + 8 \\ &= 5 + 5 + 3 \\ &= 10 + 3 \\ &= 13 \end{aligned}$$

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.

Blue 11 22 33 44  
Green 11 22 33 44

- Use a number line.

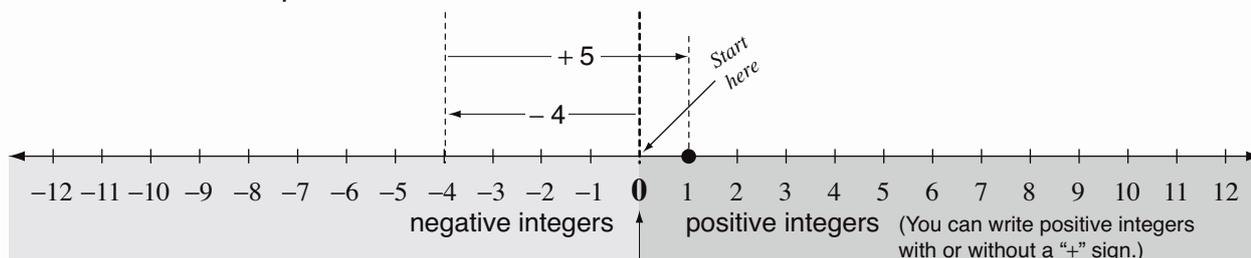
Example:  $-4 + 5$  is read as: negative 4 plus 5

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

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										

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.

Blue 11 22 33 44  
Green 11 22 33 44

EITHER

**Break down to easier numbers**

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

$$\begin{aligned} \text{Example: } 16 - 9 \\ &= 15 - 8 \\ &= 14 - 7 \\ &= 13 - 6 \\ &= 12 - 5 \\ &= 11 - 4 \\ &= 10 - 3 \\ &= 7 \end{aligned}$$

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 groups of 10.

$$\begin{aligned} \text{Example: } 16 - 9 \\ \text{Add 1 to 9 to make 10} \\ \text{and another 6 to get to 16.} \\ 1 + 6 = 7 \end{aligned}$$

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

$$\text{Example: } 16 - 9 = ?$$

Reword the subtraction by turning it into an addition. What number when added to 9 will give 16?

From the addition table,

$$9 + 7 = 16$$

$$\text{So } 16 - 9 = 7$$

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. Yellow 1 1 2 2 3 3 4 4  
Red 1 1 2 2 3 3 4 4

- Use a number line.

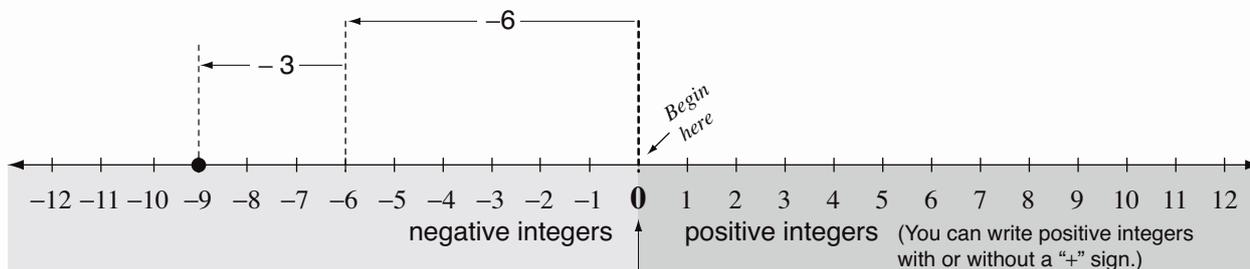
Example:  $-6 - 3$  is read as: negative 6 subtract 3 OR negative 6 minus 3

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
	-3										

Subtract 3 from each of the numbers on the top row.

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.

Blue 11 22 33 44  
Green 11 22 33 44

- 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	54	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										

### Skill 3.2 Multiplying whole numbers from 1 to 12 by negative numbers.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- 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 multiplication rules.

#### Multiplication Rules

different signs: positive  $\times$  negative = negative  
negative  $\times$  positive = negative

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

$\times$	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
$\times 6$										

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

A.

	-3	7	9	-11	5	-4	2	-10	-8	12
$\times 6$	-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
$\times 3$	9	-15								

b)

	7	-4	-2	3	8	-5	9	1	6	-10
$\times 5$	35									

c)

	-6	2	11	-5	10	8	-4	9	-7	1
$\times 11$										

d)

	-7	3	-1	-2	9	-6	10	5	-8	4
$\times 4$										

e)

	2	-7	9	-5	3	6	-12	10	-4	8
$\times 7$										

f)

	-12	3	8	-4	-7	-9	5	11	10	-6
$\times 9$										

## 4. [ $\div$ Whole Numbers to 12]

### Skill 4.1 Dividing whole numbers from 1 to 12.

Blue 11 22 33 44  
Green 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

$\times$	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
$\div 6$										

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

A. 

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

a) 

	16	28	8	40	24	20	4	32	36	44
$\div 4$	4									

b) 

	99	66	33	121	44	88	77	110	11	22
$\div 11$										

c) 

	40	90	120	30	100	10	70	50	80	60
$\div 10$										

d) 

	56	14	28	70	63	7	21	84	42	77
$\div 7$										

e) 

	120	48	36	24	144	60	12	96	84	72
$\div 12$										

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

Blue 11 22 33 44  
Green 11 22 33 44

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

### Division Rules

different signs: positive  $\div$  negative = negative  
negative  $\div$  positive = negative

Example: How many 5's go into negative 30?  
 $-30 \div 5 = ?$

Reworded: 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

$\times$	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
$\div 5$										

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

A.

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

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

a)

	12	21	-6	30	15	-18	36	-33	3	-24
$\div 3$	4									

b)

	5	-30	10	45	-35	40	-25	60	15	-20
$\div 5$										

c)

	-44	88	121	-55	22	77	-33	11	-66	99
$\div 11$										

d)

	56	72	-8	-40	32	16	64	-24	48	-80
$\div 8$										

e)

	66	-48	36	-24	18	60	-12	30	54	-42
$\div 6$										

f)

	108	-90	-9	-45	63	36	-72	99	-18	27
$\div 9$										

# 5. [Large Number +,-]

## Skill 5.1 Adding large numbers without carry over.

Blue 1 2 2 3 3 4 4  
Green 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.  $1276 + 4520 = 5796$

**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

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

thousands  
hundreds  
tens  
units

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)  $4317 + 552 =$

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

f)  $1622 + 240 =$

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

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.

Blue 1 1 2 2 3 3 4 4  
Green 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.  $4875 - 2041 =$

A.  $4875 - 2041 = 2834$

**Units:**  $5 - 1 = 4 \Rightarrow 4$  units

**Tens:**  $7 - 4 = 3 \Rightarrow 3$  tens

**Hundreds:**  $8 - 0 = 8 \Rightarrow 8$  hundreds

**Thousands:**  $4 - 2 = 2 \Rightarrow 2$  thousands

$$\begin{array}{r} 4875 \\ - 2041 \\ \hline 2834 \end{array}$$

Thousands    hundreds    tens    units

a)  $2996 - 735 =$

**2261**

$$\begin{array}{r} 2996 \\ - 735 \\ \hline 2261 \end{array}$$

b)  $1473 - 302 =$

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

c)  $1384 - 261 =$

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

d)  $5381 - 280 =$

$$\begin{array}{r} 5381 \\ - 280 \\ \hline \end{array}$$

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.

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

Q.  $7496 + 1884 =$     A.  $7496 + 1884 = 9380$

$$\begin{array}{r}
 \overset{1}{7} \overset{1}{4} \overset{1}{9} 6 \\
 + 1884 \\
 \hline
 9380 \\
 \hline
 \end{array}$$

thousands    hundreds    tens    units

**Units:**  $6 + 4 = 10$   
 $10 \text{ units} = 1 \text{ ten and } 0 \text{ units} \Rightarrow 0 \text{ units}$   
 Carry the 1 ten to the tens column.

**Tens:**  $9 + 8 + \text{carry } 1 = 18$   
 $18 \text{ tens} = 1 \text{ hundred and } 8 \text{ tens} \Rightarrow 8 \text{ tens}$   
 Carry the 1 hundred to the next column.

**Hundreds:**  $4 + 8 + \text{carry } 1 = 13$   
 $13 \text{ hundreds} = 1 \text{ thousand and } 3 \text{ hundreds} \Rightarrow 3 \text{ hundreds}$   
 Carry the 1 thousand to the next column.

**Thousands:**  $7 + 1 + \text{carry } 1 = 9$   
 $\Rightarrow 9 \text{ thousands}$

a)  $2873 + 651 =$  **3524**

$$\begin{array}{r}
 \overset{1}{2} \overset{1}{8} 7 3 \\
 + 651 \\
 \hline
 3524 \\
 \hline
 \end{array}$$

b)  $4388 + 622 =$   

$$\begin{array}{r}
 4388 \\
 + 622 \\
 \hline
 \hline
 \end{array}$$

c)  $261 + 1384 =$   

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

d)  $5783 + 2791 =$   

$$\begin{array}{r}
 5783 \\
 + 2791 \\
 \hline
 \hline
 \end{array}$$

e)  $3367 + 2945 =$   

$$\begin{array}{r}
 3367 \\
 + 2945 \\
 \hline
 \hline
 \end{array}$$

f)  $1592 + 4318 =$   

$$\begin{array}{r}
 1592 \\
 + 4318 \\
 \hline
 \hline
 \end{array}$$

g)  $6256 + 2938 =$   

$$\begin{array}{r}
 6256 \\
 + 2938 \\
 \hline
 \hline
 \end{array}$$

h)  $2098 + 3147 =$   

$$\begin{array}{r}
 2098 \\
 + 3147 \\
 \hline
 \hline
 \end{array}$$

i)  $5437 + 2659 =$   

$$\begin{array}{r}
 5437 \\
 + 2659 \\
 \hline
 \hline
 \end{array}$$

j)  $46723 + 3581 =$   

$$\begin{array}{r}
 46723 \\
 + 3581 \\
 \hline
 \hline
 \end{array}$$

k)  $42087 + 7531 =$   

$$\begin{array}{r}
 42087 \\
 + 7531 \\
 \hline
 \hline
 \end{array}$$

l)  $66249 + 5852 =$   

$$\begin{array}{r}
 66249 \\
 + 5852 \\
 \hline
 \hline
 \end{array}$$



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

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

**g)**  $6319 - 254 =$

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

**h)**  $8536 - 914 =$

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

**i)**  $2735 - 719 =$

$$\begin{array}{r} 2735 \\ - 719 \\ \hline \\ \hline \end{array}$$

**j)**  $9307 - 2453 =$

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

**k)**  $4083 - 1957 =$

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

**l)**  $7062 - 2948 =$

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

**m)**  $4208 - 657 =$

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

**n)**  $2009 - 121 =$

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

**o)**  $3564 - 285 =$

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

**p)**  $8357 - 489 =$

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

**q)**  $7231 - 645 =$

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

**r)**  $6534 - 3977 =$

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

**s)**  $64851 - 6770 =$

$$\begin{array}{r} 64851 \\ - 6770 \\ \hline \\ \hline \end{array}$$

**t)**  $31764 - 5936 =$

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

**u)**  $72004 - 4527 =$

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

**v)**  $63148 - 7980 =$

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

**w)**  $41408 - 2623 =$

$$\begin{array}{r} 41408 \\ - 2623 \\ \hline \\ \hline \end{array}$$

**x)**  $52009 - 1772 =$

$$\begin{array}{r} 52009 \\ - 1772 \\ \hline \\ \hline \end{array}$$

- Work from left to right.

**Q.**  $184 + 2076 - 532 =$

**A.**  $184 + 2076 - 532 = 1728$

Complete the addition first  
 $184 + 2076 = 2260$   
 Then subtract 532 from 2260  
 $2260 - 532 = 1728$

$$\begin{array}{r}
 \begin{array}{r}
 \overset{1}{1} \ \overset{1}{8} \ \overset{1}{4} \\
 + \ 2 \ 0 \ 7 \ 6 \\
 \hline
 2 \ 2 \ 6 \ 0
 \end{array} \\
 \begin{array}{r}
 \overset{1}{2} \ \overset{1}{2} \ \overset{5}{6} \ \overset{1}{0} \\
 - \ 5 \ 3 \ 2 \\
 \hline
 1 \ 7 \ 2 \ 8
 \end{array} \\
 \begin{array}{l}
 \text{thousands} \\
 \text{hundreds} \\
 \text{tens} \\
 \text{units}
 \end{array}
 \end{array}$$

**a)**  $1294 + 784 + 3055 =$

**5133**

**b)**  $776 + 529 + 380 =$

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

$$\begin{array}{r}
 \quad \quad 7 \ 7 \ 6 \\
 + \\
 \hline
 \\
 \hline
 \end{array}$$

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

**d)**  $598 + 1763 - 555 =$

$$\begin{array}{r}
 \quad \quad 9 \ 4 \ 5 \\
 + \\
 \hline
 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 \quad \quad 5 \ 9 \ 8 \\
 + \\
 \hline
 \\
 \hline
 \end{array}
 \quad
 \begin{array}{r}
 \quad \quad 5 \ 5 \ 5 \\
 - \\
 \hline
 \\
 \hline
 \end{array}$$

**e)**  $764 + 8359 - 847 =$

**f)**  $1435 + 2957 - 444 =$

$$\begin{array}{r}
 \quad \quad 7 \ 6 \ 4 \\
 + \\
 \hline
 \\
 \hline
 \end{array}
 \quad
 \begin{array}{r}
 \quad \quad \quad \quad \\
 - \\
 \hline
 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 + \\
 \hline
 \\
 \hline
 \end{array}
 \quad
 \begin{array}{r}
 - \\
 \hline
 \\
 \hline
 \end{array}$$

**g)**  $4000 + 10000 - 11374 =$

**h)**  $17000 + 2000 - 13857 =$

$$\begin{array}{r}
 \quad \quad 4 \ 0 \ 0 \ 0 \\
 + \\
 \hline
 \\
 \hline
 \end{array}
 \quad
 \begin{array}{r}
 - \\
 \hline
 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 + \\
 \hline
 \\
 \hline
 \end{array}
 \quad
 \begin{array}{r}
 - \\
 \hline
 \\
 \hline
 \end{array}$$

# 6. [Large Number $\times, \div$ ]

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

Blue 1 1 2 2 3 3 4 4  
Green 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.  $235 \times 1000 =$

A.  $235 \times 1000 = 235\ 000$  Add 3 zeros

a)  $318 \times 10 =$

**3180**

b)  $5090 \times 10 =$

c)  $9080 \times 10 =$

d)  $467 \times 100 =$

e)  $7015 \times 100 =$

f)  $4619 \times 100 =$

g)  $179 \times 1000 =$

h)  $412 \times 1000 =$

i)  $905 \times 1000 =$

j)  $506 \times 1000 =$

k)  $803 \times 1000 =$

l)  $248 \times 1000 =$

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

Blue 1 1 2 2 3 3 4 4  
Green 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.**  $160\,000 \div 1000 =$

**A.**  $160\cancel{000} \div 1\cancel{000} =$   
 $= 160$

OR  $160\,000 \div 1000$

$$= \frac{160\,000 \div 1000}{1000 \div 1000}$$

$$= \frac{160\cancel{000}}{1\cancel{000}}$$

$$= 160$$

Any division can be written as a fraction.

Simplify by dividing both the numerator and denominator by 1000.

Cross off the respective zeros.

**a)**  $460 \div 10 =$

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

$$= \frac{46\cancel{0}}{1\cancel{0}} = \boxed{46}$$

**b)**  $330 \div 10 =$

$$= \frac{330 \div 10}{10 \div 10}$$

$$= \frac{33\cancel{0}}{1\cancel{0}} = \boxed{\phantom{00}}$$

**c)**  $1090 \div 10 =$

$$= \frac{109\cancel{0}}{1\cancel{0}} = \boxed{\phantom{00}}$$

**d)**  $5800 \div 100 =$

$$= \frac{5800 \div 100}{100 \div 100}$$

$$= \frac{58\cancel{00}}{1\cancel{00}} = \boxed{\phantom{00}}$$

**e)**  $2700 \div 100 =$

$$= \frac{27\cancel{00}}{1\cancel{00}} = \boxed{\phantom{00}}$$

**f)**  $82000 \div 100 =$

$$= \frac{820\cancel{00}}{1\cancel{00}} = \boxed{\phantom{00}}$$

**g)**  $23000 \div 100 =$

$$= \frac{230\cancel{00}}{1\cancel{00}} = \boxed{\phantom{00}}$$

**h)**  $480000 \div 100 =$

$$= \frac{4800\cancel{00}}{1\cancel{00}} = \boxed{\phantom{00}}$$

**i)**  $200500 \div 100 =$

$$= \frac{2005\cancel{00}}{1\cancel{00}} = \boxed{\phantom{00}}$$

**j)**  $570000 \div 1000 =$

$$= \frac{570\cancel{000}}{1\cancel{000}} = \boxed{\phantom{00}}$$

**k)**  $706000 \div 1000 =$

$$= \frac{706\cancel{000}}{1\cancel{000}} = \boxed{\phantom{00}}$$

**l)**  $309000 \div 1000 =$

$$= \frac{309\cancel{000}}{1\cancel{000}} = \boxed{\phantom{00}}$$

### Skill 6.3 Multiplying a large number by a single digit.

Blue 1 1 2 3 3 4 4  
Green 1 1 2 3 3 4 4

- 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.  $3036 \times 8 =$

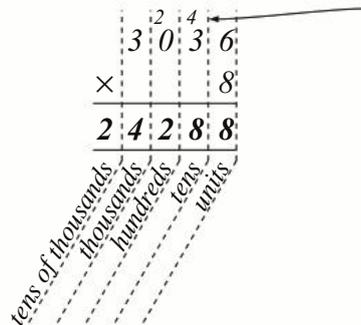
A.  $3036 \times 8 = 24288$

**Units:**  $8 \times 6 = 48$   
 $48 \text{ units} = 4 \text{ tens and } 8 \text{ units} \Rightarrow 8 \text{ units}$   
 Carry the 4 tens to the next column.

**Tens:**  $8 \times 3 = 24$ ,  $24 + 4 = 28$   
 $28 \text{ tens} = 2 \text{ hundred and } 8 \text{ tens} \Rightarrow 8 \text{ tens}$   
 Carry the 2 hundreds to the next column.

**Hundreds:**  $8 \times 0 = 0$   
 $0 + 2 = 2 \Rightarrow 2 \text{ hundreds}$

**Thousands:**  $8 \times 3 = 24 \Rightarrow 24 \text{ thousands}$



a)  $65 \times 6 =$

**390**

b)  $34 \times 9 =$

c)  $59 \times 7 =$

$$\begin{array}{r} \overset{3}{6} 5 \\ \times \quad 6 \\ \hline 390 \end{array}$$

Units first!

$$\begin{array}{r} 34 \\ \times \quad 9 \\ \hline \end{array}$$

$$\begin{array}{r} 59 \\ \times \quad 7 \\ \hline \end{array}$$

d)  $517 \times 3 =$

e)  $265 \times 4 =$

f)  $440 \times 8 =$

$$\begin{array}{r} \overset{2}{5} 1 7 \\ \times \quad 3 \\ \hline \end{array}$$

Units first!

$$\begin{array}{r} 265 \\ \times \quad 4 \\ \hline \end{array}$$

$$\begin{array}{r} 440 \\ \times \quad 8 \\ \hline \end{array}$$

g)  $413 \times 9 =$

h)  $2058 \times 6 =$

i)  $2015 \times 5 =$

$$\begin{array}{r} \overset{2}{4} 1 3 \\ \times \quad 9 \\ \hline \end{array}$$

$$\begin{array}{r} 2058 \\ \times \quad 6 \\ \hline \end{array}$$

$$\begin{array}{r} 2015 \\ \times \quad 5 \\ \hline \end{array}$$

j)  $3627 \times 2 =$

k)  $5214 \times 3 =$

l)  $4382 \times 4 =$

$$\begin{array}{r} 3627 \\ \times \quad 2 \\ \hline \end{array}$$

$$\begin{array}{r} 5214 \\ \times \quad 3 \\ \hline \end{array}$$

$$\begin{array}{r} 4382 \\ \times \quad 4 \\ \hline \end{array}$$

## Skill 6.4 Dividing a large number by a single digit.

Blue 11 22 33 44  
Green 11 22 33 44

- 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, to create a two-digit number. Then try dividing again.

**Q.**  $7168 \div 8 =$

**A.**  $7168 \div 8 = 896$

$$\begin{array}{r} 896 \\ 8 \overline{) 7168} \\ \underline{56} \phantom{0} \\ 16 \phantom{0} \\ \underline{16} \phantom{0} \\ 0 \phantom{0} \\ \underline{0} \\ 0 \end{array}$$

Divide 8 into 7.

8 does not 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**

$$\begin{array}{r} 156 \\ 3 \overline{) 468} \\ \underline{12} \phantom{0} \\ 34 \phantom{0} \\ \underline{30} \phantom{0} \\ 48 \\ \underline{48} \\ 0 \end{array}$$

**b)**  $316 \div 4 =$

$$\begin{array}{r} 78 \\ 4 \overline{) 316} \\ \underline{28} \phantom{0} \\ 36 \\ \underline{32} \\ 4 \end{array}$$

**c)**  $475 \div 5 =$

$$\begin{array}{r} 95 \\ 5 \overline{) 475} \\ \underline{45} \phantom{0} \\ 25 \\ \underline{25} \\ 0 \end{array}$$

**d)**  $546 \div 6 =$

$$\begin{array}{r} 91 \\ 6 \overline{) 546} \\ \underline{54} \phantom{0} \\ 6 \\ \underline{6} \\ 0 \end{array}$$

**e)**  $296 \div 8 =$

$$\begin{array}{r} 37 \\ 8 \overline{) 296} \\ \underline{24} \phantom{0} \\ 56 \\ \underline{56} \\ 0 \end{array}$$

**f)**  $387 \div 9 =$

$$\begin{array}{r} 43 \\ 9 \overline{) 387} \\ \underline{36} \phantom{0} \\ 27 \\ \underline{27} \\ 0 \end{array}$$

**g)**  $1731 \div 3 =$

$$\begin{array}{r} 577 \\ 3 \overline{) 1731} \\ \underline{15} \phantom{00} \\ 23 \phantom{0} \\ \underline{21} \phantom{0} \\ 21 \\ \underline{21} \\ 0 \end{array}$$

**h)**  $5052 \div 6 =$

$$\begin{array}{r} 842 \\ 6 \overline{) 5052} \\ \underline{48} \phantom{00} \\ 25 \phantom{0} \\ \underline{24} \phantom{0} \\ 12 \\ \underline{12} \\ 0 \end{array}$$

**i)**  $4085 \div 5 =$

$$\begin{array}{r} 817 \\ 5 \overline{) 4085} \\ \underline{40} \phantom{00} \\ 85 \\ \underline{85} \\ 0 \end{array}$$

**j)**  $5076 \div 4 =$

$$\begin{array}{r} 1269 \\ 4 \overline{) 5076} \\ \underline{40} \phantom{00} \\ 107 \phantom{0} \\ \underline{104} \phantom{0} \\ 36 \\ \underline{36} \\ 0 \end{array}$$

**k)**  $2387 \div 7 =$

$$\begin{array}{r} 341 \\ 7 \overline{) 2387} \\ \underline{21} \phantom{00} \\ 28 \phantom{0} \\ \underline{28} \phantom{0} \\ 7 \\ \underline{7} \\ 0 \end{array}$$

**l)**  $5496 \div 8 =$

$$\begin{array}{r} 687 \\ 8 \overline{) 5496} \\ \underline{48} \phantom{00} \\ 69 \phantom{0} \\ \underline{64} \phantom{0} \\ 56 \\ \underline{56} \\ 0 \end{array}$$

**m)**  $3608 \div 4 =$

$$\begin{array}{r} 902 \\ 4 \overline{) 3608} \\ \underline{32} \phantom{00} \\ 40 \phantom{0} \\ \underline{40} \phantom{0} \\ 8 \\ \underline{8} \\ 0 \end{array}$$

**n)**  $2235 \div 5 =$

$$\begin{array}{r} 447 \\ 5 \overline{) 2235} \\ \underline{20} \phantom{00} \\ 23 \phantom{0} \\ \underline{20} \phantom{0} \\ 35 \\ \underline{35} \\ 0 \end{array}$$

**o)**  $9189 \div 9 =$

$$\begin{array}{r} 1021 \\ 9 \overline{) 9189} \\ \underline{90} \phantom{00} \\ 18 \phantom{0} \\ \underline{18} \phantom{0} \\ 9 \\ \underline{9} \\ 0 \end{array}$$

**Skill 6.5** Multiplying a large number by a multiple of 10.

- Consider the zeros as making groups of 10's or 100's and place them first, from right to left.
- Then multiply by the remaining digit as though it was a unit.

**Q.**  $264 \times 600 =$

**A.**  $264 \times 600 = 158400$

Consider 600 as 6 groups of 100.

To show we want groups of 100, place two zeros in the first two positions from the right.

Multiply 264 by 6:  
 $264 \times 6 = 1584$

$$\begin{array}{r}
 \begin{array}{cccc}
 & & 3 & 2 \\
 & & 2 & 6 & 4 \\
 \times & 6 & 0 & 0 \\
 \hline
 1 & 5 & 8 & 4 & 0 & 0
 \end{array}
 \end{array}$$

**a)**  $57 \times 80 =$

**4560**

$$\begin{array}{r}
 \begin{array}{ccc}
 & 5 & 7 \\
 \times & 8 & 0 \\
 \hline
 4 & 5 & 6 & 0
 \end{array}
 \end{array}$$

**b)**  $45 \times 40 =$

$$\begin{array}{r}
 \begin{array}{cc}
 & 2 \\
 & 4 & 5 \\
 \times & 4 & 0 \\
 \hline
 & & 0
 \end{array}
 \end{array}$$

**c)**  $619 \times 20 =$

$$\begin{array}{r}
 \begin{array}{ccc}
 & 6 & 1 & 9 \\
 \times & & 2 & 0 \\
 \hline
 & & & 0
 \end{array}
 \end{array}$$

**d)**  $346 \times 50 =$

$$\begin{array}{r}
 \begin{array}{ccc}
 & 3 & 4 & 6 \\
 \times & & 5 & 0 \\
 \hline
 & & & 
 \end{array}
 \end{array}$$

**e)**  $477 \times 40 =$

$$\begin{array}{r}
 \begin{array}{ccc}
 & 4 & 7 & 7 \\
 \times & & 4 & 0 \\
 \hline
 & & & 
 \end{array}
 \end{array}$$

**f)**  $537 \times 30 =$

$$\begin{array}{r}
 \begin{array}{ccc}
 & 5 & 3 & 7 \\
 \times & & 3 & 0 \\
 \hline
 & & & 
 \end{array}
 \end{array}$$

**g)**  $327 \times 400 =$

$$\begin{array}{r}
 \begin{array}{cccc}
 & & 1 & 3 & 2 & 7 \\
 \times & & & 4 & 0 & 0 \\
 \hline
 1 & 3 & 0 & 8 & 0 & 0
 \end{array}
 \end{array}$$

**h)**  $148 \times 600 =$

$$\begin{array}{r}
 \begin{array}{ccc}
 & 1 & 4 & 8 \\
 \times & & 6 & 0 & 0 \\
 \hline
 & & & & 
 \end{array}
 \end{array}$$

**i)**  $546 \times 300 =$

$$\begin{array}{r}
 \begin{array}{ccc}
 & 5 & 4 & 6 \\
 \times & & 3 & 0 & 0 \\
 \hline
 & & & & 
 \end{array}
 \end{array}$$

**j)**  $206 \times 500 =$

$$\begin{array}{r}
 \begin{array}{ccc}
 & 2 & 0 & 6 \\
 \times & & 5 & 0 & 0 \\
 \hline
 & & & & 
 \end{array}
 \end{array}$$

**k)**  $815 \times 700 =$

$$\begin{array}{r}
 \begin{array}{ccc}
 & 8 & 1 & 5 \\
 \times & & 7 & 0 & 0 \\
 \hline
 & & & & 
 \end{array}
 \end{array}$$

**l)**  $3478 \times 200 =$

$$\begin{array}{r}
 \begin{array}{cccc}
 & 3 & 4 & 7 & 8 \\
 \times & & 2 & 0 & 0 \\
 \hline
 & & & & 
 \end{array}
 \end{array}$$

**m)**  $2500 \times 60 =$

$$\begin{array}{r}
 \begin{array}{ccc}
 & 2 & 5 & 0 & 0 \\
 \times & & & 6 & 0 \\
 \hline
 & & & & 
 \end{array}
 \end{array}$$

**n)**  $1200 \times 70 =$

$$\begin{array}{r}
 \begin{array}{ccc}
 & 1 & 2 & 0 & 0 \\
 \times & & & 7 & 0 \\
 \hline
 & & & & 
 \end{array}
 \end{array}$$

**o)**  $1500 \times 80 =$

$$\begin{array}{r}
 \begin{array}{ccc}
 & 1 & 5 & 0 & 0 \\
 \times & & & 8 & 0 \\
 \hline
 & & & & 
 \end{array}
 \end{array}$$

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

Blue 1 1 2 2 3 3 4 4  
Green 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.**  $3840 \div 60 =$

**A.**  $3840 \div 60 =$

$$= \frac{384\cancel{0} \div 10}{6\cancel{0} \div 10}$$

$$= 64$$

$$\begin{array}{r} 64 \\ 6 \overline{) 3840} \\ \underline{36} \phantom{0} \\ 24 \phantom{0} \\ \underline{24} \phantom{0} \\ 0 \end{array}$$

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

Complete the division  $384 \div 6$

6 divides into 38 six times and 2 remainder.

Write a 6 above the 8 and carry the remaining 2 groups of tens to the units column to make 24 units.

6 divides into 24 four times and 0 remainder.

Write a 4 above the 4.

**a)**  $5600 \div 20 =$

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

$$\begin{array}{r} 280 \\ 2 \overline{) 5600} \\ \underline{10} \phantom{00} \\ 16 \phantom{00} \\ \underline{16} \phantom{00} \\ 00 \end{array}$$

**b)**  $4800 \div 30 =$

$$= \boxed{\phantom{000}}$$

$$\begin{array}{r} \phantom{160} \\ 3 \overline{) 4800} \\ \underline{3} \phantom{00} \\ 18 \phantom{00} \\ \underline{18} \phantom{00} \\ 00 \end{array}$$

**c)**  $9360 \div 80 =$

$$= \boxed{\phantom{000}}$$

$$\begin{array}{r} \phantom{117} \\ 8 \overline{) 9360} \\ \underline{8} \phantom{00} \\ 13 \phantom{00} \\ \underline{8} \phantom{00} \\ 56 \phantom{00} \\ \underline{56} \phantom{00} \\ 00 \end{array}$$

**d)**  $7350 \div 50 =$

$$= \boxed{\phantom{000}}$$

$$\begin{array}{r} \phantom{147} \\ 5 \overline{) 7350} \\ \underline{5} \phantom{00} \\ 23 \phantom{00} \\ \underline{20} \phantom{00} \\ 35 \phantom{00} \\ \underline{35} \phantom{00} \\ 00 \end{array}$$

**e)**  $9660 \div 60 =$

$$= \boxed{\phantom{000}}$$

$$\begin{array}{r} \phantom{161} \\ 6 \overline{) 9660} \\ \underline{6} \phantom{00} \\ 36 \phantom{00} \\ \underline{36} \phantom{00} \\ 00 \end{array}$$

**f)**  $5240 \div 40 =$

$$= \boxed{\phantom{000}}$$

$$\begin{array}{r} \phantom{131} \\ \phantom{0} \overline{) 5240} \\ \phantom{0} \underline{4} \phantom{00} \\ \phantom{0} 12 \phantom{00} \\ \phantom{0} \underline{12} \phantom{00} \\ \phantom{0} 40 \phantom{00} \\ \phantom{0} \underline{40} \phantom{00} \\ \phantom{0} 00 \end{array}$$

**g)**  $18000 \div 400 =$

$$= \boxed{\phantom{000}}$$

$$\begin{array}{r} \phantom{45} \\ 4 \overline{) 18000} \\ \underline{16} \phantom{000} \\ 20 \phantom{000} \\ \underline{20} \phantom{000} \\ 000 \end{array}$$

**h)**  $22000 \div 500 =$

$$= \boxed{\phantom{000}}$$

$$\begin{array}{r} \phantom{44} \\ 5 \overline{) 22000} \\ \underline{20} \phantom{000} \\ 20 \phantom{000} \\ \underline{20} \phantom{000} \\ 000 \end{array}$$

**i)**  $31000 \div 200 =$

$$= \boxed{\phantom{000}}$$

$$\begin{array}{r} \phantom{155} \\ \phantom{0} \overline{) 31000} \\ \phantom{0} \underline{2} \phantom{000} \\ \phantom{0} 10 \phantom{000} \\ \phantom{0} \underline{10} \phantom{000} \\ \phantom{0} 000 \end{array}$$

**j)**  $48600 \div 300 =$

$$= \boxed{\phantom{000}}$$

$$\begin{array}{r} \phantom{162} \\ 3 \overline{) 48600} \\ \underline{3} \phantom{000} \\ 18 \phantom{000} \\ \underline{18} \phantom{000} \\ 60 \phantom{000} \\ \underline{60} \phantom{000} \\ 000 \end{array}$$

**k)**  $20400 \div 600 =$

$$= \boxed{\phantom{000}}$$

$$\begin{array}{r} \phantom{34} \\ 6 \overline{) 20400} \\ \underline{18} \phantom{000} \\ 24 \phantom{000} \\ \underline{24} \phantom{000} \\ 000 \end{array}$$

**l)**  $94500 \div 700 =$

$$= \boxed{\phantom{000}}$$

$$\begin{array}{r} \phantom{135} \\ \phantom{0} \overline{) 94500} \\ \phantom{0} \underline{7} \phantom{000} \\ \phantom{0} 24 \phantom{000} \\ \phantom{0} \underline{21} \phantom{000} \\ \phantom{0} 35 \phantom{000} \\ \phantom{0} \underline{35} \phantom{000} \\ \phantom{0} 000 \end{array}$$



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

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

j)  $804 \times 75 =$

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

k)  $532 \times 28 =$

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

l)  $926 \times 45 =$

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

m)  $1602 \times 19 =$

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

n)  $4086 \times 24 =$

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

o)  $1903 \times 36 =$

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

p)  $3015 \times 45 =$

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

q)  $2038 \times 87 =$

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

r)  $5217 \times 23 =$

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

s)  $2009 \times 73 =$

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

t)  $3014 \times 46 =$

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

u)  $4268 \times 29 =$

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

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

Blue 1 1 2 2 3 3 4 4  
Green 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.**  $9690 \div 15 = 646$

$$\begin{array}{r} \phantom{0}6\phantom{0}4\phantom{0}6 \\ 15 \overline{) 9\phantom{0}6\phantom{0}9\phantom{0}0} \\ \underline{9\phantom{0}0} \phantom{0} \\ \phantom{0}6\phantom{0}9\phantom{0} \\ \underline{\phantom{0}6\phantom{0}0} \phantom{0} \\ \phantom{0}9\phantom{0}0 \\ \underline{\phantom{0}9\phantom{0}0} \\ \phantom{0}0 \end{array}$$

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.

$$\begin{array}{r} \phantom{0}6\phantom{0}4\phantom{0}6 \\ 15 \overline{) \phantom{0}9\phantom{0}6\phantom{0}9\phantom{0}0} \end{array}$$

OR Work as a short division.

**a)**  $725 \div 25 =$

**29**

$$\begin{array}{r} \phantom{0}2\phantom{0}9 \\ 25 \overline{) 7\phantom{0}2\phantom{0}5} \\ \underline{5\phantom{0}0} \phantom{0} \\ \phantom{0}2\phantom{0}2\phantom{0}5 \\ \underline{\phantom{0}2\phantom{0}2\phantom{0}5} \\ \phantom{0}0 \end{array}$$

**b)**  $912 \div 16 =$

$$\begin{array}{r} \phantom{0}5 \\ 16 \overline{) 9\phantom{0}1\phantom{0}2} \\ \underline{8\phantom{0}0} \phantom{0} \\ \phantom{0}1\phantom{0}2 \end{array}$$

**c)**  $948 \div 12 =$

$$\begin{array}{r} \phantom{0}7\phantom{0}9 \\ 12 \overline{) 9\phantom{0}4\phantom{0}8} \\ \underline{9\phantom{0}0} \phantom{0} \\ \phantom{0}4\phantom{0}8 \end{array}$$

**d)**  $4257 \div 11 =$

$$\begin{array}{r} \phantom{0}3\phantom{0}8\phantom{0}7 \\ 11 \overline{) 4\phantom{0}2\phantom{0}5\phantom{0}7} \\ \underline{3\phantom{0}3} \phantom{0} \\ \phantom{0}9\phantom{0}5\phantom{0} \\ \underline{\phantom{0}8\phantom{0}8} \phantom{0} \\ \phantom{0}7\phantom{0}7 \\ \underline{\phantom{0}7\phantom{0}7} \\ \phantom{0}0 \end{array}$$

**e)**  $3024 \div 14 =$

$$\begin{array}{r} \phantom{0}2\phantom{0}1\phantom{0}6 \\ 14 \overline{) 3\phantom{0}0\phantom{0}2\phantom{0}4} \\ \underline{2\phantom{0}8} \phantom{0} \\ \phantom{0}2\phantom{0}4 \end{array}$$

**f)**  $4368 \div 12 =$

$$\begin{array}{r} \phantom{0}3\phantom{0}6\phantom{0}4 \\ 12 \overline{) 4\phantom{0}3\phantom{0}6\phantom{0}8} \\ \underline{4\phantom{0}0} \phantom{0} \\ \phantom{0}3\phantom{0}6\phantom{0}8 \end{array}$$

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

Blue 11 22 33 44  
Green 11 22 33 44

**g)**  $5550 \div 15 =$      **h)**  $8085 \div 11 =$      **i)**  $7680 \div 12 =$

$$\begin{array}{r} 15 \overline{) 5550} \\ - \phantom{0000} \\ \phantom{00} \\ - \phantom{0000} \\ \phantom{0000} \\ - \phantom{0000} \\ \phantom{0000} \end{array}$$

$$\begin{array}{r} 11 \overline{) 8085} \\ - \phantom{0000} \\ \phantom{0000} \\ - \phantom{0000} \\ \phantom{0000} \\ - \phantom{0000} \\ \phantom{0000} \end{array}$$

$$\begin{array}{r} 12 \overline{) 7680} \\ - \phantom{0000} \\ \phantom{0000} \\ - \phantom{0000} \\ \phantom{0000} \\ - \phantom{0000} \\ \phantom{0000} \end{array}$$

**j)**  $7252 \div 14 =$      **k)**  $4224 \div 22 =$      **l)**  $5350 \div 25 =$

$$\begin{array}{r} 14 \overline{) 7252} \\ - \phantom{0000} \\ \phantom{0000} \\ - \phantom{0000} \\ \phantom{0000} \\ - \phantom{0000} \\ \phantom{0000} \end{array}$$

$$\begin{array}{r} 22 \overline{) 4224} \\ - \phantom{0000} \\ \phantom{0000} \\ - \phantom{0000} \\ \phantom{0000} \\ - \phantom{0000} \\ \phantom{0000} \end{array}$$

$$\begin{array}{r} 25 \overline{) 5350} \\ - \phantom{0000} \\ \phantom{0000} \\ - \phantom{0000} \\ \phantom{0000} \\ - \phantom{0000} \\ \phantom{0000} \end{array}$$

**m)**  $3570 \div 15 =$      **n)**  $9030 \div 21 =$      **o)**  $5681 \div 23 =$

$$\begin{array}{r} 15 \overline{) 3570} \\ - \phantom{0000} \\ \phantom{0000} \\ - \phantom{0000} \\ \phantom{0000} \\ - \phantom{0000} \\ \phantom{0000} \end{array}$$

$$\begin{array}{r} 21 \overline{) 9030} \\ - \phantom{0000} \\ \phantom{0000} \\ - \phantom{0000} \\ \phantom{0000} \\ - \phantom{0000} \\ \phantom{0000} \end{array}$$

$$\begin{array}{r} 23 \overline{) 5681} \\ - \phantom{0000} \\ \phantom{0000} \\ - \phantom{0000} \\ \phantom{0000} \\ - \phantom{0000} \\ \phantom{0000} \end{array}$$

**p)**  $36864 \div 12 =$      **q)**  $26576 \div 11 =$      **r)**  $18450 \div 25 =$

$$\begin{array}{r} 12 \overline{) 36864} \\ - \phantom{00000} \\ \phantom{00000} \\ - \phantom{00000} \\ \phantom{00000} \\ - \phantom{00000} \\ \phantom{00000} \end{array}$$

$$\begin{array}{r} 11 \overline{) 26576} \\ - \phantom{00000} \\ \phantom{00000} \\ - \phantom{00000} \\ \phantom{00000} \\ - \phantom{00000} \\ \phantom{00000} \end{array}$$

$$\begin{array}{r} 25 \overline{) 18450} \\ - \phantom{00000} \\ \phantom{00000} \\ - \phantom{00000} \\ \phantom{00000} \\ - \phantom{00000} \\ \phantom{00000} \end{array}$$



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

Blue 11 22 33 44  
Green 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 to be divided.
  - 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.**  $2534 \div 8 =$

**A.**  $2534 \div 8 = 316.75$

$$\begin{array}{r} 316.75 \\ 8 \overline{) 2534.00} \end{array}$$

Start at the left.

Divide 8 into 2534.00

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)**  $7039 \div 2 =$

$$\begin{array}{r} 3519.5 \\ 2 \overline{) 7039.0} \end{array}$$

**g)**  $4903 \div 5 =$

$$\begin{array}{r} 980.6 \\ 5 \overline{) 4903.0} \end{array}$$

**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)**  $6218 \div 4 =$

$$\begin{array}{r} 1554.5 \\ 4 \overline{) 6218.0} \end{array}$$

**k)**  $7385 \div 2 =$

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

**l)**  $5862 \div 8 =$

$$\begin{array}{r} 732.75 \\ 8 \overline{) 5862.00} \end{array}$$

**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 +,-]

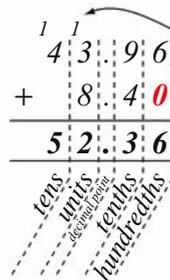
## Skill 7.1 Adding decimal numbers (1).

Blue 1 2 3 4 4  
Green 1 2 3 3 4 4

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

Q.  $43.96 + 8.4 =$

A.  $43.96 + 8.4 = 52.36$  **Hundredths:**  $6 + 0 = 6 \Rightarrow 6$  hundredths



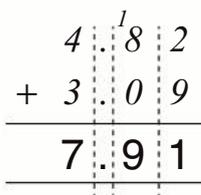
**Tenths:**  $9 + 4 = 13 \Rightarrow 3$  tenths  
Carry over 10 tenths as 1 unit

**Units:**  $3 + 8 + \text{carry } 1 = 12 \Rightarrow 2$  units  
Carry over 10 units as 1 ten

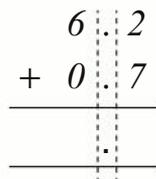
**Tens:**  $4 + 0 + \text{carry } 1 = 5 \Rightarrow 5$  tens

a)  $4.82 + 3.09 =$

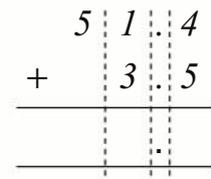
**7.91**



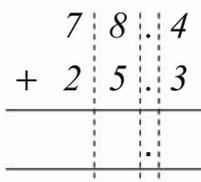
b)  $6.2 + 0.7 =$



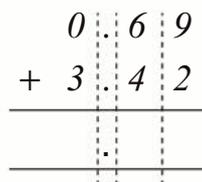
c)  $51.4 + 3.5 =$



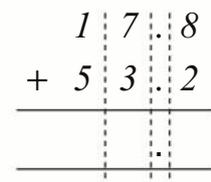
d)  $78.4 + 25.3 =$



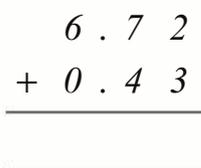
e)  $0.69 + 3.42 =$



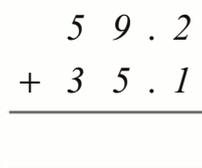
f)  $17.8 + 53.2 =$



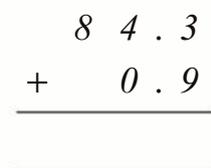
g)  $6.72 + 0.43 =$



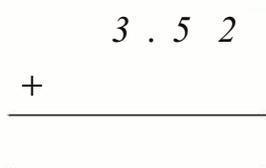
h)  $59.2 + 35.1 =$



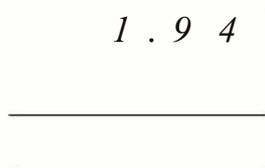
i)  $84.3 + 0.9 =$



j)  $3.52 + 40.08 =$



k)  $1.94 + 27.6 =$



l)  $51.4 + 3.58 =$



**Skill 7.1** Adding decimal numbers (2).

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

**m)**  $9.86 + 0.09 =$

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

**n)**  $7.54 + 6.3 =$

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

**o)**  $65.7 + 8 =$

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

**p)**  $42.08 + 17.95 =$

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

**q)**  $45.69 + 38.37 =$

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

**r)**  $64.8 + 9.72 =$

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

**s)**  $31.54 + 29.8 =$

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

**t)**  $5.47 + 26.7 =$

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

**u)**  $9 + 26.82 =$

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

**v)**  $0.5 + 49.7 + 6.41 =$

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

**w)**  $38.2 + 0.95 + 7 =$

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

**x)**  $51.46 + 8 + 4.9 =$

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

**y)**  $0.6 + 34.9 + 2.75 =$

$$\begin{array}{r} 0.6 \\ + \\ \hline \\ \hline \end{array}$$

**z)**  $17.8 + 3.695 + 0.23 =$

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

**A)**  $0.162 + 5.7 + 43.89 =$

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

## Skill 7.2 Subtracting decimal numbers (1).

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Always keep your working columns in line, aligning the decimal points, 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

$$\begin{array}{r}
 \overset{1}{4} \overset{1}{5} \overset{1}{.} \overset{1}{2} \overset{1}{3} \\
 - \overset{1}{2} \overset{1}{7} \overset{1}{.} \overset{1}{8} \overset{1}{4} \\
 \hline
 \overset{1}{1} \overset{1}{7} \overset{1}{.} \overset{1}{3} \overset{1}{9}
 \end{array}$$

*tens*   *units*   *tenths*   *hundredths*

**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)

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

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

a)  $6.37 - 2.76 =$

**3.61**

b)  $4.8 - 0.3 =$

c)  $62.9 - 1.5 =$

$$\begin{array}{r}
 \overset{5}{6} \overset{13}{.} \overset{13}{3} 7 \\
 - 2 \overset{13}{.} 7 6 \\
 \hline
 3 \overset{13}{.} 6 1
 \end{array}$$

Use decomposition

$$\begin{array}{r}
 4 \overset{13}{.} 8 \\
 - 0 \overset{13}{.} 3 \\
 \hline
 \overset{13}{.}
 \end{array}$$

$$\begin{array}{r}
 6 \overset{13}{2} \overset{13}{.} 9 \\
 - \overset{13}{1} \overset{13}{.} 5 \\
 \hline
 \overset{13}{.}
 \end{array}$$

d)  $87.3 - 64.5 =$

e)  $6.57 - 1.93 =$

f)  $57.6 - 38.2 =$

$$\begin{array}{r}
 8 \overset{13}{7} \overset{13}{.} 3 \\
 - 6 \overset{13}{4} \overset{13}{.} 5 \\
 \hline
 \overset{13}{.}
 \end{array}$$

$$\begin{array}{r}
 6 \overset{13}{5} \overset{13}{7} \\
 - 1 \overset{13}{9} \overset{13}{3} \\
 \hline
 \overset{13}{.}
 \end{array}$$

$$\begin{array}{r}
 5 \overset{13}{7} \overset{13}{.} 6 \\
 - 3 \overset{13}{8} \overset{13}{.} 2 \\
 \hline
 \overset{13}{.}
 \end{array}$$

g)  $8.46 - 3.95 =$

h)  $61.3 - 29.6 =$

i)  $34.7 - 28.7 =$

$$\begin{array}{r}
 8 \overset{13}{.} 4 6 \\
 - 3 \overset{13}{.} 9 5 \\
 \hline
 \overset{13}{.}
 \end{array}$$

$$\begin{array}{r}
 6 \overset{13}{1} \overset{13}{.} 3 \\
 - 2 \overset{13}{9} \overset{13}{.} 6 \\
 \hline
 \overset{13}{.}
 \end{array}$$

$$\begin{array}{r}
 3 \overset{13}{4} \overset{13}{.} 7 \\
 - 2 \overset{13}{8} \overset{13}{.} 7 \\
 \hline
 \overset{13}{.}
 \end{array}$$

## Skill 7.2 Subtracting decimal numbers (2).

Blue 1 2 3 4  
Green 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)  $15.4 - 6.89 =$

$$\begin{array}{r} 15.4 \\ - 6.89 \\ \hline \\ \hline \end{array}$$

s)  $30.19 - 12.43 =$

$$\begin{array}{r} 30.19 \\ - 12.43 \\ \hline \\ \hline \end{array}$$

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)  $66.23 - 19.54 =$

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

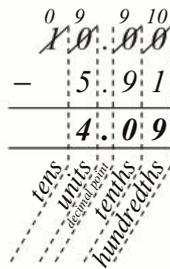
A)  $57.2 - 9.84 =$

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

- Write a decimal point at the end of the whole number.
- Add as many zeros after the decimal point as there are decimal places in the decimal number.
- Work vertically, lining up the decimal points.
- 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.  $10 - 5.91 =$   
 $= 10.00 - 5.91$   
 $= 4.09$



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

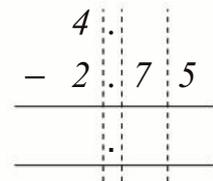
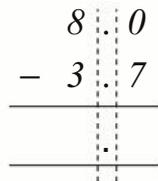
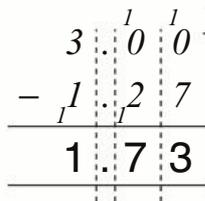
**Tens:**  $0 - 0 = 0$  tens

a)  $3 - 1.27 =$

**1.73**

b)  $8 - 3.7 =$

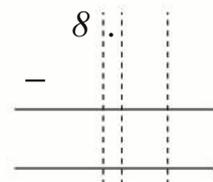
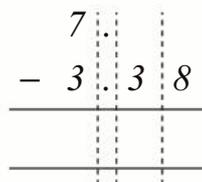
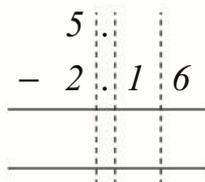
c)  $4 - 2.75 =$



d)  $5 - 2.16 =$

e)  $7 - 3.38 =$

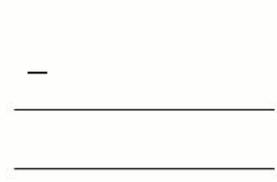
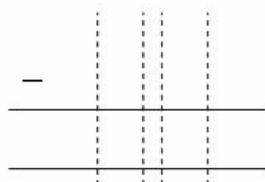
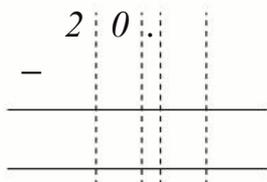
f)  $8 - 3.25 =$



g)  $20 - 6.42 =$

h)  $19 - 3.87 =$

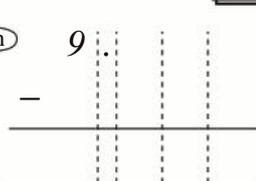
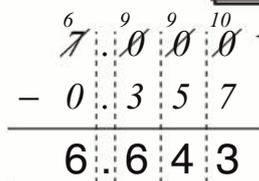
i)  $22 - 7.43 =$



j)  $7 - 0.357 =$

k)  $9 - 0.619 =$

l)  $6 - 0.802 =$





# 8. [Decimal $\times, \div$ ]

## Skill 8.1 Multiplying a decimal number by a single digit number (1).

Blue 1 2 3 4 4  
Green 1 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)  $0.9 \times 9 =$

$$\begin{array}{r} 0.9 \\ \times 9 \\ \hline \end{array}$$

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)  $6.2 \times 8 =$

$$\begin{array}{r} 6.2 \\ \times 8 \\ \hline \end{array}$$

**Skill 8.1** Multiplying a decimal number by a single digit number (2).

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

m)  $0.18 \times 7 =$

$$\begin{array}{r} 0.18 \\ \times 7 \\ \hline 1.26 \end{array}$$

n)  $0.71 \times 6 =$

$$\begin{array}{r} 0.71 \\ \times 6 \\ \hline \end{array}$$

o)  $1.56 \times 8 =$

$$\begin{array}{r} 1.56 \\ \times 8 \\ \hline \end{array}$$

p)  $2.09 \times 4 =$

$$\begin{array}{r} 2.09 \\ \times 4 \\ \hline \end{array}$$

q)  $3.75 \times 5 =$

$$\begin{array}{r} 3.75 \\ \times 5 \\ \hline \end{array}$$

r)  $4.82 \times 2 =$

$$\begin{array}{r} 4.82 \\ \times 2 \\ \hline \end{array}$$

s)  $14.02 \times 6 =$

$$\begin{array}{r} 14.02 \\ \times 6 \\ \hline \end{array}$$

t)  $4 \times 20.15 =$

$$\begin{array}{r} 20.15 \\ \times 4 \\ \hline \end{array}$$

u)  $18.02 \times 3 =$

$$\begin{array}{r} 18.02 \\ \times 3 \\ \hline \end{array}$$

v)  $8 \times 10.91 =$

$$\begin{array}{r} 10.91 \\ \times 8 \\ \hline \end{array}$$

w)  $2.008 \times 7 =$

$$\begin{array}{r} 2.008 \\ \times 7 \\ \hline \end{array}$$

x)  $6 \times 0.521 =$

$$\begin{array}{r} 0.521 \\ \times 6 \\ \hline \end{array}$$

y)  $5 \times 3.105 =$

$$\begin{array}{r} 3.105 \\ \times 5 \\ \hline \end{array}$$

z)  $5.312 \times 4 =$

$$\begin{array}{r} 5.312 \\ \times 4 \\ \hline \end{array}$$

A)  $3 \times 2.041 =$

$$\begin{array}{r} 2.041 \\ \times 3 \\ \hline \end{array}$$

## Skill 8.2 Dividing a decimal number by a single digit number.

Blue 1 1 2 2 3 3 4 4  
Green 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.

**Q.**  $5.31 \div 9 =$

**A.**  $5.31 \div 9 = 0.59$

$5 \div 9 = ?$  (less than 0) carry 5, write 0  
Line up the decimal point.

$53 \div 9 = 5$  remainder 8, carry 8

$81 \div 9 = 9$

write 5  
write 9

$$\begin{array}{r} 0.59 \\ 9 \overline{) 5.31} \\ \underline{45} \phantom{00} \\ 81 \phantom{00} \\ \underline{81} \phantom{00} \\ 00 \phantom{00} \end{array}$$

**a)**  $4.2 \div 6 =$

**0.7**

**b)**  $2.4 \div 8 =$

**c)**  $1.5 \div 3 =$

÷ from left  
left

$$\begin{array}{r} 0.7 \\ 6 \overline{) 4.2} \\ \underline{42} \\ 00 \end{array}$$

Line up decimal points

$$\begin{array}{r} \\ 8 \overline{) 2.4} \\ \underline{16} \\ 80 \\ \underline{80} \\ 00 \end{array}$$

$$\begin{array}{r} \\ 3 \overline{) 1.5} \\ \underline{15} \\ 00 \end{array}$$

**d)**  $4.5 \div 5 =$

**e)**  $9.6 \div 4 =$

**f)**  $9.8 \div 7 =$

$$\begin{array}{r} \\ 5 \overline{) 4.5} \\ \underline{45} \\ 00 \end{array}$$

$$\begin{array}{r} \\ 4 \overline{) 9.6} \\ \underline{84} \\ 120 \\ \underline{120} \\ 00 \end{array}$$

$$\begin{array}{r} \\ 7 \overline{) 9.8} \\ \underline{70} \\ 280 \\ \underline{280} \\ 00 \end{array}$$

**g)**  $13.6 \div 8 =$

**h)**  $1.11 \div 3 =$

**i)**  $23.5 \div 5 =$

$$\begin{array}{r} \\ 8 \overline{) 13.6} \\ \underline{8} \phantom{00} \\ 56 \\ \underline{56} \\ 00 \end{array}$$

$$\begin{array}{r} \\ 3 \overline{) 1.11} \\ \underline{3} \phantom{00} \\ 111 \\ \underline{90} \\ 210 \\ \underline{210} \\ 00 \end{array}$$

$$\begin{array}{r} \\ 5 \overline{) 23.5} \\ \underline{10} \phantom{00} \\ 135 \\ \underline{135} \\ 00 \end{array}$$

**j)**  $8.26 \div 7 =$

**k)**  $0.96 \div 6 =$

**l)**  $2.72 \div 8 =$

$$\begin{array}{r} \\ 7 \overline{) 8.26} \\ \underline{7} \phantom{00} \\ 126 \\ \underline{112} \\ 140 \\ \underline{140} \\ 00 \end{array}$$

$$\begin{array}{r} \\ 6 \overline{) 0.96} \\ \underline{6} \phantom{00} \\ 36 \\ \underline{36} \\ 00 \end{array}$$

$$\begin{array}{r} \\ 8 \overline{) 2.72} \\ \underline{16} \phantom{00} \\ 112 \\ \underline{112} \\ 00 \end{array}$$

**m)**  $10.4 \div 4 =$

**n)**  $1.47 \div 3 =$

**o)**  $23.4 \div 9 =$

$$\begin{array}{r} \\ \phantom{0} \overline{) \phantom{000}} \\ \phantom{00} \phantom{00} \phantom{00} \end{array}$$

$$\begin{array}{r} \\ \phantom{0} \overline{) \phantom{000}} \\ \phantom{00} \phantom{00} \phantom{00} \end{array}$$

$$\begin{array}{r} \\ \phantom{0} \overline{) \phantom{000}} \\ \phantom{00} \phantom{00} \phantom{00} \end{array}$$

### Skill 8.3 Multiplying a decimal number by a power of 10.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

#### EITHER

- Count the number of zeros in the power of 10.
- Move the decimal point to the right the same number of places.
- Remove all the zeros before and after the decimal number if needed.

Example:  $015.600 = 15.6$

- Add zeros as place holders if needed.

Example:  $2.4 \times 100 = 2.4000 \times 100 = 240.00 = 240$

#### OR

- Write the number followed by the zeros, disregarding the decimal point.
- Count the number of decimal places in the question.
- Position the decimal point the same number of places from the right in the answer.

<b>Q.</b> $1.83 \times 1000 =$  $\begin{array}{r} 1.83 \\ \times 1000 \\ \hline 1830 \end{array}$	<b>A.</b> $1.83 \times 1000 =$ $= 1.8300 \times 1000$ $= 1830$	<b>OR</b> $1.83$ ← 2 decimal places $\times 1000$ $\hline 1830.00$ ← 2 decimal places in the answer $1830.00 = 1830$
---	--	---

<b>a)</b> $2.7 \times 10 =$ <span style="border: 1px solid black; padding: 2px 10px;">27</span> $\begin{array}{r} 2.7 \\ \times 10 \\ \hline 27.0 \end{array}$	<b>b)</b> $0.8 \times 10 =$ <span style="border: 1px solid black; padding: 2px 10px;"> </span> $\begin{array}{r} 0.8 \\ \times 10 \\ \hline 08.0 \end{array}$	<b>c)</b> $5.3 \times 10 =$ <span style="border: 1px solid black; padding: 2px 10px;"> </span> $\begin{array}{r} 5.3 \\ \times 10 \\ \hline \end{array}$
---	--	---

<b>d)</b> $0.54 \times 10 =$ <span style="border: 1px solid black; padding: 2px 10px;"> </span> $\begin{array}{r} 0.54 \\ \times 10 \\ \hline 05.40 \end{array}$	<b>e)</b> $3.29 \times 10 =$ <span style="border: 1px solid black; padding: 2px 10px;"> </span> $\begin{array}{r} 3.29 \\ \times 10 \\ \hline \end{array}$	<b>f)</b> $8.04 \times 10 =$ <span style="border: 1px solid black; padding: 2px 10px;"> </span> $\begin{array}{r} 8.04 \\ \times 10 \\ \hline \end{array}$
---	---	---

<b>g)</b> $9.6 \times 100 =$ <span style="border: 1px solid black; padding: 2px 10px;"> </span> $\begin{array}{r} 9.6 \\ \times 100 \\ \hline 960.0 \end{array}$	<b>h)</b> $0.177 \times 100 =$ <span style="border: 1px solid black; padding: 2px 10px;"> </span> $\begin{array}{r} 0.177 \\ \times 100 \\ \hline 017.700 \end{array}$	<b>i)</b> $0.038 \times 100 =$ <span style="border: 1px solid black; padding: 2px 10px;"> </span> $\begin{array}{r} 0.038 \\ \times 100 \\ \hline \end{array}$
---	---	---

<b>j)</b> $13.2 \times 1000 =$ <span style="border: 1px solid black; padding: 2px 10px;"> </span> $\begin{array}{r} \times \\ \hline \end{array}$	<b>k)</b> $7.54 \times 1000 =$ <span style="border: 1px solid black; padding: 2px 10px;"> </span> $\begin{array}{r} \times \\ \hline \end{array}$	<b>l)</b> $9.06 \times 1000 =$ <span style="border: 1px solid black; padding: 2px 10px;"> </span> $\begin{array}{r} \times \\ \hline \end{array}$
--	--	--

<b>m)</b> $24.8 \times 1000 =$ <span style="border: 1px solid black; padding: 2px 10px;"> </span> $\begin{array}{r} \times \\ \hline \end{array}$	<b>n)</b> $1.02 \times 1000 =$ <span style="border: 1px solid black; padding: 2px 10px;"> </span> $\begin{array}{r} \times \\ \hline \end{array}$	<b>o)</b> $7.69 \times 1000 =$ <span style="border: 1px solid black; padding: 2px 10px;"> </span> $\begin{array}{r} \times \\ \hline \end{array}$
--	--	--

**Skill 8.4** Dividing a decimal number by a power of 10.

- Count the number of zeros in the power of 10.
- Move the decimal point to the left the same number of places.
- Remove all the zeros before and after the decimal number if needed.

Example:  $\cancel{0}15.\cancel{6}\cancel{0}\cancel{0} = 15.6$

- Add zeros as place holders if needed.

Example:  $4.9 \div 100 = \cancel{0}\cancel{0}4.9 \div 100 = \cancel{0}\cancel{0}.049 = 0.049$

**Q.**  $173.2 \div 1000 =$

**A.**  $173.2 \div 1000 =$  ← 3 zeros in 1000  
 $= \cancel{0}\cancel{0}\cancel{0}173.2 \div \cancel{1}\cancel{0}\cancel{0}\cancel{0}$  ← 3 places to the left  
 $= \mathbf{0.1732}$

**a)**  $45.6 \div 10 =$

$= \cancel{0}45.6 \div \cancel{1}\cancel{0} = \mathbf{4.56}$

**b)**  $30.8 \div 10 =$

$= \dots \dots \dots = \mathbf{\phantom{000}}$

**c)**  $94.3 \div 10 =$

$= \dots \dots \dots = \mathbf{\phantom{000}}$

**d)**  $6.58 \div 10 =$

$= \cancel{0}6.58 \div 10 = \mathbf{\phantom{000}}$

**e)**  $0.22 \div 10 =$

$= \dots \dots \dots = \mathbf{\phantom{000}}$

**f)**  $1.73 \div 10 =$

$= \dots \dots \dots = \mathbf{\phantom{000}}$

**g)**  $27.5 \div 100 =$

$= \cancel{0}\cancel{2}7.5 \div 100 = \mathbf{\phantom{000}}$

**h)**  $18.6 \div 100 =$

$= \dots \dots \dots = \mathbf{\phantom{000}}$

**i)**  $40.7 \div 100 =$

$= \dots \dots \dots = \mathbf{\phantom{000}}$

**j)**  $1.3 \div 100 =$

$= \cancel{0}\cancel{0}1.3 \div 100 = \mathbf{\phantom{000}}$

**k)**  $7.4 \div 100 =$

$= \dots \dots \dots = \mathbf{\phantom{000}}$

**l)**  $9.8 \div 100 =$

$= \dots \dots \dots = \mathbf{\phantom{000}}$

**m)**  $408.9 \div 100 =$

$= \cancel{4}\cancel{0}8.9 \div 100 = \mathbf{\phantom{000}}$

**n)**  $623.7 \div 100 =$

$= \dots \dots \dots = \mathbf{\phantom{000}}$

**o)**  $240.5 \div 100 =$

$= \dots \dots \dots = \mathbf{\phantom{000}}$

**p)**  $927.2 \div 1000 =$

$= \cancel{0}\cancel{9}\cancel{2}7.2 \div 1000 = \mathbf{\phantom{000}}$

**q)**  $103.5 \div 1000 =$

$= \dots \dots \dots = \mathbf{\phantom{000}}$

**r)**  $448.7 \div 1000 =$

$= \dots \dots \dots = \mathbf{\phantom{000}}$

## Skill 8.5 Multiplying a decimal number by another decimal number.

Blue 11 22 33 44  
Green 11 22 33 44

- 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)**  $0.2 \times 0.6 =$

**0.12**

$$\begin{array}{r} 0.2 \\ \times 0.6 \\ \hline 0.12 \end{array}$$

**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)**  $0.3 \times 0.9 =$

$$\begin{array}{r} 0.3 \\ \times 0.9 \\ \hline \end{array}$$

**f)**  $2.6 \times 0.4 =$

$$\begin{array}{r} 2.6 \\ \times 0.4 \\ \hline \end{array}$$

**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)**  $1.9 \times 0.6 =$

$$\begin{array}{r} 1.9 \\ \times 0.6 \\ \hline \end{array}$$

**j)**  $0.5 \times 0.06 =$

**0.03**

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

remove unnecessary zero

< 1 so write zero in units place

**k)**  $0.16 \times 0.3 =$

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

**l)**  $1.07 \times 0.9 =$

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

### Skill 8.6 Dividing a decimal number by another decimal number.

Blue 1 1 2 2 3 3 4 4  
Green 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 it a whole number.
- Then move the decimal point the same number of places to the right in the dividend.

Example:  $0.5\widehat{6} \div 0.\widehat{8} = 5.6 \div 8 = 0.7$

- 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. (see skill 8.2, page 35)

**Q.**  $0.48 \div 0.8 =$  \_\_\_\_\_

**A.**  $0.\widehat{48} \div 0.\widehat{8} =$   
 $= 4.8 \div 8$   
 $= \mathbf{0.6}$

$$\begin{array}{r} 0.\dot{6} \\ 8 \overline{) 4.\dot{8}} \\ \underline{8} \phantom{0} \\ 0 \phantom{0} \\ \underline{0} \phantom{0} \\ 0 \phantom{0} \\ \underline{0} \phantom{0} \\ 0 \phantom{0} \end{array}$$

$4 \div 8 = ?$  (less than 0) carry 4, write 0  
 Line up the decimal point.  
 $48 \div 8 = 6$  write 6

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

1 place right makes a whole number  
 $= 36 \div 6 = \boxed{6}$

$$\begin{array}{r} 6 \\ 3 \overline{) 36} \\ \underline{3} \phantom{0} \\ 0 \phantom{0} \end{array}$$

**b)**  $1.4 \div 0.7 =$

$=$  \_\_\_\_\_  $=$

$$\begin{array}{r} \phantom{0} \\ 7 \overline{) \phantom{00}} \\ \phantom{0} \phantom{0} \end{array}$$

**c)**  $3.5 \div 0.5 =$

$=$  \_\_\_\_\_  $=$

$$\begin{array}{r} \phantom{0} \\ \phantom{0} \overline{) \phantom{00}} \\ \phantom{0} \phantom{0} \end{array}$$

**d)**  $7.6 \div 0.2 =$

$=$  \_\_\_\_\_  $=$

$$\begin{array}{r} \phantom{0} \\ \phantom{0} \overline{) \phantom{00}} \\ \phantom{0} \phantom{0} \end{array}$$

**e)**  $6.9 \div 0.3 =$

$=$  \_\_\_\_\_  $=$

$$\begin{array}{r} \phantom{0} \\ \phantom{0} \overline{) \phantom{00}} \\ \phantom{0} \phantom{0} \end{array}$$

**f)**  $0.76 \div 0.4 =$

$=$  \_\_\_\_\_  $=$

$$\begin{array}{r} \phantom{0} \\ 4 \overline{) \phantom{00}} \\ \phantom{0} \phantom{0} \end{array}$$

**g)**  $0.06 \div 0.2 =$

$=$  \_\_\_\_\_  $=$

$$\begin{array}{r} \phantom{0} \\ \phantom{0} \overline{) \phantom{00}} \\ \phantom{0} \phantom{0} \end{array}$$

**h)**  $0.49 \div 0.7 =$

$=$  \_\_\_\_\_  $=$

$$\begin{array}{r} \phantom{0} \\ \phantom{0} \overline{) \phantom{00}} \\ \phantom{0} \phantom{0} \end{array}$$

**i)**  $6.42 \div 0.6 =$

$=$  \_\_\_\_\_  $=$

$$\begin{array}{r} \phantom{0} \\ \phantom{0} \overline{) \phantom{00}} \\ \phantom{0} \phantom{0} \end{array}$$

**j)**  $7.\widehat{5} \div 0.\widehat{03} =$

$= 750 \div 3 = \boxed{\phantom{00}}$

$$\begin{array}{r} \phantom{0} \\ 3 \overline{) 750} \\ \underline{3} \phantom{0} \\ 45 \phantom{0} \\ \underline{45} \phantom{0} \\ 0 \phantom{0} \end{array}$$

**k)**  $2.7 \div 0.09 =$

$=$  \_\_\_\_\_  $=$

$$\begin{array}{r} \phantom{0} \\ \phantom{0} \overline{) \phantom{00}} \\ \phantom{0} \phantom{0} \end{array}$$

**l)**  $7.2 \div 0.08 =$

$=$  \_\_\_\_\_  $=$

$$\begin{array}{r} \phantom{0} \\ \phantom{0} \overline{) \phantom{00}} \\ \phantom{0} \phantom{0} \end{array}$$

**m)**  $6.4 \div 0.04 =$

$=$  \_\_\_\_\_  $=$

$$\begin{array}{r} \phantom{0} \\ \phantom{0} \overline{) \phantom{00}} \\ \phantom{0} \phantom{0} \end{array}$$

**n)**  $4.5 \div 0.05 =$

$=$  \_\_\_\_\_  $=$

$$\begin{array}{r} \phantom{0} \\ \phantom{0} \overline{) \phantom{00}} \\ \phantom{0} \phantom{0} \end{array}$$

**o)**  $9.6 \div 0.06 =$

$=$  \_\_\_\_\_  $=$

$$\begin{array}{r} \phantom{0} \\ \phantom{0} \overline{) \phantom{00}} \\ \phantom{0} \phantom{0} \end{array}$$

### Skill 8.7 Dividing a whole number by a decimal number.

Blue 11 22 33 44  
Green 11 22 33 44

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

- Divide the whole numbers.

**Q.**  $9 \div 0.6 =$

add zero as place holder

**A.**  $9.\widehat{0} \div 0.\widehat{6} =$

$= 90 \div 6$

$= 15$

1 place right makes a whole number

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

$9 \div 6 = 1$

$30 \div 6 = 5$

carry 3, write 1  
write 5

**a)**  $5 \div 0.5 =$

$= 5.\widehat{0} \div 0.\widehat{5}$

$= 50 \div 5 = \boxed{10}$

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

**b)**  $6 \div 0.3 =$

$=$   
 $=$   $\boxed{\phantom{00}}$

$$\begin{array}{r} \phantom{00} \\ 3 \overline{) \phantom{00}} \end{array}$$

**c)**  $6 \div 0.4 =$

$=$   
 $=$   $\boxed{\phantom{00}}$

$$\begin{array}{r} \phantom{00} \\ \phantom{0} \overline{) \phantom{00}} \end{array}$$

**d)**  $8 \div 0.1 =$

$=$   $\boxed{\phantom{00}}$

$$\begin{array}{r} \phantom{00} \\ \phantom{0} \overline{) \phantom{00}} \end{array}$$

**e)**  $5 \div 0.2 =$

$=$   $\boxed{\phantom{00}}$

$$\begin{array}{r} \phantom{00} \\ \phantom{0} \overline{) \phantom{00}} \end{array}$$

**f)**  $7 \div 0.7 =$

$=$   $\boxed{\phantom{00}}$

$$\begin{array}{r} \phantom{00} \\ \phantom{0} \overline{) \phantom{00}} \end{array}$$

**g)**  $6 \div 0.2 =$

$=$   $\boxed{\phantom{00}}$

$$\begin{array}{r} \phantom{00} \\ \phantom{0} \overline{) \phantom{00}} \end{array}$$

**h)**  $6 \div 0.03 =$

$=$   $\boxed{\phantom{00}}$

$$\begin{array}{r} \phantom{00} \\ 6 \overline{) \phantom{00}} \end{array}$$

**i)**  $7 \div 0.04 =$

$=$   $\boxed{\phantom{00}}$

$$\begin{array}{r} \phantom{00} \\ \phantom{0} \overline{) \phantom{00}} \end{array}$$

**j)**  $4 \div 0.02 =$

$=$   $\boxed{\phantom{00}}$

$$\begin{array}{r} \phantom{00} \\ \phantom{0} \overline{) \phantom{00}} \end{array}$$

**k)**  $2 \div 0.05 =$

$=$   $\boxed{\phantom{00}}$

$$\begin{array}{r} \phantom{00} \\ \phantom{0} \overline{) \phantom{00}} \end{array}$$

**l)**  $4 \div 0.04 =$

$=$   $\boxed{\phantom{00}}$

$$\begin{array}{r} \phantom{00} \\ \phantom{0} \overline{) \phantom{00}} \end{array}$$

# 9. [Fraction +,-]

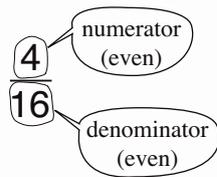
## Skill 9.1 Adding fractions with the same denominator (1).

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- 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.

### To simplify 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.

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

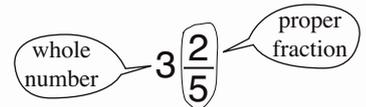
### To change an improper fraction to a mixed number



- 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.  
 $\frac{7}{3} = 7 \div 3 = 2 \frac{1}{3}$

### To change a mixed number to an improper fraction

#### MIXED NUMBER



- Multiply the whole number by the denominator and then add the result to the numerator.  
 $3 \frac{2}{5} \rightarrow 3 \times 5 + 2 = 17$
- Rewrite the total over the denominator.

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

Q.  $\frac{5}{8} + \frac{5}{8} =$

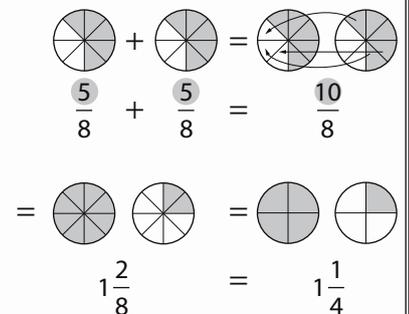
A.  $\frac{5}{8} + \frac{5}{8}$  (Add the numerators (top numbers) only)

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

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

( $10 \div 8 = 1 \text{ remainder } 2$ )

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



a)  $\frac{2}{10} + \frac{3}{10} =$  (Add the numerators (top numbers) only)

$$= \frac{2+3}{10} = \frac{5}{10 \div 2} = \boxed{\frac{1}{2}}$$

b)  $\frac{1}{6} + \frac{2}{6} =$

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

c)  $\frac{7}{15} + \frac{7}{15} =$

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

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

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

e)  $\frac{4}{11} + \frac{3}{11} =$

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

f)  $\frac{1}{5} + \frac{3}{5} =$

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

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

g)  $\frac{7}{5} + \frac{3}{5} =$

$= \frac{7+3}{5} = \frac{10}{5}$  Change to mixed number

$= 10 \div 5 = \boxed{2}$

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

$=$   
 $=$

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

$=$   
 $=$

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

$=$   
 $=$

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

$=$   
 $=$

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

$=$   
 $=$

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

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

$= \frac{3}{2} = 3 \div 2 = \boxed{\phantom{00}}$

Change to mixed number

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

$=$   
 $=$

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

$=$   
 $=$

p)  $\frac{4}{9} + \frac{2}{9} =$

$= \frac{4+2}{9} = \frac{6}{9}$

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

$=$

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

$=$

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

$=$

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

$=$

u)  $\frac{7}{18} + \frac{1}{18} =$

$=$

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

$=$

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

$=$

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

$=$

## Skill 9.2 Subtracting fractions with the same denominator.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- 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 41)

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

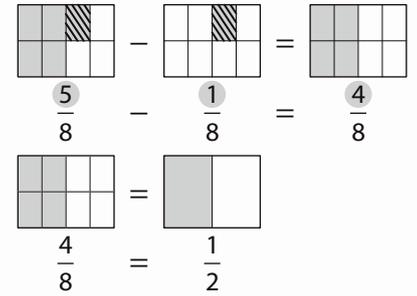
A.  $\frac{5}{8} - \frac{1}{8}$  Subtract the numerators (top numbers) only

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

Simplify

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

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



a)  $\frac{5}{21} - \frac{1}{21}$  Subtract the numerators (top numbers) only

$$= \frac{5-1}{21} = \frac{4}{21}$$

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)  $\frac{11}{6} - \frac{1}{6}$  Change to mixed number

$$= \frac{11-1}{6} = \frac{10}{6} = \frac{5}{3}$$

$$= 5 \div 3 = 1\frac{2}{3}$$

e)  $\frac{9}{4} - \frac{5}{4} =$

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

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

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

g)  $\frac{11}{12} - \frac{7}{12}$  Simplify

$$= \frac{4}{12} = \frac{\quad}{\quad}$$

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

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

i)  $\frac{9}{8} - \frac{3}{8} =$

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

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

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

k)  $\frac{13}{22} - \frac{3}{22} =$

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

l)  $\frac{9}{14} - \frac{7}{14} =$

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

m)  $\frac{7}{16} - \frac{3}{16} =$

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

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 41)
- Simplify the resulting fraction and/or change it to a mixed number if necessary. (see skill 9.1, page 41)
- Write the result as a mixed number.

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

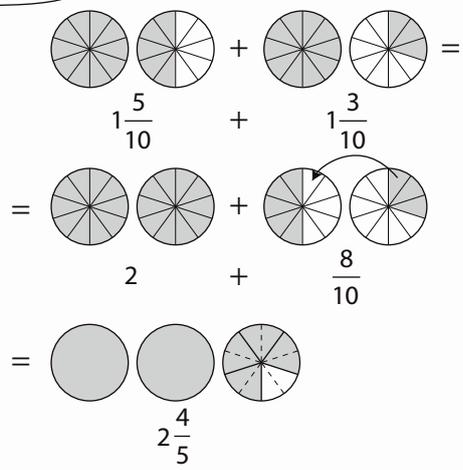
**A.**  $1 + 1 + \frac{5}{10} + \frac{3}{10}$

Add the numerators (top numbers) only

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

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

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



**a)**  $1\frac{1}{6} + 3\frac{4}{6} =$   
 $= 4 + \frac{5}{6} =$

**b)**  $2\frac{2}{5} + 3\frac{2}{5} =$   
 $=$

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

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

**e)**  $4\frac{3}{9} + 3\frac{4}{9} =$   
 $=$

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

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

**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).

m)  $1\frac{4}{5} + 2\frac{2}{5} =$   
 $= 3 + \frac{6}{5}$  Change to mixed number  
 $= 3 + 1\frac{1}{5} = \boxed{4\frac{1}{5}}$

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

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

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

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

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

s)  $3\frac{11}{15} + 2\frac{7}{15} =$   
 $= 5 + \frac{18}{15}$  Simplify  
 $= 5 + \frac{6}{5}$  Change to mixed number  
 $= 5 + 1\frac{1}{5} = \boxed{6\frac{1}{5}}$

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

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

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

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

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

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

z)  $5\frac{2}{6} + 3\frac{5}{6} =$   
 $=$   
 $=$

A)  $2\frac{7}{13} + \frac{9}{13} =$   
 $=$   
 $=$

## Skill 9.4 Subtracting mixed numbers with the same denominator (1).

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Change mixed numbers to improper fractions before subtracting. (see skill 9.1, page 41)
- Subtract the fractions. (see skill 9.2, page 43)
- Simplify the resulting fraction and/or change it to a mixed number if necessary. (see skill 9.1, page 41)

Q.  $3\frac{2}{9} - 1\frac{5}{9} =$

A.  $3\frac{2}{9} - 1\frac{5}{9}$  Change to improper fractions

$$= \frac{29}{9} - \frac{14}{9}$$

Subtract the numerators (top numbers) only

$$= \frac{15}{9}$$

Change to mixed number

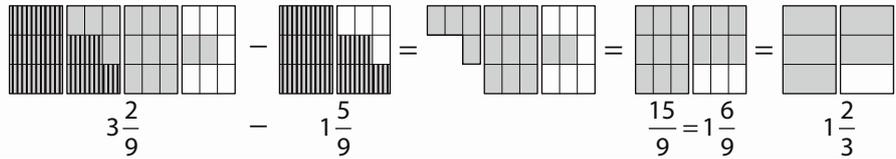
$$= 1\frac{6}{9}$$

Simplify

$$= 1\frac{2}{3}$$

$$3\frac{2}{9} = \frac{3 \times 9 + 2}{9} = \frac{29}{9}$$

$$1\frac{5}{9} = \frac{1 \times 9 + 5}{9} = \frac{14}{9}$$



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

$$= \frac{13}{4} - \frac{7}{4}$$

Subtract the numerators (top numbers) only

$$= \frac{6}{4} = \frac{3}{2}$$

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

b)  $3\frac{2}{7} - 1\frac{4}{7} =$

$$=$$

$$=$$

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

$$=$$

$$=$$

d)  $5\frac{3}{8} - 1\frac{7}{8} =$

$$=$$

$$=$$

e)  $4\frac{1}{9} - 1\frac{5}{9} =$

$$=$$

$$=$$

f)  $2\frac{3}{11} - 1\frac{8}{11} =$

$$=$$

$$=$$

g)  $2\frac{3}{10} - \frac{7}{10} =$

$$= \frac{23}{10} - \frac{7}{10}$$

$$= \frac{16}{10}$$

Change to mixed number

$$= 1\frac{6}{10}$$

$$=$$

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

$$=$$

$$=$$

i)  $4\frac{5}{12} - 1\frac{7}{12} =$

$$=$$

$$=$$

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

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Subtract the whole numbers first.
- Subtract the fractions. (see skill 9.2, page 43)
- Simplify the resulting fraction if necessary. (see skill 9.1, page 41)

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

Example:

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

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

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

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

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

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

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

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 (1)** Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Write the whole number as an improper fraction with the same denominator as the mixed number.
- Change the mixed number to an improper fraction before subtracting. (see skill 9.1, page 41)
- Subtract the fractions. (see skill 9.2, page 43)
- Simplify the resulting fraction and/or change it to a mixed number if necessary. (see skill 9.1, page 41)

**Q.**  $3 - 1\frac{1}{4} =$

**A.**  $3 - 1\frac{1}{4}$  Change to improper fractions

3 can be written as:  $\frac{3}{1} = \frac{12}{4}$

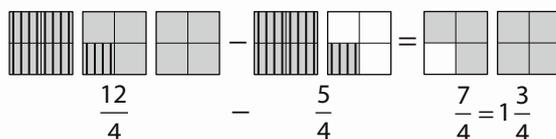
and  $1\frac{1}{4} = \frac{1 \times 4 + 1}{4} = \frac{5}{4}$

$= \frac{3}{1} - \frac{5}{4}$

$= \frac{12}{4} - \frac{5}{4}$  Subtract the numerators (top numbers) only

$= \frac{7}{4}$  Change to mixed number

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



**a)**  $2 - \frac{2}{9} =$   
 $= \frac{2}{1} - \frac{2}{9}$

2 can be written as  $\frac{2}{1}$  or  $\frac{18}{9}$

$= \frac{18}{9} - \frac{2}{9}$  Subtract the numerators (top numbers) only

$= \frac{16}{9} = \boxed{1\frac{7}{9}}$

**b)**  $5 - \frac{3}{10} =$

$=$   
.....  
 $=$   
.....  
 $=$   

**c)**  $3 - \frac{1}{6} =$

$=$   
.....  
 $=$   
.....  
 $=$   

**d)**  $4 - 1\frac{5}{7} =$

$= \frac{4}{1} - \frac{12}{7}$

$= \frac{28}{7} - \frac{12}{7}$

$= \frac{16}{7} = \boxed{\phantom{00}}$

**e)**  $3 - 1\frac{3}{5} =$

$=$   
.....  
 $=$   
.....  
 $=$   

**f)**  $3 - 1\frac{6}{11} =$

$=$   
.....  
 $=$   
.....  
 $=$   

**g)**  $4 - 1\frac{7}{8} =$

$=$   
.....  
 $=$   
.....  
 $=$   

**h)**  $3 - 2\frac{1}{8} =$

$=$   
.....  
 $=$   
.....  
 $=$   

**i)**  $5 - 3\frac{5}{12} =$

$=$   
.....  
 $=$   
.....  
 $=$

**Skill 9.5** Subtracting a fraction or a mixed number from a whole number (2) Blue 1 1 2 3 3 4 4  
Green 1 1 2 3 3 4 4

- 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 43)

**Q.**  $5 - 3\frac{5}{6} =$

**A.**  $5 - 3\frac{5}{6} =$

$$= 2 - \frac{5}{6}$$

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

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

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

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

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

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

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

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


---


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


---


$$= 3 + \frac{3}{5} = \boxed{\phantom{00}}$$

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

---



---



---


$$= \boxed{\phantom{00}}$$

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

---



---



---


$$= \boxed{\phantom{00}}$$

**m)**  $4 - 2\frac{2}{3} =$

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


---


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


---


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


---


$$= 1 + \frac{1}{3} = \boxed{\phantom{00}}$$

**n)**  $2 - 1\frac{5}{8} =$

---



---



---


$$= \boxed{\phantom{00}}$$

**o)**  $5 - 2\frac{3}{10} =$

---



---



---


$$= \boxed{\phantom{00}}$$

**p)**  $4 - 1\frac{3}{7} =$

---



---



---



---


$$= \boxed{\phantom{00}}$$

**q)**  $3 - 2\frac{9}{10} =$

---



---



---



---


$$= \boxed{\phantom{00}}$$

**r)**  $5 - 1\frac{11}{12} =$

---



---



---



---


$$= \boxed{\phantom{00}}$$

**Skill 9.6** Adding fractions with different denominators - one denominator divides evenly into the other denominator (1).

- Find the lowest common denominator of the fractions, which is the Lowest Common Multiple (LCM) of the denominators. In this case the LCM is the largest denominator.
- Change the fractions to equivalent fractions with the lowest common denominator.
- Add the fractions with the same denominators. (see skill 9.1, page 41)
- Simplify the resulting fraction and/or change it to a mixed number if necessary. (see skill 9.1, page 41)

Hint: If unsure which is the LCM of the denominators, use their product as the common denominator.

Examples:

$$\frac{5}{6} + \frac{1 \times 3}{2 \times 3} = \frac{5}{6} + \frac{3}{6} = \frac{8 \div 2}{6 \div 2} = \frac{4}{3} = 1\frac{1}{3} \quad (\text{LCM of 6 and 2 is 6, because 2 divides evenly into 6})$$

OR

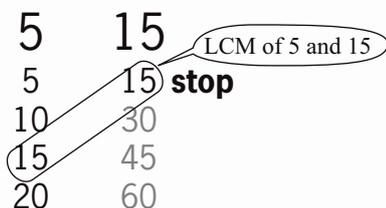
$$\frac{5}{6} + \frac{1}{2} = \frac{10}{12} + \frac{6}{12} = \frac{16 \div 4}{12 \div 4} = \frac{4}{3} = 1\frac{1}{3} \quad (\text{common denominator of 6 and 2 is } 6 \times 2 = 12)$$

**To find the Lowest 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  $\Rightarrow$  Lowest Common Multiple (LCM).

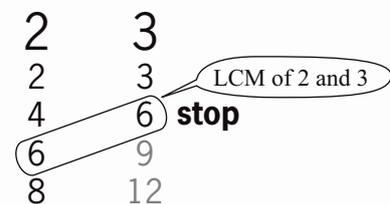
Hint: The lowest common multiple is the smallest number that the two numbers divide into.

**LCM when one number divides evenly into the other number**



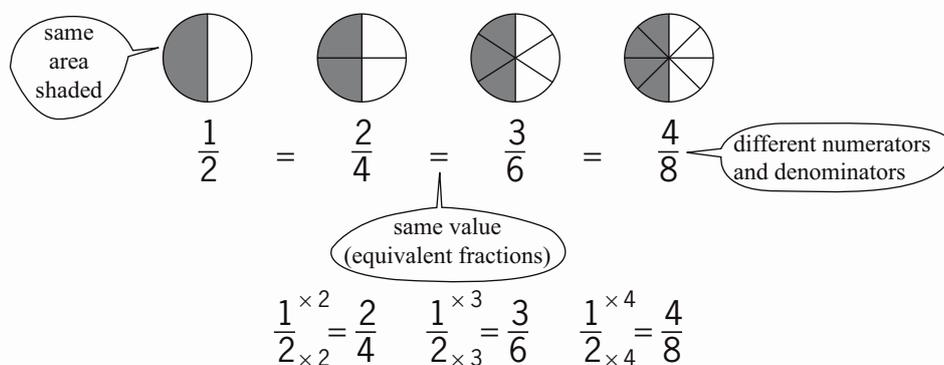
Hint: LCM is the largest number.

**LCM when the numbers have NO common factors other than 1**



Hint: LCM is the product of the numbers.

**To find equivalent fractions**



Equivalent fractions have the same value.

Equivalent fractions are formed by multiplying the numerator and denominator by the same number.

**Skill 9.6**

**Adding fractions with different denominators - one denominator divides evenly into the other denominator (2).**

**Q.**  $\frac{4}{15} + \frac{2}{5} =$

**A.**  $\frac{4}{15} + \frac{2}{5}$   
 $= \frac{4}{15} + \frac{2 \times 3}{5 \times 3}$   
 $= \frac{4}{15} + \frac{6}{15}$   
 $= \frac{10}{15}$   
 $= \frac{2}{3}$

LCM of 15 and 5 is 15

To give the second fraction a denominator of 15, multiply both the numerator and denominator by 3.

Add the fractions.

Simplify.

**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)**  $\frac{5}{8} + \frac{1}{2} =$  LCM of 8 and 2 is 8  
 $= \frac{5}{8} + \frac{1 \times 4}{2 \times 4}$   
 $= \frac{5}{8} + \frac{4}{8} = \boxed{\frac{9}{8}}$

**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)**  $\frac{1}{2} + \frac{1}{6} =$   
 $= \frac{1}{2} + \frac{1 \times 3}{6 \times 3}$   
 $= \frac{1}{2} + \frac{3}{6} = \boxed{\frac{3}{2}}$

**e)**  $\frac{1}{4} + \frac{1}{8} =$   
 $= \frac{1}{4} + \frac{1 \times 2}{8 \times 2}$   
 $= \frac{1}{4} + \frac{2}{8} = \boxed{\frac{3}{4}}$

**f)**  $\frac{7}{10} + \frac{3}{20} =$   
 $= \frac{7}{10} + \frac{3 \times 1}{20 \times 1}$   
 $= \frac{7}{10} + \frac{3}{20} = \boxed{\frac{17}{20}}$

**g)**  $\frac{1}{4} + \frac{5}{12} =$   
 $= \frac{1 \times 3}{4 \times 3} + \frac{5}{12}$   
 $= \frac{3}{12} + \frac{5}{12}$   
 $= \frac{8}{12} = \boxed{\frac{2}{3}}$

**h)**  $\frac{3}{5} + \frac{3}{20} =$   
 $= \frac{3 \times 4}{5 \times 4} + \frac{3}{20}$   
 $= \frac{12}{20} + \frac{3}{20}$   
 $= \frac{15}{20} = \boxed{\frac{3}{4}}$

**i)**  $\frac{1}{6} + \frac{5}{18} =$   
 $= \frac{1 \times 3}{6 \times 3} + \frac{5}{18}$   
 $= \frac{3}{18} + \frac{5}{18}$   
 $= \frac{8}{18} = \boxed{\frac{4}{9}}$

**j)**  $\frac{7}{15} + \frac{3}{5} =$   
 $= \frac{7}{15} + \frac{3 \times 3}{5 \times 3}$   
 $= \frac{7}{15} + \frac{9}{15}$   
 $= \frac{16}{15} = \boxed{\frac{16}{15}}$

**k)**  $\frac{3}{4} + \frac{5}{2} =$   
 $= \frac{3}{4} + \frac{5 \times 2}{2 \times 2}$   
 $= \frac{3}{4} + \frac{10}{4}$   
 $= \frac{13}{4} = \boxed{\frac{13}{4}}$

**l)**  $\frac{1}{2} + \frac{7}{12} =$   
 $= \frac{1 \times 6}{2 \times 6} + \frac{7}{12}$   
 $= \frac{6}{12} + \frac{7}{12}$   
 $= \frac{13}{12} = \boxed{\frac{13}{12}}$

**Skill 9.7** Adding fractions with different denominators -  
the denominators have no common factors other than 1 (e.g. 5 and 6).

- Find the lowest common denominator of the fractions, which is the Lowest Common Multiple (LCM) of the denominators. In this case the LCM is the product of the denominators. (see skill 9.6, page 50)
- Change the fractions to equivalent fractions with the lowest common denominator.
- Add the fractions with the same denominators. (see skill 9.1, page 41)
- Simplify the resulting fraction and/or change it to a mixed number if necessary. (see skill 9.1, page 41)

**Q.**  $\frac{1}{6} + \frac{3}{7} =$

**A.**  $\frac{1}{6} + \frac{3}{7}$   
 $= \frac{1 \times 7}{6 \times 7} + \frac{3 \times 6}{7 \times 6}$   
 $= \frac{7}{42} + \frac{18}{42}$   
 $= \frac{25}{42}$

LCM of 6 and 7  
is 42

Multiply the numerator and denominator of the first fraction by 7.

Multiply the numerator and denominator of the second fraction by 6.

Add the fractions.

**a)**  $\frac{2}{5} + \frac{3}{8} =$   
 $= \frac{2 \times 8}{5 \times 8} + \frac{3 \times 5}{8 \times 5}$   
 $= \frac{16}{40} + \frac{15}{40} = \frac{31}{40}$

LCM of 5 and 8  
is 40

**b)**  $\frac{2}{3} + \frac{3}{4} =$   
 $=$   
 $=$   $=$   $=$

**c)**  $\frac{1}{3} + \frac{4}{5} =$   
 $=$   
 $=$   $=$   $=$

**d)**  $\frac{5}{9} + \frac{1}{4} =$   
 $=$   
 $=$   $=$   $=$

**e)**  $\frac{1}{2} + \frac{4}{7} =$   
 $=$   
 $=$   $=$   $=$

**f)**  $\frac{2}{3} + \frac{1}{5} =$   
 $=$   
 $=$   $=$   $=$

**g)**  $\frac{3}{4} + \frac{3}{5} =$   
 $=$   
 $=$   
 $=$   $=$   $=$

**h)**  $\frac{1}{6} + \frac{2}{5} =$   
 $=$   
 $=$   
 $=$   $=$   $=$

**i)**  $\frac{2}{3} + \frac{4}{5} =$   
 $=$   
 $=$   
 $=$   $=$   $=$

**Skill 9.8** Subtracting fractions with different denominators - one denominator divides evenly into the other denominator.

- Find the lowest common denominator of the fractions, which is the Lowest Common Multiple (LCM) of the denominators. In this case the LCM is the largest denominator. (see skill 9.6, page 50)
- Change the fractions to equivalent fractions with the lowest common denominator.
- Subtract the fractions with the same denominators. (see skill 9.2, page 43)
- Simplify the resulting fraction and/or change it to a mixed number if necessary. (see skill 9.1, page 41)

Hint: If unsure which is the LCM of the denominators, use their product as the common denominator.

**Q.**  $\frac{3}{4} - \frac{7}{16} =$

**A.**  $\frac{3}{4} - \frac{7}{16}$  LCM of 4 and 16 is 16

$$= \frac{3 \times 4}{4 \times 4} - \frac{7}{16}$$

$$= \frac{12}{16} - \frac{7}{16}$$

$$= \frac{5}{16}$$

To give the first fraction a denominator of 16, multiply both the numerator and denominator by 4.

Subtract the fractions.

**a)**  $\frac{7}{9} - \frac{2}{3} =$  LCM of 9 and 3 is 9

$$= \frac{7}{9} - \frac{2 \times 3}{3 \times 3}$$


---


$$= \frac{7}{9} - \frac{6}{9} = \boxed{\frac{1}{9}}$$

**b)**  $\frac{2}{3} - \frac{5}{12} =$

$$= \frac{2 \times 4}{3 \times 4} - \frac{5}{12}$$


---


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

**c)**  $\frac{5}{8} - \frac{11}{24} =$

---


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

**d)**  $\frac{3}{4} - \frac{5}{8} =$

---


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

**e)**  $\frac{2}{7} - \frac{2}{21} =$

---


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

**f)**  $\frac{4}{9} - \frac{8}{27} =$

---


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

**g)**  $\frac{2}{3} - \frac{7}{15} =$

$$= \frac{2 \times 5}{3 \times 5} - \frac{7}{15}$$


---


$$= \frac{10}{15} - \frac{7}{15}$$


---


$$= \frac{3}{15} = \boxed{\quad}$$

**h)**  $\frac{7}{10} - \frac{9}{20} =$

---


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

**i)**  $\frac{3}{10} - \frac{3}{50} =$

---


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

**Skill 9.9** Subtracting fractions with different denominators - the denominators have no common factors other than 1 (e.g. 5 and 6).

- Find the lowest common denominator of the fractions, which is the Lowest Common Multiple (LCM) of the denominators. In this case the LCM is the product of the denominators. (see skill 9.6, page 50)
- Change the fractions to equivalent fractions with the lowest common denominator.
- Subtract the fractions with the same denominators. (see skill 9.2, page 43)
- Simplify the resulting fraction and/or change it to a mixed number if necessary. (see skill 9.1, page 41)

**Q.**  $\frac{3}{5} - \frac{1}{4} =$

**A.**  $\frac{3}{5} - \frac{1}{4}$  LCM of 5 and 4 is 20

$$= \frac{3 \times 4}{5 \times 4} - \frac{1 \times 5}{4 \times 5} =$$

$$= \frac{12}{20} - \frac{5}{20}$$

$$= \frac{7}{20}$$

Multiply the numerator and denominator of the first fraction by 4.

Multiply the numerator and denominator of the second fraction by 5.

Subtract the fractions.

**a)**  $\frac{2}{3} - \frac{3}{8} =$  LCM of 3 and 8 is 24

$$= \frac{2 \times 8}{3 \times 8} - \frac{3 \times 3}{8 \times 3}$$

$$= \frac{16}{24} - \frac{9}{24} = \boxed{\frac{7}{24}}$$

**b)**  $\frac{1}{2} - \frac{1}{3} =$

$$=$$

$$= \boxed{\phantom{00}}$$

**c)**  $\frac{4}{9} - \frac{2}{7} =$

$$=$$

$$= \boxed{\phantom{00}}$$

**d)**  $\frac{5}{9} - \frac{3}{10} =$

$$=$$

$$= \boxed{\phantom{00}}$$

**e)**  $\frac{3}{4} - \frac{1}{3} =$

$$=$$

$$= \boxed{\phantom{00}}$$

**f)**  $\frac{4}{5} - \frac{5}{8} =$

$$=$$

$$= \boxed{\phantom{00}}$$

**g)**  $\frac{4}{7} - \frac{1}{6} =$

$$=$$

$$= \boxed{\phantom{00}}$$

**h)**  $\frac{2}{5} - \frac{2}{7} =$

$$=$$

$$= \boxed{\phantom{00}}$$

**i)**  $\frac{2}{3} - \frac{3}{10} =$

$$=$$

$$= \boxed{\phantom{00}}$$

**j)**  $\frac{2}{5} - \frac{3}{8} =$

$$=$$

$$= \boxed{\phantom{00}}$$

**k)**  $\frac{5}{6} - \frac{2}{7} =$

$$=$$

$$= \boxed{\phantom{00}}$$

**l)**  $\frac{7}{9} - \frac{2}{5} =$

$$=$$

$$= \boxed{\phantom{00}}$$

# 10. [Fraction $\times, \div$ ]

## Skill 10.1 Multiplying a fraction by a whole number (1).

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- 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

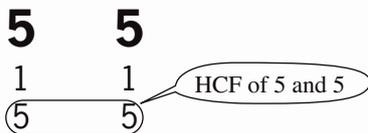
- Simplify at the end.

### To find the Highest Common Factor (HCF) 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.

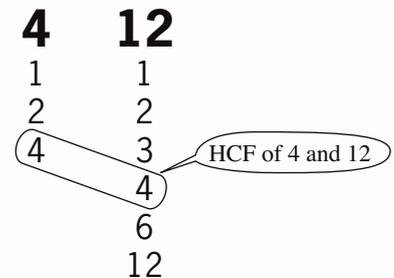
Hint: The Highest Common Factor is the largest number that divides evenly into both numbers.

#### HCF for Identical numbers



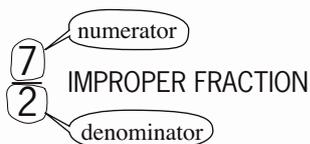
Hint: 5 is the HCF of 5 and 5 because 5 is the largest number that divides into 5 and 5.

#### HCF when one number divides evenly into the other number



Hint: 4 is the HCF of 4 and 12 because 4 is the largest number that divides into 4 and 12.

#### To change 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.

$$3 \text{ remainder } 1 = 3\frac{1}{2}$$

#### To cross multiply a fraction and a whole number

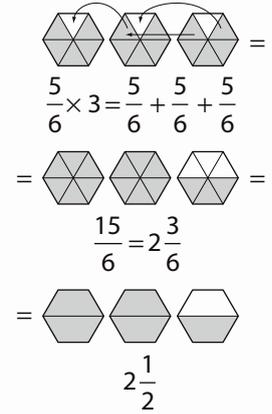
- Simplify the denominator of the fraction and the whole number. This means to divide them by the same number, usually by their Highest Common Factor.
- Cross out the denominator of the fraction and the whole number.
- Write the result of the division next to each crossed number.
- Multiply the top numbers together.

$$\begin{aligned} \frac{3}{10} \times 5 &= \frac{3}{\cancel{10}^5} \times \cancel{5}_5 \quad \text{Divide 5 and 10 by 5} \\ &= \frac{3}{2} \times 1 \quad \begin{matrix} 5 \div 5 = 1 \\ 10 \div 5 = 2 \end{matrix} \\ &= \frac{3}{2} = 1\frac{1}{2} \end{aligned}$$

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)  $7 \times \frac{3}{4} =$

$= \frac{7 \times 3}{4} = \frac{21}{4}$  *Change to a mixed number*  
 $= 21 \div 4 = 5\frac{1}{4}$

b)  $\frac{2}{5} \times 8 =$

$=$   
 $=$    $=$

c)  $4 \times \frac{3}{7} =$

$=$   
 $=$    $=$

d)  $\frac{4}{5} \times 3 =$

$=$   
 $=$

e)  $3 \times \frac{5}{8} =$

$=$   
 $=$

f)  $2 \times \frac{2}{9} =$

$=$   
 $=$

g)  $3 \times \frac{5}{9} =$

$= \frac{1}{\cancel{3}} \times \frac{5}{\cancel{9}^3} = \frac{1 \times 5}{3} = \frac{5}{3} = 1\frac{2}{3}$  *Divide 3 and 9 by 3*

h)  $\frac{5}{8} \times 2 =$

$=$   
 $=$

i)  $4 \times \frac{7}{12} =$

$=$   
 $=$

j)  $6 \times \frac{5}{12} =$

$=$   
 $=$

k)  $\frac{3}{7} \times 14 =$

$=$   
 $=$

l)  $\frac{3}{5} \times 30 =$

$=$   
 $=$

m)  $9 \times \frac{1}{6} =$

$=$   
 $=$

n)  $\frac{1}{4} \times 16 =$

$=$   
 $=$

o)  $12 \times \frac{3}{4} =$

$=$   
 $=$

## Skill 10.2 Finding a fraction of a quantity.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Replace the word “of” with the multiplication symbol.
- Multiply the fraction by the whole number. (see skill 10.1, page 55)
- 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.  $\frac{4}{9}$  of \$360 =

A.  $\frac{4}{9}$  of \$360 =

OR A. To find  $\frac{4}{9}$  of \$360:

$$360 \div 9 = 40$$

$$40 \times 4 = \mathbf{\$160}$$

$$= \frac{4}{9} \times 360$$

$$= \frac{4 \times 40}{1}$$

Divide  
9 and 360 by 9

$$= \mathbf{\$160}$$

Add the \$ sign

a)  $\frac{2}{5}$  of 30 mL =

$$= \frac{2}{5} \times 30$$

$$= \frac{2 \times 6}{1} = \mathbf{12 \text{ mL}}$$

Divide  
5 and 30 by 5

b)  $\frac{1}{2}$  of 70 kg =

$$= \frac{1}{2} \times 70$$

$$= \quad = \quad$$

c)  $\frac{1}{3}$  of 48 km =

$$=$$

$$= \quad = \quad$$

d)  $\frac{7}{10}$  of 100 L =

$$=$$

$$= \quad = \quad$$

e)  $\frac{1}{6}$  of 720 m =

$$=$$

$$= \quad = \quad$$

f)  $\frac{1}{8}$  of \$400 =

$$=$$

$$= \quad = \quad$$

g)  $\frac{3}{4}$  of 120 L =

$$=$$

$$= \quad = \quad$$

h)  $\frac{1}{6}$  of 120 cm =

$$=$$

$$= \quad = \quad$$

i)  $\frac{3}{4}$  of 60 m =

$$=$$

$$= \quad = \quad$$

j)  $\frac{1}{9}$  of 720 g =

$$=$$

$$= \quad = \quad$$

k)  $\frac{3}{5}$  of 60 mL =

$$=$$

$$= \quad = \quad$$

l)  $\frac{3}{8}$  of 80 kg =

$$=$$

$$= \quad = \quad$$

### Skill 10.3 Dividing a whole number by a fraction (1).

- Copy the whole number and change “divide by” ( $\div$ ) into “times” ( $\times$ ).
- Invert the fraction.
- Multiply the whole number by the numerator of the fraction. Do not change the denominator.

To simplify:

EITHER

- Cross simplify where possible before multiplying.  
(see skill 10.1, page 55)

OR

- Simplify at the end.

**Q.**  $2 \div \frac{1}{8} =$

**A.**  $2 \div \frac{1}{8} =$

Change the sign to “ $\times$ ”

↓ ↓ Invert fraction

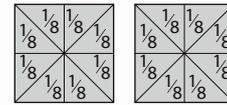
$$= 2 \times \frac{8}{1}$$

$$= \frac{2 \times 8}{1}$$

$$= 16$$

How many eighths are there in two wholes?

There are 16 eighths in two wholes.



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

**a)**  $3 \div \frac{3}{5} =$

↓ ↓ Invert fraction

$$= 3 \times \frac{5}{3}$$

Divide 3 and 3 by 3

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

**b)**  $5 \div \frac{5}{8} =$

$$=$$

$$=$$

$$=$$

$$= \boxed{\phantom{00}}$$

**c)**  $4 \div \frac{4}{7} =$

$$=$$

$$=$$

$$=$$

$$= \boxed{\phantom{00}}$$

**d)**  $6 \div \frac{6}{10} =$

$$=$$

$$=$$

$$=$$

$$= \boxed{\phantom{00}}$$

**e)**  $7 \div \frac{7}{9} =$

$$=$$

$$=$$

$$=$$

$$= \boxed{\phantom{00}}$$

**f)**  $5 \div \frac{5}{11} =$

$$=$$

$$=$$

$$=$$

$$= \boxed{\phantom{00}}$$

**g)**  $3 \div \frac{1}{8} =$

↓ ↓ Invert fraction

$$= 3 \times \frac{8}{1}$$

$$= \frac{3 \times 8}{1} = \boxed{\phantom{00}}$$

**h)**  $2 \div \frac{1}{9} =$

$$=$$

$$=$$

$$= \boxed{\phantom{00}}$$

**i)**  $4 \div \frac{1}{7} =$

$$=$$

$$=$$

$$= \boxed{\phantom{00}}$$

### Skill 10.3 Dividing a whole number by a fraction (2).

j)  $2 \div \frac{3}{8} =$  Invert fraction

$= 2 \times \frac{8}{3}$

---

$= \frac{2 \times 8}{3} = \frac{16}{3} = \boxed{5 \frac{1}{3}}$

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)  $8 \div \frac{4}{7} =$  Invert fraction

$= 8 \times \frac{7}{4}$

---

$= \frac{2}{\cancel{8}} \times \frac{7}{\cancel{4}_1}$  Divide 8 and 4 by 4

---

$= \frac{2 \times 7}{1} = \boxed{14}$

q)  $4 \div \frac{4}{9} =$

$=$

---

$=$

r)  $5 \div \frac{5}{12} =$

$=$

---

$=$

s)  $4 \div \frac{3}{6} =$

$=$

---

$=$

t)  $4 \div \frac{2}{5} =$

$=$

---

$=$

u)  $10 \div \frac{2}{3} =$

$=$

---

$=$

v)  $8 \div \frac{2}{7} =$

$=$

---

$=$

w)  $9 \div \frac{3}{7} =$

$=$

---

$=$

x)  $8 \div \frac{4}{11} =$

$=$

---

$=$

## Skill 10.4 Multiplying two fractions (1).

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Multiply the numerators of the fractions.
  - Multiply the denominators of the fractions.
- To simplify:

EITHER

- Simplify where possible before multiplying.

OR

- Simplify at the end.

### To cross multiply 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 Highest Common Factor. (see skill 10.1, page 55)
- 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.

$$\frac{3}{4} \times \frac{8}{9} = \frac{\overset{+3}{\cancel{3}} \times \overset{+4}{\cancel{8}}}{\underset{+4}{\cancel{4}} \times \underset{+3}{\cancel{9}}} = \frac{\overset{+3}{\cancel{3}} \times \overset{+4}{\cancel{8}}}{\underset{+4}{\cancel{4}} \times \underset{+3}{\cancel{9}}} = \frac{1 \times 2}{1 \times 3} = \frac{2}{3}$$

Divide 3 and 9 by 3

Divide 4 and 8 by 4

Q.  $\frac{3}{4} \times \frac{2}{9} =$

A.  $\frac{3}{4} \times \frac{2}{9} =$

OR

A.  $\frac{3}{4} \times \frac{2}{9} =$

$$= \frac{\overset{1}{\cancel{3}} \times \overset{1}{\cancel{2}}}{\underset{2}{\cancel{4}} \times \underset{3}{\cancel{9}}} =$$

Divide 3 and 9 by 3

$$= \frac{1 \times 1}{2 \times 3} =$$

Divide 2 and 4 by 2

$$= \frac{1}{6}$$

$$= \frac{3 \times 2}{4 \times 9} =$$

$$= \frac{6}{36}$$

Simplify

$$= \frac{1}{6}$$

a)  $\frac{1}{5} \times \frac{2}{7} =$

$$= \frac{1 \times 2}{5 \times 7} = \frac{2}{35}$$

b)  $\frac{3}{5} \times \frac{3}{4} =$

$$= \frac{3 \times 3}{5 \times 4} = \frac{9}{20}$$

c)  $\frac{1}{8} \times \frac{3}{4} =$

$$= \frac{1 \times 3}{8 \times 4} = \frac{3}{32}$$

d)  $\frac{4}{11} \times \frac{1}{3} =$

$$= \frac{4 \times 1}{11 \times 3} = \frac{4}{33}$$

e)  $\frac{3}{8} \times \frac{3}{4} =$

$$= \frac{3 \times 3}{8 \times 4} = \frac{9}{32}$$

f)  $\frac{3}{5} \times \frac{4}{7} =$

$$= \frac{3 \times 4}{5 \times 7} = \frac{12}{35}$$

g)  $\frac{4}{5} \times \frac{1}{3} =$

$$= \frac{4 \times 1}{5 \times 3} = \frac{4}{15}$$

h)  $\frac{5}{6} \times \frac{1}{2} =$

$$= \frac{5 \times 1}{6 \times 2} = \frac{5}{12}$$

i)  $\frac{5}{9} \times \frac{7}{10} =$

$$= \frac{5 \times 7}{9 \times 10} = \frac{35}{90} = \frac{7}{18}$$

# Skill 10.4 Multiplying two fractions (2).

j)  $\frac{3}{4} \times \frac{1}{6} =$

$= \frac{\overset{1}{\cancel{3}}}{4} \times \frac{1}{\underset{2}{\cancel{6}}} =$  Simplify

$= \frac{1 \times 1}{4 \times 2} = \boxed{\frac{1}{8}}$

k)  $\frac{5}{6} \times \frac{6}{7} =$

$=$   
 $=$   
 $=$

l)  $\frac{3}{5} \times \frac{2}{3} =$

$=$   
 $=$   
 $=$

m)  $\frac{7}{9} \times \frac{2}{7} =$

$=$   
 $=$   
 $=$

n)  $\frac{1}{2} \times \frac{4}{9} =$

$=$   
 $=$   
 $=$

o)  $\frac{3}{5} \times \frac{1}{6} =$

$=$   
 $=$   
 $=$

p)  $\frac{5}{8} \times \frac{2}{15} =$

$=$   
 $=$   
 $=$

q)  $\frac{2}{5} \times \frac{3}{4} =$

$=$   
 $=$   
 $=$

r)  $\frac{4}{5} \times \frac{1}{2} =$

$=$   
 $=$   
 $=$

s)  $\frac{7}{9} \times \frac{1}{14} =$

$=$   
 $=$   
 $=$

t)  $\frac{5}{7} \times \frac{3}{10} =$

$=$   
 $=$   
 $=$

u)  $\frac{5}{12} \times \frac{6}{7} =$

$=$   
 $=$   
 $=$

v)  $\frac{3}{12} \times \frac{4}{6} =$

$=$   
 $=$   
 $=$

w)  $\frac{2}{5} \times \frac{10}{14} =$

$=$   
 $=$   
 $=$

x)  $\frac{3}{10} \times \frac{2}{9} =$

$=$   
 $=$   
 $=$

y)  $\frac{3}{10} \times \frac{5}{9} =$

$=$   
 $=$   
 $=$

z)  $\frac{3}{4} \times \frac{8}{15} =$

$=$   
 $=$   
 $=$

A)  $\frac{4}{9} \times \frac{3}{16} =$

$=$   
 $=$   
 $=$

## Skill 10.5 Dividing a fraction by a whole number (1).

Blue 11 22 3 4 4  
Green 11 22 3 3 4 4

- 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 60)

To simplify:

EITHER

- Cross simplify where possible before dividing.

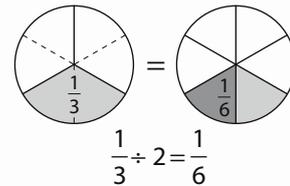
OR

- Simplify at the end.

Q.  $\frac{1}{3} \div 2 =$

A.  $\frac{1}{3} \div 2 =$   
 $= \frac{1}{3} \div \frac{2}{1}$  (Invert second fraction)  
 $= \frac{1}{3} \times \frac{1}{2}$   
 $= \frac{1 \times 1}{3 \times 2}$   
 $= \frac{1}{6}$

What is one third divided into 2 equal parts?



This can also be thought of as one half of a third.

$$\frac{1}{2} \text{ of } \frac{1}{3} = \frac{1}{2} \times \frac{1}{3} = \frac{1}{6}$$

a)  $\frac{4}{9} \div 4 =$

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


---


$$= \frac{4}{9} \times \frac{1}{4}$$


---


$$= \frac{\cancel{4}^1}{9} \times \frac{1}{\cancel{4}_1}$$
 (Divide 4 and 4 by 4)
 

---


$$= \frac{1 \times 1}{9 \times 1} = \boxed{\phantom{00}}$$

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

$$=$$


---


$$=$$


---


$$=$$


---


$$=$$


---


$$= \boxed{\phantom{00}}$$

c)  $\frac{3}{7} \div 3 =$

$$=$$


---


$$=$$


---


$$=$$


---


$$=$$


---


$$= \boxed{\phantom{00}}$$

d)  $\frac{1}{3} \div 4 =$

$$=$$


---


$$=$$


---


$$= \boxed{\phantom{00}}$$

e)  $\frac{1}{5} \div 6 =$

$$=$$


---


$$=$$


---


$$= \boxed{\phantom{00}}$$

f)  $\frac{1}{7} \div 3 =$

$$=$$


---


$$=$$


---


$$= \boxed{\phantom{00}}$$

Skill 10.5 Dividing a fraction by a whole number (2).

g)  $\frac{2}{5} \div 8 =$   
 $= \frac{2}{5} \div \frac{8}{1}$   
 $= \frac{2}{5} \times \frac{1}{8}$   
 $= \frac{\cancel{2}^1}{5} \times \frac{1}{\cancel{8}_4} = \boxed{\frac{1}{20}}$

h)  $\frac{3}{7} \div 12 =$   
 $=$   
 $=$   
 $=$

i)  $\frac{6}{11} \div 3 =$   
 $=$   
 $=$   
 $=$

j)  $\frac{5}{8} \div 15 =$   
 $=$   
 $=$   
 $=$

k)  $\frac{2}{7} \div 10 =$   
 $=$   
 $=$   
 $=$

l)  $\frac{2}{9} \div 16 =$   
 $=$   
 $=$   
 $=$

m)  $\frac{2}{3} \div 9 =$   
 $=$   
 $=$   
 $=$

n)  $\frac{5}{6} \div 4 =$   
 $=$   
 $=$   
 $=$

o)  $\frac{2}{11} \div 3 =$   
 $=$   
 $=$   
 $=$

p)  $\frac{3}{4} \div 4 =$   
 $=$   
 $=$   
 $=$

q)  $\frac{3}{5} \div 2 =$   
 $=$   
 $=$   
 $=$

r)  $\frac{7}{10} \div 6 =$   
 $=$   
 $=$   
 $=$

## Skill 10.6 Dividing two fractions (1).

Blue 11 22 33 44  
Green 11 22 33 44

- Copy the first fraction and change “divide by” ( $\div$ ) into “times” ( $\times$ ).
  - Invert the second fraction.
  - Multiply the fractions. (see skill 10.4, page 60)
- To simplify:

EITHER

- Cross simplify where possible before multiplying. (see skill 10.4, page 60)

OR

- Simplify at the end.

Q.  $\frac{3}{8} \div \frac{1}{4} =$

A.  $\frac{3}{8} \div \frac{1}{4} =$  Invert second fraction

$$= \frac{3}{8} \times \frac{4}{1}$$

$$= \frac{3}{\cancel{8}^2} \times \frac{\cancel{4}^1}{1}$$

Simplify by dividing 8 and 4 by 4

$$= \frac{3 \times 1}{2 \times 1}$$

$$= \frac{3}{2} = 1\frac{1}{2}$$

OR A.  $\frac{3}{8} \div \frac{1}{4} =$

$$= \frac{3}{8} \times \frac{4}{1}$$

$$= \frac{3 \times 4}{8 \times 1}$$

$$= \frac{12 \div 4}{8 \div 4}$$

Simplify

$$= \frac{3}{2} = 1\frac{1}{2}$$

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

$$= \frac{3}{4} \times \frac{5}{2}$$

$$= \frac{3 \times 5}{4 \times 2} = \frac{15}{8} = 1\frac{7}{8}$$

b)  $\frac{1}{6} \div \frac{5}{7} =$

$$=$$

$$=$$

c)  $\frac{2}{7} \div \frac{3}{5} =$

$$=$$

$$=$$

d)  $\frac{4}{9} \div \frac{3}{5} =$

$$=$$

$$=$$

e)  $\frac{4}{9} \div \frac{7}{11} =$

$$=$$

$$=$$

f)  $\frac{5}{12} \div \frac{2}{7} =$

$$=$$

$$=$$

g)  $\frac{2}{3} \div \frac{3}{4} =$

$$=$$

$$=$$

h)  $\frac{2}{3} \div \frac{5}{8} =$

$$=$$

$$=$$

i)  $\frac{3}{10} \div \frac{2}{9} =$

$$=$$

$$=$$

**Skill 10.6** Dividing two fractions (2).

j)  $\frac{5}{12} \div \frac{3}{4} =$   
 $= \frac{5}{12} \times \frac{4}{3}$

$= \frac{5}{\cancel{12}^3} \times \frac{\cancel{4}^1}{3}$  Divide  
12 and 4 by 4

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

k)  $\frac{7}{9} \div \frac{2}{3} =$

$=$  \_\_\_\_\_

$=$  \_\_\_\_\_

$=$  \_\_\_\_\_  $=$

l)  $\frac{5}{6} \div \frac{2}{3} =$

$=$  \_\_\_\_\_

$=$  \_\_\_\_\_

$=$  \_\_\_\_\_  $=$

m)  $\frac{1}{4} \div \frac{1}{2} =$

$=$  \_\_\_\_\_

$=$  \_\_\_\_\_

$=$  \_\_\_\_\_  $=$

n)  $\frac{1}{12} \div \frac{2}{3} =$

$=$  \_\_\_\_\_

$=$  \_\_\_\_\_

$=$  \_\_\_\_\_  $=$

o)  $\frac{9}{10} \div \frac{2}{5} =$

$=$  \_\_\_\_\_

$=$  \_\_\_\_\_

$=$  \_\_\_\_\_  $=$

p)  $\frac{5}{6} \div \frac{1}{3} =$

$=$  \_\_\_\_\_

$=$  \_\_\_\_\_

$=$  \_\_\_\_\_  $=$

q)  $\frac{3}{8} \div \frac{3}{4} =$

$=$  \_\_\_\_\_

$=$  \_\_\_\_\_

$=$  \_\_\_\_\_  $=$

r)  $\frac{3}{5} \div \frac{9}{20} =$

$=$  \_\_\_\_\_

$=$  \_\_\_\_\_

$=$  \_\_\_\_\_  $=$

s)  $\frac{4}{5} \div \frac{3}{10} =$

\_\_\_\_\_

$=$

t)  $\frac{5}{12} \div \frac{1}{6} =$

\_\_\_\_\_

$=$

u)  $\frac{7}{10} \div \frac{3}{20} =$

\_\_\_\_\_

$=$



# 11. [Percentages]

## Skill 11.1 Writing a number out of 100 as a percentage.

Blue 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Write the number followed by the percent symbol “%”  
Hint: “Percentage” means “per hundred” or “of each hundred”.

**Q.** Write as a percentage:  
14 out of 100.

**A.** 14 out of 100 =  
= 14%

**a)** Write as a percentage:  
60 out of 100.

60%

**b)** Write as a percentage:  
32 out of 100.

**c)** Write as a percentage:  
46 out of 100.

**d)** Write as a percentage:  
57 out of 100.

**e)** Write as a percentage:  
5 out of 100.

**f)** Write as a percentage:  
8 out of 100.

**g)** Write as a percentage:  
61 out of 100.

**h)** Write as a percentage:  
29 out of 100.

**i)** Write as a percentage:  
4 out of 100.

**j)** Write as a percentage:  
7 out of 100.

**k)** Write as a percentage:  
37 out of 100.

**l)** Write as a percentage:  
91 out of 100.

**m)** Write as a percentage:  
28 out of 100.

**n)** Write as a percentage:  
79 out of 100.

- Subtract the given percentages from 100%, to find the remaining percentage.

**Q.** According to a projection for 2020, 39% of the population of the USA will be aged between 0 - 29 and 35% between 30 - 59. What percentage of the population will be aged 60 or more?

**A.**  $100\% - 39\% - 35\%$   
 $= 100\% - 74\%$   
 $= 26\%$

**a)** Approximately 51% of the athletes at the 2020 Sydney Olympics were male. What percentage of the athletes were female?

$100\% - 51\%$  ..... =

**b)** School is approximately 60% of the calendar year in Russia. What percentage do holidays account for?

..... =

**c)** A dress is made of a poly cotton blend. If 65% of the fabric is cotton, what percentage is polyester?

..... =

**d)** If 80% of the West Point military academy graduates are male, what percentage are females?

..... =

**e)** If 67% of the US Supreme Court justices in 2020 are male, what percentage are female?

..... =

**f)** Milk is approximately 87% water, and the rest solids (fat and other non-fat solids). What percentage are solids?

..... =

**g)** In Mali 72% of people earn less than \$1 a day. What percentage of people earn more than \$1 a day?

..... =

**h)** If 37.5% of the adult teeth are incisors and canines, what percentage is formed by molars and pre-molars?

..... =

**i)** The 2-dollar coin is made of 92% copper, 6% aluminium and the rest is nickel. What percentage of the 2-dollar coin is nickel?

$100\% - 92\% - 6\%$  ..... =

**j)** Approximately 26% of the world population is aged between 0 and 14 years and 66% between 15 and 64 years. What percentage of the population is aged 65 years and over?

..... =

**k)** If England occupies 57% and Scotland occupies 34% of Great Britain (the main island of the United Kingdom), what percentage is occupied by Wales?

..... =

**l)** At the 2016 Rio Olympics, 27.6% of the medals won by Australia were gold, and 38% were silver. What percentage of the medals were bronze?

..... =

EITHER

- Change the percentage to a fraction out of 100.

Example:  $40\% = \frac{40}{100}$

- Rewrite the question as a multiplication (change “of” to “×”).
- 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 60)

OR

- First find 10%.
- Then multiply by the amount needed to make the required percentage, i.e. multiply by 3 to get 30%.

To find  $10\% = \frac{1}{10} \Rightarrow$  divide by 10  
 $5\% \Rightarrow$  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

Q.  $60\%$  of  $\$8.00 =$

A.  $60\%$  of  $\$8.00 =$  *OR*  $60\%$  of  $800$  *Convert \$ to cents*  
 $= 60\%$  of  $800$   
 $= \frac{60}{100} \times \frac{800}{1}$  *Simplify: ÷ 100*  
 $= 60 \times 8$   
 $= 480$  cents  
 $= \$4.80$

A.  $800 \div 10 =$  *Find 10%*  
 $= 80$  cents  
 $80 \times 6$  *Multiply by 6 to get 60%*  
 $= 480$  cents  
 $= \$4.80$

a)  $24\%$  of  $100 =$  *Divide by 100*  
 $= \frac{24}{100} \times \frac{100}{1}$   
 $= 24$

b)  $35\%$  of  $100 =$   
 $=$

c)  $69\%$  of  $100 =$   
 $=$

d)  $9\%$  of  $\$100 =$   
 $=$   \$

e)  $7\%$  of  $\$100 =$   
 $=$   \$

f)  $50\%$  of  $\$100 =$   
 $=$   \$

g)  $25\%$  of  $\$600 =$   
 $= \frac{25}{100} \times \frac{600}{1}$   
 $= 25 \times 6 =$   \$

h)  $10\%$  of  $\$900 =$  *Divide 900 by 10*  
 $=$   \$

i)  $40\%$  of  $\$800 =$  *Find 10% first*  
 $=$   \$

j)  $60\%$  of  $\$200 =$   
 $=$   
 $=$   \$

k)  $25\%$  of  $\$800 =$   
 $=$   
 $=$   \$

l)  $70\%$  of  $\$600 =$   
 $=$   
 $=$   \$

**Skill 11.3** Finding a percentage of multiples of 100 (2).

Blue 1 1 22 33 44  
Green 1 1 22 33 44

**m)** 5% of \$300 =

$$= \frac{5}{100} \times \frac{300}{1}$$

$$= 5 \times 3 = \$ \boxed{\phantom{00}}$$

**n)** 5% of \$500 =

$$500 \div 10 = 50$$

$$50 \div 2 = \$ \boxed{\phantom{00}}$$

**o)** 5% of \$700 =

$$= \phantom{00} = \$ \boxed{\phantom{00}}$$

Find 10%

5% is half of 10%

**p)** 50% of \$700 =

$$= \phantom{00} = \$ \boxed{\phantom{00}}$$

**q)** 20% of \$200 =

$$= \phantom{00} = \$ \boxed{\phantom{00}}$$

**r)** 40% of \$500 =

$$= \phantom{00} = \$ \boxed{\phantom{00}}$$

**s)** 80% of \$400 =

$$= \phantom{00} = \$ \boxed{\phantom{00}}$$

**t)** 90% of \$300 =

$$= \phantom{00} = \$ \boxed{\phantom{00}}$$

**u)** 15% of \$400 =

$$= \phantom{00} = \$ \boxed{\phantom{00}}$$

**v)** 50% of \$5.00 =

$$= \phantom{00} = \$ \boxed{\phantom{00}}$$

**w)** 20% of \$3.00 =

$$= \phantom{00} = \$ \boxed{\phantom{00}}$$

**x)** 75% of \$6.00 =

$$= \phantom{00} = \$ \boxed{\phantom{00}}$$

**y)** 5% of \$4.00 =

$$= \phantom{00} = \boxed{\phantom{00}} \text{ ¢}$$

**z)** 40% of \$3.50 =

$$= \phantom{00} = \boxed{\phantom{00}} \text{ ¢}$$

**A)** 30% of \$4.50 =

$$= \phantom{00} = \boxed{\phantom{00}} \text{ ¢}$$

EITHER

- Change the percentage to a fraction out of 100.

Example:  $40\% = \frac{40}{100}$

- Rewrite the question as a multiplication (change "of" to "×").
- 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 60)

OR

- First find 10%.
- Then multiply by the amount needed to make the required percentage, i.e. multiply by 3 to get 30%.

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

Q.  $66\frac{2}{3}\%$  of 270 =

A.  $66\frac{2}{3}\%$  of 270 =  
 $= \frac{2}{3} \times \frac{270}{1}$  (Simplify: ÷ 3)  
 $= 2 \times 90$   
 $= 180$

Substitute  $66\frac{2}{3}\%$  with  $\frac{2}{3}$   
 Change "of" to "×"  
 Change 270 to  $\frac{270}{1}$   
 Multiply  $\frac{2}{3}$  by  $\frac{270}{1}$

a)  $20\%$  of 50 =  
 $= \frac{20}{100} \times \frac{50}{1}$  (Simplify: ÷ 10, twice)  
 $= 2 \times 5 = 10$

b)  $70\%$  of 240 = (Find 10% first)  
 $240 \div 10 = 24$   
 (Multiply by 7 to get 70%)  
 $24 \times 7 = \boxed{\phantom{00}}$

c)  $80\%$  of 20 =  
 $= \dots = \boxed{\phantom{00}}$

d)  $40\%$  of 80 =  
 $= \dots = \boxed{\phantom{00}}$

e)  $60\%$  of 250 =  
 $= \dots = \boxed{\phantom{00}}$

f)  $30\%$  of 140 =  
 $= \dots = \boxed{\phantom{00}}$

g)  $70\%$  of 120 =  
 $= \dots = \boxed{\phantom{00}}$

h)  $5\%$  of 40 =  
 $= \dots = \boxed{\phantom{00}}$

i)  $5\%$  of 120 =  
 $= \dots = \boxed{\phantom{00}}$

j)  $15\%$  of 60 = (Find 10% first)  
 $10\% \quad 60 \div 10 = 6$   
 (5% is half of 10%)  
 $5\% \quad 6 \div 2 = 3$   
 $15\% \quad 6 + 3 = \boxed{\phantom{00}}$

k)  $35\%$  of 80 =  
 $10\% \dots$   
 $5\% \dots$   
 $35\% \dots = \boxed{\phantom{00}}$

l)  $45\%$  of 120 =  
 $10\% \dots$   
 $5\% \dots$   
 $45\% \dots = \boxed{\phantom{00}}$

m) 25% of 180 =

$$= \frac{25}{100} \times \frac{180}{1}$$

Simplify:  $\div 5$

$$= \frac{90}{2} = \boxed{\phantom{00}}$$

Divide by 10

n) 75% of 40 =

$$= \frac{75}{100} \times \frac{40}{1}$$

$$= \frac{300}{100} = \boxed{\phantom{00}}$$

o) 75% of 120 =

$$= \frac{75}{100} \times \frac{120}{1}$$

$$= \frac{900}{100} = \boxed{\phantom{00}}$$

p) 15% of 40 =

$$= \frac{15}{100} \times \frac{40}{1}$$

Simplify:  $\div 10$

$$= \frac{60}{10} = \boxed{\phantom{00}}$$

q) 6% of 30 =

$$= \frac{6}{100} \times \frac{30}{1}$$

$$= \frac{180}{100} = \boxed{\phantom{00}}$$

r) 8% of 80 =

$$= \frac{8}{100} \times \frac{80}{1}$$

$$= \frac{640}{100} = \boxed{\phantom{00}}$$

s) 1% of 300 =

$$= \frac{1}{100} \times \frac{300}{1}$$

$$= \frac{300}{100} = \boxed{\phantom{00}}$$

t) 1% of 150 =

$$= \frac{1}{100} \times \frac{150}{1}$$

$$= \frac{150}{100} = \boxed{\phantom{00}}$$

u) 2% of 50 =

$$= \frac{2}{100} \times \frac{50}{1}$$

$$= \frac{100}{100} = \boxed{\phantom{00}}$$

v) 12.5% of 560 =

$$= \frac{1}{8} \times \frac{560}{1}$$

Simplify:  $\div 8$

$$= \frac{70}{1} = \boxed{\phantom{00}}$$

w) 12.5% of 80 =

$$= \frac{1}{8} \times \frac{80}{1}$$

$$= \frac{80}{8} = \boxed{\phantom{00}}$$

x) 12.5% of 160 =

$$= \frac{1}{8} \times \frac{160}{1}$$

$$= \frac{160}{8} = \boxed{\phantom{00}}$$

y)  $33\frac{1}{3}\%$  of 150 =

$$= \frac{1}{3} \times \frac{150}{1}$$

Simplify:  $\div 3$

$$= \frac{50}{1} = \boxed{\phantom{00}}$$

z)  $33\frac{1}{3}\%$  of 180 =

$$= \frac{1}{3} \times \frac{180}{1}$$

$$= \frac{180}{3} = \boxed{\phantom{00}}$$

A)  $33\frac{1}{3}\%$  of 60 =

$$= \frac{1}{3} \times \frac{60}{1}$$

$$= \frac{60}{3} = \boxed{\phantom{00}}$$

B)  $66\frac{2}{3}\%$  of 90 =

$$= \frac{2}{3} \times \frac{90}{1}$$

$$= \frac{180}{3} = \boxed{\phantom{00}}$$

C)  $66\frac{2}{3}\%$  of 150 =

$$= \frac{2}{3} \times \frac{150}{1}$$

$$= \frac{300}{3} = \boxed{\phantom{00}}$$

D)  $66\frac{2}{3}\%$  of 210 =

$$= \frac{2}{3} \times \frac{210}{1}$$

$$= \frac{420}{3} = \boxed{\phantom{00}}$$

**To find the discount on an item**

- Calculate the percentage of the given amount. (see skill 11.3, page 69 and skill 11.4, page 71)  
Discount is associated with words like: *discounted, reduced, off, save, cash back*

**To find the sale price if a discount is applied**

- Calculate the percentage of the given amount.
- Subtract this result from the given amount.

**Q.** In a store a \$300 jacket is marked '20% off'. What is the sale price of the jacket?

**A.** *Discount:* 20% of 300 =

$$= \frac{20}{100} \times \frac{300}{1} \quad \text{Divide by 100}$$

$$= 20 \times 3 = 60$$

*Sale price:* 300 - 60 = **\$240**

**a)** If a \$60 beach towel is reduced by 15%, what is the discount?

*discount:* 15% of 60 =

$$= \frac{15}{100} \times \frac{60}{1} = \frac{90}{10} = \boxed{\$9.00}$$

**b)** If a \$120 bike is reduced by 25%, what is the discount?

*discount:*

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

**c)** If a \$900 dining table is reduced by 25%, what is the discount?

*discount:* 25% of 900 =

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

**d)** If an \$80 game is reduced by 40%, what is the discount?

*discount:*

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

**e)** If a \$3000 laptop is reduced by 20%, what is the sale price?

*discount:* 20% of 3000 =

$$= \frac{20}{100} \times \frac{3000}{1} = 600 \quad \text{Divide by 100}$$

*sale price:* \$3000 - \$600 =  $\boxed{\$}$

**f)** If a \$500 dress is discounted by 40%, what is the sale price?

*discount:*

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

**g)** All the flower pots are marked '50% off'. What is the sale price of a \$110 flower pot?

*discount:*

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

**h)** In a store a \$240 suitcase is marked '10% off'. What is the sale price of the suitcase?

*discount:*

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

- i) If a \$400 gold bracelet is discounted by 30%, what is the sale price?

discount:

=

sale price:

= \$

- j) If a \$25 000 car is reduced by 10%, what is the sale price?

discount:

=

sale price:

= \$

- k) In a store a \$900 canoe is labelled 'Save 60%'. What is the sale price of the canoe?

discount:

=

sale price:

= \$

- l) In a store a \$300 pram is labelled 'Save 15%'. What is the sale price of the pram?

discount:

=

sale price:

= \$

- m) A printer is priced at \$200. Which is the better deal?

- A) 20% off  
B) \$50 cash back

sale price A:

=

sale price B:

=

⇒

- n) A watch is priced at \$450. Which is the better deal?

- A) Save 30%  
B) Take \$100 off

sale price A:

=

sale price B:

=

⇒

- o) A utility is priced at \$15 000. Which is the better deal?

- A) 10% discount  
B) Reduce by  $\frac{1}{5}$

sale price A:

=

sale price B:

=

⇒

- p) A lounge suite is priced at \$6000. Which is the better deal?

- A) Save 25%  
B) Reduce by  $\frac{1}{3}$

sale price A:

=

sale price B:

=

⇒

**EITHER**

- Change the percentage to a fraction out of 100.

Example:  $150\% = \frac{150}{100}$

- Rewrite the question as a multiplication (change “of” to “×”).
- 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 60)

**OR**

- First find 100% or other multiples of 100%.
- Then find the remaining percentage.
- Add the results.

To find  $200\% = \frac{2}{1} \Rightarrow$  multiply by 2  
 $300\% = \frac{3}{1} \Rightarrow$  multiply by 3

**Q.** 250% of 60 =

**A.** 250% of 60 =

*OR*

**A.** 100% of 60 is 60

So 200% is double that, or 120

50% of 60 is 30

So 250% of 60 is

$120 + 30 = 150$

$= \frac{250}{100} \times \frac{60}{1}$  *Simplify: ÷ 10, twice*  
 $= 25 \times 6$   
 $= 150$

**a)** 200% of 30 =

$= \frac{200}{100} \times \frac{30}{1}$  *Simplify: ÷ 10, twice*

$= 20 \times 3 = \boxed{60}$

**b)** 300% of 80 =

$=$   
 $=$    $=$

**c)** 400% of 70 =

$=$   
 $=$    $=$

**d)** 160% of 50 =

*Find 100%*

$100\% \text{ of } 50 = 50$

$60\% \text{ of } 50 = 30$  *Find 60%*

*Add the results*

$50 + 30 = \boxed{\phantom{00}}$

**e)** 110% of 90 =

$=$    $=$

**f)** 250% of 30 =

$=$    $=$

**g)** 250% of 40 =

$= \frac{250}{100} \times \frac{40}{1}$   
 $= 25 \times 4 = \boxed{\phantom{00}}$

**h)** 140% of 50 =

$=$    $=$

**i)** 510% of 20 =

$=$    $=$

**j)** 130% of 60 =

$=$

**k)** 120% of 70 =

$=$

**l)** 350% of 40 =

$=$

- Form a fraction using the two numbers.

EITHER

- Multiply this fraction by 100%.
- Simplify the resulting fraction and/or change it to a mixed number if necessary. (see skill 9.1, page 41)

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 percentage. (see skill 12.11, page 92)

Hint: Both numbers must represent the same unit of measurement.

**Multiplying by 100%**

$$100\% = 1$$

Multiplying by 1 or 100% does not change the value.

**Q.** Write as a percentage:  
48 out of 50.

**A.** 48 out of 50 =

OR

**A.** 48 out of 50 =

$$= \frac{48}{50} \times 100\%$$

$$= \frac{48 \times 2}{50 \times 2}$$

$$= \frac{48}{50} \times \frac{100}{1}\%$$

$$= \frac{96}{100}$$

Simplify:  $\div 50$

$$= \frac{48 \times 2}{1}$$

$$= 96\%$$

$$= 96\%$$

**a)** Write as a percentage:  
12 out of 60.

$$\frac{12 \div 12}{60 \div 12} = \frac{1}{5}$$

Simplify:  $\div 12$

Find equivalent fraction

$$\frac{1 \times 20}{5 \times 20} = \frac{20}{100}$$

20%

**b)** In Australia 89 out of every 100 people live in an urban area. What percentage is this?

.....

.....

.....

**c)** At the 2022 Beijing Winter Olympic Games, 10 out of the 25 medals won by USA were silver. What percentage is this?

.....

.....

.....

**d)** For every 20 Skype calls made, 8 calls are video to video. What percentage is this?

.....

.....

.....

**e)** A male lion weighs 225 kg. It eats 9 kg of food each day. What percentage of its own weight does a lion eat each day?

.....

.....

.....

**f)** Of the 1 billion cattle in the world, 200 million are in India. What percentage of the world's cattle are in India?

.....

.....

.....

**Skill 11.8** Calculating profit or loss as a percentage 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 percentage of the cost price. (see skill 11.7, page 76)

**Q.** A shop buys soccer shoes in bulk for \$40 a pair, then sells them for \$100 a pair.  
Calculate the profit on each pair of soccer shoes as a percentage of the cost price.

**A.** *profit:*  $\$100 - \$40 = \$60$   
*profit out of cost price:*  $\$60 \text{ out of } \$40 = \frac{60}{40}$   
 $= \frac{60}{40} \times \frac{100}{1} \% = \frac{600}{4} \%$   
 $= 150\%$

**a)** Sam bought a house for \$400 000. He then sold it for \$350 000. What was his loss as a percentage of the cost price?

*loss:*  $\$400\,000 - \$350\,000 = \$50\,000$

*loss out of cost:*  $50\,000 \text{ out of } 400\,000 =$

$= \frac{50\,000}{400\,000} \times \frac{100}{1} \% = \frac{50}{40} \% = 12.5\%$

**b)** Serena bought a car for \$5000. If she later sold it for \$3500, find the loss as a percentage of the cost price.

$=$

**c)** Leah made \$60 profit on a curtain fabric costing \$200. What was her profit as a percentage of the cost price?

*profit:*

*profit out of cost:*

$=$

**d)** Jason lost \$15 on a book costing \$30. What was his loss as a percentage of the cost price?

*loss:*

*loss out of cost:*

$=$

**e)** The *Tea Room* shop made \$20 profit on an electric kettle costing \$80. What is the profit as a percentage of the cost price?

$=$

**f)** A shop buys school uniforms in bulk for \$75 each, then sells them for \$100 each. Find the profit as a percentage of the cost price.

$=$

**g)** Amelia bought a table for \$400. If she later sold it for \$350, find the loss as a percentage of the cost price.

$=$

**h)** A painting was bought for \$6000. If it was later sold for \$7500, find the profit as a percentage of the cost price.

$=$



# 12. [Decimals / Fractions / Percentages]

## Skill 12.1 Illustrating fractions and percentages.

Blue 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

### To recognise a shaded fraction of a shape

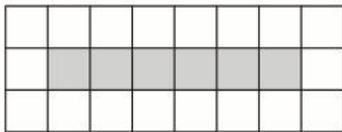
- Count the total number of equal parts in which the shape is divided.
- Use this number as the denominator of the fraction.
- Count the number of shaded parts.
- Use this number as the numerator of the fraction.
- Simplify the resulting fraction.  
(see skill 9.1, page 41)

### To recognise a shaded percentage 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 percentage is a fraction out of 100. Compare to common fractions, like one half equals 50%, one quarter equals 25% or one tenth equals 10%.

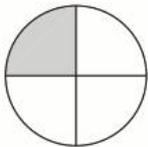
**Q.** What percentage of the shape is shaded?



$$\begin{aligned} \text{A. } 6 \text{ out of } 24 \text{ parts} &= \frac{6}{24} \\ &= \frac{1}{4} \text{ out of } 4 \text{ parts} \\ &\times 25 \left( \frac{1}{4} \right) \times 25 \\ &= 25 \text{ out of } 100 \text{ parts} \\ &= 25\% \end{aligned}$$

6 out of 24 parts are shaded. This can be first reduced to 1 group of 6 to 4 groups of 6. There are 25 lots of 4 in 100, so multiply  $1 \times 25$  to get the percentage shaded.

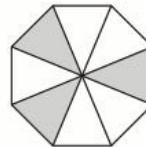
**a)** What fraction of the shape is shaded?



*1 out of 4 parts*

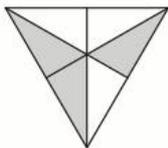
$$= \frac{1}{4}$$

**b)** What fraction of the shape is shaded?



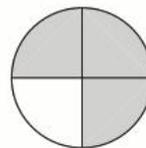
$$= \frac{3}{6}$$

**c)** What fraction of the shape is shaded?



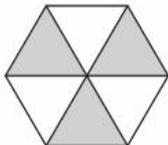
$$= \frac{2}{4}$$

**d)** What fraction of the shape is shaded?



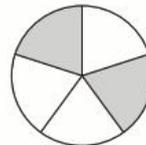
$$= \frac{3}{4}$$

**e)** What percentage of the shape is shaded?



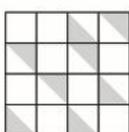
$$= \frac{3}{6} = 50\%$$

**f)** What percentage of the shape is shaded?



$$= \frac{2}{5} = 40\%$$

**g)** What percentage of the shape is shaded?



$$= \frac{5}{16} = 31.25\%$$

**h)** What percentage of the shape is shaded?



$$= \frac{5}{16} = 31.25\%$$

EITHER

- Divide both the numerator and the denominator by their Highest Common Factor (HCF).

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.

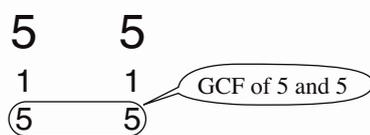
If the numbers are both even then you can start with dividing by 2.

**How to find the Highest Common Factor (HCF) 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.

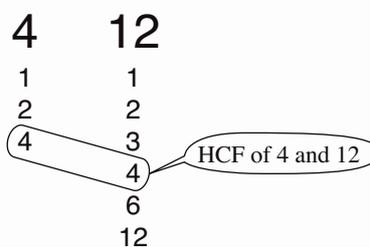
Hint: The Highest Common Factor is the largest number that divides evenly in both numbers.

**HCF for Identical numbers**



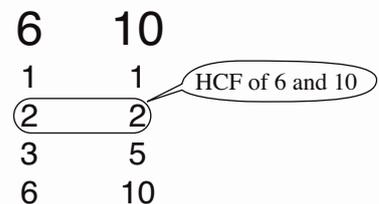
Hint: 5 is the HCF of 5 and 5 because 5 is the largest number that divides into 5 and 5.

**HCF when one number divides evenly into the other number**



Hint: 4 is the HCF of 4 and 12 because 4 is the largest number that divides into 4 and 12.

**HCF when numbers have other common factors**



Hint: 2 is the HCF of 6 and 10 because 2 is the largest number that divides into 6 and 10.

Q. Simplify  $\frac{24}{40}$

A.  $\frac{24}{40} = \frac{24 \div 8}{40 \div 8}$  (HCF of 24 and 40 is 8) OR A.  $\frac{24 \div 2}{40 \div 2} = \frac{12 \div 4}{20 \div 4}$  (Divide by 2)  
 $= \frac{3}{5}$  (Divide by 8)  $= \frac{3}{5}$  (Divide by 4)

a) Simplify  $\frac{10}{15}$  (HCF of 10 and 15 is 5)  
 $= \frac{10 \div 5}{15 \div 5} = \frac{2}{3}$

b) Simplify  $\frac{3}{6}$   
 $= \frac{\quad}{\quad}$

c) Simplify  $\frac{4}{6}$   
 $= \frac{\quad}{\quad}$

d) Simplify  $\frac{3}{12}$   
 $= \frac{\quad}{\quad}$

e) Simplify  $\frac{8}{20}$   
 $= \frac{\quad}{\quad}$

f) Simplify  $\frac{2}{6}$   
 $= \frac{\quad}{\quad}$

Skill 12.2 Simplifying fractions (2).

g) Simplify  $\frac{6}{18}$

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

h) Simplify  $\frac{7}{49}$

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

i) Simplify  $\frac{18}{27}$

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

j) Simplify  $\frac{30}{40}$

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

k) Simplify  $\frac{5}{15}$

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

l) Simplify  $\frac{15}{90}$

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

m) Simplify  $\frac{6}{12}$

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

n) Simplify  $\frac{4}{40}$

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

o) Simplify  $\frac{10}{30}$

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

p) Simplify  $\frac{5}{25}$

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

q) Simplify  $\frac{8}{16}$

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

r) Simplify  $\frac{14}{21}$

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

s) Simplify  $\frac{24}{60}$

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

t) Simplify  $\frac{8}{20}$

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

u) Simplify  $\frac{24}{30}$

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

v) Simplify  $\frac{9}{15}$

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

w) Simplify  $\frac{9}{81}$

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

x) Simplify  $\frac{25}{35}$

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

y) Simplify  $\frac{20}{25}$

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

z) Simplify  $\frac{100}{160}$

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

A) Simplify  $\frac{300}{480}$

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

**To read a fraction**

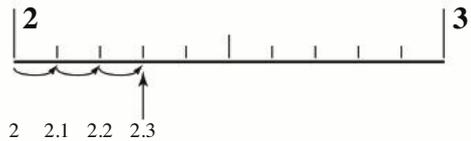
- Count the spaces between 0 and 1. (Always one more than the number of marks.)
- Write this number as the denominator of the fraction.
- Count the spaces to the dot.
- Write this number as the numerator of the fraction.

**To read a mixed number**

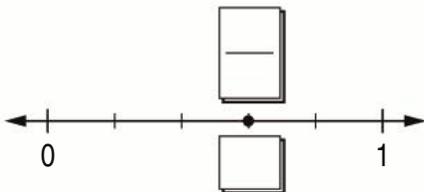
- Write the whole number from the number line in the mixed number.
- Count the spaces between two consecutive whole numbers. (Always one more than the number of marks.)
- Write this number as the denominator of the fraction.
- Count the spaces to the dot.
- Write this number as the numerator of the fraction.

**To read a decimal**

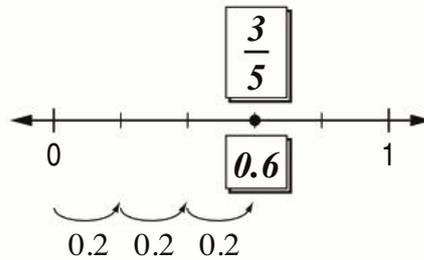
- Count the spaces between two consecutive whole numbers. (Always one more than the number of marks.)
- Work out the value of each space. Examples:
  - 10 spaces between two numbers  $\Rightarrow 1 \div 10 = 0.1$   
Each mark is further along the number line by one tenth or 0.1
  - 5 spaces between two numbers  $\Rightarrow 1 \div 5 = 0.2$   
Each mark is further along the number line by one tenth or 0.2
  - 4 spaces between two numbers  $\Rightarrow 1 \div 4 = 0.25$   
Each mark is further along the number line by one tenth or 0.25
- Starting at the last whole number, count on by the value of each space. Point to each mark as you go.



**Q.** Name the fraction and the decimal at the marked point.

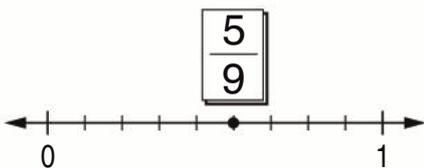


**A.**

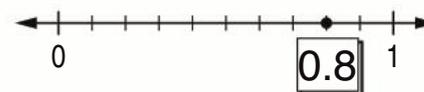


There are 5 spaces between 0 and 1.  
There are 3 spaces to the dot.  
Each space equals 0.2

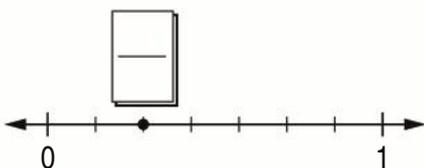
**a)** Name the fraction at the marked point.



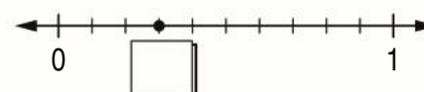
**b)** Name the decimal at the marked point.



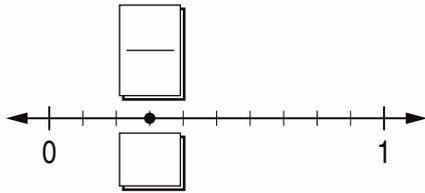
**c)** Name the fraction at the marked point.



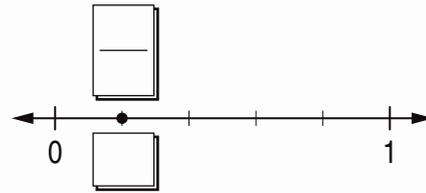
**d)** Name the decimal at the marked point.



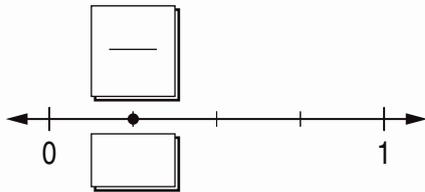
e) Name the fraction and the decimal at the marked point.



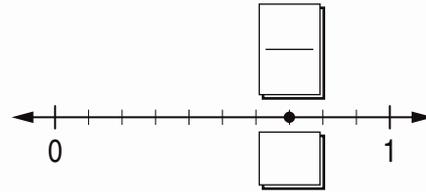
f) Name the fraction and the decimal at the marked point.



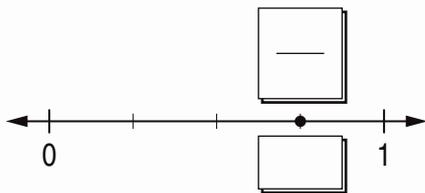
g) Name the fraction and the decimal at the marked point.



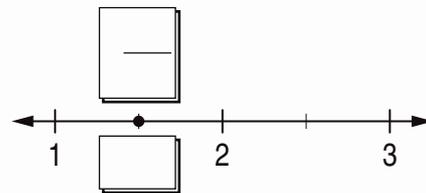
h) Name the fraction and the decimal at the marked point.



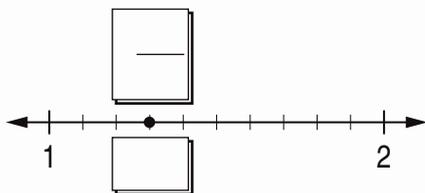
i) Name the fraction and the decimal at the marked point.



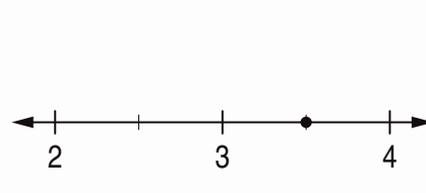
j) Name the mixed number and the decimal at the marked point.



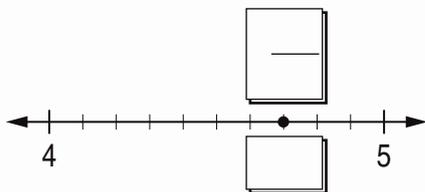
k) Name the mixed number and the decimal at the marked point.



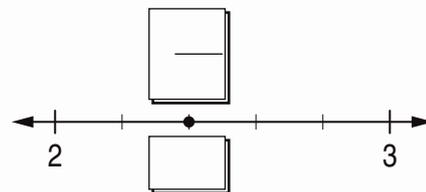
l) Name the mixed number and the decimal at the marked point.



m) Name the mixed number and the decimal at the marked point.



n) Name the mixed number and the decimal at the marked point.



**To read a scale with marks between the whole numbers**

- Count the spaces between two consecutive whole numbers on the scale.
- Work out the value of each space.

Examples:

1) 10 spaces  $\Rightarrow 1 \div 10 = \frac{1}{10} = 0.1$

Each mark is further along the scale by one tenth or 0.1

2) 5 spaces  $\Rightarrow 1 \div 5 = \frac{1}{5} = 0.2$

Each mark is further along the scale by one fifth or 0.2

3) 4 spaces  $\Rightarrow 1 \div 4 = \frac{1}{4} = 0.25$

Each mark is further along the scale by one quarter or 0.25

- Starting at the last whole number, count on by the value of each space.

**To read a scale with marks halfway between decimal numbers**

Examples:

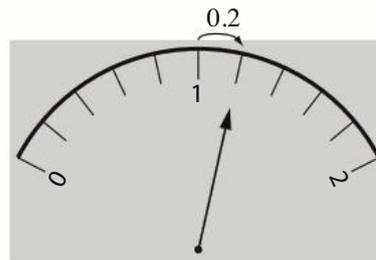
1) mark halfway between 0.1 and 0.2  
 $\Rightarrow 0.15$

2) mark halfway between 0.01 and 0.02  
 $\Rightarrow 0.015$

**Q.** What decimal number is shown on this meter?

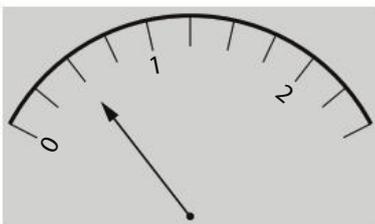


**A.** 1.2



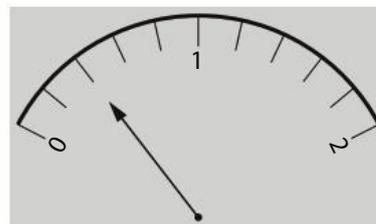
There are 5 spaces between 1 and 2.  
Each space equals 0.2

**a)** What decimal number is shown on this meter?

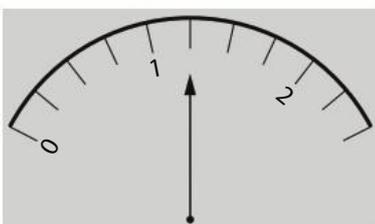


0.5

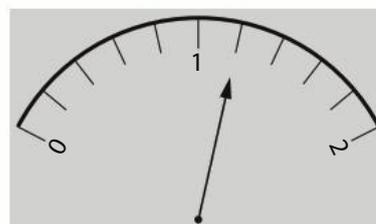
**b)** What decimal number is shown on this meter?



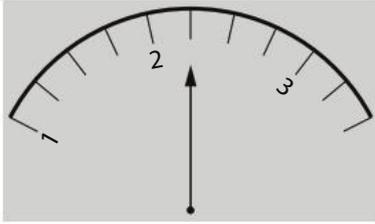
**c)** What decimal number is shown on this meter?



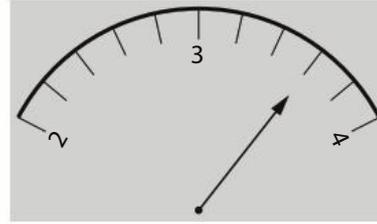
**d)** What decimal number is shown on this meter?



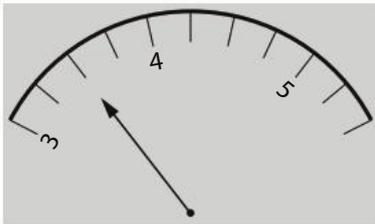
e) What decimal number is shown on this meter?



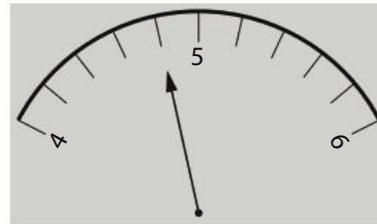

f) What decimal number is shown on this meter?



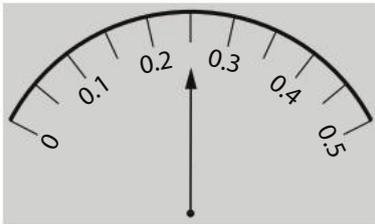

g) What decimal number is shown on this meter?



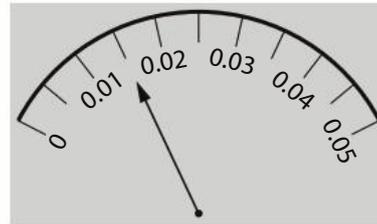

h) What decimal number is shown on this meter?



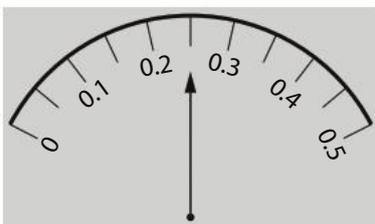

i) What decimal number is shown on this meter?



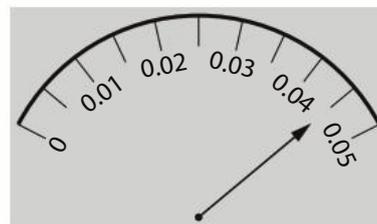

j) What decimal number is shown on this meter?



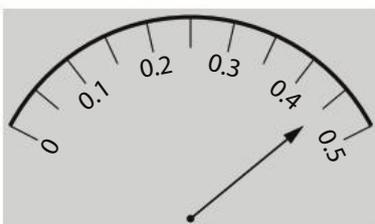

k) What decimal number is shown on this meter?



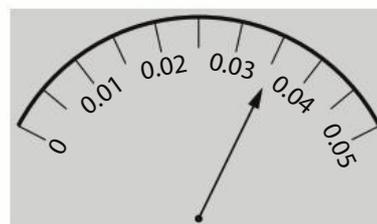

l) What decimal number is shown on this meter?




m) What decimal number is shown on this meter?




n) What decimal number is shown on this meter?



## Skill 12.5 Finding equivalent fractions.

Blue 11 22 33 44  
Green 11 22 33 44

- 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:

$$\frac{4}{5} = \frac{\boxed{?}}{15} \Rightarrow \frac{4 \times 3}{5 \times 3} = \frac{\boxed{12}}{15}$$

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.**

$$\frac{3}{5} = \frac{18}{?} \Rightarrow \frac{3 \times 6}{5 \times 6} = \frac{18}{30}$$

$$\frac{3}{5} = \frac{?}{90} \Rightarrow \frac{3 \times 18}{5 \times 18} = \frac{54}{90}$$

$$\frac{3}{5} = \frac{18}{\boxed{30}} = \frac{\boxed{54}}{90}$$

**a)** Complete the equivalent fractions:

$$\frac{\boxed{24}}{30} = \frac{4}{5}$$

$$\frac{?}{30} = \frac{4}{5} \Rightarrow ? \div 6 = 4 \Rightarrow ? = 24$$

**b)** Complete the equivalent fractions:

$$\frac{2}{7} = \frac{24}{\boxed{?}}$$

$$\frac{2}{7} = \frac{24}{?} \Rightarrow 7 \times 12 = 84$$

**c)** Complete the equivalent fractions:

$$\frac{3}{8} = \frac{\boxed{?}}{72}$$

$\Rightarrow$

**d)** Complete the equivalent fractions:

$$\frac{13}{\boxed{?}} = \frac{39}{45}$$

$\Rightarrow$

**e)** Complete the equivalent fractions:

$$\frac{9}{10} = \frac{\boxed{?}}{60}$$

$\Rightarrow$

**f)** Complete the equivalent fractions:

$$\frac{32}{56} = \frac{8}{\boxed{?}}$$

$\Rightarrow$

**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 12.6** Writing a decimal number as a percentage.

- Multiply the decimal number by 100, by moving the decimal point two places to the right.
  - Add the percentage sign.
- Hint: Zeros can be added at the end of any decimal number:  $0.4 = 0.4000$

**Q.** Write 0.07 as a percentage.

**A.**  $0.07 = 0.\overline{07} \times 100\% = 7\%$  2 zeros, 2 places to the right

**a)** Write 0.4 as a percentage.

$0.4 = 0.\overline{40} \times 100\% = 40\%$  Add a zero

**b)** Write 0.2 as a percentage.

..... =

**c)** Write 0.1 as a percentage.

..... =

**d)** Write 0.5 as a percentage.

..... =

**e)** Write 0.7 as a percentage.

..... =

**f)** Write 0.12 as a percentage.

..... =

**g)** Write 0.95 as a percentage.

..... =

**h)** Write 0.48 as a percentage.

..... =

**i)** Write 0.29 as a percentage.

..... =

**j)** Write 0.45 as a percentage.

..... =

**k)** Write 0.04 as a percentage.

..... =

**l)** Write 0.05 as a percentage.

..... =

**m)** Write 0.06 as a percentage.

..... =

**n)** Write 0.38 as a percentage.

..... =

**o)** Write 0.4 as a percentage.

..... =

**p)** Write 0.75 as a percentage.

..... =

**q)** Write 0.125 as a percentage.

..... =

**r)** Write 0.345 as a percentage.

..... =

- Write the percentage 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 5.4% to a decimal.

$$\begin{aligned} \text{A. } 5.4\% &= \frac{5.4}{100} \\ &= 5.4 \div 100 \\ &= \overbrace{005.4} \div 100 \\ &= \mathbf{0.054} \end{aligned}$$

2 zeros, 2 places to the left

**a)** Change 6% to a decimal.

$$6\% = \frac{6}{100} = \overbrace{006.0} \div 100 = \boxed{0.06}$$

**b)** Change 2% to a decimal.

$$2\% = \boxed{\phantom{0.02}}$$

**c)** Change 88% to a decimal.

$$= \boxed{\phantom{0.88}}$$

**d)** Change 34% to a decimal.

$$= \boxed{\phantom{0.34}}$$

**e)** Change 70% to a decimal.

$$= \boxed{\phantom{0.70}}$$

**f)** Change 90% to a decimal.

$$= \boxed{\phantom{0.90}}$$

**g)** Change 0.5% to a decimal.

$$= \boxed{\phantom{0.005}}$$

**h)** Change 1.8% to a decimal.

$$= \boxed{\phantom{0.018}}$$

**i)** In Mali 72% of people earn less than \$1 each day. Write this percentage as a decimal.

$$= \boxed{\phantom{0.72}}$$

**j)** In September 2020 the unemployment rate for Australia was 6.8%. Write this percentage as a decimal.

$$= \boxed{\phantom{0.068}}$$

**k)** The percentage of Americans between 12 and 17 who play video games is 97%. Write this percentage as a decimal.

$$= \boxed{\phantom{0.97}}$$

**l)** The Sun accounts for 99% of the mass of our solar system. Write this percentage as a decimal.

$$= \boxed{\phantom{0.99}}$$

**m)** Europe has approximately 10% of the world's population. Write this percentage as a decimal.

$$= \boxed{\phantom{0.10}}$$

**n)** Worldwide, 73% of all e-commerce sales will come from mobile devices by 2021. Write this percentage as a decimal.

$$= \boxed{\phantom{0.73}}$$

Decimal places = Zeros in the denominator  $0.\underline{04} = \frac{4}{\underline{100}}$

- 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
<b>0</b>	<b>0</b>	<b>4</b>

= 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.

**Q.** Write 0.6 as a fraction in simplest form.

**A.**  $0.\underline{6} = \frac{6}{\underline{10}}$

$= \frac{6 \div 2}{10 \div 2}$

$= \frac{3}{5}$

Write 6 as the numerator

1 zero for 1 decimal place

Simplify: ÷ 2

**a)** Write 0.7 as a fraction.

$0.7 = \textit{seven tenths} = \frac{7}{10}$

**b)** Write 0.11 as a fraction.

$0.11 = \textit{eleven hundredths} = \frac{\quad}{\quad}$

**c)** Write 0.3 as a fraction.

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

**d)** Write 0.1 as a fraction.

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

**e)** Write 0.08 as a fraction in simplest form.

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

**f)** Write 0.12 as a fraction in simplest form.

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

**g)** Write 0.5 as a fraction in simplest form.

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

**h)** Write 0.28 as a fraction in simplest form.

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

**i)** Write 0.45 as a fraction in simplest form.

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

**j)** Write 0.4 as a fraction in simplest form.

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

Zeros in the denominator = Decimal places

$$\frac{4}{100} = 0.04$$

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:  $27 = 0027.00$

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:  $\frac{3}{4} = 3 \div 4 = 3.00 \div 4 = 0.75$

$$\begin{array}{r} 0.75 \\ 4 \overline{) 3.00} \end{array}$$

Q. Change  $\frac{4}{5}$  to a decimal.

A.  $\frac{4}{5} = \frac{4 \times 20}{5 \times 20}$

OR

A.  $\frac{4}{5} = 4 \div 5$

$= \frac{80}{100}$  (Make denominator a power of 10)

$= 4.0 \div 5$   
 $= 0.8$

$= 80 \div 100$   
 $= 080.0 \div 100$  (2 zeros, 2 places to the left)  
 $= 0.80 = 0.8$

$$\begin{array}{r} 0.8 \\ 5 \overline{) 4.0} \end{array}$$

a) Change  $\frac{7}{10}$  to a decimal.

$$\frac{7 \times 10}{10 \times 10} = \frac{70}{100}$$

$= 070.0 \div 100 = \boxed{0.7}$

b) Change  $\frac{3}{20}$  to a decimal.

$= \dots = \boxed{\phantom{0.00}}$

c) Change  $\frac{9}{25}$  to a decimal.

$= \dots = \boxed{\phantom{0.00}}$

d) Change  $\frac{1}{2}$  to a decimal.

$= \dots = \boxed{\phantom{0.00}}$

e) Change  $1\frac{4}{5}$  to a decimal.

$= \dots = \boxed{\phantom{0.00}}$

f) Change  $3\frac{1}{4}$  to a decimal.

$= \dots = \boxed{\phantom{0.00}}$

g) Change  $2\frac{9}{10}$  to a decimal.

$= \dots = \boxed{\phantom{0.00}}$

h) Change  $1\frac{11}{25}$  to a decimal.

$= \dots = \boxed{\phantom{0.00}}$

i) Change  $4\frac{34}{50}$  to a decimal.

$= \dots = \boxed{\phantom{0.00}}$

## Skill 12.10 Writing a percentage as a fraction in simplest form.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Write the percentage 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 percentage is another way of writing a fraction out of one hundred.

Example: 25% is said “25 percent” and means 25 out of 100.

**Q.** USA accounts for 24% of the European Union exports. Write this percentage 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 61% as a fraction.

$$61\% = \frac{61}{100}$$

**b)** Write 7% as a fraction.

$$7\% = \frac{\quad}{\quad}$$

**c)** Write 55% as a fraction in simplest form.

$$55\% = \frac{55}{100} \xrightarrow{\text{Simplify: } \div 5} = \frac{11}{20}$$

**d)** Write 30% as a fraction in simplest form.

$$30\% = \frac{\quad}{\quad}$$

**e)** Write 8% as a fraction in simplest form.

$$8\% = \frac{\quad}{\quad}$$

**f)** Write 6% as a fraction in simplest form.

$$6\% = \frac{\quad}{\quad}$$

**g)** The common metal for medals is 84% copper. Write this percentage as a fraction in simplest form.

$$84\% = \frac{\quad}{\quad}$$

**h)** About 67 percent of all New Zealand males aged between 18 and 45 served in WWII. Write this percentage as a fraction in simplest form.

$$67\% = \frac{\quad}{\quad}$$

**i)** India is home to 40% of the world’s poor. Write this percentage as a fraction in simplest form.

$$40\% = \frac{\quad}{\quad}$$

**j)** In Australia in 2020, 26% of the cabinet ministers were female. Write this percentage as a fraction in simplest form.

$$26\% = \frac{\quad}{\quad}$$

**k)** The average person’s left hand does 56% of the typing. Write this percentage as a fraction in simplest form.

$$56\% = \frac{\quad}{\quad}$$

**l)** Approximately 60% of Australian households have a pet. Write this percentage as a fraction in simplest form.

$$60\% = \frac{\quad}{\quad}$$

# Skill 12.11 Writing a fraction as a percentage.

$$\frac{\text{Number}}{100} = \text{Number } \%$$

$$\text{Fraction} \times \frac{100}{1} \% = \text{Percentage}$$

EITHER

- Find the equivalent fraction which has a denominator of 100.
- The numerator of this fraction is the equivalent percentage.

Example:  $\frac{7}{10} \times \frac{10}{10} = \frac{70}{100} = 70\%$

OR

- Multiply the fraction by  $\frac{100}{1} \%$
- Example:  $\frac{7}{10} = \frac{7}{10} \times \frac{100}{1} \% \xrightarrow{\text{Simplify: } \div 10} = 70\%$

Q. Change  $\frac{11}{20}$  to a percentage.

A.  $\frac{11}{20} = \frac{11 \times 5}{20 \times 5} = \frac{55}{100} = 55\%$

OR A.  $\frac{11}{20} = \frac{11}{20} \times \frac{100}{1} \% \xrightarrow{\text{Simplify: } \div 20} = 11 \times 5\% = 55\%$

a) Change  $\frac{1}{10}$  to a percentage.

$= \frac{1}{10} \times \frac{10}{10} = \frac{10}{100} = 10\%$

b) Change  $\frac{21}{50}$  to a percentage.

$= \dots = \dots = \dots$

c) Change  $\frac{7}{25}$  to a percentage.

$= \dots = \dots = \dots$

d) Change  $\frac{86}{100}$  to a percentage.

$= \dots = \dots = \dots$

e) Change  $\frac{1}{2}$  to a percentage.

$= \dots = \dots = \dots$

f) Change  $\frac{2}{5}$  to a percentage.

$= \dots = \dots = \dots$

g) Change  $\frac{3}{5}$  to a percentage.

$= \dots = \dots = \dots$

h) Change  $\frac{3}{4}$  to a percentage.

$= \dots = \dots = \dots$

i) Change  $\frac{1}{3}$  to a percentage.

$= \dots = \dots = \dots$

j) Change  $\frac{14}{20}$  to a percentage.

$= \dots = \dots = \dots$

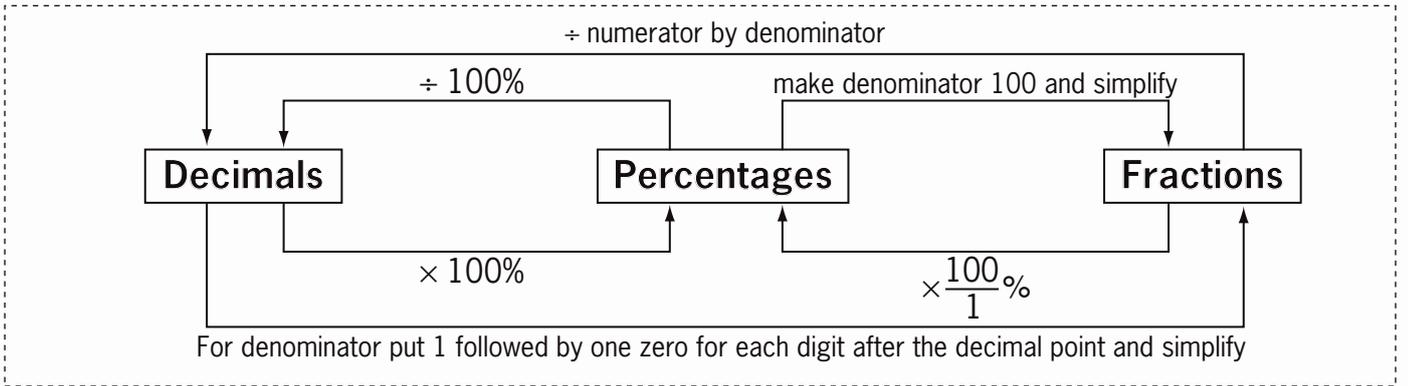
k) Change  $\frac{1}{100}$  to a percentage.

$= \dots = \dots = \dots$

l) Change  $\frac{2}{3}$  to a percentage.

$= \dots = \dots = \dots$

- Convert between decimals, fractions and percentages.  
(see skills 12.4 to 12.9, pages 84 to 90)



Q. Complete the table:

Decimal	Fraction	Percentage
	$\frac{43}{50}$	

A.

Decimal

$$\frac{43}{50} = \frac{43 \times 2}{50 \times 2} = \frac{86}{100}$$

Make denominator a power of 10

$$= \frac{86}{100} \div 100$$

$$= 0.86$$

Percentage

$$\frac{43}{50} = \frac{43}{50} \times \frac{100^2}{1} \%$$

Simplify: ÷ 50

$$= 43 \times 2\%$$

$$= 86\%$$

Decimal	Fraction	Percentage
0.86	$\frac{43}{50}$	86%

a) Complete the table:

Decimal	Fraction	Percentage
0.04	$\frac{1}{25}$	4%

$$0.04 = \frac{4}{100} \div 4 = \frac{1}{25}$$

$$0.04 = 0.04 \times 100\% = 4\%$$

b) Complete the table:

Decimal	Fraction	Percentage
		25%

c) Complete the table:

Decimal	Fraction	Percentage
0.8		

d) Complete the table:

Decimal	Fraction	Percentage
	$\frac{9}{20}$	

e) Complete the table:

Decimal	Fraction	Percentage
0.07		

.....

.....

f) Complete the table:

Decimal	Fraction	Percentage
		70%

.....

.....

g) Complete the table:

Decimal	Fraction	Percentage
0.1		

.....

.....

h) Complete the table:

Decimal	Fraction	Percentage
	$\frac{9}{10}$	

.....

.....

i) Complete the table:

Decimal	Fraction	Percentage
0.4		

.....

.....

j) Complete the table:

Decimal	Fraction	Percentage
		55%

.....

.....

k) Complete the table:

Decimal	Fraction	Percentage
		60%

.....

.....

l) Complete the table:

Decimal	Fraction	Percentage
	$\frac{17}{50}$	

.....

.....

- Convert the decimals, fractions and percentages to the same form, by writing all as decimals, or as fractions, or as percentages. (see skill 12.12, page 93)
- Compare the decimals, or the fractions, or the percentages.

Hint: The most convenient form is the decimal form. Write the fractions and percentages as decimals.

**Q.** Which is greater?

$\frac{1}{4}$  or 30%

**A.**  $\frac{1}{4} = \frac{1 \times 25}{4 \times 25} = \frac{25}{100} = 25 \div 100 = 0.25$

Write the fraction as a decimal

Make denominator a power of 10

Fraction

$30\% = \frac{30}{100} = 30 \div 100 = 0.3$

Write the percentage as a decimal

Percentage

0.3 is greater than 0.25, so  $30\% > \frac{1}{4}$   
30% is greater.

**a)** Which is greater?  
0.07 or 70%

$70\% = \frac{70}{100} = 70 \div 100 = 0.7$

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  $\frac{1}{4}$

.....

i) 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]

## Skill 13.1 Comparing and ordering integers (1).

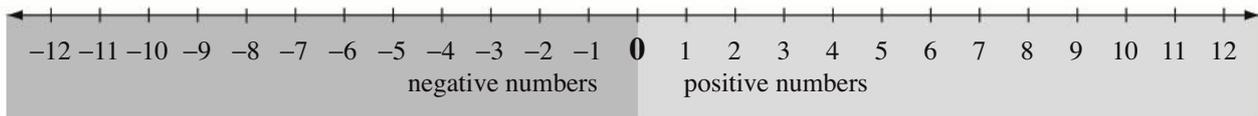
Blue 11 22 33 44  
Green 11 22 33 44

- 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.

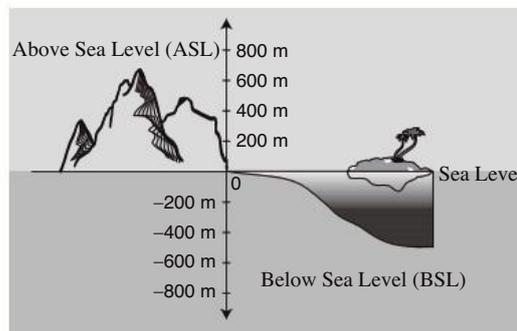
### NUMBER LINE

A negative number is always smaller than a positive number.



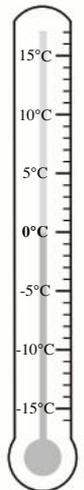
### ALTITUDE

An altitude is lower when further down, below sea level (BSL) and higher when further up, above sea level (ASL).



### TEMPERATURE

Temperatures below zero are lower than temperatures above zero.

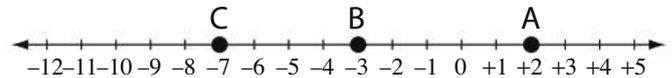


**Q.** Who won the 2020 Women's British Open Golf Tournament?

[Hint: In golf the lowest score wins.]

- A) +2 J. Song
- B) -3 M. Lee
- C) -7 S. Popov

**A. C** Find the lowest score to determine the winner.



**a)** Which of Saturn's moons has the highest temperature?

- A)  $-201^{\circ}\text{C}$  Enceladus
- B)  $-200^{\circ}\text{C}$  Mimas
- C)  $-187^{\circ}\text{C}$  Tethys



**b)** Which temperature for oxygen is higher?

- A)  $-183^{\circ}\text{C}$  boiling point
- B)  $-218^{\circ}\text{C}$  melting point



**c)** Who won the 2019 The Open Golf Championship?

[Hint: In golf the lowest score wins.]

- A) -16 S. Lawry
- B) +2 J. Day
- C) -7 T. Finau

**d)** Which body of water is at the lowest altitude?

- A) -40 m Lake Chott Melrhir Algeria
- B) -105 m Laguna del Carbon Argentina
- C) -71 m Salton Sea California, USA

e) Which location has the lowest altitude?

- A) 3 m above sea level  
Amsterdam (Netherlands)
- B) 133 m below sea level  
Qattara Depression (Egypt)
- C) 2430 m 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)



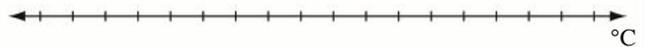
g) Which location recorded the lowest temperature?

- A)  $-25.6^{\circ}\text{C}$  Kabul
- B)  $+14.1^{\circ}\text{C}$  Christmas Island
- C)  $-15.2^{\circ}\text{C}$  La Paz

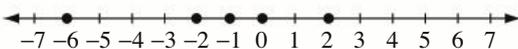


h) Which continent has the lowest recorded temperature?

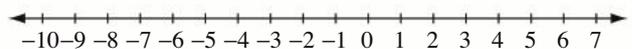
- A)  $-63^{\circ}\text{C}$  North America
- B)  $-23^{\circ}\text{C}$  Australia
- C)  $-55^{\circ}\text{C}$  Europe



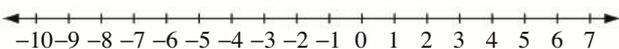
i) Arrange in ascending order:  
 $-2, -6, 0, 2, -1$



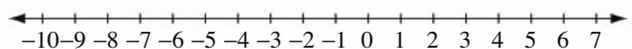

j) Arrange in order from largest to smallest:  
 $0, 8, -9, 6, -4$



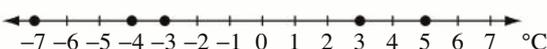

k) Arrange in descending order:  
 $-9, 7, 3, -7, 5$



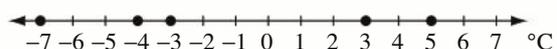

l) Arrange in order from smallest to largest:  
 $-2, -6, 0, -3, 5$




m) Arrange in order from coldest to warmest:  
 $2^{\circ}\text{C}, -3^{\circ}\text{C}, 4^{\circ}\text{C}, -5^{\circ}\text{C}$




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'.

Blue 1 1 2 2 3 3 4 4  
Green 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 ( $<$ )  $-2$

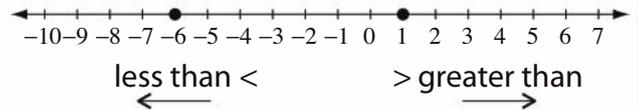
The smaller the negative number the greater the value, e.g.  $-4$  is greater than ( $>$ )  $-6$

**Q.** Use  $<$  or  $>$  to make a true statement.

$$1 \quad \square \quad -6$$

**A.**  $1 > -6$

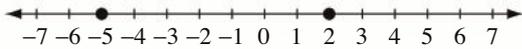
a positive is always greater than a negative



**a)** Use  $<$  or  $>$  to make a true statement.

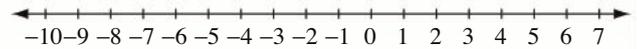
a negative number is less than a positive number

$$-5 \quad \square \quad 2$$



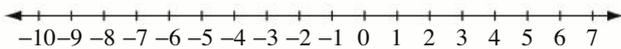
**b)** Use  $<$  or  $>$  to make a true statement.

$$-4 \quad \square \quad 0$$



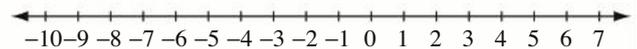
**c)** Use  $<$  or  $>$  to make a true statement.

$$-3 \quad \square \quad -8$$



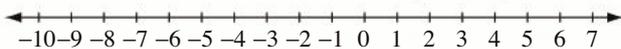
**d)** Use  $<$  or  $>$  to make a true statement.

$$-6 \quad \square \quad 3$$



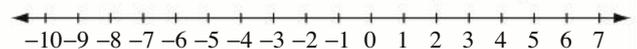
**e)** Use  $<$  or  $>$  to make a true statement.

$$1 \quad \square \quad -2$$



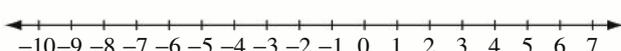
**f)** Use  $<$  or  $>$  to make a true statement.

$$-1 \quad \square \quad -9$$



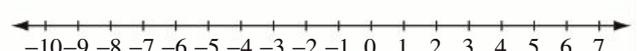
**g)** Use  $<$  or  $>$  to make a true statement.

$$-10 \quad \square \quad 0$$



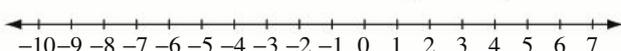
**h)** Use  $<$  or  $>$  to make a true statement.

$$3 \quad \square \quad -6$$



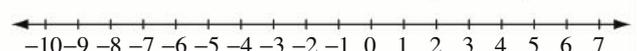
**i)** Use  $<$  or  $>$  to make a true statement.

$$4 \quad \square \quad -7$$



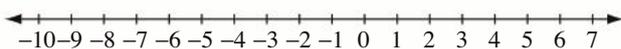
**j)** Use  $<$  or  $>$  to make a true statement.

$$-4 \quad \square \quad -2$$



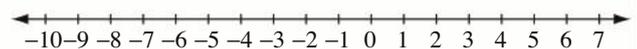
**k)** Use  $<$  or  $>$  to make a true statement.

$$-8 \quad \square \quad -5$$



**l)** Use  $<$  or  $>$  to make a true statement.

$$-2 \quad \square \quad -4$$

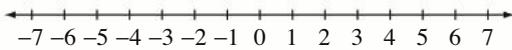


### Skill 13.3 Modelling integer subtraction on a number line.

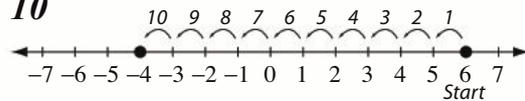
Blue 1 1 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- 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.

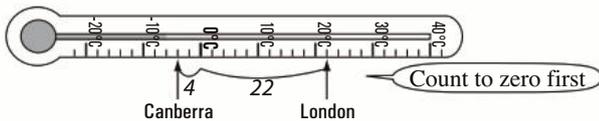
**Q.** How many units between 6 and  $-4$ ?



**A.** 10



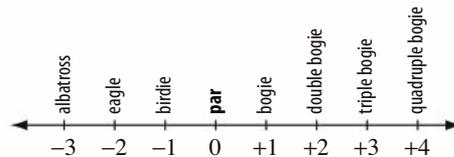
**a)** How much cooler is it in Canberra than in London on this day in July?



$$4 + 22$$

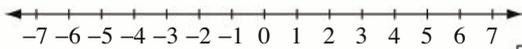
$$= \boxed{26 \text{ } ^\circ\text{C}}$$

**b)** If Karrie Webb scores a triple bogie and Greg Norman scores an eagle, what is the difference between their scores?



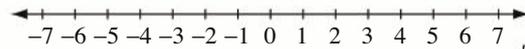
$$= \boxed{\phantom{00}}$$

**c)** How many units between 5 and  $-4$ ?



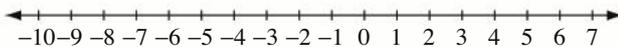
$$= \boxed{\phantom{00}}$$

**d)** How many units between  $-5$  and 3?



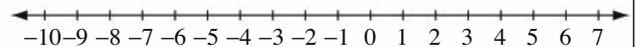
$$= \boxed{\phantom{00}}$$

**e)** How many units between  $-9$  and 2?



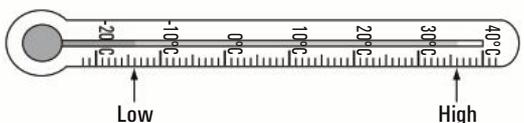
$$= \boxed{\phantom{00}}$$

**f)** How many units between 6 and  $-7$ ?



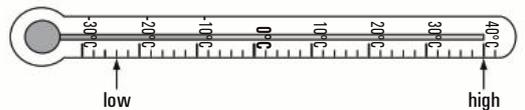
$$= \boxed{\phantom{00}}$$

**g)** What is the difference between the highest and the lowest temperatures recorded in Dunedin, New Zealand?



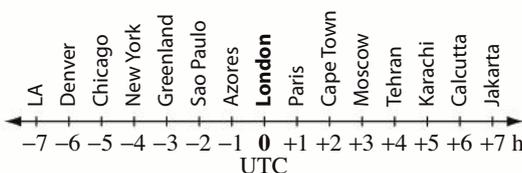
$$= \boxed{\phantom{00}} \text{ } ^\circ\text{C}$$

**h)** What is the difference between the highest and the lowest temperatures recorded in Paris, France?



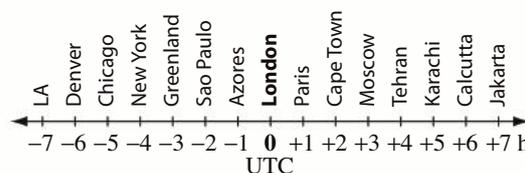
$$= \boxed{\phantom{00}} \text{ } ^\circ\text{C}$$

**i)** What is the time difference in hours between Denver, USA and Cape Town, South Africa?



$$= \boxed{\phantom{00}} \text{ h}$$

**j)** What is the time difference in hours between Sao Paulo, Brazil and Calcutta, India?



$$= \boxed{\phantom{00}} \text{ h}$$

- Visualise the position of the values on a number line.
- Translate the words to number sentences.
- Add the numbers ignoring their signs.

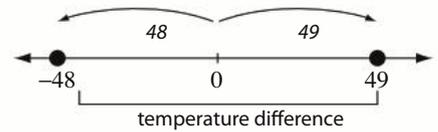
Hint: Taking away negative 5 is the same as adding positive 5.

$$0 - (-5) = +5$$

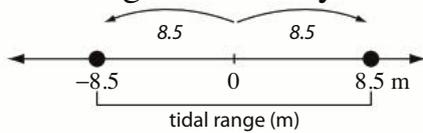
**Q.** In Washington state the highest recorded temperature is  $49^{\circ}\text{C}$  and the lowest is  $-48^{\circ}\text{C}$ . What is the difference between these temperatures?

$$\begin{aligned} \text{A. } & 49 - (-48) \\ & = 49 + 48 \\ & = 97^{\circ}\text{C} \end{aligned}$$

Instead of subtracting negative 48, add positive 48 to 49.



**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  $26^{\circ}\text{C}$  and the lowest is  $-25^{\circ}\text{C}$ . What is the temperature difference?

$$= \boxed{^{\circ}\text{C}}$$

**e)** In Luxembourg the highest recorded temperature is  $38^{\circ}\text{C}$  and the lowest is  $-23^{\circ}\text{C}$ . What is the temperature difference?

$$= \boxed{^{\circ}\text{C}}$$

**f)** In Shanghai (China) the highest recorded temperature is  $40^{\circ}\text{C}$  and the lowest is  $-12^{\circ}\text{C}$ . What is the temperature difference?

$$= \boxed{^{\circ}\text{C}}$$

**g)** The lowest point in Asia is  $-409$  m at the Dead Sea and the highest is 8848 m at Mt Everest. What is the height difference between these points?

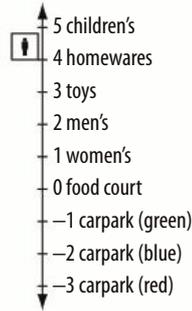
$$= \boxed{\text{m}}$$

**h)** The highest point in South America is 6960 m at Mt Aconcagua and the lowest is  $-40$  m in the Valdes Peninsula. What is the height difference?

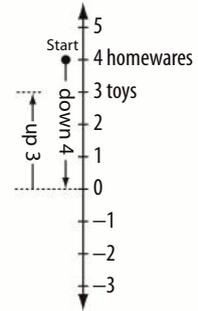
$$= \boxed{\text{m}}$$

- Start at the given point on the number line.
- Count up or down the number of spaces as directed.

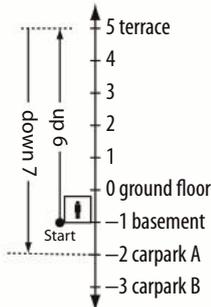
**Q.** From homewares Bec rides the elevator down 4 levels and up 3 levels. At what level is Bec now?



**A.** down 4 levels (add  $-4$ )  
up 3 levels (add  $+3$ )  
 $\Rightarrow$  **toys**



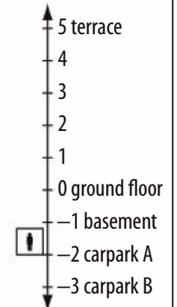
**a)** From level  $-1$  basement, Rob rides the elevator up 6 levels and down 7. At what level is Rob now?



up 6 levels (add 6)

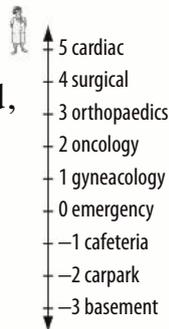
down 7 levels (add  $-7$ )

**b)** From the carpark B, Eddie rides the elevator up 3 levels and then up 4 levels. At what level is Eddie now?



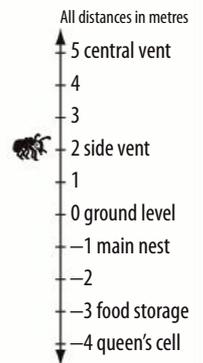
$\Rightarrow$

**c)** A nurse starts in cardiac ward, goes down 6 levels and then up 3 levels. Where does she finish?



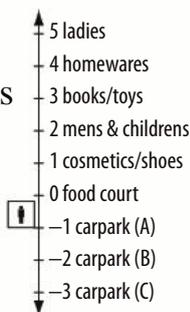
$\Rightarrow$

**d)** A termite entered its tower via the side vent and went to the food storage level. How far did the termite travel?



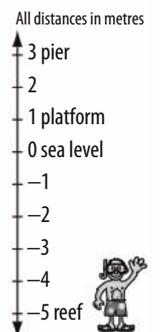
$\Rightarrow$

**e)** From carpark (A) Todd rides the elevator down 2 levels and up 7 levels. At what level is Todd now?



$\Rightarrow$

**f)** A snorkeller at the reef surfaces for lunch on the pier and then goes back to the reef. How far does he travel?



$\Rightarrow$

- Start at the given point.
- Work in the given order.
- Visualise the position of the values on a number line.

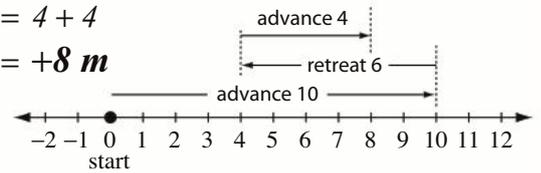
Hint: Positive words: up, above, over, forward, advance, gained, earned, later  
Negative words: down, below, under, backward, retreat, lost, owed, earlier

**Q.** During a football game the ball advanced 10 m, retreated 6 m and then advanced 4 m. Where did the ball finish in relation to its starting point?

**A.** Start:  $0 + 10 - 6 + 4$

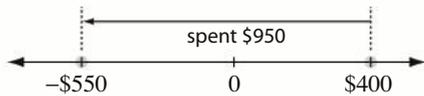
$$= 4 + 4$$

$$= +8 \text{ m}$$



**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?

$$= \dots = \boxed{\phantom{000}}$$

**c)** Shafiq owes \$420. If he earned \$280, what is Shafiq's bank balance?

$$= \dots = \boxed{\phantom{000}}$$

**d)** Carbon dioxide boils at  $-78^{\circ}\text{C}$ . At  $21^{\circ}\text{C}$  below this, carbon dioxide solidifies. At what temperature does carbon dioxide solidify?

$$= \dots = \boxed{\phantom{000}}^{\circ}\text{C}$$

**e)** The Persians destroyed the original Acropolis in 480 BC. Pericles rebuilt it 31 years later. What year was that?

$$= \dots = \boxed{\phantom{000}}$$

**f)** Tutankhamun reigned for 9 years up until 1323 BC. What year did Tutankhamun come to the throne?

$$= \dots = \boxed{\phantom{000}}$$

**g)** Oxygen boils at  $-183^{\circ}\text{C}$ . At  $35^{\circ}\text{C}$  below this, oxygen solidifies. What is the temperature of solid oxygen?

$$= \dots = \boxed{\phantom{000}}^{\circ}\text{C}$$

**h)** Helium boils at  $-269^{\circ}\text{C}$ . At  $3^{\circ}\text{C}$  below this, helium solidifies. At what temperature does helium solidify?

$$= \dots = \boxed{\phantom{000}}^{\circ}\text{C}$$

**i)** You bought \$2000 worth of shares on the stock market. After the first year you lost \$1060, but after the second year you gained \$590. What is the current value of your shares?

$$= \dots = \boxed{\phantom{000}}$$

**j)** A bear weighs 130 kg. During the winter hibernation it loses 25 kg. After hibernation it gains 20 kg. What is the current weight of the bear?

$$= \dots = \boxed{\phantom{000}} \text{ kg}$$

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.

**Using a number line**

- Start at 0.
- When the number is “+” move that many to the right.
- When the number is “-” move that many to the left.

**Using Addition Rules**

**Addition Rules**

same signs:

Add the numbers, ignoring their signs.  
Keep that sign.

**Addition Rules**

different signs:

Subtract the numbers, ignoring their signs.  
Keep the sign of the larger number.

Example:

$$(+4) + (+3) = +(4 + 3) = +7 = 7 \text{ or simply } 4 + 3 = 7$$

$$(-5) + (-8) = -(5 + 8) = -13 \text{ or simply } -5 + -8 = -13$$

Example:

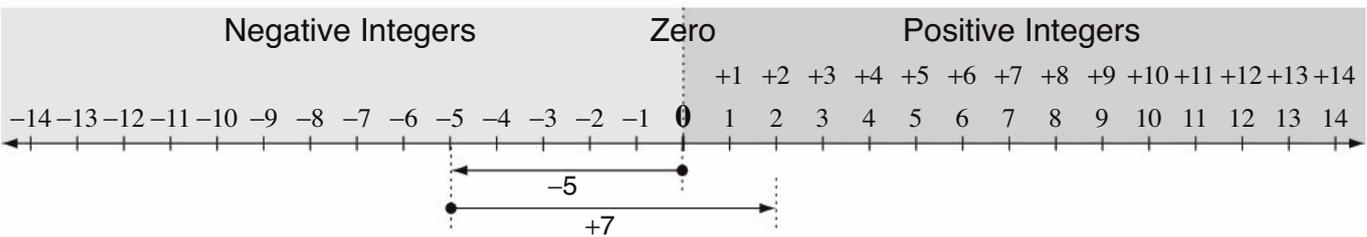
$$(-9) + (+3) = -(9 - 3) = -6 \text{ or simply } -9 + 3 = -6$$

$$(-4) + (+11) = +(11 - 4) = +7 = 7 \text{ or simply } -4 + 11 = 7$$

**Q.**  $-5 + 7 =$

**A.**  $-5 + 7 =$   
 $= +(7 - 5)$   
 $= 2$

Starting at 0 go 5 units to the left. From this point, move 7 units right. You stop at positive 2.



**a)**  $-2 + (-3) =$

$= -(2 + 3) = -5$   
 both negative keep “-”  
 same signs, add

**b)**  $-4 + 3 =$

$=$

**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)**  $-3 + (-6) =$

$=$

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.

**Using a number line**

- Start at 0.
- When the number is “+” move that many to the right.
- When the number is “-” move that many to the left.

**Using Addition Rules**

- Consider subtracting an integer as adding its opposite. So change the number to be subtracted to its opposite. Example:  $8 - (-2) = 8 + (+2)$
- Then apply the addition rules.

**Addition Rules**

same signs:  
Add the numbers, ignoring their signs. Keep that sign.

Example:  
 $(-9) - (-3) = (-9) + (+3) = -(9 - 3) = -6$   
 or simply  $-9 + 3 = -6$   
 $(-4) - (-11) = (-4) + (+11) = +(11 - 4)$   
 $= +7 = 7$  or simply  $-4 + 11 = 7$

**Addition Rules**

different signs:  
Subtract the numbers, ignoring their signs. Keep the sign of the larger number.

Example:  
 $(-5) - (+8) = (-5) + (-8) = -(5 + 8) = -13$   
 or simply  $-5 + -8 = -13$   
 $(+4) - (-3) = (+4) + (+3) = +(4 + 3) = +7 = 7$   
 or simply  $4 + 3 = 7$

**Q.**  $-3 - 6 =$

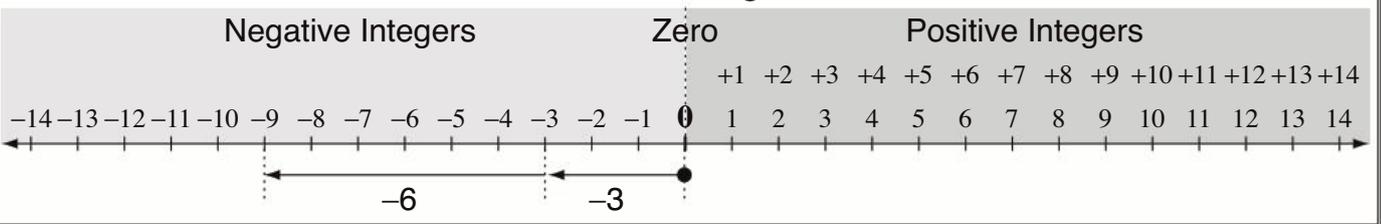
start at -3, move backward 6

**A.**  $-3 - 6 =$

$= -3 + (-6)$   
 $= -(3 + 6)$   
 $= -9$

Negative 3 take away positive 6 is the same as negative 3 plus negative 6.

OR Using a number line:  
 Starting at 0 go 3 units to the left.  
 From this point, move 6 units left. You stop at negative 9.



**a)**  $1 - 7 =$

subtract 7 means add -7

$= +1 + (-7)$   
 different signs, subtract  
 $= -(7 - 1) = \boxed{-6}$

**b)**  $0 - 8 =$

$=$   
 $=$   $\boxed{\phantom{00}}$

**c)**  $4 - 8 =$

$=$   
 $=$   $\boxed{\phantom{00}}$

**d)**  $-3 - 5 =$

$=$   
 $=$   $\boxed{\phantom{00}}$

**e)**  $-9 - 2 =$

$=$   
 $=$   $\boxed{\phantom{00}}$

**f)**  $2 - (-1) =$

$=$   
 $=$   $\boxed{\phantom{00}}$

g)  $3 - (-4) =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

h)  $-8 - (-4) =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

i)  $-2 - (-2) =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

j)  $-8 - 5 =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

k)  $9 - (-6) =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

l)  $-7 - (-3) =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

m)  $2 - 11 =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

n)  $5 - (+7) =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

o)  $-8 - (-2) =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

p)  $0 - (-5) =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

q)  $-6 - (+2) =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

r)  $-3 - 7 =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

s)  $5 - (-2) =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

t)  $-4 - (-10) =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

u)  $8 - (-9) =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

v)  $-6 - 10 =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

w)  $3 - 9 =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

x)  $-1 - 8 =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

y)  $0 - 12 =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

z)  $10 - (+3) =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

A)  $-7 - 2 =$

$$=$$

$$= \dots = \boxed{\phantom{00}}$$

### Skill 13.9 Multiplying integers.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Multiply the integers ignoring the signs.
- Determine the sign of the result using the multiplication rules.

#### Multiplication Rules

same signs: positive  $\times$  positive = positive  
negative  $\times$  negative = positive

#### Multiplication Rules

different signs: positive  $\times$  negative = negative  
negative  $\times$  positive = negative

Example:  $-9 \times (-3) = 27$   
 (---+)

Example:  $9 \times (-3) = -27$   
 (+---)

Q.  $-5 \times (-10) =$

A.  $-5 \times (-10) = 50$   
 (---+)

$5 \times 10 = 50$   
 Same signs, both negative  
 $\Rightarrow$  positive result  
 $\Rightarrow +50$

- a)  $-6 \times 7 =$   (---+)
- 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 integer.

Blue 11 22 33 44  
Green 11 22 33 44

- Divide the integers ignoring the signs.
- Determine the sign of the result using the division rules.

### Division Rules

same signs: positive  $\div$  positive = positive  
negative  $\div$  negative = positive

### Division Rules

different signs: positive  $\div$  negative = negative  
negative  $\div$  positive = negative

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.  
 $\Rightarrow -5$

- 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.

Blue 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

EITHER

- Find the largest number that divides evenly into each number of the ratio (Highest Common Factor).
- Divide each number by the HCF.

Hint: ‘:’ means fraction and is read as ‘to’.

$$\text{Ratio } a : b = \frac{a}{b}$$

OR

- Divide each number of the ratio by any factor until the ratio is reduced to simplest form.

Q. Simplify the ratio 36 : 63

A.  $\begin{matrix} \div 9 & & \div 9 \\ \swarrow & & \searrow \\ 36 & : & 63 \\ \swarrow & & \searrow \\ 4 & & 7 \\ \hline 4 & : & 7 \end{matrix}$

HCF of 36 and 63 is 9 so  $\div 9$

OR A.  $\begin{matrix} \div 3 & & \div 3 \\ \swarrow & & \searrow \\ 36 & : & 63 \\ \swarrow & & \searrow \\ 12 & : & 21 \\ \div 3 & & \div 3 \\ \swarrow & & \searrow \\ 4 & : & 7 \\ \hline 4 & : & 7 \end{matrix}$

Simplify:  $\div 3$   
Simplify:  $\div 3$

a) Simplify the ratio 10 : 12

$$= \overset{5}{\cancel{10}} : \overset{6}{\cancel{12}} \xrightarrow{\text{Simplify: } \div 2} = \boxed{5 : 6}$$

b) Simplify the ratio 6 : 12

$$= 6 : 12 \xrightarrow{\text{Simplify: } \div 6} = \boxed{\quad : \quad}$$

c) Simplify the ratio 40 : 90

$$= \quad : \quad = \boxed{\quad : \quad}$$

d) Simplify the ratio 25 : 35

$$= \quad : \quad = \boxed{\quad : \quad}$$

e) Simplify the ratio 60 : 12

$$= \overset{5}{\cancel{60}} : \overset{1}{\cancel{12}} \xrightarrow{\text{Simplify: } \div 12} = \boxed{\quad : \quad}$$

f) Simplify the ratio 16 : 24

$$= \quad : \quad = \boxed{\quad : \quad}$$

g) Simplify the ratio 200 : 50

$$= \quad : \quad = \boxed{\quad : \quad}$$

h) Simplify the ratio 32 : 8

$$= \quad : \quad = \boxed{\quad : \quad}$$

i) Simplify the ratio 24 : 96

$$= \quad : \quad = \boxed{\quad : \quad}$$

j) Simplify the ratio 30 : 54

$$= \quad : \quad = \boxed{\quad : \quad}$$

k) Simplify the ratio 24 : 30

$$= \quad : \quad = \boxed{\quad : \quad}$$

l) Simplify the ratio 24 : 16

$$= \quad : \quad = \boxed{\quad : \quad}$$

m) Simplify the ratio 300 : 75

$$= \quad : \quad = \boxed{\quad : \quad}$$

n) Simplify the ratio 80 : 120

$$= \quad : \quad = \boxed{\quad : \quad}$$

## Skill 14.2 Simplifying ratios by comparing two quantities.

Blue 1 1 2 2 3 3 4 4  
Green 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 (Highest Common Factor).
- Divide each quantity by the HCF.

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.

$$\text{Ratio } a : b = \frac{a}{b}$$

**Q.** Simplify the ratio 3 h : 80 min

**A.**  $3 \text{ h} = 3 \times 60 \text{ min} = 180 \text{ min}$  1 h = 60 min

$$3 \text{ h} : 80 \text{ min}$$

$$= 180 \text{ min} : 80 \text{ min}$$

$$\xrightarrow{\div 20} \begin{matrix} 9 & 4 \\ 180 \text{ min} & : & 80 \text{ min} \end{matrix} \xrightarrow{\div 20}$$

HCF of 180 and 80 is 20 so  $\div 20$

$$= 9 : 4$$

Ignore the units

**a)** Simplify the ratio 300 g : 120 g

$$= \overset{5}{\cancel{300}} : \overset{2}{\cancel{120}} \xrightarrow{\text{Simplify: } \div 60} = \boxed{\phantom{00}} : \boxed{\phantom{00}}$$

**b)** Simplify the ratio 36 mm : 90 mm

$$= 36 : 90 \xrightarrow{\text{Simplify: } \div 18} = \boxed{\phantom{00}} : \boxed{\phantom{00}}$$

**c)** Simplify the ratio 120 cm : 36 cm

$$= \boxed{\phantom{00}} : \boxed{\phantom{00}}$$

**d)** Simplify the ratio 150 g : 175 g

$$= \boxed{\phantom{00}} : \boxed{\phantom{00}}$$

**e)** Simplify the ratio \$2.00 : 75 cents

\$1 = 100¢

2 zeros, 2 places right

$$\$2.00 = 2.00 \times 100¢ = 200¢$$

$$= \overset{8}{\cancel{200}}¢ : \overset{3}{\cancel{75}}¢ \xrightarrow{\text{Simplify: } \div 25} = \boxed{\phantom{00}} : \boxed{\phantom{00}}$$

**f)** Simplify the ratio 40 s : 2 min

$$= \boxed{\phantom{00}} : \boxed{\phantom{00}}$$

**g)** Simplify the ratio 8 m : 20 cm

$$= \boxed{\phantom{00}} : \boxed{\phantom{00}}$$

**h)** Simplify the ratio \$6.00 : 60 cents

$$= \boxed{\phantom{00}} : \boxed{\phantom{00}}$$

**i)** Simplify the ratio 5 weeks : 15 days

$$= \boxed{\phantom{00}} : \boxed{\phantom{00}}$$

**j)** Simplify the ratio 5 min : 50 s

$$= \boxed{\phantom{00}} : \boxed{\phantom{00}}$$

$$\begin{aligned} \text{speed } (v) &= \frac{\text{distance travelled } (d)}{\text{time taken } (t)} & \text{OR } v &= \frac{d}{t} \\ \text{distance travelled } (d) &= \text{speed } (v) \times \text{time taken } (t) & \text{OR } d &= vt \\ \text{time taken } (t) &= \frac{\text{distance travelled } (d)}{\text{speed } (v)} & \text{OR } t &= \frac{d}{v} \end{aligned}$$

- Write the formula for speed or distance or time taken to travel.
- Convert the given units into the required units if necessary. (see Maths Facts, page 383)  
Hints: If the speed must be calculated in km/h, convert the units for distance to km 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 900 km/h. At this rate how long would it take to travel 4050 kilometres?

**A.**  $t = \frac{\text{distance travelled}}{\text{speed}} = \frac{d}{v}$

$$= \frac{4050 \text{ km}}{900 \text{ km/h}}$$

Substitute into the formula

$$= \frac{4050}{900} \text{ h}$$

Simplify:  $\div 50$

$$= \frac{81}{20} \text{ h}$$

Simplify:  $\div 9$

$$= 4.5 \text{ h}$$

**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  $d = vt$

$$d = 10 \text{ km/h} \times 0.75 \text{ h} = \boxed{7.5 \text{ km}}$$

**b)** How far will a salmon swim in 12 minutes if it swims at 45 km/h?

$$t =$$

$$d = \quad = \boxed{\text{km}}$$

**c)** A cyclist rides at an average speed of 18 km/h. At this rate how long would it take to travel 45 km?

$$t = \frac{d}{v}$$

$$= \frac{45 \text{ km}}{18 \text{ km/h}} = \boxed{\text{h}}$$

Simplify:  $\div 9$

**d)** A hot air balloon travels at a speed of 21 km/h. At this rate how far will it travel in 40 minutes?

$$t =$$

$$d = \quad = \boxed{\text{km}}$$

**e)** The X-15 rocket plane is the fastest aircraft with a maximum speed of 7275 km/h, reached in 1967. At this speed how far could it travel in 4 hours?

$$d =$$

$$= \quad = \boxed{\text{km}}$$

**f)** An airplane flew from Sydney to Cairns a distance of 2000 km. If the plane travelled at an average speed of 800 km/h, how long did the trip take?

$$t =$$

$$= \quad = \boxed{\text{h min}}$$

- g) An airplane flew from Melbourne to Adelaide, a distance of 650 km. If the plane travelled 1.3 hours, how fast did it travel?

$$v = \frac{d}{t} = \frac{650 \text{ km}}{1.3 \text{ h}} = 500 \div 1 \text{ km/h}$$

Simplify:  $\div 13$

.....  
= 500  $\div$  1 km/h =  km/h

- h) An airplane flew from Alice Springs to Darwin, a distance of 1300 km. If the plane travelled 2.5 hours, how fast did it travel?

v =

.....  
=  =  km/h

- i) An emu can run 9 km in 12 minutes. What is its average speed in kilometres per hour?

v =

.....  
=  =  km/h

- j) Some species of dolphin can swim 15 km at 60 km/h. How long would it take to swim this distance?

t =

.....  
=  =  min

- k) A train travels at an average speed of 76 km/h. What distance would it travel in one hour and 15 minutes?

d =

.....  
=  =  km

- l) A satellite orbits the earth at an average speed of 8 km/s. What distance does it travel in 20 minutes?

d =

.....  
=  =  km

- m) Earth moves around the sun at an average speed of 108 000 km/h. What distance does it move in a quarter of an hour?

d =

.....  
=  =  km

- n) In 1904 the first speeding ticket went to Harry Myers of Dayton, Ohio. Harry drove 20 km/h in town. At this speed how far could he travel in 15 minutes?

d =

.....  
=  =  km

- o) A rifle was fired at a target 600 m away. If the bullet travelled at an average speed of 800 m/s, how long did the bullet take to hit the target?

t =

.....  
=  =  s

- p) It is 18 km from Wodonga Creek to Doctors Point. If a Murray cod travelled at an average speed of 8 km/h, how long would this trip take?

t =

.....  
=  =  h min

**Skill 14.4** Simplifying ratios by comparing three numbers.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

EITHER

- Find the largest number that divides evenly into each number of the ratio (Highest Common Factor).
- Divide each number by the HCF.

OR

- Divide each number of the ratio by any factor until the ratio is reduced to simplest form.

**Q.** Simplify the ratio  
16 : 8 : 80

**A.**  $\begin{matrix} 16 : 8 : 80 \\ \div 8 \quad \quad \quad \div 8 \\ \hline 2 : 1 : 10 \\ \div 8 \end{matrix}$  HCF of 16, 8 and 80 is 8 so  $\div 8$

$= 16 : 8 : 80$   
 $= 2 : 1 : 10$

**OR A.**  $\begin{matrix} 16 : 8 : 80 \\ \div 2 \quad \quad \quad \div 2 \\ \hline 8 : 4 : 40 \\ \div 4 \quad \quad \quad \div 4 \\ \hline 2 : 1 : 10 \end{matrix}$  Simplify:  $\div 2$   
Simplify:  $\div 4$

$= 16 : 8 : 80$   
 $= 8 : 4 : 40$   
 $= 2 : 1 : 10$

**a)** Simplify the ratio 72 : 16 : 40

$= \overset{9}{\cancel{72}} : \overset{2}{\cancel{16}} : \overset{5}{\cancel{40}}$  Simplify:  $\div 8$  = **9 : 2 : 5**

**b)** Simplify the ratio 6 : 12 : 30

= ..... = **: :**

**c)** Simplify the ratio 3 : 9 : 27

= ..... = **: :**

**d)** Simplify the ratio 15 : 25 : 40

= ..... = **: :**

**e)** Simplify the ratio 28 : 12 : 8

= ..... = **: :**

**f)** Simplify the ratio 18 : 36 : 27

= ..... = **: :**

**g)** Simplify the ratio 35 : 21 : 14

= ..... = **: :**

**h)** Simplify the ratio 50 : 200 : 70

= ..... = **: :**

**i)** Simplify the ratio 36 : 12 : 60

= ..... = **: :**

**j)** Simplify the ratio 30 : 45 : 90

= ..... = **: :**

**k)** Simplify the ratio 42 : 14 : 21

= ..... = **: :**

**l)** Simplify the ratio 40 : 60 : 80

= ..... = **: :**

### Skill 14.5 Deciding if two ratios are equivalent.

Blue 11 22 3 4 4  
Green 11 22 3 3 4 4

- 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 equivalent (or form a proportion).

$$a:b = c:d \quad \text{2 ratios}$$

$$\frac{a}{b} \times \frac{c}{d} \quad \text{Cross product}$$

$$a \times d = b \times c$$

$$ad = bc$$

**Q.** Which ratio is equivalent to 3 : 7?

- A) 6 : 21    B) 9 : 14    C) 15 : 35

**A.**  $\frac{3}{7} \times \frac{6}{21} \Rightarrow 3 \times 21 = 7 \times 6$  A  
 $\Rightarrow 63 = 42 \Rightarrow \text{false}$

Cross multiply

$\frac{3}{7} \times \frac{9}{14} \Rightarrow 3 \times 14 = 7 \times 9$  B  
 $\Rightarrow 42 = 63 \Rightarrow \text{false}$

$\frac{3}{7} \times \frac{15}{35} \Rightarrow 3 \times 35 = 7 \times 15$  C  
 $\Rightarrow 105 = 105 \Rightarrow \text{true}$

The answer is **C**

**a)** 4 : 5 is equivalent to 32 : 40  
True or false?

$$\frac{4}{5} \times \frac{32}{40} \Rightarrow 4 \times 40 = 5 \times 32$$

$$160 = 160 \Rightarrow \boxed{\phantom{00}}$$

**b)** 6 : 11 is equivalent to 60 : 121  
True or false?

$$\Rightarrow \boxed{\phantom{00}}$$

**c)** Which ratio is equivalent to 4 : 9?  
A) 16 : 81    B) 12 : 27    C) 8 : 36

A  $\frac{4}{9} \times \frac{16}{81} \Rightarrow 3 \times 25 = 5 \times 9 \Rightarrow 75 = 45 (F)$

B  $\frac{4}{9} = \frac{12}{27} \Rightarrow$

C  $\Rightarrow \Rightarrow \boxed{\phantom{00}}$

**d)** Which ratio is equivalent to 5 : 8?  
A) 10 : 80    B) 20 : 40    C) 25 : 40

A  $\Rightarrow$

B  $\Rightarrow$

C  $\Rightarrow \Rightarrow \boxed{\phantom{00}}$

**e)** Which ratio is equivalent to 2 : 7?  
A) 8 : 28    B) 10 : 70    C) 4 : 49

A  $\Rightarrow$

B  $\Rightarrow$

C  $\Rightarrow \Rightarrow \boxed{\phantom{00}}$

**f)** Which ratio is equivalent to 7 : 9?  
A) 21 : 36    B) 49 : 81    C) 35 : 45

A  $\Rightarrow$

B  $\Rightarrow$

C  $\Rightarrow \Rightarrow \boxed{\phantom{00}}$

**Skill 14.6** Completing equivalent ratios (1).

- Write the equivalent ratios 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).

$a : b = c : d$  ← 2 ratios  
 $\frac{a}{b} = \frac{c}{d}$  ← Cross product  
 $a \times d = b \times c$   
 $ad = bc$

**Q.** Complete the equivalent ratios:

: 36 = 10 : 3

**A.**  $\frac{x}{36} = \frac{10}{3}$

$\frac{x}{36} = \frac{10}{3}$  ← Cross multiply

$x \times 3 = 36 \times 10$

$3x = 360$

$\frac{1}{3}x = \frac{120}{1}$  ← Simplify: ÷ 3

$\frac{1}{1}x = \frac{120}{1}$

$x = 120$

**a)** Complete the equivalent ratios:

5 :  = 20 : 32

$\frac{5}{x} = \frac{20}{32} \Rightarrow x \times 20 = 5 \times 32$

$\frac{1}{20}x = \frac{160}{20} \Rightarrow x = 8$  ← Simplify: ÷ 20

**b)** Complete the equivalent ratios:

42 : 12 =  : 4

$\frac{42}{12} = \frac{x}{4} \Rightarrow 12 \times x = 42 \times 4$

$\frac{12x}{12} = \frac{168}{12} \Rightarrow x = 14$

**c)** Complete the equivalent ratios:

7 : 9 =  : 72

$\Rightarrow$

$\Rightarrow x =$

**d)** Complete the equivalent ratios:

: 3 = 120 : 60

$\Rightarrow$

$\Rightarrow x =$

**e)** Complete the equivalent ratios:

$\frac{5}{9} = \frac{35}{\text{input}}$

$\Rightarrow$

$\Rightarrow x =$

**f)** Complete the equivalent ratios:

$\frac{3}{7} = \frac{18}{\text{input}}$

$\Rightarrow$

$\Rightarrow x =$

g) Complete the equivalent ratios:

$$\frac{1}{7} = \frac{\square}{56}$$

⇒

⇒  $x =$ 

h) Complete the equivalent ratios:

$$\frac{7}{20} = \frac{\square}{140}$$

⇒

⇒  $x =$ 

i) Complete the equivalent ratios:

$$\frac{24}{40} = \frac{3}{\square}$$

⇒

⇒  $x =$ 

j) Complete the equivalent ratios:

$$\frac{20}{15} = \frac{4}{\square}$$

⇒

⇒  $x =$ 

k) Complete the equivalent ratios:

$$\frac{10}{45} = \frac{\square}{9}$$

⇒

⇒  $x =$ 

l) Complete the equivalent ratios:

$$\frac{64}{80} = \frac{\square}{10}$$

⇒

⇒  $x =$ 

m) Complete the equivalent ratios:

$$\frac{63}{18} = \frac{\square}{2}$$

⇒

⇒  $x =$ 

n) Complete the equivalent ratios:

$$\frac{11}{5} = \frac{\square}{15}$$

⇒

⇒  $x =$

**EITHER**

- Find the unit price for each case, by dividing the cost price by the quantity.
- 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, e.g. double, triple or halving the cost or the quantity.

**Q.** Which is cheaper per can?

- A) \$2.50 for a 6-pack  
B) \$6 for a 12-pack

**A.** Deal A)

$$\frac{\$2.50}{6 \text{ cans}} = \frac{\$0.42}{1 \text{ can}}$$

⇒ unit price = \$0.42

Deal B)

$$\frac{\$6.00}{12 \text{ cans}} = \frac{\$0.50}{1 \text{ can}}$$

⇒ unit price = \$0.50

Deal A) is cheaper.

**OR**

**A.** Make the same number of cans:

Deal A)

double the quantity ⇒  
double the cost

\$2.50 for 6 cans ⇒  
\$5.00 for 12 cans

Deal B)

\$6.00 for 12 cans ⇒

Deal A) is cheaper.

**a)** Which is cheaper per card?

- A) \$6 for 10 cards  
B) \$8 for 12 cards

make the same cost

A) \$6 for 10 cards ⇒ \$24 for 40 cards

B) \$8 for 12 cards ⇒ \$24 for 36 cards

**A**

**b)** Which is cheaper per pen?

- A) \$4 for 6 pens  
B) \$9 for 15 pens

make the same cost

A) \_\_\_\_\_

B) \_\_\_\_\_ ⇒

**c)** Which is cheaper per kilogram?

- A) \$20 for 10 kg  
B) \$40 for 22 kg

A) \_\_\_\_\_

B) \_\_\_\_\_ ⇒

**d)** Which is cheaper per kilogram?

- A) \$16 for 15 kg  
B) \$27 for 25 kg

A) \_\_\_\_\_

B) \_\_\_\_\_ ⇒

**e)** Which is cheaper per apple?

- A) \$4.80 for 4 apples  
B) \$6.50 for 6 apples

A) \_\_\_\_\_

B) \_\_\_\_\_ ⇒

**f)** Which is cheaper per metre?

- A) \$25 for 12 m  
B) \$40 for 17 m

A) \_\_\_\_\_

B) \_\_\_\_\_ ⇒

**g) Which is the best buy?**

- A) a 300 g Vegemite jar at \$6
- B) a 750 g Vegemite jar at \$14

A) .....

B) ..... ⇒

**h) Which is the best buy?**

- A) a 300 g pack of lollies at \$7.80
- B) a 200 g pack of lollies at \$5.50

A) .....

B) ..... ⇒

**i) Which is the best buy?**

- A) a 500 g cereal box at \$6.40
- B) a 750 g cereal box at \$9.90

A) .....

B) ..... ⇒

**j) Which is the best buy?**

- A) an 8 toilet roll pack at \$4.00
- B) a 20 toilet roll pack at \$9.00

A) .....

B) ..... ⇒

**k) Which is the best buy?**

- A) a 12 soft drink cans pack at \$20.00
- B) an 18 soft drink cans pack at \$24.00

A) .....

B) ..... ⇒

**l) Which is the best buy?**

- A) a box of 100 latex gloves at \$11.00
- B) a box of 20 latex gloves at \$3.00

A) .....

B) ..... ⇒

**m) Which is the best buy?**

- A) a 4 kg bag of onions at \$7.00
- B) 4 kg of loose onions at \$1.95 per kg

A) .....

B) ..... ⇒

**n) Which is the best buy?**

- A) 3 kg of loose oranges at \$2.50 per kg
- B) a 3 kg bag of oranges at \$6.90

A) .....

B) ..... ⇒

**o) Which is the best buy?**

- A) a 3 kg bag of potatoes at \$8.00
- B) 3 kg of loose potatoes at \$2.98 per kg

A) .....

B) ..... ⇒

**p) Which is the best buy?**

- A) a 2 kg bag of tomatoes at \$8.00
- B) 2 kg of loose tomatoes at \$4.98 per kg

A) .....

B) ..... ⇒

**Skill 14.8** Finding the ratio of two quantities (1).

- 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 (Highest Common Factor) and divide each quantity by the HCF.

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 alloy for sterling silver is 92.5% silver, and the rest is copper. Find the ratio of silver to copper.

**A.**  $copper = 100\% - 92.5\% = 7.5\%$   
 $silver : copper$   
 $= 92.5\% : 7.5\%$  *Multiply both sides by 10*  
 $= \frac{925}{10} : \frac{75}{10}$   
 $= 925 : 75$  *Simplify:  $\div 25$*   
 $= 37 : 3$

**a)** The length of the school year in Egypt is 36 weeks and in Indonesia is 44 weeks. Find the ratio of the school year duration in Indonesia compared to Egypt.

$Indonesia : Egypt$   
 $44 : 36$  *Simplify:  $\div 4$*   
 $\xrightarrow{\div 4} 11 : 9$   
 $= \boxed{11 : 9}$

**b)** A computer screen with a diagonal of 60 cm has a length of 50 cm. Find the ratio of the length to the diagonal.

$length : diagonal$   
 $60 : 50$   
 $= \boxed{\quad : \quad}$

**c)** The composition of the 10 cent coin is 75% copper, and the rest is nickel. Find the ratio of nickel to copper in the 10 cent coin.

$nickel : copper$   
 $\quad : \quad$   
 $= \boxed{\quad : \quad}$

**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.

$\quad : \quad$   
 $\quad : \quad$   
 $= \boxed{\quad : \quad}$

**e)** The 8-carat gold is 33% gold, 20% silver and the rest is copper. Find the ratio of silver to other components.

$\quad : \quad$   
 $\quad : \quad$   
 $= \boxed{\quad : \quad}$

**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.

$\quad : \quad$   
 $\quad : \quad$   
 $= \boxed{\quad : \quad}$

**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 2020, of the 100 seats in the US Senate, 26 are held by women. What is the ratio of women to men in the US Senate?

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

**j)** Find the ratio of the height of the Statue of Liberty (93 m including the pedestal) to the height of the Eureka Tower, Melbourne (300 m).

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

**k)** A soccer field is 120 metres long and 80 metres wide. Find the ratio of width to length.

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

**l)** The highest temperature recorded in Africa is 57°C and in South America is 48°C. Find the ratio of the highest temperature in Africa compared to South America.

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

**m)** The lowest temperature recorded in Europe is -55°C and in Antarctica is -90°C. Find the ratio of the lowest temperature in Europe compared to Antarctica.

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

**n)** The sensory, language and memory centres 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.**

$$\text{rate} = \frac{\text{amount}}{\text{time}}$$

**Rate of change**

- Divide the amount by the time taken.  
Example: A 300 L bathtub can be filled in 10 minutes.

$$\text{Rate} = \frac{300 \text{ L}}{10 \text{ min}} = 30 \text{ L/min}$$

$$\text{amount} = \text{rate} \times \text{time}$$

**Amount**

- Multiply the rate by the time taken.  
Example: Sam worked 7 h at a rate of \$16/h.

$$\text{Amount (pay)} = 16 \times 7 = \$112$$

$$\text{time} = \frac{\text{amount}}{\text{rate}}$$

**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 up to 30 metres per year. At this rate how long will they grow in a month?

**A.**  $\text{rate} = 30 \text{ m per year}$   
 $1 \text{ year} = 12 \text{ months}$   
 $\text{rate per month} = 30 \text{ m} \div 12 = 2.5 \text{ m}$

**a)** A Mini Cooper Diesel with a 1.6 L engine emits 104 g/km of the greenhouse gas carbon dioxide (CO<sub>2</sub>). How many grams of CO<sub>2</sub> will be emitted during a 400 km trip?

$$\text{amount (g)} = \text{rate (g/km)} \times \text{distance (km)}$$

$$= 104 \text{ g/km} \times 400 \text{ km} = \boxed{41\,600 \text{ g}}$$

**b)** Most of the Lambert Glacier (Antarctica) moves around 150 metres 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 104 m per year. What is this rate in metres per week?

$$1 \text{ year} = 52 \text{ weeks}$$

$$\text{rate/wk} = \dots = \boxed{\phantom{000}}$$

**d)** It takes 45 minutes to fill a 2700 litre swimming pool. What is the average rate in litres per minute?

$$\text{rate} =$$

$$= \dots = \boxed{\phantom{000}}$$

**e)** A Holden Cruze has a fuel consumption of 7 L of petrol per 100 km. How much petrol does it need for a 250 km trip?

$$\text{amount} =$$

$$= \dots = \boxed{\phantom{000} \text{ L}}$$

**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?

$$1 \text{ week} =$$

$$\text{bottles} = \dots = \boxed{\phantom{000}}$$

**g)** A Honda Civic Hybrid automatic has a highway consumption of 45 L of petrol per 1000 km. How much petrol does it need for a 200 km trip?

$$\text{amount} =$$

$$= \dots = \boxed{\phantom{000} \text{ L}}$$

**h)** The annual fuel cost for a Lamborghini Coupe is around \$2490. How much is the cost per month?

$$1 \text{ year} =$$

$$= \dots = \boxed{\phantom{000} \$}$$



# 15. [Indices / Square Roots]

**Skill 15.1** Expressing powers as products and products as powers.

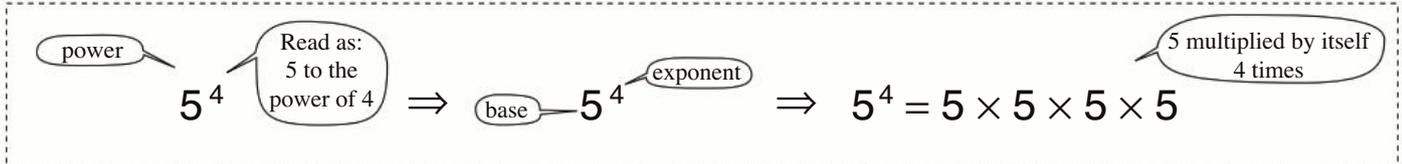
Blue 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

## 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 index.

## To write a power as a product

- Multiply the base by itself the same number of times as indicated by the index.



**Q.** Write the power as a product:

$7^4 =$

**A.**  $7^4 =$

$= 7 \times 7 \times 7 \times 7$

7 multiplied by itself 4 times

**a)** Write the product as a power:

$10 \times 10 \times 10 \times 10 \times 10 =$

$10^5$

5 factors of 10  $\Rightarrow$   
10 is the base  
5 the exponent

**b)** Write the product as a power:

$2 \times 2 \times 2 =$

**c)** Write the product as a power:

$5 \times 5 =$

**d)** Write the product as a power:

$3 \times 3 \times 3 \times 3 \times 3 \times 3 =$

**e)** Write the power as a product:

$6^4 =$

**f)** Write the power as a product:

$11^3 =$

**g)** Write the power as a product:

$2^6 =$

**h)** Write the power as a product:

$9^3 =$

**i)** Write the product as a power:

$1 \times 1 =$

**j)** Write the product as a power:

$7 \times 7 \times 7 =$

**k)** Write the power as a product:

$6^4 =$

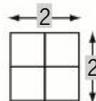
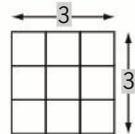
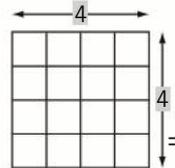
**l)** Write the product as a power:

$2 \times 2 =$

## Skill 15.2 Squaring whole numbers.

Blue 1 1 2 2 3 4 4  
Green 1 1 2 2 3 3 4 4

- Multiply the number by itself.

$1^2$ = one squared  $= \square 1 = 1 \text{ square}$ $= 1 \times 1$ $= \mathbf{1}$	$2^2$ = two squared   $= 4 \text{ squares}$ $= 2 \times 2$ $= \mathbf{4}$	$3^2$ = three squared   $= 9 \text{ squares}$ $= 3 \times 3$ $= \mathbf{9}$	$4^2$ = four squared   $= 16 \text{ squares}$ $= 4 \times 4$ $= \mathbf{16}$
--	---	---	--

**Q.**  $90^2 =$

**A.**  $90^2 =$   
 $= 90 \times 90$   
 $= \mathbf{8100}$

90 multiplied by itself  
2 times

$$\begin{array}{r} 8 \phantom{0} \\ \times 90 \\ \hline 8100 \end{array}$$

**a)**  $7^2 =$

7 multiplied by itself  
2 times

$= 7 \times 7$

$= \mathbf{49}$

**b)**  $3^2 =$

$= \dots = \square$

**c)**  $2^2 =$

$= \dots = \square$

**d)**  $10^2 =$

$= \dots = \square$

**e)**  $5^2 =$

$= \dots = \square$

**f)**  $1^2 =$

$= \dots = \square$

**g)**  $12^2 =$

$= \dots = \square$

**h)**  $11^2 =$

$= \dots = \square$

**i)**  $0^2 =$

$= \dots = \square$

**j)**  $4^2 =$

$= \dots = \square$

**k)**  $9^2 =$

$= \dots = \square$

**l)**  $20^2 =$

$= \dots = \square$

**m)**  $50^2 =$

$= \dots = \square$

**n)**  $30^2 =$

$= \dots = \square$

**o)**  $70^2 =$

$= \dots = \square$

**p)**  $80^2 =$

$= \dots = \square$

**q)**  $40^2 =$

$= \dots = \square$

**r)**  $60^2 =$

$= \dots = \square$

**Skill 15.3** Calculating powers of 10.

- Put the same number of zeros in the answer as the index shows.

Example:  $10^4 \Rightarrow$  index is 4 so the answer ends in 4 zeros  
 $10^4 = 10\,000$

**Q.**  $10^5 =$

**A.**  $10^5 =$  Index is 5

$= 10 \times 10 \times 10 \times 10 \times 10$

$= \mathbf{100\,000}$  Answer ends in 5 zeros

**a)**  $10^9 =$  10 multiplied by itself 9 times

$= 10 \times 10$

$=$  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)**  $10^{10} =$

$=$

## Skill 15.4 Finding square roots of whole numbers.

Blue 1 1 2 3 4  
Green 1 1 2 3 4

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

$\sqrt{25} = \sqrt{5 \times 5} = 5$

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.  $\sqrt{49} =$   
 $= \sqrt{7 \times 7}$   
 $= 7$

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)  $\sqrt{25} =$   
 $= \sqrt{5 \times 5} =$  5

b)  $\sqrt{1} =$   
 $=$   

c)  $\sqrt{81} =$   
 $=$   

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)  $\sqrt{12100} =$   
 $=$

## Skill 15.5 Evaluating powers of whole numbers.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Observe the index.
- Multiply the number (base) the same number of times by itself as the index shows.  
(see skill 15.1, page 123)

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.**  $5^4 =$   
 $= 5 \times 5 \times 5 \times 5$   
 $= 125 \times 5$   
 $= 625$

5 multiplied by itself  
4 times

"5 raised to the power of 4"  
means 4 lots of 5 in the  
equation.

**a)**  $6^3 =$

6 multiplied by itself  
3 times

$= 6 \times 6 \times 6$

$= 36 \times 6 = \boxed{216}$

**b)**  $2^4 =$

$=$

$=$   $=$   $\boxed{\phantom{000}}$

**c)**  $4^4 =$

$=$

$=$   $=$   $\boxed{\phantom{000}}$

**d)**  $1^4 =$

$=$

$=$   $=$   $\boxed{\phantom{000}}$

**e)**  $2^5 =$

$=$

$=$   $=$   $\boxed{\phantom{000}}$

**f)**  $4^4 =$

$=$

$=$   $=$   $\boxed{\phantom{000}}$

**g)**  $3^4 =$

$=$

$=$   $=$   $\boxed{\phantom{000}}$

**h)**  $0^2 =$

$=$

$=$   $=$   $\boxed{\phantom{000}}$

**i)**  $2^6 =$

$=$

$=$   $=$   $\boxed{\phantom{000}}$

**j)**  $4^0 =$

$=$

$=$   $=$   $\boxed{\phantom{000}}$

**k)**  $3^3 =$

$=$

$=$   $=$   $\boxed{\phantom{000}}$

**l)**  $7^3 =$

$=$

$=$   $=$   $\boxed{\phantom{000}}$

**m)**  $3^6 =$

$=$

$=$   $=$   $\boxed{\phantom{000}}$

**n)**  $8^3 =$

$=$

$=$   $=$   $\boxed{\phantom{000}}$

**o)**  $4^5 =$

$=$

$=$   $=$   $\boxed{\phantom{000}}$

**p)**  $10^0 =$

$=$

$=$   $=$   $\boxed{\phantom{000}}$

**q)**  $2^8 =$

$=$

$=$   $=$   $\boxed{\phantom{000}}$

**r)**  $9^3 =$

$=$

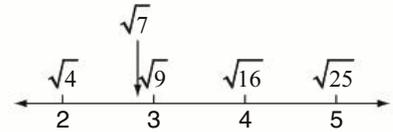
$=$   $=$   $\boxed{\phantom{000}}$

**Skill 15.6** Estimating square roots.

- Find the two perfect squares closest to the number under the square root: one greater than ( $>$ ) the number and one less than ( $<$ ) the number.
- Take square root of these two numbers to estimate the size of the square root.

**Q.** Between which two consecutive whole numbers does  $\sqrt{7}$  lie?

**A.**  $4 < 7 < 9$   
 $\sqrt{4} < \sqrt{7} < \sqrt{9}$   
 $\sqrt{4} = 2$   
 $\sqrt{9} = 3$   
 $2 < \sqrt{7} < 3$



The answer is **2 and 3**

**a)** Between which two consecutive whole numbers does  $\sqrt{66}$  lie?

$\sqrt{64} = 8$      $\sqrt{81} = 9$      $\Rightarrow$  **8 and 9**

**b)** Between which two consecutive whole numbers does  $\sqrt{18}$  lie?

.....  $\Rightarrow$  **and**

**c)** Between which two consecutive whole numbers does  $\sqrt{5}$  lie?

.....  $\Rightarrow$  **and**

**d)** Between which two consecutive whole numbers does  $\sqrt{50}$  lie?

.....  $\Rightarrow$  **and**

**e)** Between which two consecutive whole numbers does  $\sqrt{30}$  lie?

.....  $\Rightarrow$  **and**

**f)** Between which two consecutive whole numbers does  $\sqrt{24}$  lie?

.....  $\Rightarrow$  **and**

**g)** Between which two consecutive whole numbers does  $\sqrt{80}$  lie?

.....  $\Rightarrow$  **and**

**h)** Between which two consecutive whole numbers does  $\sqrt{75}$  lie?

.....  $\Rightarrow$  **and**

**i)** Between which two consecutive whole numbers does  $\sqrt{58}$  lie?

.....  $\Rightarrow$  **and**

**j)** Between which two consecutive whole numbers does  $\sqrt{95}$  lie?

.....  $\Rightarrow$  **and**

**k)** Between which two consecutive whole numbers does  $\sqrt{45}$  lie?

.....  $\Rightarrow$  **and**

**l)** Between which two consecutive whole numbers does  $\sqrt{90}$  lie?

.....  $\Rightarrow$  **and**

## Skill 15.7 Finding powers of negative whole numbers.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Observe the index.
- Multiply the number (base) the same number of times by itself as the index shows.  
(see skill 15.1, page 123)
- Give the result a sign.

A negative number raised to an **even index** gives a **positive result**

$$\begin{aligned} (-5)^2 &= -5 \times (-5) \\ &= +25 \end{aligned}$$

A negative number raised to an **odd index** gives a **negative result**

$$\begin{aligned} (-5)^3 &= -5 \times (-5) \times (-5) \\ &= +25 \times (-5) \\ &= -125 \end{aligned}$$

**Q.**  $(-6)^3 =$

**A.**  $(-6^3) =$  odd index  
 $= -6 \times (-6) \times (-6)$   
 $= 36 \times (-6)$   
 $= -216$  negative result

“-6 raised to the power of 3” means 3 lots of -6 in the equation.

**a)**  $(-3)^4 =$  even index  
 $= -3 \times (-3) \times (-3) \times (-3)$   
 $= 9 \times 9 =$  81 positive result

**b)**  $(-2)^4 =$   
 $=$   
 $=$   

**c)**  $(-6)^2 =$   
 $=$   
 $=$   

**d)**  $(-1)^7 =$   
 $=$   
 $=$   

**e)**  $(-3)^3 =$   
 $=$   
 $=$   

**f)**  $(-4)^2 =$   
 $=$   
 $=$   

**g)**  $(-2)^3 =$   
 $=$   
 $=$   

**h)**  $(-5)^2 =$   
 $=$   
 $=$   

**i)**  $(-3)^5 =$   
 $=$   
 $=$   

**j)**  $(-4)^4 =$   
 $=$   
 $=$   

**k)**  $(-1)^9 =$   
 $=$   
 $=$   

**l)**  $(-7)^2 =$   
 $=$   
 $=$   

**m)**  $(-2)^6 =$   
 $=$   
 $=$   

**n)**  $(-12)^2 =$   
 $=$   
 $=$   

**o)**  $(-10)^3 =$   
 $=$   
 $=$



# 16. [Order of Operations]

Skill 16.1 Using 'order of operations' mixing only  $\times$  and/or  $+$ , or  $+$  and/or  $-$  Blue 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

## 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  
 $= 28$

**a)**  $7 + 21 - 5 =$  add first  
 $= 29 - 5 =$  14

**b)**  $9 - 5 + 3 =$   
 $=$

**c)**  $6 - 3 + 8 =$   
 $=$

**d)**  $3 + 6 - 5 =$   
 $=$

**e)**  $2 \times 9 \div 6 =$   
 $=$

**f)**  $3 \times 3 \times 2 =$   
 $=$

**g)**  $16 + 7 - 3 =$   
 $=$

**h)**  $32 \div 8 \div 2 =$   
 $=$

**i)**  $36 \div 9 \times 5 =$   
 $=$

**j)**  $2 \times 9 \div 3 =$   
 $=$

**k)**  $2 \times 3 \times 4 =$   
 $=$

**l)**  $36 \div 3 \div 3 =$   
 $=$

**m)**  $19 - 5 + 2 =$   
 $=$

**n)**  $13 - 8 + 6 =$   
 $=$

**o)**  $24 \div 4 \times 5 =$   
 $=$

**p)**  $4 \times 6 \div 2 =$   
 $=$

**q)**  $2 \times 5 \times 7 =$   
 $=$

**r)**  $72 \div 12 \times 3 =$   
 $=$

**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.**  $5 + 35 \div 7 \times 4 =$

**A.**  $5 + 35 \div 7 \times 4 =$  work from left to right  
 $= 5 + 5 \times 4$  divide first  
 $= 5 + 20$   
 $= 25$

**a)**  $2 + 3 \times 5 =$  multiply first

$= 2 + 15 = 17$

**b)**  $6 + 9 \div 3 =$

$= 6 + 3 = 9$

**c)**  $4 \times 3 - 7 =$

$= 12 - 7 = 5$

**d)**  $2 + 7 \times 4 =$

$= 2 + 28 = 30$

**e)**  $14 - 12 \div 2 =$

$= 14 - 6 = 8$

**f)**  $2 \times 5 + 8 =$

$= 10 + 8 = 18$

**g)**  $18 \div 6 - 3 =$

$= 3 - 3 = 0$

**h)**  $8 + 12 \div 6 =$

$= 8 + 2 = 10$

**i)**  $40 - 7 \times 3 =$

$= 40 - 21 = 19$

**j)**  $14 + 21 \div 7 =$

$= 14 + 3 = 17$

**k)**  $9 + 2 \times 8 =$

$= 9 + 16 = 25$

**l)**  $17 - 12 \div 3 =$

$= 17 - 4 = 13$

**m)**  $6 + 15 \div 3 \times 2 =$

$= 6 + 5 \times 2$  divide first  
 $= 6 + 10 = 16$

**n)**  $6 \times 5 - 3 \times 7 =$

$= 30 - 21 = 9$

**o)**  $19 + 16 - 4 \times 7 =$

$= 19 + 16 - 28 = 7$

**p)**  $21 \div 3 - 15 \div 5 =$

$= 7 - 3 = 4$

**q)**  $28 + 9 - 7 \times 3 =$

$= 28 + 9 - 21 = 16$

**r)**  $4 \times 8 - 18 \div 2 =$

$= 32 - 9 = 23$

**s)**  $5 + 48 \div 8 \times 3 =$

$= 5 + 6 \times 3 = 23$

**t)**  $10 \times 2 - 44 \div 11 =$

$= 20 - 4 = 16$

**u)**  $30 - 4 \times 4 + 2 =$

$= 30 - 16 + 2 = 16$

**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.**  $14 + (18 - 9) + 7 =$

**A.**  $14 + (18 - 9) + 7 =$  simplify inside the brackets  
 $= 14 + 9 + 7$  work from left to right  
 $= 23 + 7$   
 $= 30$

**a)**  $16 + 7 - (11 + 9) =$

$= 16 + 7 - 20$

$= 23 - 20$

**3**

**b)**  $5 + 4 - (3 - 1) =$

$=$

$=$

**c)**  $9 - (3 + 4) + 6 =$

$=$

$=$

**d)**  $6 - (9 - 5) + 6 =$

$=$

$=$

**e)**  $18 - 6 - (3 + 5) =$

$=$

$=$

**f)**  $8 + 15 - (3 + 4) =$

$=$

$=$

**g)**  $20 - (9 + 4) + 7 =$

$=$

$=$

**h)**  $13 - (11 - 4) - 2 =$

$=$

$=$

**i)**  $7 + 6 - (8 - 4) =$

$=$

$=$

**j)**  $14 + 9 - (4 + 7) =$

$=$

$=$

**k)**  $15 - (7 - 2) + 8 =$

$=$

$=$

**l)**  $6 + 9 - (3 + 5) =$

$=$

$=$

**m)**  $4 + (13 - 8) + 6 =$

$=$

$=$

**n)**  $18 - (10 - 4) - 3 =$

$=$

$=$

**o)**  $17 - (6 + 7) + 4 =$

$=$

$=$

**p)**  $19 - (3 + 9) - 7 =$

$=$

$=$

**q)**  $9 + 16 - (8 + 3) =$

$=$

$=$

**r)**  $14 - (16 - 9) + 3 =$

$=$

$=$

**Order of operations rules**

First evaluate inside the brackets.  
Then multiply ( $\times$ ) and/or divide ( $\div$ ) in order from left to right.  
Finally add ( $+$ ) and/or subtract ( $-$ ) in order from left to right.

**Q.**  $9 + 3 \times (2 + 10) =$

**A.**  $9 + 3 \times (2 + 10) =$  simplify inside the brackets  
 $= 9 + 3 \times 12$  then multiply  
 $= 9 + 36$   
 $= 45$

**a)**  $5 \times (4 + 6) =$  brackets first  
 $= 5 \times 10 =$  50

**b)**  $3 \times (5 - 2) =$   
 $=$  .....  $=$   

**c)**  $8 \div (1 + 3) =$   
 $=$  .....  $=$   

**d)**  $15 \div (8 - 3) =$   
 $=$  .....  $=$   

**e)**  $(10 - 3) \div 7 =$   
 $=$  .....  $=$   

**f)**  $(42 - 6) \div 9 =$   
 $=$  .....  $=$   

**g)**  $(12 - 4) \times 6 =$   
 $=$  .....  $=$   

**h)**  $6 \times (8 - 3) =$   
 $=$  .....  $=$   

**i)**  $5 \times (3 + 8) =$   
 $=$  .....  $=$   

**j)**  $24 \div (3 + 5) =$   
 $=$  .....  $=$   

**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)**  $10 + 40 \div (7 - 2) =$   
 $=$  .....  
 $=$  .....  $=$   

**q)**  $5 + 4 \times (6 + 2) =$   
 $=$  .....  
 $=$  .....  $=$   

**r)**  $8 + (14 - 4) \times 2 =$   
 $=$  .....  
 $=$  .....  $=$   

**s)**  $11 - (19 - 3 \times 5) =$   
 $=$  .....  
 $=$  .....  $=$   

**t)**  $(6 - 3) \times (9 - 4) =$   
 $=$  .....  
 $=$  .....  $=$   

**u)**  $(7 + 2 \times 8) - 15 =$   
 $=$  .....  
 $=$  .....  $=$

**Order of operations rules**

First evaluate inside the brackets.

Secondly evaluate the powers.

Then multiply ( $\times$ ) and/or divide ( $\div$ ) in order from left to right.Finally add ( $+$ ) and/or subtract ( $-$ ) in order from left to right.

**Q.**  $8 + 6^2 \div 4 =$

**A.**  $8 + 6^2 \div 4 =$

$= 8 + 36 \div 4$

$= 8 + 9$

$= 17$

evaluate the power

then divide

work from left to right

**a)**  $8 + 9^2 \times 2 =$

$= 8 + 81 \times 2$

$= 8 + 162 = \boxed{170}$

**b)**  $32 - 3^2 \times 2 =$

$=$

$= \dots = \boxed{\phantom{000}}$

**c)**  $7 + 2^3 \times 2 =$

$=$

$= \dots = \boxed{\phantom{000}}$

**d)**  $5 + (9 - 4)^2 =$

$=$

$= \dots = \boxed{\phantom{000}}$

**e)**  $9 + 5^2 \times 2 =$

$=$

$= \dots = \boxed{\phantom{000}}$

**f)**  $2 \times (15 - 3)^2 =$

$=$

$= \dots = \boxed{\phantom{000}}$

**g)**  $(14 - 10)^2 \div 4 =$

$=$

$= \dots = \boxed{\phantom{000}}$

**h)**  $(12 - 7)^2 =$

$=$

$= \dots = \boxed{\phantom{000}}$

**i)**  $(8 - 1)^2 =$

$=$

$= \dots = \boxed{\phantom{000}}$

**j)**  $16 - 2^2 + 3 \times 1 =$

$=$

$= \dots = \boxed{\phantom{000}}$

**k)**  $27 - 18 \div 3^2 - 2 =$

$=$

$= \dots = \boxed{\phantom{000}}$

**l)**  $10^2 - (5 - 2) \times 8 =$

$=$

$= \dots = \boxed{\phantom{000}}$

**m)**  $(6 - 1 \times 2)^2 =$

$=$

$= \dots = \boxed{\phantom{000}}$

**n)**  $21 \div 3 + (9 - 5)^2 =$

$=$

$= \dots = \boxed{\phantom{000}}$

**o)**  $24 \div 8 + 2^2 - 4 =$

$=$

$= \dots = \boxed{\phantom{000}}$

**p)**  $2 \times 6 + 4 \times 5^2 =$

$=$

$= \dots = \boxed{\phantom{000}}$

**q)**  $32 - (9 + 7) \div 2^2 =$

$=$

$= \dots = \boxed{\phantom{000}}$

**r)**  $(15 - 9 \div 3)^2 =$

$=$

$= \dots = \boxed{\phantom{000}}$

**Order of operations rules**

First evaluate inside the brackets.  
Secondly evaluate the powers.  
Then multiply ( $\times$ ) and/or divide ( $\div$ ) in order from left to right.  
Finally add ( $+$ ) and/or subtract ( $-$ ) in order from left to right.

**Q.**  $8 + (-4)^3 \div (-2 - 2) =$

**A.**  $8 + (-4)^3 \div (-2 - 2) =$  *evaluate the bracket*  $-4 \times -4 \times -4 =$   
 $= 8 + (-4)^3 \div -4$  *evaluate the power*  $= 16 \times -4$   
 $= 8 + (-64) \div -4$  *evaluate the division*  $= -64$   
 $= 8 + 16$   
 $= 24$

**a)**  $-4 - 60 + 3^3 \times 2 =$

$= -4 - 60 + 27 \times 2$   
 $= -4 - 60 + 54$  *work from left to right*  
 $= -64 + 54 = \boxed{-10}$

**b)**  $(-3 - 2) \times (-2) - 4^2 =$

$=$   
 $=$   
 $=$   $= \boxed{\phantom{00}}$

**c)**  $3^2 - (8 + 4) \div (-3) =$

$=$   
 $=$   
 $=$   $= \boxed{\phantom{00}}$

**d)**  $(-3 - 2)^2 + 4 \times 1 =$

$=$   
 $=$   
 $=$   $= \boxed{\phantom{00}}$

**e)**  $5 \times 2 + (-3 - 4)^2 =$

$=$   
 $=$   
 $=$   $= \boxed{\phantom{00}}$

**f)**  $5^2 - (2 + 6) \times (-5) =$

$=$   
 $=$   
 $=$   $= \boxed{\phantom{00}}$

**g)**  $(-2 - 8)^2 \times 14 \div 7 =$

$=$   
 $=$   
 $=$   $= \boxed{\phantom{00}}$

**h)**  $10 + (-25) \div 5 - 2^3 =$

$=$   
 $=$   
 $=$   $= \boxed{\phantom{00}}$

**i)**  $-3 \times 5 - 4^2 \times 2 =$

$=$   
 $=$   
 $=$   $= \boxed{\phantom{00}}$

**j)**  $(-1)^3 - 2 \times 4 \div 2 =$

$= -1 - 2 \times 4 \div 2$   
 $=$   
 $=$   $= \boxed{\phantom{00}}$

**k)**  $1 + (-1)^3 \div (5 - 6) =$

$=$   
 $=$   
 $=$   $= \boxed{\phantom{00}}$

**l)**  $15 + 30 \div 6 - 2^3 =$

$=$   
 $=$   
 $=$   $= \boxed{\phantom{00}}$

**Order of operations rules**

First evaluate inside the brackets.  
 Secondly evaluate the powers.  
 Then multiply ( $\times$ ) and/or divide ( $\div$ ) in order from left to right.  
 Finally add ( $+$ ) and/or subtract ( $-$ ) in order 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)  $\sqrt{25 + 144} =$

$= \sqrt{169}$

$= \sqrt{13 \times 13} =$

b)  $\sqrt{16 + 9} =$

$=$    
 $=$

c)  $\sqrt{6^2 + 8^2} =$

$=$    
 $=$

d)  $\sqrt{64} \times 2 + 2^2 =$

$=$    
 $=$    
 $=$

e)  $\sqrt{25} + 16 \div 2^2 =$

$=$    
 $=$    
 $=$

f)  $\sqrt{81} \div 3^2 + 9 =$

$=$    
 $=$    
 $=$

g)  $2^3 \times \sqrt{36} - 20 =$

$=$    
 $=$    
 $=$

h)  $18 - 4^3 \div \sqrt{4} =$

$=$    
 $=$    
 $=$

i)  $\sqrt{25} \times 2^3 - 7 =$

$=$    
 $=$    
 $=$

j)  $50 - 3 \times \sqrt{100} + 2^3 =$

$=$    
 $=$    
 $=$

k)  $3 \times \sqrt{49} + 4 - 2^3 =$

$=$    
 $=$    
 $=$

l)  $13 + 5^2 \div \sqrt{25} =$

$=$    
 $=$    
 $=$



# 17. [Exploring Numbers]

## Skill 17.1 Comparing whole numbers.

Blue 1 2 2 3 3 4 4  
Green 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)**  $35\,702 > 35\,270$   
True or false?

compare the hundreds place

$7 > 2$

⇒

true

**b)**  $8105 < 8051$   
True or false?

⇒

**c)**  $40\,296 > 42\,960$   
True or false?

⇒

**d)**  $8134 < 8341$   
True or false?

⇒

**e)**  $62\,920 > 62\,290$   
True or false?

⇒

**f)**  $5713 > 5731$   
True or false?

⇒

**g)** Which number is the largest?

- A) 1805  
B) 1850  
C) 1800

compare the digits in the tens place

$5 > 0$

⇒

B

**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) Blue 1 1 2 2 3 3 4 4  
Green 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	6 000	100	50	8	$\frac{2}{10}$	$\frac{4}{100}$	$\frac{7}{1000}$
	<b>3</b>	<b>6</b>	<b>1</b>	<b>5</b>	<b>8</b>	.	<b>2</b>	<b>4</b>
						↑		
						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><b>a)</b> In the number 14058 which digit is in the tens place?</p> <div style="text-align: center; margin-left: 150px;"> <div style="border: 1px solid black; padding: 2px 10px; display: inline-block;">5</div> </div>           | <p><b>b)</b> In the number 9023 which digit is in the units place?</p> <div style="text-align: center; margin-left: 150px;"> <div style="border: 1px solid black; width: 40px; height: 25px; display: inline-block;"></div> </div>         |
| <p><b>c)</b> In the number 5836 which digit is in the hundreds place?</p> <div style="text-align: center; margin-left: 150px;"> <div style="border: 1px solid black; width: 40px; height: 25px; display: inline-block;"></div> </div> | <p><b>d)</b> In the number 72 401 which digit is in the thousands place?</p> <div style="text-align: center; margin-left: 150px;"> <div style="border: 1px solid black; width: 40px; height: 25px; display: inline-block;"></div> </div>   |
| <p><b>e)</b> In the number 16.253 which digit is in the units place?</p> <div style="text-align: center; margin-left: 150px;"> <div style="border: 1px solid black; width: 40px; height: 25px; display: inline-block;"></div> </div>  | <p><b>f)</b> In the number 0.096 which digit is in the hundredths place?</p> <div style="text-align: center; margin-left: 150px;"> <div style="border: 1px solid black; width: 40px; height: 25px; display: inline-block;"></div> </div>   |
| <p><b>g)</b> In the number 81.304 which digit is in the tenths place?</p> <div style="text-align: center; margin-left: 150px;"> <div style="border: 1px solid black; width: 40px; height: 25px; display: inline-block;"></div> </div> | <p><b>h)</b> In the number 0.0256 which digit is in the thousandths place?</p> <div style="text-align: center; margin-left: 150px;"> <div style="border: 1px solid black; width: 40px; height: 25px; display: inline-block;"></div> </div> |
| <p><b>i)</b> What is the value of the underlined digit in the number 5<u>8</u>2?</p> <p><i>8 tens</i> ⇒ <div style="border: 1px solid black; padding: 2px 10px; display: inline-block; margin-left: 100px;">80</div></p>              | <p><b>j)</b> What is the value of the underlined digit in the number 4<u>1</u>30?</p> <p>⇒ <div style="border: 1px solid black; width: 40px; height: 25px; display: inline-block; margin-left: 150px;"></div></p>                          |
| <p><b>k)</b> What is the value of the underlined digit in the number 2<u>7</u>095?</p> <p>⇒ <div style="border: 1px solid black; width: 40px; height: 25px; display: inline-block; margin-left: 150px;"></div></p>                    | <p><b>l)</b> What is the value of the underlined digit in the number 68<u>5</u>17?</p> <p>⇒ <div style="border: 1px solid black; width: 40px; height: 25px; display: inline-block; margin-left: 150px;"></div></p>                         |

m) What is the value of the underlined digit in the number 5124?

⇒

n) What is the value of the underlined digit in the number 73061?

⇒

o) What is the value of the underlined digit in the number 29603?

⇒

p) What is the value of the underlined digit in the number 8714?

⇒

q) What is the value of the underlined digit in the number 50.029?

$2 \text{ hundredths} = \frac{2}{100} = \boxed{0.02}$

r) What is the value of the underlined digit in the number 4.376?

$6 \text{ thousandths} = \frac{6}{1000} = \boxed{\phantom{0.006}}$

s) What is the value of the underlined digit in the number 0.81?

=

t) What is the value of the underlined digit in the number 9.034?

=

u) In which number does the digit 4 have greater value?  
A) 4.65  
B) 30.4

A) value 4

B) value 0.4       $4 > 0.4 \Rightarrow \boxed{A}$

v) In which number does the digit 6 have greater value?  
A) 20406  
B) 1063

A)

B) ⇒

w) In which number does the digit 1 have greater value?  
A) 3.15  
B) 1.98

A)

B) ⇒

x) In which number does the digit 9 have greater value?  
A) 4907  
B) 10892

A)

B) ⇒

y) In which number does the digit 3 have greater value?  
A) 8.931  
B) 1.375

A)

B) ⇒

z) In which number does the digit 5 have greater value?  
A) 0.652  
B) 0.526

A)

B) ⇒

- Write the digits in order.
- Leave a space between the thousands and the hundreds, and between the millions and the hundreds of thousands.
- Write a zero in any place that is left empty between other digits.

**Q.** Express in numerals:  
fifty thousand, six hundred and 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 and fifteen
- b)** Express in numerals:  
four thousand, one hundred and fifty
- c)** Express in numerals:  
six thousand and eighty-two
- d)** Express in numerals:  
eight thousand, one hundred and seventeen
- e)** Express in numerals:  
nine hundred and two
- f)** Express in numerals:  
three thousand, four hundred
- g)** Express in numerals:  
two hundred and ninety-eight
- h)** Express in numerals:  
seven thousand, three hundred and nine
- i)** Express in numerals:  
five hundred and thirty
- j)** Express in numerals:  
twelve thousand, six hundred
- k)** Express in numerals:  
seven hundred and fourteen
- l)** Express in numerals:  
fourteen thousand and sixty-three
- m)** Express in numerals:  
sixty thousand, five hundred and forty
- n)** Express in numerals:  
thirty-one thousand and seven
- o)** Express in numerals:  
four hundred and three thousand, two hundred
- p)** Express in numerals:  
eight hundred thousand and fifty
- q)** Express in numerals:  
one million, nine hundred thousand and twenty-six
- r)** Express in numerals:  
seven million, six hundred thousand and forty

- Start from left and write the word for each digit (unless it is a 0), followed by its place value.
- Do not write anything for any 0's.

word first!

200 = two hundred

place next

**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'.
- Write 'and' after the word 'hundred', if other values follow.

**To write 4-digit numbers in words**

- Describe the number of thousands first. Always write 'thousand' not 'thousands'.
- Write 'and' between the word 'thousand' and the following numerals when hundreds are missing.

**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 8047 in words.

**A.** *eight thousand and forty-seven*

Th.	H	T	U
8	0	4	7

8 thousands, 0 hundreds, 4 tens and 7 units become in words:  
eight thousand and forty-seven

**a)** Write the number 216 in words.

two hundred and sixteen

**b)** Write the number 95 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.

**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 3800 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.

- 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 ( $\geq 5$ ) - **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	⇒	Th.	H	T	U
4	0	6	7		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.

12360 3 < 5 round down by keeping 2 ⇒ 12 000

**b)** Round 915 to the nearest ten. ⇒  

**c)** Round 8592 to the nearest hundred. ⇒  

**d)** Round 407 to the nearest ten. ⇒  

**e)** Round 663 to the nearest ten. ⇒  

**f)** Round 48 550 to the nearest thousand. ⇒  

**g)** Round 1657 to the nearest hundred. ⇒  

**h)** Round 21 089 to the nearest thousand. ⇒  

**i)** Round 2305 to the nearest ten. ⇒  

**j)** Round 1449 to the nearest hundred. ⇒  

**k)** Round 10 507 to the nearest thousand. ⇒  

**l)** Round 3650 to the nearest hundred. ⇒  

**m)** Round 168 to the nearest ten. ⇒  

**n)** Round 5630 to the nearest hundred. ⇒

## Skill 17.6 Ordering decimal numbers.

Blue 1 1 2 2 3 4 4  
Green 1 1 2 2 3 3 4 4

- 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:  
0.38, 0.08, 0.308, 0.803

	U	T	H	Th
3rd	0	3	8	
smallest 1st	0	0	8	
2nd	0	3	0	8
largest 4th	0	8	0	3

**A.** 0.08, 0.308, 0.38, 0.803

Find the smallest digits.  
Work from left to right.

**Units:** all 0  
**Tenths:**  $0 < 3 < 8$   
so 0.08 is the smallest  
0.803 is the largest  
either 0.308 or 0.38 is the  
2nd smallest  
**Hundredths:**  $0 < 8$   
so 0.308 is the 2nd smallest  
0.38 is the 3rd smallest

**a)** Place in order from largest to smallest:  
0.042, 0.24, 0.204, 0.04

U	T	H	Th
0	0	4	2
0	2	4	
0	2	0	4
0	0	4	

the largest number

the smallest number

**b)** Place in ascending order:  
0.059, 0.95, 0.509, 0.095

U	T	H	Th

**c)** Place in ascending order:  
0.306, 0.06, 0.063, 0.36

**d)** Place in descending order:  
0.478, 0.87, 0.407, 0.847

**e)** Place in ascending order:  
0.807, 0.07, 0.87, 0.087, 0.708

**f)** Place in order from smallest to largest:  
0.364, 0.063, 0.63, 0.34, 0.043

**g)** Place in order from largest to smallest:  
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 17.7 Comparing and ordering fractions.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Find the least common denominator of the fractions, which is the Lowest Common Multiple (LCM) of the denominators.
- Change the fractions to equivalent fractions with the lowest common denominator.
- Arrange the fractions in order of the numerators (the smallest fraction has the smallest numerator and so on).

smallest numerator = smallest fraction  $\frac{1}{6} < \frac{3}{6} < \frac{5}{6}$  same denominator

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 ascending order:

$$\frac{3}{5}, \frac{1}{2}, \frac{2}{3}$$

**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?

$$\frac{1}{6} \text{ or } \frac{3}{10} \quad \text{LCM of 6 and 10 is 30}$$

$$\frac{1 \times 5}{6 \times 5} = \frac{5}{30} \quad \frac{3 \times 3}{10 \times 3} = \frac{9}{30} \Rightarrow \frac{5}{30} < \frac{9}{30} \Rightarrow \boxed{\frac{3}{10}}$$

**b)** Which fraction has greater value?

$$\frac{7}{8} \text{ or } \frac{7}{11}$$

$$\dots\dots\dots \boxed{\phantom{\frac{7}{11}}}$$

**c)** Which fraction has greater value?

$$\frac{3}{4} \text{ or } \frac{7}{8}$$

$$\dots\dots\dots \boxed{\phantom{\frac{7}{8}}}$$

**d)** Which fraction has greater value?

$$\frac{1}{2} \text{ or } \frac{7}{15}$$

$$\dots\dots\dots \boxed{\phantom{\frac{7}{15}}}$$

**e)** Place in order from smallest to largest:

$$\frac{1}{2}, \frac{5}{8}, \frac{3}{5} \quad \text{LCM of 2, 8 and 5 is } 8 \times 5 = 40$$

$$\frac{1 \times 20}{2 \times 20} = \frac{20}{40} \quad \frac{5 \times 5}{8 \times 5} =$$

$$\dots\dots\dots \boxed{\phantom{\frac{3}{5}}}$$

**f)** Place in order from largest to smallest:

$$\frac{3}{4}, \frac{2}{3}, \frac{7}{10}$$

$$\dots\dots\dots \boxed{\phantom{\frac{7}{10}}}$$

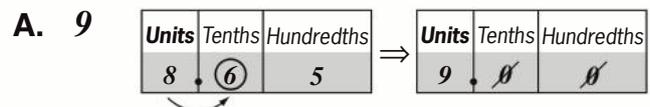
**To round a decimal number to the nearest whole number**

- 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 ( $\geq 5$ ) - **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** (One decimal place means tenths, two decimal places means hundredths and three decimal places means 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 ( $\geq 5$ ) - **round up** - add 1 to the digit in the requested place and drop all following digits.

**Q.** Round 8.65 to the nearest whole number.



The first digit after the decimal point is 6  
 $6 \geq 5$  so round up.  
 Add 1 to the 8 in the units place to make 9.  
 Omit the digits after the decimal point.

**a)** Round 13.4 to the nearest whole number.

13.4 ⇒

*4 < 5 round down by keeping 3*

**b)** Round 52.03 to the nearest whole number.

..... ⇒

**c)** Round 79.75 to the nearest whole number.

..... ⇒

**d)** Round 6.385 to the nearest whole number.

..... ⇒

**e)** Round 0.4305 to three decimal places.

0.4305 ⇒

*5 ≥ 5 round up by adding 1 to 0*

**f)** Round 27.896 to two decimal places.

..... ⇒

**g)** Round 0.59 to one decimal place.

..... ⇒

**h)** Round 9.81 to one decimal place.

..... ⇒

**i)** Round 7.843 to two decimal places.

..... ⇒

**j)** Round 0.0856 to three decimal places.

..... ⇒

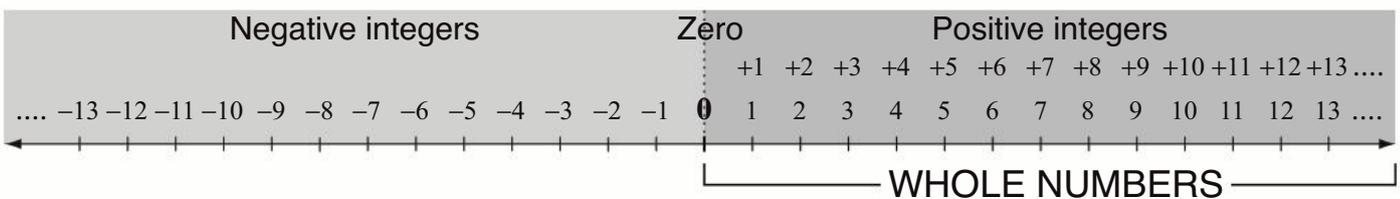
**k)** Round 0.52 to one decimal place.

..... ⇒

**l)** Round 0.1968 to three decimal places.

..... ⇒

INTEGERS



Whole Numbers

Negative integers, fractions and decimals are **not** whole numbers apart from these 2 situations:

- 1) Any positive fraction whose numerator is divisible by the denominator.  $\frac{12}{4} = 3$
- 2) Any positive decimal with only zeros after the decimal point.  $8.00 = 8$

Integers

Fractions and decimals are **not** integers, apart from these 2 situations:

- 1) Any fraction whose numerator is divisible by the denominator.  $-\frac{5}{1} = -5$
- 2) Any decimal with only zeros after the decimal point.  $-3.00 = -3$

**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:

$30, -11, \frac{10}{2}, 6.25, 4000$

**Rational Numbers**Include all **Integers**

$$-2, 0, 700, \frac{5}{1}, \frac{25}{5}$$

all **Fractions**

$$-\frac{3}{4}, \frac{12}{85}, \frac{23}{500}$$

all **Terminating decimals**

$$2.16, -5.753469$$

all **Square roots of perfect squares**

$$\sqrt{9}, \sqrt{16}$$

**Q.** Which numbers are rational?

- A) 0.17      B)  $\pi$   
C)  $\sqrt{3}$       D) -26

**A.** A) 0.17 is rational (terminating decimal)B)  $\pi$  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)

**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)  $\pi$   
C) 3.1415      D)  $\frac{7}{8}$

and

**f)** Which numbers are rational?

- A)  $\pi$       B) 0.0004  
C)  $\frac{3}{4}$       D)  $\sqrt{20}$

and

**g)** Which numbers are rational?

- A) 8.2323      B)  $\sqrt{3}$   
C)  $1\frac{1}{7}$       D)  $-\frac{\pi}{4}$

and

**h)** Which numbers are rational?

- A) -1      B)  $\sqrt{5}$   
C)  $\frac{\pi}{3}$       D)  $\frac{23}{800}$

and

**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.

Blue 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

EITHER

- 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.**  $5 \times 1 = 5$

$5 \times 2 = 10$

$5 \times 3 = 15$

$5 \times 4 = 20$

$5 \times 5 = 25$

$\Rightarrow 5, 10, 15, 20, 25$

**a)** List all the multiples of 8 up to 32.

**b)** List all the multiples of 2 up to 14.

$8 + 8 = 16, 16 + 8 = 24, 24 + 8 = 32$  keep adding 8

8, 16, 24, 32

**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 7 up to 35.

**j)** List all the multiples of 12 up to 60.

**Skill 18.2** Finding the common multiples of two numbers.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- 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 4

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 lowest common multiple (LCM) of two numbers.

- List the multiples of each number.
- Compare the lists and find the lowest matching number (Lowest 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 lowest common multiple (LCM) of 6 and 10?

**A.** *Multiples of 6:*  
6, 12, 18, 24, 30, 36, ...  
*Multiples of 10:*  
10, 20, 30, 40, ...  
*Lowest Common Multiple (LCM):*  
**30**

**a)** What is the lowest common multiple (LCM) of 4 and 9?

4, 8, 12, 16, 20, 24, 28, 32, 36, 40, ...  
9, 18, 27, 36, 45, ...

**36**

**b)** What is the lowest common multiple (LCM) of 3 and 7?

.....  
.....  
.....

**c)** What is the lowest common multiple (LCM) of 4 and 11?

.....  
.....  
.....

**d)** What is the lowest common multiple (LCM) of 5 and 8?

.....  
.....  
.....

**e)** What is the lowest common multiple (LCM) of 3 and 18?

.....  
.....  
.....

**f)** What is the lowest common multiple (LCM) of 4 and 20?

.....  
.....  
.....

**g)** What is the lowest common multiple (LCM) of 9 and 12?

.....  
.....  
.....

**h)** What is the lowest common multiple (LCM) of 6 and 8?

.....  
.....  
.....

**i)** What is the lowest common multiple (LCM) of 8 and 10?

.....  
.....  
.....

**j)** What is the lowest common multiple (LCM) of 9 and 15?

.....  
.....  
.....

**To decide if a number is a factor of another number**

- Divide the first number into the second number.
- Check the remainder:  
If the number divides evenly, then it is a factor.  
If the number does not divide evenly, then it is not a factor.

Hint: A number always has at least 2 factors, 1 and the number itself.

**To find all the factors of a number**

- 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 14 in ascending order.

**A.**  $14 \div 1 = 14$   
 $14 \div 2 = 7$   
 $14 \div 3 = 4 \text{ remainder } 2, 14 \div 4 = 3 \text{ remainder } 2$   
 $14 \div 5 = 2 \text{ remainder } 4, 14 \div 6 = 2 \text{ remainder } 2$   
 ————— Back to 7 & 2 so possibilities exhausted  
 $\Rightarrow 1, 2, 7, 14$

**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 24 in ascending order.

**f)** List all the factors of 36 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.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- List the factors of each number.
- Compare the lists and find any matching numbers (common factors).

**Q.** List all the common factors of 28 and 70.

**A.** *Factors of 28:*

1, 2, 4, 7, 14, 18

*Factors of 70:*

1, 2, 5, 7, 10, 14, 35, 70

*Common factors of 28 and 70:*

1, 2, 7

**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 18 and 24.

.....  
.....  
.....

**c)** List all the common factors of 10 and 50.

.....  
.....

**d)** List all the common factors of 30 and 42.

.....  
.....

**e)** List all the common factors of 15 and 45.

.....  
.....

**f)** List all the common factors of 15 and 50.

.....  
.....

**g)** List all the common factors of 24 and 36.

.....  
.....

**h)** List all the common factors of 28 and 70.

.....  
.....

**Skill 18.6** Finding the highest common factor (HCF) of two numbers.

Blue 11 22 33 44  
Green 11 22 33 44

- List the factors of each number.
- Compare the lists and find the highest matching number (Highest Common Factor, HCF).

**Q.** What is the highest common factor (HCF) 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

*Highest common factor (HCF):*

⇒ 12

**a)** What is the highest common factor (HCF) 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 highest common factor (HCF) of 27 and 33?

.....

**c)** What is the highest common factor (HCF) of 40 and 45?

.....

**d)** What is the highest common factor (HCF) of 20 and 80?

.....

**e)** What is the highest common factor (HCF) of 24 and 48?

.....

**f)** What is the highest common factor (HCF) of 16 and 48?

.....

**g)** What is the highest common factor (HCF) of 24 and 60?

.....

**h)** What is the highest common factor (HCF) of 50 and 75?

.....

**i)** What is the highest common factor (HCF) of 12 and 44?

.....

**j)** What is the highest common factor (HCF) of 30 and 75?

.....

**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 154)

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 all 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?

.....

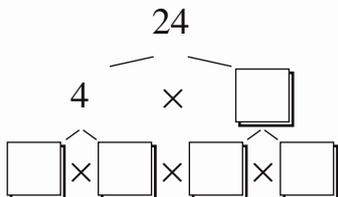
**j)** What is the next prime number after 90?

.....

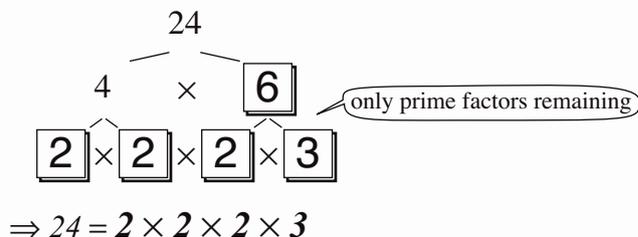
**Skill 18.8** Expressing a number as a product of its prime factors using a factor tree (1).

- 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.

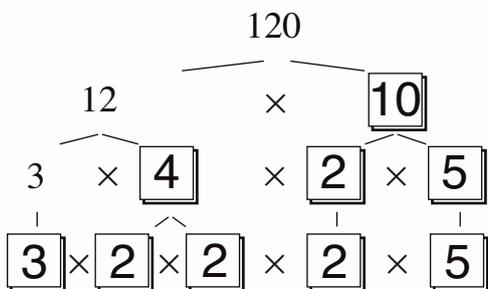
**Q.** Express 24 as a product of prime numbers by completing the factor tree.



**A.**  $24 = 4 \times 6$   
 $4 = 2 \times 2$  and  $6 = 2 \times 3$

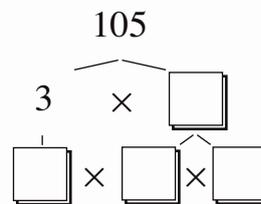


**a)** Express 120 as a product of prime numbers by completing the factor tree.



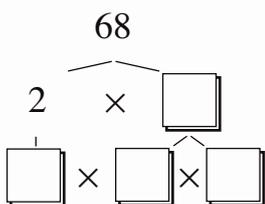
$120 = 2 \times 2 \times 2 \times 3 \times 5$

**b)** Express 105 as a product of prime numbers by completing the factor tree.



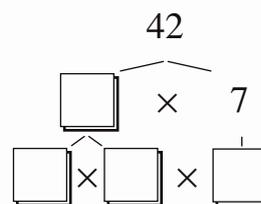
$105 = \dots\dots\dots$

**c)** Express 68 as a product of prime numbers by completing the factor tree.



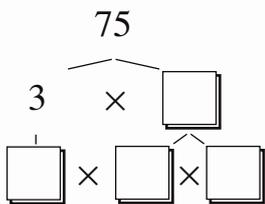
$68 = \dots\dots\dots$

**d)** Express 42 as a product of prime numbers by completing the factor tree.



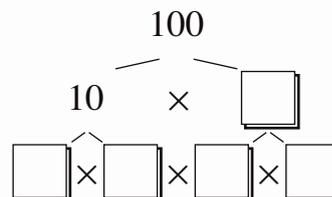
$42 = \dots\dots\dots$

**e)** Express 75 as a product of prime numbers by completing the factor tree.



$75 = \dots\dots\dots$

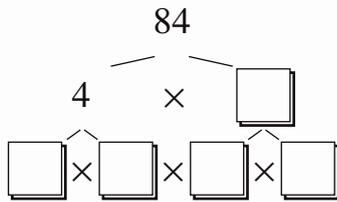
**f)** Express 100 as a product of prime numbers by completing the factor tree.



$100 = \dots\dots\dots$

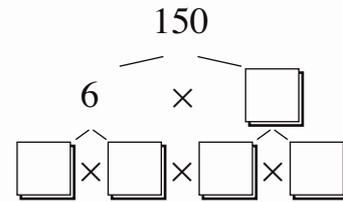
**Skill 18.8** Expressing a number as a product of its prime factors using a factor tree (2).

**g)** Express 84 as a product of prime numbers by completing the factor tree.



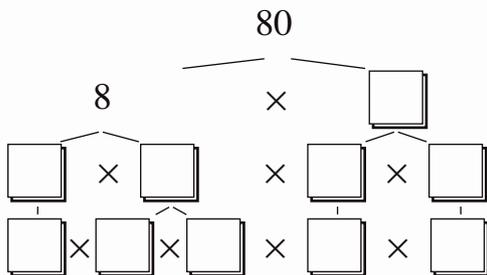
84 = .....

**h)** Express 150 as a product of prime numbers by completing the factor tree.



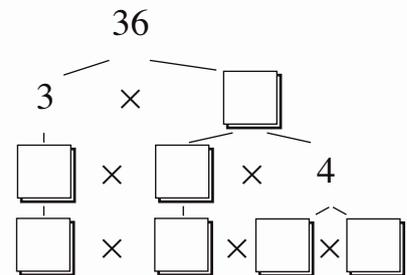
150 = .....

**i)** Express 80 as a product of prime numbers by completing the factor tree.



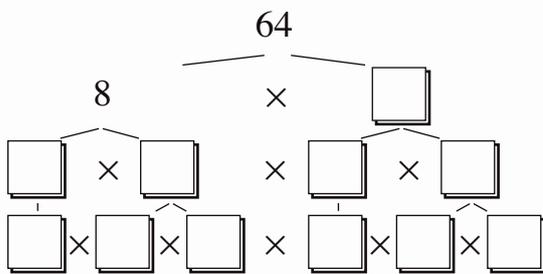
80 = .....

**j)** Express 36 as a product of prime numbers by completing the factor tree.



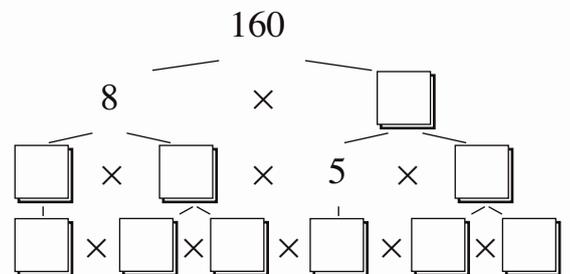
36 = .....

**k)** Express 64 as a product of prime numbers by completing the factor tree.



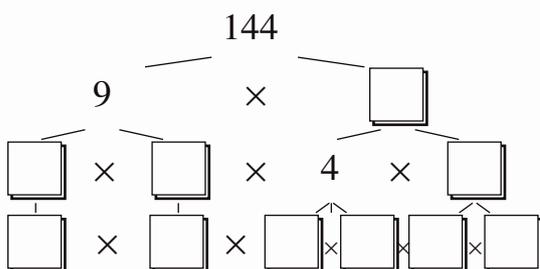
64 = .....

**l)** Express 160 as a product of prime numbers by completing the factor tree.



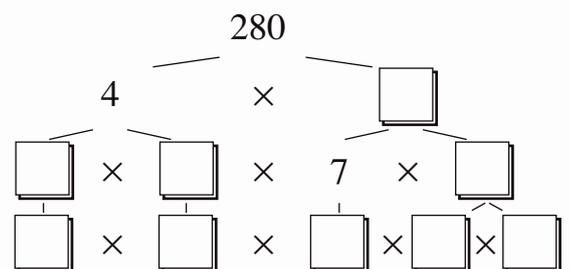
160 = .....

**m)** Express 144 as a product of prime numbers by completing the factor tree.



144 = .....

**n)** Express 280 as a product of prime numbers by completing the factor tree.



280 = .....

**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 337)  
Hints: All even numbers are divisible by 2  
All numbers ending in 0 are divisible by 10 ( $2 \times 5$ )

OR

- Use a factor tree. (see skill 18.8, page 158)

**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  
 $\Rightarrow 84 = 2 \times 2 \times 3 \times 7$

**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	

$110 = 2 \times 5 \times 11$

**b)** Express 65 as a product of its prime factors.

$65 \div$  .....

65	
----	--

$65 =$

**c)** List the prime factors of 69.

$69$  .....

69	
----	--

**d)** List the prime factors of 27.

.....

27	
----	--

**e)** Express 124 as a product of its prime factors.

.....

124	
-----	--

**f)** Express 198 as a product of its prime factors.

.....

198	
-----	--

**g)** Express 81 as a product of its prime factors.

.....

81	
----	--

**h)** Express 40 as a product of its prime factors.

.....

40	
----	--

**Skill 18.10** Expressing a number as a product of its prime factors using index notation.

- Express the number as a product of its prime factors. (see skill 18.8, page 158 and skill 18.9, page 160)
- Group like factors in ascending order.
- Use index notation to simplify like factors. (see skill 15.1, page 123)

**Q.** Express 126 as a product of its prime factors using index notation.

**A.**  $126 \div 2 = 63$  126 divides evenly by 2  $126 \begin{array}{l} \overline{) 2} \\ 63 \\ 21 \\ 7 \\ 1 \end{array}$

$63 \div 3 = 21$  21 divides evenly by 3

$21 \div 3 = 7$

$126 = 2 \times 3 \times 3 \times 7$

$\Rightarrow 126 = 2 \times 3^2 \times 7$

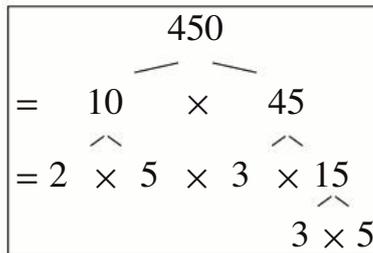
**a)** Express 450 as a product of its prime factors using index notation.

$450 = 10 \times 45$

$10 = 2 \times 5$

$45 = 3 \times 3 \times 5$

$450 = 2 \times 3 \times 3 \times 5 \times 5$



$450 = 2 \times 3^2 \times 5^2$

**b)** Express 200 as a product of its prime factors using index notation.

$200 \begin{array}{l} \overline{) 2} \\ 100 \\ 50 \\ 25 \\ 12 \\ 6 \\ 3 \end{array}$

.....

.....

.....

.....

$200 =$

**c)** Express 360 as a product of its prime factors using index notation.

.....

.....

.....

.....

$360 =$

**d)** Express 64 as a product of its prime factors using index notation.

.....

.....

.....

.....

$64 =$

**e)** Express 900 as a product of its prime factors using index notation.

.....

.....

.....

.....

$900 =$

**f)** Express 576 as a product of its prime factors using index notation.

.....

.....

.....

.....

$576 =$



# 19. [Number Patterns]

## Skill 19.1 Completing number patterns by adding the same number.

Blue 1 1 2 2 3 3 4 4  
Green 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,  ,  First note that

$$\begin{array}{c} \curvearrowright \quad \curvearrowright \quad \curvearrowright \\ +9 \quad +9 \quad +9 \end{array}$$

each term in the pattern is increasing. Then find by how much.

**Rule:** Add 9 to each term.

$$29 + 9 = 38$$

$$38 + 9 = 47$$

2, 11, 20, 29, **38, 47**

**a)** Complete the pattern:

0, 4, 8, 12,  ,

$$\begin{array}{c} \curvearrowright \quad \curvearrowright \quad \curvearrowright \quad \curvearrowright \\ +4 \quad +4 \quad +4 \quad +4 \end{array}$$

$$12 + 4 = 16, \quad 16 + 4 = 20$$

**b)** Complete the pattern:

1, 7, 13, 19,  ,

$$\begin{array}{c} \curvearrowright \quad \curvearrowright \quad \curvearrowright \quad \curvearrowright \\ +6 \quad +6 \quad +6 \quad +6 \end{array}$$

**c)** Complete the pattern:

4, 9, 14, 19, 24,  ,

**d)** Complete the pattern:

8, 10, 12, 14,  ,

**e)** Complete the pattern:

5, 9, 13, 17,  ,

**f)** Complete the pattern:

2, 10, 18, 26, 34,  ,

**g)** Complete the pattern:

3, 11, 19, 27,  ,

**h)** Complete the pattern:

2, 9, 16, 23,  ,

**i)** Complete the pattern:

2, 13, 24, 35,  ,

**j)** Complete the pattern:

5, 14, 23, 32,  ,

## Skill 19.2 Completing number patterns by subtracting the same number.

Blue 1 1 2 2 3 3 4 4  
Green 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:

60, 54, 48, 42,

**A.** 60, 54, 48, 42, \_\_\_, \_\_\_

$\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \\ -6 & -6 & -6 & \end{array}$

**Rule:** Subtract 6 from each term.

$$42 - 6 = 36$$

$$36 - 6 = 30$$

60, 54, 48, 42, **36, 30**

First note that each term in the pattern is decreasing. Then find by how much.

**a)** Complete the pattern:

50, 46, 42, 38,

$\begin{array}{ccccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & & \curvearrowright & \\ -4 & -4 & -4 & -4 & & -4 & \end{array}$

$$38 - 4 = 34, \quad 34 - 4 = 30$$

**b)** Complete the pattern:

16, 14, 12, 10, 8,

$\begin{array}{ccccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ -2 & -2 & -2 & -2 & -2 & -2 & \end{array}$

**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:

85, 76, 67, 58, 49,

**h)** Complete the pattern:

38, 31, 24, 17,

**i)** Complete the pattern:

72, 62, 52, 42,

**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:

0.6, 1, 1.4, 1.8,  ,

**A.** 0.6 , 1 , 1.4 , 1.8 ,  ,

$+0.4 +0.4 +0.4$

**Rule:** Add 0.4 to each term.

$1.8 + 0.4 = 2.2$

$2.2 + 0.4 = 2.6$

0.6 , 1 , 1.4 , 1.8 , **2.2** , **2.6**

First note that each term in the pattern is increasing. Then find by how much.

**a)** Complete the pattern:

0.2, 0.5, 0.8, 1.1,  ,

$+0.3 +0.3 +0.3+0.3 +0.3$

$1.1 + 0.3 = 1.4$ ,  $1.4 + 0.3 = 1.7$

**b)** Complete the pattern:

5.6, 5.0, 4.4, 3.8,  ,

$-0.6 -0.6 -0.6 -0.6 -0.6$

**c)** Complete the pattern:

1.5, 1.7, 1.9, 2.1, 2.3,  ,

**d)** Complete the pattern:

1, 1.5, 2, 2.5,  ,

**e)** Complete the pattern:

1.3, 2.0, 2.7, 3.4,  ,

**f)** Complete the pattern:

2.7, 2.4, 2.1, 1.8,  ,

**g)** Complete the pattern:

5, 4.6, 4.2, 3.8,  ,

**h)** Complete the pattern:

1, 2.1, 3.2, 4.3,  ,

**i)** Complete the pattern:

0.8, 1.4, 2, 2.6,  ,

**j)** Complete the pattern:

2.9, 2.5, 2.1, 1.7,  ,

**Skill 19.4** Completing number patterns by adding or subtracting fractions. Blue 11 22 33 44  
Green 11 22 33 44

- 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:

$$\frac{2}{9}, \frac{3}{9}, \frac{4}{9}, \frac{5}{9}, \boxed{\quad, \quad}$$

**A.**  $\frac{2}{9}, \frac{3}{9}, \frac{4}{9}, \frac{5}{9}, \quad, \quad$

$$\begin{array}{c} \curvearrowright \quad \curvearrowright \quad \curvearrowright \\ +\frac{1}{9} \quad +\frac{1}{9} \quad +\frac{1}{9} \end{array}$$

First note that each numerator in the pattern is increasing. Then find by how much.

**Rule:** Add  $\frac{1}{9}$  to each term.

$$\frac{5}{9} + \frac{1}{9} = \frac{6}{9}$$

$$\frac{6}{9} + \frac{1}{9} = \frac{7}{9}$$

$$\frac{2}{9}, \frac{3}{9}, \frac{4}{9}, \frac{5}{9}, \frac{6}{9}, \frac{7}{9}$$

**a)** Complete the pattern:

$$\frac{1}{7}, \frac{3}{7}, \frac{5}{7}, \frac{7}{7}, \boxed{\frac{9}{7}, \frac{11}{7}}$$

$$\begin{array}{c} \curvearrowright \quad \curvearrowright \quad \curvearrowright \\ +\frac{2}{7} \quad +\frac{2}{7} \quad +\frac{2}{7} \end{array}$$

$$\frac{7}{7} + \frac{2}{7} = \frac{9}{7}$$

$$\frac{9}{7} + \frac{2}{7} = \frac{11}{7}$$

**b)** Complete the pattern:

$$\frac{2}{8}, \frac{5}{8}, \frac{8}{8}, \frac{11}{8}, \boxed{\quad, \quad}$$

$$\begin{array}{c} \curvearrowright \\ +\frac{3}{8} \end{array}$$

**c)** Complete the pattern:

$$\frac{2}{11}, \frac{5}{11}, \frac{8}{11}, \frac{11}{11}, \boxed{\quad, \quad}$$

**d)** Complete the pattern:

$$\frac{34}{10}, \frac{31}{10}, \frac{28}{10}, \frac{25}{10}, \boxed{\quad, \quad}$$

**e)** Complete the pattern:

$$\frac{41}{11}, \frac{39}{11}, \frac{37}{11}, \frac{35}{11}, \boxed{\quad, \quad}$$

**f)** Complete the pattern:

$$\frac{25}{12}, \frac{23}{12}, \frac{21}{12}, \frac{19}{12}, \boxed{\quad, \quad}$$

**g)** Complete the pattern:

$$\frac{40}{9}, \frac{35}{9}, \frac{30}{9}, \frac{25}{9}, \boxed{\quad, \quad}$$

**h)** Complete the pattern:

$$\frac{33}{15}, \frac{29}{15}, \frac{25}{15}, \frac{21}{15}, \boxed{\quad, \quad}$$

**Skill 19.5** Completing number patterns in table format by adding the same number.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- 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

No. of floors	2	3	4	5	6
No. 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

No. of floors	2	3	4	5	6
No. 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

No. of days	1	2	3	4	5	6
Length of worms (m)	4	8	12			

**d)** Complete the table:

Children (9 - 13)

calories (hundreds)	17	34			85
days	1	2	3	4	5

**e)** Complete the table:

Rent

No. of bedrooms	1	2	3	4	5
Cost per week (\$)	200		350	425	

**f)** Complete the table:

Shark teeth regeneration (thousands)

No. 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:

Blinks per minute

men	1	2	3	4	5	6
women	2	4	6			12

## Skill 19.6 Completing number patterns by multiplying by the same number.

Blue 11 2 2 33 44  
Green 11 2 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:

$$\frac{1}{8}, \frac{1}{4}, \frac{1}{2}, 1, 2, \boxed{\quad, \quad}$$

**A.**  $\frac{1}{8}, \frac{1}{4}, \frac{1}{2}, 1, 2, \underline{\quad}, \underline{\quad}$

$\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ \times 2 & \times 2 & \times 2 & \times 2 \end{array}$

First note that each term in the pattern is increasing. Then find by how much.

**Rule:** Multiply each term by 2

$$2 \times 2 = 4$$

$$4 \times 2 = 8$$

$$\frac{1}{8}, \frac{1}{4}, \frac{1}{2}, 1, 2, 4, 8$$

**a)** Complete the pattern:

$$1, 4, 16, 64, \boxed{256, 1024}$$

$\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ \times 4 & \times 4 & \times 4 & \times 4 \end{array}$

$$64 \times 4 = 256, \quad 256 \times 4 = 1024$$

**b)** Complete the pattern:

$$3, 9, 27, 81, \boxed{\quad, \quad}$$

$\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright \\ \times 3 & \times 3 & \times 3 & \times 3 \end{array}$

**c)** Complete the pattern:

$$5, 10, 20, 40, \boxed{\quad, \quad}$$

**d)** Complete the pattern:

$$2, 10, 50, 250, \boxed{\quad, \quad}$$

**e)** Complete the pattern:

$$0.375, 0.75, 1.5, 3, \boxed{\quad, \quad}$$

**f)** Complete the pattern:

$$\frac{7}{100}, \frac{7}{10}, 7, 70, \boxed{\quad, \quad}$$

**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:

$$\frac{5}{36}, \frac{5}{6}, 5, 30, \boxed{\quad, \quad}$$

## Skill 19.7 Completing number patterns by dividing by the same number.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- 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,  ,

$$\begin{array}{cccc} \curvearrowright & \curvearrowright & \curvearrowright & \\ \div 2 & \div 2 & \div 2 & \end{array}$$

First note that each term in the pattern is decreasing. Then find by how much.

**Rule:** Divide each term by 2.

$$80 \div 2 = 40$$

$$40 \div 2 = 20$$

640, 320, 160, 80, **40**, **20**

**a)** Complete the pattern:

20 000, 4000, 800, 160,  ,

$$\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ \div 5 & \end{array}$$

$$160 \div 5 = 32, \quad 32 \div 5 = \frac{32}{5}$$

**b)** Complete the pattern:

1024, 256, 64, 16,  ,

$$\begin{array}{cccccc} \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \curvearrowright & \\ \div 4 & \end{array}$$

**c)** Complete the pattern:

1458, 486, 162, 54,  ,

**d)** Complete the pattern:

2400, 1200, 600, 300,  ,

**e)** Complete the pattern:

1000, 100, 10, 1, 0.1,  ,

**f)** Complete the pattern:

729, 243, 81, 27,  ,

**g)** Complete the pattern:

14.4, 7.2, 3.6, 1.8,  ,

**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 19.8 Completing number patterns by using changing values in the rule.

Blue 11 22 34  
Green 11 23 44

- 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:

4, 8, 16, 28, 44,

**A.** 4, 8, 16, 28, 44,  First note

$+4$   $+8$   $+12$   $+16$

that each term in the pattern is increasing. Then find by how much.

**Rule:** Add 4 then 8 then 12 etc. to each term.

(i.e. consecutive multiples of 4)

$$44 + 20 = 64$$

$$64 + 24 = 88$$

4, 8, 16, 28, 44, **64, 88**

**a)** Complete the pattern:

18, 20, 24, 30, 38,

$+2$   $+4$   $+6$   $+8$   $+10$   $+12$

$$38 + 10 = 48, \quad 48 + 12 = 60$$

**b)** Complete the pattern:

72, 60, 50, 42, 36,

$-12$   $-10$   $-8$   $-6$   $-?$   $-?$

**c)** Complete the pattern:

49, 46, 40, 31,

**d)** Complete the pattern:

2, 2, 3, 5, 8, 12,

**e)** Complete the pattern:

14, 13, 10, 9, 6,

**f)** Complete the pattern:

1, 3, 7, 9, 13,

**g)** Complete the pattern:

2, 5, 11, 20, 32,

**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 19.9** 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:

$$3, -1, -5, -9, \boxed{\quad, \quad}$$

**A.**  $3, -1, -5, -9, \quad, \quad$

$$\begin{array}{ccccccc} 3 & , & -1 & , & -5 & , & -9 & , & \quad & , & \quad \\ & & \curvearrowright & & \curvearrowright & & \curvearrowright & & & & \\ & & -4 & & -4 & & -4 & & & & \end{array}$$

**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:

$$29, 21, 13, 5, -3, \boxed{-11, -19}$$

$$\begin{array}{ccccccccc} & \curvearrowright & \\ & -8 & & -8 & & -8 & & -8 & & -8 & \end{array}$$

$$-3 - 8 = -11, \quad -11 - 8 = -19$$

**b)** Complete the pattern:

$$-16, -12, -8, -4, \boxed{\quad, \quad}$$

$$\begin{array}{ccccccccc} & \curvearrowright & \\ & +4 & & +4 & & +4 & & +4 & & +4 & \end{array}$$

**c)** Complete the pattern:

$$-21, -15, -9, -3, \boxed{\quad, \quad}$$

**d)** Complete the pattern:

$$5, 2, -1, -4, \boxed{\quad, \quad}$$

**e)** Complete the pattern:

$$13, 8, 3, -2, \boxed{\quad, \quad}$$

**f)** Complete the pattern:

$$-13, -7, -1, 5, \boxed{\quad, \quad}$$

**g)** Complete the pattern:

$$17, 8, -1, -10, \boxed{\quad, \quad}$$

**h)** Complete the pattern:

$$-23, -16, -9, -2, \boxed{\quad, \quad}$$

**i)** Complete the pattern:

$$7, 3, -1, -5, \boxed{\quad, \quad}$$

**j)** Complete the pattern:

$$-23, -15, -7, 1, \boxed{\quad, \quad}$$

EITHER

- Find the terms in order until you get to the required 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	$6 \times 1 + 2$	$6 \times 2 + 2$	$6 \times 3 + 2$	$6 \times 4 + 2$		$6 \times 8 + 2$

Relationship: 6 times the term number + 2

The 8th term of the pattern is  $6 \times 8 + 2 = 50$

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	$2 \times 1 - 1$	$2 \times 2 - 1$	$2 \times 3 - 1$	$2 \times 4 - 1$		$2 \times 14 - 1$

Relationship: 2 times the term number - 1

The 14th term of the pattern is  $2 \times 14 - 1 = 27$

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 30th term in the pattern:

4, 8, 12, 16, 20, ...

term number	1	2	3	4	....	30
pattern	4	8	12	16		?
relationship						

Relationship:

The 30th term of the pattern is

d) Find the 20th term in the pattern:

6, 12, 18, 24, 30, ...

term number	1	2	3	4	....	20
pattern	6	12	18	24		?
relationship						

Relationship:

The 20th term of the pattern is

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 19.11** Finding a particular term of a sequence given its general rule.

Blue 11 22 33 44  
Green 11 22 33 44

- 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 ( $n = 10$ ).

$$\begin{aligned} & n - 4 \\ = & 10 - 4 = \boxed{6} \end{aligned}$$

**b)** If the general rule of a pattern is  $n + 5$  find the 20th term ( $n = 20$ ).

$$\begin{aligned} & n + 5 \\ = & \dots = \boxed{\phantom{00}} \end{aligned}$$

**c)** If the general rule of a pattern is  $n - 8$  find the 13th term ( $n = 13$ ).

$$\begin{aligned} & \dots \\ = & \dots = \boxed{\phantom{00}} \end{aligned}$$

**d)** If the general rule of a pattern is  $n + 8$  find the 16th term ( $n = 16$ ).

$$\begin{aligned} & \dots \\ = & \dots = \boxed{\phantom{00}} \end{aligned}$$

**e)** If the general rule of a pattern is  $2n + 1$  find the 20th term ( $n = 20$ ).

$$\begin{aligned} & \dots \\ = & \dots = \boxed{\phantom{00}} \end{aligned}$$

**f)** If the general rule of a pattern is  $50 - 5n$  find the 6th term ( $n = 6$ ).

$$\begin{aligned} & \dots \\ = & \dots = \boxed{\phantom{00}} \end{aligned}$$

**g)** If the general rule of a pattern is  $5n + 7$  find the 9th term ( $n = 9$ ).

$$\begin{aligned} & \dots \\ = & \dots = \boxed{\phantom{00}} \end{aligned}$$

**h)** If the general rule of a pattern is  $14 - 2n$  find the 6th term ( $n = 6$ ).

$$\begin{aligned} & \dots \\ = & \dots = \boxed{\phantom{00}} \end{aligned}$$

**i)** If the general rule of a pattern is  $n^2 + 1$  find the 10th term ( $n = 10$ ).

$$\begin{aligned} & \dots \\ = & \dots = \boxed{\phantom{00}} \end{aligned}$$

**j)** If the general rule of a pattern is  $n^2 + 6$  find the 8th term ( $n = 8$ ).

$$\begin{aligned} & \dots \\ = & \dots = \boxed{\phantom{00}} \end{aligned}$$

## 20. [Expressions]

**Skill 20.1** Simplifying expressions by adding and subtracting like terms (coefficient = 1).

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Add or subtract, as instructed, all like terms. (see Glossary, page 346)
- In your answer, write the coefficient (number) first followed by the variable (letter) (see glossary, pages 330 and 375)

Hint: In the term  $m$ , 1 is the coefficient:  $m = 1 \times m$

**Q.** Simplify  
 $kl + kl + kl - kl + kl$

**A.**  $kl + kl + kl \rightarrow \cancel{kl} + \cancel{kl}$  cancel first  
 $= 3kl$

coefficient first

**a)** Simplify  
 $n + n + n + n$

$4n$

**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  
 $m - m + m + m$

**i)** Simplify  
 $e + e - e + e$

**j)** Simplify  
 $k + k + k + k - k - k$

**k)** Simplify  
 $p + p - p - p + p$

**l)** Simplify  
 $d + d + d - d - d + d$

**m)** Simplify  
 $ab + ab$

**n)** Simplify  
 $pq + pq + pq$

**o)** Simplify  
 $fg + fg + fg + fg$

**p)** Simplify  
 $xy + xy + xy + xy$

**q)** Simplify  
 $tu + tu + tu + tu + tu$

**r)** Simplify  
 $lm - lm + lm + lm$

**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  $\geq 1$ ).

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Add or subtract the coefficients (numbers) first.
- Write the variable (letters) next.

Hint: In the term  $m$ , 1 is the coefficient:  $m = 1 \times m$

**Q.** Simplify  
 $7b - 2b + b$

**A.**  $7b - 2b + b$   
 $= 5b + b$   
 $= 6b$

<p>a) Simplify <math>3m + 2m</math></p> <p><i>coefficient first</i> <span style="border: 1px solid black; padding: 2px;"><math>5m</math></span></p>	<p>b) Simplify <math>2h + 4h</math></p> <p><span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>	<p>c) Simplify <math>3g + 4g</math></p> <p><span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>
<p>d) Simplify <math>3j + j</math></p> <p><span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>	<p>e) Simplify <math>z + 5z</math></p> <p><span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>	<p>f) Simplify <math>8b - 6b</math></p> <p><span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>
<p>g) Simplify <math>5q - q</math></p> <p><span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>	<p>h) Simplify <math>5a - 4a</math></p> <p><span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>	<p>i) Simplify <math>3k - k</math></p> <p><span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>
<p>j) Simplify <math>r + 2r + r</math></p> <p><math>= 3r + r</math></p> <p><math>=</math> <span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>	<p>k) Simplify <math>f + 2f + 4f</math></p> <p><math>=</math> <span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>	<p>l) Simplify <math>3a + a + 2a</math></p> <p><math>=</math> <span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>
<p>m) Simplify <math>z + z + 9z</math></p> <p><math>=</math> <span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>	<p>n) Simplify <math>4m + 2m + m</math></p> <p><math>=</math> <span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>	<p>o) Simplify <math>h + 5h + 3h</math></p> <p><math>=</math> <span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>
<p>p) Simplify <math>j - j + 5j</math></p> <p><math>=</math> <span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>	<p>q) Simplify <math>2c + 2c - c</math></p> <p><math>=</math> <span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>	<p>r) Simplify <math>s + 6s - s</math></p> <p><math>=</math> <span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>
<p>s) Simplify <math>op + 5op</math></p> <p><math>=</math> <span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>	<p>t) Simplify <math>4xy - 3xy</math></p> <p><math>=</math> <span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>	<p>u) Simplify <math>7kl - kl</math></p> <p><math>=</math> <span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>
<p>v) Simplify <math>5mn + 2mn</math></p> <p><math>=</math> <span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>	<p>w) Simplify <math>2ij - ij</math></p> <p><math>=</math> <span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>	<p>x) Simplify <math>9bc - 3bc</math></p> <p><math>=</math> <span style="border: 1px solid black; display: inline-block; width: 40px; height: 20px;"></span></p>

- 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, altogether, in total, more than”  $\Rightarrow$  addition  $\Rightarrow +$   
 “Difference, less than, change”  $\Rightarrow$  subtraction  $\Rightarrow -$   
 “Product, times, lots of”  $\Rightarrow$  multiplication  $\Rightarrow \times$

**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 14

*and*  $\Rightarrow +$   $\Rightarrow$   $n + 14$

**b)** Write as an expression:  
 The sum of  $b$  and  $c$

$\Rightarrow$

**c)** Write as an expression:  
 The sum of 7 and  $g$

$\Rightarrow$

**d)** Write as an expression:  
 A number that is equal to  $x$  more than  $y$

$\Rightarrow$

**e)** Write as an expression:  
 A number that is equal to 9 less than  $w$

$\Rightarrow$

**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 three times  $m$

$\Rightarrow$

**h)** Write as an expression:  
 A number that is equal to two times  $d$

$\Rightarrow$

**i)** Write as an expression:  
 A number that is equal to twice as much as  $d$

$\Rightarrow$

**j)** Write as an expression:  
 A number that is equal to three times as much as  $m$

$\Rightarrow$

**k)** Write as an expression:  
 The product of eleven and  $p$

$\Rightarrow$

**l)** Write as an expression:  
 The product of seven and  $z$

$\Rightarrow$

- m) A person grows 2 cm every year for  $y$  years. How much did he grow?

.....  $\Rightarrow$

- n) A tree grew 4 cm every year for  $b$  years. How much did it grow?

.....  $\Rightarrow$

- o) There are  $a$  local and  $b$  imported products at the supermarket. How many products are there altogether?

.....  $\Rightarrow$

- p) Mia's health insurance payment is  $m$  dollars per month. How much does this cost in six months?

.....  $\Rightarrow$

- q) Fiona spent  $d$  dollars from her \$400 monthly allowance. How much does she have left for the rest of the month?

.....  $\Rightarrow$

- r) In a store a \$200 ring is discounted by  $r$  dollars. What is the sale price of the ring?

.....  $\Rightarrow$

- s) Isabelle handed  $x$  dollars to the checkout when she purchased a \$70 game. How much change did she receive?

.....  $\Rightarrow$

- t) There are  $h$  hours left until the plane's departure from Perth. The trip from Perth to Sydney takes 5 hours. How many hours are left until the plane's arrival to Sydney?

.....  $\Rightarrow$

- u) A shop makes \$15 profit for each school bag sold. Which expression shows the profit for  $x$  bags sold?

- A)  $15 + x$   
B)  $15 \times x$   
C)  $x - 15$

.....  $\Rightarrow$

- v) To hire a taxi you pay a start fee of \$7 and then \$4.50 for each kilometre. If you travel for  $g$  km, which expression shows the total taxi fee?

- A)  $7 + 4.5 \times g$   
B)  $4.5 + 7 \times g$   
C)  $7 \times 4.5 + g$

.....  $\Rightarrow$

- w) An adult aquarium entry ticket is \$40, and a child ticket is \$30. Which expression shows the total cost for  $c$  adults and  $d$  children?

- A)  $30 \times c + 40 \times d$   
B)  $40 \times c + 30 \times d$   
C)  $40 \times c + 40 \times d$

.....  $\Rightarrow$

- x) Hannah is  $x$  years old, and Tegan is  $y$  years old. If Hannah is 2 years older than Tegan, which expression shows this?

- A)  $x + y = 2$   
B)  $x - y = 2$   
C)  $y - x = 2$

.....  $\Rightarrow$

## Skill 20.4 Finding like terms.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Look at the combination of letters in all terms.
- Find the **like terms**, which use the same combination of letters.

Example:  $4c$  and  $c$   
 $gh$  and  $3gh$  like 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:  
 $4a^2, 4a, a$

**j)** Choose the like terms:  
 $cd, 2d, 2c, 2cd$

**k)** Choose the like terms:  
 $3v, 2w, 3vw, w$

**l)** Choose the like terms:  
 $5h, 2g, 5g, 5$

**m)** Choose the like terms:  
 $-x, 3y, 3x, -3$

**n)** Choose the like terms:  
 $4y, -y, 4z, -4$

**o)** Choose the like terms:  
 $-p, 2q - pq, 2pq$

**p)** Choose the like terms:  
 $n, 3o, 2no, no$

**q)** Choose the like terms:  
 $3j, 3k, -jk, -3j$

**r)** Choose the like terms:  
 $3st, s, 4t, st$

## Skill 20.5 Simplifying expressions by first grouping like terms.

Blue 11 22 33 44  
Green 11 22 33 44

- Group like terms. (see skill 20.3, page 177)
  - 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  
 $d + e + d$

$= \dots = \boxed{\phantom{2s + r}}$

**c)** Simplify  
 $h + i + h$

$= \dots = \boxed{\phantom{2s + r}}$

**d)** Simplify  
 $a + b + b + a$

$= \dots = \boxed{\phantom{2s + r}}$

**e)** Simplify  
 $l + m + l + m$

$= \dots = \boxed{\phantom{2s + r}}$

**f)** Simplify  
 $r + r + r + s$

$= \dots = \boxed{\phantom{2s + r}}$

**g)** Simplify  
 $y + x + x + y + y$

$= \dots = \boxed{\phantom{2s + r}}$

**h)** Simplify  
 $e + f + e + f + e$

$= \dots = \boxed{\phantom{2s + r}}$

**i)** Simplify  
 $m + m + n - m + n$

$= \dots = \boxed{\phantom{2s + r}}$

**j)** Simplify  
 $t + u + u - t + t$

$= \dots = \boxed{\phantom{2s + r}}$

**k)** Simplify  
 $jk + jk + kl - jk + kl$

$= \dots = \boxed{\phantom{2s + r}}$

**l)** Simplify  
 $rs - rs + qr + qr + rs$

$= \dots = \boxed{\phantom{2s + r}}$

**m)** Simplify  
 $cd - de + de + de + cd$

$= \dots = \boxed{\phantom{2s + r}}$

**n)** Simplify  
 $4h + 3i + h - 2i$

$= \dots = \boxed{\phantom{2s + r}}$

**o)** Simplify  
 $5j + 3k - 2j + 2k$

$= \dots = \boxed{\phantom{2s + r}}$

**p)** Simplify  
 $6g + 4 - 2g - 1$

$= \dots = \boxed{\phantom{2s + r}}$

**q)** Simplify  
 $7l + 5 - 3l - 4$

$= \dots = \boxed{\phantom{2s + r}}$

**r)** Simplify  
 $4x + 2y - y - 3x$

$= \dots = \boxed{\phantom{2s + r}}$

**s)** Simplify  
 $4q + p + 2q + 4p$

$= \dots = \boxed{\phantom{2s + r}}$

**t)** Simplify  
 $5b + 2a - 3b + a$

$= \dots = \boxed{\phantom{2s + r}}$

**u)** Simplify  
 $j + 4k + 2j - 2k$

$= \dots = \boxed{\phantom{2s + r}}$

# 21. [Substitution]

## Skill 21.1 Substituting one value into expressions involving + and -

Blue 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Replace the letter (variable) with the given value.
- Add (+) and/or subtract (-) from left to right.

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

$$\begin{aligned} \text{A. } 13 - a & \text{ — substitute } a = 5 \\ & = 13 - 5 \\ & = 8 \end{aligned}$$

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

$$= 5 + 2 = \boxed{7}$$

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

$$= \dots = \boxed{\phantom{00}}$$

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

$$= \dots = \boxed{\phantom{00}}$$

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

$$= \dots = \boxed{\phantom{00}}$$

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

$$= \dots = \boxed{\phantom{00}}$$

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

$$= \dots = \boxed{\phantom{00}}$$

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

$$= \dots = \boxed{\phantom{00}}$$

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

$$= \dots = \boxed{\phantom{00}}$$

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

$$= \dots = \boxed{\phantom{00}}$$

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

$$= \dots = \boxed{\phantom{00}}$$

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

$$= \dots = \boxed{\phantom{00}}$$

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

$$= \dots = \boxed{\phantom{00}}$$

**m)** If  $w = 5$ , find the value of  $2w - 7$

$$= \dots = \boxed{\phantom{00}}$$

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

$$= \dots = \boxed{\phantom{00}}$$

**o)** If  $m = 2$ , find the value of  $4 + m + 3m$

$$= \dots = \boxed{\phantom{00}}$$

**p)** If  $a = 6$ , find the value of  $4a - 9$

$$= \dots = \boxed{\phantom{00}}$$

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

$$= \dots = \boxed{\phantom{00}}$$

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

$$= \dots = \boxed{\phantom{00}}$$

## Skill 21.2 Substituting one value into expressions involving $\times$ and $\div$

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Replace the letter (variable) with the given value.
- Multiply ( $\times$ ) and/or divide ( $\div$ ) from left to right.

**Q.** If  $m = 4$ , find the value of  $6m$

$$\begin{aligned} \text{A. } 6m & \quad \text{substitute } m = 4 \\ & = 6 \times \\ & 4 \end{aligned}$$

**a)** If  $a = 6$ , find the value of  $9 \times a$

$$= 9 \times 6 = \boxed{54}$$

**b)** If  $n = 4$ , find the value of  $3 \times n$

$$= \dots = \boxed{\phantom{00}}$$

**c)** If  $y = 5$ , find the value of  $2 \times y$

$$= \dots = \boxed{\phantom{00}}$$

**d)** If  $w = 7$ , find the value of  $w \times 3$

$$= \dots = \boxed{\phantom{00}}$$

**e)** If  $p = 8$ , find the value of  $4 \times p$

$$= \dots = \boxed{\phantom{00}}$$

**f)** If  $z = 6$ , find the value of  $7 \times z$

$$= \dots = \boxed{\phantom{00}}$$

**g)** If  $b = 10$ , find the value of  $3b$

$$= \dots = \boxed{\phantom{00}}$$

**h)** If  $h = 2$ , find the value of  $9h$

$$= \dots = \boxed{\phantom{00}}$$

**i)** If  $n = 5$ , find the value of  $7n$

$$= \dots = \boxed{\phantom{00}}$$

**j)** If  $m = 32$ , find the value of  $m \div 4$

$$= \dots = \boxed{\phantom{00}}$$

**k)** If  $n = 7$ , find the value of  $42 \div n$

$$= \dots = \boxed{\phantom{00}}$$

**l)** If  $t = 8$ , find the value of  $48 \div t$

$$= \dots = \boxed{\phantom{00}}$$

**m)** If  $d = 9$ , find the value of  $81 \div d$

$$= \dots = \boxed{\phantom{00}}$$

**n)** If  $p = 8$ , find the value of  $64 \div p$

$$= \dots = \boxed{\phantom{00}}$$

**o)** If  $i = 6$ , find the value of  $42 \div i$

$$= \dots = \boxed{\phantom{00}}$$

**p)** If  $m = 7$ , find the value of  $56 \div m$

$$= \dots = \boxed{\phantom{00}}$$

**q)** If  $c = 40$ , find the value of  $\frac{c}{5}$

$$= \dots = \boxed{\phantom{00}}$$

**r)** If  $w = 9$ , find the value of  $\frac{108}{w}$

$$= \dots = \boxed{\phantom{00}}$$

### Skill 21.3 Substituting one value into expressions involving +, -, × and ÷

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Replace the letter (variable) with the given value.
- 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  $q = 8$   
 $= 4 \times 8 + 2$   
 $= 32 + 2$   
 $= 34$

**a)** If  $w = 6$ , find the value of  $20 - 3w$

$= 20 - 3 \times 6$  Do × first  
 $= 20 - 18 = \boxed{2}$

**b)** If  $x = 2$ , find the value of  $5x + 1$

$=$   
 $=$   $\boxed{\phantom{00}}$

**c)** If  $m = 3$ , find the value of  $2 + 3m$

$=$   
 $=$   $\boxed{\phantom{00}}$

**d)** If  $x = 5$ , find the value of  $12 + 5x$

$=$   
 $=$   $\boxed{\phantom{00}}$

**e)** If  $a = 4$ , find the value of  $6 + 4a$

$=$   
 $=$   $\boxed{\phantom{00}}$

**f)** If  $b = 7$ , find the value of  $2b + 9$

$=$   
 $=$   $\boxed{\phantom{00}}$

**g)** If  $s = 3$ , find the value of  $7 + 11s$

$=$   
 $=$   $\boxed{\phantom{00}}$

**h)** If  $v = 4$ , find the value of  $9v - 8$

$=$   
 $=$   $\boxed{\phantom{00}}$

**i)** If  $p = 9$ , find the value of  $2p - 12$

$=$   
 $=$   $\boxed{\phantom{00}}$

**j)** If  $k = 7$ , find the value of  $35 - 4k$

$=$   
 $=$   $\boxed{\phantom{00}}$

**k)** If  $w = 2$ , find the value of  $8w - 5$

$=$   
 $=$   $\boxed{\phantom{00}}$

**l)** If  $v = 4$ , find the value of  $25 - 5v$

$=$   
 $=$   $\boxed{\phantom{00}}$

**m)** If  $n = 6$ , find the value of  $\frac{n+21}{3}$

$=$   
 $=$   $\boxed{\phantom{00}}$

**n)** If  $s = 3$ , find the value of  $\frac{s+4}{7}$

$=$   
 $=$   $\boxed{\phantom{00}}$

**o)** If  $c = 3$ , find the value of  $\frac{19-c}{4}$

$=$   
 $=$   $\boxed{\phantom{00}}$

## Skill 21.4 Substituting negative values into expressions.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Replace the letter (variable) with the given value.
- First multiply ( $\times$ ) 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 104 to 107)

**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  $19 + e$

$$= 19 + (-12) = \boxed{7}$$

**b)** If  $y = -3$ , find the  
value of  $9y$

$$= \dots = \boxed{\phantom{00}}$$

**c)** If  $c = -4$ , find the  
value of  $4c$

$$= \dots = \boxed{\phantom{00}}$$

**d)** If  $m = -6$ , find the  
value of  $m + 5$

$$= \dots = \boxed{\phantom{00}}$$

**e)** If  $y = -7$ , find the  
value of  $10 - y$

$$= \dots = \boxed{\phantom{00}}$$

**f)** If  $h = -6$ , find the  
value of  $8 + h$

$$= \dots = \boxed{\phantom{00}}$$

**g)** If  $j = -2$ , find the  
value of  $8 - j$

$$= \dots = \boxed{\phantom{00}}$$

**h)** If  $v = -8$ , find the  
value of  $v - 5$

$$= \dots = \boxed{\phantom{00}}$$

**i)** If  $b = -5$ , find the  
value of  $7 + b$

$$= \dots = \boxed{\phantom{00}}$$

**j)** If  $b = -9$ , find the  
value of  $4b$

$$= \dots = \boxed{\phantom{00}}$$

**k)** If  $k = -3$ , find the  
value of  $-8k$

$$= \dots = \boxed{\phantom{00}}$$

**l)** If  $i = -6$ , find the  
value of  $-5i$

$$= \dots = \boxed{\phantom{00}}$$

**m)** If  $a = -12$ , find the  
value of  $\frac{a}{4}$

$$= \dots = \boxed{\phantom{00}}$$

**n)** If  $x = -18$ , find the  
value of  $\frac{x}{6}$

$$= \dots = \boxed{\phantom{00}}$$

**o)** If  $c = -32$ , find the  
value of  $\frac{c}{8}$

$$= \dots = \boxed{\phantom{00}}$$

**p)** If  $s = -4$ , find the  
value of  $2 + 3s$

$$= \dots = \boxed{\phantom{00}}$$

**q)** If  $q = -3$ , find the  
value of  $7q - 5$

$$= \dots = \boxed{\phantom{00}}$$

**r)** If  $x = -9$ , find the  
value of  $4d + 10$

$$= \dots = \boxed{\phantom{00}}$$

**Skill 21.5** Substituting two values into expressions involving + and -

Blue 11 22 33 44  
Green 11 22 33 44

- Substitute each letter (variable) with the given value.
- Add (+) and/or subtract (-) from left to right.
- Determine the sign of the result. (see skills 13.7 to 13.10, pages 104 to 107)

**Q.** If  $a = 8$  and  $b = -5$ ,  
find the value of  $a + b$

**A.**  $a + b$       substitute  $a = 8$  and  $b = -5$   
 $= 8 + (-5)$   
 $= 3$

**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  $d = 14$  and  $e = 9$ ,  
find the value of  $e + d$

$=$  .....  $=$

**h)** If  $n = 5$  and  $o = 8$ ,  
find the value of  $n - o$

$=$  .....  $=$

**i)** If  $x = 5$  and  $y = 15$ ,  
find the value of  $x - y$

$=$  .....  $=$

**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  $j = -9$  and  $k = 6$ ,  
find the value of  $j - k$

$=$  .....  $=$

**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 $\times$ and $\div$

Blue 11 22 33 44  
Green 11 22 33 44

- Substitute each letter (variable) with the given value.
- Multiply ( $\times$ ) and/or divide ( $\div$ ) from left to right.
- Determine the sign of the result. (see skills 13.7 to 13.10, pages 104 to 107)

**Q.** If  $q = 6$  and  $r = 8$ ,  
find the value of  $qr$

**A.**  $qr$  substitute  $q = 6$  and  $r = 8$   
 $= 6 \times 8$   
 $= 48$

**a)** If  $e = 3$  and  $f = 7$ ,  
find the value of  $e \times f$

$= 3 \times 7$   $=$  21

**b)** If  $n = 4$  and  $o = 2$ ,  
find the value of  $n \times o$

$=$   $=$

**c)** If  $b = 10$  and  $c = 3$ ,  
find the value of  $b \times c$

$=$   $=$

**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  $l = -2$  and  $m = -5$ ,  
find the value of  $lm$

$=$   $=$

**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  $g = -4$  and  $h = 32$ ,  
find the value of  $h \div g$

$=$   $=$

**m)** If  $a = 54$  and  $b = 6$ , find  
the value of  $\frac{a}{b}$

$=$   $=$

**n)** If  $r = 84$  and  $s = 6$ , find  
the value of  $\frac{r}{s}$

$=$   $=$

**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  $t = -4$  and  $u = 5$ ,  
find the value of  $7tu$

$=$   $=$

**r)** If  $d = 5$  and  $e = 3$ ,  
find the value of  $7de$

$=$   $=$

**Skill 21.7** Substituting two values into expressions involving +, −, × and ÷

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Substitute each letter (variable) with the given value.
- 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 104 to 107)

**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  
 $2t + u$

$= 2 \times 6 + 7$   
 $= 12 + 7$       Do × first       $= 19$

**b)** If  $d = 8$  and  $e = 3$ ,  
find the value of  
 $16 - d + e$

$=$   
 $=$        $=$        $=$

**c)** If  $h = 3$  and  $i = 7$ ,  
find the value of  
 $11 + h - i$

$=$   
 $=$        $=$        $=$

**d)** If  $i = 5$  and  $j = 6$ ,  
find the value of  
 $3ij$

$=$   
 $=$        $=$        $=$

**e)** If  $a = 3$  and  $b = 0$ ,  
find the value of  
 $8ab$

$=$   
 $=$        $=$        $=$

**f)** If  $m = 4$  and  $n = 1$ ,  
find the value of  
 $3m - n$

$=$   
 $=$        $=$        $=$

**g)** If  $m = 3$  and  $n = 2$ ,  
find the value of  
 $4m - 2n$

$=$   
 $=$        $=$        $=$

**h)** If  $c = -5$  and  $d = 8$ ,  
find the value of  
 $2cd - 10$

$=$   
 $=$        $=$        $=$

**i)** If  $g = 2$  and  $h = 9$ ,  
find the value of  
 $-2gh + 2h$

$=$   
 $=$        $=$        $=$

**j)** If  $a = 6$  and  $b = 3$ ,  
find the value of  
 $-4a + 5b$

$=$   
 $=$        $=$        $=$

**k)** If  $y = 3$  and  $z = 2$ ,  
find the value of  
 $\frac{9-y}{z}$

$=$   
 $=$        $=$        $=$

**l)** If  $y = -8$  and  $z = 12$ ,  
find the value of  
 $\frac{z-4}{y}$

$=$   
 $=$        $=$        $=$

## Skill 21.8 Substituting into formulae.

Blue 11 22 33 44  
Green 11 22 33 44

- Substitute each letter (variable) with the given value.
- First evaluate all powers.
- Then multiply ( $\times$ ) and/or divide ( $\div$ ) from left to right.
- Finally add ( $+$ ) and/or subtract ( $-$ ) from left to right.

**Q.** Use  $V = lwh$  to find the volume ( $V$ ) of a rectangular prism where  $l = 5$ ,  $w = 3$  and  $h = 4$

**A.**  $V = lwh$       substitute  $l = 5, w = 3, h = 4$

$$= 5 \times 3 \times 4$$

$$= 15 \times 4$$

$$= \mathbf{60}$$

**a)** Use  $V = BH$  to find the volume ( $V$ ) of a prism where  $B = 200$  and  $H = 8$

$$V = 200 \times 8 = \boxed{\phantom{000}}$$

**b)** Use  $P = 4l$  to find the perimeter ( $P$ ) of a square where  $l = 6.5$

$$\phantom{P = 4l} = \boxed{\phantom{000}}$$

**c)** Use  $C = 2\pi r$  to find the circumference ( $C$ ) of a circle where  $\pi = 3.14$  and  $r = 10$

$$\phantom{C = 2\pi r} = \boxed{\phantom{000}}$$

**d)** Use  $A = l^2$  to find the area ( $A$ ) of a square where  $l = 9$

$$\phantom{A = l^2} = \boxed{\phantom{000}}$$

**e)** Use  $A = \frac{xy}{2}$  to find the area ( $A$ ) of a rhombus where  $x = 5$  and  $y = 20$

$$\phantom{A = \frac{xy}{2}} = \phantom{000}$$

$$= \phantom{000}$$

$$= \phantom{000}$$

$$= \phantom{000}$$

**f)** Use  $d = vt$  to find the distance ( $d$ ) where  $v = 95$  and  $t = 2$

$$\phantom{d = vt} = \boxed{\phantom{000}}$$

**g)** Use  $P = 2(l + w)$  to find the perimeter ( $P$ ) of a rectangle where  $l = 11$  and  $w = 3$

$$= \phantom{000}$$

$$= \phantom{000}$$

$$= \phantom{000}$$

$$= \phantom{000}$$

**h)** Use  $P = 10l$  to find the perimeter ( $P$ ) of a regular decagon where  $l = 7.2$

$$\phantom{P = 10l} = \boxed{\phantom{000}}$$

**i)** Use  $A = \frac{1}{2}bh$  to find the area ( $A$ ) of a triangle where  $b = 12$  and  $h = 5$

$$= \phantom{000}$$

$$= \phantom{000}$$

$$= \phantom{000}$$

$$= \phantom{000}$$

**j)** Use  $V = l^2h$  to find the volume ( $V$ ) of a square prism where  $l = 5$  and  $h = 4$

$$\phantom{V = l^2h} = \boxed{\phantom{000}}$$

**k)** Use  $V = l^3$  to find the volume ( $V$ ) of a cube where  $l = 8$

$$\phantom{V = l^3} = \boxed{\phantom{000}}$$

**l)** Use  $A = \pi r^2$  to find the area ( $A$ ) of a circle where  $\pi \approx \frac{22}{7}$  and  $r = 7$

$$\phantom{A = \pi r^2} = \boxed{\phantom{000}}$$

- Substitute each letter (variable) with the given value.
- First evaluate all powers.
- Then multiply ( $\times$ ) and/or divide ( $\div$ ) from left to right.
- Finally add ( $+$ ) and/or subtract ( $-$ ) from left to right.

**Q.** If  $i = 4$ ,  
find the value of  
 $2i^2 - i$

**A.**  $2i^2 - i$       substitute  $i = 4$   
 $= 2 \times (4 \times 4) - 4$   
 $= 2 \times 16 - 4$   
 $= 32 - 4$   
 $= 28$

**a)** If  $x = 5$ ,  
find the value of  
 $40 - x^2$

$= 40 - 5 \times 5$       multiply first  
 $= 40 - 25 = 15$

**b)** If  $j = 8$ ,  
find the value of  
 $j^2$

$= \dots = \boxed{\phantom{00}}$

**c)** If  $g = 6$ ,  
find the value of  
 $g^2 - 12$

$= \dots = \boxed{\phantom{00}}$

**d)** If  $c = 5$ ,  
find the value of  
 $4c^2$

$= \dots = \boxed{\phantom{00}}$

**e)** If  $e = 4$ ,  
find the value of  
 $30 - e^2$

$= \dots = \boxed{\phantom{00}}$

**f)** If  $j = 7$ ,  
find the value of  
 $50 - j^2$

$= \dots = \boxed{\phantom{00}}$

**g)** If  $z = 6$ ,  
find the value of  
 $2z^2 - 32$

$= \dots = \boxed{\phantom{00}}$

**h)** If  $y = 10$ ,  
find the value of  
 $2y^2 + y$

$= \dots = \boxed{\phantom{00}}$

**i)** If  $a = 3$ ,  
find the value of  
 $4a^2 - 16$

$= \dots = \boxed{\phantom{00}}$

**j)** If  $m = 5$ ,  
find the value of  
 $2m^2 + m$

$= \dots = \boxed{\phantom{00}}$

**k)** If  $p = 8$ ,  
find the value of  
 $-2p^2$

$= \dots = \boxed{\phantom{00}}$

**l)** If  $b = 9$ ,  
find the value of  
 $\frac{b^2 - 1}{4}$

$= \dots = \boxed{\phantom{00}}$

- Substitute each letter (variable) with the given value.
- First evaluate inside the brackets.
- Then multiply ( $\times$ ) 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 104 to 107)

**Q.** If  $x = 6$ , find the value of  $3(x - 4)$

**A.**  $3(x - 4)$  substitute  $x = 6$   
 $= 3 \times (6 - 4)$   
 $= 3 \times 2$   
 $= 6$

**a)** If  $b = 4$ , find the value of  $5(2 + b)$

$= 5 \times (2 + 4)$  Do ( ) first  
 $= 5 \times 6$

**b)** If  $y = 9$ , find the value of  $2(15 - y)$

$=$   
 $=$

**c)** If  $t = 10$ , find the value of  $t(t - 8)$

$=$   
 $=$

**d)** If  $a = 7$ , find the value of  $5(a + 5)$

$=$   
 $=$

**e)** If  $r = 5$ , find the value of  $4(r - 2)$

$=$   
 $=$

**f)** If  $r = 9$ , find the value of  $r(2 + r)$

$=$   
 $=$

**g)** If  $q = 2$ , find the value of  $9(q + 8)$

$=$   
 $=$

**h)** If  $k = 4$ , find the value of  $k(k - 8)$

$=$   
 $=$

**i)** If  $h = -5$ , find the value of  $4(h - 2)$

$=$   
 $=$

**j)** If  $f = 9$ , find the value of  $6(f + 6)$

$=$   
 $=$

**k)** If  $p = 6$ , find the value of  $p(2 - p)$

$=$   
 $=$

**l)** If  $n = 4$ , find the value of  $2n(14 - n)$

$=$   
 $=$

**m)** If  $e = -8$ , find the value of  $3(e + 5)$

$=$   
 $=$

**n)** If  $h = -1$ , find the value of  $h(2 - h)$

$=$   
 $=$

**o)** If  $k = -3$ , find the value of  $k(k - 7)$

$=$   
 $=$

- Substitute each letter (variable) with the given value.
- First evaluate all powers.
- Then evaluate inside the brackets.
- Then multiply ( $\times$ ) and/or divide ( $\div$ ) from left to right.
- Finally add ( $+$ ) and/or subtract ( $-$ ) from left to right.

**Q.** If  $a = 6$  and  $b = 3$ , find the value of  $a^2 - ab$

**A.**  $a^2 - ab$  substitute  $a = 6$  and  $b = 3$

$$= 6^2 - 6 \times 3$$

$$= 36 - 18$$

$$= 18$$

**a)** If  $x = 4$  and  $y = 1$ , find the value of  $x(x + y)$

Do ( ) first

$$= 4(4 + 1)$$

$$= 4 \times 5 = \boxed{20}$$

**b)** If  $c = 7$  and  $d = 4$ , find the value of  $c(d + c)$

$$= \dots$$

$$= \dots = \boxed{\phantom{00}}$$

**c)** If  $g = 9$  and  $h = 5$ , find the value of  $h(g + h)$

$$= \dots$$

$$= \dots = \boxed{\phantom{00}}$$

**d)** If  $p = 8$  and  $q = 6$ , find the value of  $3p(p - q)$

$$= \dots$$

$$= \dots = \boxed{\phantom{00}}$$

**e)** If  $m = 3$  and  $n = 6$ , find the value of  $2n(n - m)$

$$= \dots$$

$$= \dots = \boxed{\phantom{00}}$$

**f)** If  $e = 5$  and  $f = 1$ , find the value of  $2e(e - f)$

$$= \dots$$

$$= \dots = \boxed{\phantom{00}}$$

**g)** If  $j = 2$  and  $k = 12$ , find the value of  $j^2 + jk$

$$= \dots$$

$$= \dots = \boxed{\phantom{00}}$$

**h)** If  $s = 7$  and  $t = 4$ , find the value of  $s^2 - st$

$$= \dots$$

$$= \dots = \boxed{\phantom{00}}$$

**i)** If  $u = 3$  and  $v = 8$ , find the value of  $v^2 - uv$

$$= \dots$$

$$= \dots = \boxed{\phantom{00}}$$

**j)** If  $l = 10$  and  $m = 5$ , find the value of  $3l - m^2$

$$= \dots$$

$$= \dots = \boxed{\phantom{00}}$$

**k)** If  $r = 6$  and  $s = 20$ , find the value of  $2s - r^2$

$$= \dots$$

$$= \dots = \boxed{\phantom{00}}$$

**l)** If  $w = 22$  and  $x = 4$ , find the value of  $2w - x^2$

$$= \dots$$

$$= \dots = \boxed{\phantom{00}}$$



# 22. [Equations]

## Skill 22.1 Finding the missing number in equations involving + and - (1).

Blue 1 1 2 2 3 3 4 4  
Green 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:

$$4 + \boxed{?} = 12$$

$$4 + 8 = 12$$

$$12 = 12 \text{ (true)}$$

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.**  $20 - \boxed{\phantom{00}} = 13$       **A.**  $20 - ? = 13$     OR     $\boxed{20} - ? = 13$

What number subtracted from 20 gives 13?       $20 - 7 = 13$        $\cancel{20} - \cancel{20} - ? = 13 - 20$       If 20 was added to the missing number, then do the inverse operation and subtract 20 from both sides of the equation. Finally, reverse the signs on both sides.

Guess ? = 7       $13 = 13 \text{ (true)}$        $-? = -7$        $? = 7$

The solution is 7

Use trial and error

**a)**  $16 - \boxed{7} = 9$

$$16 - ? = 9$$

$$? = 7$$

**b)**  $7 + \boxed{\phantom{00}} = 15$

$$7 + ? = 15$$

$$? =$$

**c)**  $\boxed{\phantom{00}} + 24 = 30$

$$? + 24 = 30$$

$$? =$$

**d)**  $16 - \boxed{\phantom{00}} = 7$

$$? =$$

**e)**  $15 - \boxed{\phantom{00}} = 8$

$$? =$$

**f)**  $8 + \boxed{\phantom{00}} = 21$

$$? =$$

**g)**  $\boxed{\phantom{00}} + 8 = 20$

$$? =$$

**h)**  $14 + \boxed{\phantom{00}} = 21$

$$? =$$

**i)**  $\boxed{\phantom{00}} - 8 = 13$

$$? =$$

**Skill 22.1** Finding the missing number in equations involving + and - (2).

Blue 11 22 33 44  
Green 11 22 33 44

Operation: + 18

Use inverse operations

j)  $18 + \boxed{9} = 27$

k)  $\boxed{\phantom{00}} - 14 = 13$

l)  $\boxed{\phantom{00}} + 20 = 25$

~~$18 + ? - 18 = 27 - 18$~~

~~$? - 14 + 14 = 13 + 14$~~

$? = 9$

$? =$

$? =$

m)  $\boxed{\phantom{00}} + 6 = 23$

n)  $4 + \boxed{\phantom{00}} = 20$

o)  $16 + \boxed{\phantom{00}} = 27$

p)  $15 + \boxed{\phantom{00}} = 29$

q)  $\boxed{\phantom{00}} + 16 = 34$

r)  $\boxed{\phantom{00}} + 18 = 38$

s)  $\boxed{\phantom{00}} - 7 = 18$

t)  $\boxed{\phantom{00}} - 18 = 15$

u)  $\boxed{\phantom{00}} - 13 = 14$

v)  $\boxed{\phantom{00}} - 31 = 4$

w)  $12 - \boxed{\phantom{00}} = 3$

x)  $16 - \boxed{\phantom{00}} = 9$

y)  $24 - \boxed{\phantom{00}} = 9$

z)  $\boxed{\phantom{00}} - 8 = 16$

A)  $\boxed{\phantom{00}} - 8 = 12$

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.

$$\boxed{\phantom{00}} \times 20 = 100$$

A.

$$? \times 20 = 100$$

OR  $? \times \boxed{20} = 100$

If 20 was

What number multiplied by 20 gives 100?

$$5 \times 20 = 100$$

$$? \times \cancel{20} \div \cancel{20} = 100 \div 20$$

multiplied

$$100 = 100 \text{ (true)}$$

$$? = 5$$

by the missing

Guess ? = 5

The solution is **5**.

number, then do the inverse operation and divide by 20 both sides of the equation.

Use trial and error

a)  $5 \times \boxed{\phantom{00}} = 75$

$$5 \times ? = 75$$

$$? = 15$$

b)  $10 \times \boxed{\phantom{00}} = 40$

$$10 \times ? = 40$$

$$? =$$

c)  $\boxed{\phantom{00}} \times 8 = 64$

$$? =$$

d)  $\boxed{\phantom{00}} \times 4 = 24$

$$? =$$

e)  $4 \times \boxed{\phantom{00}} = 20$

$$? =$$

f)  $7 \times \boxed{\phantom{00}} = 56$

$$? =$$

g)  $6 \times \boxed{\phantom{00}} = 12$

$$? =$$

h)  $\boxed{\phantom{00}} \times 9 = 54$

$$? =$$

i)  $\boxed{\phantom{00}} \times 8 = 72$

$$? =$$

**Skill 22.2** Finding the missing number in equations involving  $\times$  (2).

Blue 11 22 33 44  
Green 11 22 33 44

Operation:  $\times 6$

Use inverse operations

j)  $6 \times \boxed{5} = 30$

~~$6 \times ? \div 6 = 30 \div 6$~~   
Inverse of  $\times 6$  is  $\div 6$

$? = 5$

k)  $\boxed{\phantom{00}} \times 5 = 60$

~~$? \times 5 \div 5 = 60 \div 5$~~

$? =$

l)  $\boxed{\phantom{00}} \times 12 = 72$

$? =$

m)  $\boxed{\phantom{00}} \times 5 = 55$

n)  $13 \times \boxed{\phantom{00}} = 39$

o)  $9 \times \boxed{\phantom{00}} = 360$

p)  $\boxed{\phantom{00}} \times 14 = -28$

q)  $-8 \times \boxed{\phantom{00}} = -24$

r)  $-4 \times \boxed{\phantom{00}} = -28$

s)  $\boxed{\phantom{00}} \times 10 = -30$

t)  $-9 \times \boxed{\phantom{00}} = -81$

u)  $-7 \times \boxed{\phantom{00}} = 63$

v)  $-9 \times \boxed{\phantom{00}} = 18$

w)  $\boxed{\phantom{00}} \times 5 = -35$

x)  $-8 \times \boxed{\phantom{00}} = -88$

y)  $\boxed{\phantom{00}} \times (-3) = -75$

z)  $\boxed{\phantom{00}} \times (-8) = 16$

A)  $-7 \times \boxed{\phantom{00}} = 49$

**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:

$$\frac{1}{4} \text{ of } \boxed{?} = 3$$

$$\frac{1}{\cancel{4}} \times \overset{3}{\cancel{12}} = 3$$

$$3 = 3 \text{ (true)}$$

The equation is true, so **12** is the solution.

**'OF'** is another way of saying ' $\times$ '

**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:  $\frac{1}{4} \times \boxed{?} = 3$

$$\frac{1}{\cancel{4}} \times ? \times \cancel{4} = 3 \times 4$$

$$? = 12$$

**Q.**  $\frac{3}{5}$  of  $\boxed{\phantom{000}} = 21$

**A.**  $\frac{3}{5}$  of ? = 21

OR  $\left(\frac{3}{5}\right)$  of ? = 21

What number multiplied by  $\frac{3}{5}$  gives 21?

Guess ? = 30

Guess ? = 35

$$\frac{3}{\cancel{5}} \times \overset{6}{\cancel{30}} = 21$$

$$1 \quad 18 = 21 \text{ (false)}$$

$$\frac{3}{\cancel{5}} \times \overset{7}{\cancel{35}} = 21$$

$$1 \quad 21 = 21 \text{ (true)}$$

The solution is **35**.

$$\frac{3}{5} \times ? = 21$$

$$\frac{3}{\cancel{5}} \times ? \times \cancel{5} = 21 \times 5$$

$$3 \times ? = 105$$

$$3 \times ? \div 3 = 105 \div 3$$

$$? = \mathbf{35}$$

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.

Use trial and error

**a)**  $\frac{1}{6}$  of  $\boxed{48} = 8$

$$\frac{1}{6} \times ? = 8$$

Guess ? = 48

$$\frac{1}{\cancel{6}} \times \overset{8}{\cancel{48}} = 8 \Rightarrow 8 = 8$$

$$? = 48$$

**b)**  $\frac{1}{2}$  of  $\boxed{\phantom{000}} = 17$

$$\frac{1}{2} \times ? = 17$$

$$\frac{1}{2} \times 34 = 17 \Rightarrow 17 = 17$$

$$? =$$

**c)**  $\frac{1}{7}$  of  $\boxed{\phantom{000}} = 9$

$$\frac{1}{7} \times ? = 9$$

$$? =$$

**d)**  $\frac{1}{5} \times \boxed{\phantom{000}} = 9$

$$? =$$

**e)**  $\frac{1}{9} \times \boxed{\phantom{000}} = 10$

$$? =$$

**f)**  $\frac{1}{10} \times \boxed{\phantom{000}} = 5$

$$? =$$

Operation:  $\div 8$

Use inverse operations

g)  $\frac{1}{8} \times \boxed{64} = 8$

h)  $\frac{1}{4} \times \boxed{\phantom{00}} = 48$

i)  $\frac{1}{3} \times \boxed{\phantom{00}} = 60$

Inverse of  $\div 8$  is  $\times 8$   
 $\frac{1}{8} \times ? \times 8 = 8 \times 8$

.....  
 $? = 64$   
 .....

.....  
 $? =$   
 .....

.....  
 $? =$   
 .....

j)  $\frac{2}{3}$  of  $\boxed{\phantom{00}} = 10$

k)  $\frac{3}{4}$  of  $\boxed{\phantom{00}} = 15$

l)  $\frac{2}{5}$  of  $\boxed{\phantom{00}} = 12$

.....  
 .....

.....  
 .....

.....  
 .....

m)  $\frac{4}{5} \times \boxed{\phantom{00}} = 20$

n)  $\frac{5}{6} \times \boxed{\phantom{00}} = 50$

o)  $\frac{2}{7} \times \boxed{\phantom{00}} = 12$

.....  
 .....

.....  
 .....

.....  
 .....

p)  $\frac{1}{3} \times \boxed{\phantom{00}} = -21$

q)  $\frac{1}{4} \times \boxed{\phantom{00}} = -11$

r)  $\frac{1}{5} \times \boxed{\phantom{00}} = -12$

.....  
 .....

.....  
 .....

.....  
 .....

s)  $\frac{1}{6} \times \boxed{\phantom{00}} = -5$

t)  $\frac{1}{8} \times \boxed{\phantom{00}} = -7$

u)  $\frac{1}{9} \times \boxed{\phantom{00}} = -3$

.....  
 .....

.....  
 .....

.....  
 .....

**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.**  $4 \times (17 - \boxed{\phantom{00}}) = 20$  **A.**  $4 \times (17 - ?) = 20$  *OR*  $4 \times (17 - ?) \div 4 = 20 \div 4$

What number multiplied by 4 gives 20?

What number minus 13 gives 15?

Guess ? = 12

The solution is **12**.

$$17 - ? = 5$$

$$17 - 12 = 5$$

$$5 = 5 \text{ (true)}$$

$$17 - ? = 5$$

$$17 - ? - 17 = 5 - 17$$

$$-? = -12$$

$$? = 12$$

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)**  $8 + 4 \times \boxed{10} = 48$

$$8 + 4 \times ? = 48$$

$$4 \times ? = 40$$

$$? = 10$$

**b)**  $5 + 6 \times \boxed{\phantom{00}} = 47$

$$5 + 6 \times ? = 47$$

$$6 \times ? = 42$$

$$? =$$

**c)**  $12 + 4 \times \boxed{\phantom{00}} = 44$

$$? =$$

**d)**  $4 \times (9 - \boxed{\phantom{00}}) = 16$

$$4 \times (9 - ?) = 16$$

$$9 - ? = 4$$

$$? =$$

**e)**  $3 \times (8 - \boxed{\phantom{00}}) = 15$

$$? =$$

**f)**  $7 \times (9 - \boxed{\phantom{00}}) = 21$

$$? =$$

**Skill 22.4** Finding the missing number in equations involving +, -, x and/or brackets (2).

Blue 11 22 33 44  
Green 11 22 33 44

Operation: + 15

Use inverse operations

**g)**  $15 + 6 \times \boxed{5} = 45$

**h)**  $16 + 2 \times \boxed{\phantom{00}} = 40$

**i)**  $21 + 5 \times \boxed{\phantom{00}} = 61$

~~$15 + 6 \times ? - 15 = 45 - 15$~~

$6 \times ? \div 6 = 30 \div 6$

$? = 5$

$? =$

$? =$

**j)**  $8 \times (16 - \boxed{\phantom{00}}) = 24$

**k)**  $4 \times (13 - \boxed{\phantom{00}}) = 16$

**l)**  $8 \times (20 - \boxed{\phantom{00}}) = 32$

**m)**  $5 \times \boxed{\phantom{00}} - 20 = 25$

**n)**  $6 \times \boxed{\phantom{00}} - 36 = 12$

**o)**  $4 \times \boxed{\phantom{00}} - 16 = 12$

**p)**  $5 \times \boxed{\phantom{00}} + 6 = 51$

**q)**  $7 \times \boxed{\phantom{00}} + 12 = 82$

**r)**  $\boxed{\phantom{00}} \times 7 + 8 = 50$

**s)**  $36 - 6 \times \boxed{\phantom{00}} = 12$

**t)**  $50 - 7 \times \boxed{\phantom{00}} = 15$

**u)**  $42 - 10 \times \boxed{\phantom{00}} = 22$

# Skill 22.5 Finding the missing number in equations involving decimals.

Blue 11 22 33 44  
Green 11 22 33 44

- Use trial and error or inverse operation to find the missing number. (see skill 22.1, page 193 and skill 22.2, page 195)

**Q.**  $\square + 2.7 = 3.4$

**A.**  $? + 2.7 = 3.4$  OR  $? + 2.7 = 3.4$   
 $0.7 + 2.7 = 3.1$   $? + \cancel{2.7} - \cancel{2.7} = 3.4 - 2.7$   
 $3.4 = 3.4$  (true)  $? = 0.7$

What number added to 2.7 gives 3.4?  
 Guess ? = 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)

Guess ? = 4  $? \times 1.6 = 6.4$   
 $? = 4$

**b)**  $1.4 + \square = 2.6$

$1.4 + ? = 2.6$   
 $? =$

**c)**  $2.8 + \square = 4.4$

$? =$

**d)**  $3.8 - \square = 3$

$? =$

**e)**  $2.9 - \square = 0.7$

$? =$

**f)**  $\square \times 1.3 = 3.9$

$? =$

**g)**  $4.2 - \square = 2.7$  (Operation: + 4.2) (Use inverse operations)

$\cancel{4.2} - ? - \cancel{4.2} = 2.7 - 4.2$   
 $-? = -1.5$   
 $? = 1.5$

**h)**  $3.5 - \square = 1.2$

$? =$

**i)**  $2.8 - \square = 0.6$

$? =$

**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).

Blue 11 22 33 44  
Green 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.
- Hint: Remember that you must do the same operation to both sides of the equation.

Operation	Inverse Operation	Operation	Inverse Operation
+	-	-	+
$x + 3 = 6$ $x + 3 - 3 = 6 - 3$ $x = 3$		$x - 3 = 6$ $x - 3 + 3 = 6 + 3$ $x = 9$	

**Q.** Solve for  $p$ :  $17 - p = 13$     **A.**  $+17 - p = 13$     Operation: + 17

$\cancel{17} - p - \cancel{17} = 13 - 17$     Inverse of + 17 is - 17

Simplify:  $17 - 17 = 0$      $-p = -4$     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

$t + \cancel{6} - \cancel{6} = 15 - 6$      $y + 5 - 5 = 12 - 5$

$t = 9$

$y =$

$r =$

**d)** Solve for  $a$ :  $a + 10 = 30$     **e)** Solve for  $x$ :  $8 + x = 17$     **f)** Solve for  $m$ :  $5 + m = 15$

$a =$

$x =$

$m =$

**g)** Solve for  $e$ :  $e + 9 = 12$     **h)** Solve for  $g$ :  $g + 7 = 11$     **i)** Solve for  $s$ :  $13 + s = 22$

$e =$

$g =$

$s =$

**j)** Solve for  $t$ :  $t - 3 = 6$     **k)** Solve for  $y$ :  $y - 4 = 9$     **l)** Solve for  $z$ :  $z - 5 = 2$

$t =$

$y =$

$z =$

**Skill 22.6** Solving one-step equations by using the inverse operations of + and - (2).

Blue 11 22 33 44  
Green 11 22 33 44

**m)** Solve for  $x$ :  $x - 12 = 20$

.....  
.....  
 $x =$

**n)** Solve for  $b$ :  $b - 15 = 8$

.....  
.....  
 $b =$

**o)** Solve for  $s$ :  $s - 13 = 27$

.....  
.....  
 $s =$

**p)** Solve for  $a$ :  $14 - a = 6$

.....  
 $14 - a - 14 = 6 - 14$

.....  
 $-a = -8$

.....  
 $a = 8$

**q)** Solve for  $z$ :  $24 - z = 10$

.....  
.....  
 $z =$

**r)** Solve for  $s$ :  $18 - s = 7$

.....  
.....  
 $s =$

**s)** Solve for  $j$ :  $10 - j = 2$

.....  
.....  
 $j =$

**t)** Solve for  $c$ :  $22 - c = 7$

.....  
.....  
 $c =$

**u)** Solve for  $e$ :  $16 - e = 9$

.....  
.....  
 $e =$

**v)** Solve for  $d$ :  $-3 + d = 9$

.....  
.....  
 $d =$

**w)** Solve for  $v$ :  $-6 + v = 12$

.....  
.....  
 $v =$

**x)** Solve for  $n$ :  $-8 + n = 7$

.....  
.....  
 $n =$

**y)** Solve for  $h$ :  $-9 + h = 12$

.....  
.....  
 $h =$

**z)** Solve for  $k$ :  $-7 + k = 25$

.....  
.....  
 $k =$

**A)** Solve for  $m$ :  $-5 + m = 16$

.....  
.....  
 $m =$

**Skill 22.7** Solving one-step equations by using the inverse operations of  $\times$  and  $\div$  (1).

Blue 11 22 33 44  
Green 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
$\times$	$\div$	$\div$	$\times$
$3x = 6$		$\frac{x}{3} = 6$	
$\frac{3x}{3} = \frac{6}{3}$		$\frac{x}{3} \times 3 = 6 \times 3$	
$x = 2$		$x = 18$	

**Q.** Solve for  $x$ :  $\frac{x}{8} = 6$

**A.**  $\frac{x}{8} = 6$  Operation:  $\div 8$

Simplify:  $8 \div 8 = 1$   $\frac{x}{\cancel{8}} \times \frac{1}{\cancel{8}} = 6 \times 8$  Inverse of  $\div 8$  is  $\times 8$

$x = 48$

Operation:  $\times 5$

**a)** Solve for  $a$ :  $5 \times a = 45$

**b)** Solve for  $m$ :  $4 \times m = 40$

**c)** Solve for  $c$ :  $6 \times c = 72$

Inverse of  $\times 5$  is  $\div 5$   $\frac{5a}{\cancel{5}} = \frac{45}{\cancel{5}}$  Simplify:  $\div 5$

$a = 9$

$m =$

$c =$

**d)** Solve for  $h$ :  $7 \times h = 77$

**e)** Solve for  $n$ :  $9 \times n = 81$

**f)** Solve for  $p$ :  $8 \times p = 64$

$h =$

$n =$

$p =$

**g)** Solve for  $b$ :  $8b = 24$

**h)** Solve for  $z$ :  $7z = 28$

**i)** Solve for  $l$ :  $9l = 54$

$b =$

$z =$

$l =$

**j)** Solve for  $r$ :  $10r = 120$

**k)** Solve for  $y$ :  $5y = 75$

**l)** Solve for  $u$ :  $4u = 36$

$r =$

$y =$

$u =$

**Skill 22.7** Solving one-step equations by using the inverse operations of  $\times$  and  $\div$  (2).

Blue 11 22 33 44  
Green 11 22 33 44

**m)** Solve for  $g$ :  $15g = -30$

$$15 \times g \div 15 = -30 \div 15$$

$$g = -2$$

**n)** Solve for  $a$ :  $20a = -100$

$$a =$$

**o)** Solve for  $s$ :  $3s = -21$

$$s =$$

**p)** Solve for  $m$ :  $5m = 60$

$$m =$$

**q)** Solve for  $n$ :  $14n = -28$

$$n =$$

**r)** Solve for  $g$ :  $7g = 49$

$$g =$$

**s)** Solve for  $d$ :  $10d = -80$

$$d =$$

**t)** Solve for  $p$ :  $12p = -36$

$$p =$$

**u)** Solve for  $h$ :  $9h = -90$

$$h =$$

Operation:  $\div 4$

**v)** Solve for  $x$ :  $\frac{x}{4} = 9$

**w)** Solve for  $c$ :  $\frac{c}{5} = 6$

**x)** Solve for  $q$ :  $\frac{q}{3} = 8$

Inverse of  $\div 4$  is  $\times 4$

$$\frac{x}{4} \times 4 = 9 \times 4$$

$$x =$$

$$c =$$

$$q =$$

**y)** Solve for  $n$ :  $\frac{n}{7} = 3$

$$n =$$

**z)** Solve for  $r$ :  $\frac{r}{8} = 12$

$$r =$$

**A)** Solve for  $j$ :  $\frac{j}{4} = 15$

$$j =$$

**B)** Solve for  $b$ :  $\frac{b}{6} = 12$

$$b =$$

**C)** Solve for  $e$ :  $\frac{e}{9} = 10$

$$e =$$

**D)** Solve for  $k$ :  $\frac{k}{2} = 35$

$$k =$$

**Skill 22.8** Solving two-step equations by using the inverse operations of  $+$ ,  $-$ ,  $\times$  and  $\div$  (1).

Blue 11 22 33 44  
Green 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 202 and skill 22.7, page 204).
- 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.**

$$\begin{aligned}
 9v - 2 &= -20 && \text{Operation: } -2 \\
 9v - \cancel{2} + \cancel{2} &= -20 + 2 && \text{Inverse of } -2 \text{ is } +2 \\
 9v &= -18 && \text{Operation: } \times 9 \\
 \frac{1}{\cancel{9}} 9v &= \frac{-18}{\cancel{9} 1} && \text{Inverse of } \times 9 \text{ is } \div 9 \\
 v &= -2
 \end{aligned}$$

**a)** Solve for  $x$ :  $7x + 8 = 50$

Operation:  $+ 8$

Inverse of  $+ 8$  is  $- 8$

$$7x + \cancel{8} - \cancel{8} = 50 - 8$$

Inverse of  $\times 7$  is  $\div 7$

$$7x = 42$$

$$\frac{1}{\cancel{7}} 7x = \frac{42}{\cancel{7} 1}$$

Simplify:  $\div 7$

$$x =$$

**b)** Solve for  $y$ :  $6y - 9 = 21$

$$y =$$

**c)** Solve for  $a$ :  $3a + 8 = 29$

$$a =$$

**d)** Solve for  $d$ :  $4d + 5 = 29$

$$d =$$

**e)** Solve for  $e$ :  $3e - 5 = 25$

$$e =$$

**f)** Solve for  $u$ :  $8u - 10 = 22$

$$u =$$

**g)** Solve for  $x$ :  $2x - 26 = -2$

$$x =$$

**h)** Solve for  $t$ :  $7t - 3 = -24$

$$t =$$

**i)** Solve for  $h$ :  $5h - 6 = -6$

$$h =$$

**Skill 22.8** Solving two-step equations by using the inverse operations of  $+$ ,  $-$ ,  $\times$  and  $\div$ .

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- j)** Solve for  $i$ :  $6i - 9 = -21$     **k)** Solve for  $q$ :  $5q - 7 = -32$     **l)** Solve for  $s$ :  $8s - 20 = -4$

.....

.....

.....

.....

.....

.....

$i =$

$q =$

$s =$

- m)** Solve for  $i$ :  $4i + 12 = -20$     **n)** Solve for  $j$ :  $3j + 5 = -10$     **o)** Solve for  $l$ :  $10l + 4 = -26$

.....

.....

.....

.....

.....

.....

$i =$

$j =$

$l =$

- p)** Solve for  $x$ :  $9x + 10 = 1$     **q)** Solve for  $z$ :  $4z + 19 = 3$     **r)** Solve for  $c$ :  $6c + 17 = 5$

.....

.....

.....

.....

.....

.....

$x =$

$z =$

$c =$

- s)** Solve for  $g$ :  $7g + 8 = 1$     **t)** Solve for  $m$ :  $9m + 40 = 4$     **u)** Solve for  $p$ :  $2p + 18 = 6$

.....

.....

.....

.....

.....

.....

$g =$

$m =$

$p =$



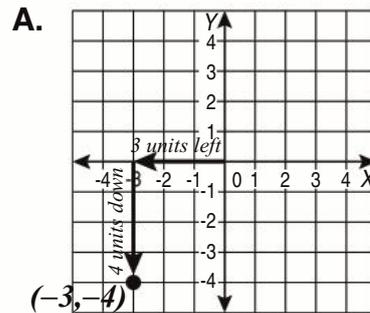
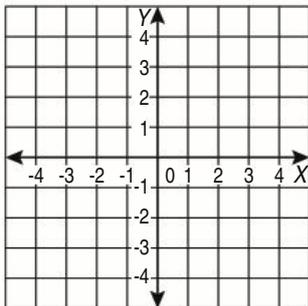
# 23. [Coordinates]

## Skill 23.1 Describing the position of ordered pairs on a Cartesian plane.

Blue 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

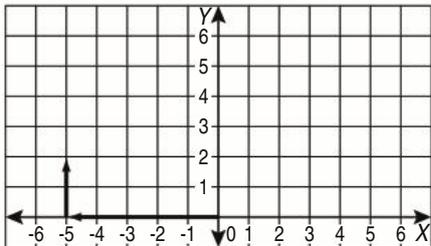
- Start at the origin (0,0).
- Move left or right by the number of given units. This first number becomes the x-coordinate. Use a “+” sign if you moved to the right and use a “-” if you moved to the left.
- From that point, move up or down by the number of given units. This second number becomes the y-coordinate. Use a “+” sign if you moved up and use a “-” if you moved down.
- Plot the final point on the Cartesian plane.

**Q.** Start at the origin. Move 3 units to the left along the  $x$ -axis and then down 4 units. Plot a point. What are the coordinates of the point?



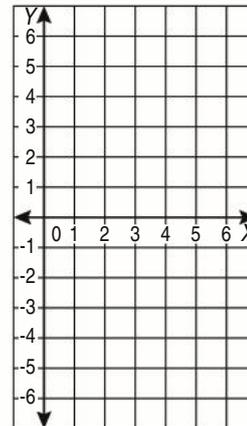
The first coordinate is  $-3$  (3 units left)  
The second coordinate is  $-4$  (4 units down)  
The answer is  $(-3, -4)$

**a)** Start at the origin. Move 5 units to the left along the  $x$ -axis and then up 2 units. Plot a point. What are the coordinates of the point?



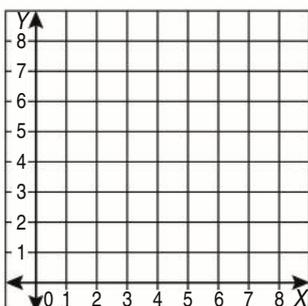
( , )

**b)** Start at the origin. Move 6 units to the right along the  $x$ -axis and then down 5 units. Plot a point. What are the coordinates of the point?



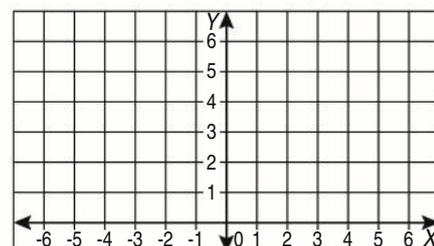
( , )

**c)** Start at the origin. Move 8 units to the right along the  $x$ -axis and then up 3 units. Plot a point. What are the coordinates of the point?



( , )

**d)** Start at the origin. Move 4 units to the left along the  $x$ -axis and then up 6 units. Plot a point. What are the coordinates of the point?



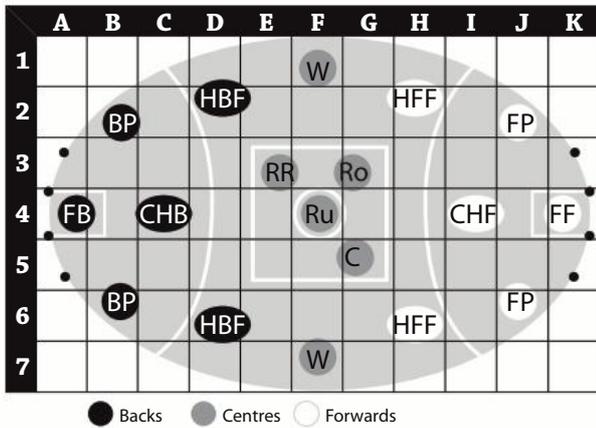
( , )

**Skill 23.2** Using grid references to describe location on a map (1).

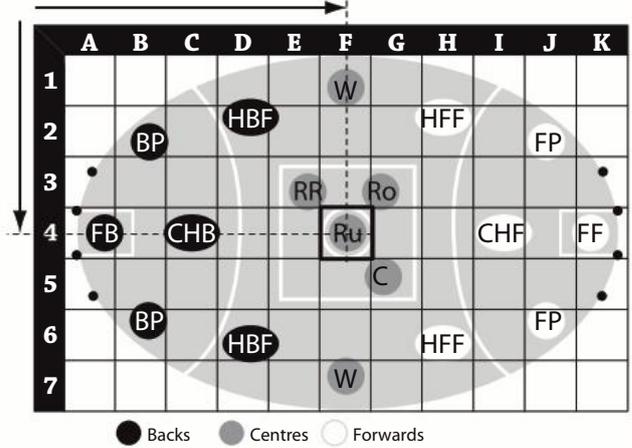
Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Locate the object on the grid.
- Starting from the left, first read across the horizontal axis to find the letter that matches the column of the object.
- Then read along the vertical axis to find the number that matches the row of the object.
- Write the letter followed by the number to specify the grid reference.

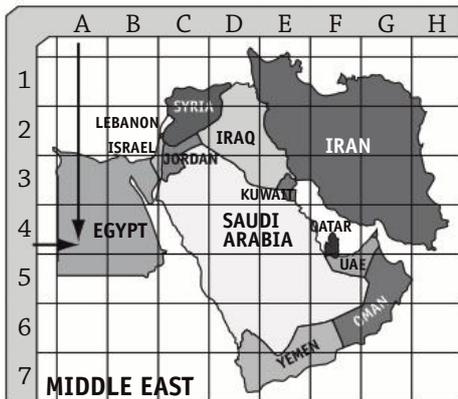
**Q.** In this AFL starting line up, what is the grid reference of the Ruck (Ru)?



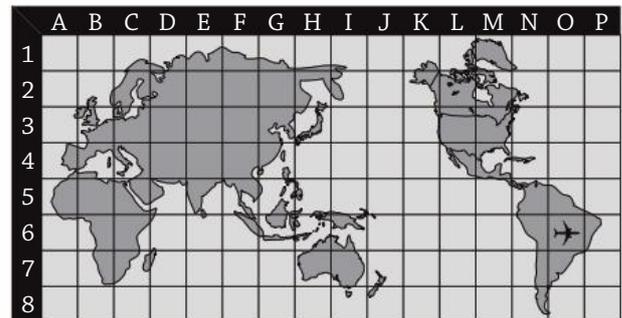
**A.** The grid reference is **F4**.



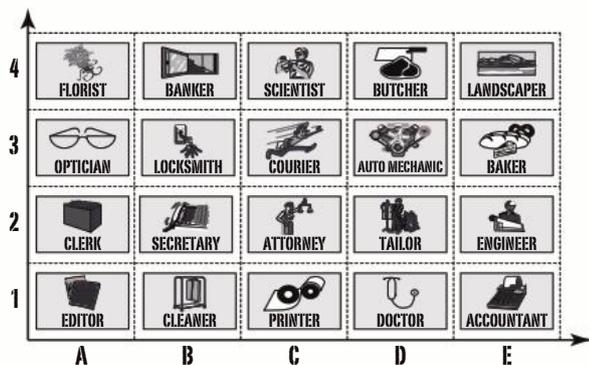
**a)** In which country would you be if you were located at A4?




**b)** Above which continent would you be if your airplane is flying at O6?



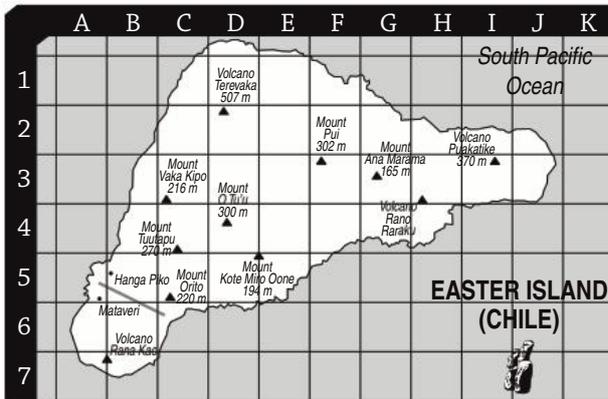

**c)** Which occupation is listed at C4?



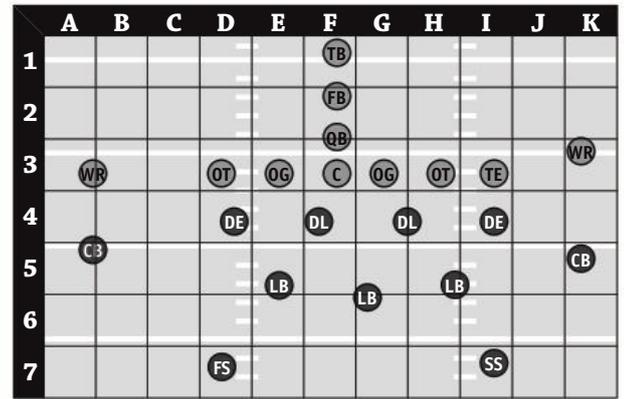

**d)** On which island would you be if you were located at G8?



e) On which mountain would you be located at C5?

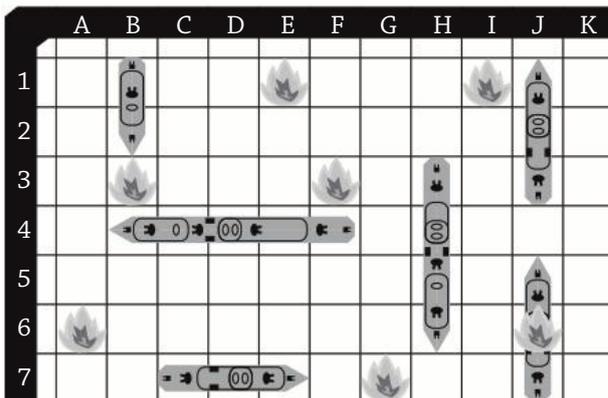



f) In this gridiron starting line up, what is the grid reference of the Tight End (TE)?



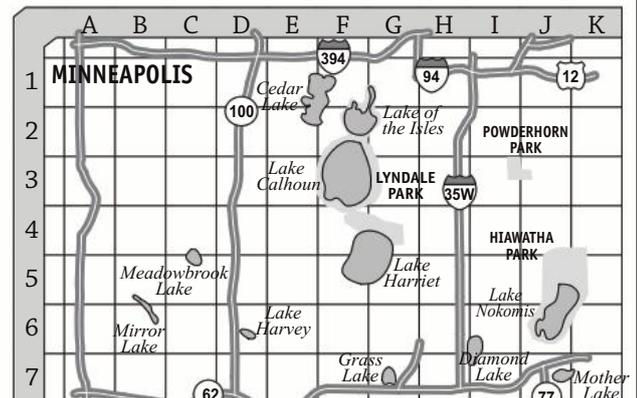
● Offense  
● Defense

g) What is the grid reference of an enemy hit on a battleship?

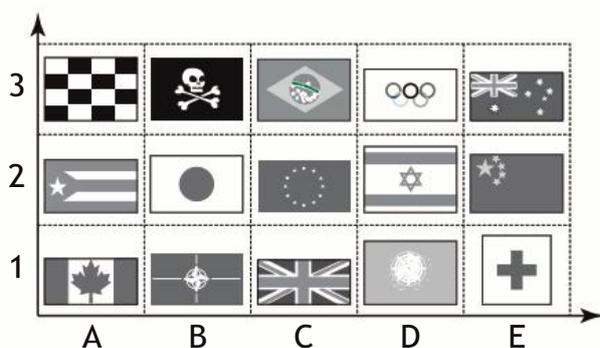


☹ Enemy hit  
🚢 Battleship

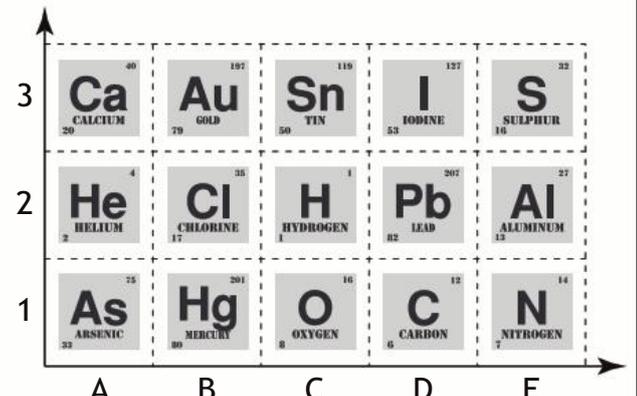
h) What is the grid reference of Grass Lake?




i) What is the grid reference of the Red Cross flag?




j) What is the grid reference of Hydrogen (H)?

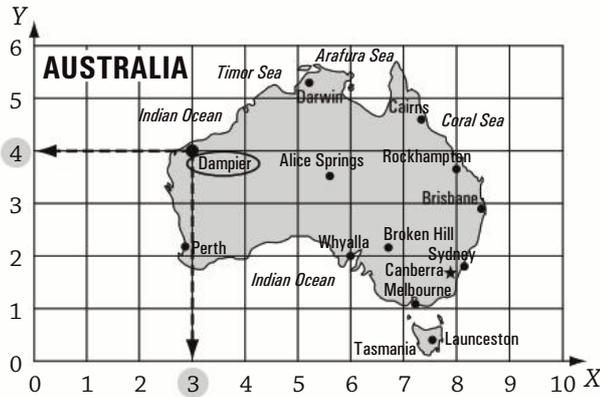


### Skill 23.3 Using coordinates to describe location on a map.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Locate the object 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 ( ,  $y$ ).
  - 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 Dampier?



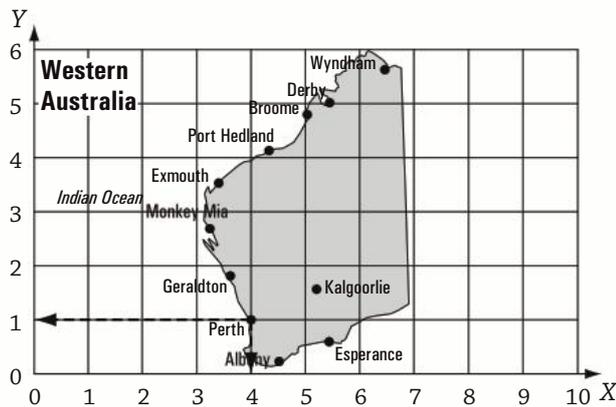
**A.** Locate Dampier on the map.

Follow the vertical line that Dampier is on, down to where it meets the horizontal axis. The  $x$ -coordinate is 3.

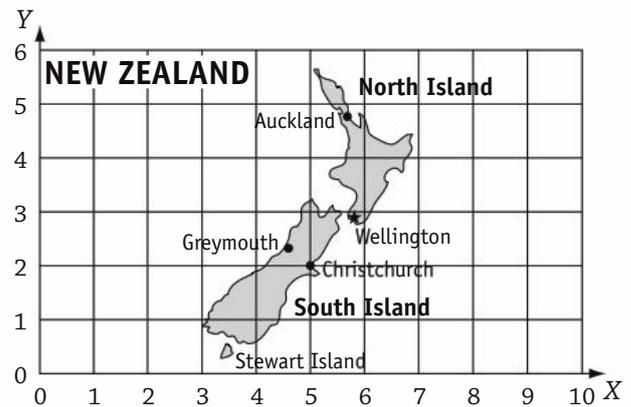
Follow the horizontal line that Dampier is on, back to where it meets the vertical axis. The  $y$ -coordinate is 4.

The coordinates that describe the location of Dampier are **(3,4)**.

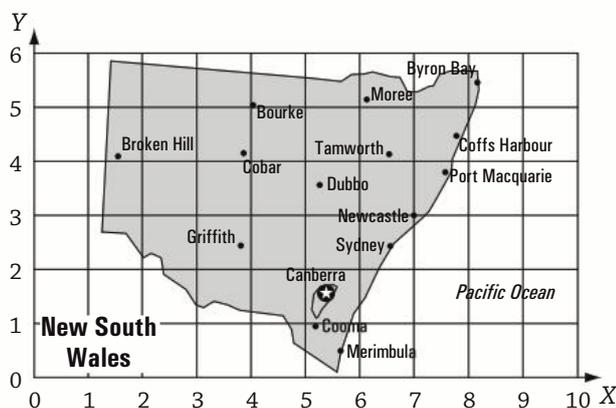
**a)** What are the coordinates of Perth?



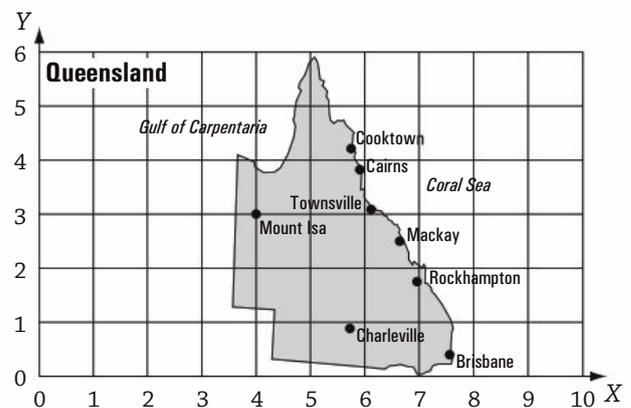

**b)** Which city is located at the coordinates (5,2)?




**c)** What are the coordinates of Newcastle?

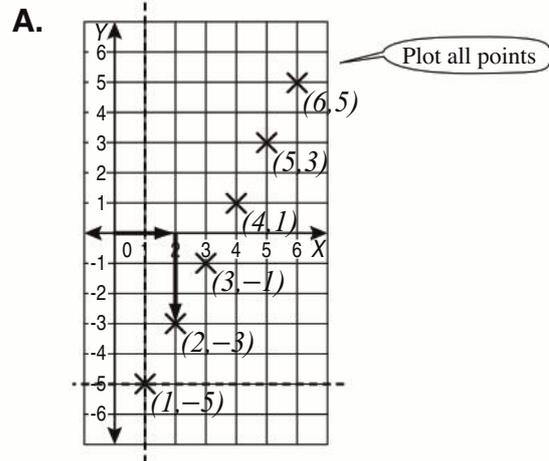
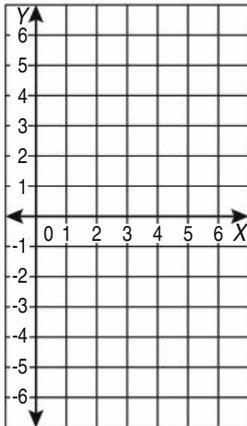



**d)** What are the coordinates of Mount Isa?

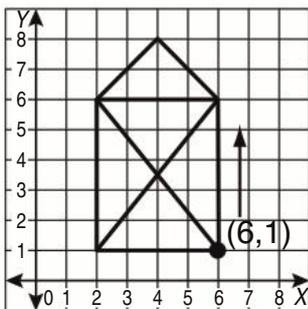


- Start at the origin (0,0) of the Cartesian plane.
- Move across the  $x$ -axis by the number of units equal to the first coordinate (move to the right if the coordinate is positive and to the left if the coordinate is negative).
- Draw a vertical line passing through this point.
- From the origin, move along the  $y$ -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.
- Plot the point at the intersection of these two lines.

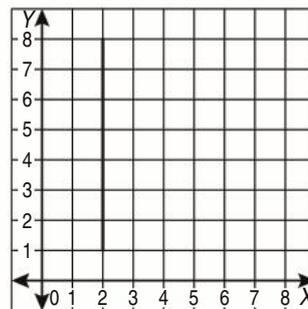
**Q.** Draw crosses at the following points:  
(1,-5), (2,-3), (3,-1), (4,1), (5,3), (6,5)



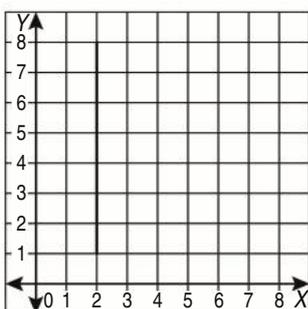
**a)** Starting at (6,1), draw a line to (6,6) then continue to (2,6), (2,1), (6,1), (2,6), (4,8), (6,6) and (2,1). What shape have you drawn?



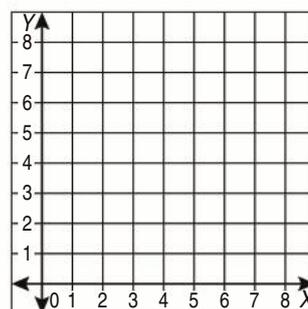

**b)** Starting at (2,8), draw a line to (3,8) then continue to (3,5), (6,5), (6,8), (7,8), (7,1), (6,1), (6,4), (3,4), (3,1) and (2,1). What letter have you drawn?




**c)** Starting at (2,8), draw a line to (7,8) then continue to (7,7), (3,7), (3,5), (6,5), (6,4), (3,4), (3,1) and (2,1). What letter have you drawn?




**d)** Plot point G at coordinates (4,7) on this Cartesian plane.

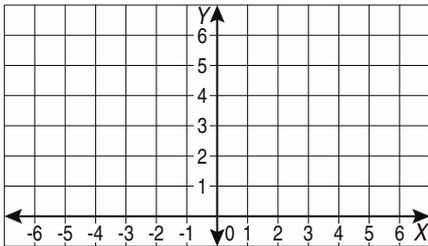


**Skill 23.4** Plotting ordered pairs on a Cartesian plane (2).

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

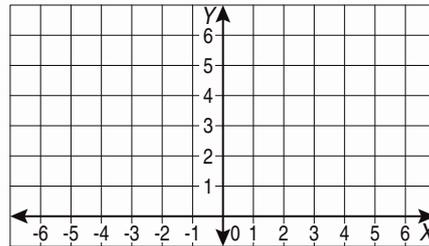
- e)** Plot the following points on this Cartesian plane:

M at coordinates  $(-6,0)$   
N at coordinates  $(3,5)$



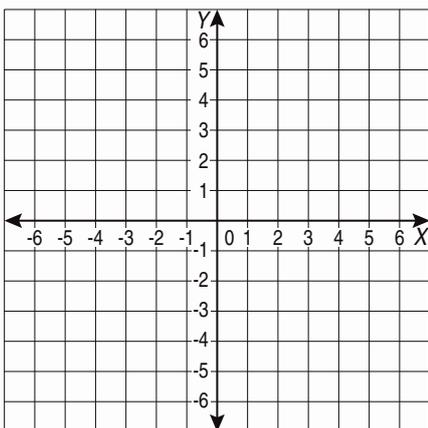
- f)** Plot the following points on this Cartesian plane:

D at coordinates  $(0,4)$   
E at coordinates  $(-4,6)$



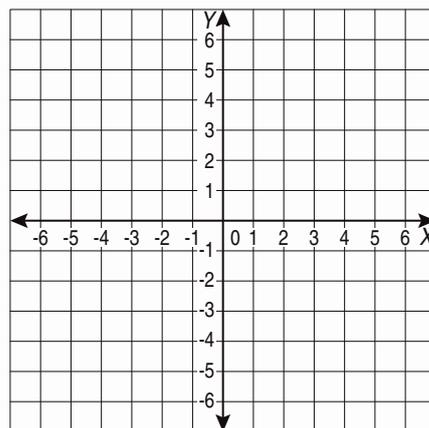
- g)** Plot the following points on this Cartesian plane:

P at coordinates  $(-5,3)$   
Q at coordinates  $(-4,-1)$   
R at coordinates  $(3,-2)$

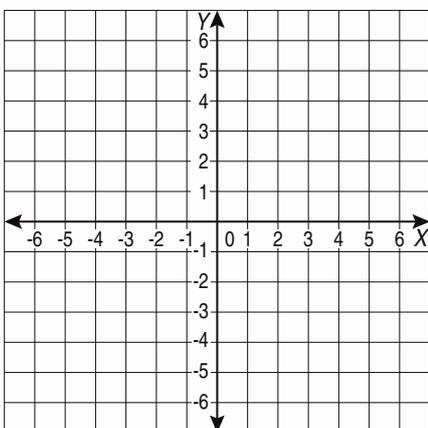


- h)** Plot the following points on this Cartesian plane:

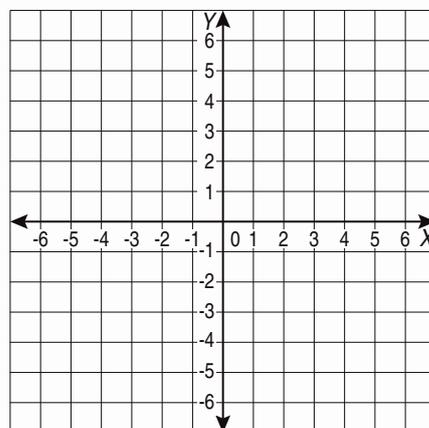
E at coordinates  $(-6,4)$   
F at coordinates  $(0,1)$   
G at coordinates  $(-3,-3)$



- i)** Draw circles at the following points:  
 $(-6,-3)$ ,  $(-4,-1)$ ,  $(-2,1)$ ,  $(0,3)$ ,  $(2,5)$



- j)** Draw circles at the following points:  
 $(-6,5)$ ,  $(-3,4)$ ,  $(0,3)$ ,  $(3,2)$ ,  $(6,1)$

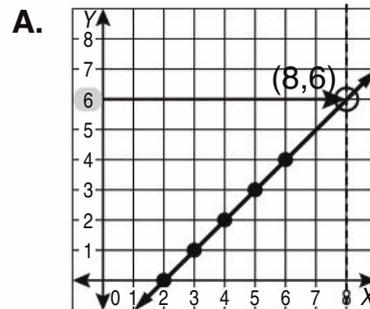
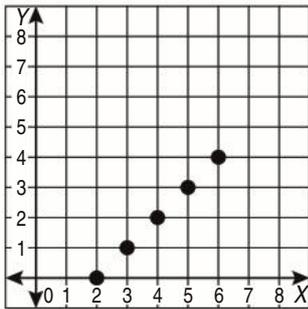


- Locate the point on the coordinate plane.
- Move vertically from the object until you intersect the horizontal axis ( $x$ -axis).
- Write the number you find on the horizontal axis as the  $x$ -coordinate of the point ( $x$ , ).
- Move horizontally from the object until you intersect the vertical axis ( $y$ -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 O are (0,0).

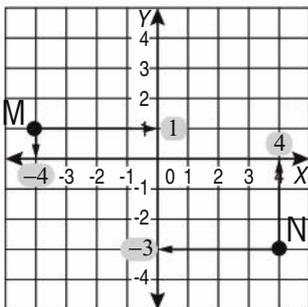
**Q.** These dots, if joined, would form a line. A point on this line has an  $x$ -coordinate of 8. What is the  $y$ -coordinate of this point?



Join the given dots. Draw a vertical line through the  $x$ -coordinate 8. Plot the point where the vertical line intersects the other line. Read the  $y$ -coordinate of this point.

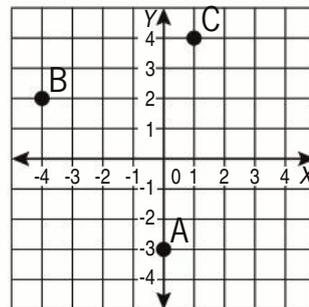
The  $y$ -coordinate is 6

**a)** What are the coordinates of the points M and N on this Cartesian plane?



M(-4, 1) N( , )

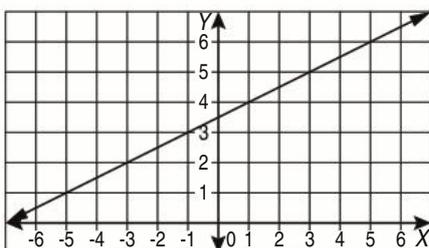
**b)** What are the coordinates of the points A, B and C on this Cartesian plane?



A( , ) B( , ) C( , )

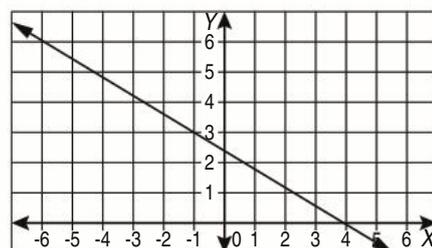
**c)** Which point lies on the line graphed below?

M(-5,1) N(0,5) P(6,6)

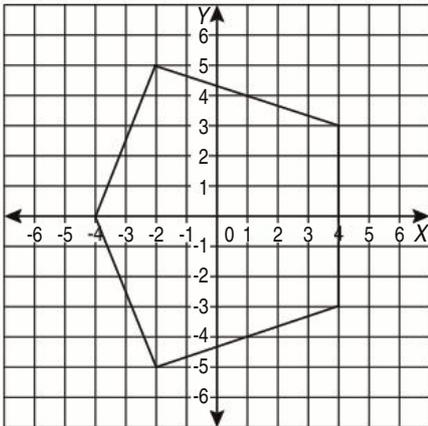



**d)** Which point lies on the line graphed below?

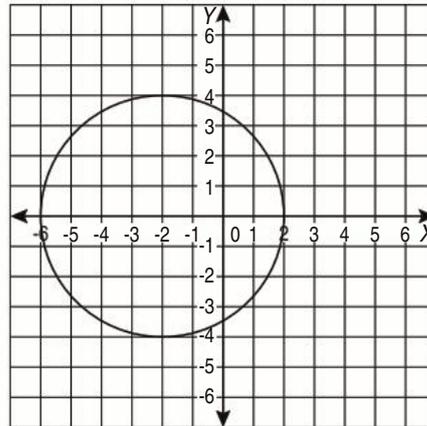
E(-4,0) F(3,3) G(-1,3)



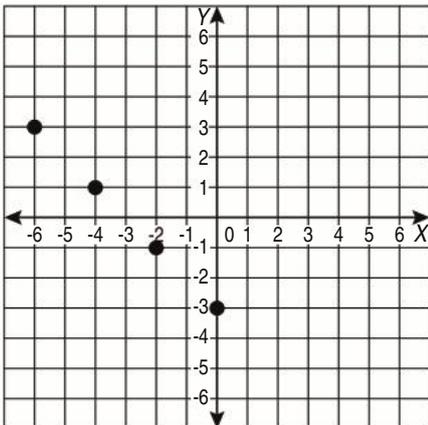
- e) Which ordered pair lies within this pentagon?  
A)  $(-6, -2)$  B)  $(-3, 4)$  C)  $(3, -2)$



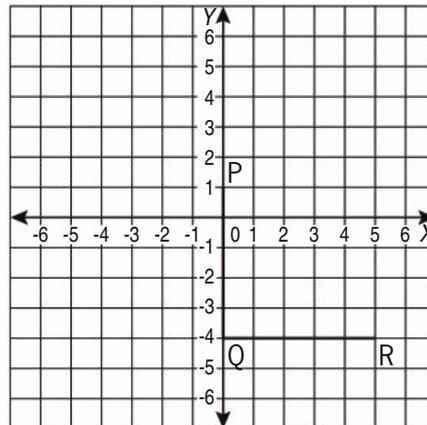

- f) Which ordered pair lies within this circle?  
A)  $(-4, 5)$  B)  $(-5, -2)$  C)  $(3, -6)$



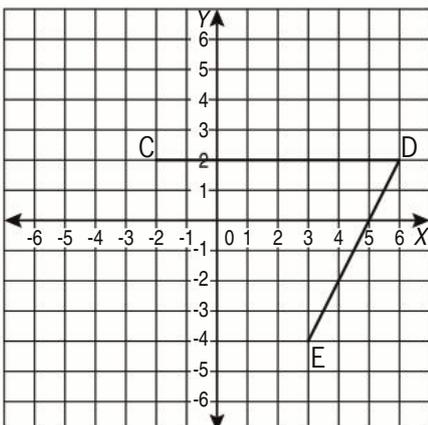

- g) These dots, if joined, would form a line. A point on this line has an  $x$ -coordinate of 3. What is the  $y$ -coordinate of this point?



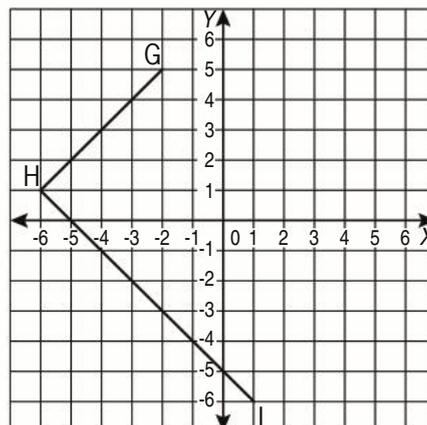

- h) What are the coordinates of point S that will make PQRS a square?




- 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 23.6** Completing a table of values for a linear rule (1).

- Substitute the variable  $x$  with the given values.
- Calculate the values of  $y$ .

**Q.** Complete the table of values for the linear rule  $y = -2 + x$

$x$	$y = -2 + x$	$y$
0	$y = -2 + 0 = -2$	-2
1		
2		
3		
4		
5		

**A.**  $y = -2 + x$   
 $x = 1 \Rightarrow y = -2 + 1 = -1$   
 $x = 2 \Rightarrow y = -2 + 2 = 0$   
 $x = 3 \Rightarrow y = -2 + 3 = 1$   
 $x = 4 \Rightarrow y = -2 + 4 = 2$   
 $x = 5 \Rightarrow y = -2 + 5 = 3$

Substitute  $x = 1$

$\Rightarrow$

$x$	$y = -2 + x$	$y$
0	$y = -2 + 0 = -2$	-2
1	$y = -2 + 1 = -1$	-1
2	$y = -2 + 2 = 0$	0
3	$y = -2 + 3 = 1$	1
4	$y = -2 + 4 = 2$	2
5	$y = -2 + 5 = 3$	3

**a)** Complete the table for this rule:

Houses sold ( $x$ )	Earnings (2000 $x$ )
1	$2000 \times 1 = 2000$
2	$2000 \times 2 = 4000$
3	$2000 \times 3 = 6000$
4	
5	
6	

**b)** Complete the table for this rule:

Number of guests ( $x$ )	Dinner cost in dollars (15 $x$ )
4	$15 \times 4 = 60$
8	
12	
16	
20	
24	

**c)** Complete the table for this rule:

No. of days ( $x$ )	Records entered (90 $x$ )
1	$90 \times 1 = 90$
2	
3	
4	
5	
6	

**d)** Complete the table for this rule:

No. of days ( $x$ )	Number of T-shirts sold (16 $x$ )
1	$16 \times 1 = 16$
2	
3	
4	
5	
6	

**e)** Complete the table for this rule:

No. of hours worked ( $x$ )	Pay in dollars (8 $x$ )
2	$8 \times 2 = 16$
4	
6	
8	
10	
12	

**f)** Complete the table for this rule:

No. of seconds ( $x$ )	Distance travelled in metres (18 $x$ )
10	$18 \times 10 = 180$
20	
30	
40	
50	
60	

- g) Complete the table of values for the linear rule  $y = x + 5$

$x$	$y = x + 5$	$y$
0	$y = 0 + 5 = 5$	5
1	$y = 1 + 5 = 6$	6
2	$y = 2 + 5 = 7$	7
3		
4		
5		

- h) Complete the table of values for the linear rule  $y = 8 - x$

$x$	$y = 8 - x$	$y$
3	$y = 8 - 3 = 5$	5
4		
5		
6		
7		
8		

- i) Complete the table of values for the linear function  $y = 7 + x$

$x$	$y = 7 + x$	$y$
0	$y = 7 + 0 = 7$	7
2		
4		
6		
8		
10		

- j) Complete the table of values for the linear function  $y = x - 4$

$x$	$y = x - 4$	$y$
0	$y = 0 - 4 = -4$	-4
1		
2		
3		
4		
5		

- k) Complete the table of values for the linear function  $y = 3x$

$x$	$y = 3x$	$y$
0	$y = 3 \times 0 = 0$	0
1		
2		
3		
4		
5		

- l) Complete the table of values for the linear function  $y = x - 6$

$x$	$y = x - 6$	$y$
1	$y = 1 - 6 = -5$	-5
2		
3		
4		
5		
6		

- m) Complete the table of values for the linear function  $y = 100 \div x$

$x$	$y = 100 \div x$	$y$
5	$y = 100 \div 5 = 20$	20
10		
20		
25		
50		
100		

- n) Complete the table of values for the linear function  $y = 2 - x$

$x$	$y = 2 - x$	$y$
0	$y = 2 - 0 = 2$	2
1		
2		
3		
4		
5		

**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.

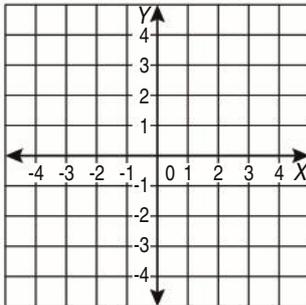
OR

- Check for special properties of the x-coordinates 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.

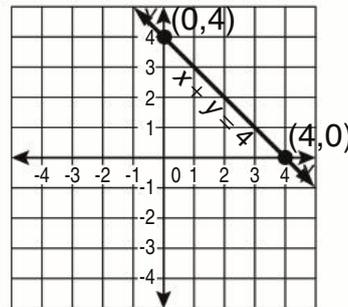
**Q.** Draw a line connecting all the points where the  $x$ -coordinate and the  $y$ -coordinate add to 4 (line of equation  $x + y = 4$ ).



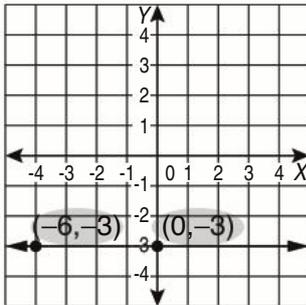
**A.**  $x + y = 4$

Choose  $x = 4$  and  $y = 0 \Rightarrow$  the point  $(4,0)$

Choose  $x = 0$  and  $y = 4 \Rightarrow$  the point  $(0,4)$



**a)**



The line above shows:

- A) All points where  $x - y = 3$
- B) All points where  $x = -3$
- C) All points where  $y = -3$

$x - y = 3$  A)  $0 - (-3) = 3$  or  $3 = 3$  (true)  $x = 0$  and  $y = -3$

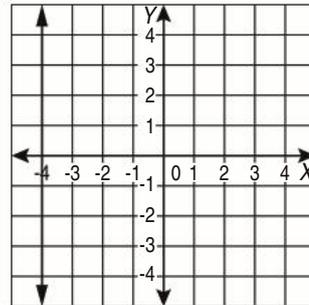
$-6 - (-3) = 3$  or  $-3 = 3$  (false)  $x = -6$  and  $y = -3$

$x = -3$  B)  $0 = -3$  (false) and  $-6 = -3$  (false)

$y = -3$  C)  $-3 = -3$  (true)

$-3 = -3$  (true)  $\Rightarrow$

**b)**



The line above shows:

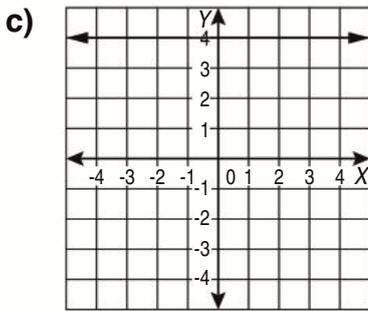
- A) All points where  $y - x = 4$
- B) All points where  $x = -4$
- C) All points where  $y = -4$

A) .....

B) .....

C) .....

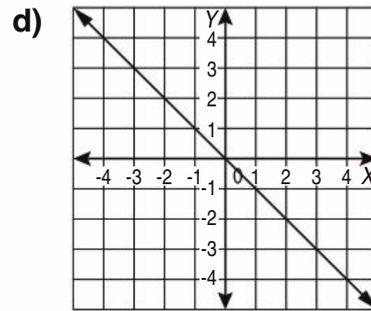
$\Rightarrow$



The line above shows:

- A) All points where  $y = 4$
- B) All points where  $x = 4$
- C) All points where  $x + y = 4$

.....  $\Rightarrow$

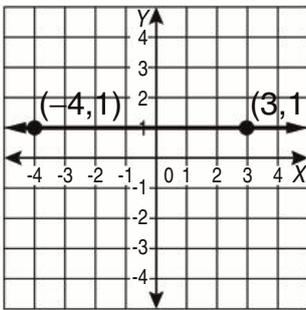


The line above shows:

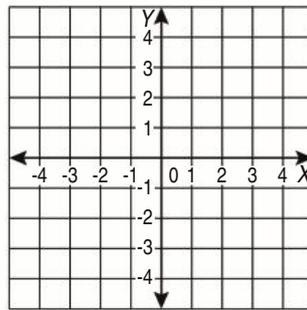
- A) All points where  $x = 0$
- B) All points where  $y = -x$
- C) All points where  $y = 0$

.....  $\Rightarrow$

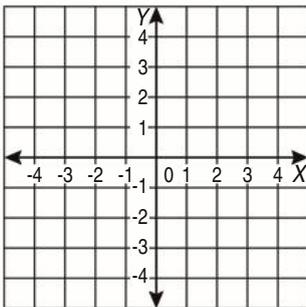
- e) Draw a line through all the points where the y-coordinate is 1.



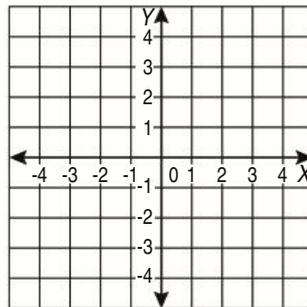
- f) Draw a line connecting all the points which have an x-coordinate of -3.



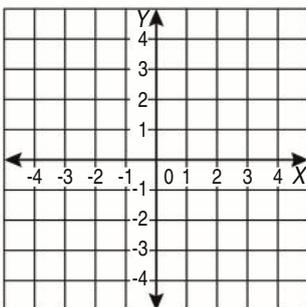
- g) Draw a line through all the points where the y-coordinate is 3 more than the x-coordinate (line of equation  $y = x + 3$ ).



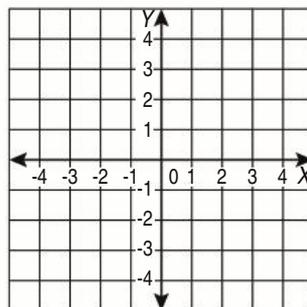
- h) Draw a line through all the points where the x-coordinate is 3 more than the y-coordinate (line of equation  $y = x - 3$ ).



- i) Draw a line through all the points where the x-coordinate and the y-coordinate add to 3 (line of equation  $x + y = 3$ ).



- j) Draw a line through all the points where the x-coordinate and the y-coordinate add to 1 (line of equation  $x + y = 1$ ).



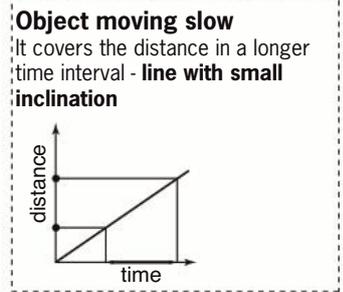
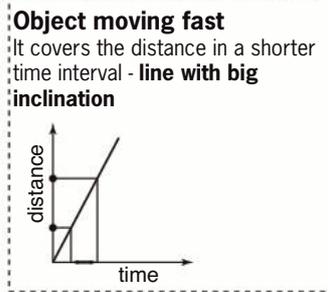
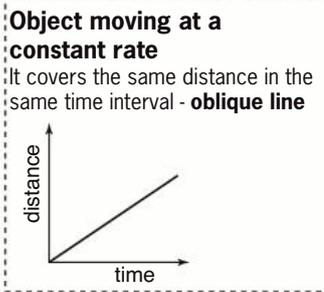
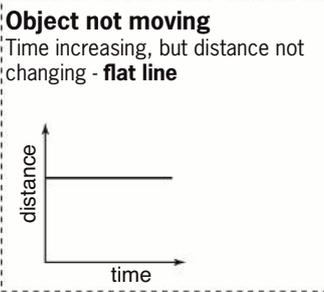
**To find the time taken to travel when the distance is given**

- 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.

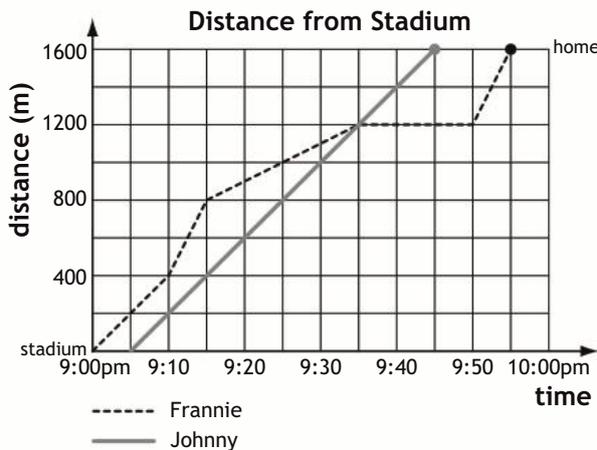
**To find the distance travelled**

- Measure the value on the vertical axis, starting from the origin of the axes.

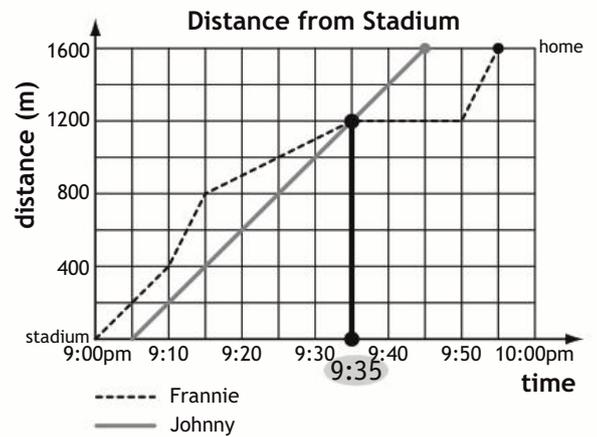
**To interpret distance-time graphs**



**Q.** Twins Johnny and Frannie walk home leaving the stadium 5 minutes apart. What time does Johnny catch up with his sister?

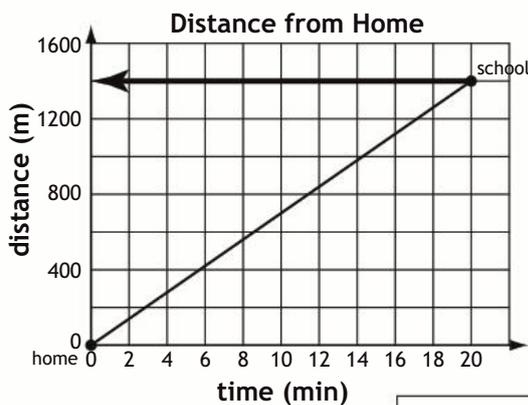


**A.**



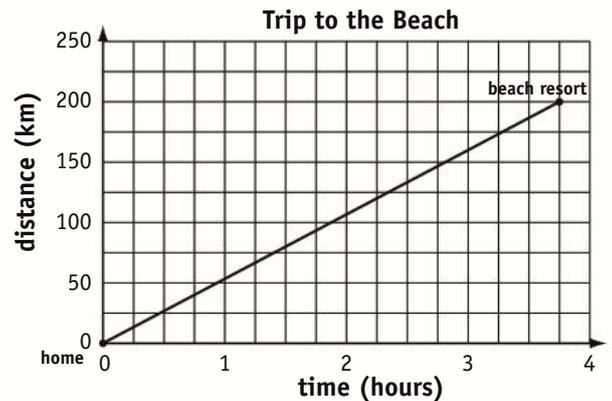
The two lines intersect at the 1200 m mark. The time corresponding with the intersection is **9:35 pm**

**a)** This graph shows Grace's distance from home as she walks to school. How far is the school from home?



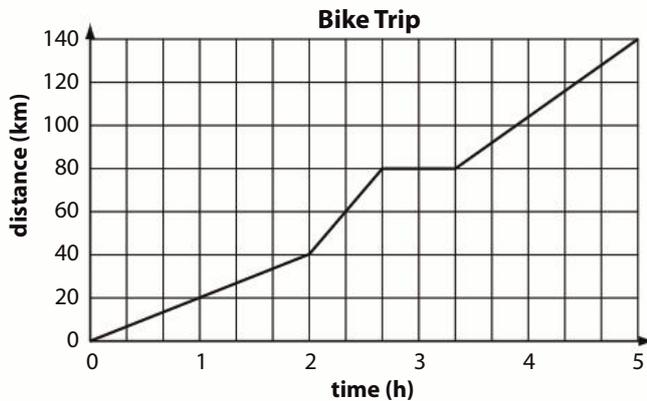
**1400 m**

**b)** Chloe leaves home at 1:00 pm. At what time does she arrive at the beach resort?



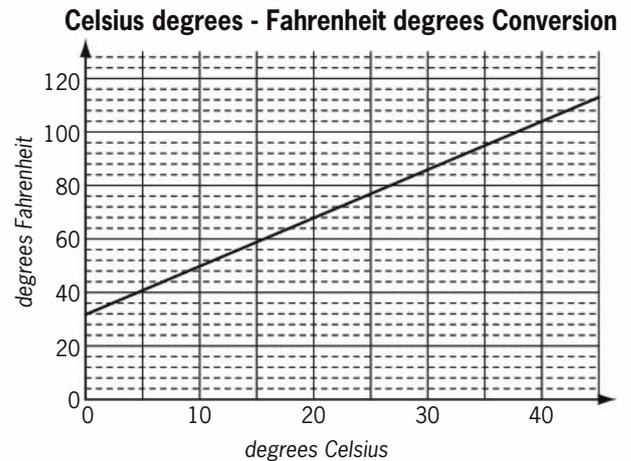
**3:00 pm**

- c) Jean-Luc is training for the Tour de France. The graph shows a 5-hour ride. How long did it take him to reach the 60 km mark? [Give the answer in hours and minutes.]



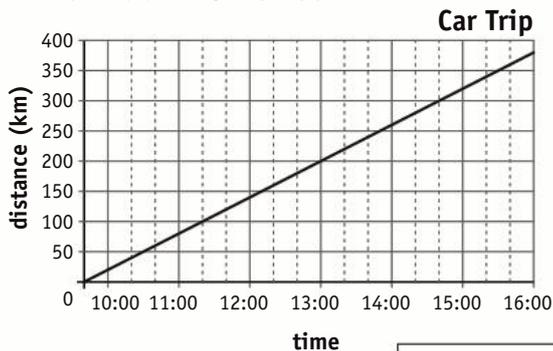
h      min

- d) Approximately how many degrees Celsius are equivalent to 104 degrees Fahrenheit?



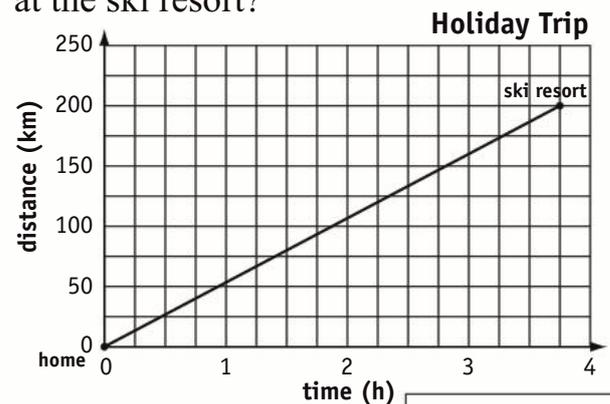
°C

- e) This graph shows the distance Felix travelled between 9:40 am and 4:00 pm. How many minutes did the car take to travel 200 kilometres?

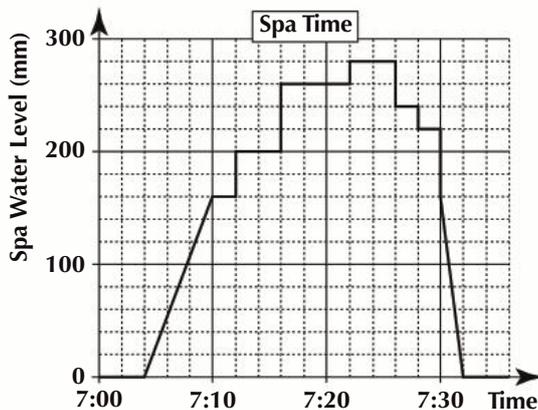


min

- f) Rebecca goes on holidays leaving home at 1:00 pm. What time does she arrive at the ski resort?

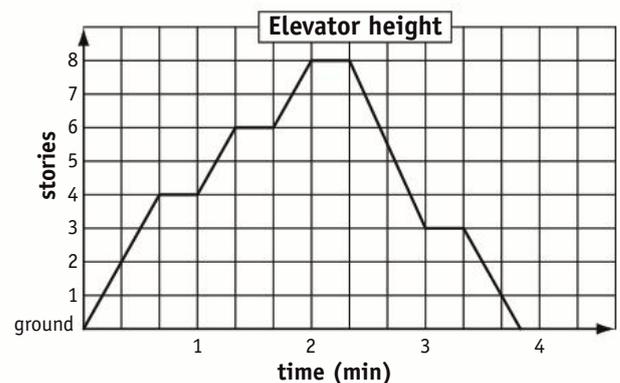


- g) At 7:12 Caitlin got into the spa, followed later by Emma and then her younger sister. For how long was Emma in the spa?

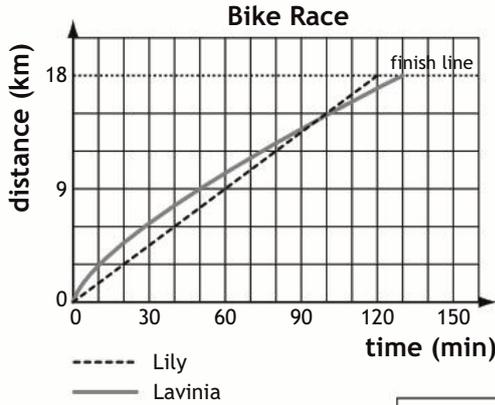


min

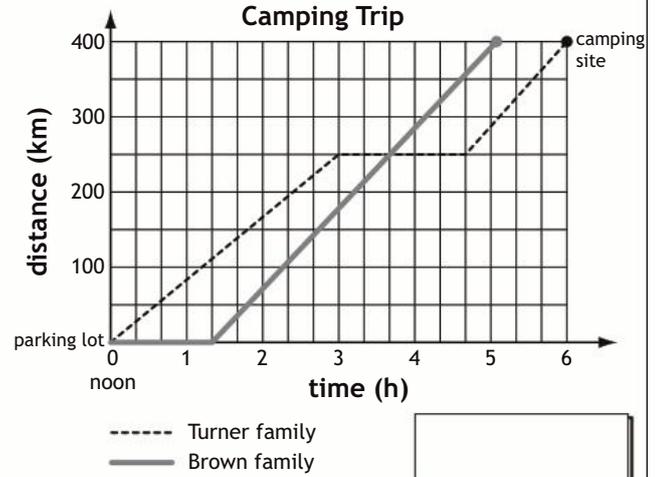
- h) This graph shows the height of an elevator in an eight-story building. How many times does the elevator stop on its way to the top?



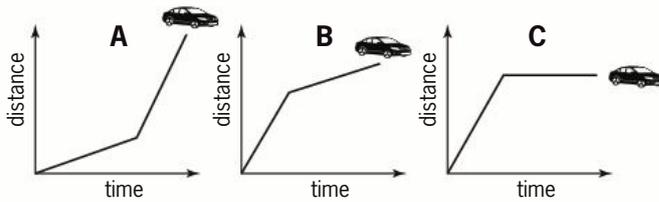
i) Lily and Lavinia had an 18-kilometre bike race. Who was winning at the half way point?



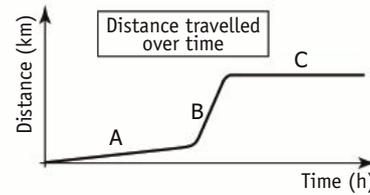

j) The Turners and the Browns leave from a parking lot at noon, to reach a camping site 400 km away. What time do they meet on their way?



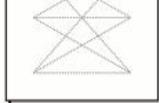

k) A car is driving on a freeway at constant speed. It then stops in a traffic jam due to an accident of the freeway. Which graph shows this?



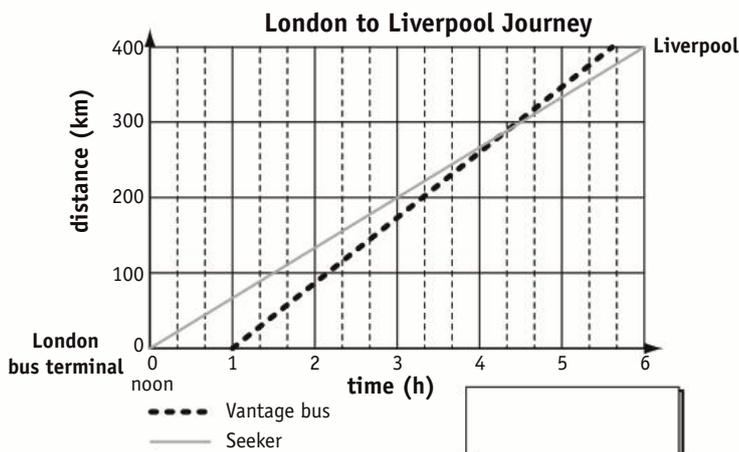

l) The graph of a trip is shown below. It is divided into 3 parts.



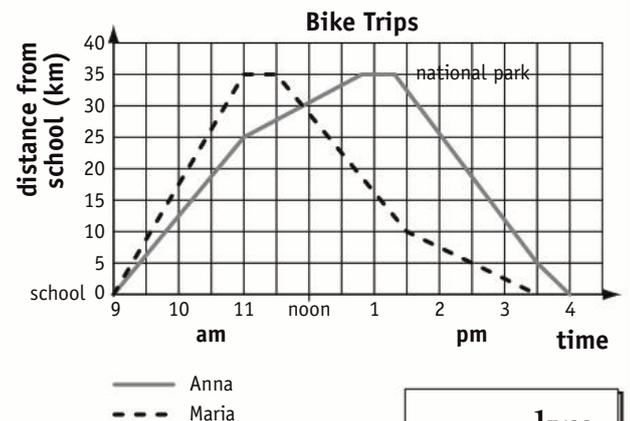
Match each part with its best description.

- A  Stopped for lunch
- B  Driving on a dirt road
- C  Driving on a freeway

m) The graph shows the distance travelled by two sightseeing buses, on the same journey from London to Liverpool. At what time does the Vantage bus overtake to Seeker bus?




n) Anna and Maria ride their bikes from school to the national park and back. How far from the park do they meet?



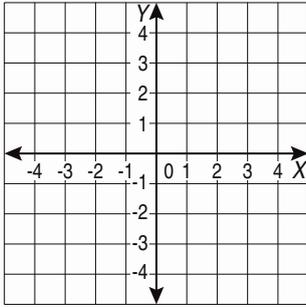
### Skill 23.9 Plotting points from a table of values on a Cartesian plane.

Blue 11 22 33 44  
Green 11 22 33 44

- For each point read the x-coordinate and the y-coordinate from the table of values.
- Plot and label each point on the Cartesian plane.

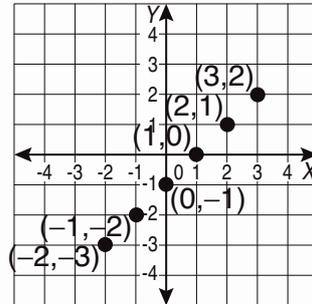
**Q.** Using the table of values, plot the points on the Cartesian plane.

<i>x</i>	-2	-1	0	1	2	3
<i>y</i>	-3	-2	-1	0	1	2



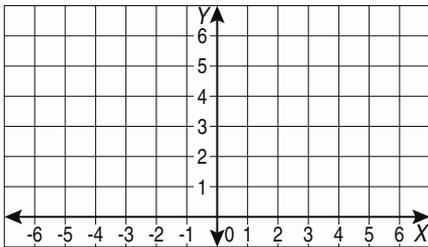
**A.** *x*-coordinate  $-2$ , *y*-coordinate  $-3$   
 $\Rightarrow$  point  $(-2, -3)$

Continue reading the ordered pairs:  
 $\Rightarrow$  points  $(-1, -2)$   $(0, -1)$   $(1, 0)$   $(2, 1)$   $(3, 2)$



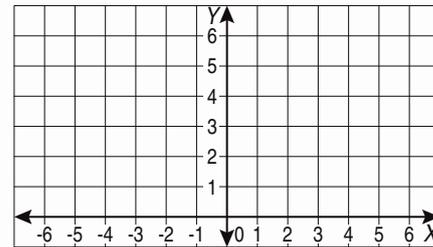
**a)** Using the table of values, plot the points on the Cartesian plane.

<i>x</i>	-4	-2	0	2	4	6
<i>y</i>	1	2	3	4	5	6



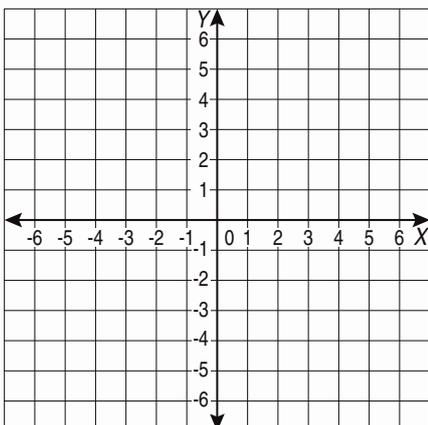
**b)** Using the table of values, plot the points on the Cartesian plane.

<i>x</i>	-6	-4	-2	0	2	4
<i>y</i>	5	4	3	2	1	0



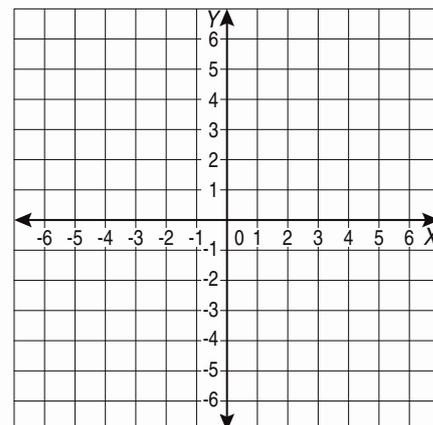
**c)** Using the table of values, plot the points on the Cartesian plane.

<i>x</i>	-3	-2	-1	0	1	2
<i>y</i>	6	4	2	0	-2	-4



**d)** Using the table of values, plot the points on the Cartesian plane.

<i>x</i>	-5	-3	-1	1	3	5
<i>y</i>	-5	-3	-1	1	3	5



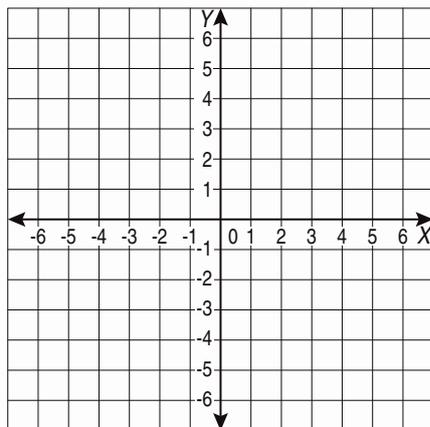
# Skill 23.10 Plotting linear graphs from a table of values on a Cartesian plane (1).

- Complete the table of values for the rule. (see skill 21.3, page 183 and skill 23.6, page 217)
- Plot each point on the Cartesian plane. (see skill 23.4, page 213)
- Draw the line that joins these points.
- Label the line with the rule.

**Q.** Graph the line of equation  $y = -2x - 1$  on the Cartesian plane below, by first completing this table of values.

[Label the graph with the equation.]

x	-2	-1	0	1	2
y	3				
(x,y)	(-2,3)	( , )	( , )	( , )	( , )



**A.**  $y = -2x - 1 = -2 \times x - 1$   $2x = 2 \times x$

$x = -1 \Rightarrow y = -2 \times -1 - 1 = 1 \Rightarrow (-1, 1)$

$x = 0 \Rightarrow y = -2 \times 0 - 1 = -1 \Rightarrow (0, -1)$

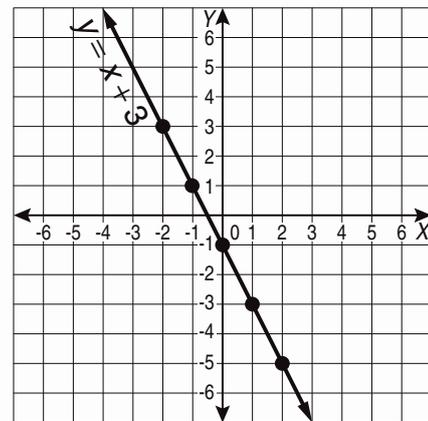
$x = 1 \Rightarrow y = -2 \times 1 - 1 = -3 \Rightarrow (1, -3)$

$x = 2 \Rightarrow y = -2 \times 2 - 1 = -5 \Rightarrow (2, -5)$

x	-2	-1	0	1	2
y	3	1	-1	-3	-5
(x,y)	(-2,3)	(-1, 1)	(0, -1)	(1, -3)	(2, -5)

Complete the table of values.

- Plot the points.
- Join the points with a line.
- Label the line with the rule  $y = -2x - 1$



**a)** Graph the line of equation  $y = -x$  on the Cartesian plane below, by first completing this table of values.

[Label the graph with the equation.]

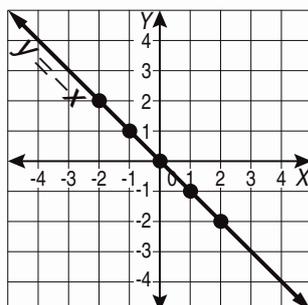
$x = -1 \Rightarrow y = -(-1) = 1 \Rightarrow (-1, 1)$

$x = 0 \Rightarrow y = -0 = 0 \Rightarrow (0, 0)$

$x = 1 \Rightarrow y = -1 \Rightarrow (1, -1)$

$x = 2 \Rightarrow y = -2 \Rightarrow (2, -2)$

x	-2	-1	0	1	2
y	2	1	0	-1	-2
(x,y)	(-2,2)	(-1, 1)	(0, 0)	(1, -1)	(2, -2)



**b)** Graph the line of equation  $y = x - 4$  on the Cartesian plane below, by first completing this table of values.

[Label the graph with the equation.]

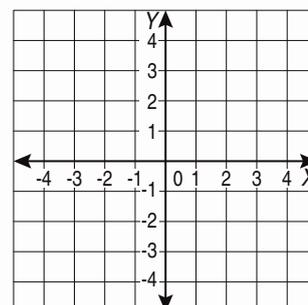
$x = 1 \Rightarrow y = 1 - 4 = -3 \Rightarrow (1, -3)$

$x = 2 \Rightarrow y = \Rightarrow$

$x = 3 \Rightarrow y = \Rightarrow$

$x = 4 \Rightarrow y = \Rightarrow$

x	0	1	2	3	4
y	-4				
(x,y)	(0, -4)	( , )	( , )	( , )	( , )



**Skill 23.10** Plotting linear graphs from a table of values on a Cartesian plane (2).

Blue 11 22 33 44  
Green 11 22 33 44

- c)** Graph the line of equation  $y = 2x$  on the Cartesian plane below, by first completing this table of values.

[Label the graph with the equation.]

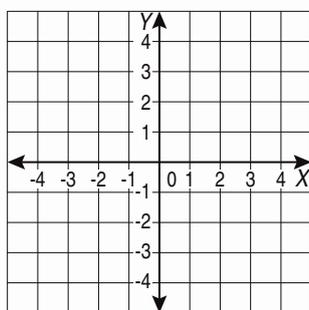
$x = -1 \Rightarrow y = 2 \times -1 = -2 \Rightarrow$

$x = 0 \Rightarrow y = \quad \Rightarrow$

$x = 1 \Rightarrow y = \quad \Rightarrow$

$x = 2 \Rightarrow y = \quad \Rightarrow$

$x$	-2	-1	0	1	2
$y$	-4				
$(x,y)$	$(-2,-4)$	$( \quad , \quad )$			



- d)** Graph the line of equation  $y = -x + 4$  on the Cartesian plane below, by first completing this table of values.

[Label the graph with the equation.]

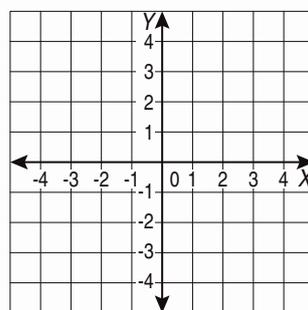
$x = 2 \Rightarrow y = \quad \Rightarrow$

$x = 3 \Rightarrow y = \quad \Rightarrow$

$x = 4 \Rightarrow y = \quad \Rightarrow$

$x = 5 \Rightarrow y = \quad \Rightarrow$

$x$	0	1	2	3	4
$y$	4				
$(x,y)$	$(0,4)$	$( \quad , \quad )$			



- e)** Graph the line of equation  $y = 3x - 1$  on the Cartesian plane below, by first completing this table of values.

[Label the graph with the equation.]

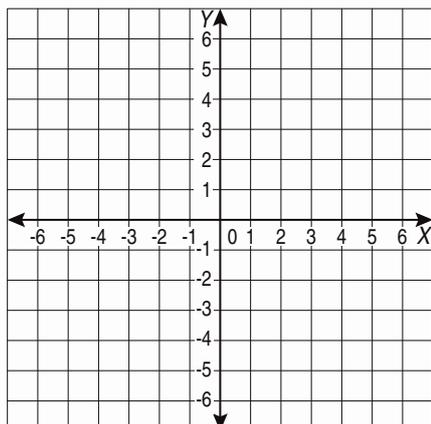
$x = -1 \Rightarrow y = \quad \Rightarrow$

$x = 0 \Rightarrow y = \quad \Rightarrow$

$x = 1 \Rightarrow y = \quad \Rightarrow$

$x = 2 \Rightarrow y = \quad \Rightarrow$

$x$	-2	-1	0	1	2
$y$	-7				
$(x,y)$	$(-2,-7)$	$( \quad , \quad )$			



- f)** Graph the line of equation  $y = -2x - 3$  on the Cartesian plane below, by first completing this table of values.

[Label the graph with the equation.]

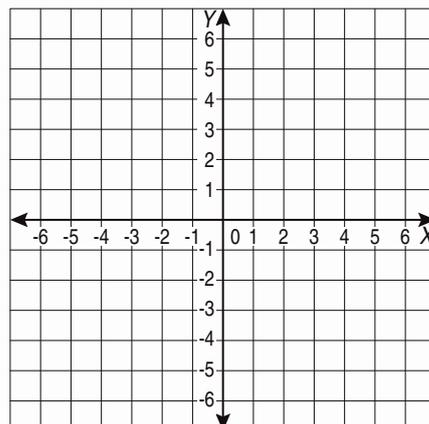
$x = -1 \Rightarrow y = \quad \Rightarrow$

$x = 0 \Rightarrow y = \quad \Rightarrow$

$x = 1 \Rightarrow y = \quad \Rightarrow$

$x = 2 \Rightarrow y = \quad \Rightarrow$

$x$	-2	-1	0	1	2
$y$	1				
$(x,y)$	$(-2,1)$	$( \quad , \quad )$			



# 24. [Units of Measurement / Time]

## Skill 24.1 Converting units of time (1).

Blue 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

### Conversion Facts - TIME

$$\begin{aligned}
 1 \text{ week} &= 7 \text{ days} = 168 \text{ h} = 10\,080 \text{ min} = 604\,800 \text{ s} \\
 1 \text{ day} &= 24 \text{ h} = 1\,440 \text{ min} = 86\,400 \text{ s} \\
 1 \text{ h} &= 60 \text{ min} = 3\,600 \text{ s} \\
 1 \text{ min} &= 60 \text{ s}
 \end{aligned}$$

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.** 5 min 20 s =  s

**A.**  $5 \text{ min } 20 \text{ s} = 5 \times 60 \text{ s} + 20 \text{ s}$  (min to s:  $\times 60$ )  
 $= 300 \text{ s} + 20 \text{ s}$   
 $= 320 \text{ s}$

**a)** 480 seconds =  minutes

(s to min:  $\div 60$ )

$480 \text{ s} = 480 \div 60 = 8 \text{ min}$

**b)** 7 hours =  minutes

(h to min:  $\times 60$ )

**c)** 3 minutes =  seconds

**d)** 180 s =  min

**e)** 9 h =  min

**f)** 240 min =  h

**g)** 300 min =  h

**h)** 5 min =  s

**i)** 4 days =  h

**j)** 3 weeks =  days

Skill 24.1 Converting units of time (2).

k) 10 years =  months

.....

l) 5 days =  h

.....

m) 90 min =  h

.....

n) 270 min =  h

.....

o) 3 h 35 min =  min

.....

p) 5 min 30 s =  s

.....

q) 4 weeks, 4 days =  days

.....

r) 2 h 50 min =  min

.....

s) 2 min 25 s =  s

.....

t) 6 h 10 min =  min

.....

u)  $2\frac{1}{3}$  days =  h

$2 \times 24 + \frac{1}{3} \times 24 = 48 + 8 = 56$  day to h:  $\times 24$

.....

v)  $3\frac{1}{4}$  h =  min

.....

w)  $\frac{3}{4}$  day =  h

.....

x)  $2\frac{1}{2}$  h =  min

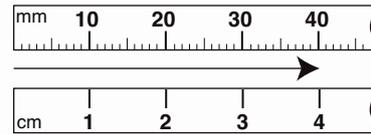
.....

**Conversion Facts - 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.**  $3800 \text{ cm} = \boxed{\phantom{000}} \text{ m}$

**A.**  $3800 \text{ cm} = 3800 \div 100 \text{ m}$  cm to m: ÷ 100  
 $= 38 \text{ m}$

**a)**  $15 \text{ cm} = \boxed{\phantom{00}} \text{ mm}$   
cm to mm: × 10

$15 \times 10 = 150$

**b)**  $60 \text{ mm} = \boxed{\phantom{00}} \text{ cm}$  mm to cm: ÷ 10

**c)**  $200 \text{ cm} = \boxed{\phantom{000}} \text{ mm}$

**d)**  $7 \text{ km} = \boxed{\phantom{000}} \text{ m}$

**e)**  $9000 \text{ m} = \boxed{\phantom{0000}} \text{ km}$

**f)**  $4 \text{ m} = \boxed{\phantom{000}} \text{ cm}$

**g)**  $13 \text{ m} = \boxed{\phantom{000}} \text{ mm}$

**h)**  $400 \text{ mm} = \boxed{\phantom{000}} \text{ cm}$

**i)**  $55 \text{ km} = \boxed{\phantom{000}} \text{ m}$

**j)**  $11\,000 \text{ m} = \boxed{\phantom{000}} \text{ km}$

## Skill 24.2 Converting units of length (2).

Blue 1 1 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

k)  $8.2 \text{ m} = \boxed{\phantom{000}} \text{ mm}$

.....

l)  $2.7 \text{ m} = \boxed{\phantom{000}} \text{ cm}$

.....

m)  $3000 \text{ m} = \boxed{\phantom{000}} \text{ km}$

.....

n)  $5000 \text{ cm} = \boxed{\phantom{000}} \text{ m}$

.....

o)  $460 \text{ m} = \boxed{\phantom{000}} \text{ cm}$

.....

p)  $4.5 \text{ cm} = \boxed{\phantom{000}} \text{ mm}$

.....

q)  $910 \text{ cm} = \boxed{\phantom{000}} \text{ m}$

.....

r)  $30 \text{ m} = \boxed{\phantom{000}} \text{ cm}$

.....

s)  $700 \text{ mm} = \boxed{\phantom{000}} \text{ m}$

.....

t)  $3.8 \text{ km} = \boxed{\phantom{000}} \text{ m}$

.....

u)  $1.6 \text{ m} = \boxed{\phantom{000}} \text{ mm}$

.....

v)  $600 \text{ m} = \boxed{\phantom{000}} \text{ km}$

.....

w)  $0.2 \text{ km} = \boxed{\phantom{000}} \text{ m}$

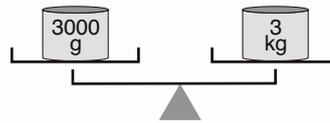
.....

x)  $3.7 \text{ m} = \boxed{\phantom{000}} \text{ mm}$

.....

**Conversion Facts - MASS**

1 tonne = 1000 kg = 1 000 000 g  
1 kg = 1000 g



To change from **smaller** units to **larger** units:

- Divide by the conversion factor (because you need less).

Example: To change g to kg ÷ by 1000

To change from **larger** units to **smaller** units:

- Multiply by the conversion factor (because you need more).

Example: To change tonnes (t) to kg × by 1000

**Q.** 4.8 kg =  g

**A.** 4.8 kg =  $4.8 \times 1000$  g kg to g: × 1000  
 =  $4.800$  3 zeros, 3 places to the right  
 = **4800 g**

**a)** 6 t =  kg t to kg: × 1000  
3 zeros, 3 places to the right  
 $6 \times 1000 = 6000$

**b)** 9000 g =  kg g to kg: ÷ 1000

**c)** 7000 kg =  tonnes

**d)** 9.3 kg =  g

**e)** 4500 g =  kg

**f)** 16000 g =  kg

**g)** 2 tonnes =  kg

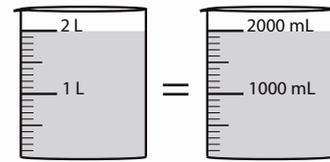
**h)** 1.9 kg =  g

**i)** 20000 g =  kg

**j)** 30000 kg =  t

**Conversion Facts - CAPACITY**

1 ML (megalitre) = 1 000 kL = 1 000 000 L  
 1 kL = 1000 L  
 1 L = 1000 mL (millilitre)



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. 3600 mL =  L

A.  $3600 \text{ mL} = 3600 \div 1000 \text{ L}$  (mL to L:  $\div 1000$ )  
 $= 3600.0$  (3 zeros, 3 places to the left)  
 $= 3.6 \text{ L}$

a) 1.5 L =  mL  
 (L to mL:  $\times 1000$ )  
 $1.5 \times 1000 = 1500$

b) 8 L =  mL

c) 22 L =  mL

d) 4000 mL =  L

e) 70 L =  mL

f) 20.3 L =  mL

g) 0.9 L =  mL

h) 6.4 L =  mL

i) 20000 mL =  L

j) 15.3 L =  mL

k) 100 mL =  L

l) 950 mL =  L

**Skill 24.5** Converting units of time, length, mass and capacity by using real-life facts.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Use the conversion factors to convert the units of time, length, mass and capacity. (see skills 24.1 to 24.4, pages 227 to 232)

**Q.** The ruby throated hummingbird can beat its wings at a rate of 4200 beats per minute. Is this more or less than 200 000 beats per hour?

**A.** 4200 beats in a minute  
 $1\text{ h} = 60\text{ min}$   
 $\Rightarrow 4200 \times 60\text{ min} = 252\,000\text{ beats in an hour}$   
 $252\,000 > 200\,000$   
 $\Rightarrow$  The answer is **more**.

**a)** The longest river in the world is the Nile (North-East Africa). It is 6655 km long. Express this in metres.

km to m:  $\times 1000$

$$6655 \times 1000\text{ m} = 6\,655\,000\text{ m}$$

.....  
 m

**b)** A water efficient shower head uses approximately 9 litres of water per minute. Express this in millilitres.

.....  
 mL

**c)** The average weight of an adult blue whale is 120 tonnes. Express this in kilograms.

.....  
 kg

**d)** Bamboo can grow up to 1 metre in a day. How many centimetres is this?

.....  
 cm

**e)** The first athlete to run a mile in under four minutes was Australian distance champion John Landy, who ran it in 3 minutes and 58 seconds. Express this in seconds.

.....  
 s

**f)** The newborns' average respiratory rate is 45 breaths per minute. Is this more than or less than 3000 breaths per hour?

.....

**g)** The average weight of a small car is about 1300 kg. Express this weight in tonnes.

.....  
 t

**h)** The average adult has about 4.5 L of blood circulating inside the body. Express this in millilitres.

.....  
 mL

**i)** An average sized mare can give birth to a foal weighing about 45 kg. Express this in grams.

.....  
 g

**j)** Carbonated soft drink cans are typically 330 mL. How many litres of drink is this?

.....  
 L

**Skill 24.6** Finding the elapsed time between two events.

- Calculate the time until the next closest hour.  
**am to pm**
- Add the time to midday.
- Then add the remaining time.

- **pm to am**
- Add the time to midnight.
- Then add the remaining time.

**Q.** The school canteen operates daily between at 10:30 am and 2:15 pm. How long, in hours and minutes, is the school canteen open daily?

**A.**  $10:30 \text{ am to } 11:00 \text{ am} = 30 \text{ min}$   
 $11:00 \text{ am to } 12:00 \text{ pm} = 1 \text{ h}$   
 $12:00 \text{ pm to } 2:15 \text{ pm} = 2 \text{ h } 15 \text{ min}$   
 $30 \text{ min} + 1 \text{ h} + 2 \text{ h } 15 \text{ min}$   
 $= 3 \text{ h } 45 \text{ min}$

**a)** Find the time in hours and minutes between 7:40 am and 4:00 pm the same day.

$7:40 \text{ to } 8:00 = 20 \text{ min}, 8:00 \text{ to } 12:00 = 4 \text{ h}$

$12:00 \text{ to } 4:00 = 4 \text{ h}$

$20 \text{ min} + 4 \text{ h} + 4 \text{ h} \Rightarrow$

**b)** The school concert begins at 4:30 pm and ends at 7:00 pm. How long is the concert in hours and minutes?

.....

.....

$\Rightarrow$

**c)** The movie starts at 6:15 pm and finishes at 9:10 pm. How long is the movie in hours and minutes?

.....

.....

$\Rightarrow$

**d)** Find the time in hours and minutes between 8:20 pm and 1:40 am the next day.

.....

.....

$\Rightarrow$

**e)** Find the time in hours and minutes between 5:00 am and 3:35 pm on the same day.

.....

.....

$\Rightarrow$

**f)** Find the time in hours and minutes between 09:40 and 18:20 on the same day.

.....

.....

$\Rightarrow$

**To calculate the time ahead**

- Add the time difference to the given time (count forward on the clock).

**To calculate the time behind**

- Subtract the time difference from the given time (count backward on the clock).

**To calculate the time difference**

- Subtract the two given times.

**Q.** A Virgin Blue flight departs Gold Coast at 12:05 pm and arrives in Perth the same day at 5:05 pm. If Perth time is 2 hours behind Gold Coast time how long was the flight?

**A.** Gold Coast departure time = 12:05 pm  
 (Perth time = 12:05 less 2 h = 10:05 am)  
 Perth arrival time = 5:05 pm  
 Flight time (using Perth time) =  
 10:05 am to 5:05 pm  
 = 7 h

**a)** It is 10:15 pm in Sydney. If London time is 9 hours behind Sydney time, what time is it in London?

subtract the time difference

London time = 10:15 pm less 9 h

⇒

**b)** You live in Canberra and want to call Grandma in Darwin, at noon, on Christmas day, Darwin time. If Darwin time is 1.5 h behind Canberra time, at what time should you call?

⇒

**c)** Roger is in Brisbane and wants to ring Alina in Los Angeles (LA) at midnight on New Year, LA time. If LA time is 17 hours behind Brisbane time, at what time in Brisbane should he call?

⇒

**d)** Sven is in Melbourne and wants to ring Oscar in London at 9:00 am London time. If London time is 11 h behind Melbourne time, at what time in Melbourne should he call?

⇒

**e)** It is Sunday, 1825 hours in Shanghai, China, and Sunday, 2125 hours in Sydney. By how many hours is Shanghai time behind Sydney time?

⇒

**f)** A Qantas flight departs Sydney on Friday at 5:40 pm and arrives in Singapore on Friday at 10:30 pm. If Singapore time is 3 hours behind Sydney time, how long is the flight?

⇒



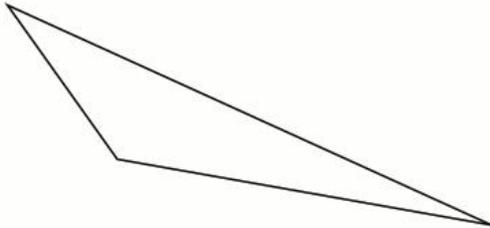
# 25. [Perimeter]

**Skill 25.1** Finding the perimeter of polygons by measuring their side lengths.

Blue 11 22 33 44  
Green 11 22 33 44

- Measure each side length of the shape.
- Add together the side lengths.

**Q.** Use a ruler to find the perimeter of the scalene triangle in millimetres.



Start here

**A.**  $70\text{ mm} + 50\text{ mm} + 25\text{ mm}$   
 $= 145\text{ mm}$

25 mm

70 mm

50 mm

Measure the side lengths.  
Write down the lengths next to each side.

**a)** Use a ruler to find the perimeter of the square in centimetres.



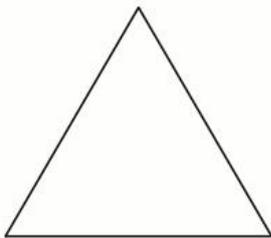
..... =  cm

**b)** Use a ruler to find the perimeter of the rectangle in millimetres



..... =  mm

**c)** Use a ruler to find the perimeter of the right-angled triangle in centimetres.



..... =  cm

**d)** Use a ruler to find the perimeter of the trapezium in centimetres.



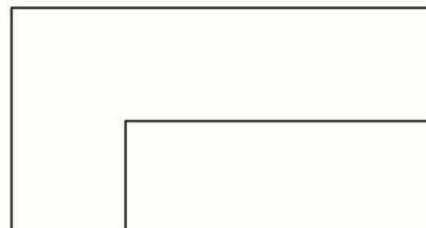
..... =  cm

**e)** Use a ruler to find the perimeter of the parallelogram in millimetres.



..... =  mm

**f)** Use a ruler to find the perimeter of the polygon in millimetres.



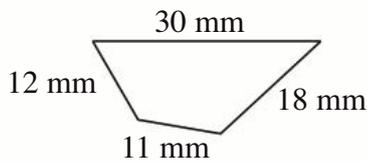
..... =  mm

**Skill 25.2** Calculating the perimeter of polygons when all side lengths are given (1).

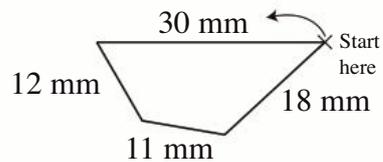
Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Add together the side lengths.

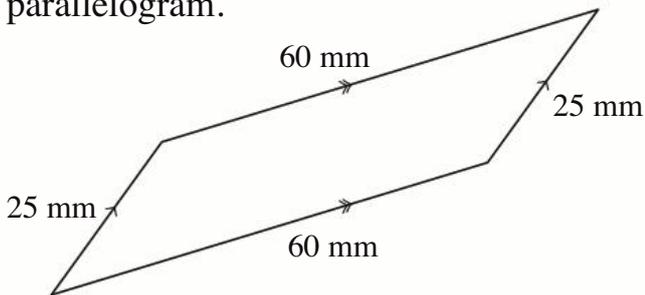
**Q.** Calculate the perimeter of the quadrilateral.



**A.**  $30\text{ mm} + 12\text{ mm} + 11\text{ mm} + 18\text{ mm}$   
 $= 71\text{ mm}$

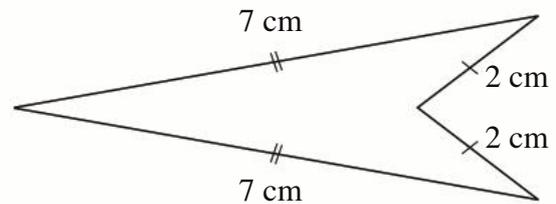


**a)** Calculate the perimeter of the parallelogram.



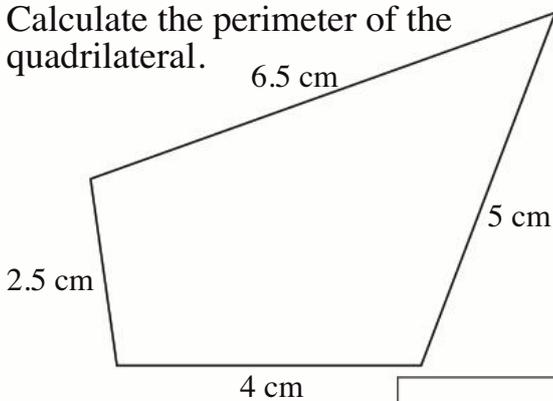
$25 + 60 + 25 + 60 = \boxed{\text{mm}}$

**b)** Calculate the perimeter of the polygon.



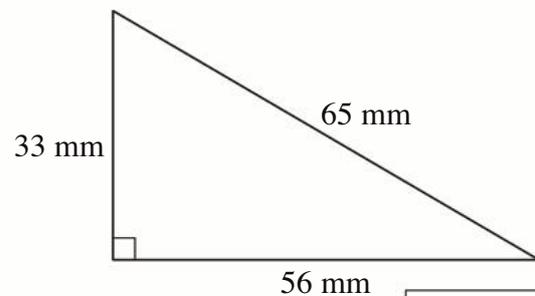
..... =  $\boxed{\text{cm}}$

**c)** Calculate the perimeter of the quadrilateral.



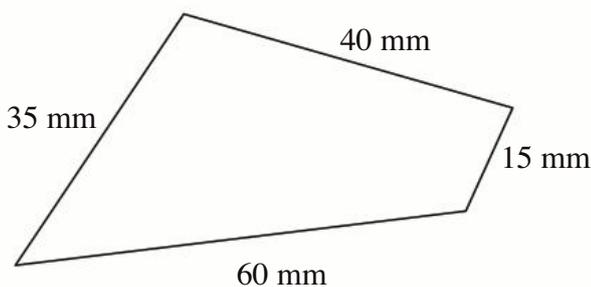
..... =  $\boxed{\text{cm}}$

**d)** Calculate the perimeter of the right-angled triangle.



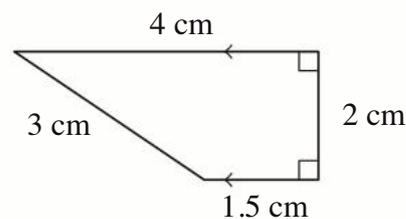
..... =  $\boxed{\text{mm}}$

**e)** Calculate the perimeter of the quadrilateral.



..... =  $\boxed{\text{mm}}$

**f)** Calculate the perimeter of the trapezium.

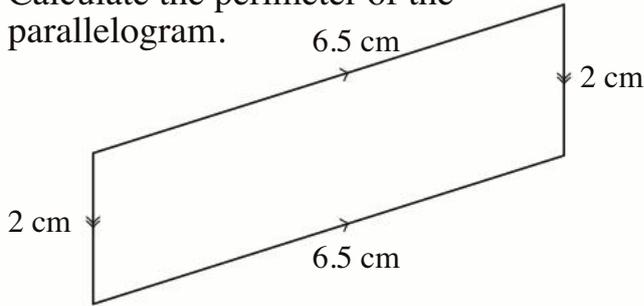


..... =  $\boxed{\text{cm}}$

**Skill 25.2** Calculating the perimeter of polygons when all side lengths are given (2).

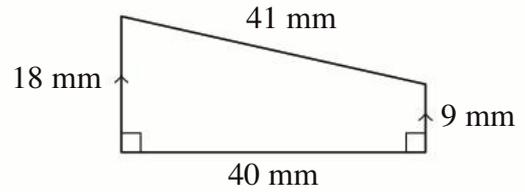
Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

**g)** Calculate the perimeter of the parallelogram.



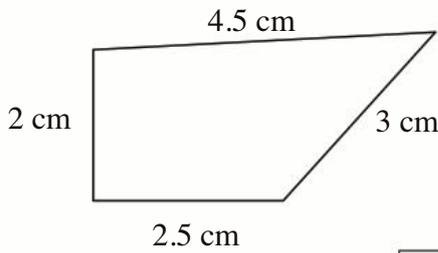
$6.5 + 2 + 6.5 + 2 = \boxed{\text{cm}}$

**h)** Calculate the perimeter of the trapezium.



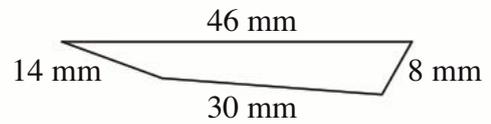
$\dots\dots\dots = \boxed{\text{mm}}$

**i)** Calculate the perimeter of the quadrilateral.



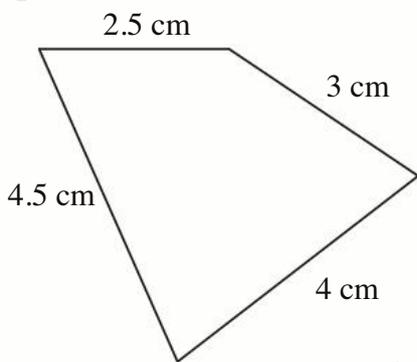
$\dots\dots\dots = \boxed{\text{cm}}$

**j)** Calculate the perimeter of the quadrilateral.



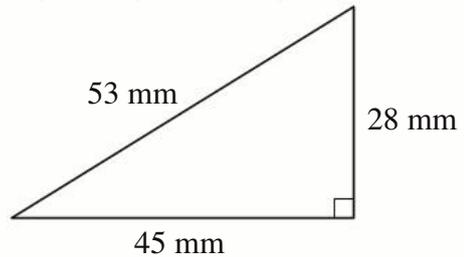
$\dots\dots\dots = \boxed{\text{mm}}$

**k)** Calculate the perimeter of the quadrilateral.



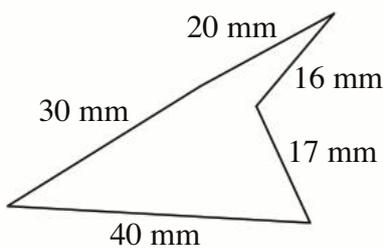
$\dots\dots\dots = \boxed{\text{cm}}$

**l)** Calculate the perimeter of the right-angled triangle.



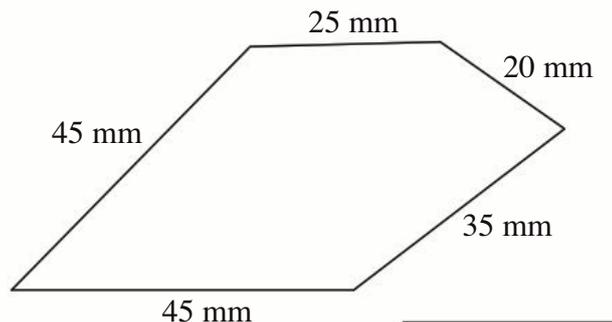
$\dots\dots\dots = \boxed{\text{mm}}$

**m)** Calculate the perimeter of the polygon.



$\dots\dots\dots = \boxed{\text{mm}}$

**n)** Calculate the perimeter of the polygon.



$\dots\dots\dots = \boxed{\text{mm}}$

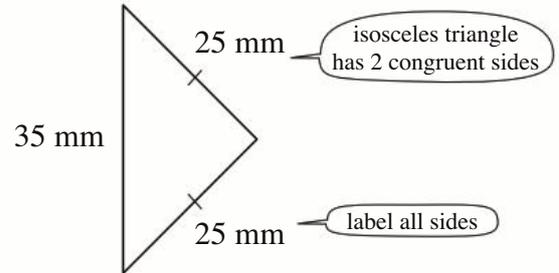
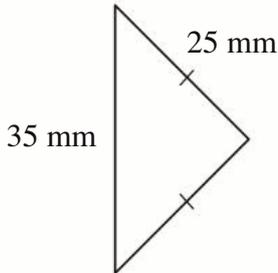
**Skill 25.3** Calculating the perimeter of polygons by recognising congruent sides.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

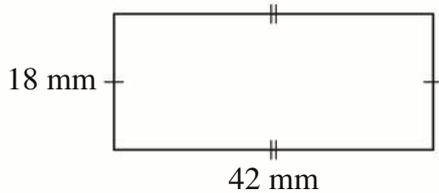
- Determine and label all side lengths.  
Hint: Sides marked with a dash (|) are of equal length.  
Sides marked with two dashes (||) are of equal length etc.
- Add together the side lengths.

**Q.** Calculate the perimeter of the isosceles triangle.

**A.**  $25\text{ mm} + 25\text{ mm} + 35\text{ mm}$   
 $= 85\text{ mm}$

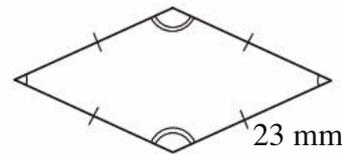


**a)** Calculate the perimeter of the regular pentagon.



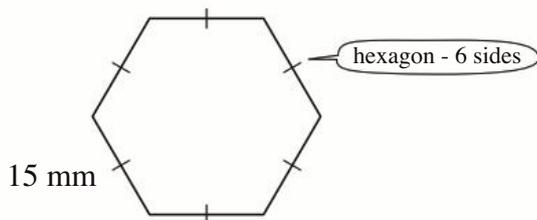
$18 + 42 = \boxed{\text{mm}}$

**b)** Calculate the perimeter of the rhombus.



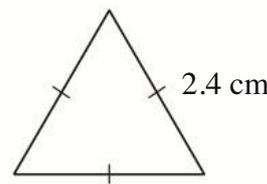
$\dots = \boxed{\text{mm}}$

**c)** Calculate the perimeter of the regular hexagon.



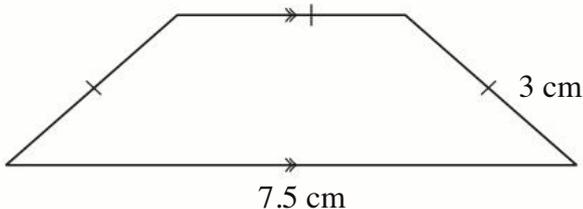
$\dots = \boxed{\text{mm}}$

**d)** Calculate the perimeter of the equilateral triangle.



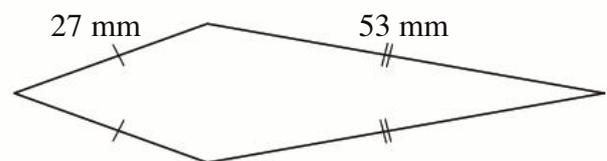
$\dots = \boxed{\text{cm}}$

**e)** Calculate the perimeter of the trapezium.



$\dots = \boxed{\text{cm}}$

**f)** Calculate the perimeter of the kite.



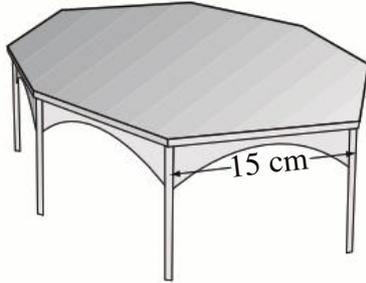
$\dots = \boxed{\text{mm}}$

**Skill 25.4** Calculating the perimeter of polygons using real-life examples.

Blue 11 22 33 44  
Green 11 22 33 44

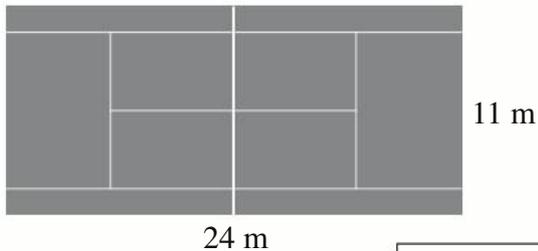
- Determine and label all side lengths.  
Hint: Sides marked with a dash (|) are of equal length.  
Sides marked with two dashes (||) are of equal length etc.
- Add together the side lengths.

**Q.** Calculate the perimeter of the regular octagonal table top.



**A.**  $15 + 15 + 15 + 15 + 15 + 15 + 15 + 15$   
 $= 15 \times 8$   
 $= 120 \text{ cm}$

**a)** What is the perimeter of the rectangular tennis court?



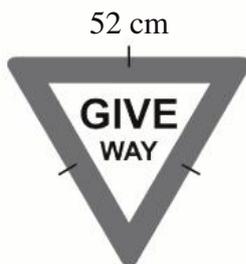
..... =  m

**b)** What is the perimeter of the rectangular banknote?



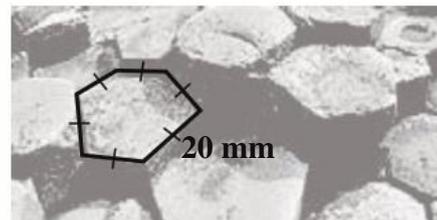
..... =  mm

**c)** What is the perimeter of this triangular road sign?



..... =  cm

**d)** What is the perimeter of the upper surface of this regular hexagonal column of basalt seen at the Giant's Causeway in Ireland?



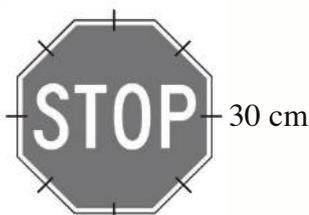
..... =  mm

**e)** What is the perimeter of this square road sign?



..... =  cm

**f)** What is the perimeter of this octagonal road sign?



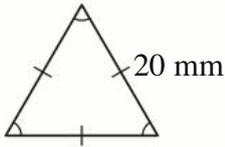
..... =  cm

## Skill 25.5 Calculating the perimeter of polygons using unit conversions.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Convert all measurements to the same unit. (see skill 24.2, page 229)
- 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.

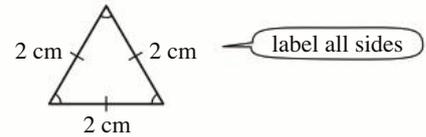
**Q.** Calculate the perimeter of the equilateral triangle in centimetres.



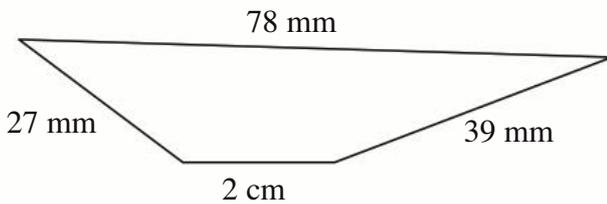
**A.**  $20 \text{ mm} = 20 \div 10 \text{ cm} = 2 \text{ cm}$  mm to cm:  $\div 10$

$$P = 3 \times 2$$

$$= \mathbf{6 \text{ cm}}$$

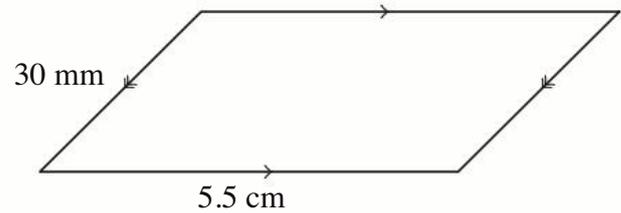


**a)** Calculate the perimeter of the trapezoid in millimetres.



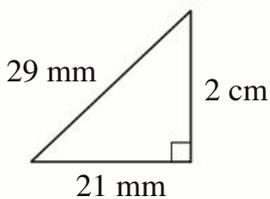
$P =$  mm

**b)** Express all measurements in centimetres and then find the perimeter of the parallelogram.



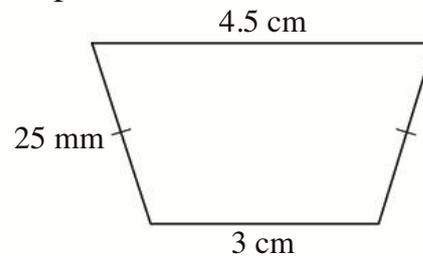
$P =$  cm

**c)** Express all measurements in millimetres and then find the perimeter of the right-angled triangle.



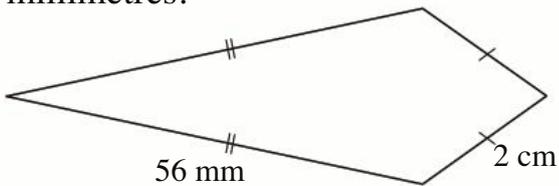
$P =$  mm

**d)** Calculate the perimeter of the trapezium in centimetres.



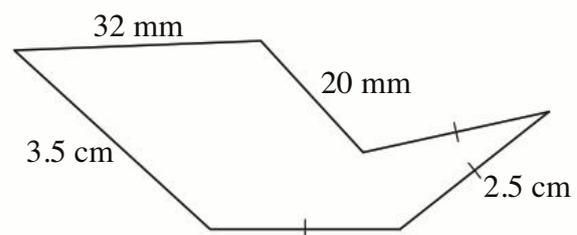
$P =$  cm

**e)** Calculate the perimeter of the kite in millimetres.



$P =$  mm

**f)** Calculate the perimeter of this polygon in centimetres.



$P =$  cm

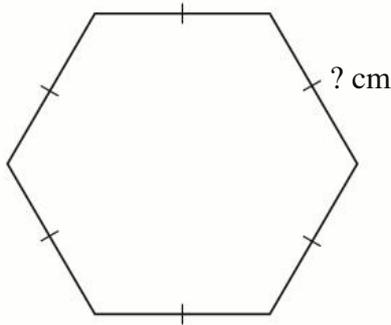
EITHER

- 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 hexagon is 132 cm. What is the length of a side?



**A.** If ? represents the length of a side:

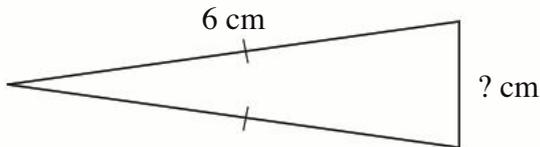
$$\text{Perimeter} = 132 \text{ cm}$$

$$6 \times ? = 132$$

$$? = 132 \div 6$$

$$? = \mathbf{22 \text{ mm}}$$

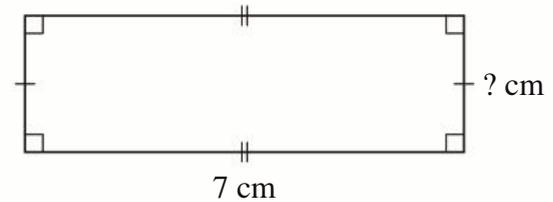
**a)** The perimeter of this isosceles triangle is 14.5 cm. Find the missing side length.



$$P = 6 + 6 + ?$$

$$12 + ? = 14.5 \quad \text{so } ? = \boxed{\text{cm}}$$

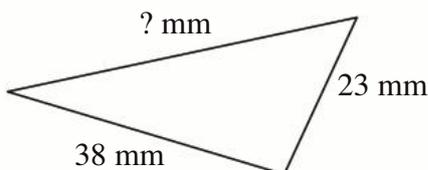
**b)** The perimeter of the rectangle is 20 cm. Find the missing side length.



$$P =$$

$$= \quad \text{so } ? = \boxed{\text{cm}}$$

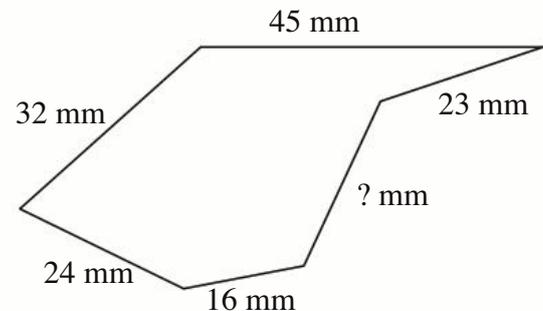
**c)** The perimeter of this scalene triangle is 108 mm. Find the missing side length.



$$P =$$

$$= \quad \text{so } ? = \boxed{\text{mm}}$$

**d)** The perimeter of this polygon is 165 mm. Find the missing side length.



$$P =$$

$$= \quad \text{so } ? = \boxed{\text{mm}}$$

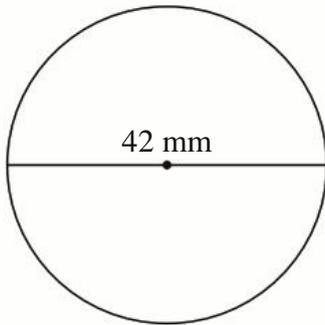
**Skill 25.7** Calculating the circumference of circles (1).

Blue 11 22 33 44  
Green 11 22 33 44

- Substitute the known values into the formula for the circumference of a circle.

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  $r = 21$   $r = \frac{d}{2}$

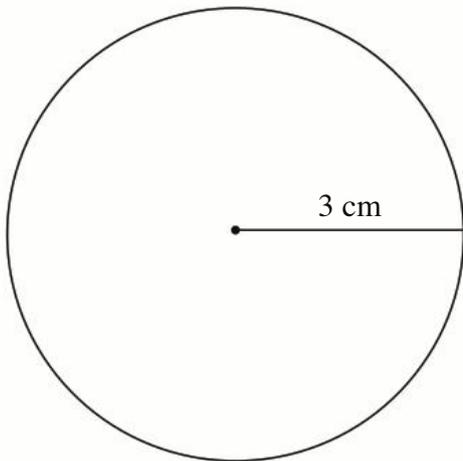
$$= 2 \times \frac{22}{7} \times 21$$

Simplify:  $\div 7$

$$= 44 \times 3$$

$$= \mathbf{132 \text{ mm}}$$

**a)** Using  $C = 2\pi r$  where  $\pi \approx 3.14$ , calculate the circumference of the circle.

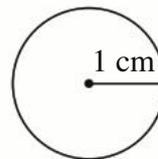


$$C = 2\pi r = 2 \times 3.14 \times 3$$


---


$$= 6 \times 3.14 = \mathbf{cm}$$

**b)** Using  $C = 2\pi r$  where  $\pi \approx 3.14$ , calculate the circumference of the circle.

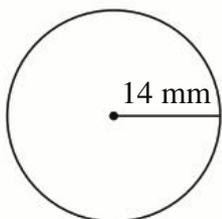


$$C =$$


---


$$= \mathbf{cm}$$

**c)** Using  $C = 2\pi r$  where  $\pi \approx \frac{22}{7}$ , calculate the circumference of the circle.

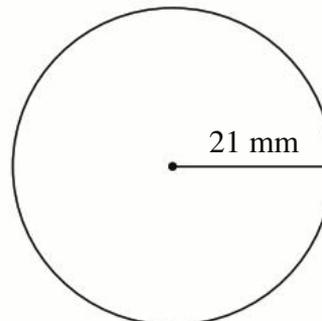


$$C =$$


---


$$= \mathbf{mm}$$

**d)** Using  $C = 2\pi r$  where  $\pi \approx \frac{22}{7}$ , calculate the circumference of the circle.

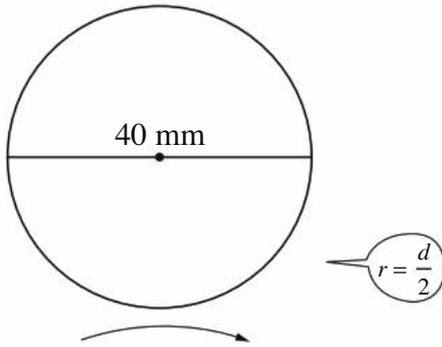


$$C =$$


---


$$= \mathbf{mm}$$

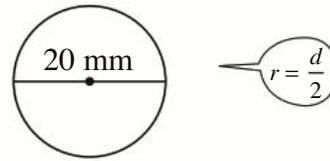
- e) Using  $C = 2\pi r$  where  $\pi \approx 3.14$ , calculate the circumference of the circle.



$$C = 2 \times 3.14 \times 20 \text{ where } d = 40 \text{ and } r = 20$$

$$= 40 \times 3.14 = \boxed{\text{mm}}$$

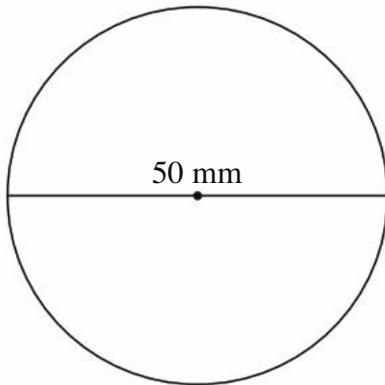
- f) Using  $C = 2\pi r$  where  $\pi \approx 3.14$ , calculate the circumference of the circle.



$$C =$$

$$= \boxed{\text{mm}}$$

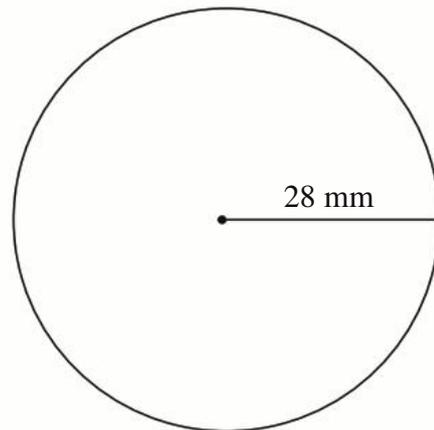
- g) Using  $C = 2\pi r$  where  $\pi \approx 3.14$ , calculate the circumference of the circle.



$$C =$$

$$= \boxed{\text{mm}}$$

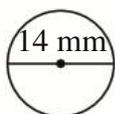
- h) Using  $C = 2\pi r$  where  $\pi \approx \frac{22}{7}$ , calculate the circumference of the circle.



$$C =$$

$$= \boxed{\text{mm}}$$

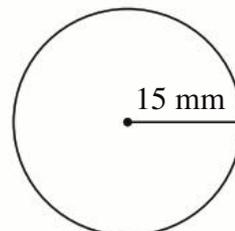
- i) Using  $C = 2\pi r$  where  $\pi \approx \frac{22}{7}$ , calculate the circumference of the circle.



$$C =$$

$$= \boxed{\text{mm}}$$

- j) Using  $C = 2\pi r$  where  $\pi \approx 3.14$ , calculate the circumference of the circle.



$$C =$$

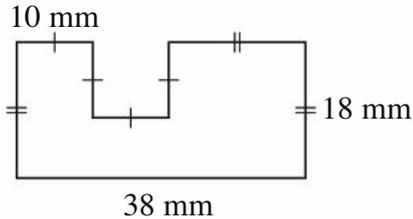
$$= \boxed{\text{mm}}$$

## Skill 25.8 Calculating the perimeter of composite shapes.

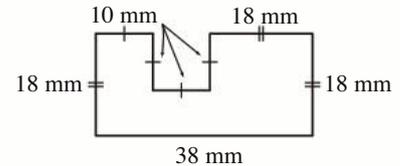
Blue 11 22 33 44  
Green 11 22 33 44

- 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.

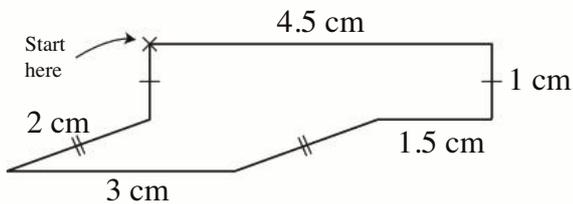
**Q.** Calculate the perimeter of the polygon.



**A.**  $10 + 10 + 10 + 10 + 18 + 18 + 38 + 18$   
 $= 40 + 36 + 56$   
 $= 132 \text{ mm}$   
 OR  $(10 \times 4) + (18 \times 3) + 38$   
 $= 40 + 54 + 38$   
 $= 132 \text{ mm}$



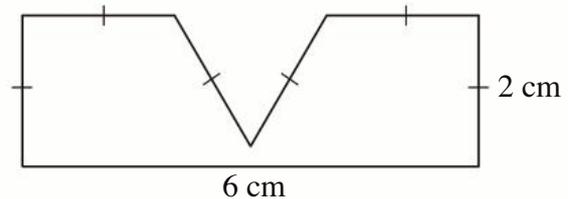
**a)** Calculate the perimeter of the polygon.



$$4.5 + 1 + 1.5 + 2 + 3 + 2 + 1$$

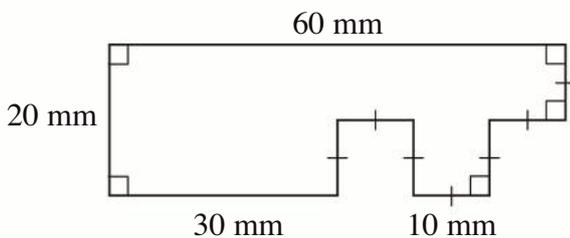
$$= 5.5 + 3.5 + 6 = \boxed{\text{cm}}$$

**b)** Calculate the perimeter of the polygon.



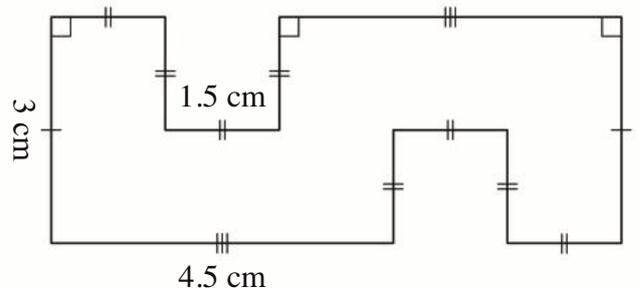
$$= \boxed{\text{cm}}$$

**c)** Calculate the perimeter of the polygon.



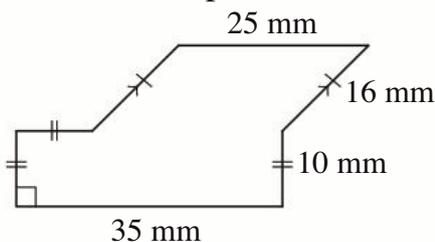
$$= \boxed{\text{mm}}$$

**d)** Calculate the perimeter of the polygon.



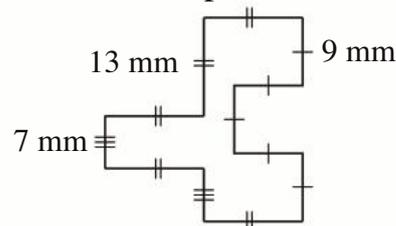
$$= \boxed{\text{cm}}$$

**e)** Calculate the perimeter of the polygon.



$$= \boxed{\text{mm}}$$

**f)** Calculate the perimeter of the polygon.



$$= \boxed{\text{mm}}$$

# 26. [Area / Volume]

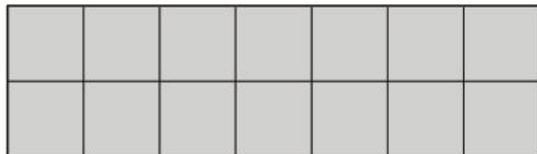
**Skill 26.1** Calculating the area of polygons by counting squares and triangles on a square grid (1).

Blue 1 2 2 3 3 4 4  
Green 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 shortcuts 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.



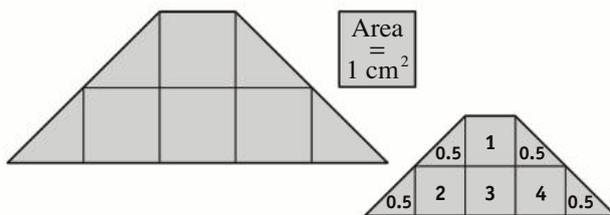
Area  
= 1 cm<sup>2</sup>

**A.**  $7 \times 2$  There are 7 squares in a row  
=  $14 \text{ cm}^2$  and 2 squares in a column.



Area  
= 1 cm<sup>2</sup>

**a)** Find the area of the trapezium.



$4 + 0.5 + 0.5 + 0.5 + 0.5 =$  cm<sup>2</sup>

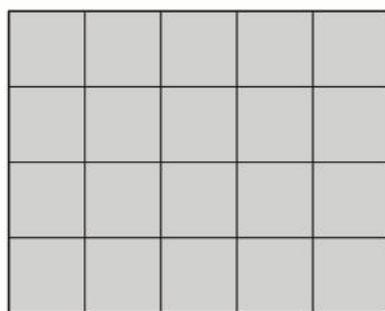
**b)** Find the area of the rectangle.



Area  
= 1 cm<sup>2</sup>

$1 \times 6 =$  cm<sup>2</sup>

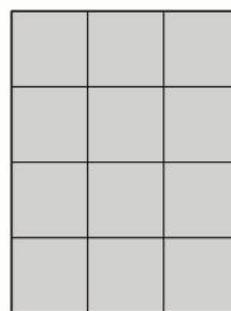
**c)** Find the area of the rectangle.



Area  
= 1 cm<sup>2</sup>

$..... =$  cm<sup>2</sup>

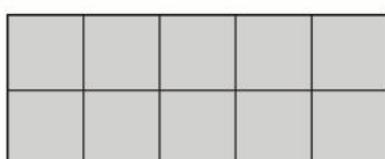
**d)** Find the area of the rectangle.



Area  
= 1 cm<sup>2</sup>

$..... =$  cm<sup>2</sup>

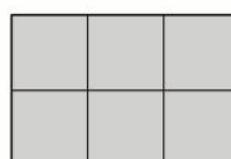
**e)** Find the area of the rectangle.



Area  
= 1 cm<sup>2</sup>

$..... =$  cm<sup>2</sup>

**f)** Find the area of the rectangle.



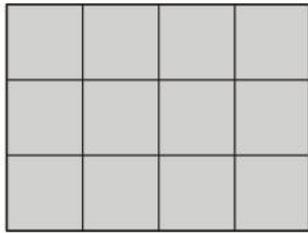
Area  
= 1 cm<sup>2</sup>

$..... =$  cm<sup>2</sup>

**Skill 26.1** Calculating the area of polygons by counting squares and triangles on a square grid (2).

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

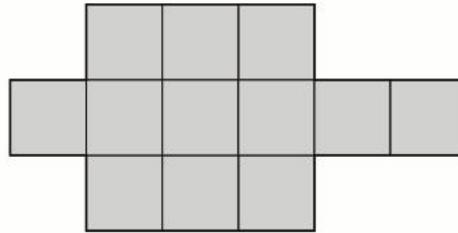
**g)** Find the area of the rectangle.



Area = 1 cm<sup>2</sup>

..... =  cm<sup>2</sup>

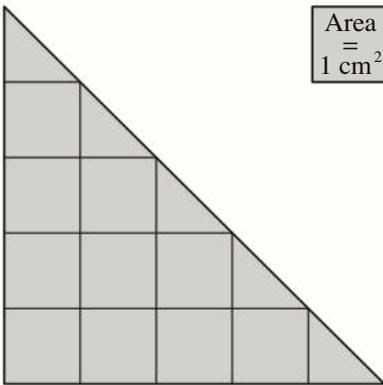
**h)** Find the area of the polygon.



Area = 1 cm<sup>2</sup>

..... =  cm<sup>2</sup>

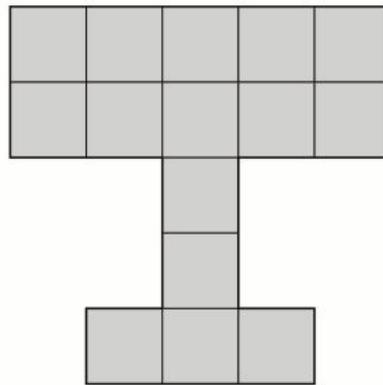
**i)** Find the area of the triangle.



Area = 1 cm<sup>2</sup>

..... =  cm<sup>2</sup>

**j)** Find the area of the polygon.



Area = 1 cm<sup>2</sup>

..... =  cm<sup>2</sup>

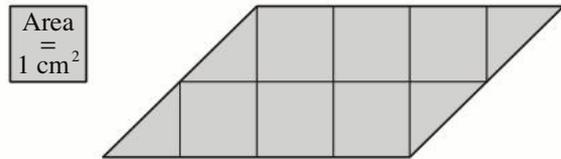
**k)** Find the area of the trapezium.



Area = 1 cm<sup>2</sup>

..... =  cm<sup>2</sup>

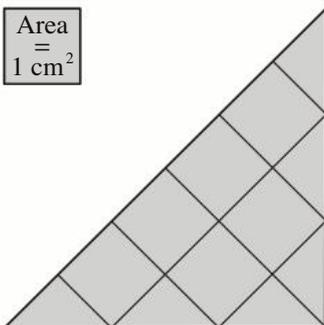
**l)** Find the area of the parallelogram.



Area = 1 cm<sup>2</sup>

..... =  cm<sup>2</sup>

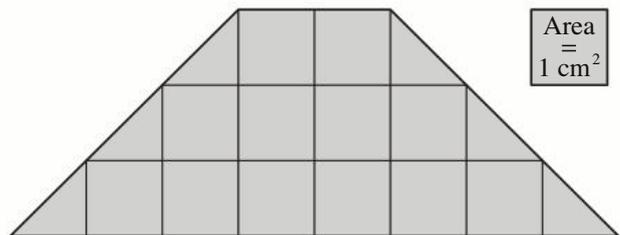
**m)** Find the area of the triangle.



Area = 1 cm<sup>2</sup>

..... =  cm<sup>2</sup>

**n)** Find the area of the trapezium.

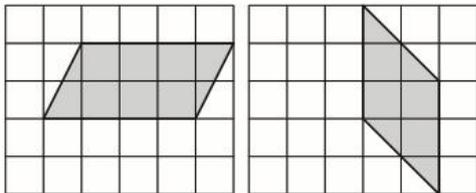


Area = 1 cm<sup>2</sup>

..... =  cm<sup>2</sup>

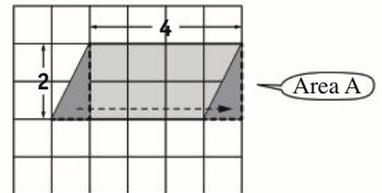
- Break the shape up into rectangles and triangles if necessary.
- Calculate the area of any rectangle by:
  - Counting the squares
  - OR
  - Multiplying the number of squares in a row by the number of squares in a column.
- Calculate the area of any triangle by halving the area of the rectangle that would enclose it.
- Compare your results.

**Q.** Do these parallelograms have the same area?

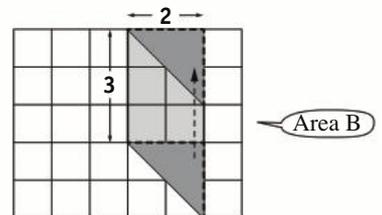


**A.**

Area A =  $4 \times 2 = 8$  sq. units



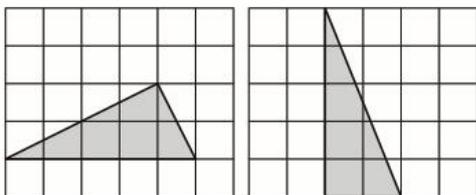
Area B =  $3 \times 2 = 6$  sq. units



$Area A \neq Area B$

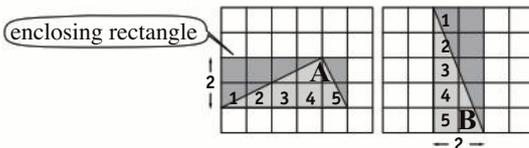
$\Rightarrow$  **No**

**a)** Do these triangles have the same area?



Draw the rectangles enclosing the triangles.

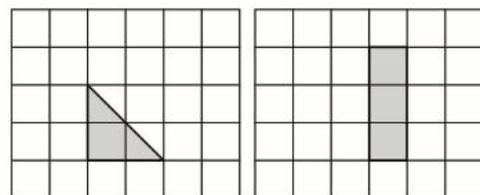
The area of a triangle is half of the area of the enclosing rectangle.



$Area A = \frac{1}{2} \times 5 \times 2 = 5$

$Area B = \frac{1}{2} \times 2 \times 5 = 5 \Rightarrow$  **yes**

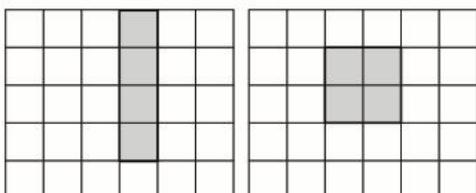
**b)** Do the triangle and the rectangle have the same area?



$Area A =$

$Area B =$

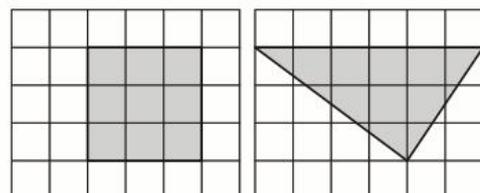
**c)** Do the rectangle and the square have the same area?



$Area A =$

$Area B =$

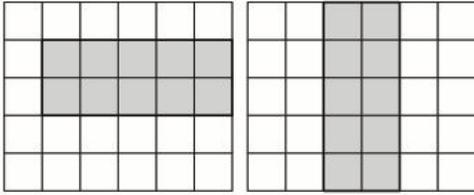
**d)** Do the square and the triangle have the same area?



$Area A =$

$Area B =$

e) Do these rectangles have the same area?

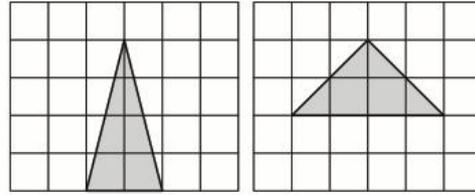


Area A =

Area B =

⇒

f) Do these triangles have the same area?

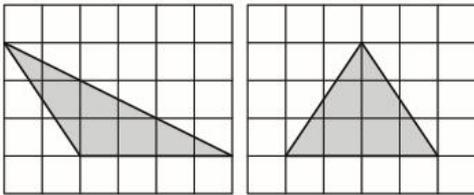


Area A =

Area B =

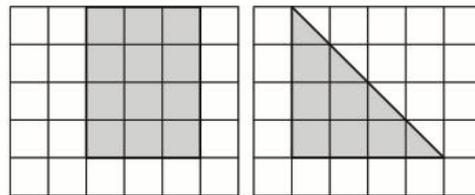
⇒

g) Do these triangles have the same area?



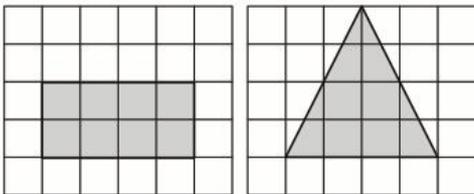
.....  
.....  
..... ⇒

h) Do the rectangle and the triangle have the same area?



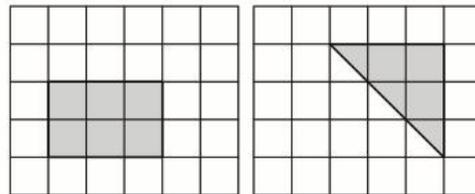
.....  
.....  
..... ⇒

i) Do the rectangle and the triangle have the same area?



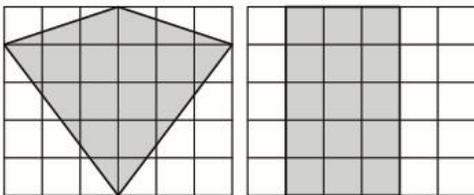
.....  
.....  
..... ⇒

j) Do the rectangle and the triangle have the same area?



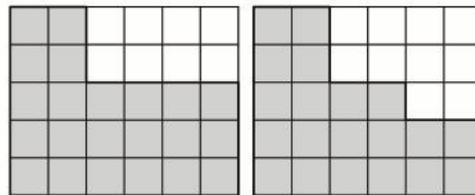
.....  
.....  
..... ⇒

k) Do the kite and the rectangle have the same area?



.....  
.....  
..... ⇒

l) Do these polygons have the same area?

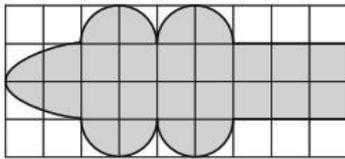


.....  
.....  
..... ⇒

- 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.]

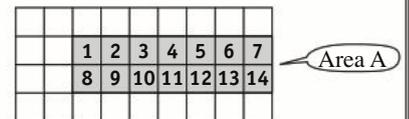


**A.** Area A + Area B

$$= 14 + 9$$

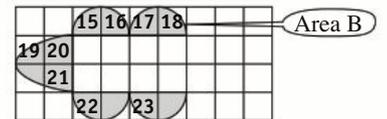
$$= 23 \text{ sq. units}$$

Area A = 14 whole units



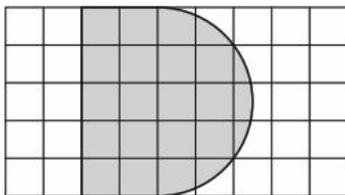
Area B = 9 units

(made up from 12 part units)

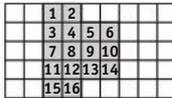


**a)** Find the area of the shaded shape.

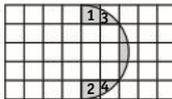
[Round to the nearest whole number.]



Area A = whole squares



Area B = partial squares

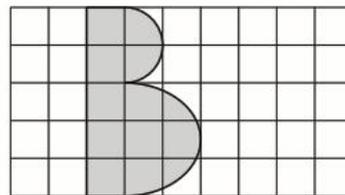


Area A = 16 and Area B = 4

$$A + B = 16 + 4 = \boxed{20} \text{ sq. units}$$

**b)** Find the area of the shaded shape.

[Round to the nearest whole number.]

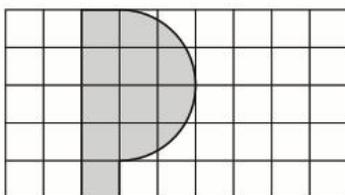


Area A = \_\_\_\_\_ and Area B = \_\_\_\_\_

$$A + B = \boxed{\phantom{00}} \text{ sq. units}$$

**c)** Find the area of the shaded shape.

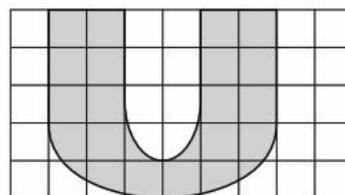
[Round to the nearest whole number.]



\_\_\_\_\_ =  $\boxed{\phantom{00}}$  sq. units

**d)** Find the area of the shaded shape.

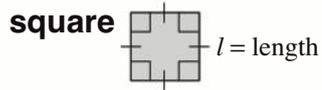
[Round to the nearest whole number.]



\_\_\_\_\_ =  $\boxed{\phantom{00}}$  sq. units

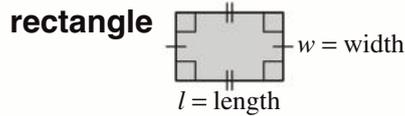
**Skill 26.4** Calculating the area of squares, rectangles and parallelograms (1).

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4



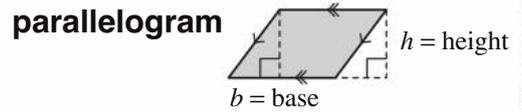
$$A = l \times l$$

$$= l^2$$



$$A = l \times w$$

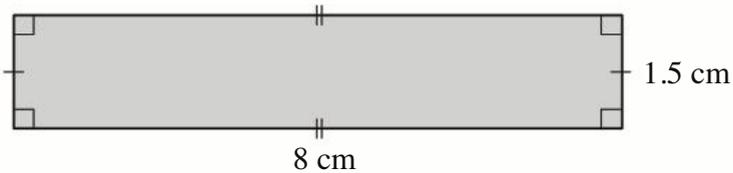
$$= lw$$



$$A = b \times h$$

$$= bh$$

**Q.** Using Area = length  $\times$  width find the area of the rectangle.

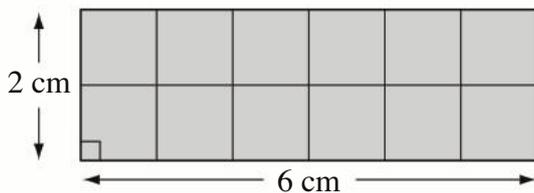


**A.**  $A = lw$  where  $l = 8$  and  $w = 1.5$

$$= 8 \times 1.5$$

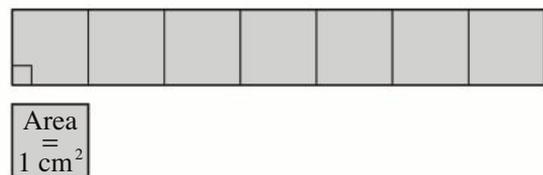
$$= 12 \text{ cm}^2$$

**a)** Find the area of the rectangle.



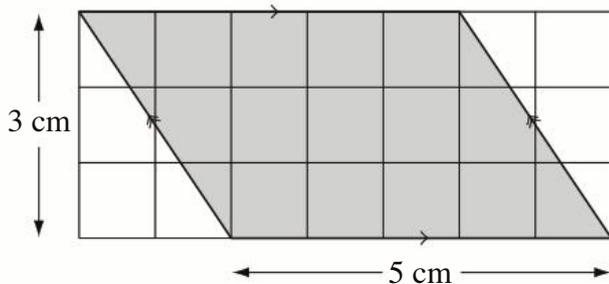
$$A = 6 \times 2 = \boxed{\text{cm}^2}$$

**b)** Find the area of the rectangle.



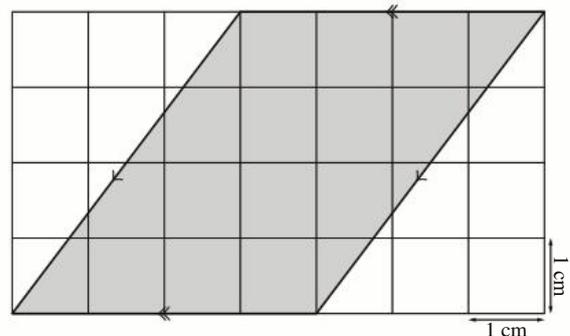
$$A = \dots = \boxed{\text{cm}^2}$$

**c)** Find the area of the parallelogram.



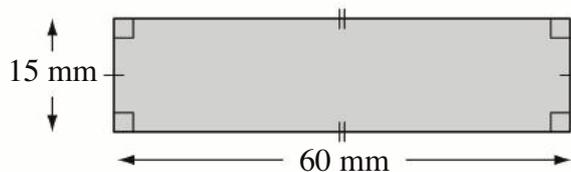
$$A = \dots = \boxed{\text{cm}^2}$$

**d)** Find the area of the parallelogram.



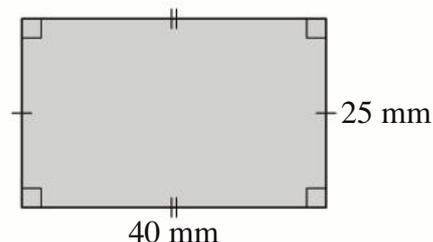
$$A = \dots = \boxed{\text{cm}^2}$$

**e)** Find the area of the rectangle.



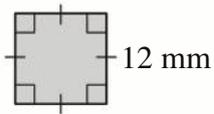
$$A = \dots = \boxed{\text{mm}^2}$$

**f)** Find the area of the rectangle.



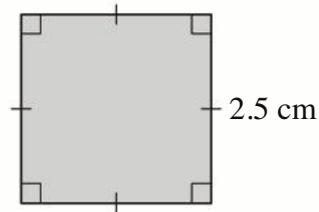
$$A = \dots = \boxed{\text{mm}^2}$$

**g)** Find the area of the square.



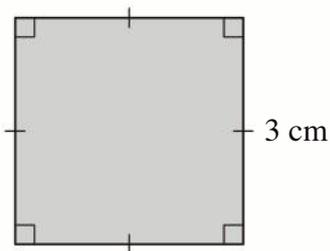
$A =$  ..... =

**h)** Find the area of the square.



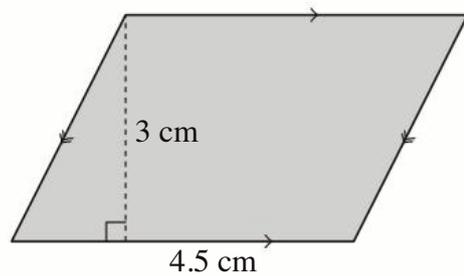
$A =$  ..... =

**i)** Find the area of the square.



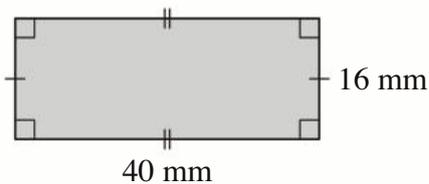
$A =$  ..... =

**j)** Find the area of the parallelogram.



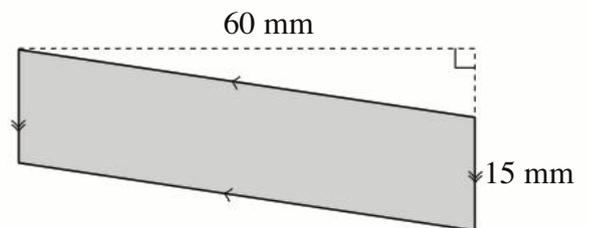
$A =$  ..... =

**k)** Find the area of the rectangle.



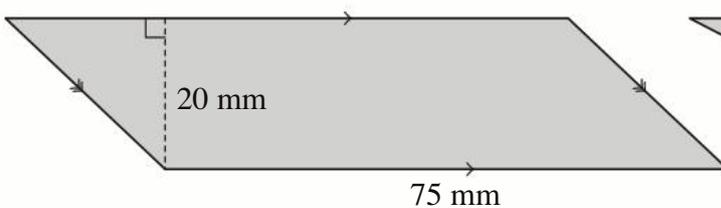
$A =$  ..... =

**l)** Find the area of the parallelogram.



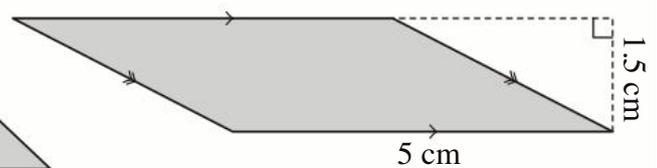
$A =$  ..... =

**m)** Find the area of the parallelogram.



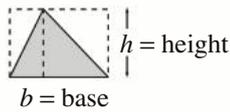
$A =$  ..... =

**n)** Find the area of the parallelogram.



$A =$  ..... =

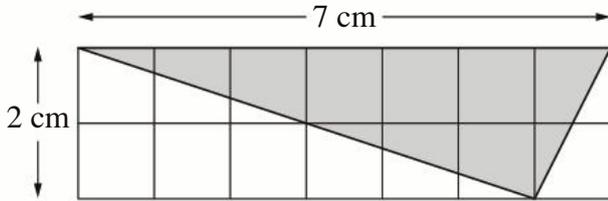
**Area of a triangle**



$$A = \frac{1}{2} \times b \times h$$

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

**Q.** Using Area =  $\frac{1}{2} \times \text{base} \times \text{height}$  find the area of the triangle.



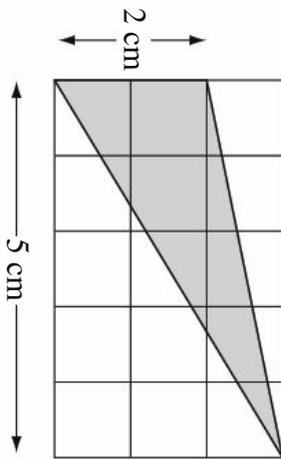
**A.**  $A = \frac{1}{2} bh$  where  $b = 7$  and  $h = 2$

$$= \frac{1}{2} \times 7 \times 2$$

$$= \frac{1}{2} \times 14$$

$$= 7 \text{ cm}^2$$

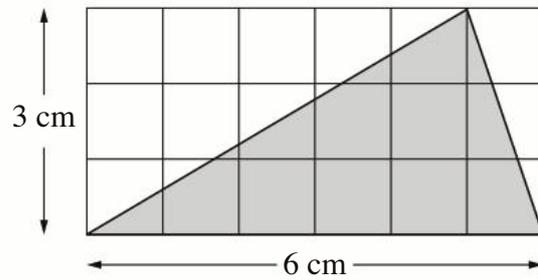
**a)** Find the area of the triangle.



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

$$= \frac{1}{2} \times 10 = \boxed{\phantom{00}} \text{ cm}^2$$

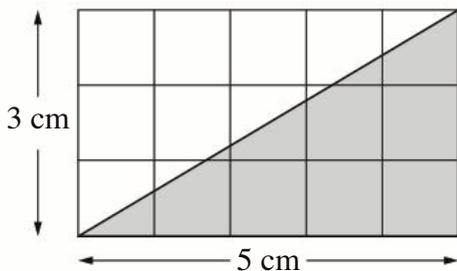
**b)** Find the area of the triangle.



$$A =$$

$$= \phantom{00} = \boxed{\phantom{00}} \text{ cm}^2$$

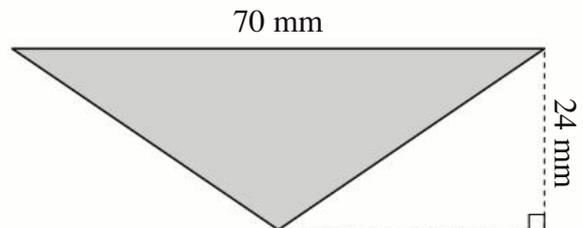
**c)** Find the area of the triangle.



$$A =$$

$$= \phantom{00} = \boxed{\phantom{00}} \text{ cm}^2$$

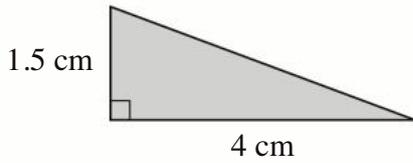
**d)** Find the area of the triangle.



$$A =$$

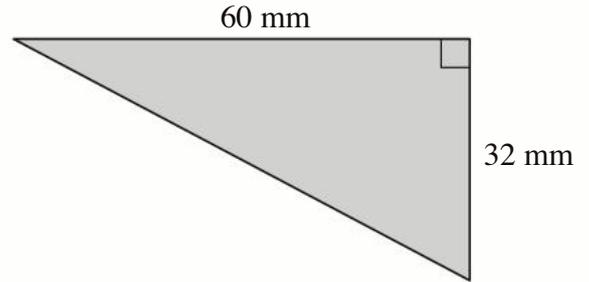
$$= \phantom{00} = \boxed{\phantom{00}} \text{ mm}^2$$

e) Find the area of the triangle.



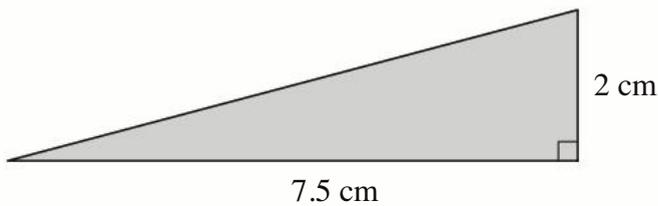
$A =$   
.....  
= =

f) Find the area of the triangle.



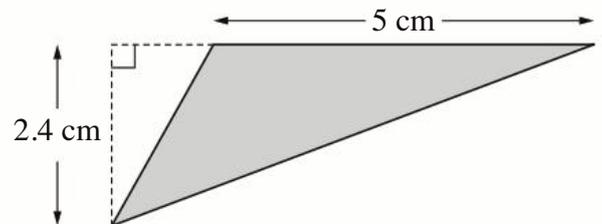
$A =$   
.....  
= =

g) Find the area of the triangle.



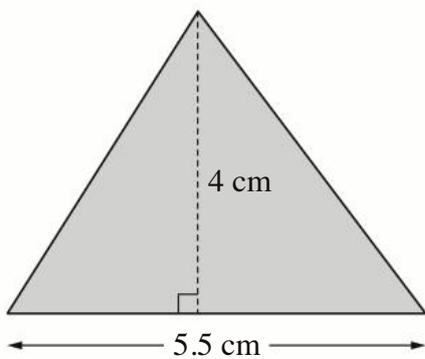
$A =$   
.....  
= =

h) Find the area of the triangle.



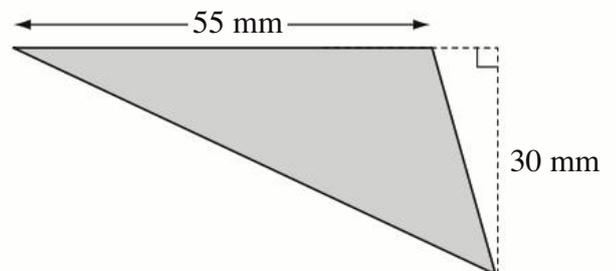
$A =$   
.....  
= =

i) Find the area of the triangle.



$A =$   
.....  
= =

j) Find the area of the triangle.



$A =$   
.....  
= =

## Skill 26.6 Calculating the volume of prisms by counting cubes (1).

Blue 11 22 3 44  
Green 11 22 33 44

- Count the cubes.  
Hint: Count the cubes in one layer and then multiply the result by the total number of layers.
- OR For the rectangular prisms, multiply the length by width by height.

**Q.** Find the volume of the rectangular prism. **A.**  $V = 80 \times 6$

$$= 480 \text{ cm}^3$$

80 cubes in top layer

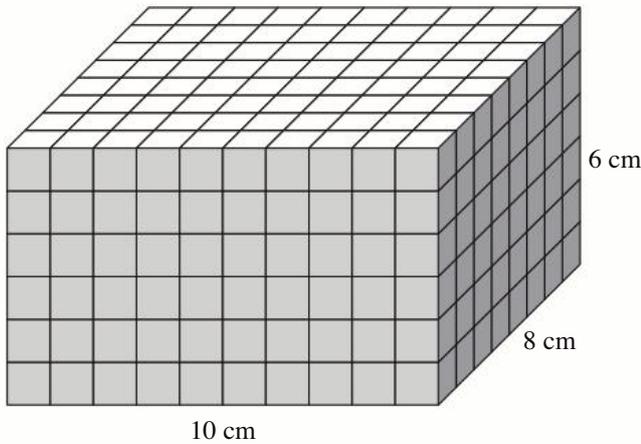
6 layers altogether

OR

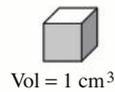
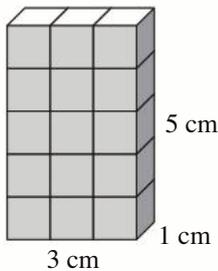
$$V = 10 \times 8 \times 6$$

$$= 80 \times 6$$

$$= 480 \text{ cm}^3$$

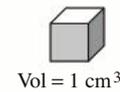
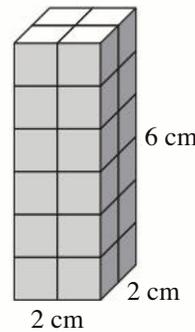


**a)** Find the volume of the prism.



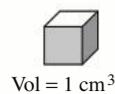
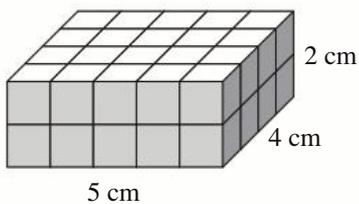
$$V = 3 \times 5 = \boxed{\text{cm}^3}$$

**b)** Find the volume of the prism.



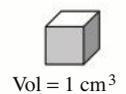
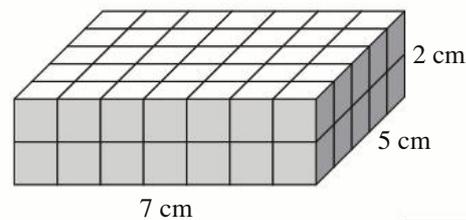
$$V = \dots = \boxed{\text{cm}^3}$$

**c)** Find the volume of the prism.



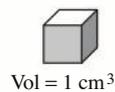
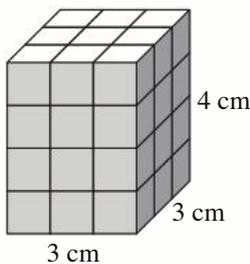
$$V = \dots = \boxed{\text{cm}^3}$$

**d)** Find the volume of the prism.



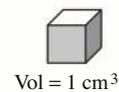
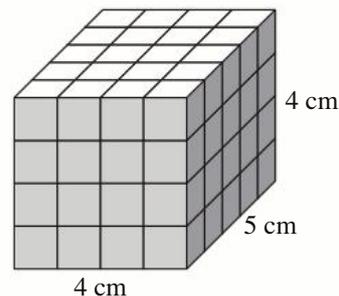
$$V = \dots = \boxed{\text{cm}^3}$$

**e)** Find the volume of the prism.



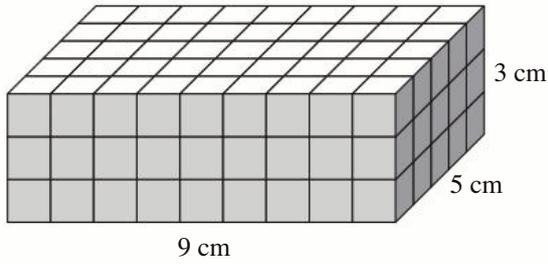
$$V = \dots = \boxed{\text{cm}^3}$$

**f)** Find the volume of the prism.



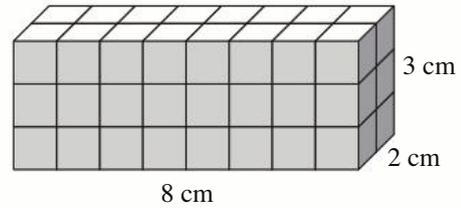
$$V = \dots = \boxed{\text{cm}^3}$$

g) Find the volume of the prism.



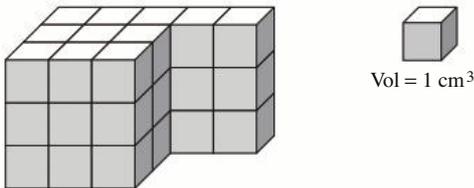
$V =$  ..... =

h) Find the volume of the prism.



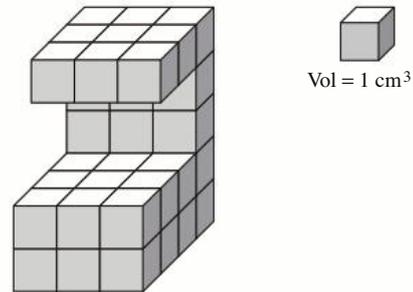
$V =$  ..... =

i) Find the volume of the prism.



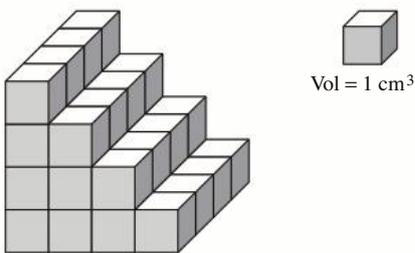
$V =$  ..... =

j) Find the volume of the prism.



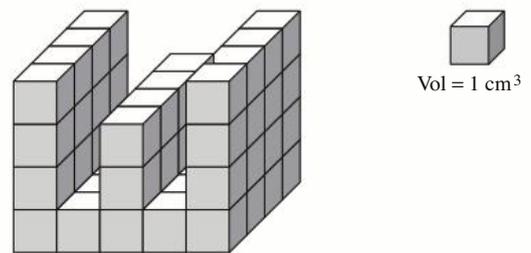
$V =$  ..... =

k) Find the volume of the prism.



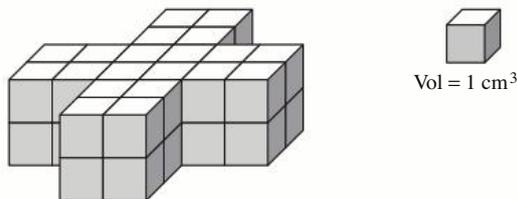
$V =$  ..... =

l) Find the volume of the prism.



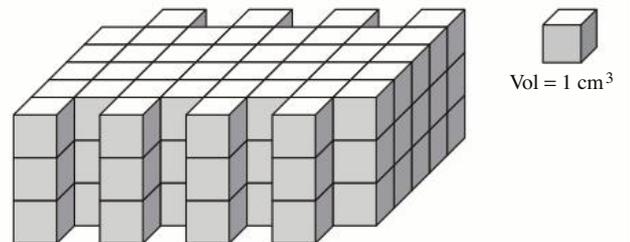
$V =$  ..... =

m) Find the volume of the prism.



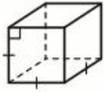
$V =$  ..... =

n) Find the volume of the prism.



$V =$  ..... =

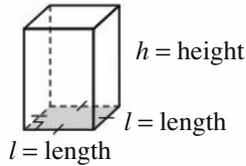
**Volume of a cube**



$$V = l \times l \times l$$

$$= l^3$$

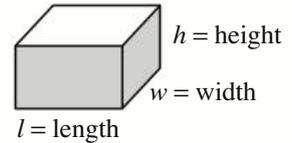
**Volume of a square prism**



$$V = l \times l \times h$$

$$= l^2 h$$

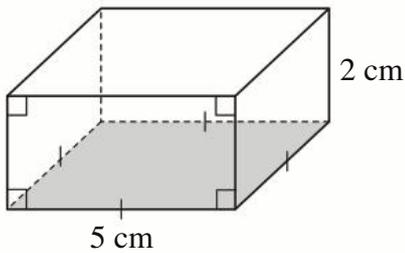
**Volume of a rectangular prism**



$$V = l \times w \times h$$

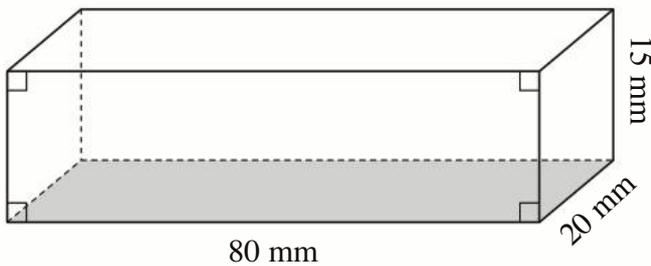
$$= lwh$$

**Q.** Using  $V = l^2 h$  find the volume of the square prism.



**A.**  $V = 5^2 \times 2$   
 $= 25 \times 2$   
 $= 50 \text{ cm}^3$

**a)** Using  $V = lwh$  find the volume of the rectangular prism.

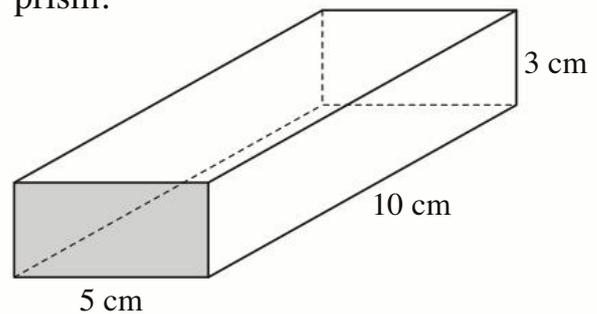


$$V = 80 \times 20 \times 15$$


---


$$= 80 \times 300 = \boxed{\text{mm}^3}$$

**b)** Find the volume of the rectangular prism.

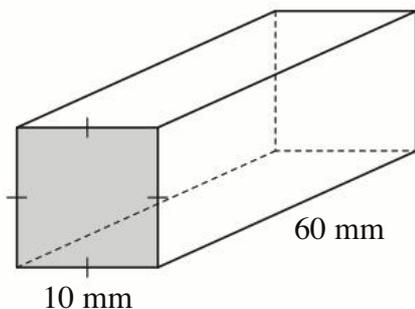


$$V =$$


---


$$= \quad = \boxed{\text{cm}^3}$$

**c)** Find the volume of the square prism.

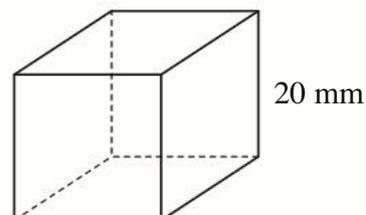


$$V =$$


---


$$= \quad = \boxed{\text{mm}^3}$$

**d)** Find the volume of the cube.

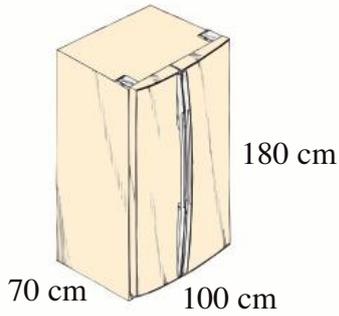


$$V =$$


---


$$= \quad = \boxed{\text{mm}^3}$$

e) Find the volume of the fridge in the shape of a rectangular prism.

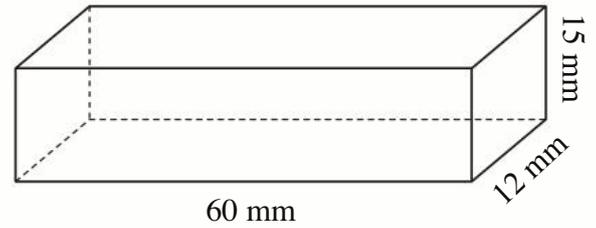


$$V =$$


---


$$= \quad = \quad \boxed{\text{cm}^3}$$

f) Find the volume of the rectangular prism.

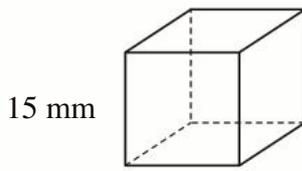


$$V =$$


---


$$= \quad = \quad \boxed{\text{mm}^3}$$

g) Find the volume of the cube.

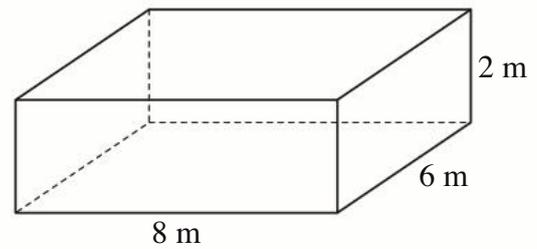


$$V =$$


---


$$= \quad = \quad \boxed{\text{mm}^3}$$

h) Find the volume of the rectangular prism.

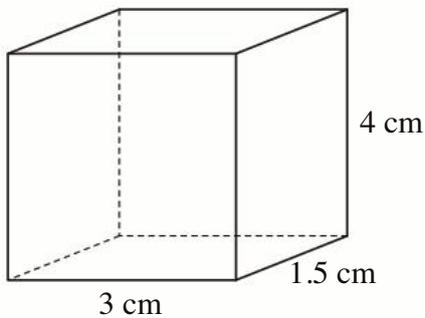


$$V =$$


---


$$= \quad = \quad \boxed{\text{m}^3}$$

i) Find the volume of the prism.

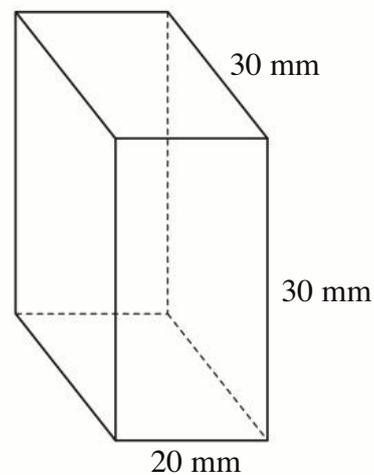


$$V =$$


---


$$= \quad = \quad \boxed{\text{cm}^3}$$

j) Find the volume of the prism.



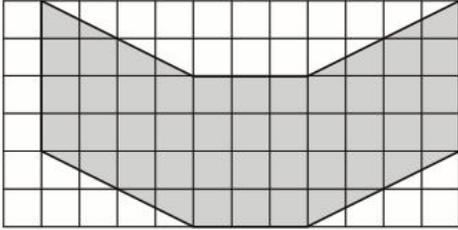
$$V =$$


---


$$= \quad = \quad \boxed{\text{mm}^3}$$

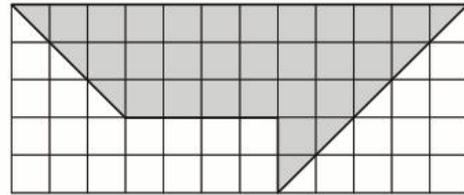


e) Find the area of the shaded polygon.



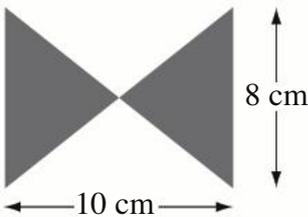
.....  
.....  
.....  
 $A =$  ..... =

f) Find the area of the shaded polygon.



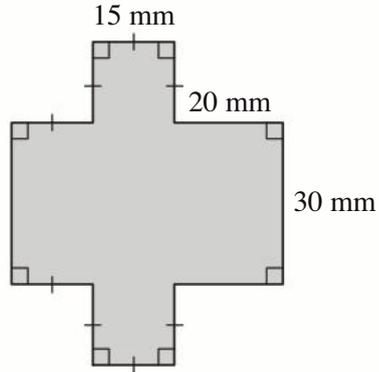
.....  
.....  
.....  
 $A =$  ..... =

g) Find the area of the bowtie.



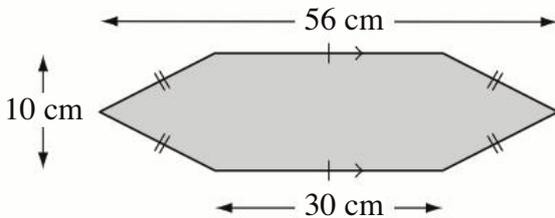
.....  
.....  
.....  
 $A =$  ..... =

h) Find the area of the polygon.



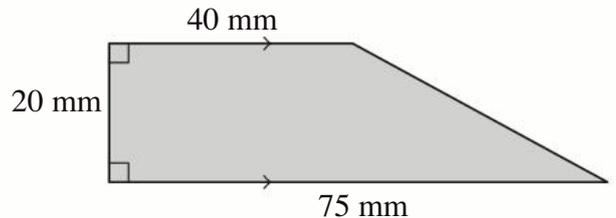
.....  
.....  
.....  
 $A =$  ..... =

i) Find the area of the shaded polygon.



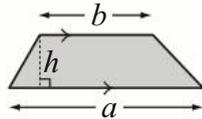
.....  
.....  
.....  
 $A =$  ..... =

j) Find the area of the polygon.



.....  
.....  
.....  
 $A =$  ..... =

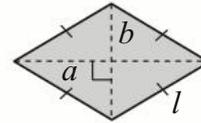
**Area of a trapezium**



$$A = \frac{1}{2} (\text{base } a + \text{base } b) \times \text{height } h$$

$$= \frac{1}{2} (a + b)h$$

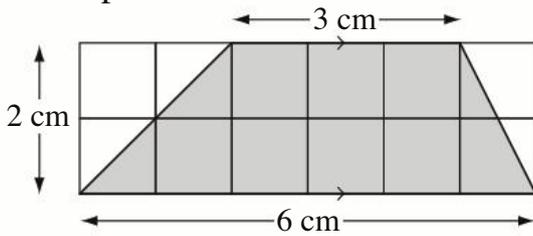
**Area of a rhombus**



$$A = \frac{1}{2} \times \text{diagonal } a \times \text{diagonal } b$$

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

**Q.** Using  $A = \frac{1}{2}(a + b)h$  find the area of the trapezium.



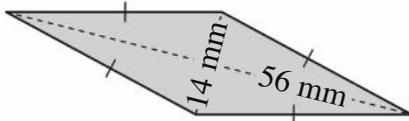
**A.**  $A = \frac{1}{2}(a + b)h$  where  $a = 3$ ,  $b = 6$  and  $h = 2$

$$= \frac{1}{2} \times (6 + 3) \times 2$$

$$= \frac{1}{2} \times 9 \times 2$$

$$= \mathbf{9 \text{ cm}^2}$$

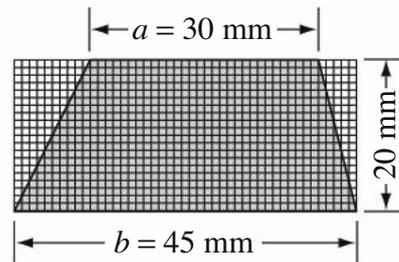
**a)** Using  $A = \frac{1}{2}ab$  find the area of the rhombus.



$$A = \frac{1}{2} \times 14 \times 56$$

$$= 7 \times 56 = \boxed{\text{mm}^2}$$

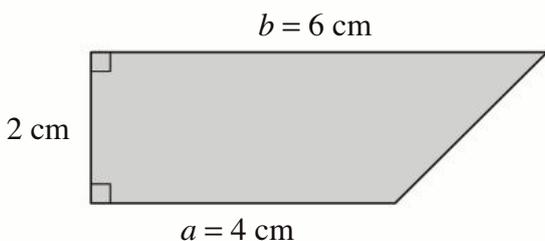
**b)** Using Area =  $\frac{1}{2}(\text{base } a + \text{base } b) \times \text{height}$  find the area of the trapezium.



$$A =$$

$$= \boxed{\text{mm}^2}$$

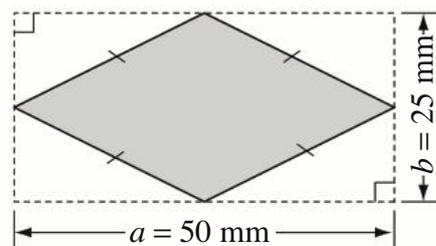
**c)** Using  $A = \frac{1}{2}(a + b)h$  find the area of the trapezium.



$$A =$$

$$= \boxed{\text{cm}^2}$$

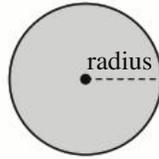
**d)** Using Area =  $\frac{1}{2} \times \text{diagonal } a \times \text{diagonal } b$  find the area of the rhombus.



$$A =$$

$$= \boxed{\text{mm}^2}$$

**Area of a circle**



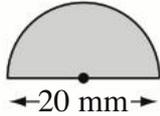
$$A = \pi \times \text{radius} \times \text{radius}$$

$$= \pi r^2$$

where  $\pi \approx 3.14\dots$   
or  $\approx \frac{22}{7}$

Hint: If you are given the diameter then halve to find the radius:  $r = \frac{d}{2}$

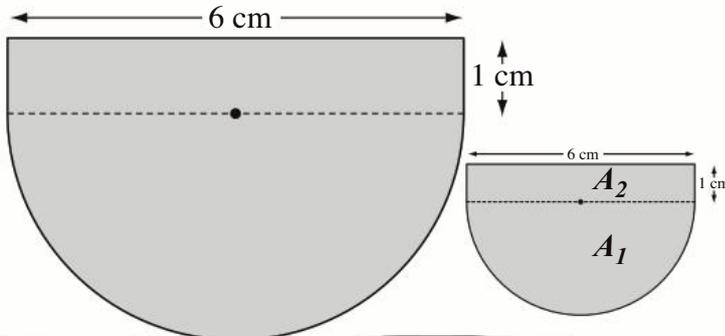
**Q.** Using  $A = \pi r^2$  and  $\pi \approx 3.14$ , find the area of the semi-circle.



**A.** Area of circle =  $\pi r^2$  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  $r = 3$

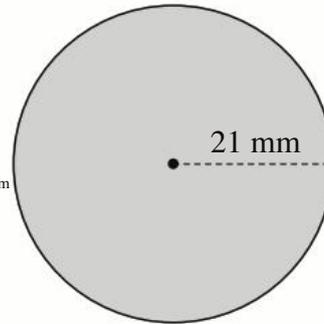
$\div 2$  for the semi-circle

$$A_1 = 3.14 \times 3 \times 3 \div 2 = 14.13$$

$$A_2 = 6 \times 1 = 6 \text{ and using } A = A_1 + A_2$$

$$A = 14.13 + 6 = \boxed{\text{cm}^2}$$

**b)** Using  $A = \pi r^2$  and  $\pi \approx \frac{22}{7}$ , find the area of the circle.

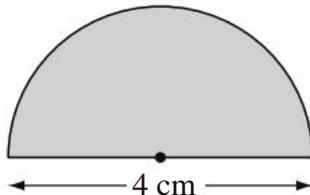


$$A =$$

$$=$$

$$= \boxed{\text{mm}^2}$$

**c)** Using  $\pi \approx 3.14$ , find the area of the semi-circle.

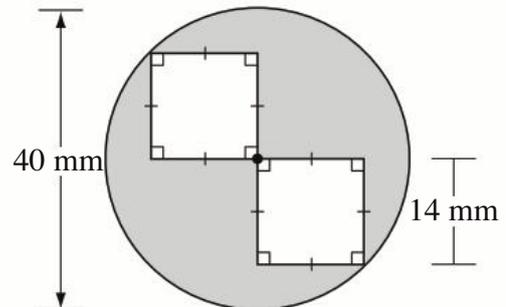


$$A =$$

$$=$$

$$= \boxed{\text{cm}^2}$$

**d)** Using  $\pi \approx 3.14$ , find the area of the shaded shape.

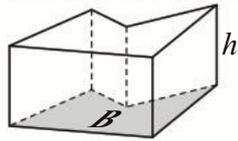


$$A =$$

$$=$$

$$= \boxed{\text{mm}^2}$$

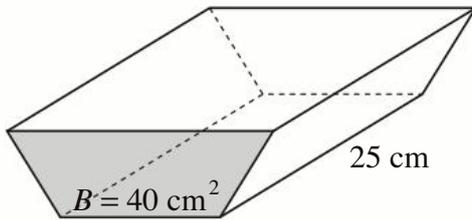
**Volume of a prism**



$$V = \text{Area of base} \times \text{height of prism}$$

$$= Bh$$

**Q.** Using Volume = area of base  $\times$  height find the volume of the prism.

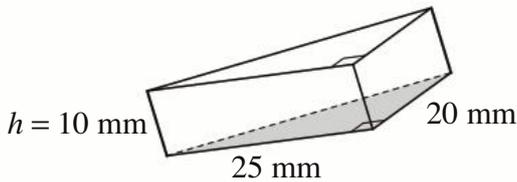


**A.**  $A = Bh$  where  $B = 40$  and  $h = 25$

$$= 40 \times 25$$

$$= 1000 \text{ cm}^3$$

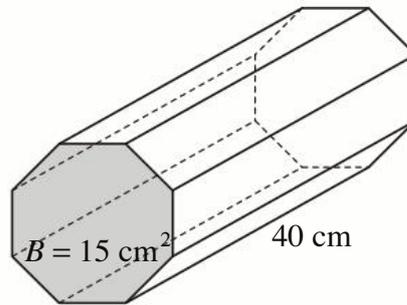
**a)** Using  $V = Bh$  find the volume of the triangular prism.



$$B = \frac{1}{2} \times 25 \times 20 = 250$$

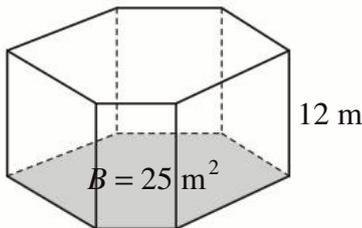
$$V = 250 \times 10 = \boxed{\text{mm}^3}$$

**b)** Find the volume of the prism.



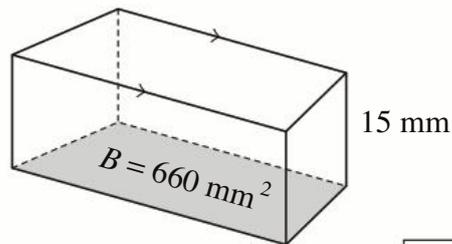
$$V = \dots = \boxed{\text{cm}^3}$$

**c)** Find the volume of the prism.



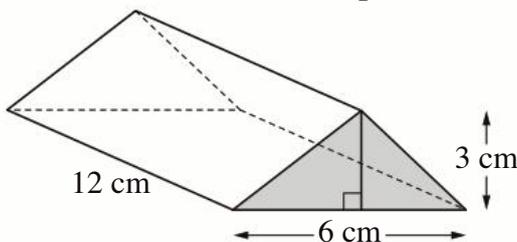
$$V = \dots = \boxed{\text{m}^3}$$

**d)** Find the volume of the prism.



$$V = \dots = \boxed{\text{mm}^3}$$

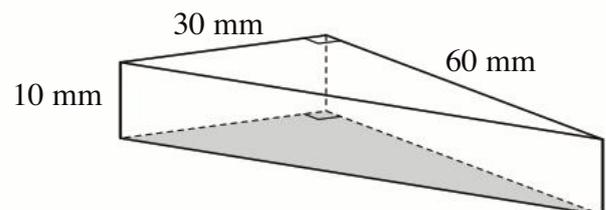
**e)** Find the volume of the prism.



$$B = \dots$$

$$V = \dots = \boxed{\text{cm}^3}$$

**f)** Find the volume of the prism.



$$B = \dots$$

$$V = \dots = \boxed{\text{mm}^3}$$

# 27. [Shapes]

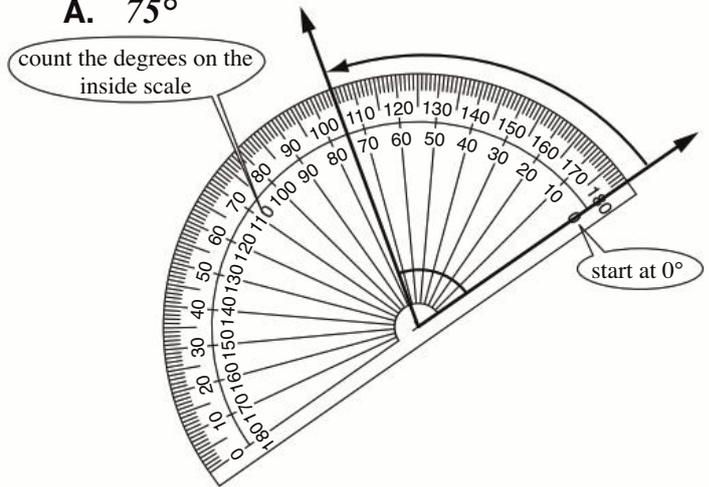
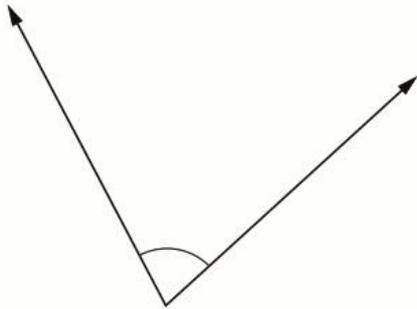
## Skill 27.1 Measuring angles using a protractor (1).

Blue 1 2 2 3 3 4 4  
Green 1 2 2 3 3 4 4

- Place the centre 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.

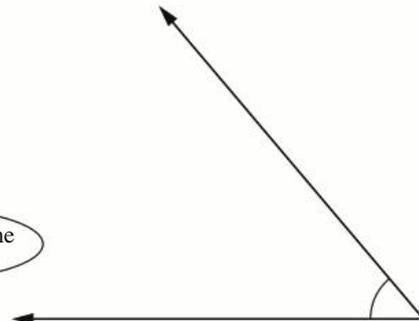
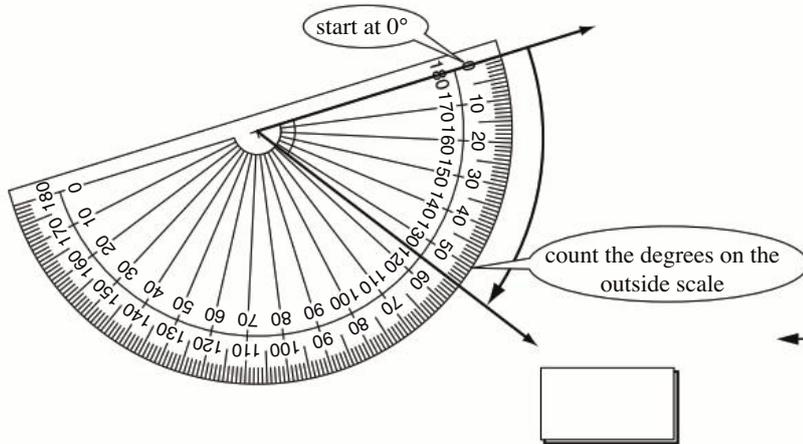
Q. Use a protractor to measure this angle.

A. 75°



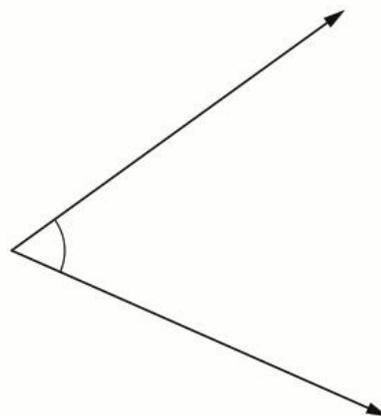
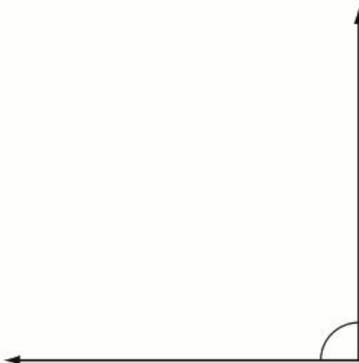
a) Use a protractor to measure this angle.

b) Use a protractor to measure this angle.

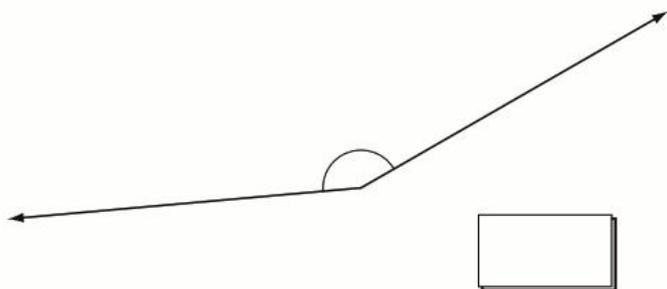


c) Use a protractor to measure this angle.

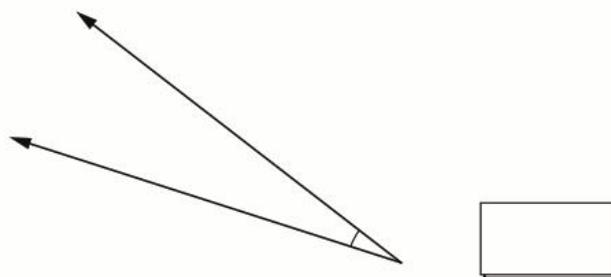
d) Use a protractor to measure this angle.



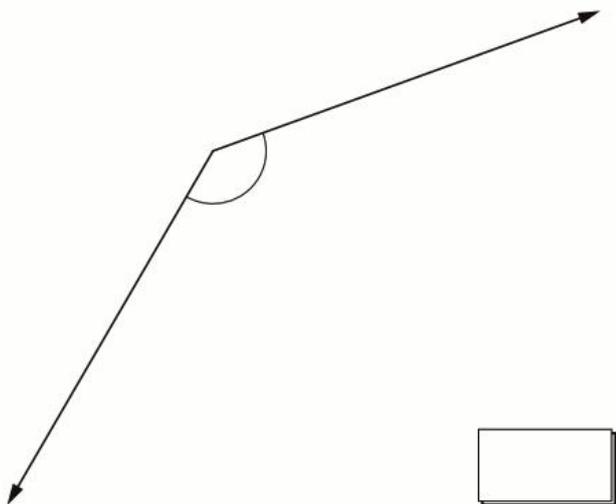
e) Use a protractor to measure this angle.



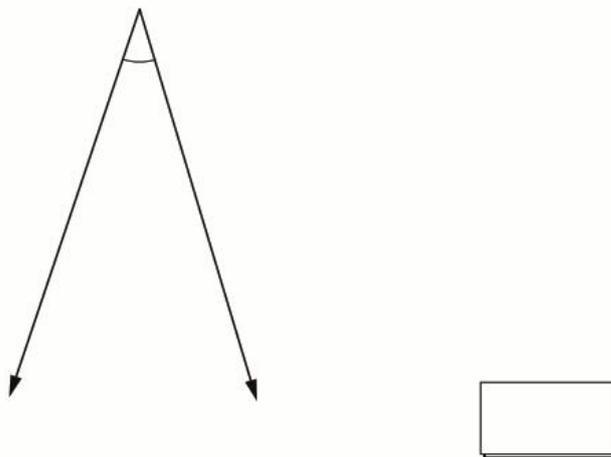
f) Use a protractor to measure this angle.



g) Use a protractor to measure this angle.



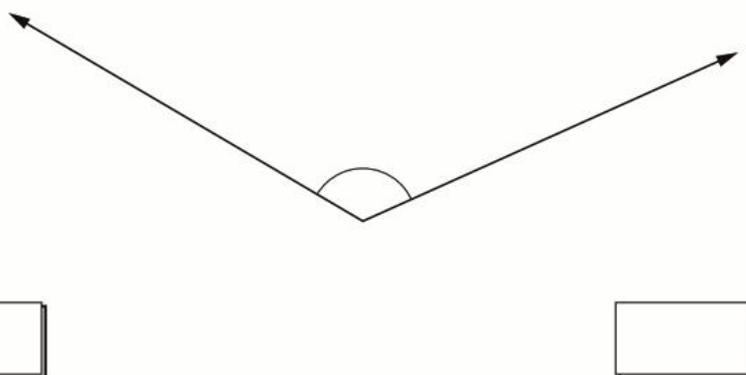
h) Use a protractor to measure this angle.



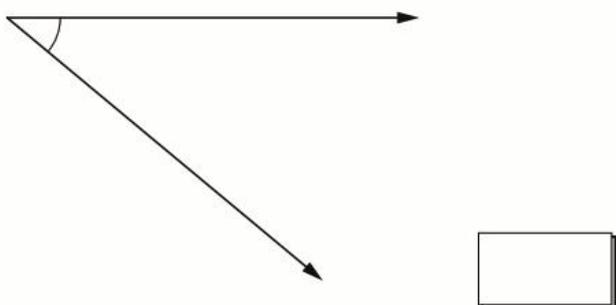
i) Use a protractor to measure this angle.



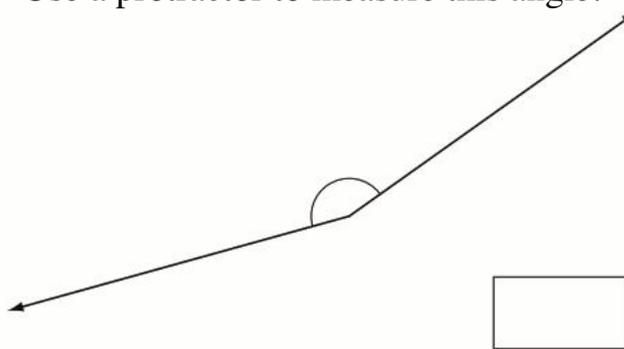
j) Use a protractor to measure this angle.



k) Use a protractor to measure this angle.

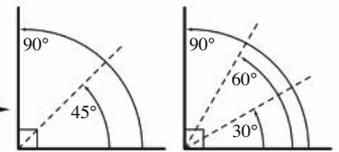


l) Use a protractor to measure this angle.



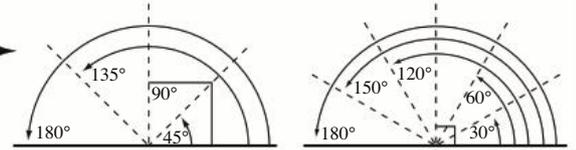
**To estimate the size of an acute angle**

- Draw a right angle ( $90^\circ$ ) overlapping one line of the given angle.
- Divide the right angle into smaller divisions, e.g. halves or thirds.

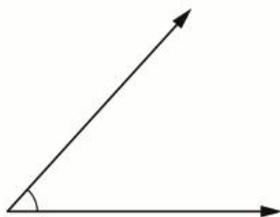


**To estimate the size of an obtuse angle**

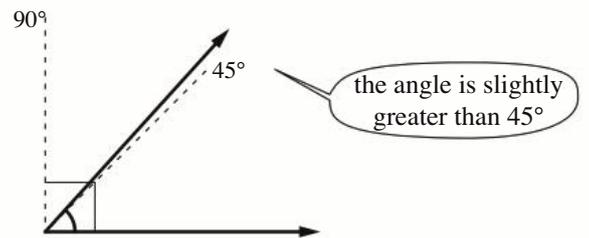
- Draw a straight angle ( $180^\circ$ ) overlapping one line of the given angle.
- Divide the straight angle into smaller divisions, e.g. quarters or sixths.



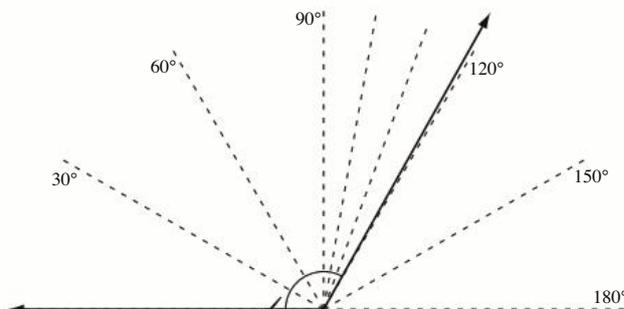
**Q.** Without measuring, would you estimate that the size of this angle is closer to  $45^\circ$  or to  $60^\circ$ ?



**A.**  $45^\circ$

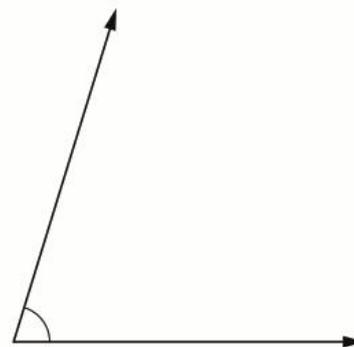


**a)** Without measuring, would you estimate that the size of this angle is closer to  $110^\circ$  or to  $120^\circ$ ?

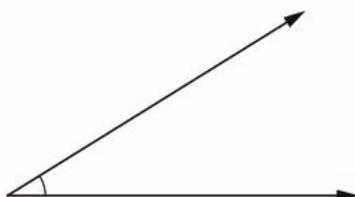


the angle is slightly smaller than  $120^\circ$

**b)** Without measuring, would you estimate that the size of this angle is closer to  $60^\circ$  or to  $75^\circ$ ?




**c)** Without measuring, would you estimate that the size of this angle is closer to  $30^\circ$  or to  $45^\circ$ ?



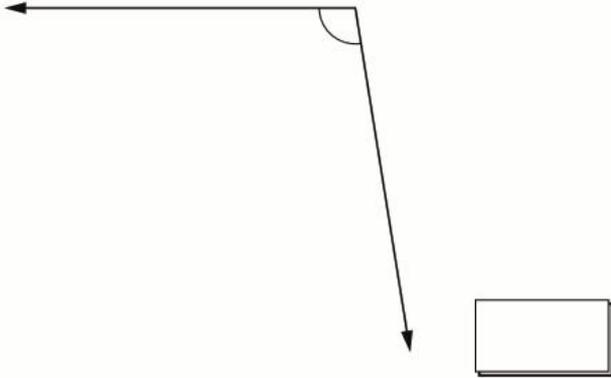

**d)** Without measuring, would you estimate that the size of this angle is closer to  $150^\circ$  or to  $170^\circ$ ?



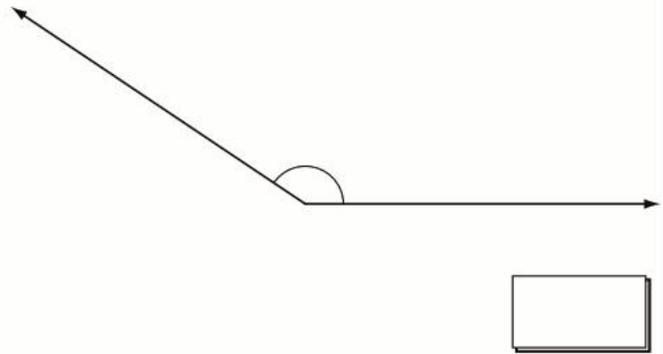
Skill 27.2 Estimating the size of angles (2).

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

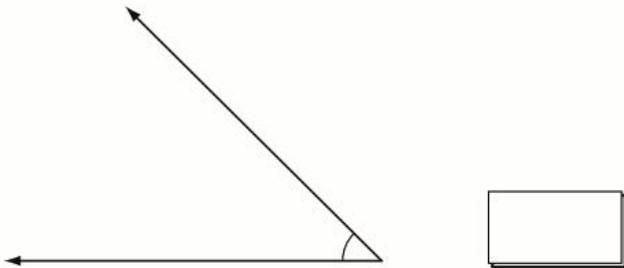
- e) Without measuring, would you estimate that the size of this angle is closer to  $100^\circ$  or to  $120^\circ$ ?



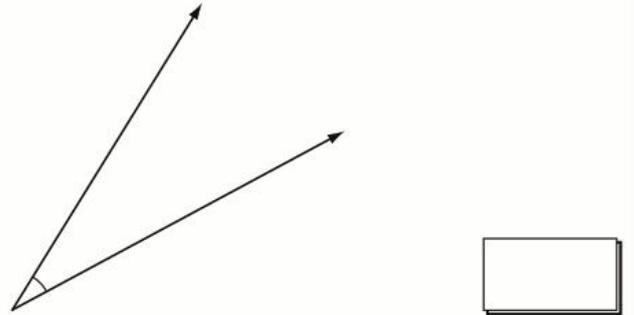
- f) Without measuring, would you estimate that the size of this angle is closer to  $135^\circ$  or to  $145^\circ$ ?



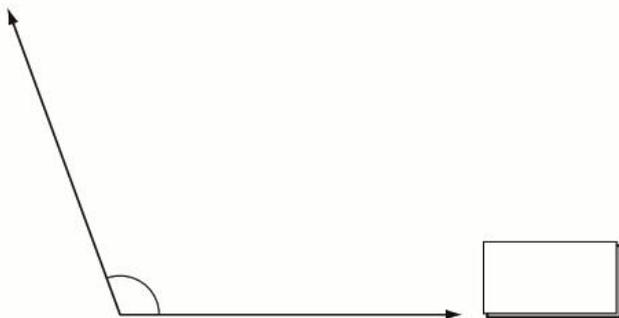
- g) Without measuring, would you estimate that the size of this angle is closer to  $45^\circ$  or to  $60^\circ$ ?



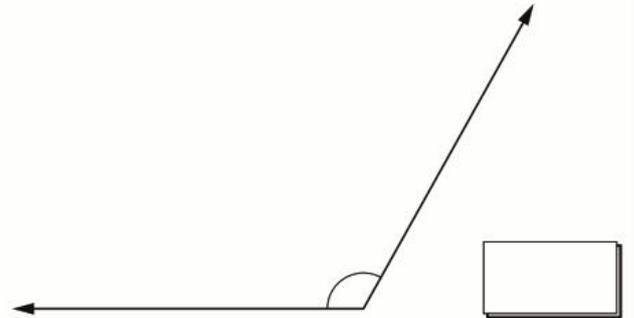
- h) Without measuring, would you estimate that the size of this angle is closer to  $30^\circ$  or to  $45^\circ$ ?



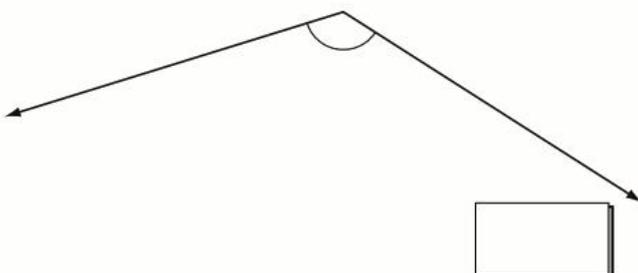
- i) Without measuring, would you estimate that the size of this angle is closer to  $95^\circ$  or to  $110^\circ$ ?



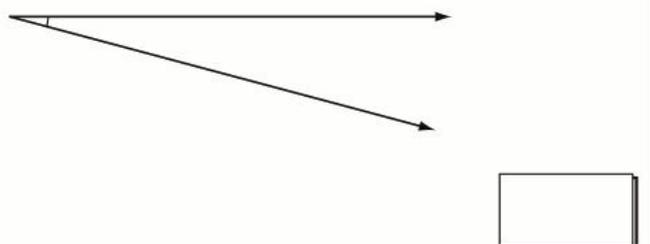
- j) Without measuring, would you estimate that the size of this angle is closer to  $120^\circ$  or to  $135^\circ$ ?



- k) Without measuring, would you estimate that the size of this angle is closer to  $130^\circ$  or to  $150^\circ$ ?

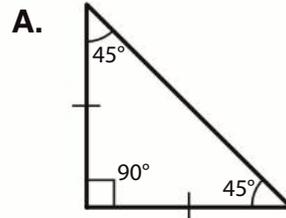


- l) Without measuring, would you estimate that the size of this angle is closer to  $5^\circ$  or to  $15^\circ$ ?



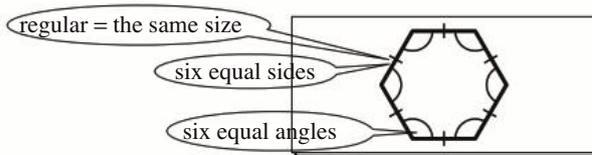
- Consider the definitions of triangles, squares, rectangles, rhombi, parallelograms, kites, trapeziums and regular polygons. (see Glossary)
- Mark:  
 Right angles with a corner ( $\perp$ ).  
 Congruent angles with similar curved lines ( $\frown$ )  
 (the second pair of congruent angles takes on a 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 takes on a second pair of arrows).

**Q.** Draw an isosceles right-angled triangle marking the congruent sides and congruent angles.



One corner marking the right angle ( $90^\circ$ )  
 One dash marking each of the congruent sides  
 One curved line marking each of the congruent angles ( $45^\circ$ )

**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.



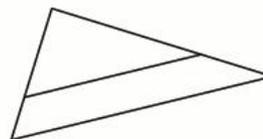
**d)** Draw an isosceles obtuse-angled triangle marking the congruent sides and congruent angles.



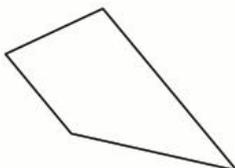
**e)** Draw a regular pentagon marking the congruent sides and congruent angles.



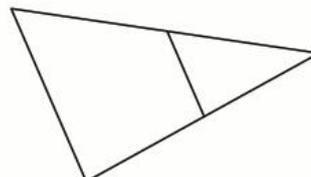
**f)** Use arrows to show the pair of parallel lines in this diagram.



**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 27.4 Classifying angles.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

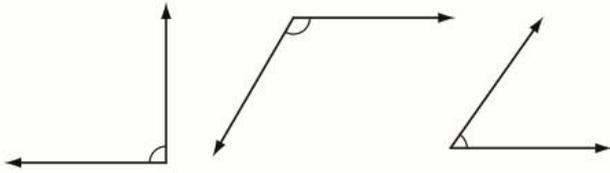
- Consider the definitions and properties of a variety of angles.

(see Glossary and Maths Facts, page 386)

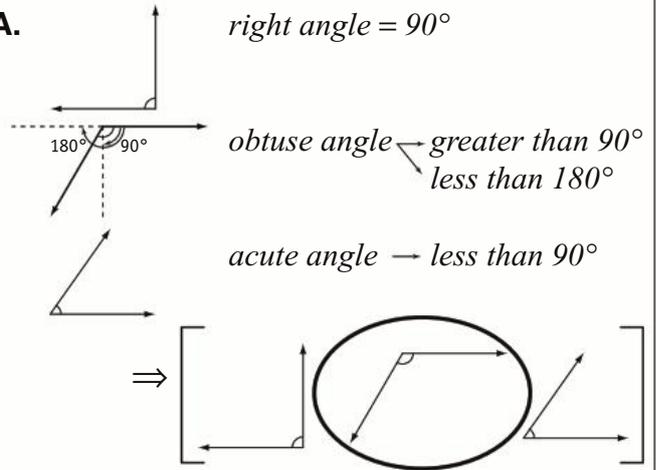
Hints: An angle can be classified according to its size (acute, right, obtuse, straight and reflex).

Two angles can be classified according to their position in relation to one another (adjacent, supplementary, complementary or vertically opposite).

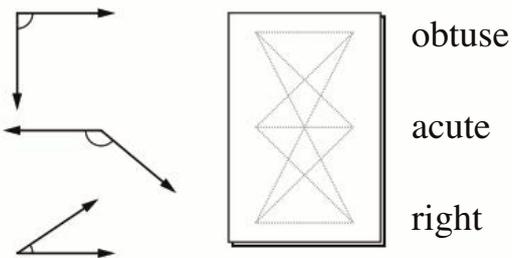
**Q.** Circle the obtuse angle.



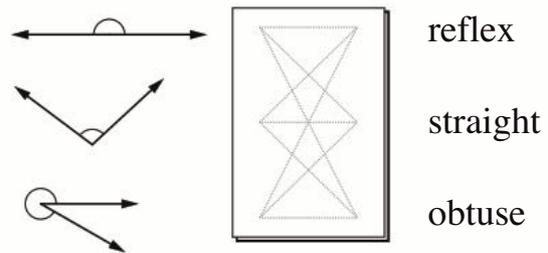
**A.**



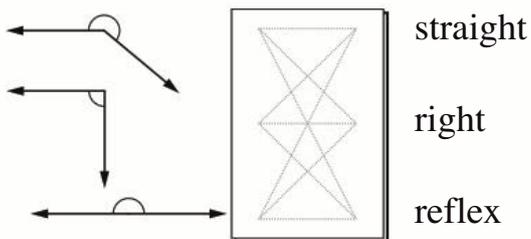
**a)** Match each angle to its description:



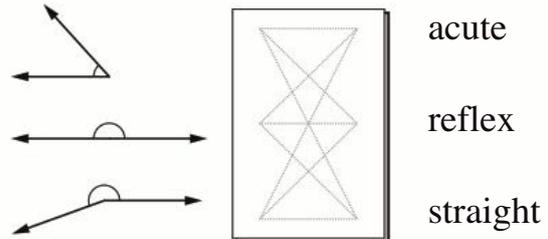
**b)** Match each angle to its description:



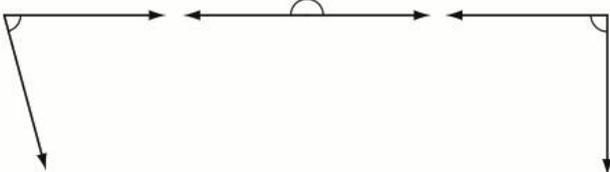
**c)** Match each angle to its description:



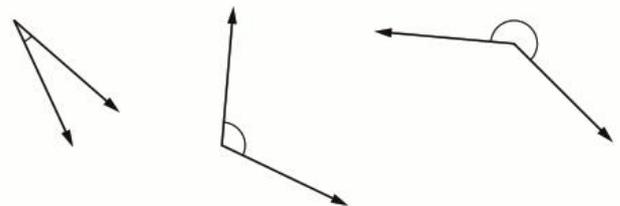
**d)** Match each angle to its description:



**e)** Circle the right angle.



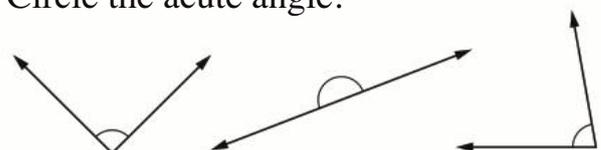
**f)** Circle the obtuse angle.



**g)** Circle the reflex angle.



**h)** Circle the acute angle.



**Skill 27.5** Classifying and describing the properties of triangles.

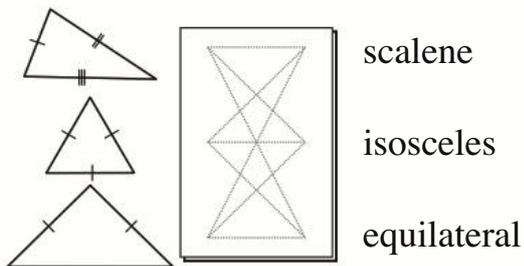
Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- 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	<b>scalene</b>
two equal sides/angles	<b>isosceles</b>
three equal sides/angles	<b>equilateral</b>

Angles	Triangle type
all acute angles	<b>acute-angled</b>
one right angle	<b>right-angled</b>
one obtuse angle	<b>obtuse-angled</b>

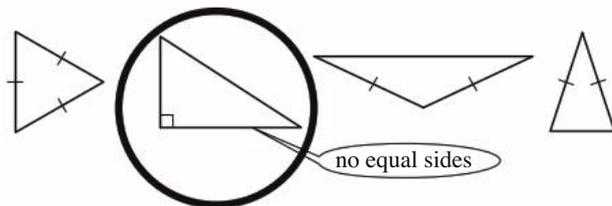
**Q.** Match each triangle to its description:



**A.** *no equal sides* ⇒ **scalene**  
*two equal sides* ⇒ **isosceles**  
*three equal sides* ⇒ **equilateral**

⇒ scalene  
 isosceles  
 equilateral

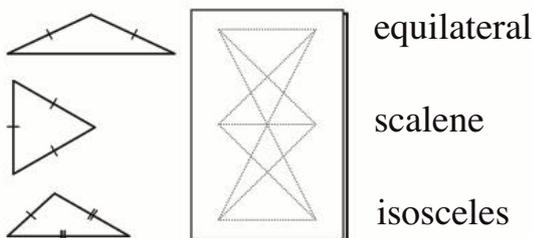
**a)** Circle the triangle that is **not** isosceles.



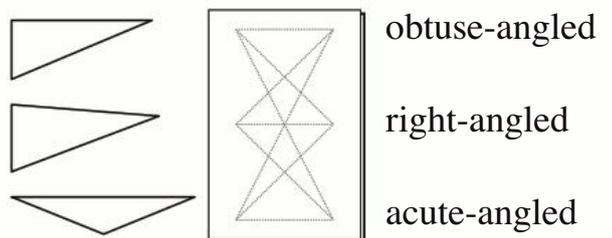
**b)** Circle the triangle that is obtuse-angled.



**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-angled 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-angled triangle
- B) a right-angled triangle
- C) an equilateral triangle
- D) an obtuse-angled triangle



- Consider the properties of squares, rectangles, rhombi, parallelograms, kites and trapeziums. (see Glossary, page 360)

**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 trapezium
- C) a kite
- D) a square

- A.** A) a rhombus has opposite sides parallel  $\Rightarrow A$  false  
 B) a trapezium 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)** I am a 2-dimensional shape with four sides. Both my pairs of opposite sides are parallel. All angles are equal to  $90^\circ$ . What am I?

- A) a trapezium
- B) a rectangle
- C) a rhombus
- D) a parallelogram

 B

**b)** 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

**c)** 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

**d)** I am a quadrilateral with all my angles equal to  $90^\circ$ . My diagonals are equal in length. What am I?

- A) a trapezium
- B) a parallelogram
- C) a rectangle
- D) a rhombus

**e)** I am a 2-dimensional shape with four sides. My diagonals are not equal in length and bisect each other but not at right angles. What am I?

- A) a rhombus
- B) a parallelogram
- C) a kite
- D) a trapezium

**f)** I am a 2-dimensional shape with four sides. Adjacent angles are not equal and I have two axes of symmetry. What am I?

- A) a rhombus
- B) a rectangle
- C) a parallelogram
- D) a square

**g)** I am a quadrilateral with both pairs of opposite sides parallel and diagonals equal in length. What am I?

- A) a kite
- B) a rectangle
- C) a rhombus
- D) a parallelogram

**h)** I am a quadrilateral with both pairs of opposite sides equal in length, but no axis of symmetry. What am I?

- A) a trapezium
- B) a parallelogram
- C) a rectangle
- D) a rhombus

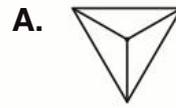
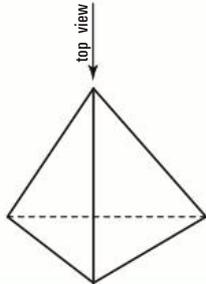
EITHER

- Imagine what you would see from the stated direction

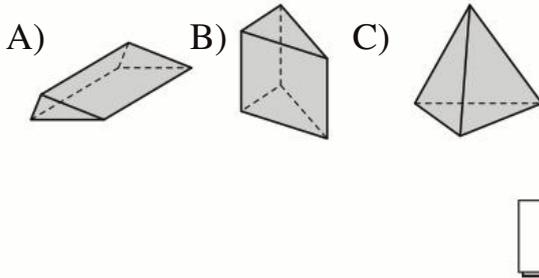
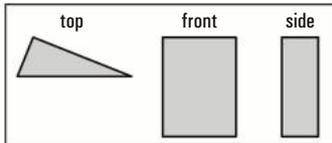
OR

- Make a model and observe the view.

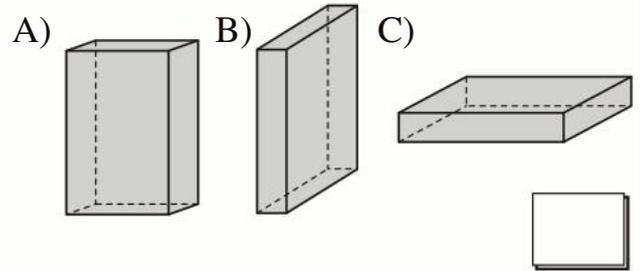
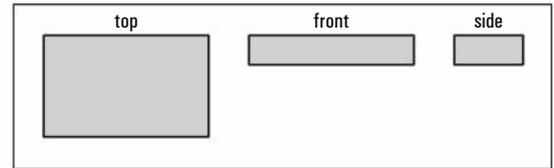
**Q.** Sketch the top view of this regular triangular pyramid.



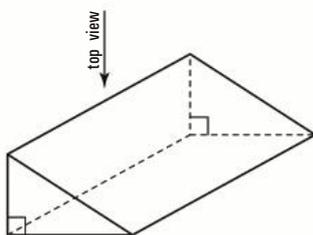
**a)** Which solid has the top, front and side views shown?



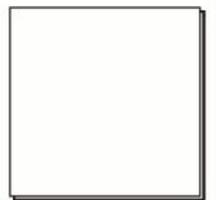
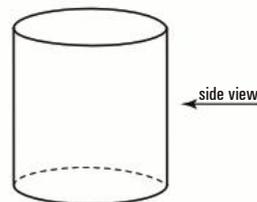
**b)** Which solid has the top, front and side views shown?



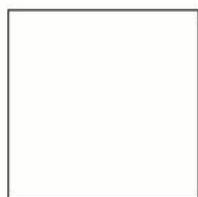
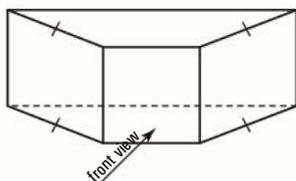
**c)** Sketch the front view of this triangular prism.



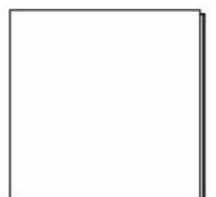
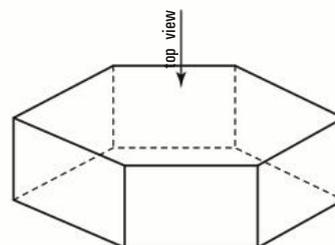
**d)** Sketch the side view of this cylinder.



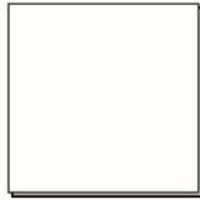
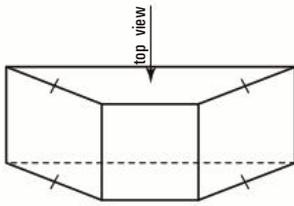
**e)** Sketch the front view of this prism.



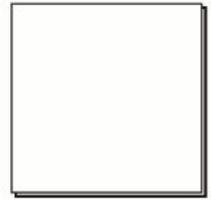
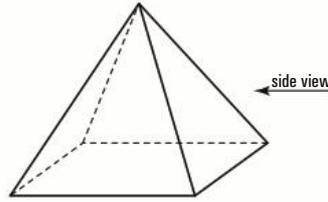
**f)** Sketch the top view of this regular hexagonal prism.



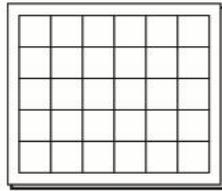
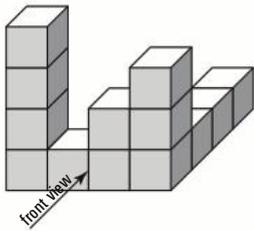
**g)** Sketch the top view of this prism.



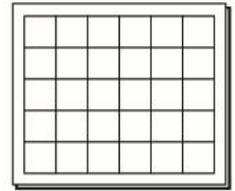
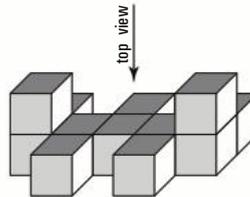
**h)** Sketch the side view of this rectangular pyramid.



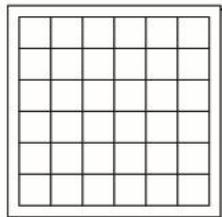
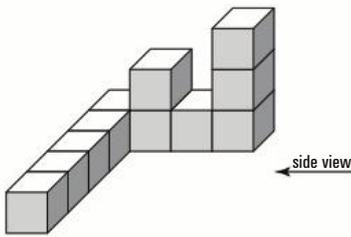
**i)** Draw the front view of this solid.



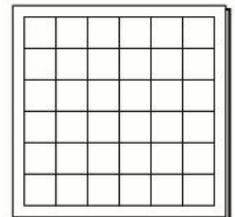
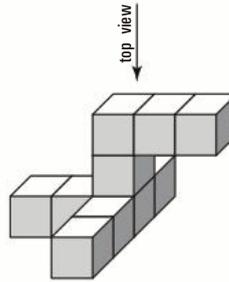
**j)** Draw the top view of this solid.



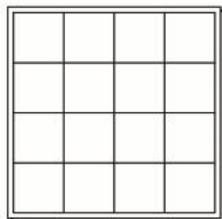
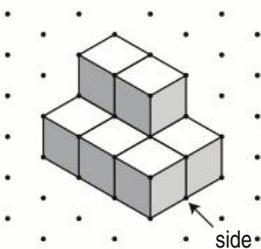
**k)** Draw the side view of this solid.



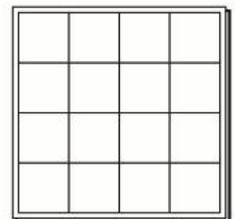
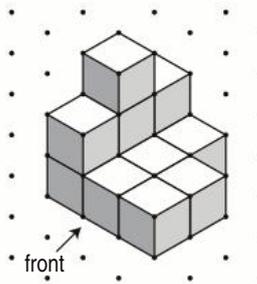
**l)** Draw the top view of this solid.



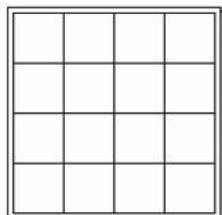
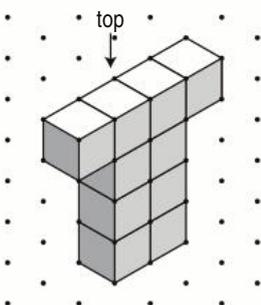
**m)** Draw the side view of this solid.



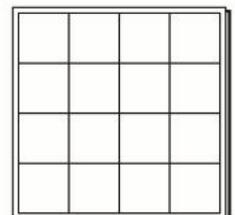
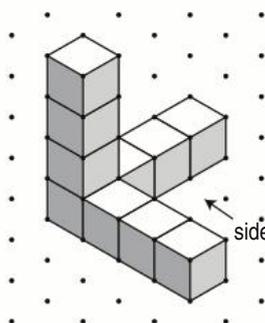
**n)** Draw the front view of this solid.



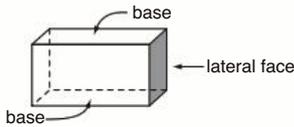
**o)** Draw the top view of this solid.



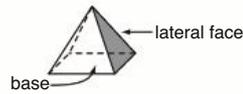
**p)** Draw the side view of this solid.



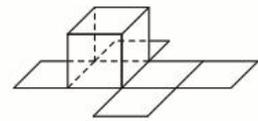
**Prism**



**Pyramid**



**Cube**



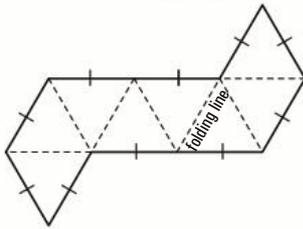
EITHER

- Identify the shapes in the net.
- Imagine the shape folded.

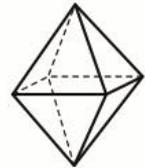
OR

- Make a model by tracing, cutting out and folding the net.

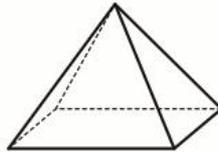
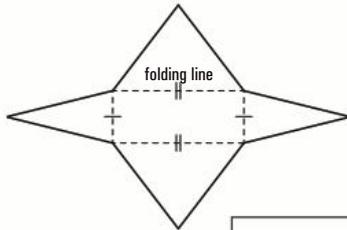
**Q.** What 3-dimensional shape can this net be used to make?



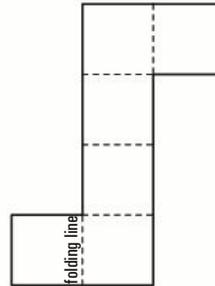
**A.** *regular octahedron*



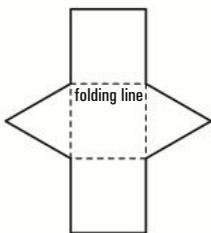
**a)** What 3-dimensional shape can this net be used to make?



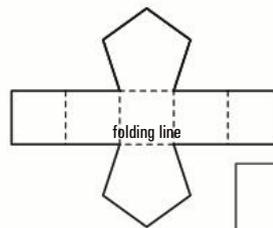

**b)** What 3-dimensional shape can this net be used to make?



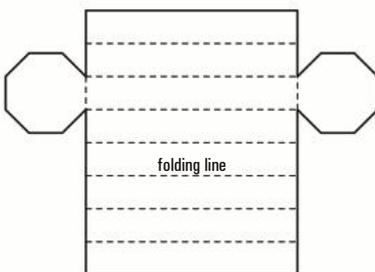

**c)** What 3-dimensional shape can this net be used to make?



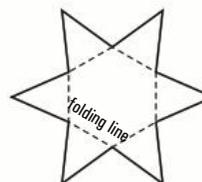

**d)** What 3-dimensional shape can this net be used to make?




**e)** What 3-dimensional shape can this net be used to make?

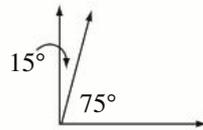



**f)** What 3-dimensional shape can this net be used to make?



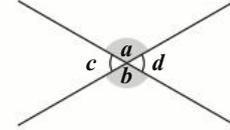
**Complementary angles** - add to  $90^\circ$

$$15^\circ + 75^\circ = 90^\circ$$



**Vertically opposite angles** - are equal

$$\angle a = \angle b, \angle c = \angle d$$



**To find the size of an angle when its complementary angle/angles are given**

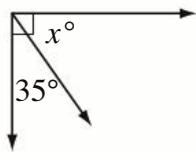
EITHER

- Subtract the given angles from  $90^\circ$ .

OR

- Write an equation involving the unknown angle  $x^\circ$ .
- Solve the equation for  $x^\circ$ .

**Q.** Find the value of  $x^\circ$ .



**A.**  $x^\circ$  and  $35^\circ$  are complementary: OR

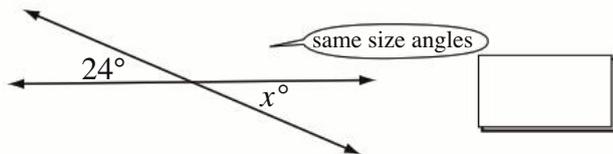
$$x^\circ = 90^\circ - 35^\circ = 55^\circ$$

$$x^\circ + 35^\circ = 90^\circ$$

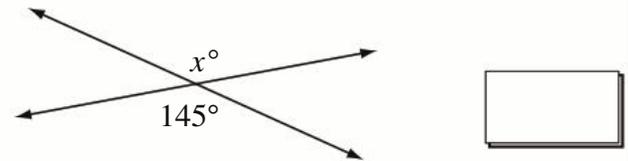
$$x^\circ + 35^\circ - 35^\circ = 90^\circ - 35^\circ$$

$$x^\circ = 55^\circ$$

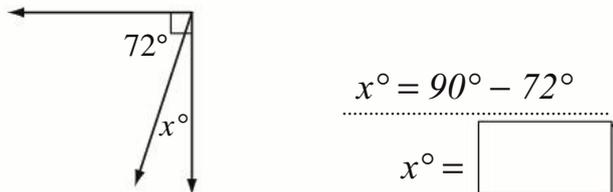
**a)** Find the value of  $x^\circ$ .



**b)** Find the value of  $x^\circ$ .



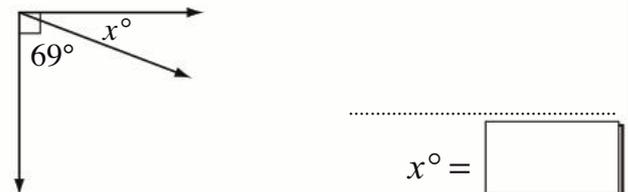
**c)** Find the value of  $x^\circ$ .



$$x^\circ = 90^\circ - 72^\circ$$

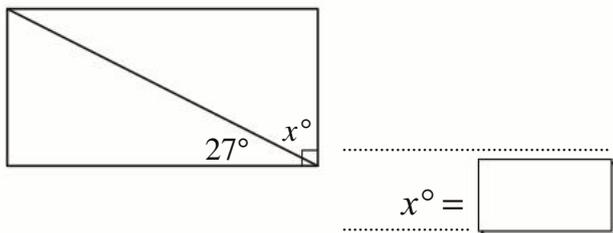
$$x^\circ = \boxed{\phantom{00}}$$

**d)** Find the value of  $x^\circ$ .



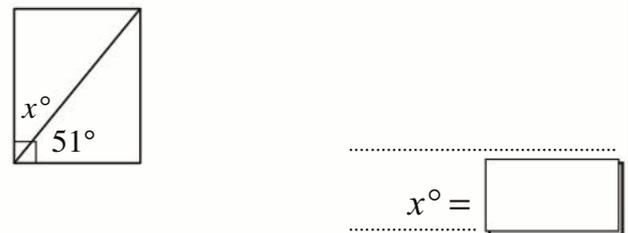
$$x^\circ = \boxed{\phantom{00}}$$

**e)** Find the value of  $x^\circ$ .



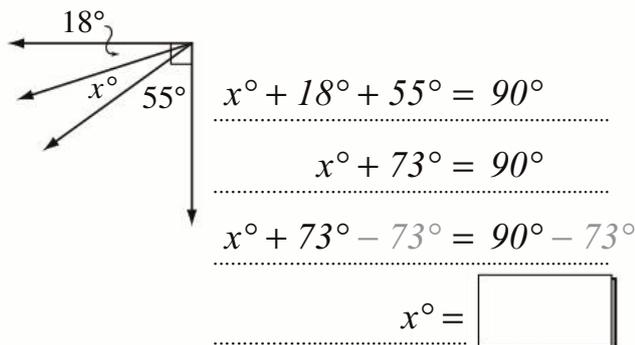
$$x^\circ = \boxed{\phantom{00}}$$

**f)** Find the value of  $x^\circ$ .



$$x^\circ = \boxed{\phantom{00}}$$

**g)** Find the value of  $x^\circ$ .



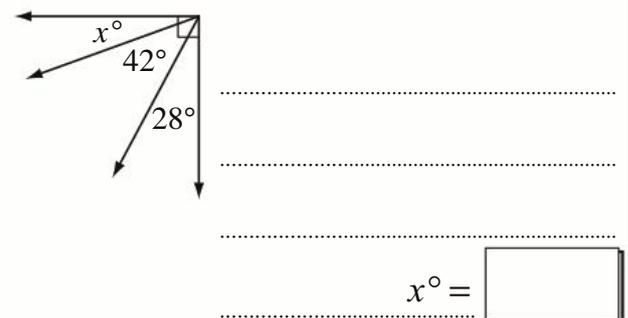
$$x^\circ + 18^\circ + 55^\circ = 90^\circ$$

$$x^\circ + 73^\circ = 90^\circ$$

$$x^\circ + 73^\circ - 73^\circ = 90^\circ - 73^\circ$$

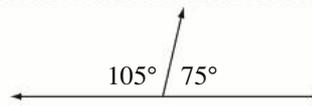
$$x^\circ = \boxed{\phantom{00}}$$

**h)** Find the value of  $x^\circ$ .



$$x^\circ = \boxed{\phantom{00}}$$

**Supplementary angles** - add to  $180^\circ$



$$105^\circ + 75^\circ = 180^\circ$$

**To find the size of an angle when its supplementary angle/angles are given**

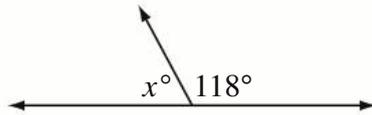
EITHER

- Subtract the given angles from  $180^\circ$ .

OR

- Write an equation involving the unknown angle  $x^\circ$ .
- Solve the equation for  $x^\circ$ .

**Q.** Find the value of  $x^\circ$ .



**A.**  $x^\circ$  and  $118^\circ$  are supplementary:

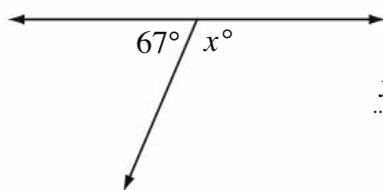
$$x^\circ = 180^\circ - 118^\circ = 62^\circ$$

OR  $x^\circ + 118^\circ = 180^\circ$

$$x^\circ + 118^\circ - 118^\circ = 180^\circ - 118^\circ$$

$$x^\circ = 62^\circ$$

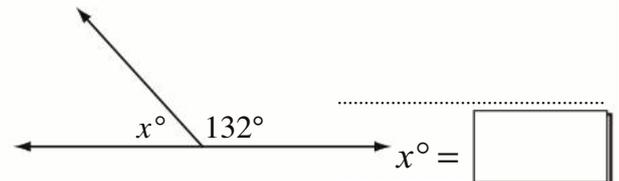
**a)** Find the value of  $x^\circ$ .



$$x^\circ = 180^\circ - 67^\circ$$

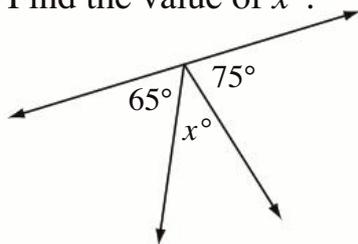
$$x^\circ = \boxed{\phantom{00}}$$

**b)** Find the value of  $x^\circ$ .



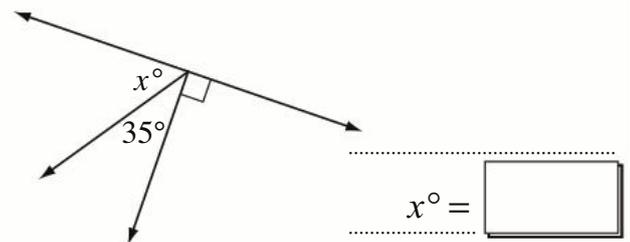
$$x^\circ = \boxed{\phantom{00}}$$

**c)** Find the value of  $x^\circ$ .



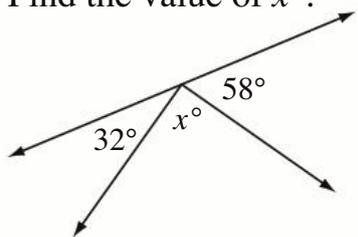
$$x^\circ = \boxed{\phantom{00}}$$

**d)** Find the value of  $x^\circ$ .



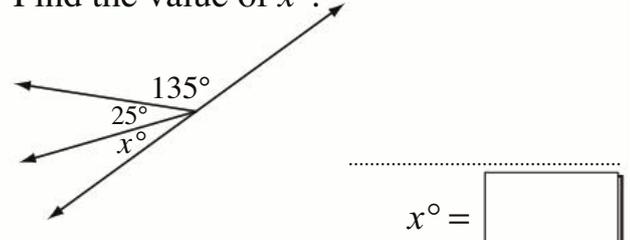
$$x^\circ = \boxed{\phantom{00}}$$

**e)** Find the value of  $x^\circ$ .



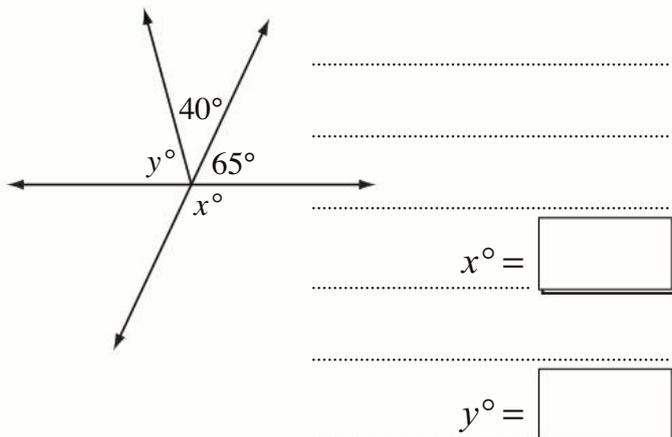
$$x^\circ = \boxed{\phantom{00}}$$

**f)** Find the value of  $x^\circ$ .

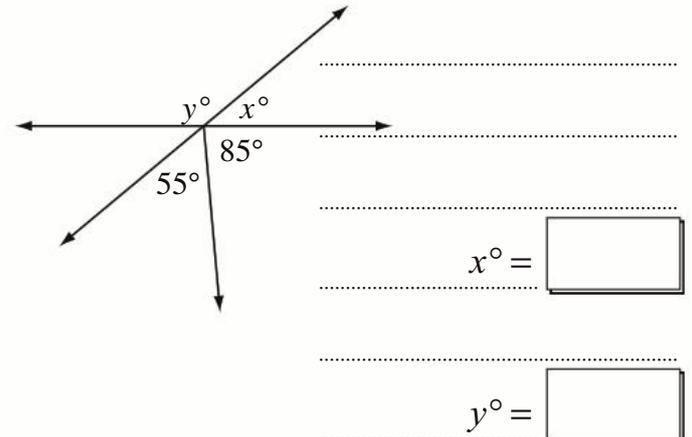


$$x^\circ = \boxed{\phantom{00}}$$

**g)** Find the values of  $x^\circ$  and  $y^\circ$ .

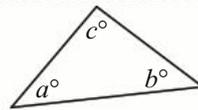


**h)** Find the values of  $x^\circ$  and  $y^\circ$ .



**Sum of interior angles in a triangle =  $180^\circ$**

$$a^\circ + b^\circ + c^\circ = 180^\circ$$



**To find the size of an angle of a triangle when the other two angles are given**

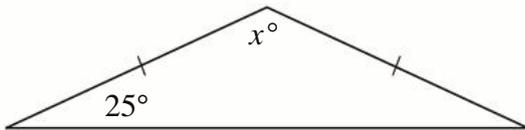
**EITHER**

- Subtract the sum of the given angles from  $180^\circ$ .

**OR**

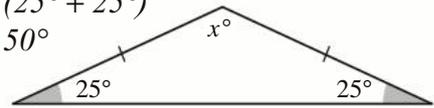
- Write an equation involving the unknown angle  $x^\circ$ .
- Solve the equation for  $x^\circ$ .

**Q.** Find the value of  $x^\circ$ .



**A.** *Isosceles triangle*  $\Rightarrow$  base angles are equal:

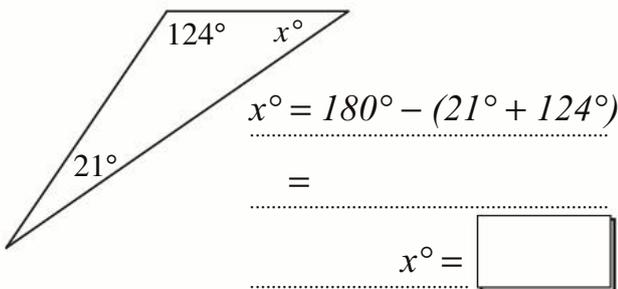
$$\begin{aligned} x^\circ &= 180^\circ - (25^\circ + 25^\circ) \\ &= 180^\circ - 50^\circ \\ &= \mathbf{130^\circ} \end{aligned}$$



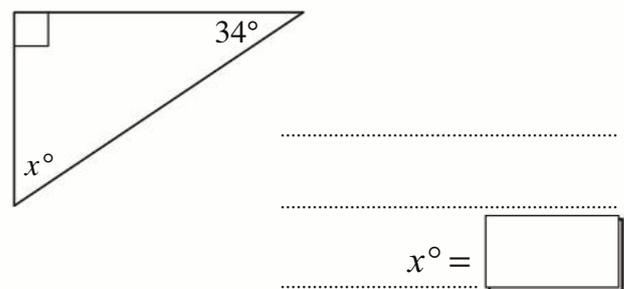
**OR**

$$\begin{aligned} x^\circ + 25^\circ + 25^\circ &= 180^\circ \\ x^\circ + 50^\circ - 50^\circ &= 180^\circ - 50^\circ \\ x^\circ &= \mathbf{130^\circ} \end{aligned}$$

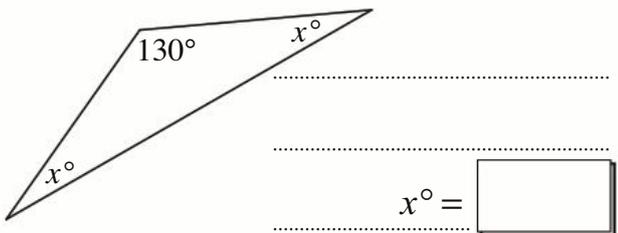
**a)** Find the value of  $x^\circ$ .



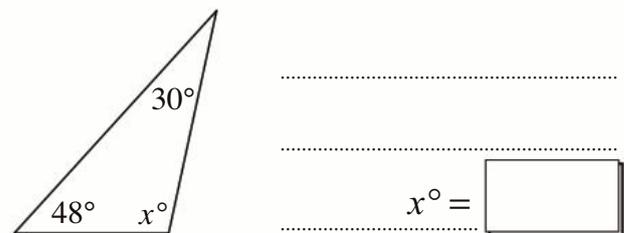
**b)** Find the value of  $x^\circ$ .



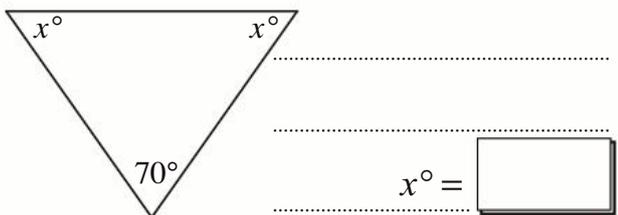
**c)** Find the value of  $x^\circ$ .



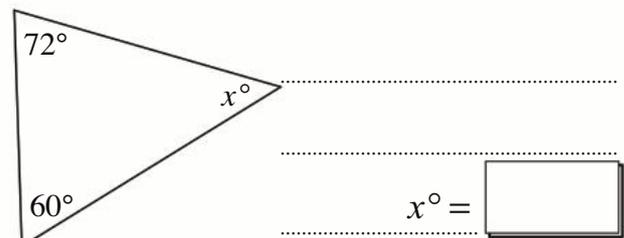
**d)** Find the value of  $x^\circ$ .



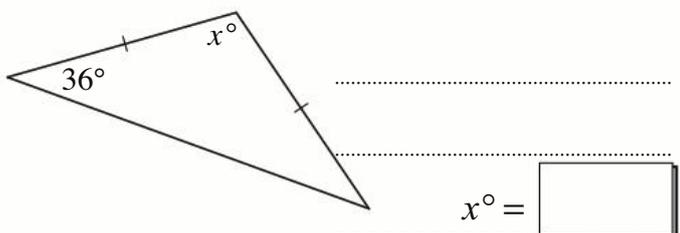
**e)** Find the value of  $x^\circ$ .



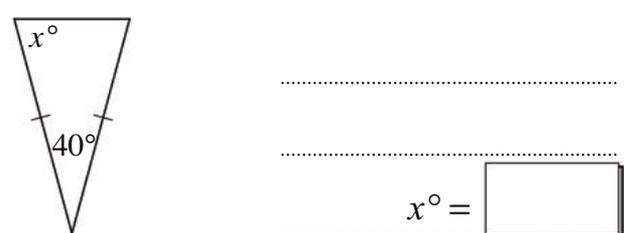
**f)** Find the value of  $x^\circ$ .



**g)** Find the value of  $x^\circ$ .

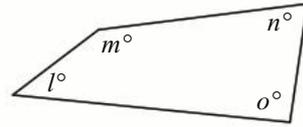


**h)** Find the value of  $x^\circ$ .



**Sum of interior angles in a quadrilateral** =  $360^\circ$

$$l^\circ + m^\circ + n^\circ + o^\circ = 360^\circ$$



**To find the size of an angle of a quadrilateral when the other two angles are given**

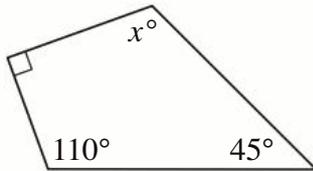
**EITHER**

- Subtract the sum of the given angles from  $360^\circ$ .

**OR**

- Write an equation involving the unknown angle  $x^\circ$ .
- Solve the equation for  $x^\circ$ .

**Q.** Find the value of  $x^\circ$ .

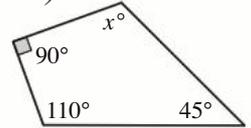


$$\begin{aligned} \text{A. } x^\circ &= 360^\circ - (90^\circ + 110^\circ + 45^\circ) \\ &= 360^\circ - 245^\circ \\ &= 115^\circ \end{aligned}$$

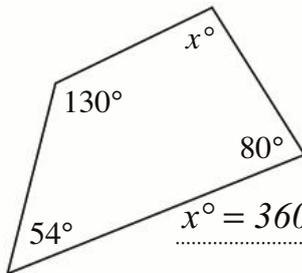
OR

$$\begin{aligned} x^\circ + 90^\circ + 110^\circ + 45^\circ &= 360^\circ \\ x^\circ + 245^\circ - 245^\circ &= 360^\circ - 245^\circ \end{aligned}$$

$$x^\circ = 115^\circ$$

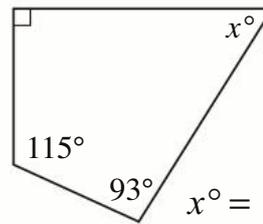


**a)** Find the value of  $x^\circ$ .



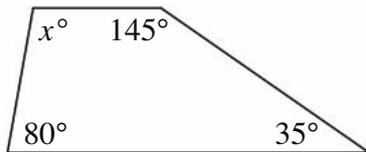
$$\begin{aligned} x^\circ &= 360^\circ - (130^\circ + 54^\circ + 80^\circ) \\ &= 360^\circ - 264^\circ = \boxed{\phantom{00}} \end{aligned}$$

**b)** Find the value of  $x^\circ$ .



$$x^\circ = \boxed{\phantom{00}}$$

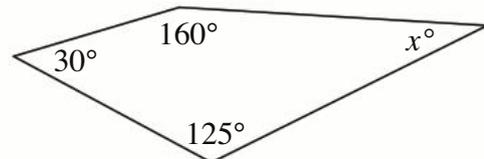
**c)** Find the value of  $x^\circ$ .



$$x^\circ = \boxed{\phantom{00}}$$

=

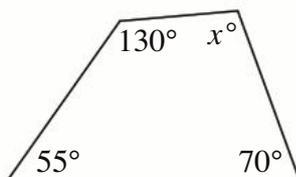
**d)** Find the value of  $x^\circ$ .



$$x^\circ = \boxed{\phantom{00}}$$

=

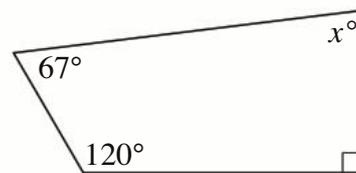
**e)** Find the value of  $x^\circ$ .



$$x^\circ = \boxed{\phantom{00}}$$

=

**f)** Find the value of  $x^\circ$ .



$$x^\circ = \boxed{\phantom{00}}$$

=

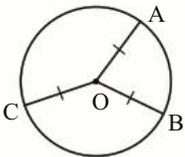
**Skill 27.13** Describing the properties of circles.

Blue 11 22 33 44  
Green 11 22 33 44

- Consider the definitions and properties of radius (plural radii), chord, diameter, tangent and circumference of a circle. (see Glossary, and Math Facts, page 386)

**Radius**

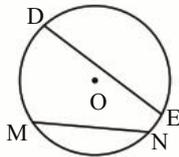
joins the centre with any point on the circle



$OA = OB = OC$

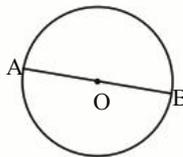
**Chord**

joins any two points on the circle



**Diameter**

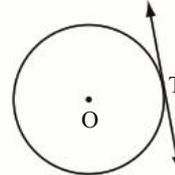
a chord passing through the centre



$AB = 2OA$

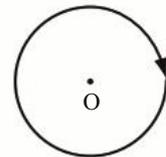
**Tangent**

a line touching the circle in one point



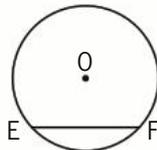
**Circumference**

the distance around the circle



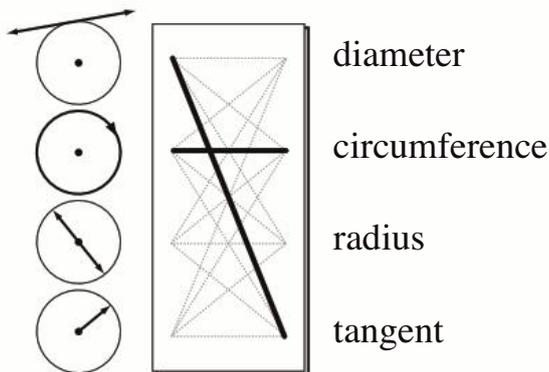
**Q.** What is  $\overline{EF}$  in this diagram?

- A) diameter
- B) tangent
- C) chord
- D) radius



**A.**  $\overline{EF}$  joins two points on the circle and does not pass through the centre  $\Rightarrow$  **chord**

**a)** Match each diagram to its description:



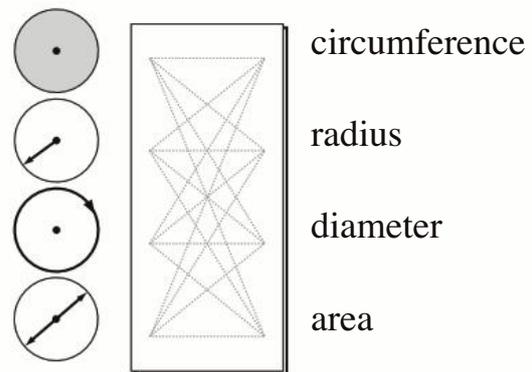
diameter

circumference

radius

tangent

**b)** Match each diagram to its description:



circumference

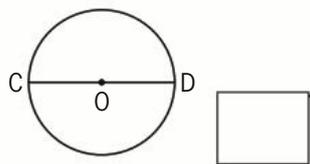
radius

diameter

area

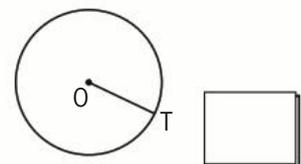
**c)** What is  $\overline{CD}$  in this diagram?

- A) tangent
- B) diameter
- C) radius
- D) circumference

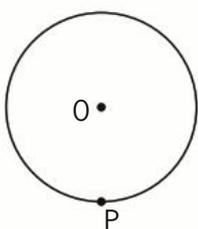


**d)** What is  $\overline{OT}$  in this diagram?

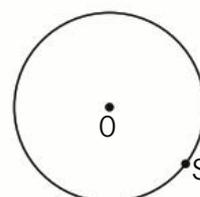
- A) chord
- B) tangent
- C) diameter
- D) radius



**e)** Draw the diameter passing through P.



**f)** Draw the radius passing through S.



# 28. [Location / Transformation]

**Skill 28.1** Following directions and using compass bearings to describe location on a map.

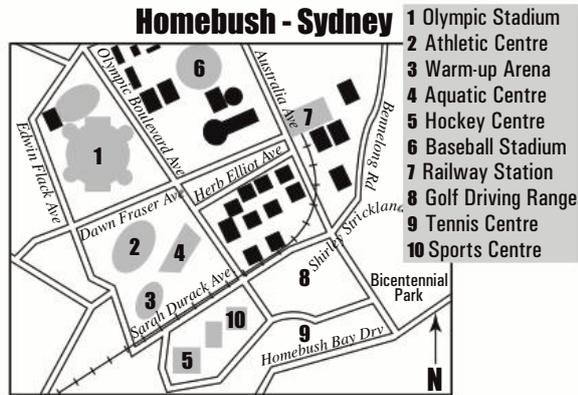
Blue 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- Follow the directions one at a time.

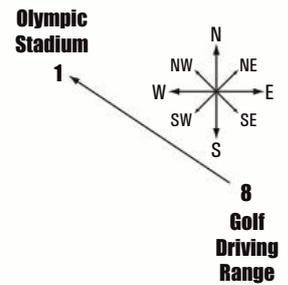
Hints: A compass showing North will allow you to find your bearings.

Clockwise from North, "Never Eat Sea Weed" is one way to remember the 4 point compass.

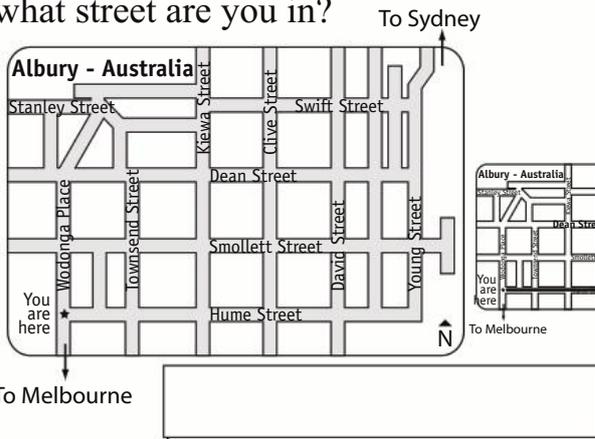
**Q.** At Homebush, in which direction is the Olympic Stadium from the Golf Driving Range?



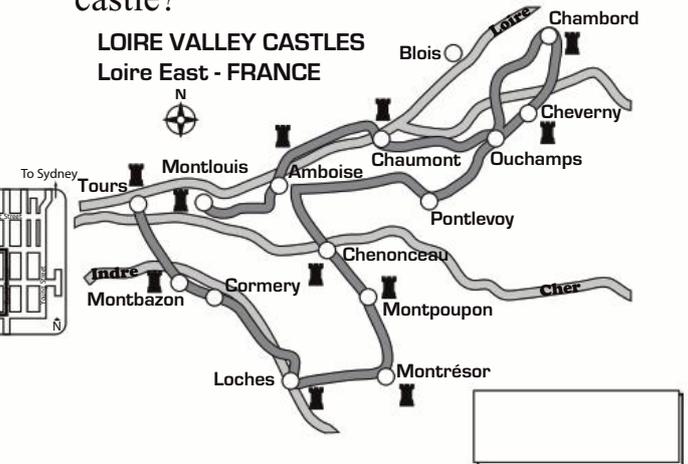
**A.** *NW* Focus on the relevant information.



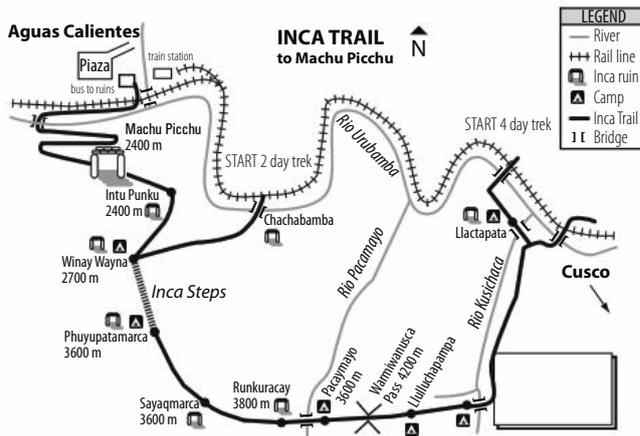
**a)** From where you are, travel east until you reach David Street. Then walk north. If you take the second turn left, what street are you in?



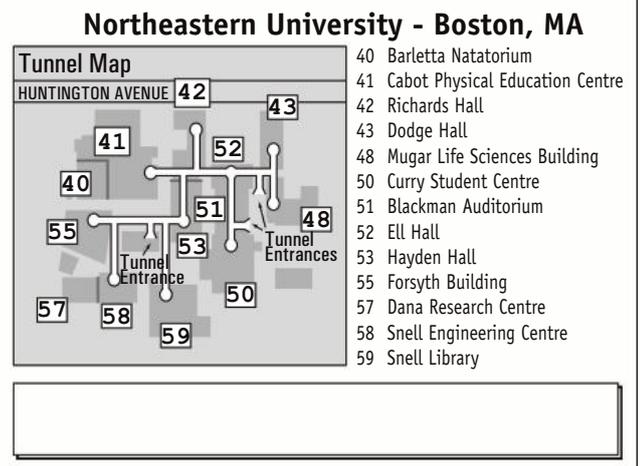
**b)** From Montrésor castle, which direction do you have to drive to reach Loches castle?



**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?



**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?



- Imagine a line along which the shape can be folded to have one part fit exactly over the other part.

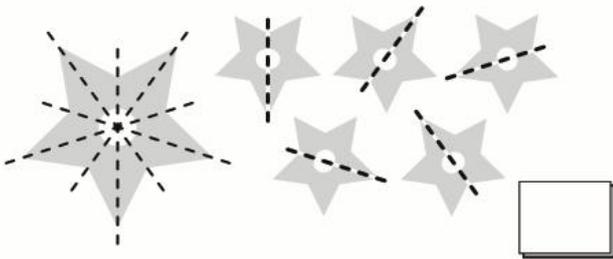
**Q.** Draw the axes of symmetry for these shapes. Circle the shapes that are both horizontally and vertically symmetrical.



**A.**

vertically & horizontally symmetrical ✓	horizontally symmetrical only	vertically symmetrical only	vertically & horizontally symmetrical ✓

**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.



- Place a piece of paper against the scale matching the starting points.
- Slide the paper across the length of the scale 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 kilometres?

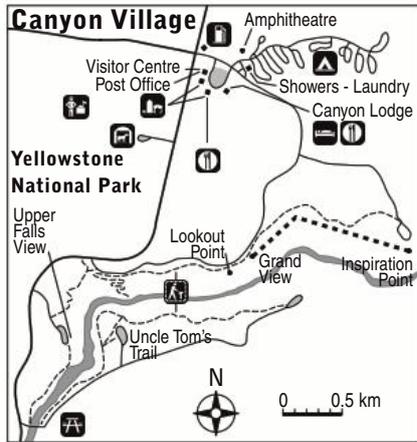
**A.**  $0.5 + 0.5 + 0.5 = 1.5 \text{ km}$

There are 2 distances to be measured.

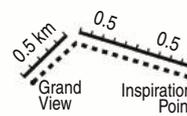
Mark the start of the first distance and the turning point on paper. Rotate the paper to match the second distance and then mark the end.

Check the paper against the scale.

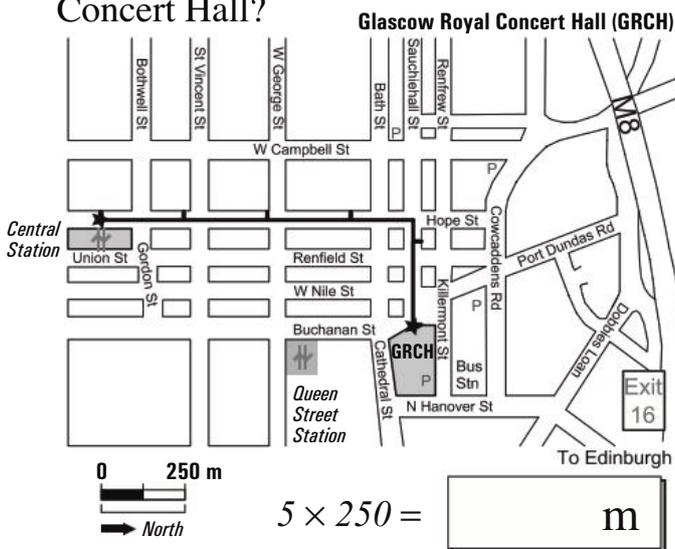
Slide the paper along the scale as necessary.



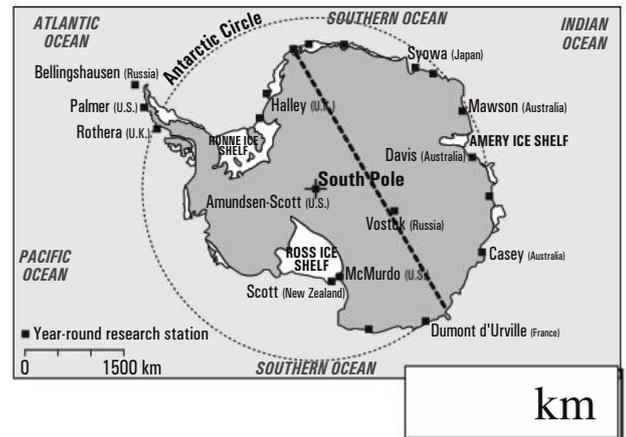
- Services & Facilities**
- Ranger station
  - Campground
  - Lodging
  - Food service
  - Picnic area
  - Store
  - Gas station
  - Self-guiding trail
  - Horse rental



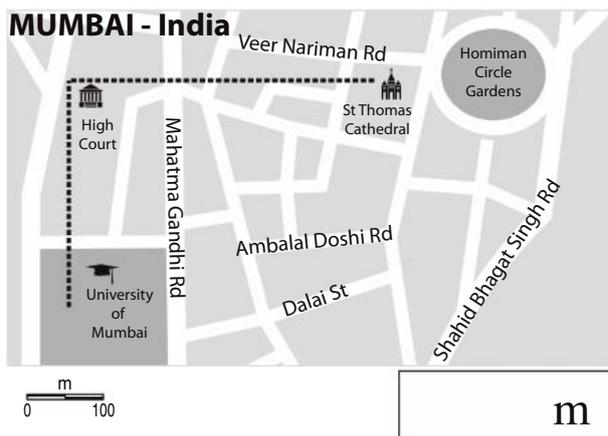
**a)** How far is it from Central Station, along Hope St. to the Glasgow Royal Concert Hall?



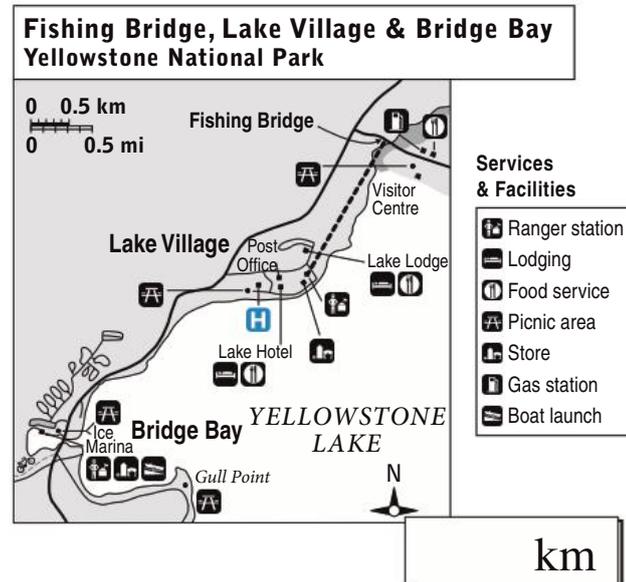
**b)** Using the scale, what is the marked distance on this map of Antarctica?



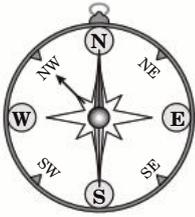
**c)** Using the scale, what is the marked distance from the University via the High Court to the Homiman Circle Gardens?



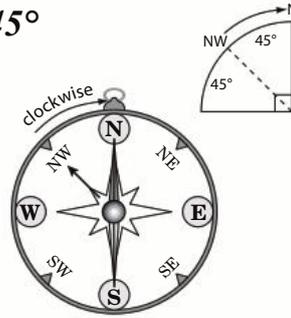
**d)** Using the scale, what is the marked distance from the ranger station closest to Lake Hotel to Fishing Bridge?



**Q.** According to the compass, you are facing north-west. How many degrees clockwise must you turn to face north?



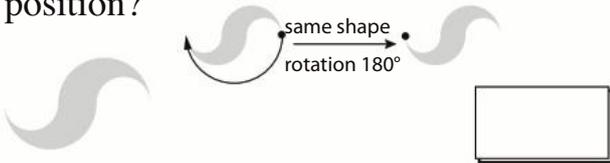
**A.** 45°



Find the North direction.

Calculate the number of degrees by picturing a circle.

**a)** By how many degrees must this shape be rotated to first match the original position?




**b)** By how many degrees must this shape be rotated to first match the original position?




**c)** By how many degrees must this shape be rotated to first match the original position?




**d)** By how many degrees must this shape be rotated to first match the original position?



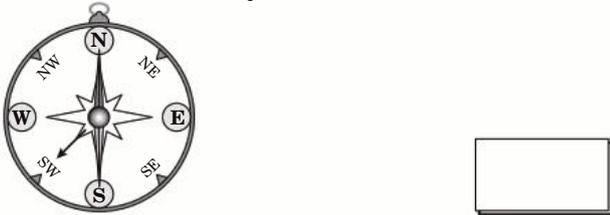

**e)** By how many degrees must the big hand of this clock rotate to show exactly 11:05?




**f)** By how many degrees must the big hand of this clock rotate to show exactly 2:00?




**g)** This compass shows that you are facing south-west. How many degrees clockwise must you turn to face north?




**h)** This compass shows that you are facing south. How many degrees anticlockwise must you turn to face north-west?




**i)** How many degrees must the big hand of this clock turn to show exactly 9:45?




**j)** According to the compass, you are facing south-east. How many degrees clockwise must you turn to face west?



**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)

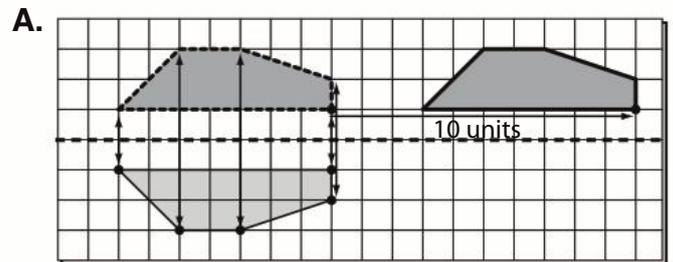
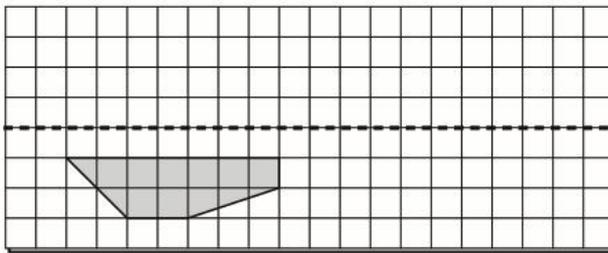
- Draw a perpendicular line to the mirror line from each vertex of the shape.
- Extend the perpendicular line beyond the mirror line by the same distance.
- Plot and join the reflected points.

**Rotation** (turning about a point or centre of rotation)

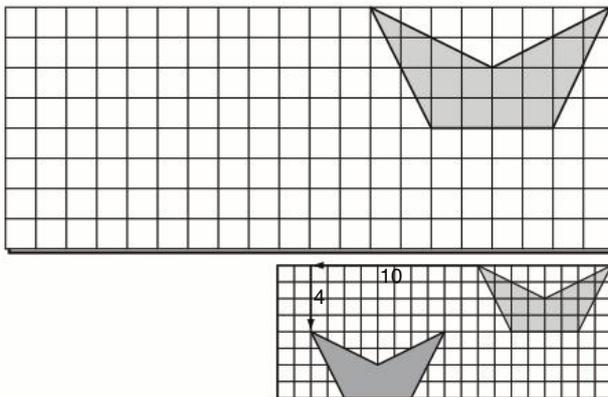
- Rotate each vertex by the given angle, in the given direction.
- Plot and join the rotated points.

Hint: The resulting shapes are always congruent to the original shapes (same size and shape).

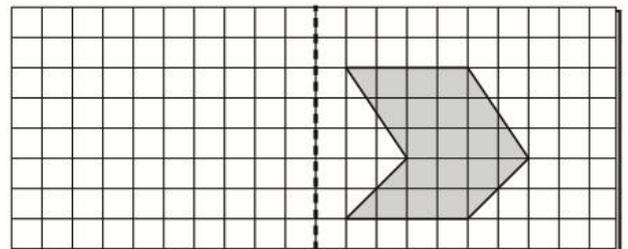
**Q.** Redraw this shape after reflecting it in the horizontal dotted line and then translating it 10 units to the right.



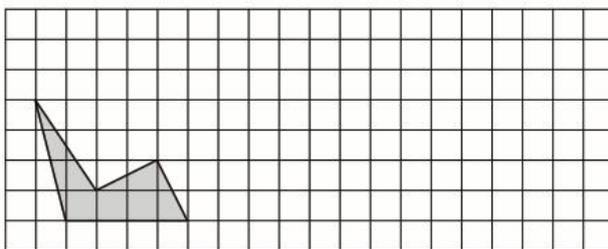
**a)** Redraw this shape after translating it 10 units to the left and 4 units down.



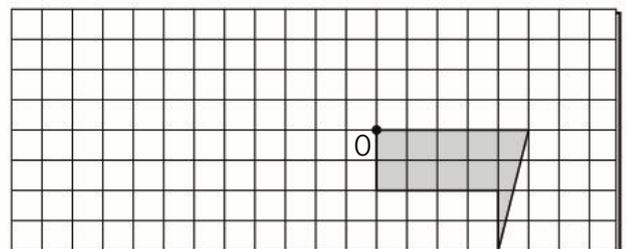
**b)** Redraw this shape after reflecting it in the vertical dotted line.



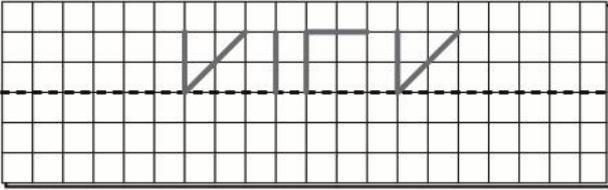
**c)** Redraw this shape after translating it 3 units up and 12 units to the right.



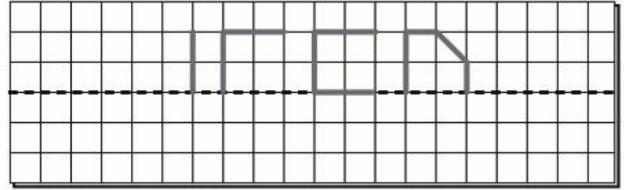
**d)** Redraw this shape after rotating it 180° about the point O.



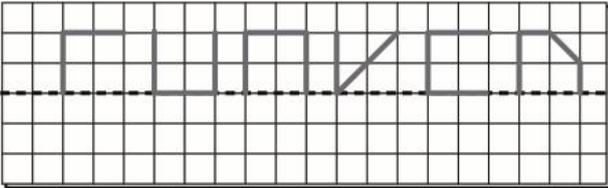
- e) Redraw this diagram after reflecting it in the horizontal dotted line.



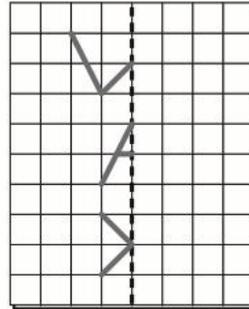
- f) Redraw this diagram after reflecting it in the horizontal dotted line.



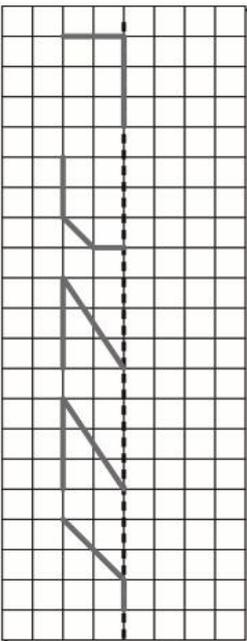
- g) Redraw this diagram after reflecting it in the horizontal dotted line.



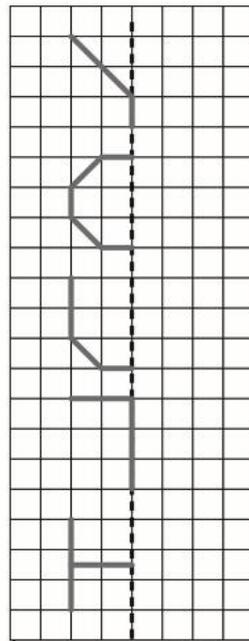
- h) Redraw this diagram after reflecting it in the vertical dotted line.



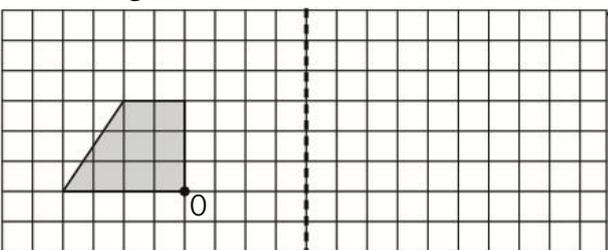
- i) Redraw this diagram after reflecting it in the vertical dotted line.



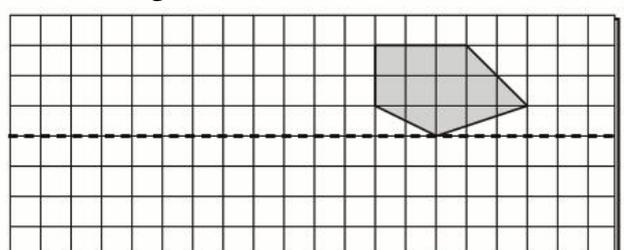
- j) Redraw this diagram after reflecting it in the vertical dotted line.



- k) Redraw this shape after rotating it  $90^\circ$  clockwise about point O and then reflecting it in the vertical dotted line.



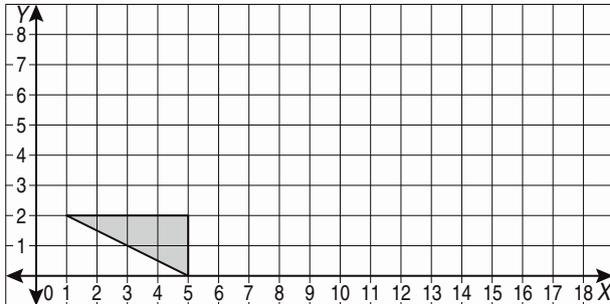
- l) Redraw this shape after reflecting it in the horizontal dotted line and then translating it 9 units to the left.



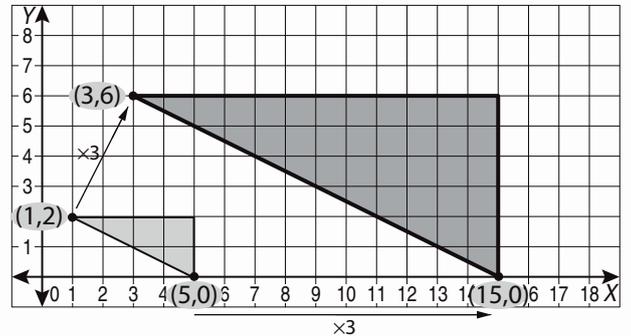
- Multiply or divide the  $x$ - and  $y$ -coordinates of the vertices of the given shape.
- Plot the new points.
- Join these points to form a new shape.

Hint: The resulting shape is always similar to the original shape (same shape, but different size).

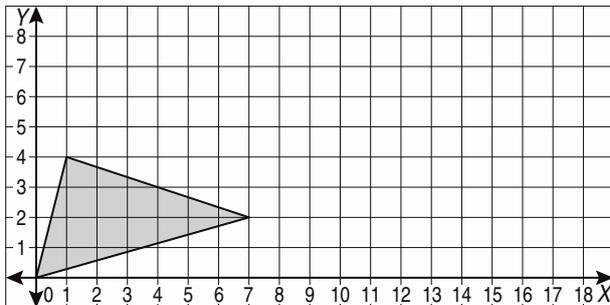
**Q.** Redraw the shape after multiplying the coordinates of its vertices by 3.



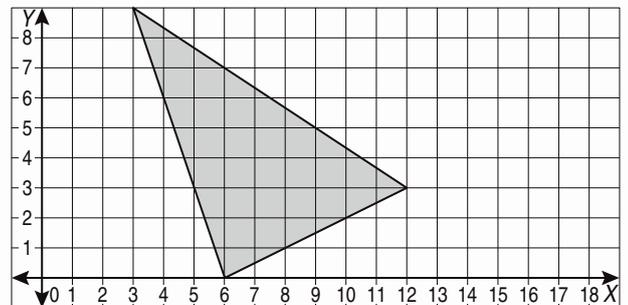
**A.**



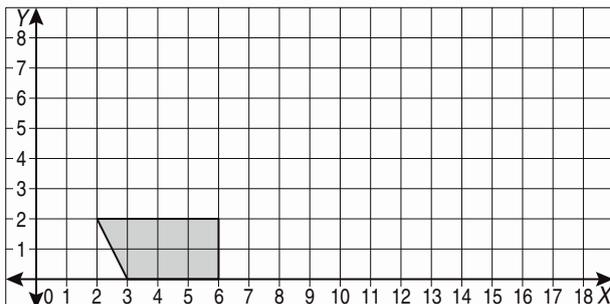
**a)** Redraw the triangle after doubling the coordinates of its vertices.



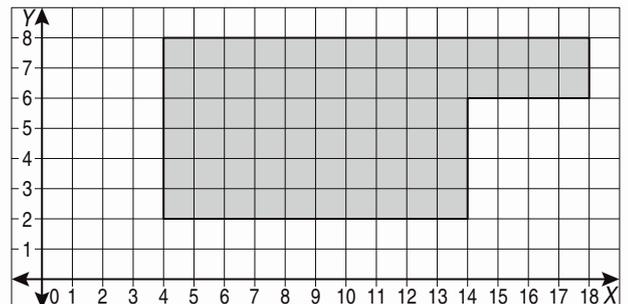
**b)** Redraw the triangle after reducing the coordinates of its vertices by a third.



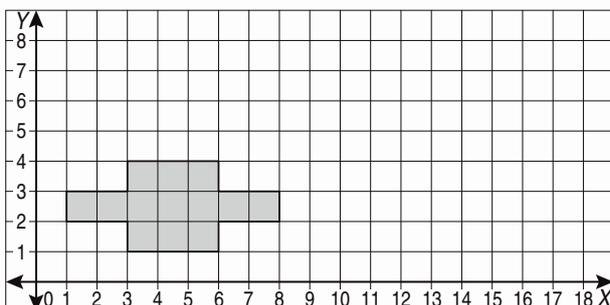
**c)** Redraw the trapezium after multiplying the coordinates of its vertices by 3.



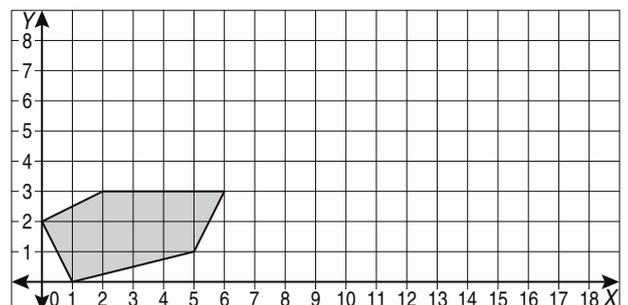
**d)** Redraw the polygon after halving the coordinates of its vertices.



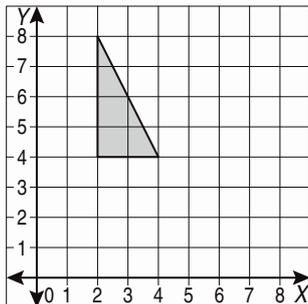
**e)** Redraw the polygon after doubling the coordinates of its vertices.



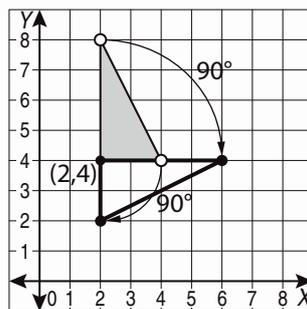
**f)** Redraw the pentagon after tripling the coordinates of its vertices.



**Q.** Redraw this triangle after rotating it  $90^\circ$  clockwise about the point of coordinates (2,4).



**A.**



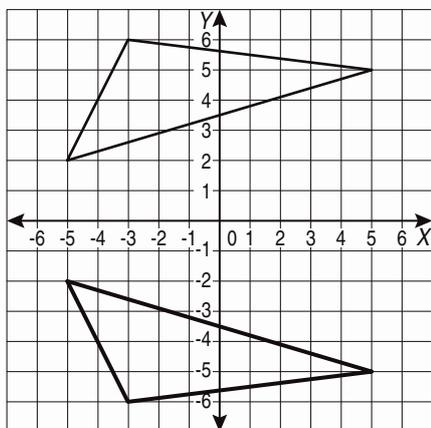
Move each vertex of the triangle by  $90^\circ$  clockwise.

Plot the new points.

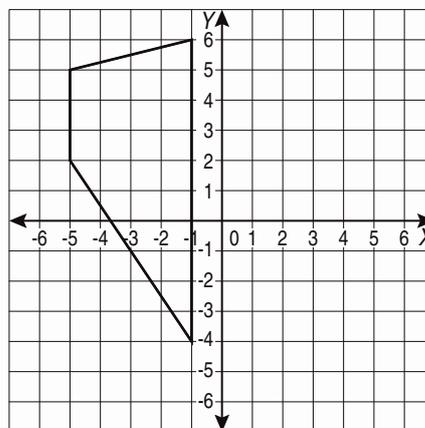
The point of coordinates (2,4) does not move.

Join the new points.

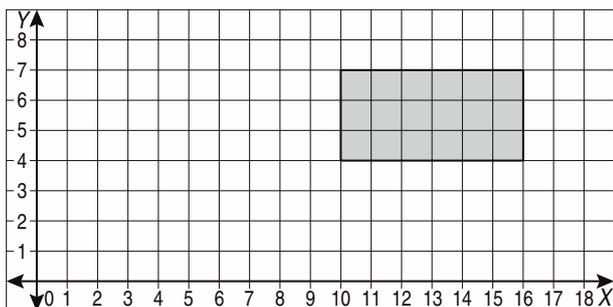
**a)** Redraw this triangle after reflecting it in the  $x$ -axis.



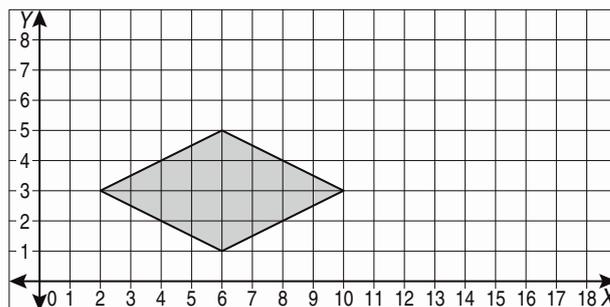
**b)** Redraw this trapezium after reflecting it in the  $y$ -axis.



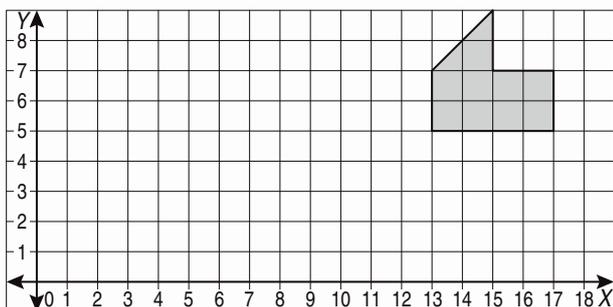
**c)** Redraw this rectangle after subtracting 4 units from the coordinates of its vertices.



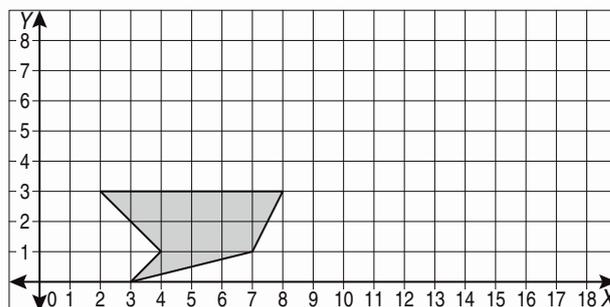
**d)** Redraw this rhombus after adding 3 units to the coordinates of its vertices.



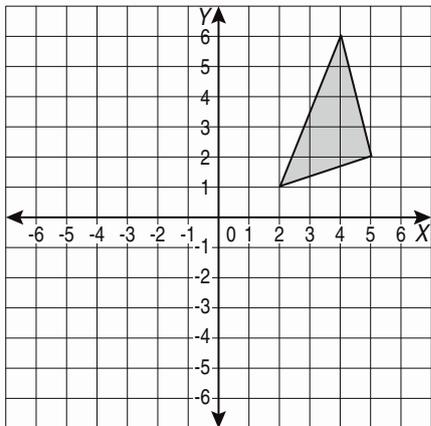
**e)** Redraw this shape after subtracting 5 units from the coordinates of its vertices.



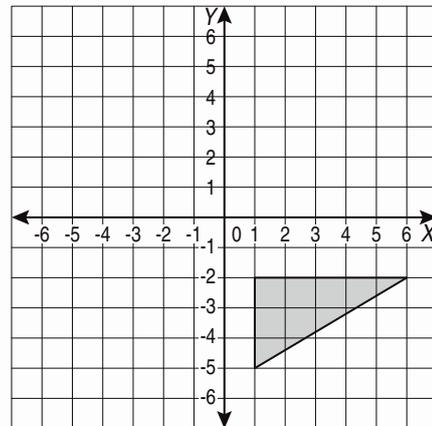
**f)** Redraw this shape after adding 5 units to the coordinates of its vertices.



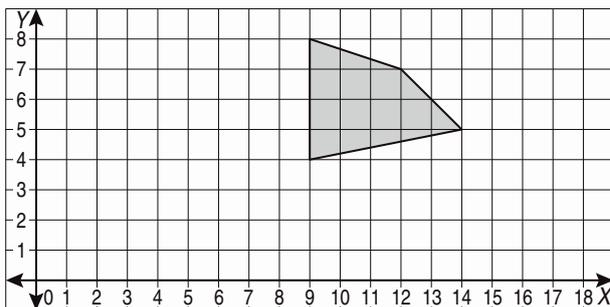
- g)** Redraw this triangle after subtracting 5 units from the  $x$ -coordinates and 6 units from the  $y$ -coordinates of its vertices.



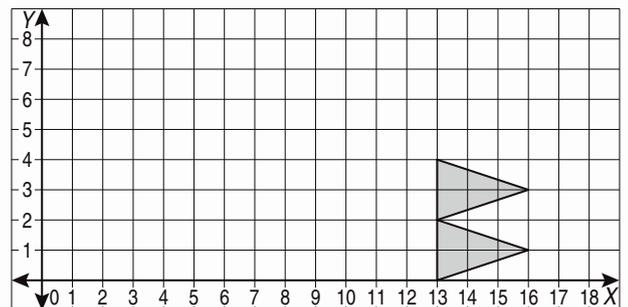
- h)** Redraw this triangle after subtracting 7 units from the  $x$ -coordinates and adding 4 units to the  $y$ -coordinates of its vertices.



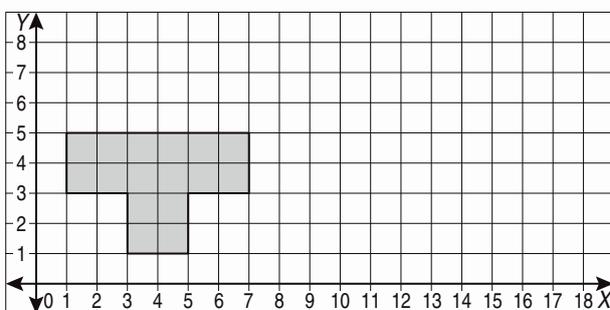
- i)** Redraw this shape after rotating it  $180^\circ$  about the point of coordinates (9,4).



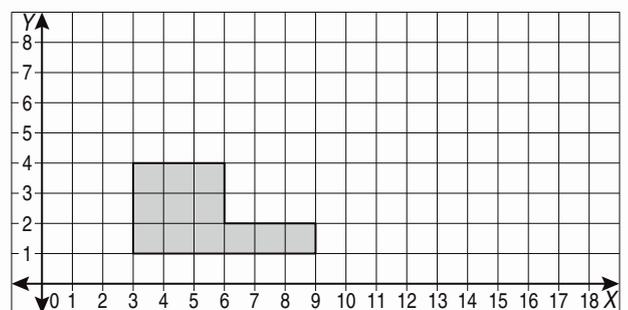
- j)** Redraw this shape after rotating it  $180^\circ$  about the point of coordinates (13,4).



- k)** Redraw this shape after rotating it  $180^\circ$  about the point of coordinates (7,5).

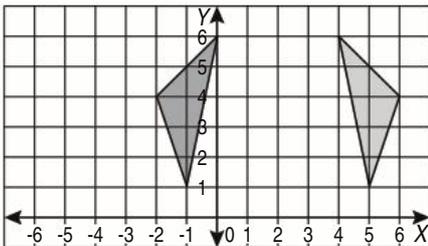


- l)** Redraw this shape after rotating it  $90^\circ$  clockwise about the point of coordinates (9,1).



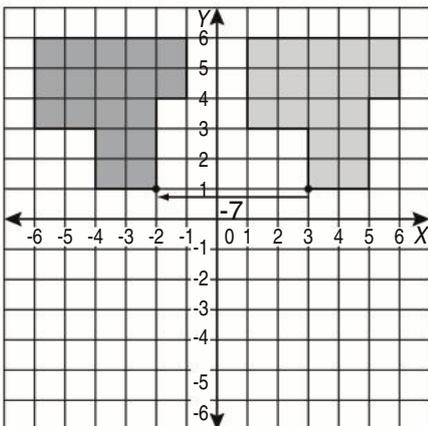
- The transformation is a **translation** if the two shapes have the same size and orientation.
- The transformation is a **reflection** if the two shapes have the same size and are symmetrical about a vertical or horizontal line.
- The transformation is a **rotation** if the two shapes have the same size, different orientation and are **not** symmetrical about a vertical or horizontal line.

- Q.** Which transformation has moved the triangle?
- A) a translation of  $-4$  along the  $x$ -axis  
 B) a reflection in the line  $x = 2$   
 C) a rotation of  $180^\circ$

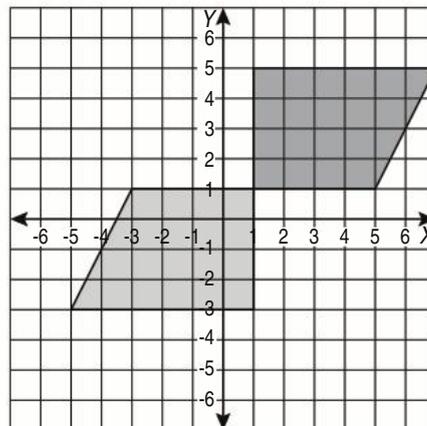


- A.** A) the shapes have different orientation  $\Rightarrow$  not a translation  
 B) the shapes are symmetrical about a vertical line  $\Rightarrow$  a reflection  
 C) the shapes are symmetrical about a vertical line  $\Rightarrow$  not a rotation  
 The answer is **B**.

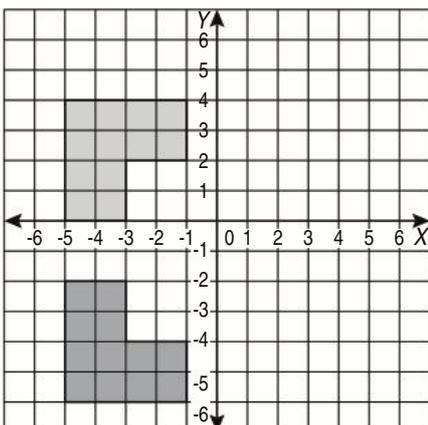
- a)** Which transformation has moved the shape?
- A) a translation of  $-7$  along the  $x$ -axis  
 B) a reflection in the  $y$ -axis  
 C) a rotation of  $180^\circ$



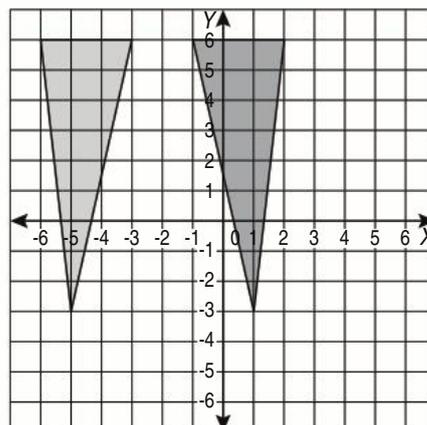
- b)** Which transformation has moved the trapezium?
- A) a translation of 4 along the  $x$ -axis  
 B) a reflection in the line  $x = 1$   
 C) a rotation of  $180^\circ$



- c)** Which transformation has moved the shape?
- A) a translation of  $-6$  along the  $y$ -axis  
 B) a reflection in the line  $x = -1$   
 C) a rotation of  $90^\circ$  anticlockwise



- d)** Which transformation has moved the triangle?
- A) a translation of  $-3$  along the  $y$ -axis  
 B) a reflection in the line  $y = -2$   
 C) a rotation of  $90^\circ$  clockwise



**Skill 28.9** Drawing reflections of shapes in lines of given equations on a Cartesian plane.

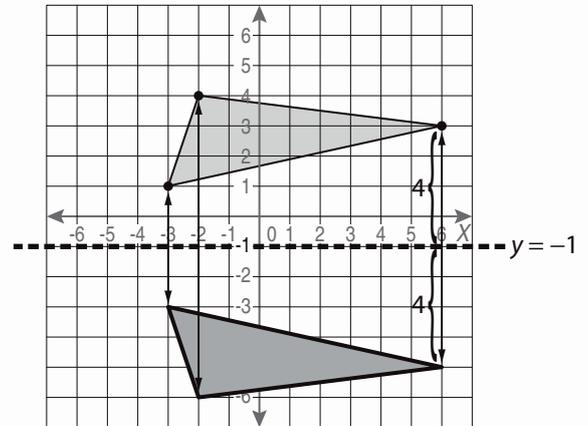
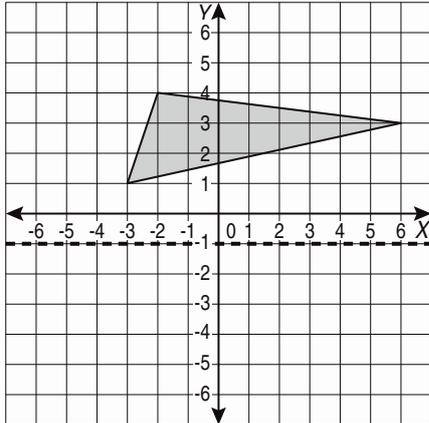
Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

**Reflection** (like in a mirror)

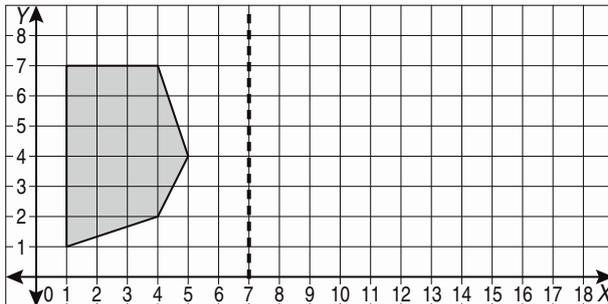
- Draw a perpendicular line to the mirror line from each vertex of the shape.
- Extend the perpendicular line beyond the mirror line by the same number of units.
- Plot and join the reflected points.

Hint: The resulting shapes are always congruent to the original shapes (same size and shape).

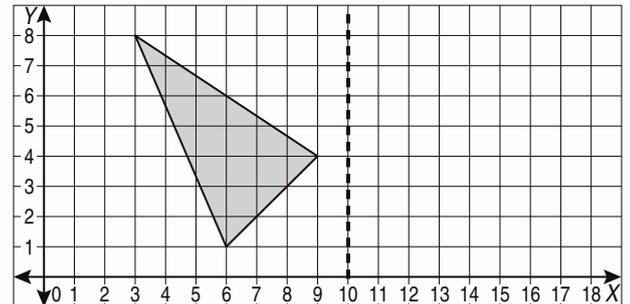
**Q.** Redraw this triangle after reflecting it in the line of equation  $y = -1$  **A.**



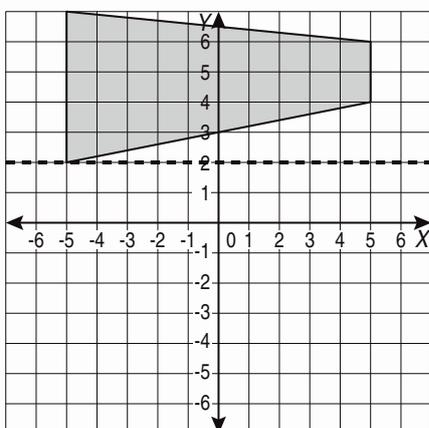
**a)** Redraw this shape after reflecting it in the line of equation  $x = 7$



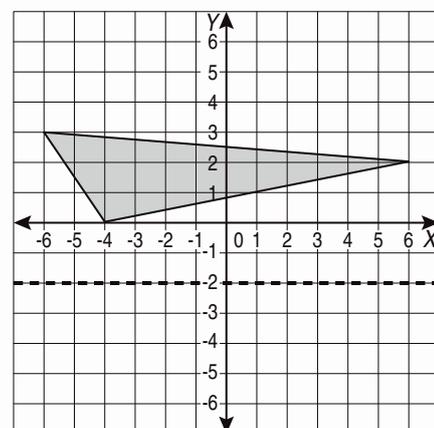
**b)** Redraw this triangle after reflecting it in the line of equation  $x = 10$



**c)** Redraw this trapezium after reflecting it in the line of equation  $y = 2$



**d)** Redraw this triangle after reflecting it in the line of equation  $y = -2$





# 29. [Statistics]

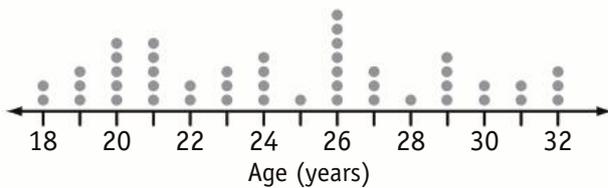
## Skill 29.1 Interpreting dot plots.

Blue 1 2 2 3 3 4 4  
Green 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.

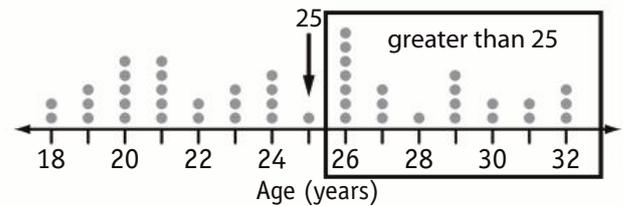
**Q.** How many Collingwood players are over the age of 25?

AFL Playing List - Collingwood 2020



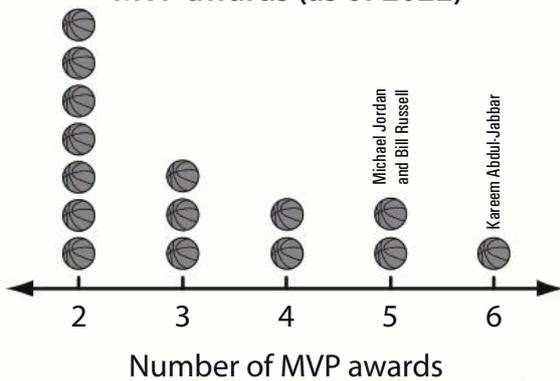
**A.**  $7 + 3 + 1 + 4 + 2 + 2 + 3$   
 $= 22$

AFL Playing List - Collingwood 2020



**a)** How many NBA players have won more than 2 Most Valuable Player awards?

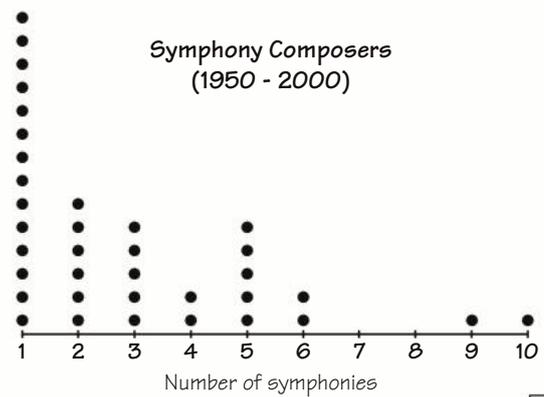
Players who have won 2 or more MVP awards (as of 2022)



=

**b)** Between 1950 and 2000, how many musicians composed at most 3 symphonies?

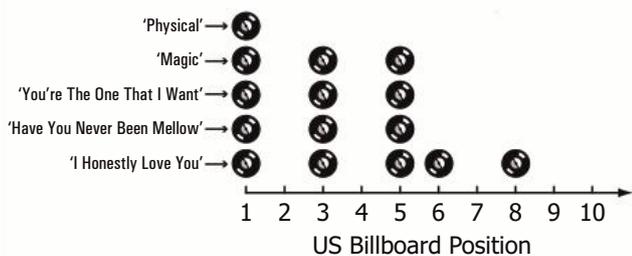
Symphony Composers (1950 - 2000)



=

**c)** Olivia Newton-John had 15 singles make it into the top ten of the US Billboard. How many of her singles reached a higher ranking than fifth?

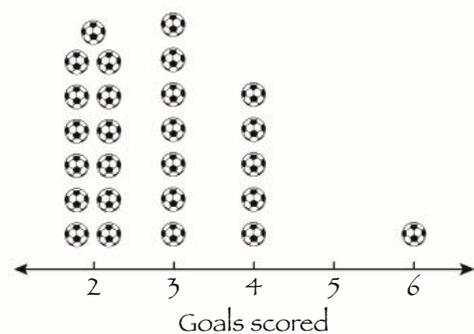
Olivia Newton-John SINGLES



=

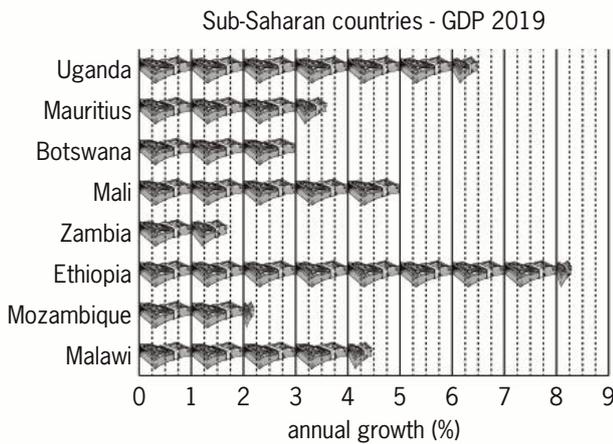
**d)** How many players scored a minimum of 4 goals in the 2018 soccer world cup?

2018 FIFA World Cup Players

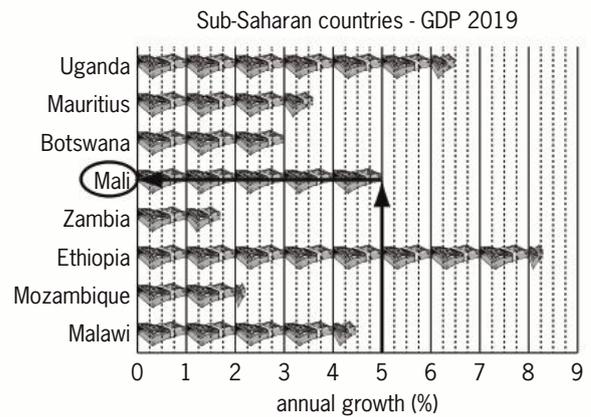


=

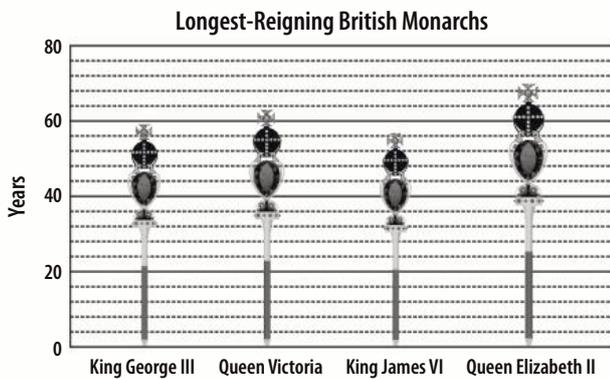
Q. Which Sub-Saharan African country had 5% annual growth in 2019?



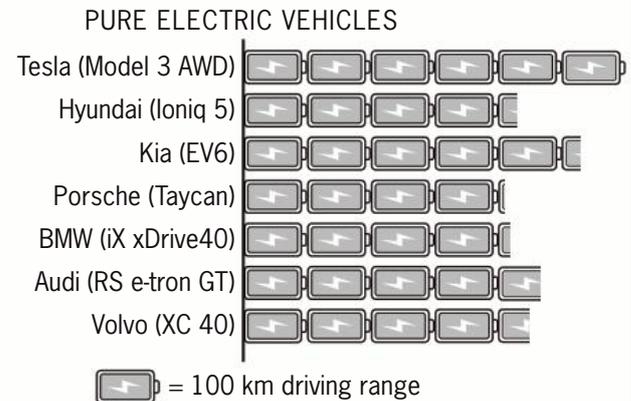
A. *Mali*



a) Which British monarch reigned for approximately 63 years?

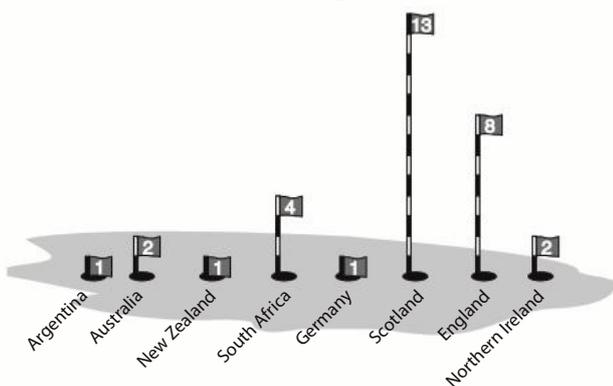



b) Which electric vehicle has a driving range closest to 400 km?

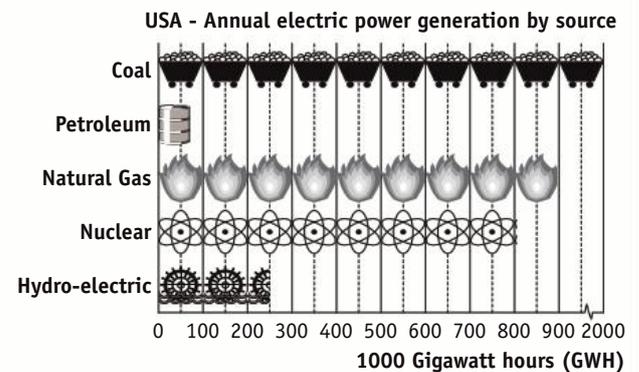



c) Which country has won the US Open twice as often as South Africa?

Countries to win the US Open (Golf) 1895 - 2019 (excluding USA)




d) Which source of power generates approximately 250 000 gigawatt hours of electricity each year in the USA?



- 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.** Which type of nut contains twice as much protein as a walnut?

Nut (100 g)	energy (kj)	proteins (g)	fats (g)	carbohydrates (g)
cashew	2314	18.2	43.9	28.72
peanut	2385	25	47	16.5
almond	2418	19.8	50	19
pistachio	2391	21.4	46	27.7
walnut	2578	9.9	59	8.6

**A. almond**

Walnut protein is 9.9 g

$$9.9 \times 2 = 19.8$$

Almond protein is 19.8 g

Nut (100 g)	energy (kj)	proteins (g)	fats (g)	carbohydrates (g)
cashew	2314	18.2	43.9	28.72
peanut	2385	25	47	16.5
almond	2418	19.8	50	19
pistachio	2391	21.4	46	27.7
walnut	2578	9.9	59	8.6

**a)** Of the birds listed, which bird has a wingspan of 3.4 metres?

Wing Spans (m)							
barn owl	wedge tailed eagle	kooka-burra	swan	white pelican	condor	stork	albatross
0.9	2.5	2	2.2	3	3	3.4	3.5

**b)** Which type of coal has the highest percentage 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%

**c)** Which activity expends one third of the amount of 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

**d)** How many chemicals in seawater have a content of more than one part per thousand?

Principal constituents of seawater	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO <sub>2</sub> )	Sulphate (SO <sub>4</sub> )	Chloride (Cl)	Bromide (Br)	Total dissolved solids (Salinity)	
	Chemical Constituent	Content (parts per thousand)	0.419	1.304	10.710	0.390	0.145	2.690	19.350	0.070
Content (parts per thousand)	0.419	1.304	10.710	0.390	0.145	2.690	19.350	0.070	19.350	

**e)** Which ski field listed below has the second most number of lifts?

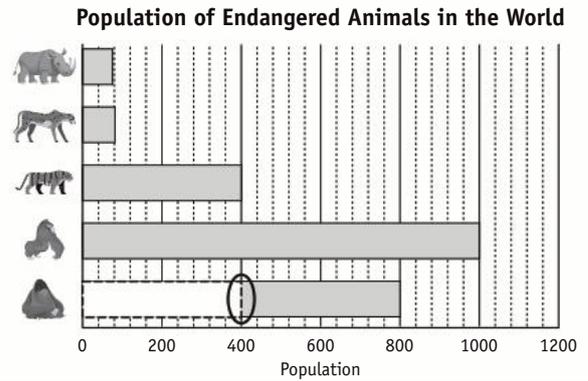
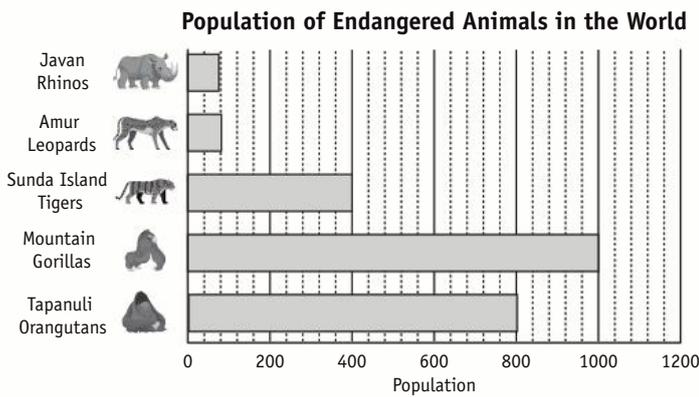
Australian snow field	Skiable area (hectares)	Number of Lifts
Perisha Blue	1245	49
Thredbo	480	14
Selwyn	45	12
Charlotte Pass	50	4
Mt Buller	180	25
Mt Hotham	245	13
Falls Creek	451	14
Mt Baw Baw	30	7

**f)** Which animal has the greatest  $\frac{\text{jump height}}{\text{weight}}$  ratio?

How high can they jump?	Antelope	Human	Cat	Galago	Cuban tree frog	Locust	Flea
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

**Q.** Which animal has half the population of Tapanuli Orangutans?

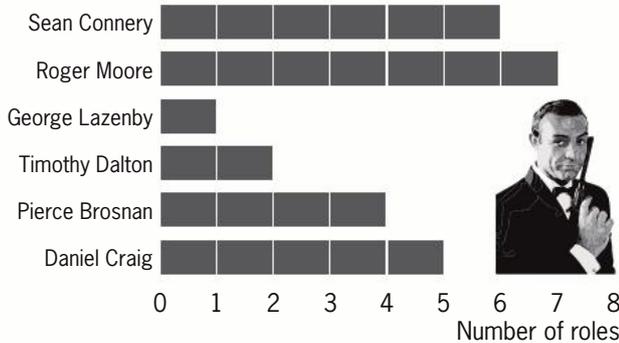
**A.** *Sunda Island Tigers* Find the Tapanuli Orangutans bar. Halve the bar length and compare to other bar lengths.



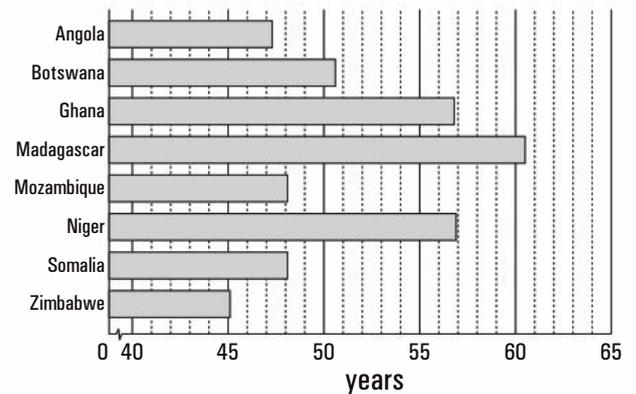
**a)** How many actors have played James Bond more often than Pierce Brosnan?

**b)** Using the graph below, how many countries have a life expectancy of less than 50 years?

**James Bond Actors** (as of 2022)



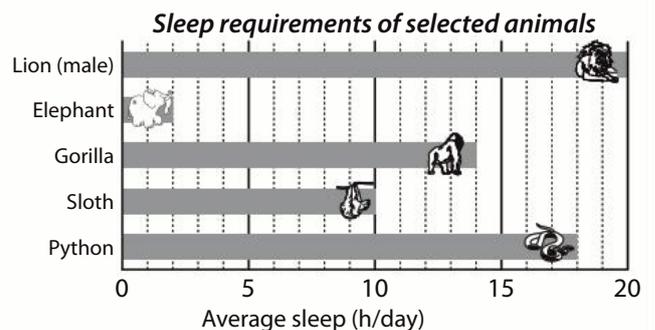
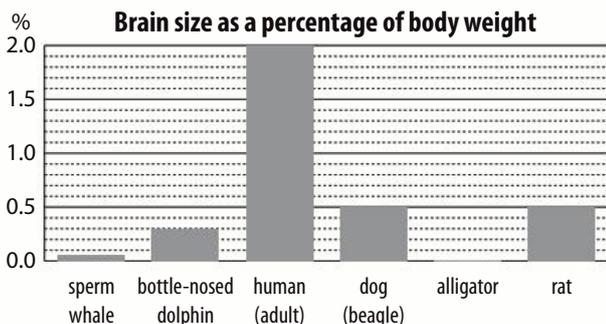
**Life Expectancy**



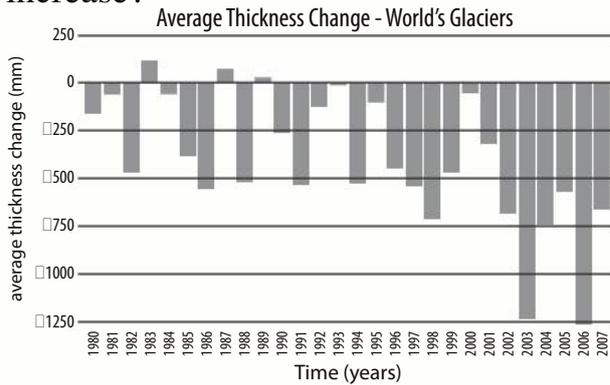


**c)** Which creature listed below has a brain weighing 0.3% of their body weight?

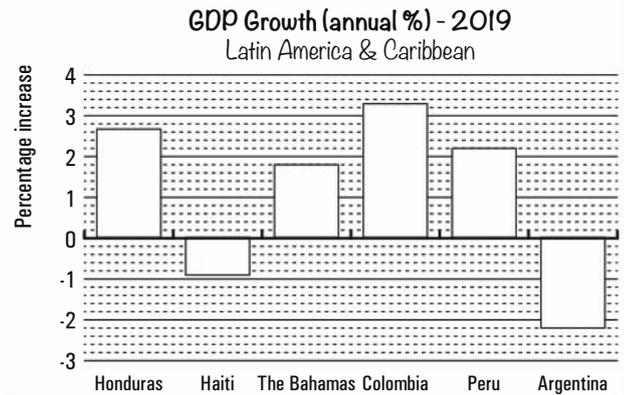
**d)** Which of the animals shown below sleeps for 7 times as many hours as an elephant?



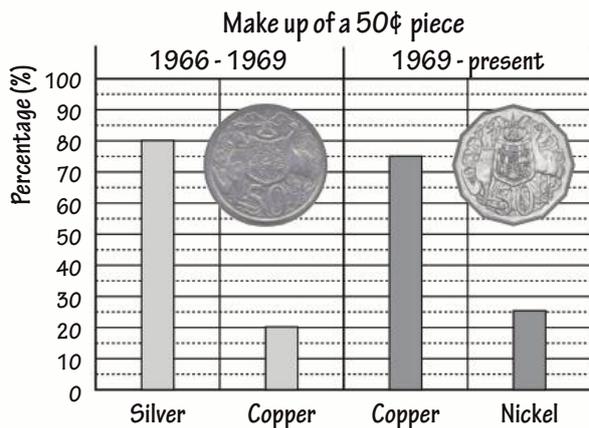
- e) In which years did the average thickness of the world's glaciers increase?



- f) Which of the countries shown has a percentage decrease of the GDP closest to 1%?

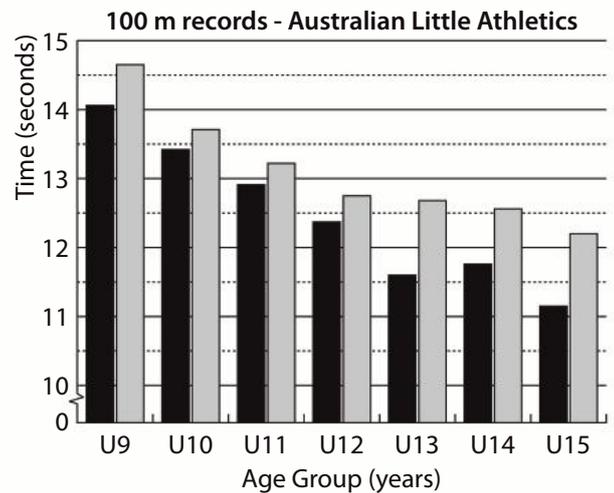


- g) After 1969 what is the percentage difference in the amount of copper in a 50 cent piece?



%

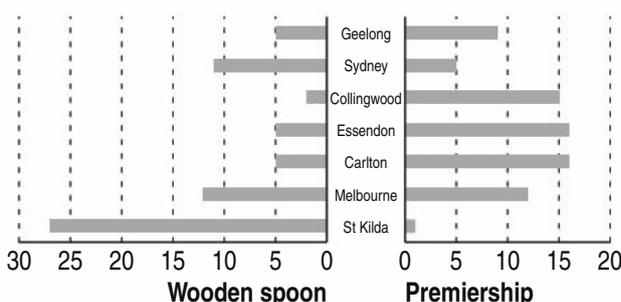
- h) In which age group is there the least difference in 100 m records for boys and girls at Little Athletics?



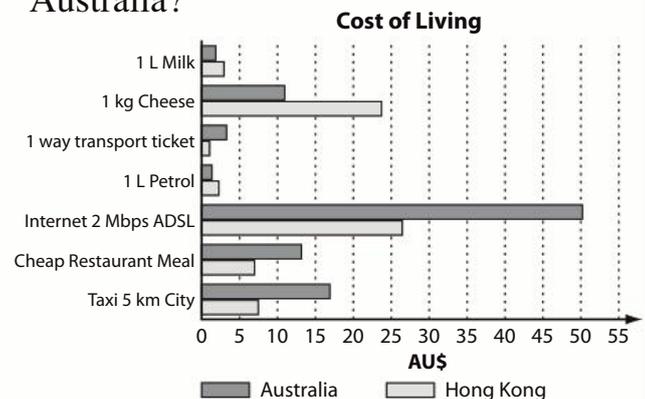
■ Boys ■ Girls

- i) How many of these AFL teams have won both more than 10 premierships and less than 5 wooden spoons since 1900?

AFL Premierships / Wooden spoons 1900 - 2019



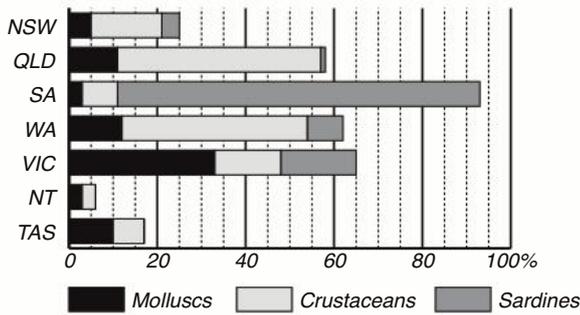
- j) Which cost of living item is twice as expensive in Hong Kong as it is in Australia?



■ Australia ■ Hong Kong

Q. Which state or territory catches the most sardines out of their total production?

Wild-Caught Fishery Production, % of total

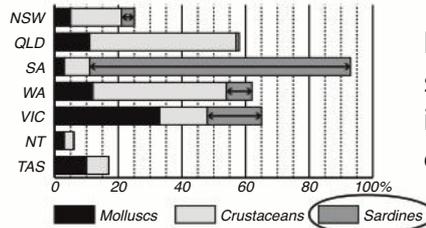


A. SA

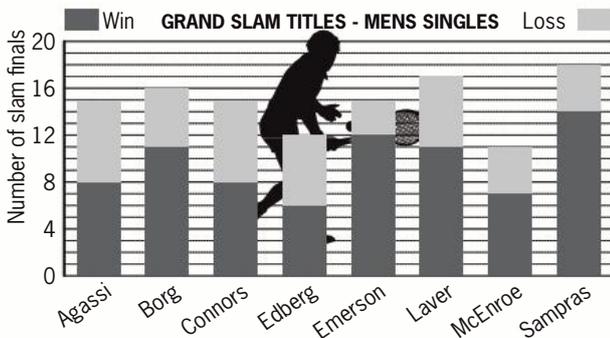
The width of the SA bar for sardines represents close to 80%.

No other bar for sardines is as long in any other state or territory shown.

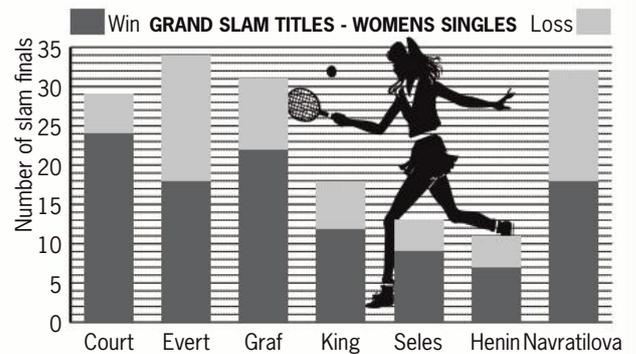
Wild-Caught Fishery Production, % of total



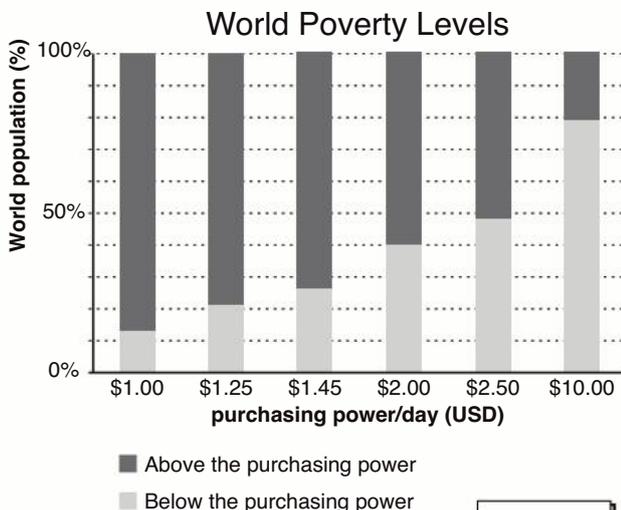
a) Who had the best ratio of wins to losses in their grand slam singles finals?



b) Who had the best ratio of wins to losses in their grand slam singles finals?

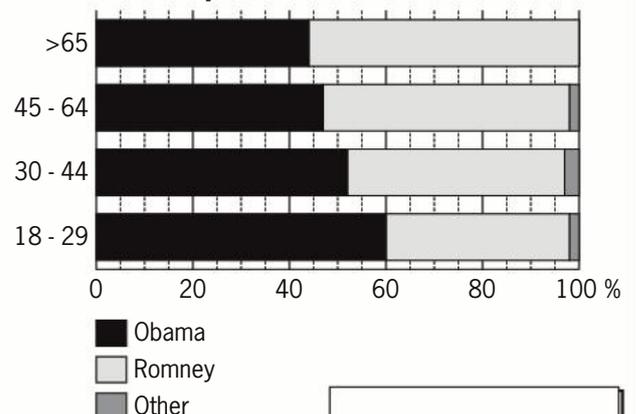


c) What percentage of the world's population lives on less than \$10 a day?

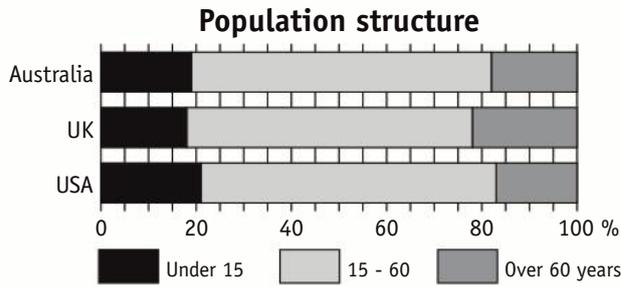


d) Obama and Romney split their votes 51% to 47% in the 2012 election. Which age group best reflects this result?

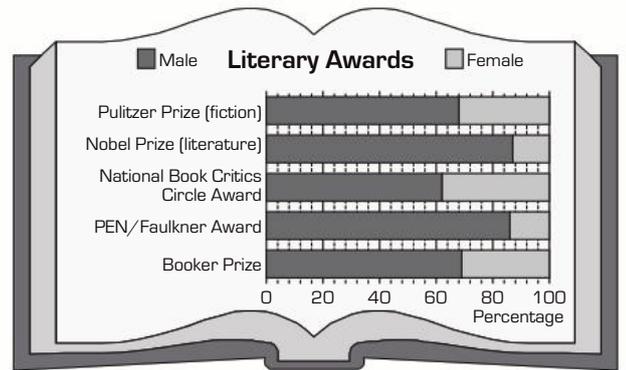
2012 US presidential election result



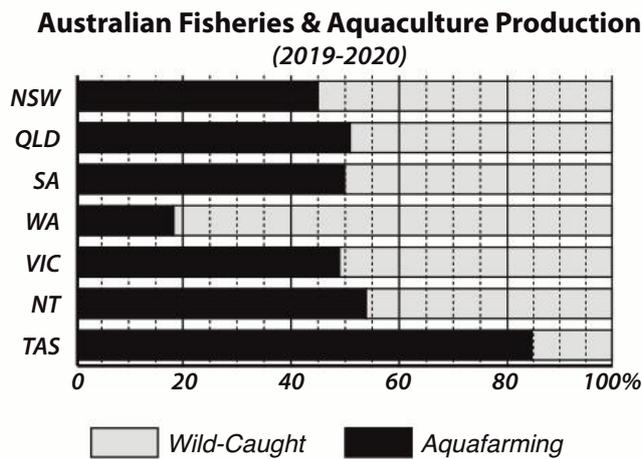
e) Which of the countries shown below has approximately 22% of their population over 60 years of age?



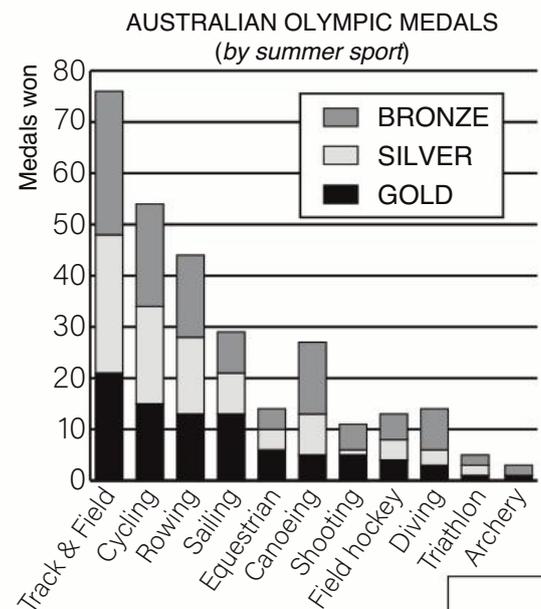

f) For which of the literary awards shown did males make up closest to three fifths of the recipients?



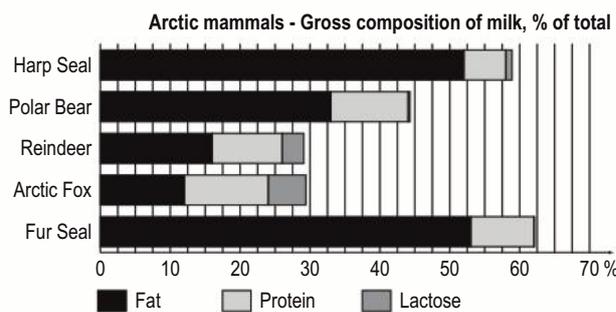

g) In which state or territory does wild-caught fishing account for more than three fifths of total production?



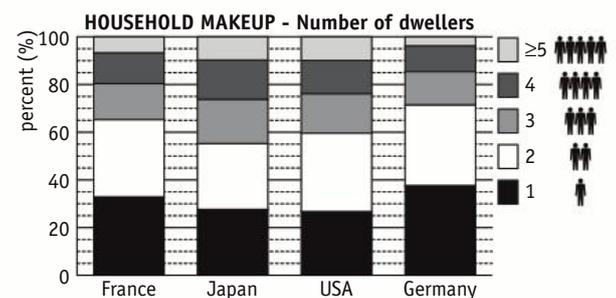

h) Of the sports with more than 10 medals, which produced the least silver medals?




i) Which of the mammals shown has the lowest protein content in their milk?




j) Which country has the highest percentage of people living on their own?



## Skill 29.6 Calculating the mean and median of sets of data (1).

Blue 11 22 33 44  
Green 11 22 33 44

### 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

$$\Rightarrow \frac{4+6}{2} = \frac{10}{2}$$

average 2 middle values

median =

- b)** This table shows the NASCAR sprint finishes for Denny Hamlin between 2016 and 2020 at Pocono Raceway. Find the median of the data.

Pocono Raceway NASCAR sprint car series '16 - '20 finishes - Carl Edwards									
14	7	12	4	35	10	6	1	2	1

$\Rightarrow$  median =

- 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

$\Rightarrow$  median =

- d)** This table shows a 7-day temperature forecast for Hamilton. Find the median high temperature for the interval.

Hamilton NZ 7-day Forecast Oct 16 2020							
	WED	THU	FRI	SAT	SUN	MON	TUE
High	19°C	21°C	22°C	22°C	23°C	23°C	22°C
Low	10°C	5°C	10°C	4°C	5°C	10°C	10°C

order values

$\Rightarrow$  median =

- 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

4 values in the set, so divide by 4

$12 + 12 + 15 + 25 = 64$

Mean =  $64 \div 4$

mean =

- 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 =

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
potatoes	70
macaroni	95
spaghetti	100
pasta	105
rice	140
bread	210

Mean =

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 =

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 1998 to 2018. Find the mean and median of the data.

[Round the mean to the nearest integer, and the median to 1 decimal place.]

**United States Winter Olympics Medals**

year	1998	2002	2006	2010	2014	2018
medals	13	34	25	37	28	23

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 gold medals won by Great Britain at the summer Olympics. Find the mode and range of the data.

Great Britain Olympic Gold Medals

year	1988	1992	1996	2000	2004	2008	2012	2016
medals	5	5	1	11	9	19	29	27

Range =

mode =                      range =

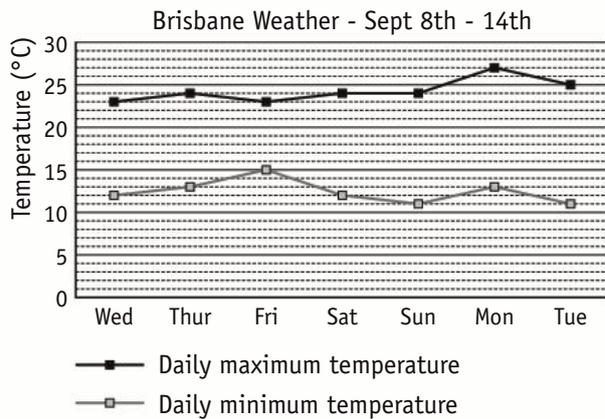
**d)** This table shows the number of calories per serving of some fruits. Find the mode and range of the data.

Fruit	Calories per 100 g
Apple	47
Orange	40
Banana	95
Grapes	60
Kiwi fruit	49
Pear	40

Range =

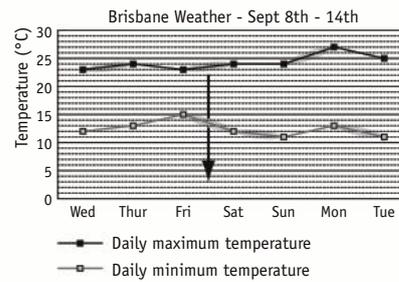
mode =                      range =

**Q.** In Brisbane, between which 2 days did the maximum temperature increase and the minimum temperature decrease?



**A. Friday & Saturday**

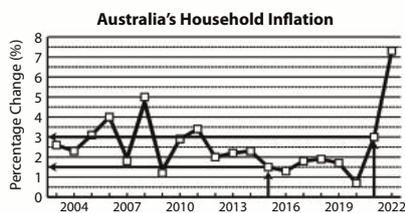
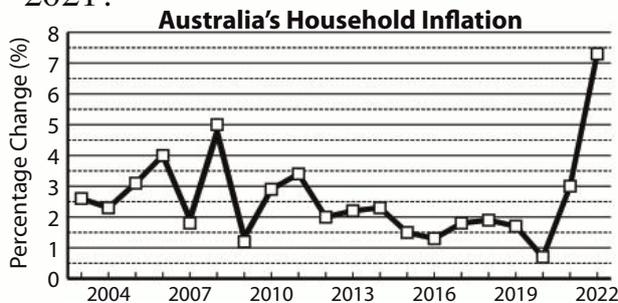
Find the daily maximum temperature graph and mark where the line increases between days.



Then find the minimum graph and mark where the line decreases.

They match between Friday and Saturday.

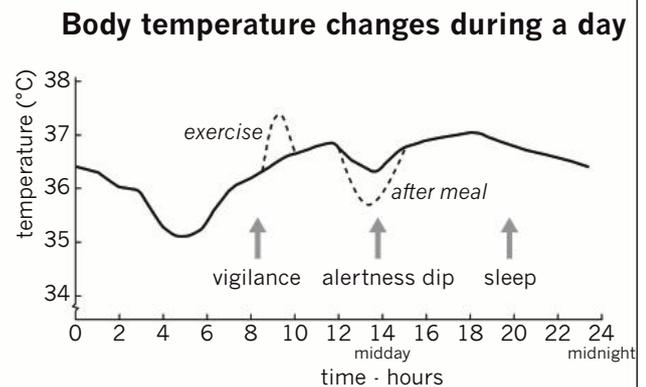
**a)** What was the difference in Australia's household inflation between 2015 and 2021?



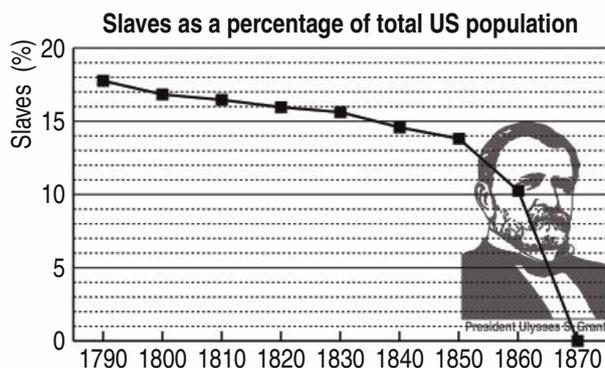
1.5 %

**b)** At what time of day is your body temperature the lowest?

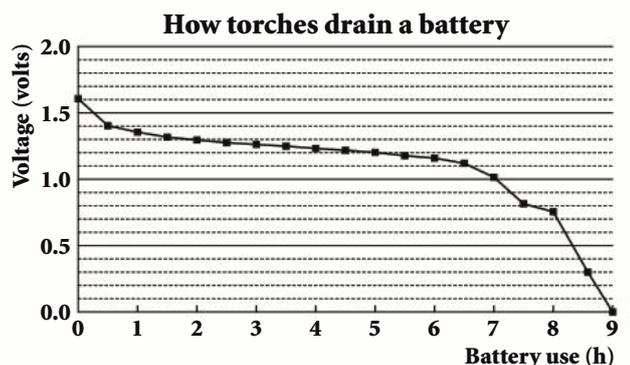
[Give your answer to the nearest hour.]



**c)** In which decade was the biggest percentage decrease in the number of slaves?

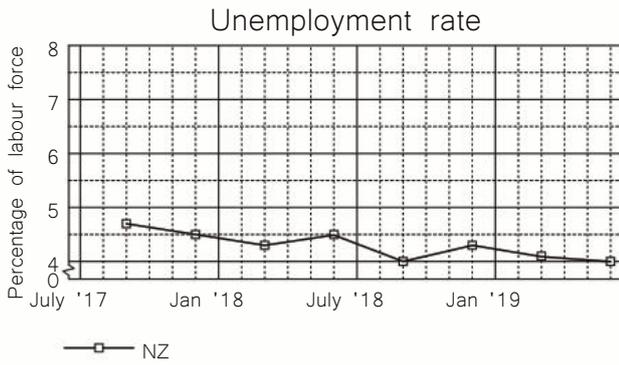


**d)** For how many hours would this torch have been in use if the battery had 1.2 volts remaining?

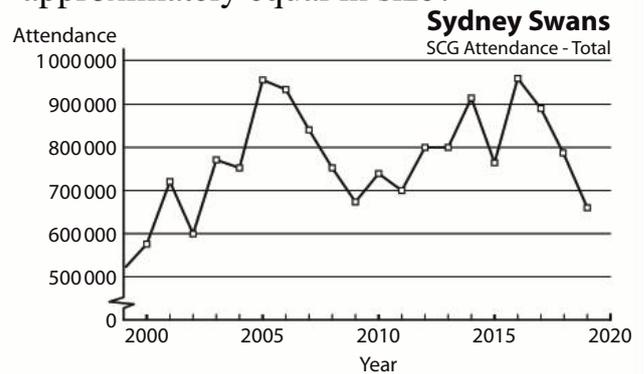


h

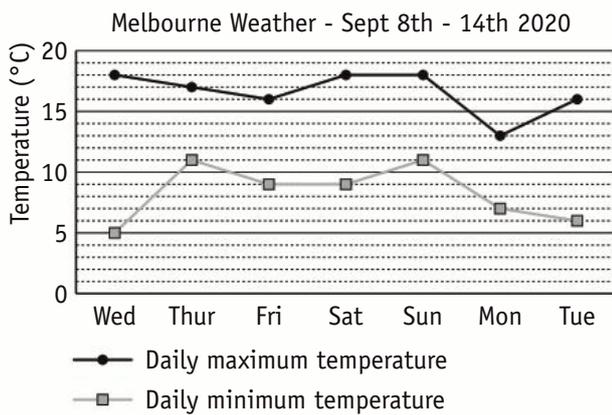
e) What was the unemployment rate in New Zealand in June 2018?



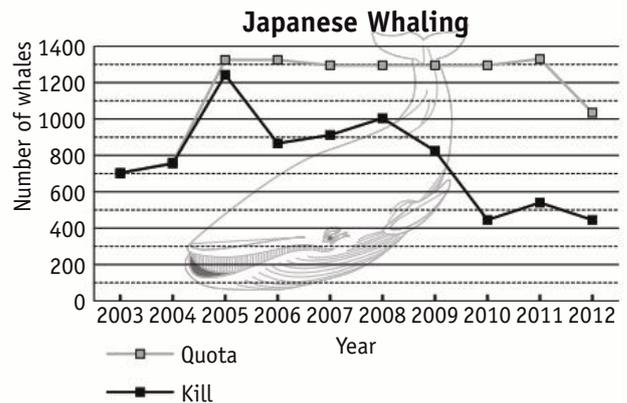

f) Between which two consecutive years was the Sydney Swans attendance approximately equal in size?



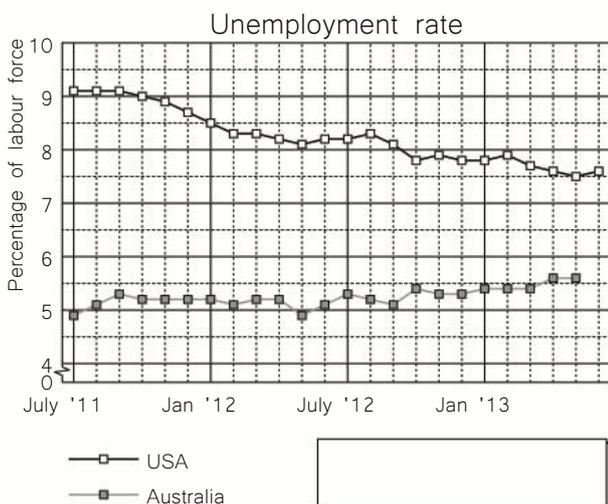

g) Which day of the week in Melbourne had a difference between the daily maximum and daily minimum temperatures of 9°C?



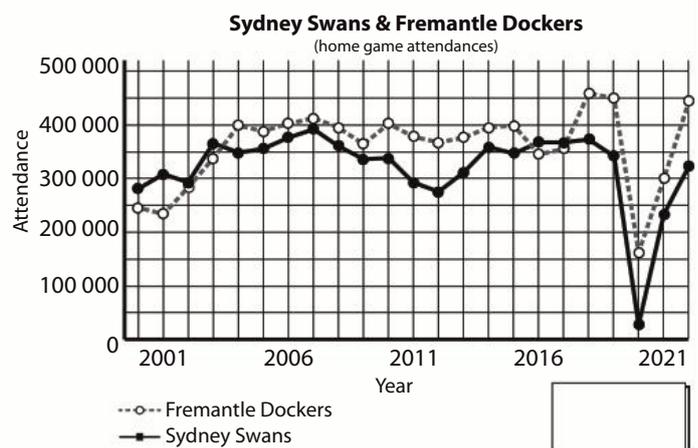

h) In which year was there the greatest difference between the quota and the kill by Japanese whalers?




i) Which country has the least change in unemployment rate between July 2011 and July 2012?

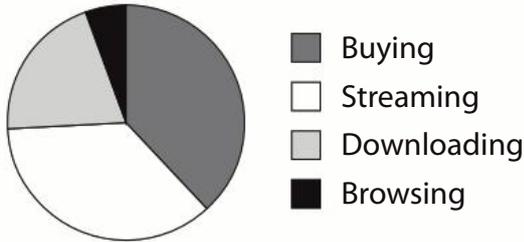



j) Between 2000 and 2022 how many times has Sydney's home game attendance exceeded Fremantle's home game attendance?

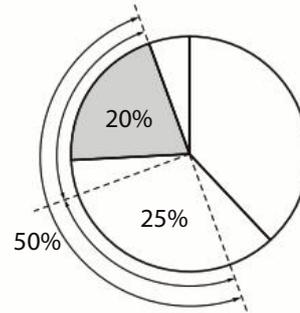


Q. Which activity makes up 20% of iTunes traffic?

Daily iTunes traffic composition

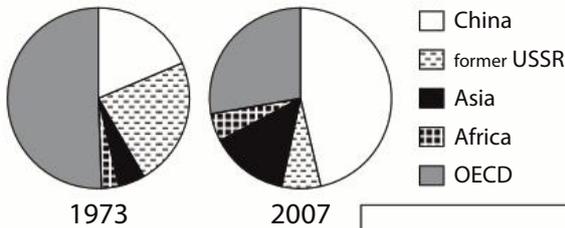


A. downloading



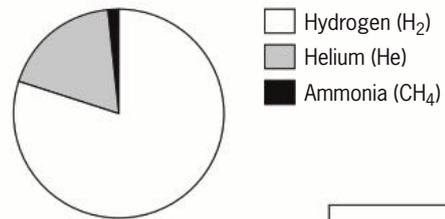
a) Which region closest to halved their hard coal production between 1973 and 2007?

Hard coal production



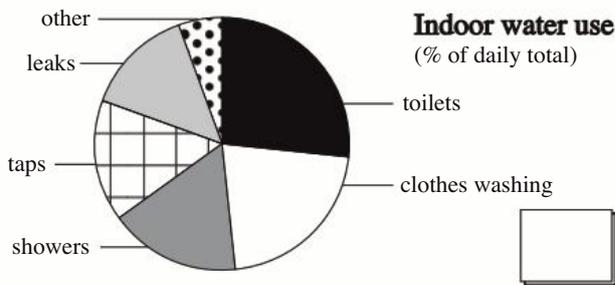

b) Which element makes up about 80% of Neptune's atmosphere?

Atmospheric composition of Neptune



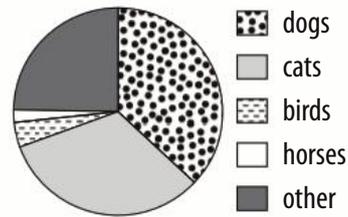

c) Approximately what percentage of indoor water usage is accounted for by showers?

- A) 5%      B) 15%  
C) 25%     D) 50%




d) Which two animals account for 70% of all pets?

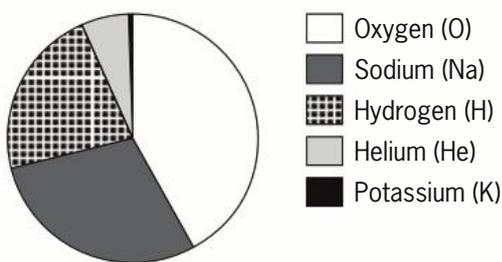
Pet owners' choice




e) Approximately what percentage of Mercury's atmosphere is sodium?

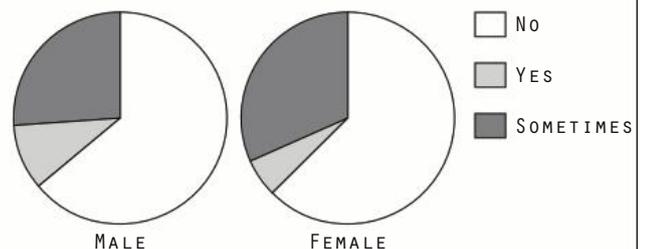
- A) 15%      B) 20%  
C) 30%      D) 45%

Atmospheric composition of Mercury




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?



**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	
STEM	LEAF	
0	2	= 2
1	5 7	= 15 and 17

hundreds & tens values	units value	
STEM	LEAF	
23	7	= 237

**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:**

{ 13, 18, 18, 19, 20, 21, 21, 22, 22, 22, 29, 30, 31 }

median (7th element) = 21

range

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 number of winners of the Tour de France by country. Find the median of the data.

Stem	Leaf
0	1 1 1 2 2 4 9
1	0 2 8
2	
3	6

18 = 18

**A.** 11 countries have Tour de France winners ⇒  
median = 6th score  
= 4

Stem	Leaf
0	1 1 1 2 2 4 9
1	0 2 8
2	
3	6

18 = 18

5 values above  
middle leaf  
5 values below

- a) Complete the stem-and-leaf plot for the data:  
21, 41, 37, 38, 31, 19, 24, 45, 39, 12, 12, 44, 38, 40

Stem	Leaf
1	2 _ _ _

Key  
2|1 = 21

- b) Complete the stem-and-leaf plot for the data showing the results of the women's high jump at the Tokyo 2020 Olympics:  
196, 198, 196, 200, 196, 204, 202, 196, 193, 193, 184, 196, 193

Stem	Leaf
18	4 <span style="float: right;">19 5 = 195 cm</span>

- c) Find the median and range of the monthly average low temperatures for Gold Coast, QLD.

Stem	Leaf
1	4 5 5 7 7 8
2	0 1 2 2 3 3

lowest score = 14  
highest score = 23  
 $1|6 = 16^{\circ}\text{C}$   
12 scores, so middle score is halfway between score 6 (18) and score 7 (20)

median =

range =

median =                      range =

- d) This stem-and-leaf plot shows the times of the women's canoe slalom final at the Tokyo 2020 Olympics. Find the median and range of the data.

Stem	Leaf
10	5 8
11	1 5 9
12	0 4 7 9
13	
14	
15	
16	4

$13|1 = 131$  seconds

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

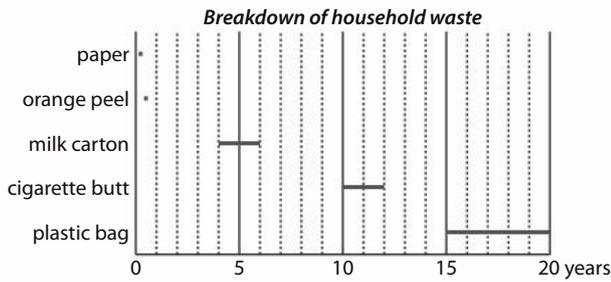
$12|6 = 126$  mL

median =

range =

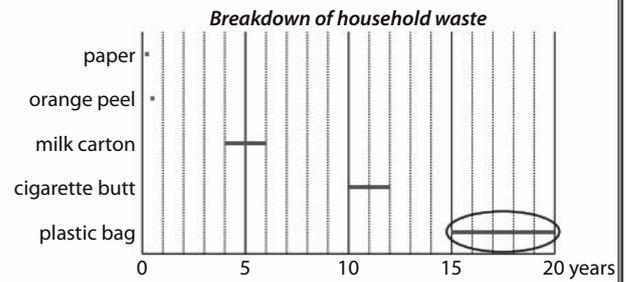
median =                      range =

Q. Of the items shown which has the longest breakdown time span?

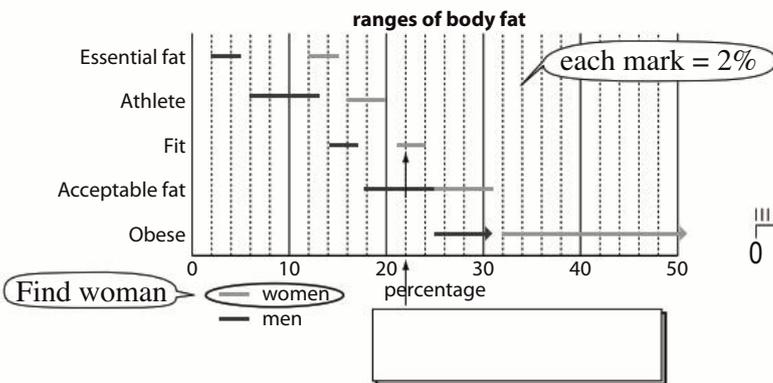


A. *plastic bag*

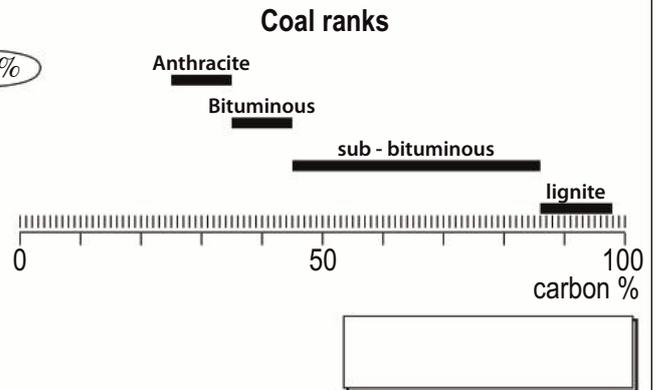
Check the length of each line segment.



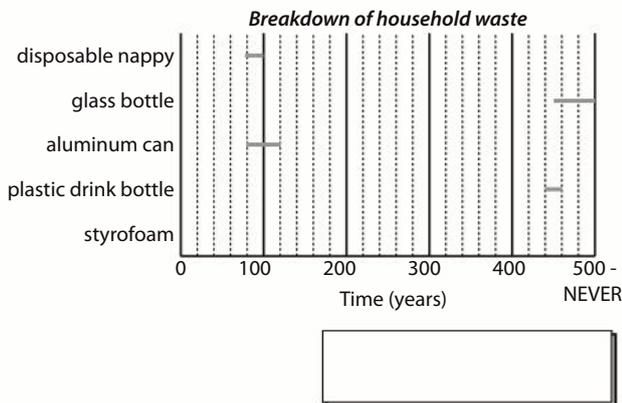
a) If you were a female with 22% body fat into which category would you fall?



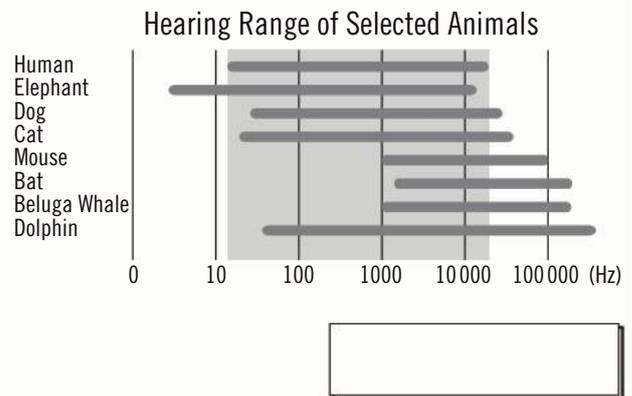
b) A sample of coal contains 38% carbon. To which category does it belong?



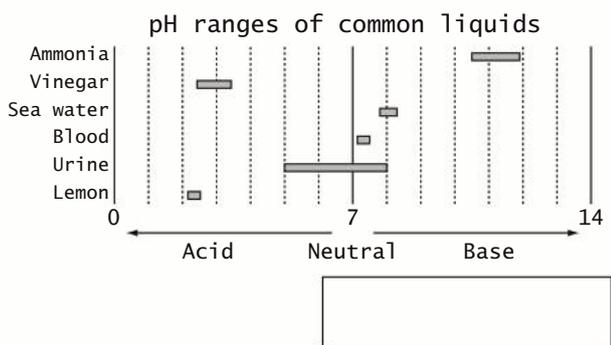
c) Apart from styrofoam which product has the longest breakdown time span?



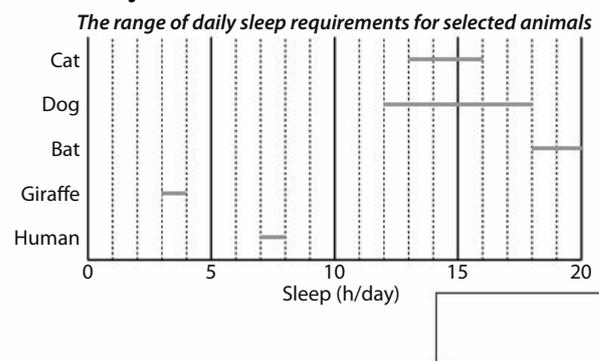
d) Which animal can hear sounds with a frequency of less than 10 Hz?



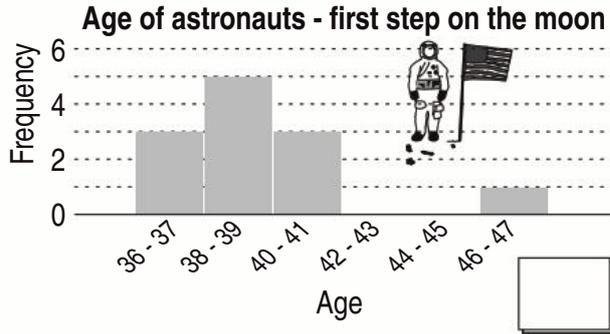
e) Of the liquids shown below which could have a pH that is neutral?



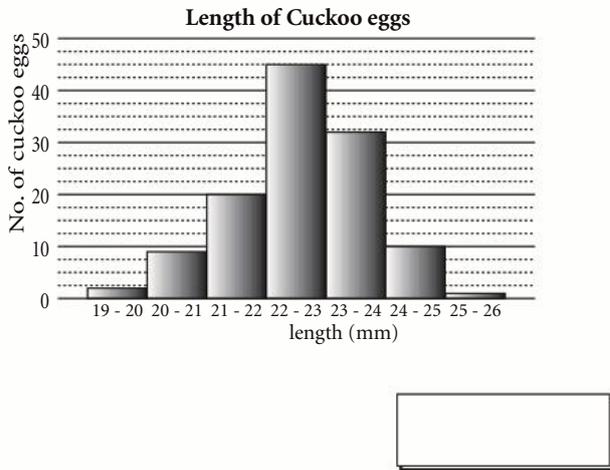
f) Which animal sleeps the most hours each day?



- g) How many astronauts were less than 40 years old when they first stepped on the moon?

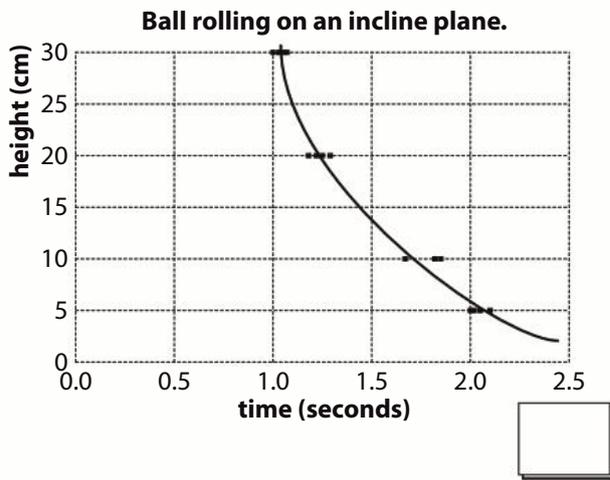


- i) Are more cuckoo eggs longer than or shorter than 23 mm?

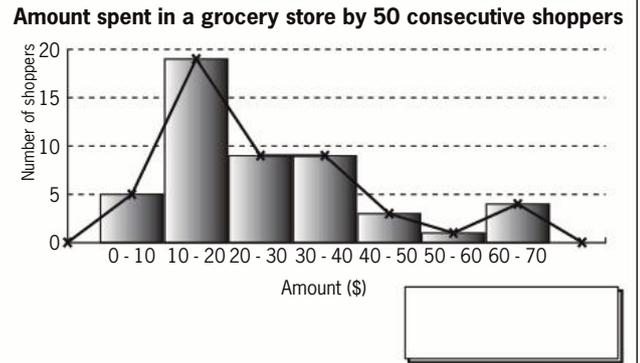


- k) An inclined plane is propped at one end to a certain height and a ball is rolled down. Which best describes the trend line for the time taken for a ball to roll the length of the inclined plane?

- A) no height, faster rolling ball  
B) greater height, faster rolling ball  
C) lesser height, faster rolling ball

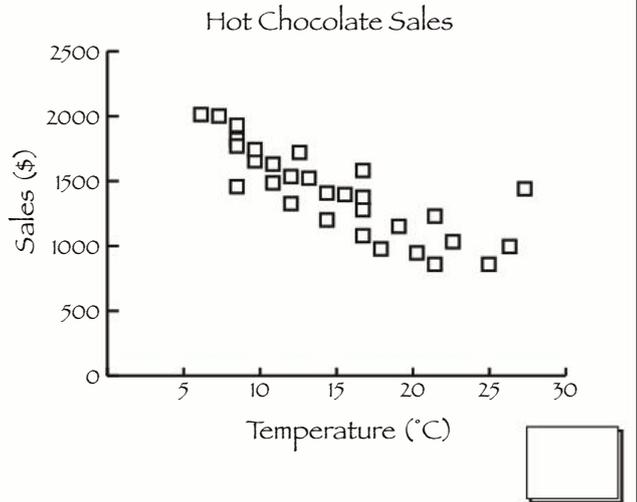


- h) Did most shoppers spend more or less than \$20?

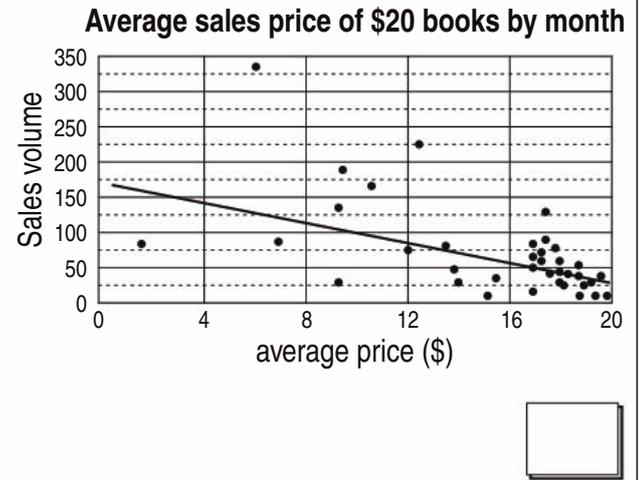


- j) Based on the data provided, what would be a reasonable amount of hot chocolate sales when it is 20°C outside?

- A) \$2000      B) \$1000  
C) \$300      D) \$500



- l) Which best describes the sample?
- A) increased price, decreased sales  
B) increased price, increased sales  
C) decreased price, decreased sales





# 30. [Probability]

## Skill 30.1 Describing the degree of likelihood of an event.

Blue 1 2 2 3 3 4 4  
Green 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 at least one 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 coloured 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 at least one chocolate biscuit?

*..... =*

**c)** Linda has 8 maltesers and 12 coolmints in her bag. How many lollies does she need to take out of her bag to make sure she has at least 3 coolmints?

*..... =*

**d)** There are 7 orange, 9 red and 6 white jellybeans in a jar. Without looking, how many jellybeans do you have to select in order to pick at least one white jellybean?

*..... =*

**e)** There are twenty different pairs of socks in the drawer. Without looking, how many socks need to be picked up 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?

*..... =*

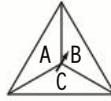


**Skill 30.3** Finding the possible outcomes (sample spaces) of an event by completing tables.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- 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 colour (red, blue and green) and tossing a coin? [Complete the table.]

Possible outcomes		Primary colour		
		R	G	B
Coin	H	R,H		
	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 labelled 1, 2, 3, 4, 5 and flipping a coin? [Complete the table.]

Possible outcomes		Spinner				
		1	2	3	4	5
Coin	H	1,H				
	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? [Complete the table.]

Outcomes (sample space)		
vanilla	waffle	hot fudge
vanilla		caramel
vanilla		

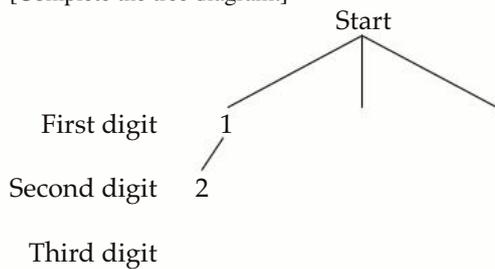
**Skill 30.4** Finding the possible outcomes (sample spaces) of an event by completing tree diagrams (1).

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

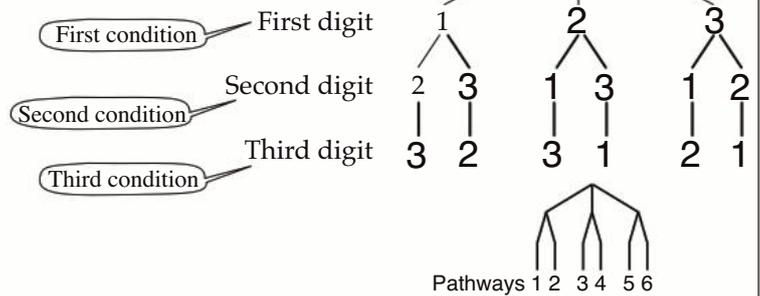
- From the start use the first condition to list all the possible outcomes (PO) on the first set of branches.
- From each of the first outcomes create enough branches to list all the possible outcomes of the second condition.
- Continue in this way until the tree diagram is completed.
- Count the number 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?

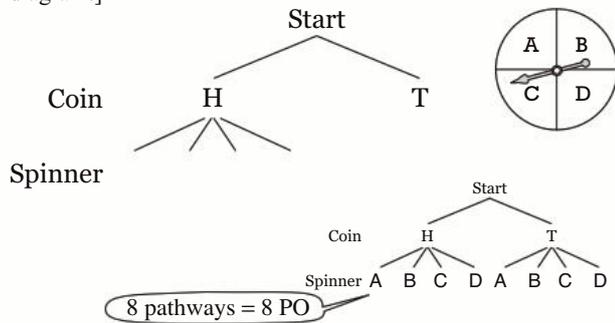
[Complete the tree diagram.]



**A.** Possible outcomes (PO)  
= 123, 132, 213, 231, 312, 321  
= 6

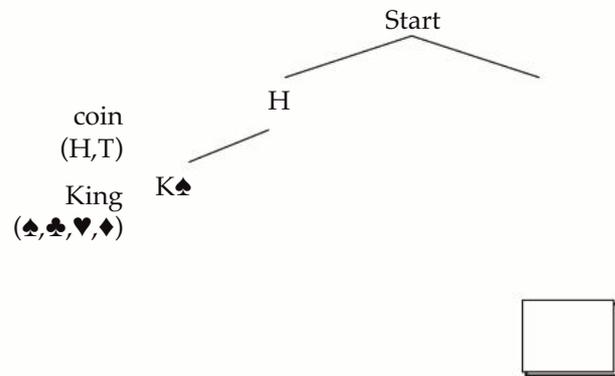


**a)** How many different outcomes are possible when flipping a coin and spinning this spinner? [Complete the tree diagram.]

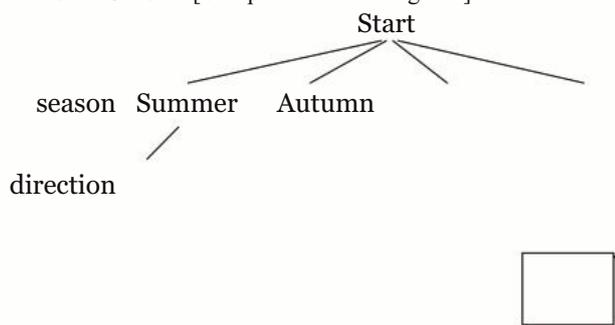


PO = HA, HB, HC, HD, TA, TB, TC, TD =

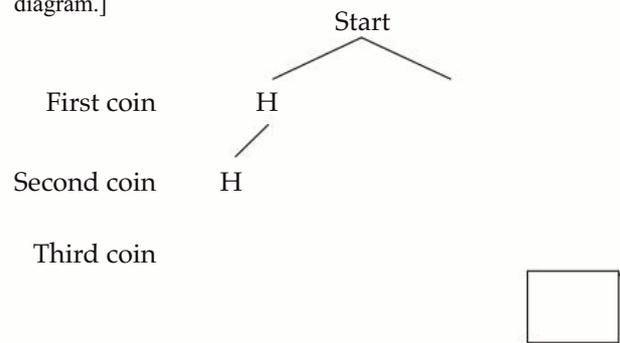
**b)** How many different outcomes are possible when flipping a coin and cutting a king from any of the 4 suits in a pack of cards? [Complete the tree diagram.]



**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.]



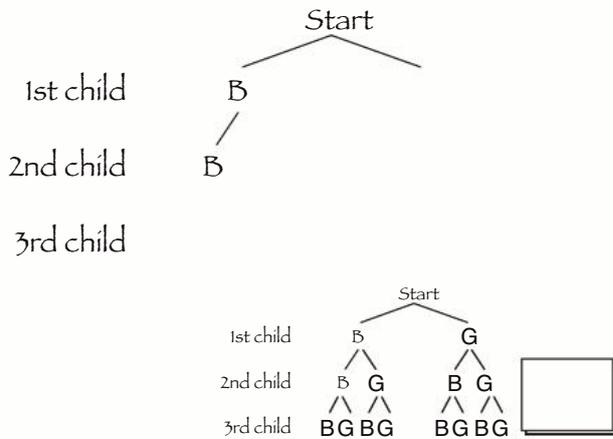
**d)** How many different outcomes are possible when flipping 3 coins (assuming order matters)? [Complete the tree diagram.]



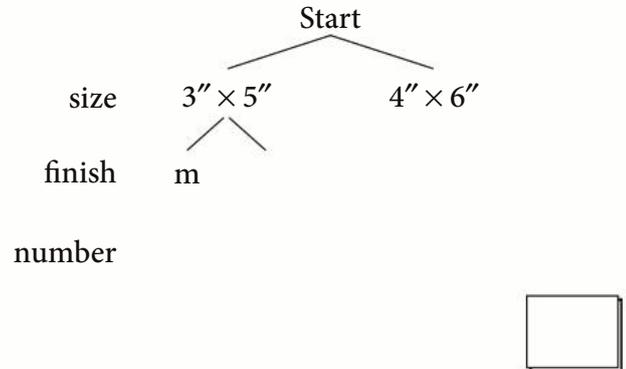
**Skill 30.4** Finding the possible outcomes (sample spaces) of an event by completing tree diagrams (2).

- e)** How many different gender combinations are possible if a couple have 3 children and order matters?

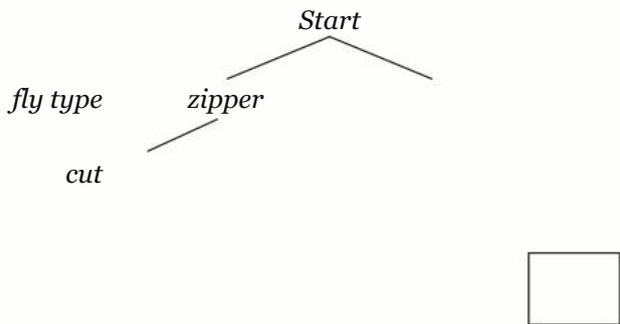
[Complete the tree diagram.]



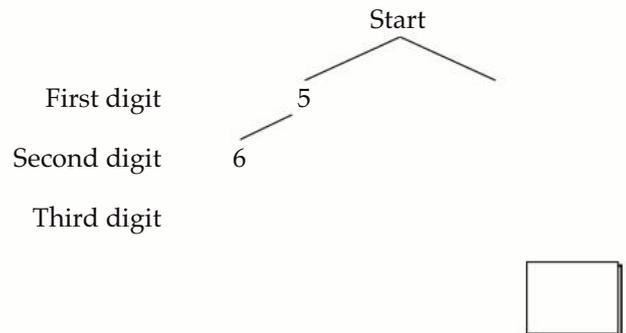
- f)** Photos can be printed in various sizes ( $3'' \times 5''$ ,  $4'' \times 6''$ ) and finishes (matte, gloss) with single or double prints an option. How many choices are possible? [Complete the tree diagram.]



- g)** Jeans come with 2 fly types (zipper or button fly) and 5 cuts (boot cut, stove pipe, straight leg, skinny, flared). How many choices of jeans are possible? [Complete the tree diagram.]

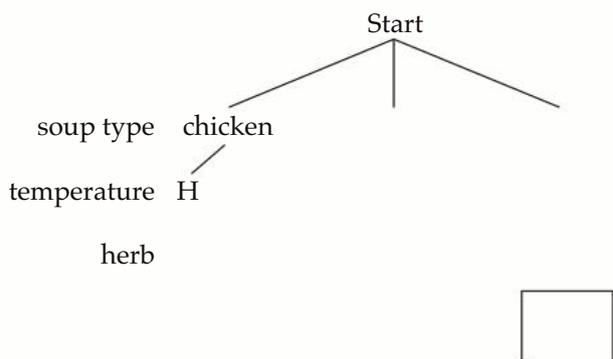


- h)** How many different 3-digit numbers less than 700 can be made using the digits 5, 6, 7 and 8 if the digits can be used only once? [Complete the tree diagram.]



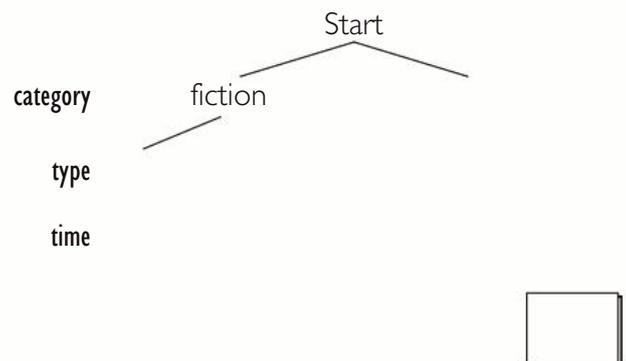
- i)** There are 3 kinds of soup on the menu: chicken, vegetable and pumpkin. They may be served hot or cold and always with a condiment of parsley or basil. How many choices are possible?

[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.]



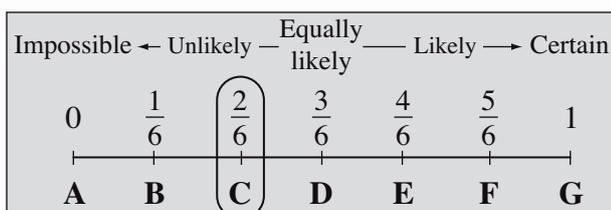
### Skill 30.5 Calculating the probability of a simple event (1).

- Find the number of favourable outcomes for the event.
- Find the total number of possible outcomes.
- Divide the number of favourable outcomes by the number of possible outcomes:

$$\Pr(\text{event}) = \frac{\text{number of favourable outcomes}}{\text{number of possible outcomes}} = \frac{\text{FO}}{\text{PO}}$$



Example:	Experiment	throwing a standard die
	Event	throwing a number greater than 4
	Possible outcomes (PO)	6 (throwing a 1, 2, 3, 4, 5 or a 6)
	Favourable outcomes (FO)	2 (throwing a 5 or a 6)
	Probability (Pr)	2 out of 6 = $\frac{2}{6}$ (FO out of PO)

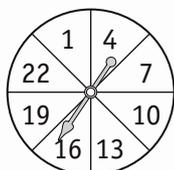


Hints: Probability ranges from 0 to 1.

The closer the probability is to 1, the more likely the event is to happen.

The closer the probability is to 0, the more unlikely the event is to happen.

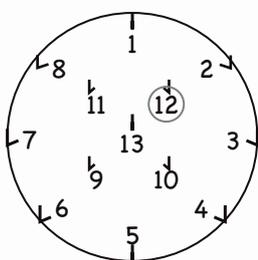
**Q.** When a spinner is spun, what is the probability of spinning a number greater than 10? [Give your answer as a fraction in simplest form.]



**A.** FO = 4 (13, 16, 19, 22)  
PO = 8 (1, 4, 7, 10, 13, 16, 19, 22)

$$\begin{aligned} \Pr(\text{number} > 10) &= \frac{\text{FO}}{\text{PO}} \\ &= \frac{4}{8} \\ &= \frac{1}{2} \end{aligned}$$

**a)** A hookey ring is thrown. What is the probability of hooking an even number? [Give your answer as a fraction.]

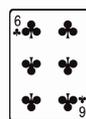


$$\text{FO} = 6 \quad (2, 4, 6, 8, 10, 12)$$

$$\text{PO} = 13 \quad (1 \text{ to } 13)$$

$$\Pr(\text{even number}) = \frac{\text{FO}}{\text{PO}} = \boxed{\phantom{00}}$$

**b)** 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 black card? [Give your answer as a fraction in simplest form.]

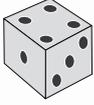


$$\text{FO} = \dots$$

$$\text{PO} = \dots$$

$$\Pr(\text{black card}) = \frac{\text{FO}}{\text{PO}} = \dots = \boxed{\phantom{00}}$$

- c) When a die is rolled, what is the probability of rolling an even number?  
[Give your answer as a fraction in simplest form.]

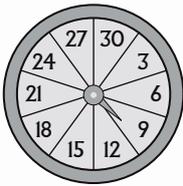


FO = .....

PO = .....

$$Pr(\text{even number}) = \frac{FO}{PO} = \boxed{\phantom{00}}$$

- e) A spinner is divided into 10 equal parts. When it is spun once, what is the probability of spinning an odd number?  
[Give your answer as a fraction in simplest form.]



FO = .....

PO = .....

$$Pr(\text{odd number}) = \frac{FO}{PO} = \boxed{\phantom{00}}$$

- 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?  
[Give your answer as a fraction in simplest form.]

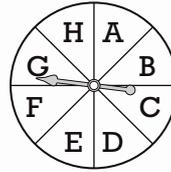


FO = .....

PO = .....

$$Pr(\text{king}) = \frac{FO}{PO} = \boxed{\phantom{00}}$$

- d) When a spinner is spun, what is the probability of spinning a G?  
[Give your answer as a fraction.]

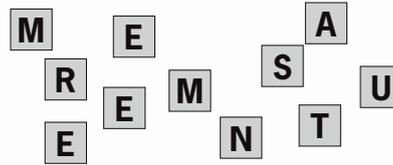


FO = .....

PO = .....

$$Pr(\text{spinning a G}) = \frac{FO}{PO} = \boxed{\phantom{00}}$$

- f) If a letter tile is chosen at random, find the probability of choosing letter M.  
[Give your answer as a fraction.]



FO = .....

PO = .....

$$Pr(\text{letter M}) = \frac{FO}{PO} = \boxed{\phantom{00}}$$

- h) A day is randomly selected from the month of September. What is the probability that it will be a holiday?  
[Give your answer as a fraction in simplest form.]

September						
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	

holiday

FO = .....

PO = .....

$$Pr(\text{holiday}) = \frac{FO}{PO} = \boxed{\phantom{00}}$$

- i) Lily bought a box of 18 batteries at a discounted price. She was told that 3 of the batteries in the box are discharged. One battery is randomly selected from the box. What is the probability of selecting a discharged battery?

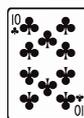


$FO =$  .....

$PO =$  .....

$Pr(\text{winning key}) = \frac{FO}{PO} =$

- 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? [Give your answer as a fraction in simplest form.]



$FO =$  .....

$PO =$  .....

$Pr(\text{club}) =$    $=$    $=$

- 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? [Give your answer as a fraction in simplest form.]

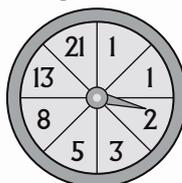


$FO =$  .....

$PO =$  .....

$Pr(\text{red card}) =$    $=$    $=$

- l) A spinner is divided into 8 equal parts. When it is spun once, what is the probability of spinning an even number? [Give your answer as a fraction in simplest form.]

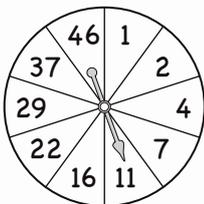


$FO =$  .....

$PO =$  .....

$Pr(\text{even number}) =$    $=$    $=$

- m) When the spinner is spun once, what is the probability of spinning a prime number? [Give your answer as a fraction in simplest form.]

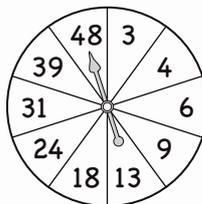


$FO =$  .....

$PO =$  .....

$Pr(\text{prime number}) =$    $=$    $=$

- n) When the spinner is spun once, what is the probability of spinning a composite number? [Give your answer as a fraction.]



$FO =$  .....

$PO =$  .....

$Pr(\text{composite number}) =$    $=$

**o)** There are 8 horses, 10 dogs, 6 chickens and 12 pigs in a yard. If an animal is selected at random, what is the probability that a chicken is chosen?  
[Give your answer as a fraction in simplest form.]

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**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. [Give your answer as a fraction in simplest form.]

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**q)** There are 15 milk chocolates, 8 white chocolates, 12 dark chocolates and 5 strawberry chocolates in the box. If a chocolate is chosen at random, what is the probability that it is a dark chocolate?  
[Give your answer as a fraction in simplest form.]

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**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? [Give your answer as a fraction in simplest form.]

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**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

⇒ **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

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**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

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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

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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

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w) Which event is most unlikely to happen?

- A) marking a 'cross' playing *noughts and crosses*
- B) selecting an even number from the numbers 1 to 8
- C) throwing a 13 on a hookey board marked 1 to 13

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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 *noughts and crosses*

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y) Which event is most likely to happen?

- A) selecting 'red' from the 7 colours 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

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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

.....

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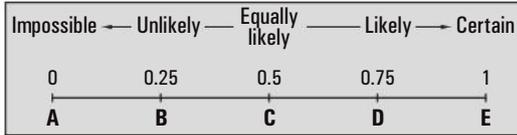
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**Skill 30.6** Calculating the probability of a simple event using probability scales.

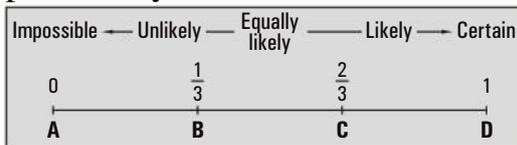
- Divide the number of favourable outcomes (FO) by the number of possible outcomes (PO). (see skill 30.5, page 316)

**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)  
 $Pr(\text{event}) = \frac{FO}{PO}$  possible outcomes  
 $= \frac{1}{2}$   
 $= 0.5$   
 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?

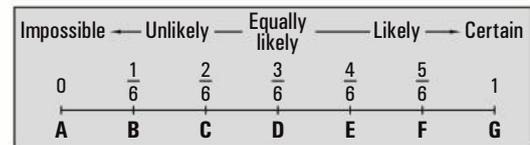


$FO = 4$        $PO = 12$

---

$\frac{FO}{PO} = \frac{4}{12} = \frac{1}{3}$  simplify: ÷ 4      ⇒

**b)** ‘A die is rolled and a 6 comes up.’  
Which letter A to G best represents the probability of the event?

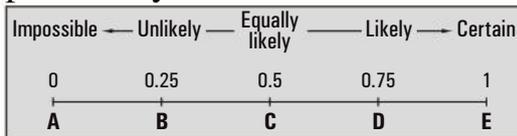


$FO =$        $PO =$

---

$\frac{FO}{PO} =$       ⇒

**c)** ‘A caramel chocolate will be drawn from a box containing 12 caramel and 4 spearmint chocolates.’  
Which letter A to E best represents the probability of the event?

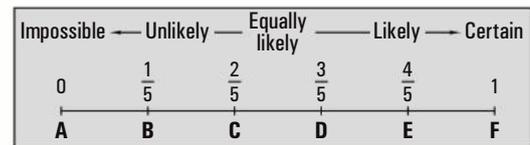


$FO =$        $PO =$

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$=$       ⇒

**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?

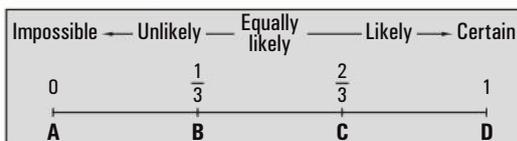


$FO =$        $PO =$

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$=$       ⇒

**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?

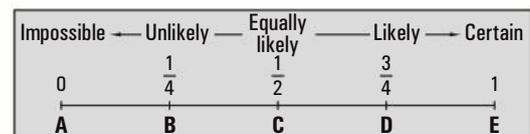


$FO =$        $PO =$

---

$=$       ⇒

**f)** ‘A club is drawn from a pack of 52 playing cards.’  
Which letter A to E best represents the probability of the event?



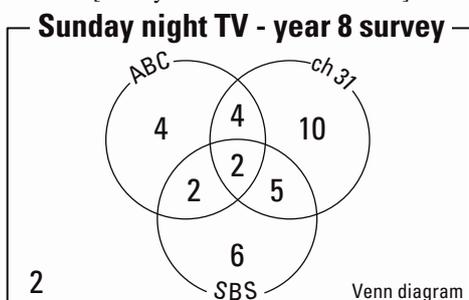
$FO =$        $PO =$

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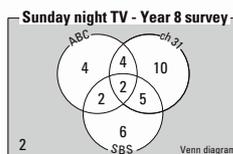
$=$       ⇒

- Count the total number of possible outcomes.
- Shade the areas inside the Venn diagram that fit the description for favourable 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? [Give your answer as a fraction.]

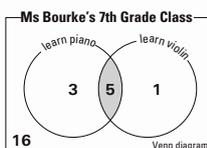
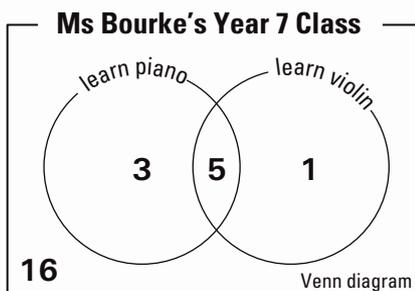


**A.**  $FO = 2$   
 $PO = 4 + 4 + 2 + 2 + 10 + 5 + 6 + 2$   
 $= 35$   
 $Pr(event) = \frac{FO}{PO} = \frac{2}{35}$



Students who do not watch TV are shown in the shaded area. Students who do watch TV are shown in the white area.

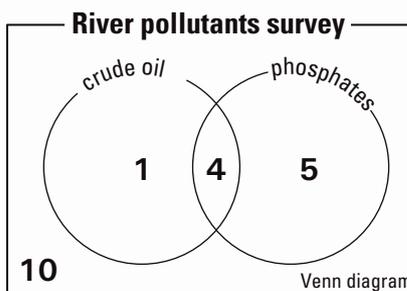
**a)** What is the probability that a student chosen at random from Ms Bourke's class learns both piano and violin? [Give your answer as a fraction in simplest form.]



$FO = 5$     $PO = 16 + 3 + 5 + 1 = 25$

$Pr(event) = \frac{FO}{PO} = \frac{5}{25} = \frac{1}{5}$

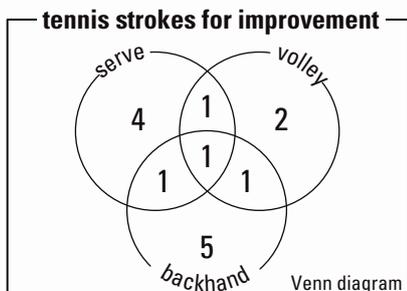
**b)** What is the probability that a surveyed river, visited at random, contained only phosphate pollutants? [Give your answer as a fraction in simplest form.]



$FO =$     $PO =$

$Pr(event) = \frac{FO}{PO} = \frac{\quad}{\quad} = \frac{\quad}{\quad}$

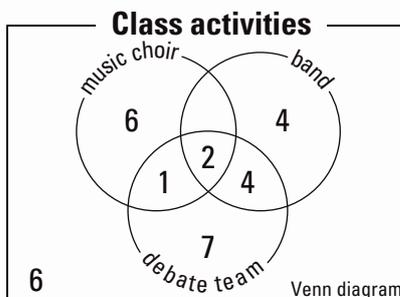
**c)** What is the probability that a tennis player chosen at random named the serve as the stroke that needs improvement? [Give your answer as a fraction.]



$FO =$     $PO =$

$Pr(event) = \frac{FO}{PO} = \frac{\quad}{\quad} = \frac{\quad}{\quad}$

**d)** What is the probability that a student chosen at random is involved in the band and the debate team? [Give your answer as a fraction in simplest form.]



$FO =$     $PO =$

$Pr(event) = \frac{FO}{PO} = \frac{\quad}{\quad} = \frac{\quad}{\quad}$

- Identify and calculate the probability of the event.

$$\Pr(\text{event}) = \frac{\text{number of favourable outcomes}}{\text{number of possible outcomes}} = \frac{FO}{PO}$$

- Identify the complementary events.
- 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. [Give your answer as a fraction in simplest form.]

**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 your answer as a percentage.]

$$\Pr(\text{earthquake}) = 2\%$$

$$\Pr(\text{no earthquake}) = 100\% - 2\% = \boxed{\phantom{00}}$$

- 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? [Give your answer as a fraction in simplest form.]

$$\Pr(\text{burnt}) =$$

$$\Pr(\text{not burnt}) =$$

$$= \boxed{\phantom{00}}$$

- 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? [Give your answer as a fraction.]

$$\Pr(\text{gold}) =$$

$$\Pr(\text{not gold}) =$$

$$= \boxed{\phantom{00}}$$

- 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). [Give your answer as a fraction.]

$$\Pr(\text{perfect square}) =$$

$$\Pr(\text{not perfect square}) =$$

$$= \boxed{\phantom{00}}$$

- e)** A ballot box contains 20 liberal, 12 green and 18 labor votes. If one vote is picked at random, what is the probability that it is not labor? [Give your answer as a fraction in simplest form.]

$$= \boxed{\phantom{00}}$$

- f)** Of the New Zealand families who have children, 41% have one child and 36% have two children. What is the probability that a New Zealand family with children, when selected at random, has more than two children? [Give your answer as a percentage.]

$$= \boxed{\phantom{00}}$$

### Skill 30.9 Calculating the probability of mutually exclusive events.

- Find the probability of each event.

$$\Pr(\text{event}) = \frac{\text{number of favourable outcomes}}{\text{number of possible outcomes}} = \frac{FO}{PO}$$

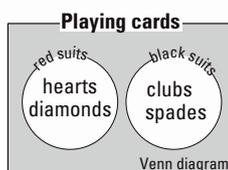
- Add the probabilities of each event in order to find the probability of both events occurring.

$$\Pr(A \text{ and } B) = \Pr(A) + \Pr(B)$$

- 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, but not both.



- Q.** A stable contains 3 mares, 1 stallion and 8 geldings. If a horse is selected at random, find the probability that it is a mare or a gelding. [Give your answer as a fraction.]

**A.**  $Pr(M) = \frac{3}{12}$   
 $Pr(G) = \frac{8}{12}$   
 $Pr(M \text{ or } G) = Pr(M) + Pr(G)$   
 $= \frac{3}{12} + \frac{8}{12}$   
 $= \frac{11}{12}$

- a)** What is the probability of drawing a red card or a club from a pack of cards?

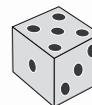
[Give your answer as a fraction in simplest form.]

$$Pr(\text{red}) = \frac{26}{52} \quad Pr(\text{club}) = \frac{13}{52}$$

$$Pr(\text{red or club}) = Pr(\text{red}) + Pr(\text{club})$$

$$= \frac{26}{52} + \frac{13}{52} = \frac{39}{52} = \boxed{\phantom{00}}$$

- b)** When a die is rolled, what is the probability of rolling a 5 or a 6?



[Give your answer as a fraction in simplest form.]

$$Pr(5) = \quad Pr(6) =$$

$$Pr(5 \text{ or } 6) = Pr(5) + Pr(6)$$

$$= \quad = \boxed{\phantom{00}}$$

- 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. [Give your answer as a fraction in simplest form.]

$$Pr(\text{lolly}) = \quad Pr(\text{marble}) =$$

$$Pr(\text{lolly or marble}) = Pr(\text{lolly}) + Pr(\text{marble})$$

$$= \quad = \boxed{\phantom{00}}$$

- d)** When a die is rolled, what is the probability of rolling an odd number or an even number? [Give your answer as a fraction in simplest form.]

$$Pr(\text{odd}) = \quad Pr(\text{even}) =$$

$$Pr(\text{odd or even}) = Pr(\text{odd}) + Pr(\text{even})$$

$$= \quad = \boxed{\phantom{00}}$$

**Skill 30.10** Finding the possible outcomes of an event by applying the counting principle.

Blue 1 1 2 2 3 3 4 4  
Green 1 1 2 2 3 3 4 4

- 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 1 chemistry class, 1 maths class, 1 history class and 1 English class. According to the schedule she has 2 different chemistry classes, 4 different maths classes, 3 different history classes and 3 different English classes to choose from. If no scheduling conflicts exist, how many different 4-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?

$$N = \dots = \boxed{\phantom{000}}$$

**c)** A coin and a six-sided die are tossed. How many results are possible?

$$N = \dots = \boxed{\phantom{000}}$$

**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?

$$N = \dots = \boxed{\phantom{000}}$$

**e)** Two coins and one five-sided die are tossed. How many results are possible?

$$N = \dots = \boxed{\phantom{000}}$$

**f)** In how many ways can six books be arranged on a shelf?

$$N = \dots = \boxed{\phantom{000}}$$

**g)** How many possible outfits can be created with 3 different dresses, 5 different vests and 2 different pairs of shoes?

$$N = \dots = \boxed{\phantom{000}}$$

**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?

$$N = \dots = \boxed{\phantom{000}}$$

**i)** In how many ways can a coach select two emergencies from a total of five players?

$$N = \dots = \boxed{\phantom{000}}$$

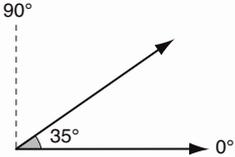
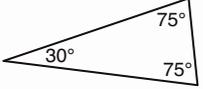
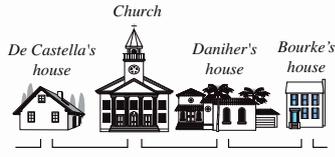
**j)** In how many ways can any 4 of the vowels be grouped assuming they are not repeated?

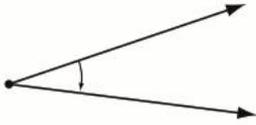
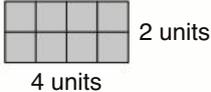
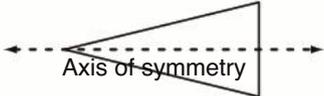
$$N = \dots = \boxed{\phantom{000}}$$

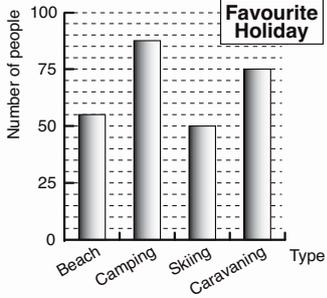
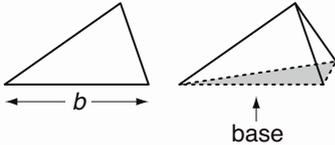
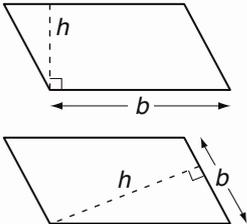
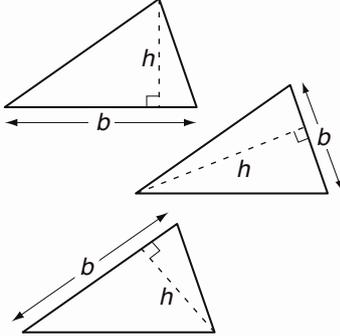


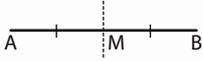
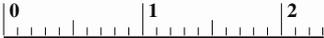
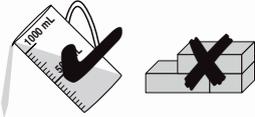
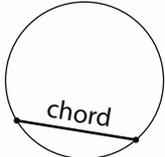
# GLOSSARY

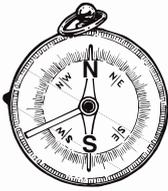
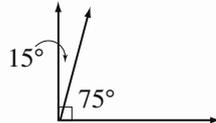
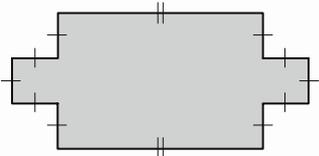
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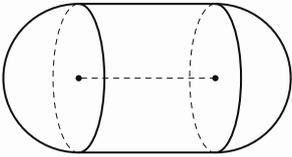
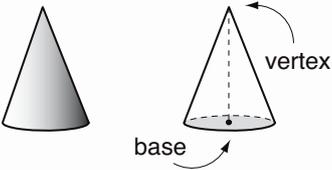
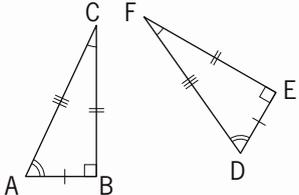
TERMS	DEFINITIONS	EXAMPLES
<b>accuracy</b>	<ul style="list-style-type: none"> <li>A measure of how close the result of a measuring comes to the true value.</li> </ul>	3.14 is a fairly accurate estimation of $\pi$ .
<b>acute angle</b>	<ul style="list-style-type: none"> <li>An <i>angle</i> measuring less than <math>90^\circ</math>.</li> </ul>	
<b>acute-angled triangle</b>	<ul style="list-style-type: none"> <li>A <i>triangle</i> in which every <i>angle</i> measures less than <math>90^\circ</math>.</li> </ul>	
<b>add (+)</b>	<ul style="list-style-type: none"> <li>To join together.</li> </ul>	<p>If you add 1 black cow and 2 white cows, there are <math>1 + 2 = 3</math> cows altogether.</p> 
<b>addition</b>	<ul style="list-style-type: none"> <li>The <i>operation</i> of finding the total or sum of two or more numbers to make one number.</li> <li>The result is called the <i>sum</i> or <i>total</i>.</li> </ul>	<p>Adding 15 and 6 we reach a total (sum) of 21.  <math>15 + 6 = 21</math></p>
<b>adjacent</b>	<ul style="list-style-type: none"> <li>Immediately next to.</li> </ul>	<p>The Daniher's live adjacent to the Bourke's.</p> 
<b>algebra</b>	<ul style="list-style-type: none"> <li>A branch of Mathematics where numbers are represented by letters or symbols, called <i>variables</i>.</li> </ul>	<p><math>x + x = 6</math>, so <math>x</math> equals 3  <math>\clubsuit \div 3 = 12</math>, so <math>\clubsuit</math> equals 36</p>
<b>am</b> (ante meridiem)	<ul style="list-style-type: none"> <li>The <i>time</i> from midnight to midday (morning).</li> </ul>	
<b>analogue clock</b>	<ul style="list-style-type: none"> <li>A clock or watch that has rotating hands and shows 12 <i>hour time</i>.</li> </ul>	

<b>angle</b>	<ul style="list-style-type: none"> <li>• The amount of turning between two straight <i>lines</i> that are fixed at a <i>point</i>.</li> <li>• An angle is measured in <i>degrees</i>.</li> </ul>	
<b>annual</b>	<ul style="list-style-type: none"> <li>• Happening <i>once a year</i>.</li> </ul>	
<b>anticlockwise</b>	<ul style="list-style-type: none"> <li>• Moving in the <i>opposite direction</i> to the hands on a clock.</li> </ul>	
<b>approximate</b>	<ul style="list-style-type: none"> <li>• Very close to the actual size.</li> <li>• To <i>estimate</i> by <i>rounding off</i>.</li> </ul>	<p>If you have \$24.85 in your wallet, you can say you have approximately \$25.00</p>
<b>area</b>	<ul style="list-style-type: none"> <li>• The amount of surface covered by a <i>2D shape</i>.</li> <li>• Area is measured in <i>square units</i>, e.g. square centimetres (cm<sup>2</sup>) or square metres (m<sup>2</sup>).</li> </ul>	<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> 
<b>ascending order</b>	<ul style="list-style-type: none"> <li>• Arranged from smallest to largest.</li> <li>• Becoming larger, greater or higher.</li> </ul>	<p>3, 5 and 7 are in ascending order.</p>
<b>associative property</b> of addition and multiplication	<ul style="list-style-type: none"> <li>• Rule: When <i>adding</i> or <i>multiplying</i>, no matter how the numbers are grouped, the answers will always be the same.</li> </ul>	$a + (b + c) = (a + b) + c$ $1 + (3 + 4) = (1 + 3) + 4$ $8 = 8$ <p style="text-align: right;">“+”</p> $a \times (b \times c) = (a \times b) \times c$ $1 \times (3 \times 4) = (1 \times 3) \times 4$ $12 = 12$ <p style="text-align: right;">“×”</p>
<b>average</b>	<ul style="list-style-type: none"> <li>• Or <i>mean</i>, is the total of all scores divided by how many scores there are.</li> <li>• 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>.</li> </ul>	<p>The average of 5, 7 and 9 is 7.  <math>5 + 7 + 9 = 21</math> and  <math>21 \div 3 = 7</math>      So <math>7 + 7 + 7 = 21</math></p>
<b>average speed</b>	<ul style="list-style-type: none"> <li>• See <i>speed</i>.</li> </ul>	
<b>axis of symmetry</b>	<ul style="list-style-type: none"> <li>• (pl. <b>axes</b>) See <i>line of symmetry</i>.</li> </ul>	

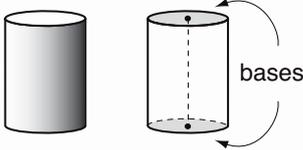
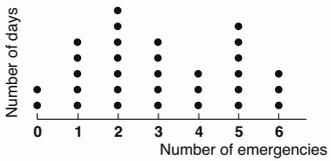
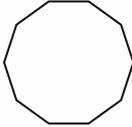
<p><b>backwards</b></p>	<ul style="list-style-type: none"> <li>• Away from your front.</li> <li>• In reverse of the usual way.</li> </ul>											
<p><b>balance</b> (money)</p>	<ul style="list-style-type: none"> <li>• The amount of money remaining in a bank account after all transactions have been completed.</li> </ul>	<p>The bank account held \$32. After \$12 was withdrawn the balance of the account was \$20.</p>										
<p><b>bar graph</b></p>	<ul style="list-style-type: none"> <li>• A graph using <i>columns</i> to show quantities or numbers so they can be easily compared.</li> </ul>	<p>Camping is the favourite holiday.</p>  <table border="1"> <caption>Favourite Holiday</caption> <thead> <tr> <th>Type</th> <th>Number of people</th> </tr> </thead> <tbody> <tr> <td>Beach</td> <td>55</td> </tr> <tr> <td>Camping</td> <td>90</td> </tr> <tr> <td>Skiing</td> <td>50</td> </tr> <tr> <td>Caravaning</td> <td>75</td> </tr> </tbody> </table>	Type	Number of people	Beach	55	Camping	90	Skiing	50	Caravaning	75
Type	Number of people											
Beach	55											
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<p><b>base</b></p>	<ul style="list-style-type: none"> <li>• A <i>line</i> or surface on which a figure stands.</li> </ul>											
<p><b>base of a parallelogram</b></p>	<ul style="list-style-type: none"> <li>• The base (<i>b</i>) of a <i>parallelogram</i> is the <i>length</i> of any of its <i>sides</i>.</li> </ul>											
<p><b>base of a triangle</b></p>	<ul style="list-style-type: none"> <li>• The base (<i>b</i>) of a <i>triangle</i> is the <i>length</i> of any of its <i>sides</i>.</li> </ul>											
<p><b>between</b></p>	<ul style="list-style-type: none"> <li>• At a place bounded by two or more places.</li> </ul>	<p>The child is between her parents.</p> 										
<p><b>bi</b></p>	<ul style="list-style-type: none"> <li>• (or <b>di</b>) Prefix meaning two.</li> </ul>	<p>A bicycle has 2 wheels.</p> 										

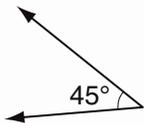
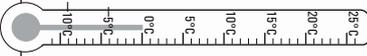
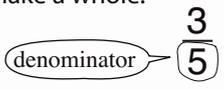
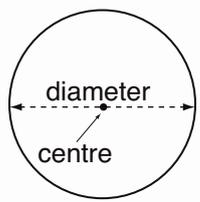
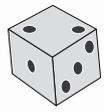
<b>bisect</b>	<ul style="list-style-type: none"> <li>To split into two <i>equal</i> parts.</li> </ul>	$AM = MB$ 
<b>brackets ( )</b>	<ul style="list-style-type: none"> <li>A <i>pair</i> of symbols used to enclose a mathematical <i>expression</i>.</li> </ul>	$(12 - 4) \div 2 = 4$ Brackets group 12 take away 4.
<b>calculate</b>	<ul style="list-style-type: none"> <li>To find the exact value of mathematical operations.</li> </ul>	$3 + 5 + 6 = 14$ 
<b>calendar</b>	<ul style="list-style-type: none"> <li>A <i>time</i> chart that tells us what <i>day</i>, <i>week</i>, <i>month</i> and <i>year</i> it is.</li> </ul>	
<b>calibration</b>	<ul style="list-style-type: none"> <li>A mark on a <i>scale</i>.</li> </ul>	
<b>cancel</b>	<ul style="list-style-type: none"> <li>To strike out an <i>equal term</i> on each side of an <i>equation</i>.</li> </ul>	$x - 3 = 6$ cancel $-3$ by adding 3 to both sides of the equation $x - \cancel{3} + \cancel{3} = 6 + 3 \quad -3 + 3 = 0$ $x = 9$
<b>capacity</b>	<ul style="list-style-type: none"> <li>Or <i>volume</i>, is the measure of the amount of liquid a container can hold.</li> </ul>	A jug has capacity because it can hold liquid, a brick does not. 
<b>Cartesian plane</b>	<ul style="list-style-type: none"> <li>See <i>coordinate plane</i>.</li> </ul>	
<b>chance</b>	<ul style="list-style-type: none"> <li>The likelihood that a particular result or <i>outcome</i> will occur.</li> </ul>	The chance of rolling a 2 with a standard die is 1 in 6. 
<b>chord</b>	<ul style="list-style-type: none"> <li>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.</li> </ul>	
<b>closest</b>	<ul style="list-style-type: none"> <li>Nearest to.</li> </ul>	The son is closest to the mother. 
<b>coefficient</b>	<ul style="list-style-type: none"> <li>The number which multiplies a <i>variable</i>.</li> </ul>	3 is the coefficient of $3x$ 6 is the coefficient of $6y^4$

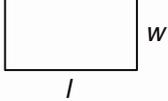
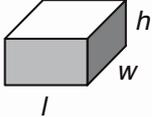
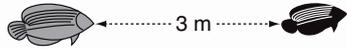
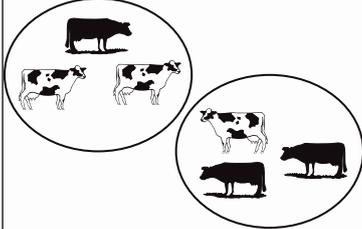
<p><b>column</b></p>	<ul style="list-style-type: none"> <li>• A <i>vertical</i> line of <i>data</i> in a table.</li> </ul>	<p><b>Medal Tally - Beijing Olympics 2008</b></p> <table border="1"> <thead> <tr> <th>COUNTRY</th> <th>Gold</th> <th>Silver</th> <th>Bronze</th> </tr> </thead> <tbody> <tr> <td>China</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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<p><b>combinations</b></p>	<ul style="list-style-type: none"> <li>• A selection of objects from a collection. Order is irrelevant.</li> </ul>	<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><b>common factor</b></p>	<ul style="list-style-type: none"> <li>• A <i>whole number</i> that is a <i>factor</i> of two or more non-zero whole numbers.</li> </ul>	<p>The common factors of 18 and 24 are 1, 2, 3 and 6.</p>																												
<p><b>common multiple</b></p>	<ul style="list-style-type: none"> <li>• A <i>whole number</i> that is a <i>multiple</i> of two or more non-zero <i>whole numbers</i>.</li> </ul>	<p>The common multiples of 5 and 6 are 30, 60, 90, .....</p>																												
<p><b>compass</b></p>	<ul style="list-style-type: none"> <li>• An instrument that shows <i>direction</i>.</li> </ul>																													
<p><b>complement of an angle</b></p>	<ul style="list-style-type: none"> <li>• An <i>angle</i> that, when added to the first angle, makes a <i>right angle</i> (or <math>90^\circ</math> in total).</li> </ul>	<p><math>75^\circ</math> is the complement of <math>15^\circ</math>, because <math>75^\circ + 15^\circ = 90^\circ</math></p> 																												
<p><b>complementary event</b></p>	<ul style="list-style-type: none"> <li>• The <i>opposite</i> of an event. All of the outcomes that are not included in the <i>event</i>.</li> </ul>	<p>If the event is "raining" then the complementary event is "not raining".</p>																												
<p><b>composite number</b></p>	<ul style="list-style-type: none"> <li>• A <i>positive integer</i> that has <i>factors</i> other than just 1 and the number itself.</li> </ul>	<p>12 is a composite number.  <math>12 = 1 \times 12 = 2 \times 6 = 3 \times 4</math>                      The factors of 12 are:                      1, 2, 3, 4, 6, 12</p>																												
<p><b>composite shapes</b></p>	<ul style="list-style-type: none"> <li>• A combination of two or more <i>2D</i> shapes into one figure.</li> </ul>	 <p>The above diagram is the composite of 3 rectangular shapes.</p> 																												

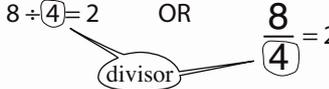
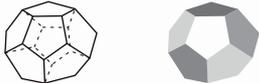
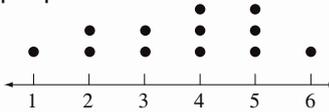
<p><b>composite space figures</b></p>	<ul style="list-style-type: none"> <li>• A combination of two or more <i>3D</i> shapes into one object.</li> </ul>	
<p><b>cone</b></p>	<ul style="list-style-type: none"> <li>• A <i>solid</i> with one circular base and one <i>vertex</i>.</li> </ul>	
<p><b>congruent shapes</b></p>	<ul style="list-style-type: none"> <li>• Have exactly the same size and shape.</li> </ul>	<p>Triangles ABC and DEF are congruent.</p>  <p><b>Sides</b> Corresponding sides are congruent:  <math>\overline{AB} \cong \overline{DE}</math>, <math>\overline{BC} \cong \overline{EF}</math>, <math>\overline{AC} \cong \overline{DF}</math></p> <p><b>Angles</b> Corresponding angles are congruent:  <math>\angle A \cong \angle D</math>, <math>\angle B \cong \angle E</math>, <math>\angle C \cong \angle F</math></p>
<p><b>consecutive numbers</b></p>	<ul style="list-style-type: none"> <li>• Numbers that follow each other.</li> </ul>	<p>4 and 5 are consecutive numbers.</p> 
<p><b>constant term</b></p>	<ul style="list-style-type: none"> <li>• A <i>term</i> that has a fixed value and does not contain a <i>variable</i>.</li> </ul>	<p>In <math>y = x + 5</math>  5 is constant  x and y are variables.</p> <p>The speed of light in a vacuum (c) is a constant.  <math>c = 299\,792\,458</math> m/s</p>
<p><b>conversion factor</b></p>	<ul style="list-style-type: none"> <li>• 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>.</li> </ul>	<p>1 m = 100cm  The conversion factor for changing metres to centimetres is 100</p>
<p><b>convert</b></p>	<ul style="list-style-type: none"> <li>• Change from a <i>unit</i> to another.</li> </ul>	<p>25 kg can be converted to 25 000 g.</p>

<p><b>coordinate plane (Cartesian plane)</b></p>	<ul style="list-style-type: none"> <li>• 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>.</li> </ul>	
<p><b>coordinates</b></p>	<ul style="list-style-type: none"> <li>• An <i>ordered pair</i> of numbers that locate a <i>point</i> on a <i>coordinate plane</i>.</li> <li>• 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>.</li> <li>• They are written in <i>brackets</i> with a comma in between.</li> </ul>	<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><b>counting number</b></p>	<ul style="list-style-type: none"> <li>• Any of the <i>whole numbers</i> from zero onwards.</li> </ul>	<p>0, 1, 2, 3, 4, 5..... are counting numbers.</p>
<p><b>cross multiply</b></p>	<ul style="list-style-type: none"> <li>• To simplify a <i>proportion</i>, written as two <i>equal fractions</i> OR</li> <li>• To <i>multiply</i> each <i>numerator</i> by the <i>denominator</i> of the fraction across from it.</li> </ul>	$a : b = c : d$ $\frac{a}{b} \times \frac{c}{d}$ $a \times d = b \times c$ $ad = bc$
<p><b>cross section</b></p>	<ul style="list-style-type: none"> <li>• The <i>shape</i> of the <i>face</i> that results when an object is cut through.</li> </ul>	
<p><b>cross simplify</b></p>	<ul style="list-style-type: none"> <li>• To <i>divide</i> the <i>diagonal</i> numbers (when <i>multiplying two fractions</i>) by the same number to reduce their value before multiplying.</li> </ul>	$\frac{3}{4} \times \frac{8}{9} = \frac{\overset{+3}{\cancel{3}} \times \overset{+4}{\cancel{8}}}{\underset{+4}{\cancel{4}} \times \underset{+3}{\cancel{9}}} = \frac{1 \times 2}{1 \times 3} = \frac{2}{3}$
<p><b>cube</b></p>	<ul style="list-style-type: none"> <li>• A <i>solid</i> with six identical <i>square</i> faces.</li> </ul>	
<p><b>cubed</b></p>	<ul style="list-style-type: none"> <li>• A number cubed is the third <i>power</i> of the number.</li> </ul>	<p>5 cubed = <math>5^3 = 5 \times 5 \times 5 = 125</math></p>
<p><b>cubic unit</b></p>	<ul style="list-style-type: none"> <li>• A unit of <i>volume</i> expressed in cubic form.</li> </ul>	<p>The volume of a solid is measured in the appropriate cubic units, e.g. <math>\text{cm}^3</math> or <math>\text{m}^3</math>.</p>

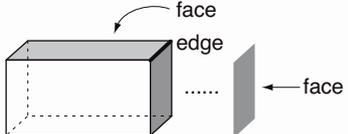
<p><b>cylinder</b></p>	<ul style="list-style-type: none"> <li>• A <i>solid</i> with two <i>parallel</i> circular <i>bases</i> of the same size.</li> </ul>													
<p><b>data</b></p>	<ul style="list-style-type: none"> <li>• Collection of information that can include facts, numbers or measurements.</li> </ul>	<p><b>HOSPITAL EMERGENCIES (MAY)</b></p> 												
<p><b>day</b></p>	<ul style="list-style-type: none"> <li>• A <i>unit</i> of <i>time</i> equal to 24 <i>hours</i>.</li> </ul>	<p>A day starts and ends at midnight.</p> 												
<p><b>daylight saving time</b></p>	<ul style="list-style-type: none"> <li>• Use of fictitious time in the summer months that prolongs light in the evening hours.</li> </ul>	<p>During daylight saving clocks are one hour ahead of real time.</p>												
<p><b>deca</b></p>	<ul style="list-style-type: none"> <li>• Prefix meaning ten.</li> </ul>	<p>Decathlon is an athletics contest with ten events.</p>												
<p><b>decade</b></p>	<ul style="list-style-type: none"> <li>• A <i>unit</i> of <i>time</i> equal to 10 <i>years</i>.</li> </ul>	<p>2011 to 2020 make a decade.</p>												
<p><b>decagon</b></p>	<ul style="list-style-type: none"> <li>• A shape with 10 <i>sides</i>.</li> </ul>													
<p><b>decimal number</b></p>	<ul style="list-style-type: none"> <li>• 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>.</li> </ul>	<p>The decimal number 4.3 represents: 4 - ones 3 - tenths OR 4 and 3 tenths.</p>												
<p><b>decimal place</b></p>	<table border="1" data-bbox="395 1532 683 1686"> <tr> <td>units</td> <td>tenths</td> <td>hundredths</td> <td>thousandths</td> </tr> <tr> <td>0</td> <td>.</td> <td>7</td> <td>6</td> </tr> <tr> <td></td> <td></td> <td></td> <td>3</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>
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0	.	7	6											
			3											
<p><b>decimal point (.)</b></p>	<ul style="list-style-type: none"> <li>• A point that separates the <i>units</i> and <i>tenths</i> in a <i>decimal number</i>.</li> </ul>	<p>2.5 is a decimal number where the 2 and the 5 are separated by a decimal point.</p>												
<p><b>decrease</b></p>	<ul style="list-style-type: none"> <li>• To make smaller.</li> </ul>	<p>8 must decrease by 5 to become 3.</p>												
<p><b>deduct</b></p>	<ul style="list-style-type: none"> <li>• To take away.</li> </ul>	<p>If you deduct 1 from 3 there are 2 left. <math>3 - 1 = 2</math></p>												

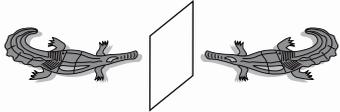
<b>degree (°)</b>	<ul style="list-style-type: none"> <li>A <i>unit</i> used to measure the amount of turn in an <i>angle</i>.</li> </ul>	<p>Angle measures <math>45^\circ</math>.</p> 
<b>degrees Celsius (°C)</b>	<ul style="list-style-type: none"> <li>A <i>unit</i> used to measure temperature on the Celsius scale, used in the metric system. The Celsius (or centigrade) thermometer was invented by Swedish astronomer Anders Celsius in 1742.</li> </ul>	<p><math>0^\circ\text{C}</math> = freezing point of water  <math>100^\circ\text{C}</math> = boiling point of water  <math>37^\circ\text{C}</math> = human body temperature</p> 
<b>denominator</b>	<ul style="list-style-type: none"> <li>The number below the fraction bar in a <i>fraction</i>.</li> <li>The number of equal parts in one whole.</li> </ul>	<p>Considering fifths, 5 parts would make a whole.</p> 
<b>deposit</b> (money)	<ul style="list-style-type: none"> <li>To pay an amount of money into a bank account.</li> </ul>	<p>A deposit of \$15 into a bank account with a balance of \$25 will increase the account balance to \$40.</p>
<b>descending order</b>	<ul style="list-style-type: none"> <li>Arranged from largest to smallest. Becoming smaller, lesser or lower.</li> </ul>	<p>8, 6 and 2 are in descending order.</p>
<b>diagonal</b>	<ul style="list-style-type: none"> <li>A straight <i>line</i> inside a <i>polygon</i> joining any two <i>vertices</i> that are not next to each other.</li> </ul>	
<b>diameter of a circle</b>	<ul style="list-style-type: none"> <li>A <i>segment</i> that passes through the <i>centre</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>.</li> </ul>	
<b>die</b>	<ul style="list-style-type: none"> <li>(pl. <b>dice</b>) 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.</li> </ul>	
<b>difference</b>	<ul style="list-style-type: none"> <li>The result when a number is <i>subtracted</i> from another number.</li> <li>The amount by which one number is bigger or smaller than another number.</li> </ul>	<p>The difference between 5 and 3 is 2.  <math>5 - 3 = 2</math></p>
<b>digit</b>	<ul style="list-style-type: none"> <li>Any of the first ten <i>whole numbers</i> from 0 to 9.</li> </ul>	<p>There are 10 digits:  0, 1, 2, 3, 4, 5, 6, 7, 8 or 9</p>
<b>digit sum</b>	<ul style="list-style-type: none"> <li>The <i>sum</i> of the <i>digits</i> in a number.</li> </ul>	<p>124 has a digit sum of 7.  <math>1 + 2 + 4 = 7</math></p>

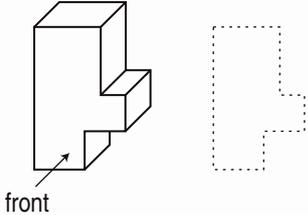
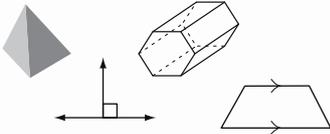
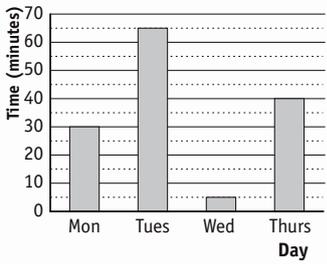
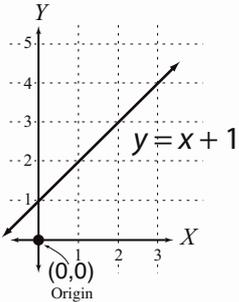
<b>digital clock</b>	<ul style="list-style-type: none"> <li>• A clock that uses only numbers to show the <i>time</i>. (No hands!)</li> </ul>	
<b>dimension</b>	<ul style="list-style-type: none"> <li>• A measure of size. A <i>two-dimensional</i> shape (2D shape) has <i>length</i> and <i>width</i>. A <i>three-dimensional</i> shape (3D shape) has <i>length</i>, <i>width</i> and <i>height</i>.</li> </ul>	<p>2D shape </p> <p>3D shape </p>
<b>direction</b>	<ul style="list-style-type: none"> <li>• The way something is placed, pointing or moving.</li> </ul>	<p>North, east, south, west, up, down, sideways, backwards and forwards.</p> 
<b>discount</b> (money)	<ul style="list-style-type: none"> <li>• An amount <i>subtracted</i> from the regular price of an item to get the sale price.</li> </ul>	<p>When \$80 track shoes are on sale at 25% off <math>\Rightarrow</math> discount = 25% of \$80 = \$20.</p>
<b>distance</b>	<ul style="list-style-type: none"> <li>• The <i>length</i> between two <i>points</i>.</li> </ul>	<p>The distance between the fish is 3 metres.</p> 
<b>divide (<math>\div</math>)</b>	<ul style="list-style-type: none"> <li>• To share into groups.</li> </ul>	<p>These 6 cows are divided into 2 groups.</p>  <p><math>6 \div 2 = 3</math> in each group</p>
<b>dividend</b>	<ul style="list-style-type: none"> <li>• 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>.</li> </ul>	<p>In the division: <math>144 \div 9 = 16</math> the number 144 is called the dividend.</p>
<b>divisible</b>	<ul style="list-style-type: none"> <li>• Can be divided without a <i>remainder</i>.</li> </ul>	<p><math>20 \div 2 = 10</math> with 0 remainder. So 20 is divisible by 2 and 10.</p>

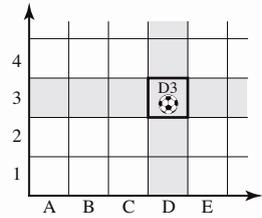
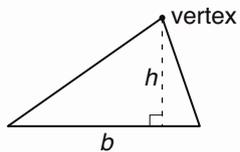
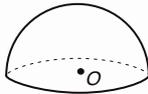
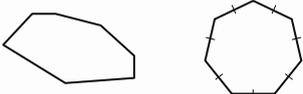
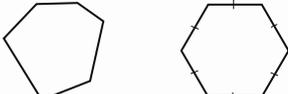
<p><b>divisibility tests</b></p>	<ul style="list-style-type: none"> <li>• Checks performed to help find the <i>factors</i> of a number.</li> </ul>	
<p><b>Divisibility tests (factor tricks)</b></p>		<p><b>Examples</b></p>
<p><b>2 is a factor</b> of all even numbers.</p>		<p>Numbers that end with 0, 2, 4, 6 and 8, e.g. 754, 120</p>
<p><b>3 is a factor</b> of all numbers with a digit sum that is divisible by 3.</p>		<p>252 has 3 as a factor because <math>2 + 5 + 2 = 9</math> and 9 is divisible by 3.</p>
<p><b>4 is a factor</b> of all numbers where the last two digits are divisible by 4.</p>		<p>1532 has 4 as a factor because 32 is divisible by 4.</p>
<p><b>5 is a factor</b> of all numbers whose last digit is a 5 or a 0.</p>		<p>120 and 4935 both have 5 as a factor.</p>
<p><b>6 is a factor</b> of all numbers that have both 2 and 3 as factors.</p>		<p>102 has 6 as a factor because 2 and 3 are both factors.</p>
<p><b>9 is a factor</b> of all numbers with a digit sum that is divisible by 9.</p>		<p>1764 has 9 as a factor because <math>1 + 7 + 6 + 4 = 18</math> and 18 is divisible by 9.</p>
<p>For <b>11 to be a factor</b> 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.</p>		<p>81917 has 11 as a factor because <math>1 + 1 = 2</math>  <math>8 + 9 + 7 = 24</math> and  <math>24 - 2 = 22</math> which is divisible by 11.</p>
<p>For <b>10, 100, 1000 .... to be a factor</b> of a number, that number must end in one 0 or two 0's or three 0's, etc.</p>		<p>270 has 10 as a factor, 1400 has 100 as a factor etc.</p>
<p><b>division</b></p>	<ul style="list-style-type: none"> <li>• The <i>operation</i> of sharing or grouping a number into <i>equal</i> parts.</li> </ul>	<p>The division <math>6 \div 2 = 3</math> 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?  <math>\Rightarrow</math> 3 groups of 2.</p> 
<p><b>divisor</b></p>	<ul style="list-style-type: none"> <li>• The <i>second</i> number written in a <i>division</i>.</li> <li>• It is the number that will divide the <i>dividend</i>.</li> </ul> <p>In a <i>fraction</i> the divisor is the <i>denominator</i>.</p>	<p><math>8 \div 4 = 2</math> OR <math>\frac{8}{4} = 2</math></p> 
<p><b>dodecahedron</b></p>	<ul style="list-style-type: none"> <li>• A regular <i>solid</i> in which all twelve <i>faces</i> are <i>regular pentagons</i>.</li> </ul>	
<p><b>dot plot</b></p>	<ul style="list-style-type: none"> <li>• A <i>graph</i> showing the frequency of data, using a <i>number line</i>.</li> <li>• The number line has all the numbers in the <i>sample</i>. Each observation is marked with a point above the <i>line</i>.</li> </ul>	<p>A graph using dots to show how many hours are dedicated to sport by 12 people.</p> 

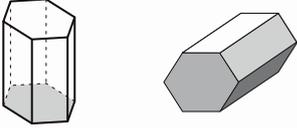
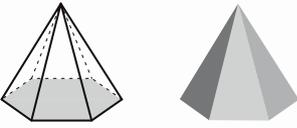
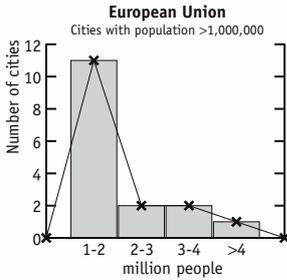
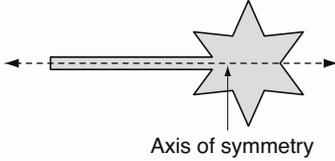
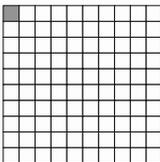
<p><b>double</b></p>	<ul style="list-style-type: none"> <li>• <i>Twice</i> as much.</li> <li>• <i>Multiplied</i> by two.</li> </ul>	<p>Double 4 is:  <math>4 + 4 = 8</math> OR  <math>4 \times 2 = 8</math>.</p>																		
<p><b>double bar graph</b></p>	<ul style="list-style-type: none"> <li>• A <i>bar graph</i> that shows two sets of <i>data</i> on the same graph.</li> </ul>	<p><b>Officially Spoken Languages</b></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>~1000</td> <td>~12</td> </tr> <tr> <td>SPANISH</td> <td>~450</td> <td>~20</td> </tr> <tr> <td>ARABIC</td> <td>~300</td> <td>~25</td> </tr> <tr> <td>ENGLISH</td> <td>~350</td> <td>~55</td> </tr> <tr> <td>FRENCH</td> <td>~250</td> <td>~50</td> </tr> </tbody> </table>	Language	Speakers (millions)	Countries	CHINESE	~1000	~12	SPANISH	~450	~20	ARABIC	~300	~25	ENGLISH	~350	~55	FRENCH	~250	~50
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<p><b>east</b></p>	<ul style="list-style-type: none"> <li>• A <i>compass direction</i>.</li> </ul>	<p>The sun rises in the east.</p>																		
<p><b>edges of a solid</b></p>	<ul style="list-style-type: none"> <li>• The <i>segment</i> (line part) where two <i>faces</i> of a <i>solid</i> meet.</li> </ul>	<p>A rectangular prism has 12 edges.</p>																		
<p><b>eighth</b></p>	<ul style="list-style-type: none"> <li>• The position after <i>seventh</i>.</li> </ul>	<p>1st, 2nd, 3rd, 4th, 5th, 6th, 7th, <b>8th</b>.....</p>																		
<p><b>elapsed time</b></p>	<ul style="list-style-type: none"> <li>• The amount of <i>time</i> between the start time and the finish time.</li> </ul>	<p>The amount of elapsed time from 2:15 pm to 3:00 pm is 45 minutes.</p>																		
<p><b>ellipse</b></p>	<ul style="list-style-type: none"> <li>• A curved shape that looks like a squashed <i>circle</i>.</li> </ul>	<p>The orbit of the Earth around the Sun is approximately an ellipse.</p>																		
<p><b>enlargement</b></p>	<ul style="list-style-type: none"> <li>• To reproduce and make bigger.</li> </ul>	<p>The second object is an enlargement of the first.</p>																		
<p><b>equal (=)</b></p>	<ul style="list-style-type: none"> <li>• Exactly the same in value or size.</li> </ul>	<p><math>7 + 2 = 9</math>  100 centimetres is equal to 1 metre:  <math>100 \text{ cm} = 1 \text{ m}</math></p>																		
<p><b>equation</b></p>	<ul style="list-style-type: none"> <li>• A mathematical sentence formed by placing an <i>equals</i> sign (=) between two <i>expressions</i>.</li> </ul>	<p><math>6 \times 2 = 9 + 3</math>  <math>4x - 5 = 0</math>  <math>2y^2 - 2 = 0</math>  are examples of equations.</p>																		
<p><b>equilateral triangle</b></p>	<ul style="list-style-type: none"> <li>• A <i>triangle</i> with all three <i>sides</i> of equal <i>length</i>.</li> </ul>																			

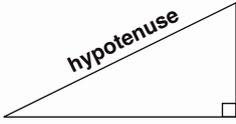
<b>equivalent fractions</b>	<ul style="list-style-type: none"> <li>• <i>Fractions</i> that represent the same number.</li> </ul>	$\frac{2}{16}$ and $\frac{8}{64}$ are equivalent fractions. They both equal $\frac{1}{8}$ .	
<b>error</b>	<ul style="list-style-type: none"> <li>• The variation of a measurement. It may be contributed to by the <i>precision</i> of the instrument or the <i>accuracy</i> of the measured value.</li> </ul>	"My measuring may be off by 1%!"	
<b>estimate</b>	<ul style="list-style-type: none"> <li>• To make a close guess based on <i>rounding</i>.</li> </ul>	$48 + 21 = ?$ By rounding to $50 + 20$ , the estimation of the sum is 70.	
<b>evaluate</b>	<ul style="list-style-type: none"> <li>• To work out the value.</li> </ul>	Evaluate: $7 \times 3 - 10 = 21 - 10$ $= 11$	
<b>even numbers</b>	<ul style="list-style-type: none"> <li>• A <i>whole number</i> that can be <i>divided</i> by two.</li> <li>• Even numbers end with 0, 2, 4, 6 or 8.</li> </ul>	134 is an even number. $134 \checkmark$ 431 is not an even number. $431 \times$	
<b>event</b>	<ul style="list-style-type: none"> <li>• Possible <i>outcomes</i> resulting from a particular <i>experiment</i>.</li> </ul>	Experiment: A die is rolled. Possible outcomes: Either a 5 or a 6 may result 	
<b>expense</b> (money)	<ul style="list-style-type: none"> <li>• The cost involved.</li> </ul>	You buy 3 CDs at \$15 each. Your expense is \$45.	
<b>experiment</b>	<ul style="list-style-type: none"> <li>• A controlled, repeatable process carried out in the study of <i>probability</i>.</li> </ul>	Tossing a coin is an experiment. 	
<b>expression</b>	<ul style="list-style-type: none"> <li>• A <i>sequence</i> of numbers and/or <i>variables</i> (letters) connected by <i>operation</i> signs.</li> </ul>	$42 \div 3 - 10$ $x + 2y$ $2x^2 - 2$	are examples of expressions
<b>faces of a solid</b>	<ul style="list-style-type: none"> <li>• <i>Polygons</i> that join on their <i>edges</i> to form a <i>solid</i>.</li> </ul>	A rectangular prism has 6 rectangular faces. 	

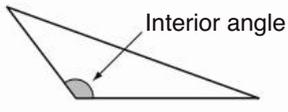
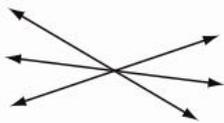
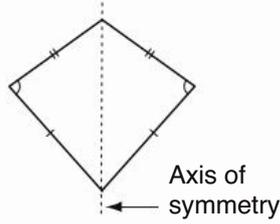
<p><b>factor</b></p>	<ul style="list-style-type: none"> <li>• When <i>whole numbers</i>, other than zero, are multiplied together, each number is a factor of the <i>product</i>.</li> <li>OR A whole number that divides exactly into another number.</li> <li>See <i>divisibility tests</i>.</li> <li>• To write a number as a <i>product</i> of its <i>factors</i>.</li> <li>• To write an <i>expression</i> as a product of two or more expressions.</li> </ul>	<p>Because <math>1 \times 12 = 12</math>  <math>2 \times 6 = 12</math>  and <math>3 \times 4 = 12</math></p> <p>1, 2, 3, 4, 6 and 12 are all factors of 12.</p> <p>Factor:  <math>3x + 15 = 3(x + 5)</math>  because <math>3 = 3 \times 1</math>  and <math>15 = 3 \times 5</math></p>
<p><b>factor tree</b></p>	<ul style="list-style-type: none"> <li>• 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.</li> </ul>	<p>The prime factors of 12 are 2 and 3.</p> $  \begin{array}{c}  12 \\  / \quad \backslash \\  2 \quad \times \quad 6 \\  / \quad \backslash \quad / \quad \backslash \\  2 \quad \times \quad 2 \quad \times \quad 3  \end{array}  $
<p><b>favourable outcome</b></p>	<ul style="list-style-type: none"> <li>• The result that you are hoping or testing for.</li> </ul>	<p>Experiment: A die is rolled.  Event: A number <math>&gt; 2</math> comes up  Favourable outcomes: 3, 4, 5 or 6.</p>
<p><b>fifth</b></p>	<ul style="list-style-type: none"> <li>• The position after <i>fourth</i>.</li> </ul>	<p>1st, 2nd, 3rd, 4th, <b>5th</b>.....</p>
<p><b>finite</b></p>	<ul style="list-style-type: none"> <li>• With limits. Able to be counted.</li> </ul>	<p>There are a finite number (12) of months in the year.</p>
<p><b>first</b></p>	<ul style="list-style-type: none"> <li>• Placed before anything else.</li> </ul>	<p>The first athlete to cross the finish line won the gold medal.</p>
<p><b>flip</b></p>	<ul style="list-style-type: none"> <li>• To turn across a line so the result is a mirror image. See <i>reflection</i>.</li> </ul>	
<p><b>formula</b></p>	<ul style="list-style-type: none"> <li>• (pl. <b>formulae</b>) A mathematical <i>rule</i>, usually an <i>equation</i>, describing a relationship between two or more quantities.</li> <li>For example, the formula describing the area of a circle is <math>A = \pi r^2</math> where <math>A</math> is the symbol for the area and <math>r</math> is the symbol for the <i>radius</i>.</li> </ul>	<p>Find the area of a circle of radius 10 cm, using <math>\pi \approx 3.14</math></p> <p>Use the formula <math>A = \pi r^2</math> and substitute <math>r = 10</math>  <math>A = 3.14 \times 10^2</math>  <math>= 3.14 \times 100</math>  <math>= 314 \text{ cm}^2</math></p>
<p><b>fortnight</b></p>	<ul style="list-style-type: none"> <li>• A <i>unit</i> of <i>time</i> equal to 2 whole <i>weeks</i> or 14 <i>days</i>.</li> </ul>	

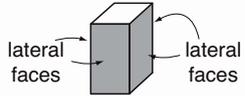
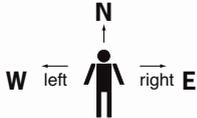
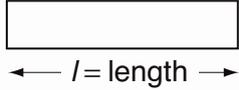
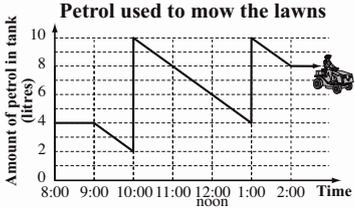
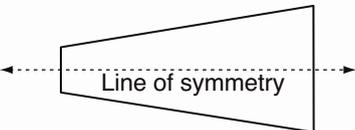
<b>forwards</b>	<ul style="list-style-type: none"> <li>• In the <i>direction</i> of your front.</li> <li>• The usual way.</li> </ul>											
<b>fourth</b>	<ul style="list-style-type: none"> <li>• The position after <i>third</i>.</li> </ul>	1st, 2nd, 3rd, <b>4th</b> .....										
<b>fraction</b>	<ul style="list-style-type: none"> <li>• Part of a group.</li> <li>• Part of a whole.</li> <li>• A number in the form <math>\frac{a}{b}</math> (<math>b \neq 0</math>) where <math>a</math> is the <i>numerator</i> and <math>b</math> is the <i>denominator</i>.</li> <li>• Fractions can be <i>proper fractions</i> or <i>improper fractions</i>.</li> </ul>	5 out of 8 dots are circled.  $\frac{5}{8}$ 1 half of a whole orange.  $\frac{1}{2}$										
<b>front view</b>	<ul style="list-style-type: none"> <li>• What you see of an object looking from a frontal perspective.</li> <li>• <i>Three-dimensional</i> objects have 3 views: front, top and side.</li> </ul>											
<b>function (f)</b>	<ul style="list-style-type: none"> <li>• A relationship or correspondence in which values of one <i>variable</i> determine the values of another: <math>f(x) = \text{rule}</math> or <math>y = \text{rule}</math>.</li> </ul>	$f(x) = x^2 - 4$ or $y = x^2 - 4$ See rule and linear function.										
<b>geometry</b>	<ul style="list-style-type: none"> <li>• A branch of Mathematics studying the properties and relations of <i>lines</i>, surfaces and <i>solids</i>.</li> </ul>											
<b>gram (g)</b>	<ul style="list-style-type: none"> <li>• A <i>unit</i> of measurement for mass equal to 1000 <i>milligrams</i>.</li> </ul>	250 g of butter. 										
<b>graph</b>	<ul style="list-style-type: none"> <li>• A diagram that shows a collection of <i>data</i>.</li> </ul>	<p style="text-align: center;"><b>Homework time</b></p>  <table border="1"> <caption>Homework time data</caption> <thead> <tr> <th>Day</th> <th>Time (minutes)</th> </tr> </thead> <tbody> <tr> <td>Mon</td> <td>30</td> </tr> <tr> <td>Tues</td> <td>65</td> </tr> <tr> <td>Wed</td> <td>5</td> </tr> <tr> <td>Thurs</td> <td>40</td> </tr> </tbody> </table>	Day	Time (minutes)	Mon	30	Tues	65	Wed	5	Thurs	40
Day	Time (minutes)											
Mon	30											
Tues	65											
Wed	5											
Thurs	40											
<b>graph of a rule</b>	<ul style="list-style-type: none"> <li>• The picture obtained by plotting all the points of the <i>rule</i>.</li> </ul>											

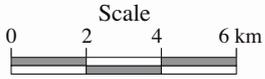
<b>greater than (&gt;)</b>	<ul style="list-style-type: none"> <li>An <i>inequality symbol</i> showing which is bigger.</li> </ul>	$10 > 2$ means 10 <b>is greater than</b> 2.
<b>grid reference</b>	<ul style="list-style-type: none"> <li>A pair of letters and/or numbers that describe <i>location</i> within a grid. See also <i>coordinates</i>.</li> </ul>	The grid reference for the ball is D3. 
<b>half</b>	<ul style="list-style-type: none"> <li>(pl. <b>halves</b>) One of two <i>equal</i> parts expressed as a fraction.</li> </ul>	One half is 1 of 2 parts of one whole pizza: 
<b>hedron</b>	<ul style="list-style-type: none"> <li>(pl. <b>hedra</b>) Face.</li> </ul>	Polyhedron - A solid object that has multiple (poly) faces. 
<b>height</b>	<ul style="list-style-type: none"> <li>The <i>vertical</i> distance from top to bottom.</li> </ul>	The height of the Taj Mahal is 76 m. 
<b>height of a triangle</b>	<ul style="list-style-type: none"> <li>The height (<i>h</i>) is the <i>distance</i> from the <i>vertex</i> to the <i>opposite</i> side of the <i>triangle</i>.</li> </ul>	
<b>hemisphere</b>	<ul style="list-style-type: none"> <li>One half of a <i>sphere</i>.</li> </ul>	
<b>hepta</b>	<ul style="list-style-type: none"> <li>Prefix meaning seven.</li> </ul>	See <i>heptagon</i>
<b>heptagon</b>	<ul style="list-style-type: none"> <li>A <i>polygon</i> with 7 sides.</li> </ul>	 Heptagon      Regular heptagon
<b>hexa</b>	<ul style="list-style-type: none"> <li>Prefix meaning six.</li> </ul>	See <i>hexagon</i>
<b>hexagon</b>	<ul style="list-style-type: none"> <li>A <i>polygon</i> with 6 sides.</li> </ul>	 Hexagon      Regular hexagon

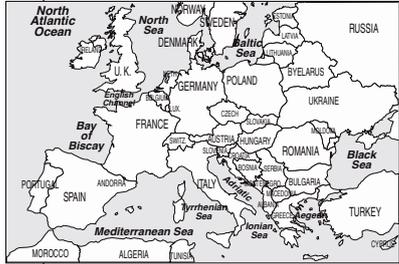
<p><b>hexagonal prism</b></p>	<ul style="list-style-type: none"> <li>• A <i>three-dimensional</i> shape.</li> <li>Two identical <i>bases</i> are <i>hexagons</i>.</li> <li>Six <i>faces</i> are <i>rectangles</i>.</li> </ul>															
<p><b>hexagonal pyramid</b></p>	<ul style="list-style-type: none"> <li>• A <i>three-dimensional</i> shape.</li> <li>The <i>base</i> is a <i>hexagon</i>.</li> <li>Six faces are <i>triangles</i>.</li> </ul>															
<p><b>hexahedron</b></p>	<ul style="list-style-type: none"> <li>• A <i>regular solid</i>.</li> <li>Six faces are <i>square</i> (<i>cube</i>).</li> </ul>															
<p><b>highest common factor (HCF)</b></p>	<ul style="list-style-type: none"> <li>• The largest number that is a <i>factor</i> of all the given numbers.</li> </ul>	<p>Factors of 12: 1, 2, 3, 4, 6, 12 Factors of 30: 1, 2, 3, 5, 6, 10, 15, 30 The HCF of 12 and 30 is 6.</p>														
<p><b>histogram</b></p>	<ul style="list-style-type: none"> <li>• A <i>vertical bar graph</i> used to represent the <i>frequency</i> of individual scores.</li> </ul>															
<p><b>horizontal line</b></p>	<ul style="list-style-type: none"> <li>• <i>Parallel</i> to the horizon.</li> </ul>															
<p><b>horizontal symmetry</b></p>	<ul style="list-style-type: none"> <li>• A shape has horizontal symmetry if an <i>axis of symmetry</i> is horizontal.</li> </ul>															
<p><b>hour (h)</b></p>	<ul style="list-style-type: none"> <li>• A <i>unit of time equal</i> to 60 <i>minutes</i>.</li> </ul>	<p>One hour is the amount of time between 1 o'clock and 2 o'clock.</p>														
<p><b>hundreds</b></p>	<ul style="list-style-type: none"> <li>• The <i>place value</i> between <i>tens</i> and <i>thousands</i>.</li> </ul>	<p>1825.763 has 8 hundreds.</p> <table border="1" data-bbox="1182 1738 1538 1883"> <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><b>hundredth</b></p>	<ul style="list-style-type: none"> <li>• One part out of 100 parts of one whole.</li> </ul>															

<p><b>hundredths</b></p>	<ul style="list-style-type: none"> <li>The <i>place value</i> between <i>tenths</i> and <i>thousandths</i>.</li> </ul>	<p>1825.763 has 6 hundredths.</p> <table border="1" data-bbox="1110 143 1469 286"> <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><b>hypotenuse</b></p>	<ul style="list-style-type: none"> <li>The side <i>opposite</i> the <i>right angle</i> of a <i>right-angled triangle</i>.</li> <li>The longest side of a right-angled triangle.</li> </ul>															
<p><b>icosahedron</b></p>	<ul style="list-style-type: none"> <li>A <i>regular solid</i> in which all twenty <i>faces</i> are <i>equilateral triangles</i>.</li> </ul>															
<p><b>improper fraction</b></p>	<ul style="list-style-type: none"> <li>Any <i>fraction</i> in which the <i>numerator</i> is greater than or equal to the <i>denominator</i>.</li> </ul>	<p><math>\frac{9}{8}</math> the numerator is 9 the denominator is 8. <math>9 \geq 8</math> so <math>\frac{9}{8}</math> is an improper fraction.</p>														
<p><b>increase</b></p>	<ul style="list-style-type: none"> <li>To make larger or grow in size.</li> </ul>	<p>8 must increase by 5 to get to 13.</p>														
<p><b>index</b></p>	<ul style="list-style-type: none"> <li>(pl. <b>indices</b>) A number placed to the upper right of a base number, showing how many times the base number is multiplied by itself.</li> </ul>	<p><math>7^4 = 7 \times 7 \times 7 \times 7 = 2401</math> The index is 4. It is read as 'seven to the power of four'.</p>														
<p><b>index notation</b></p>	<ul style="list-style-type: none"> <li>Quantities in the form of a <i>base</i> number and an <i>index</i>. Index notation indicates what <i>power</i> is to be used and makes it easier to use multiple <i>factors</i>.</li> </ul>	<p><math>3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3</math> can be more easily written using index notation as <math>3^7</math>.</p>														
<p><b>inequality symbols</b></p>	<ul style="list-style-type: none"> <li>Symbols that tell us how the two objects or <i>expressions</i> in a mathematical sentence are not <i>equal</i>.</li> </ul>	<p><math>&lt;</math>, <math>&gt;</math>, <math>\leq</math> and <math>\geq</math> are inequality symbols.</p>														
<p><b>infinite (<math>\infty</math>)</b></p>	<ul style="list-style-type: none"> <li>Has no limits. Unable to be counted.</li> <li>The symbol for infinity is (<math>\infty</math>).</li> </ul>	<p>There are an infinite number of integers: ..... -3, -2, -1, 0, 1, 2, 3 .....</p>														
<p><b>integer (<math>\mathbb{Z}</math>)</b></p>	<ul style="list-style-type: none"> <li>Any <i>negative number</i>, zero or <i>positive number</i>.</li> </ul>	<p>-3, -2, -1, 0, 1, 2, 3 are integers. <math>3.5</math> and <math>5\frac{2}{3}</math> are not integers.</p>														

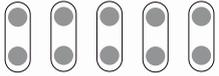
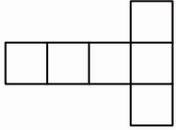
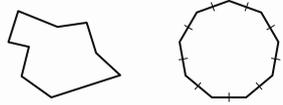
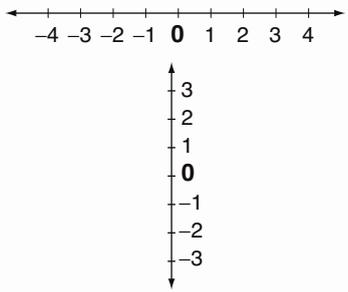
<b>interior angle</b>	<ul style="list-style-type: none"> <li>An <i>angle</i> inside a <i>polygon</i>.</li> </ul>						
<b>intersecting lines</b>	<ul style="list-style-type: none"> <li><i>Lines</i> that meet at a <i>point</i>.</li> </ul>						
<b>inverse of an operation</b>	<ul style="list-style-type: none"> <li>The <i>opposite</i> operation. Operations that undo each other.</li> </ul>	+ is opposite – × is opposite ÷					
Operation +	Inverse Operation –	Operation –	Inverse Operation +	Operation ×	Inverse Operation ÷	Operation ÷	Inverse Operation ×
$x + 3 = 6$ $x + 3 - 3 = 6 - 3$ $x = 3$	$x - 3 = 6$ $x - 3 + 3 = 6 + 3$ $x = 9$	$3x = 6$ $\frac{3x}{3} = \frac{6}{3}$ $x = 2$	$\frac{x}{3} = 6$ $\frac{x}{3} \times 3 = 6 \times 3$ $x = 18$				
<b>invest</b> (money)	<ul style="list-style-type: none"> <li>To put some form of money at risk to make a <i>profit</i>.</li> </ul>	It is common to invest in shares.					
<b>investment</b> (money)	<ul style="list-style-type: none"> <li>The act of laying out some form of money in an enterprise to make a <i>profit</i>.</li> </ul>						
<b>irrational number</b>	<ul style="list-style-type: none"> <li>A <i>real number</i> that can be written as an infinite non-repeating decimal, but not as a <i>fraction</i>.</li> <li>Not a <i>rational number</i>.</li> </ul>	$\pi, \phi, e, \sqrt{2}, \sqrt{3}, \sqrt{5}, \dots$ 2.6293045632.... $\cos 30^\circ$ $\tan 60^\circ$					
<b>isosceles triangle</b>	<ul style="list-style-type: none"> <li>A <i>triangle</i> with two sides of equal length.</li> </ul>						
<b>kilogram (kg)</b>	<ul style="list-style-type: none"> <li>A <i>unit of weight equal to 1000 grams</i>.</li> </ul>	My father weighs 75 kg.					
<b>kilometre (km)</b>	<ul style="list-style-type: none"> <li>A <i>unit of distance equal to 1000 metres</i>.</li> </ul>	The distance from Melbourne to Sydney is 925 km. 					
<b>kite</b>	<ul style="list-style-type: none"> <li>A <i>quadrilateral</i> where one <i>diagonal</i> is an <i>axis of symmetry</i>.</li> </ul>						

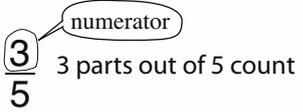
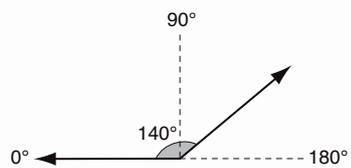
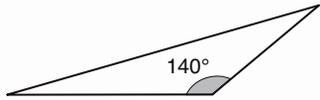
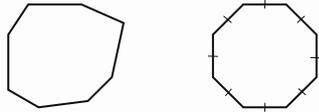
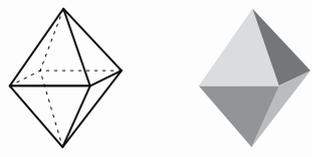
<p><b>largest to smallest</b></p>	<ul style="list-style-type: none"> <li>• Ranking in order from the biggest to the littlest.</li> </ul>	
<p><b>lateral area</b></p>	<ul style="list-style-type: none"> <li>• The <i>sum</i> of the area of the <i>lateral faces</i> of a solid.</li> </ul>	<p>A rectangular prism has 4 lateral faces.</p>
<p><b>lateral faces</b></p>	<ul style="list-style-type: none"> <li>• The <i>vertical</i> surfaces on a solid.</li> </ul>	<p>A rectangular prism has 4 lateral faces.</p> 
<p><b>leap year</b></p>	<ul style="list-style-type: none"> <li>• 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.</li> </ul>	<p>A leap year is divisible by 4. 2024 is a leap year.</p>
<p><b>left</b></p>	<ul style="list-style-type: none"> <li>• The <i>direction</i> to the <i>west</i> of your body if you are facing <i>north</i>.</li> </ul>	
<p><b>length</b></p>	<ul style="list-style-type: none"> <li>• The <i>distance</i> from one end to the other.</li> <li>• How long a shape is.</li> </ul>	
<p><b>less than (&lt;)</b></p>	<ul style="list-style-type: none"> <li>• An <i>inequality symbol</i> showing which is smaller.</li> </ul>	<p><math>2 &lt; 10</math> means that 2 <b>is less than</b> 10.</p>
<p><b>like terms</b></p>	<ul style="list-style-type: none"> <li>• <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.</li> </ul>	<ul style="list-style-type: none"> <li>• <math>7, \frac{6}{9}</math> and <math>-18</math> are like terms.</li> <li>• <math>6a, a</math> and <math>-3a</math> are like terms.</li> <li>• <math>xy^2, 5xy^2</math> and <math>-3xy^2</math> are like terms.</li> <li>• <math>7, 6a</math> and <math>-4y^3</math> are not like terms.</li> <li>• <math>5w, \frac{6}{w}</math> and <math>-18w^2</math> are not like terms.</li> </ul>
<p><b>line graph</b></p>	<ul style="list-style-type: none"> <li>• 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>.</li> </ul>	<p><b>Petrol used to mow the lawns</b></p> 
<p><b>line of symmetry</b></p>	<ul style="list-style-type: none"> <li>• 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.</li> </ul>	

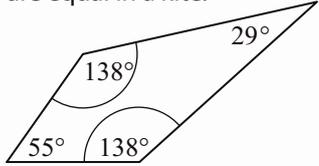
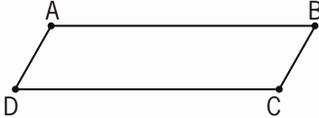
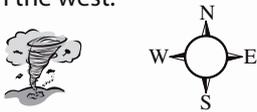
<p><b>linear equation</b></p>	<ul style="list-style-type: none"> <li>An algebraic <i>expression</i> in which the <i>variable</i> is in the first <i>power</i>. It can be solved for <math>x</math> and the value of <math>x</math> for which the <i>equation</i> is true is called the <i>solution</i>.</li> </ul> <p>The <i>graph</i> of a linear equation is always a straight <i>line</i>. See <i>linear rule</i>.</p>	<p><math>4x - 2 = x</math> is a linear equation.</p>
<p><b>linear rule (linear function)</b></p>	<ul style="list-style-type: none"> <li>A <i>rule</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 <math>y = ax + b</math> where <math>a</math> and <math>b</math> are <i>real numbers</i>.</li> </ul> <p>The <i>graph</i> of this rule is a straight line.</p>	<p>Used to describe things like the movement of a car travelling at a constant speed. <math>y = x + 4</math> <math>y = -4</math> <math>3x - 4y = 0.5</math> are linear rules.</p>
<p><b>linear scale</b></p>	<ul style="list-style-type: none"> <li>A <i>scale</i> shown on a line.</li> </ul> <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><b>litre (L)</b></p>	<ul style="list-style-type: none"> <li>A <i>unit of capacity</i> equal to 1000 millilitres.</li> </ul>	<p>1 litre of milk.</p> 
<p><b>location</b></p>	<ul style="list-style-type: none"> <li>The exact place, where something is situated.</li> </ul>	
<p><b>longest</b></p>	<ul style="list-style-type: none"> <li>Having the biggest <i>length</i>.</li> </ul>	<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><b>loss</b> (money)</p>	<ul style="list-style-type: none"> <li>A reduction in the value of an investment.</li> <li>Expenses &gt; Revenue</li> </ul>	<p>Revenue from a business activity is \$20. If the expenses are \$25 then the loss would be \$5.</p>
<p><b>lowest common denominator</b></p>	<ul style="list-style-type: none"> <li>The <i>lowest common multiple</i> of the <i>denominators</i> of two or more <i>fractions</i>.</li> </ul>	<p>The lowest common denominator of <math>\frac{2}{3}</math> and <math>\frac{4}{5}</math> is the lowest common multiple of 3 and 5, which is 15.</p>
<p><b>lowest common multiple (LCM)</b></p>	<ul style="list-style-type: none"> <li>The smallest of the common <i>multiples</i> of two or more non-zero <i>whole numbers</i>.</li> </ul>	<p>The lowest 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.</p>

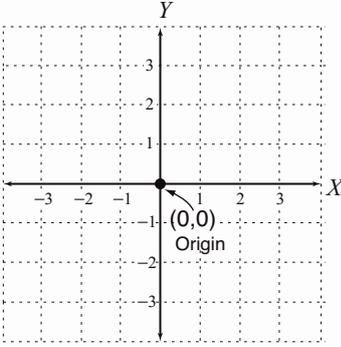
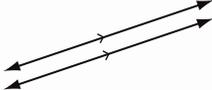
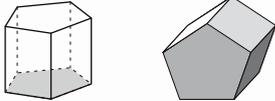
<p><b>magic square</b></p>	<ul style="list-style-type: none"> <li>• A square grid filled with numbers.</li> <li>• The <i>sum</i> of the numbers in every <i>row</i>, <i>column</i> and <i>diagonal</i> is the same.</li> </ul>	<table border="1" style="display: inline-table; vertical-align: top;"> <tr><td>4</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: <math>4 + 9 + 2 = 15</math>  <math>3 + 5 + 7 = 15</math>  <math>8 + 1 + 6 = 15</math></p> <p>Columns: <math>4 + 3 + 8 = 15</math>  <math>9 + 5 + 1 = 15</math>  <math>2 + 7 + 6 = 15</math></p> <p>Diagonals: <math>4 + 5 + 6 = 15</math>  <math>2 + 5 + 8 = 15</math></p>	4	9	2	3	5	7	8	1	6	
4	9	2										
3	5	7										
8	1	6										
<p><b>map</b></p>	<ul style="list-style-type: none"> <li>• A diagram of a region showing its position in the world.</li> </ul>	<p style="text-align: center;"><b>Europe</b></p> 										
<p><b>mass</b></p>	<ul style="list-style-type: none"> <li>• The amount of matter that an object contains. It is measured in <i>units</i> like grams (g) and kilograms (kg). Often called weight, but not the same.</li> </ul>	<p>The mass of the block of butter is 250 g.          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><b>maximum</b></p>	<ul style="list-style-type: none"> <li>• The highest value.</li> </ul>	<p>The maximum speed in a residential area is 60 km per hour.</p> 										
<p><b>mean</b></p>	<ul style="list-style-type: none"> <li>• Or <i>average</i>, is the total of all scores divided by how many scores there are.</li> <li>• To calculate the mean:             <ol style="list-style-type: none"> <li>1) <i>Add</i> up the values.</li> <li>2) <i>Divide</i> the total by the number of values.</li> </ol> </li> </ul>	<table style="border-collapse: collapse;"> <tr><td style="padding-right: 20px;">4</td><td><math>24 \div 4 = 6</math></td></tr> <tr><td>6</td><td>The average</td></tr> <tr><td>5</td><td>or mean of</td></tr> <tr><td><u>+ 9</u></td><td>4, 6, 5 and 9 is 6.</td></tr> <tr><td style="border-top: 1px solid black;">24</td><td></td></tr> </table>	4	$24 \div 4 = 6$	6	The average	5	or mean of	<u>+ 9</u>	4, 6, 5 and 9 is 6.	24	
4	$24 \div 4 = 6$											
6	The average											
5	or mean of											
<u>+ 9</u>	4, 6, 5 and 9 is 6.											
24												
<p><b>median</b></p>	<ul style="list-style-type: none"> <li>• The middle value of an ordered <i>set</i> of values.</li> <li>• If there is an <i>even number</i> of values then the median is the <i>average</i> of the two middle numbers.</li> </ul>	<p>Data: 2, 5, <u>6</u>, 8, 9          Median is 6</p> <p>Data: 2, 3, <u>5</u>, <u>6</u>, 8, 8          Average the two middle values:  <math>5 + 6 = 11</math>  <math>11 \div 2 = 5.5</math>          Median is 5.5</p>										
<p><b>metre (m)</b></p>	<ul style="list-style-type: none"> <li>• A <i>unit of length equal</i> to 100 centimetres.</li> </ul>	<p>Track distances are measured in metres.</p>										
<p><b>millilitre (mL)</b></p>	<ul style="list-style-type: none"> <li>• A <i>unit of capacity</i>.</li> <li>• 1000 millilitres is <i>equal</i> to 1 litre.</li> </ul>	<p>Medicines are measured in mL.</p>										

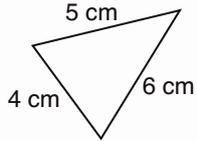
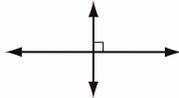
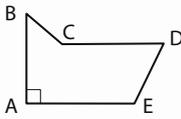
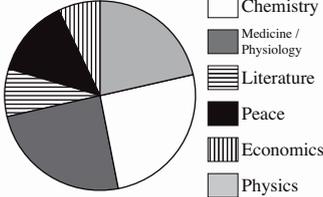
<b>millimetre (mm)</b>	<ul style="list-style-type: none"> <li>• A <i>unit</i> of <i>length</i>.</li> <li>• 1000 millimetres is <i>equal</i> to 1 <i>metre</i>.</li> </ul>	Timber length is measured in millimetres.																																				
<b>million</b>	<ul style="list-style-type: none"> <li>• A thousand thousands.</li> </ul>																																					
<b>minimum</b>	<ul style="list-style-type: none"> <li>• The lowest value.</li> </ul>	The minimum temperature reached yesterday was 10°C.																																				
<b>minus (-)</b>	<ul style="list-style-type: none"> <li>• Another word for <i>subtract</i>. To take away.</li> </ul>	\$20 minus \$5 is \$15. $20 - 5 = 15$																																				
<b>minute (min)</b>	<ul style="list-style-type: none"> <li>• A <i>unit</i> of <i>time</i> <i>equal</i> to 60 <i>seconds</i>.</li> </ul>	One minute has 60 seconds.																																				
<b>mixed number</b>	<ul style="list-style-type: none"> <li>• The <i>sum</i> of a <i>whole number</i> and a <i>fraction</i> less than one.</li> </ul>	$3\frac{5}{7}$ is a mixed number.																																				
<b>mode</b>	<ul style="list-style-type: none"> <li>• The most frequent score in a set of <i>data</i>.</li> </ul>	Data: 2, 3, 5, 7, 7, 7, 8, 8, 9 The mode is 7 as 7 occurs three times.																																				
<b>month</b>	<ul style="list-style-type: none"> <li>• A <i>unit</i> of <i>time</i> <i>equal</i> to 28, 29, 30 or 31 <i>days</i>.</li> </ul>	There are 12 months in a year starting with January. 																																				
<b>morning</b>	<ul style="list-style-type: none"> <li>• The early part of the <i>day</i> ending at 12 noon.</li> </ul>																																					
<b>multiple</b>	<ul style="list-style-type: none"> <li>• A multiple of a <i>whole number</i> is the <i>product</i> of that number with any non-zero whole number.</li> </ul>	The multiples of 2 are 2, 4, 6, 8, 10, ..... $2 \times 1 = 2$ $2 \times 2 = 4$ $2 \times 3 = 6$ etc.																																				
<b>multiple events</b>	<ul style="list-style-type: none"> <li>• 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.</li> </ul>	 <table border="1"> <tr> <td colspan="2" rowspan="2">Possible outcomes</td> <td colspan="6">Die</td> </tr> <tr> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> </tr> <tr> <td rowspan="3">Spinner</td> <td>1</td> <td>(1,1)</td> <td>(1,2)</td> <td>(1,3)</td> <td>(1,4)</td> <td>(1,5)</td> <td>(1,6)</td> </tr> <tr> <td>2</td> <td>(2,1)</td> <td>(2,2)</td> <td>(2,3)</td> <td>(2,4)</td> <td>(2,5)</td> <td>(2,6)</td> </tr> <tr> <td>3</td> <td>(3,1)</td> <td>(3,2)</td> <td>(3,3)</td> <td>(3,4)</td> <td>(3,5)</td> <td>(3,6)</td> </tr> </table>	Possible outcomes		Die						1	2	3	4	5	6	Spinner	1	(1,1)	(1,2)	(1,3)	(1,4)	(1,5)	(1,6)	2	(2,1)	(2,2)	(2,3)	(2,4)	(2,5)	(2,6)	3	(3,1)	(3,2)	(3,3)	(3,4)	(3,5)	(3,6)
Possible outcomes		Die																																				
		1	2	3	4	5	6																															
Spinner	1	(1,1)	(1,2)	(1,3)	(1,4)	(1,5)	(1,6)																															
	2	(2,1)	(2,2)	(2,3)	(2,4)	(2,5)	(2,6)																															
	3	(3,1)	(3,2)	(3,3)	(3,4)	(3,5)	(3,6)																															

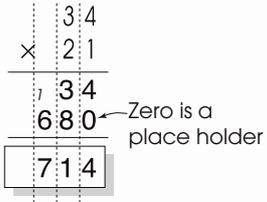
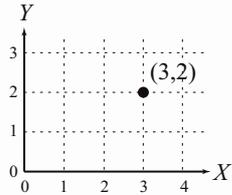
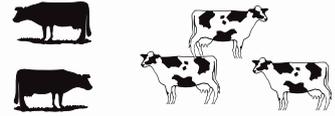
<p><b>multiplication</b></p>	<ul style="list-style-type: none"> <li>• An <i>operation</i> where a number is added to itself a number of times.</li> </ul>	<p><math>2 + 2 + 2 + 2 + 2 = 10</math> or  <math>5 \times 2 = 10</math></p> 
<p><b>multiply (×)</b></p>	<ul style="list-style-type: none"> <li>• To find total in a number of groups.</li> </ul>	<p>Three lots of 2 cows is 6.  <math>3 \times 2 = 6</math> or <math>2 + 2 + 2 = 6</math></p> 
<p><b>natural number (N)</b></p>	<ul style="list-style-type: none"> <li>• A counting number from 1 to <i>infinity</i>.</li> </ul>	<p>1, 2, 3, 4, 5.....∞</p>
<p><b>negative number</b></p>	<ul style="list-style-type: none"> <li>• A number that is <i>less than</i> zero.</li> </ul>	<p>-1, -2, -3, -4, -5, ....          are negative numbers.</p>
<p><b>net</b></p>	<ul style="list-style-type: none"> <li>• The pattern cut out to form a <i>3D</i> shape.</li> </ul>	<p>Possible net of a cube.</p> 
<p><b>ninth</b></p>	<ul style="list-style-type: none"> <li>• The <i>position</i> after <i>eighth</i>.</li> </ul>	<p>1st, 2nd, 3rd, 4th, 5th, 6th,          7th, 8th, <b>9th</b>.....</p>
<p><b>nona</b></p>	<ul style="list-style-type: none"> <li>• Prefix meaning nine.</li> </ul>	<p>See nonagon</p>
<p><b>nonagon</b></p>	<ul style="list-style-type: none"> <li>• A <i>polygon</i> with 9 sides.</li> </ul>	 <p>Nonagon      Regular nonagon</p>
<p><b>north</b></p>	<ul style="list-style-type: none"> <li>• A <i>compass direction</i>.</li> </ul>	
<p><b>north-east</b></p>	<ul style="list-style-type: none"> <li>• A <i>compass direction</i>.</li> </ul>	
<p><b>north-west</b></p>	<ul style="list-style-type: none"> <li>• A <i>compass direction</i>.</li> </ul>	
<p><b>number line</b></p>	<ul style="list-style-type: none"> <li>• An evenly marked <i>line</i> that shows position of numbers.</li> <li>• <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).</li> <li>• Zero represents the <i>origin</i> of a number line.</li> </ul>	

<b>number sentence</b>	<ul style="list-style-type: none"> <li>• A sentence using numbers and operations instead of words.</li> </ul>	<p>"Mary had four cats and two dogs. How many pets did she have?"</p> <p>Number sentence: <math>4 + 2 = 6</math></p>
<b>numeral</b>	<ul style="list-style-type: none"> <li>• A symbol used to represent a number.</li> </ul>	<p>Arabic numerals: 1, 2, 3, 4, 5</p> <p>Roman numerals: I, II, III, IV, V</p>
<b>numerator</b>	<ul style="list-style-type: none"> <li>• The number above the fraction bar in a <i>fraction</i>.</li> <li>• The number of parts that are counted.</li> </ul>	
<b>oblique line</b>	<ul style="list-style-type: none"> <li>• A line at an <i>angle</i> to the horizon.</li> </ul>	
<b>obtuse angle</b>	<ul style="list-style-type: none"> <li>• An <i>angle</i> measuring greater than <math>90^\circ</math> and less than <math>180^\circ</math>.</li> </ul>	
<b>obtuse-angled triangle</b>	<ul style="list-style-type: none"> <li>• A triangle with one <i>angle</i> measuring greater than <math>90^\circ</math> and less than <math>180^\circ</math>.</li> </ul>	
<b>octa</b>	<ul style="list-style-type: none"> <li>• Prefix meaning eight.</li> </ul>	<p>An octopus has 8 legs.</p> 
<b>octagon</b>	<ul style="list-style-type: none"> <li>• A <i>polygon</i> with 8 sides.</li> </ul>	 <p>Octagon                      Regular octagon</p>
<b>octahedron</b>	<ul style="list-style-type: none"> <li>• A <i>solid</i> with eight <i>faces</i>.</li> <li>• A regular octahedron has faces that are all <i>equilateral triangles</i>.</li> </ul>	
<b>odd numbers</b>	<ul style="list-style-type: none"> <li>• A <i>whole number</i> that is not <i>divisible</i> by 2.</li> </ul>	<p>Odd numbers end with 1, 3, 5, 7 or 9.</p>
<b>of</b>	<ul style="list-style-type: none"> <li>• Seen in context like 'a <i>fraction of</i> a number', it means to <i>multiply</i>.</li> </ul>	<p>A quarter of 100 means <math>\frac{1}{4}</math> of 100, or <math>\frac{1}{4} \times 100 = 25</math></p>

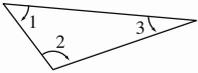
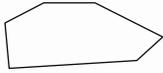
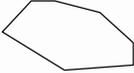
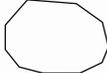
<b>once</b>	<ul style="list-style-type: none"> <li>• On one occasion.</li> </ul>	Just this time!
<b>operation</b>	<ul style="list-style-type: none"> <li>• A mathematical process performed according to certain <i>rules</i>.</li> </ul>	<p>There are four basic operations in arithmetic:</p> <p>addition      <math>3 + 12</math>  subtraction    <math>3 - 1</math>  multiplication   <math>1 \times 5</math>  division        <math>6 \div 3</math></p> <p>There are many complex operations like:  <math>\sin 30^\circ, \sqrt{9}</math> and <math>\log_{10} 100, 5^4</math>.</p>
<b>opposite angles</b>	<ul style="list-style-type: none"> <li>• Angles across from each other in a shape.</li> </ul>	<p>One pair of opposite angles are equal in a kite.</p> 
<b>opposite sides</b>	<ul style="list-style-type: none"> <li>• Sides across from each other in a shape.</li> </ul>	<p>Side <math>\overline{AB}</math> is opposite to side <math>\overline{CD}</math>  Side <math>\overline{AD}</math> is opposite to side <math>\overline{BC}</math></p> 
<b>opposites</b>	<ul style="list-style-type: none"> <li>• Two <i>numbers</i> with the same <i>absolute value</i> but different <i>signs</i>.</li> </ul>	The opposite of +4 is -4.
<b>order</b>	<ul style="list-style-type: none"> <li>• Placing a group in a special arrangement.</li> </ul>	<p>The aliens are arranged in order of height.</p> 
<b>order of operations</b>	<ul style="list-style-type: none"> <li>• The order of doing <i>operations</i> is: <ol style="list-style-type: none"> <li>1) <i>Simplify</i> inside all <i>brackets</i>.</li> <li>2) <i>Evaluate powers</i> and <i>square roots</i>.</li> <li>3) Calculate <math>\times</math> and <math>\div</math> from left to right.</li> <li>4) Calculate <math>+</math> and <math>-</math> from left to right.</li> </ol> </li> </ul>	<p>Calculate <math>4 + 3^2 \times (6 - 2)</math> by</p> <ol style="list-style-type: none"> <li>1) <math>4 + 3^2 \times (6 - 2)</math></li> <li>2) <math>= 4 + 3^2 \times 4</math></li> <li>3) <math>= 4 + 9 \times 4</math></li> <li>4) <math>= 4 + 36</math> <math>= 40</math></li> </ol>
<b>ordered pair</b>	<ul style="list-style-type: none"> <li>• See <i>coordinates</i>.</li> </ul>	
<b>ordinal numbers</b>	<ul style="list-style-type: none"> <li>• A <i>whole number</i> that shows position.</li> </ul>	1st, 2nd, 3rd, 4th, 5th..... are ordinal numbers.
<b>orientation</b>	<ul style="list-style-type: none"> <li>• Position relative to <i>direction</i>.</li> </ul>	<p>The tornado is coming from the west.</p> 

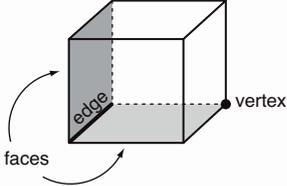
<p><b>origin</b></p>	<ul style="list-style-type: none"> <li>The point of <i>coordinates</i> (0,0) on a <i>coordinate plane</i>.</li> </ul>	
<p><b>outcome</b></p>	<ul style="list-style-type: none"> <li>Result of an event.</li> </ul>	<p>The outcome (result) of tossing a coin was to turn up a head.</p>
<p><b>pair</b></p>	<ul style="list-style-type: none"> <li>Two together.</li> </ul>	
<p><b>palindrome</b></p>	<ul style="list-style-type: none"> <li>A number with 2 or more digits that reads the same <i>forwards</i> and <i>backwards</i>.</li> </ul>	<p>44 or 6116 are palindromic numbers.</p>
<p><b>parallel lines</b></p>	<ul style="list-style-type: none"> <li><i>Lines</i> in the same <i>plane</i> that never cross over. They are marked with matching arrows.</li> </ul>	
<p><b>parallelogram</b></p>	<ul style="list-style-type: none"> <li>A special <i>quadrilateral</i>. <i>Opposite sides are parallel lines.</i> <i>Opposite sides are equal in length.</i></li> </ul>	
<p><b>pattern</b></p>	<ul style="list-style-type: none"> <li>Numbers or objects that are arranged following a <i>rule</i>.</li> </ul>	
<p><b>penta</b></p>	<ul style="list-style-type: none"> <li>Prefix meaning five.</li> </ul>	<p>See <i>pentagon</i></p>
<p><b>pentagon</b></p>	<ul style="list-style-type: none"> <li>A <i>polygon</i> with 5 sides.</li> </ul>	 <p>Pentagon      Regular pentagon</p>
<p><b>pentagonal prism</b></p>	<ul style="list-style-type: none"> <li>A <i>three-dimensional</i> shape. Two identical, <i>parallel bases</i> are <i>pentagons</i>. Five <i>faces</i> are <i>rectangles</i>.</li> </ul>	
<p><b>pentagonal pyramid</b></p>	<ul style="list-style-type: none"> <li>A <i>three-dimensional</i> shape. <i>Base</i> is a <i>pentagon</i>. Five <i>faces</i> are <i>triangles</i>.</li> </ul>	

<b>per</b>	<ul style="list-style-type: none"> <li>• For each.</li> <li>• Can be written as a forward slash (/).</li> </ul>	20 kilometres per hour or 20 km/h means 20 kilometres travelled for each hour.						
<b>percentage</b>	<ul style="list-style-type: none"> <li>• Out of 100.</li> <li>• ‘Per’ means for each, ‘cent’ means 100.</li> </ul>	$59\% = \frac{59}{100} = 0.59$						
<b>perfect square</b>	<ul style="list-style-type: none"> <li>• Any number that is the result of multiplying two <i>rational numbers</i> together.</li> </ul>	0, 1, 4, 9, 16, 25, $\frac{1}{25}$ , $\frac{4}{9}$ etc. are all perfect squares.						
<b>perimeter</b>	<ul style="list-style-type: none"> <li>• The <i>distance</i> around the outside of a <i>shape</i>.</li> </ul>	<p>Add the length of all sides. Perimeter = 4 + 5 + 6 = 15 cm</p> 						
<b>perpendicular lines</b>	<ul style="list-style-type: none"> <li>• Lines on a <i>plane</i> that <i>intersect</i> to form a <i>right angle</i>.</li> </ul>							
<b>perpendicular sides</b>	<ul style="list-style-type: none"> <li>• Sides on a <i>shape</i> that are at <i>right angles</i> to each other.</li> </ul>	<p><math>\overline{AB}</math> is perpendicular to <math>\overline{AE}</math>.</p> 						
<b>perspective</b>	<ul style="list-style-type: none"> <li>• The appearance of objects affected by size and <i>position</i>.</li> </ul>							
<b>pi (<math>\pi</math>)</b>	<ul style="list-style-type: none"> <li>• The <i>ratio</i> of the <i>circumference</i> of a <i>circle</i> to its <i>diameter</i>.</li> </ul> <p>The diameter of a circle wraps around the circle approximately 3.14 times.</p>	<p>3.14 or <math>\frac{22}{7}</math> is the approximate value of <math>\pi</math>. Pi is an infinite number. <math>\pi = 3.14159\ 26535\ 89793\dots</math></p>						
<b>pictograph</b>	<ul style="list-style-type: none"> <li>• A <i>graph</i> that uses pictures or symbols to represent <i>data</i>.</li> </ul>	<p><b>Toy Sales in Winter</b>  = 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.								
<b>pie graph</b>	<ul style="list-style-type: none"> <li>• A <i>graph</i> that represents <i>data</i> as a <i>sector</i> of a <i>circle</i>.</li> </ul>	<p><b>Nobel Prizes Won by the UK up to 2004 (Total of 98)</b></p>  <ul style="list-style-type: none"> <li>Chemistry</li> <li>Medicine / Physiology</li> <li>Literature</li> <li>Peace</li> <li>Economics</li> <li>Physics</li> </ul>						

<p><b>place holder</b></p>	<ul style="list-style-type: none"> <li>Minds a spot in a number.</li> </ul>	<p>Zeros are used as place holders in long multiplication algorithms.</p> 																						
<p><b>place value</b></p>	<ul style="list-style-type: none"> <li>Value according to position in a number.</li> </ul>	<p>954 5 is in the tens place 5 has a value of 50.</p> <table border="1" data-bbox="331 584 1476 739"> <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>1 000</td> <td>100</td> <td>10</td> <td>1</td> <td>•</td> <td><math>\frac{1}{10}</math></td> <td><math>\frac{1}{100}</math></td> <td><math>\frac{1}{1000}</math></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	1 000	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	1 000	100	10	1	•	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$														
<p><b>plane</b></p>	<ul style="list-style-type: none"> <li>A flat surface.</li> </ul>																							
<p><b>plot</b></p>	<ul style="list-style-type: none"> <li>To mark a <i>point</i> on a <i>coordinate plane</i>.</li> </ul>	<p>The point of coordinate (3,2)</p> 																						
<p><b>plus (+)</b></p>	<ul style="list-style-type: none"> <li>Another word for <i>addition</i>. To add.</li> </ul>	<p>2 cows plus 3 cows gives you 5 cows.</p> <p><math>2 + 3 = 5</math></p> 																						
<p><b>pm</b> (post meridiem)</p>	<ul style="list-style-type: none"> <li>The <i>time</i> from midday to midnight.</li> </ul>	<p>Every night Jimmy starts reading at 9 pm.</p> 																						
<p><b>point</b></p>	<ul style="list-style-type: none"> <li>A position in space represented by a dot.</li> </ul>																							

<b>polygon</b>	<ul style="list-style-type: none"> <li>A closed <i>two-dimensional</i> shape for which all sides are line segments.</li> <li>3 or more <i>sides</i> and <i>angles</i>.</li> </ul>	'Poly' means many and 'gon' means angle. Example: A triangle has 3 angles.
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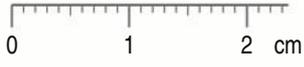
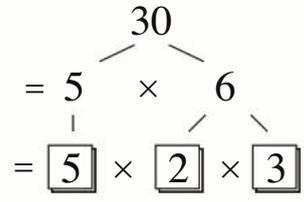
<b>polygon</b> (many angles)	<b>regular polygon</b> (all sides and all angles are equal)	Number of Sides	Number of Interior angles
<u>Triangle</u> 3 angles 	Equilateral triangle 	3	3
<u>Quadrilateral</u> 4 angles 	Square 	4	4
<u>Pentagon</u> 5 angles 	Regular pentagon 	5	5
<u>Hexagon</u> 6 angles 	Regular hexagon 	6	6
<u>Heptagon</u> 7 angles 	Regular heptagon 	7	7
<u>Octagon</u> 8 angles 	Regular octagon 	8	8
<u>Nonagon</u> 9 angles 	Regular nonagon 	9	9
<u>Decagon</u> 10 angles 	Regular decagon 	10	10

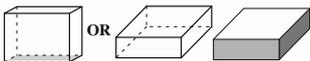
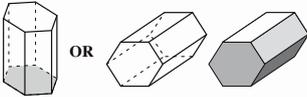
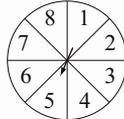
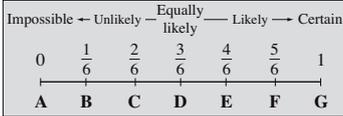
<b>polyhedron</b>	<ul style="list-style-type: none"> <li>A <i>three-dimensional</i> shape.</li> <li>Four or more <i>faces</i>.</li> <li>Described by their <i>faces</i>, <i>edges</i> and <i>vertices</i>.</li> </ul>	'Poly' means many and 'hedron' means faces. Example: A hexahedron has 6 faces. 
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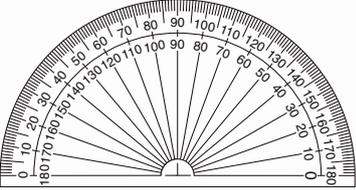
<b>population</b>	<ul style="list-style-type: none"> <li>The entire group under consideration in a statistical analysis.</li> </ul>	The population of a country is every person who lives in that country.
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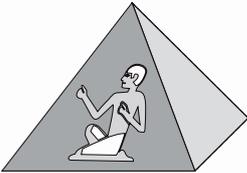
<b>position</b>	<ul style="list-style-type: none"> <li>Where something is in relation to things around it.</li> </ul>	In, on, under, behind, next to.
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<b>positive numbers</b>	<ul style="list-style-type: none"> <li>A number that is <i>greater than zero</i>.</li> </ul>	+1, +2, +3, +4, +5, ..... are positive numbers.
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<b>possible outcomes</b>	<ul style="list-style-type: none"> <li>The total number of result options.</li> </ul>	When you toss a coin there are 2 possible results: heads or tails.
<b>power</b>	<ul style="list-style-type: none"> <li>An <i>expression</i>, such as <math>4^3</math>, in which the base (4) is <i>multiplied</i> by itself a number of times equal to the <i>index</i> (3).</li> </ul>	$4^3$ or 4 to the power of 3 is $4 \times 4 \times 4 = 64$
<b>precision of an instrument</b>	<ul style="list-style-type: none"> <li>Considered to be the size of the smallest <i>unit</i> on the <i>scale</i> of the instrument.</li> </ul>	The ruler has a precision of 0.1 cm. 
<b>previous</b>	<ul style="list-style-type: none"> <li>The one before.</li> </ul>	If the current year is 2011, the previous year was 2010.
<b>prime factor</b>	<ul style="list-style-type: none"> <li>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.</li> </ul>	The prime factors of 30 are 2, 3 and 5. 
<b>prime factorisation</b>	<ul style="list-style-type: none"> <li>Writing a <i>whole number</i> as the <i>product</i> of its <i>prime factors</i>.</li> </ul>	Prime factorisation of 30: $30 = 2 \times 3 \times 5$
<b>prime number</b>	<ul style="list-style-type: none"> <li>A <i>whole number</i> that has exactly two <i>factors</i>, 1 and itself.</li> <li>1 is not a prime number.</li> </ul>	59 is a prime number as its only factors are 1 and 59.  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.

<b>prism</b>	<ul style="list-style-type: none"> <li>• A <i>three-dimensional</i> shape.</li> <li>Two <i>parallel bases</i> are the same.</li> </ul>				
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	
<b>probability</b>	<ul style="list-style-type: none"> <li>• The likelihood that an event will happen, measured as a <i>fraction</i> of the total of possible outcomes.</li> <li>See <i>chance</i>.</li> </ul>				The probability of spinning the number 5 is $\frac{1}{8}$ . 
<b>probability scale</b>	<ul style="list-style-type: none"> <li>• A measure, from 0 (no chance) to 1 (will happen), of the likelihood of an event occurring.</li> </ul>				
<b>product</b>	<ul style="list-style-type: none"> <li>• The result when two or more numbers are <i>multiplied</i>.</li> </ul>				The product of 4 and 5 is 20: $4 \times 5 = 5 \times 4 = 20$
<b>profit</b> (money)	<ul style="list-style-type: none"> <li>• What is gained, less any <i>expenses</i>.</li> <li>Profit = Revenue – Expense.</li> </ul>				Revenue from a business activity is \$20. If the expenses are \$15 then the profit would be \$5.
<b>proper fraction</b>	<ul style="list-style-type: none"> <li>• Any <i>fraction</i> in which the <i>numerator</i> is <i>less than</i> the <i>denominator</i>.</li> </ul>				$\frac{5}{8}$ the numerator is 5 the denominator is 8. $5 < 8$ so $\frac{5}{8}$ is a proper fraction. 
<b>proportion</b>	<ul style="list-style-type: none"> <li>• A comparative <i>ratio</i>, showing that two ratios are equivalent.</li> </ul>				$\frac{2}{3} = \frac{6}{9}$ is a proportion. 2 : 3 is the same ratio as 6 : 9 2 : 3 is in proportion with 6 : 9

<b>protractor</b>	<ul style="list-style-type: none"> <li>• A <i>semi-circular</i> tool used to measure <i>degrees</i>. There are 180° on a protractor.</li> </ul>	
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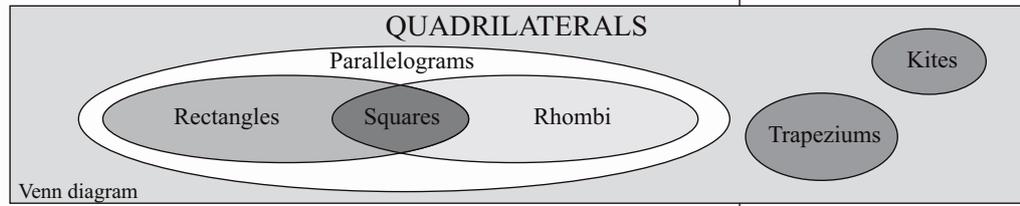
<b>pyramid</b>	<ul style="list-style-type: none"> <li>• A <i>three-dimensional</i> shape. One <i>base</i> is a <i>polygon</i>. All other <i>faces</i> are <i>triangles</i> that meet at one point called <i>vertex</i>. A pyramid is named for the shape of its base.</li> </ul>	
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<b>pyramid</b>	Properties	Number of			Examples
		Faces	Edges	Vertices	
Triangular Pyramid	Base is a triangle Lateral faces are triangles	4	6	4	
Square Pyramid	Base is a square Lateral faces are triangles	5	8	5	
Rectangular Pyramid	Base is a rectangle Lateral faces are triangles	5	8	5	
Pentagonal Pyramid	Base is a pentagon Lateral faces are triangles	6	10	6	
Hexagonal Pyramid	Base is a hexagon Lateral faces are triangles	7	12	7	

**quadrilateral**

- A *polygon* with 4 *sides*.

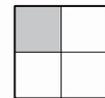
'Quad' means 4 and 'lateral' means side.



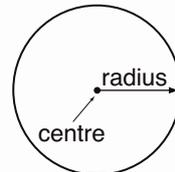
quadrilateral	Sides	Interior angles	Diagonals	Axes of symmetry	Diagram
Square	4 sides of equal length	4 right angles	2 diagonals equal in length and bisecting at right angles	4	
Rectangle	Opposite sides of equal length	4 right angles	2 diagonals equal in length and bisecting each other	2	
Trapezium	2 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	

**quarter**

- One of four *equal* parts of a group or object.
- Written as the *fraction*  $\frac{1}{4}$ .

**radius of a circle**

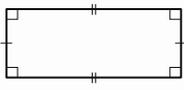
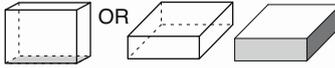
- (pl. **radii**) The distance from the *centre* to any *point* on the *circle*.

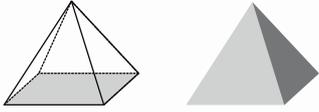
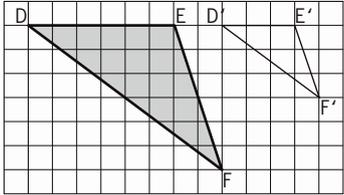
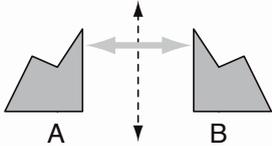
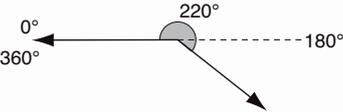
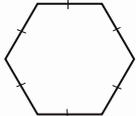
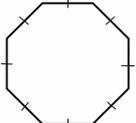
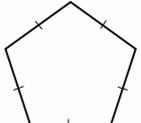
**random sample**

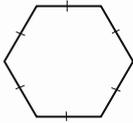
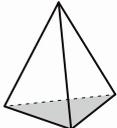
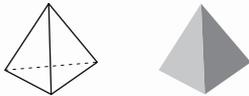
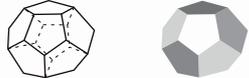
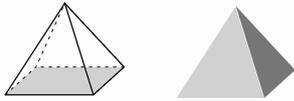
- A selection taken from a group without method or conscious choice.

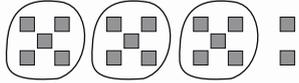
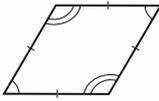
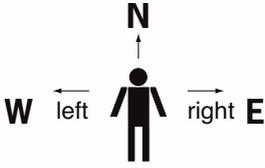
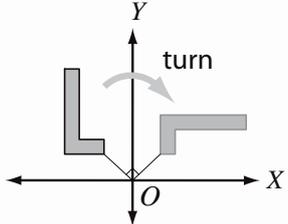
Drawing out of a hat is a random selection.

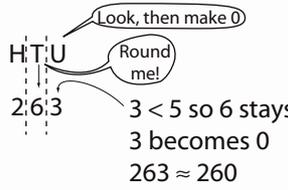
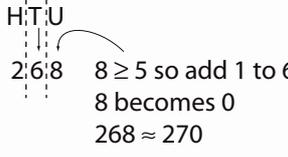
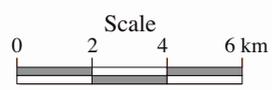


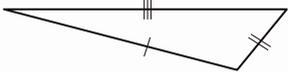
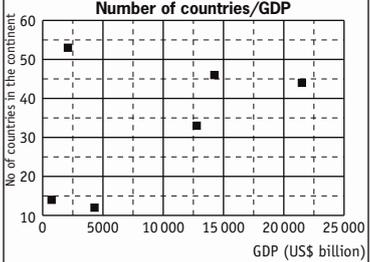
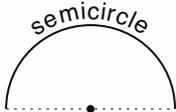
<b>range</b>	<ul style="list-style-type: none"> <li>The <i>difference</i> between the greatest and the smallest value.</li> </ul>	For the data: 21, 24, 25, 27, 27 and 28 the range is $28 - 21 = 7$			
<b>rate</b>	<ul style="list-style-type: none"> <li>The <i>ratio</i> of two measures that have different <i>units</i>.</li> </ul>	When running, calories burn at a rate of 14 cal/min.			
<b>ratio</b>	<ul style="list-style-type: none"> <li>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: <math>\frac{a}{b}</math>, <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 litres.</li> </ul>	<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>			
<b>ratio scale</b>	<ul style="list-style-type: none"> <li>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).</li> </ul>	<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>			
<b>rational number (Q)</b>	<ul style="list-style-type: none"> <li>All <i>positive</i> and <i>negative</i> fractions, including <i>integers</i> and <i>improper</i> fractions.</li> <li>Not an <i>irrational</i> number.</li> </ul>	$-2\frac{3}{7}$ , 3.010101..., $\frac{4}{10}$ , 0.56, $\sqrt{\frac{4}{9}}$			
<b>real number (R)</b>	<ul style="list-style-type: none"> <li>Any number on the <i>number line</i>.</li> <li>Includes all <i>rational</i> and <i>irrational</i> numbers.</li> </ul> <p style="text-align: center;"><b>R REAL NUMBERS</b></p>				
<div style="border: 1px solid black; padding: 10px; border-radius: 15px;"> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%; padding: 5px;"> <p style="text-align: center;">Q</p> <p style="text-align: center;">RATIONAL</p> <p style="text-align: center;"><math>-2\frac{3}{7}</math>, 3.010101..., <math>\frac{4}{10}</math>, 0.56, <math>\sqrt{\frac{4}{9}}</math></p> </td> <td style="width: 25%; padding: 5px;"> <p style="text-align: center;">Z</p> <p style="text-align: center;">INTEGERS</p> <p style="text-align: center;">..., -3, -2, -1, 0, 1, 2, 3, ...</p> </td> <td style="width: 50%; padding: 5px; border: 1px solid black; border-radius: 10px;"> <p style="text-align: center;">N</p> <p style="text-align: center;">NATURAL (Whole Numbers)</p> <p style="text-align: center;">0, 1, 2, 3, 4, 5, 6, ....</p> </td> </tr> </table> </div>			<p style="text-align: center;">Q</p> <p style="text-align: center;">RATIONAL</p> <p style="text-align: center;"><math>-2\frac{3}{7}</math>, 3.010101..., <math>\frac{4}{10}</math>, 0.56, <math>\sqrt{\frac{4}{9}}</math></p>	<p style="text-align: center;">Z</p> <p style="text-align: center;">INTEGERS</p> <p style="text-align: center;">..., -3, -2, -1, 0, 1, 2, 3, ...</p>	<p style="text-align: center;">N</p> <p style="text-align: center;">NATURAL (Whole Numbers)</p> <p style="text-align: center;">0, 1, 2, 3, 4, 5, 6, ....</p>
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<b>reciprocal</b>	<ul style="list-style-type: none"> <li>One of two numbers whose <i>product</i> is 1.</li> <li>Also called the multiplicative <i>inverse</i>.</li> </ul>	<p>The reciprocal of <math>\frac{3}{5}</math> is <math>\frac{5}{3}</math>.</p> $\frac{3}{5} \times \frac{5}{3} = 1$			
<b>rectangle</b>	<ul style="list-style-type: none"> <li>A special <i>parallelogram</i>.</li> <li>Four <i>right</i> angles.</li> </ul>				
<b>rectangular prism</b>	<ul style="list-style-type: none"> <li>A <i>three-dimensional</i> shape.</li> <li>Six rectangular faces.</li> </ul>				

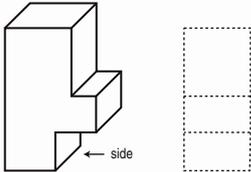
<b>rectangular pyramid</b>	<ul style="list-style-type: none"> <li>• A <i>three-dimensional</i> shape.</li> <li>One <i>rectangular base</i>.</li> <li>All the other <i>faces</i> are <i>triangles</i>.</li> </ul>	
<b>recurring decimal</b>	<ul style="list-style-type: none"> <li>• A <i>decimal</i> that has a repeating <i>digit</i> or a repeating pattern of digits.</li> <li>• A repeating digit/s is marked with a dot (•) or a bar (—).</li> </ul>	$\frac{2}{9} = 0.22222222 = 0.\dot{2}$ $\frac{1}{6} = 0.16666666 = 0.1\dot{6}$ <p>are repeating decimals, where 2 and 6 are the repeating digits respectively.</p> $\frac{1}{11} = 0.09090909 = 0.0\overline{09}$ <p>is a repeating decimal, where 09 is the repeating pattern of digits.</p>
<b>reduction</b>	<ul style="list-style-type: none"> <li>• Make smaller or decrease.</li> </ul>	<p><math>\triangle DEF</math> was reduced to <math>\triangle D'E'F'</math> by a scale factor of 2.</p> 
<b>reflection</b>	<ul style="list-style-type: none"> <li>• 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>.</li> </ul>	<p>Shape B is a reflection of shape A.</p> 
<b>reflex angle</b>	<ul style="list-style-type: none"> <li>• An <i>angle</i> measuring greater than <math>180^\circ</math> and less than <math>360^\circ</math>.</li> </ul>	
<b>regular hexagon</b>	<ul style="list-style-type: none"> <li>• A <i>polygon</i> with six sides of equal length and six equal angles.</li> </ul>	 <p>Regular hexagon</p>
<b>regular octagon</b>	<ul style="list-style-type: none"> <li>• A <i>polygon</i> with eight sides of equal length and eight equal angles.</li> </ul>	 <p>Regular octagon</p>
<b>regular pentagon</b>	<ul style="list-style-type: none"> <li>• A <i>polygon</i> with five sides of equal length and five equal angles.</li> </ul>	 <p>Regular pentagon</p>

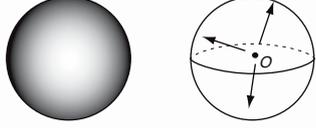
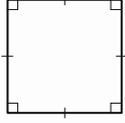
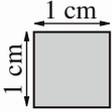
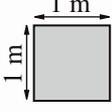
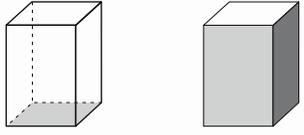
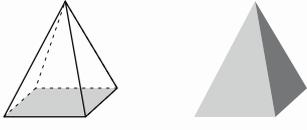
<b>regular polygon</b>	<ul style="list-style-type: none"> <li>A shape with all <i>sides</i> and all <i>angles equal</i>.</li> </ul>	<p>A regular hexagon has 6 equal sides and 6 equal angles.</p>  <p>Regular hexagon</p>			
<b>regular prism</b>	<ul style="list-style-type: none"> <li>A <i>three-dimensional</i> shape with <i>bases</i> that are <i>regular polygons</i> and all the other faces that are rectangles.</li> </ul>	<p>A regular hexagonal prism has regular hexagons as its bases.</p>			
<b>regular pyramid</b>	<ul style="list-style-type: none"> <li>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.</li> </ul>	<p>This regular triangular pyramid has an equilateral triangle as its base.</p> 			
<b>regular solid</b>	<ul style="list-style-type: none"> <li>A <i>three-dimensional</i> shape that encloses a part of space, with all faces being <i>regular polygons</i>.</li> </ul>				
<b>regular solid</b>	Properties All faces are regular polygons	In any polyhedron: $E = F + V - 2$			Examples
		Faces	Edges	Vertices	
Tetrahedron	All faces are equilateral triangles	4	6	4	
Hexahedron	All faces are squares	6	12	8	
Octahedron	All faces are equilateral triangles	8	12	6	
Dodecahedron	All faces are regular pentagons	12	30	20	
Icosahedron	All faces are equilateral triangles	20	38	20	
<b>regular square pyramid</b>	<ul style="list-style-type: none"> <li>A <i>pyramid</i> whose <i>base</i> is a <i>square</i> and whose <i>height</i> intersects the base at its centre.</li> <li>All 4 <i>slant heights</i> and 4 vertical edges are congruent.</li> </ul>				
<b>regular tetrahedron</b>	<ul style="list-style-type: none"> <li>A <i>triangular pyramid</i> whose four <i>faces</i> are equal <i>equilateral triangles</i>.</li> </ul>				

<p><b>remainder</b></p>	<ul style="list-style-type: none"> <li>The amount left over when one number cannot be <i>divided</i> exactly by another.</li> </ul>	<p><math>17 \div 5 = 3</math> with 2 remainder.</p> 
<p><b>reversible</b></p>	<ul style="list-style-type: none"> <li>Able to be turned in the <i>opposite</i> way.</li> </ul>	<p>The process of freezing the water is reversible: water → ice → water</p>
<p><b>revolution</b></p>	<ul style="list-style-type: none"> <li>A complete turn.</li> <li>An <i>angle</i> measuring <math>360^\circ</math>.</li> </ul>	
<p><b>rhombus</b></p>	<ul style="list-style-type: none"> <li>(pl. <b>rhombi</b>) A special <i>parallelogram</i>.</li> <li>Four <i>equal</i> sides.</li> <li><i>Opposite angles equal</i>.</li> </ul>	
<p><b>right</b></p>	<ul style="list-style-type: none"> <li>The <i>direction</i> to the <i>east</i> of your body if you are facing <i>north</i>.</li> </ul>	
<p><b>right angle</b></p>	<ul style="list-style-type: none"> <li>An <i>angle</i> measuring exactly <math>90^\circ</math>.</li> <li>It is marked with a corner.</li> </ul>	
<p><b>right-angled triangle</b></p>	<ul style="list-style-type: none"> <li>A <i>triangle</i> with one <i>right angle</i>.</li> </ul>	
<p><b>Roman numerals</b></p>	<ul style="list-style-type: none"> <li>Number system invented by the ancient Romans.</li> </ul>	<p>I = 1      V = 5      X = 10 L = 50    C = 100    D = 500 M = 1000</p>
<p><b>rotation</b></p>	<ul style="list-style-type: none"> <li>A movement that turns a shape about a fixed <i>point</i> (the centre of rotation) by a given <i>angle</i> (the angle of rotation).</li> </ul>	<p>The centre of rotation is the origin <i>O</i> and the angle of rotation is <math>90^\circ</math>.</p> 
<p><b>rotational symmetry</b></p>	<ul style="list-style-type: none"> <li>A shape has rotational symmetry if a <i>rotation</i> of <math>180^\circ</math> or less produces an image that fits exactly on the original shape.</li> </ul>	<p>This shape has rotational symmetry, because after a rotation of <math>120^\circ</math> it looks identical to the original.</p> 

<p><b>round</b></p>	<ul style="list-style-type: none"> <li>To <i>approximate</i> a number to a given <i>place value</i>.</li> </ul> <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.</p> <p>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><b>row of a table</b></p>	<ul style="list-style-type: none"> <li>A <i>horizontal</i> line of <i>data</i> in a table.</li> </ul>	<p><b>Medal Tally - Beijing Olympics 2008</b></p> <table border="1" data-bbox="1212 593 1532 817"> <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><b>rule</b></p>	<ul style="list-style-type: none"> <li>A relationship or correspondence in which values of one <i>variable</i> determine the values of another: <math>y = \text{rule}</math>.</li> </ul>	<p><math>y = x^2 - 4</math></p> <p>See <i>linear rule</i>.</p>																												
<p><b>sample</b></p>	<ul style="list-style-type: none"> <li>A selection taken from a group or <i>population</i>.</li> </ul>	<p>See <i>random sample</i>.</p>																												
<p><b>sample space</b></p>	<ul style="list-style-type: none"> <li>The <i>set</i> of all possible <i>outcomes</i> of an <i>experiment</i>.</li> </ul>	<p>A coin is flipped - Sample space = {HH, HT, TH,</p> <table border="1" data-bbox="1189 1243 1532 1433"> <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><b>scale</b></p>	<ul style="list-style-type: none"> <li>A key on a <i>scale drawing</i>/map that tells how the drawing's <i>dimensions</i> and life size dimensions are related.</li> </ul> <p>Can be written as:</p> <ol style="list-style-type: none"> <li>A <i>ratio scale</i> with the first number referring to the map distance and the second number referring to the real distance.</li> </ol> <p>OR</p> <ol style="list-style-type: none"> <li>A <i>linear scale</i> with a set of marks on a line.</li> </ol>	<p>On a map with a ratio scale of 1 : 10000 1 cm represents 10000 cm or 100 m. Every centimetre 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><b>scale drawing</b></p>	<ul style="list-style-type: none"> <li>Changing the size of an object but not the shape.</li> </ul>	<p>A life size staple. </p> <p>The staple scaled by 50%. </p>																												

<p><b>scale factor</b></p>	<ul style="list-style-type: none"> <li>The amount used to <i>enlarge</i>, <i>reduce</i> or find the original size of an object.</li> </ul>	<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 <math>\frac{2}{1}</math>.</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 <math>\frac{1}{2}</math>.</p>
<p><b>scalene triangle</b></p>	<ul style="list-style-type: none"> <li>A <i>triangle</i> in which all three sides are a different length.</li> </ul>	
<p><b>scatter plot</b></p>	<ul style="list-style-type: none"> <li>A <i>graph</i> in which two sets of data are plotted as ordered pairs in a <i>coordinate plane</i>.</li> </ul>	<p>Continental facts (no Antarctica) Number of countries/GDP</p> 
<p><b>second (s)</b></p>	<ul style="list-style-type: none"> <li>A very short unit of <i>time</i>.</li> </ul>	<p>There are 60 seconds in 1 minute.</p>
<p><b>second</b></p>	<ul style="list-style-type: none"> <li>The <i>position</i> after <i>first</i>.</li> </ul>	<p>1st, <b>2nd</b>.....</p>
<p><b>segment</b></p>	<ul style="list-style-type: none"> <li>Two <i>points</i> and all points on the <i>line</i> between the two points. Part of a line.</li> </ul>	<p>Segment <math>\overline{AB}</math></p> 
<p><b>semicircle</b></p>	<ul style="list-style-type: none"> <li>Half of a circle.</li> </ul>	
<p><b>sequence of numbers</b></p>	<ul style="list-style-type: none"> <li>A list of numbers that follows a certain <i>rule</i>. Each number is called a <i>term</i>.</li> </ul>	<p>35, 30, 25, 20, ... In this sequence of numbers, the next three are 15, 10 and 5.</p>
<p><b>seventh</b></p>	<ul style="list-style-type: none"> <li>The <i>position</i> after <i>sixth</i>.</li> </ul>	<p>1st, 2nd, 3rd, 4th, 5th, 6th, <b>7th</b>.....</p>
<p><b>shortest</b></p>	<ul style="list-style-type: none"> <li>Having the smallest <i>length</i>.</li> </ul>	<p>Sam is the shortest in the class.</p>
<p><b>side</b></p>	<ul style="list-style-type: none"> <li>One of the lines that form a <i>polygon</i>.</li> </ul>	

<p><b>side view</b></p>	<ul style="list-style-type: none"> <li>• What you see of an object looking from a <i>side perspective</i>.</li> <li>• <i>Three-dimensional</i> objects have 3 views: front, top and side.</li> </ul>	
<p><b>sign</b></p>	<ul style="list-style-type: none"> <li>• 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.</li> </ul>	<p>+</p> positive sign <p>-</p> negative sign
<p><b>similar shapes</b></p>	<ul style="list-style-type: none"> <li>• Shapes that are identical but not necessarily in size.</li> </ul>	<p>These stars are similar.</p> 
<p><b>simplest form of a fraction</b></p>	<ul style="list-style-type: none"> <li>• 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.</li> </ul>	<p>The simplest form of <math>\frac{6}{9}</math> is <math>\frac{2}{3}</math>          (Divide 6 and 9 by 3.          2 and 3 can only be divided by 1 so they cannot be reduced.)</p>
<p><b>simplify</b></p>	<ul style="list-style-type: none"> <li>• To reduce to the <i>simplest form</i>.</li> </ul>	<p>To simplify the ratio 14 : 6 divide both sides by 2.          14 : 6 simplified is 7 : 3.</p>
<p><b>sixth</b></p>	<ul style="list-style-type: none"> <li>• The <i>position</i> after <i>fifth</i>.</li> </ul>	<p>1st, 2nd, 3rd, 4th, 5th, <b>6th</b>.....</p>
<p><b>size</b></p>	<ul style="list-style-type: none"> <li>• How big an object is.</li> </ul>	<p>The size of the wave is 2 m.</p> 
<p><b>slide</b></p>	<ul style="list-style-type: none"> <li>• Move without changing <i>direction</i>. See <i>translation</i>.</li> </ul>	
<p><b>smallest to largest</b></p>	<ul style="list-style-type: none"> <li>• Ranking in order from the <i>littlest</i> to the <i>biggest</i>.</li> </ul>	
<p><b>solid</b></p>	<ul style="list-style-type: none"> <li>• A <i>three-dimensional</i> shape that encloses a part of space.</li> </ul>	
<p><b>south</b></p>	<ul style="list-style-type: none"> <li>• A <i>compass direction</i>.</li> </ul>	
<p><b>south-east</b></p>	<ul style="list-style-type: none"> <li>• A <i>compass direction</i>.</li> </ul>	

<p><b>south-west</b></p>	<ul style="list-style-type: none"> <li>• A <i>compass direction</i>.</li> </ul>	
<p><b>speed</b></p>	<ul style="list-style-type: none"> <li>• The <i>rate</i> at which an object moves. Speed is worked out by dividing the distance traveled by the time taken.</li> <li>We call this average speed <math>v = \frac{d}{t}</math></li> </ul>	<p>The average speed for a car which travels 150 km in 3 hours is:</p> $v = \frac{\text{distance}}{\text{time}} = \frac{150}{3} = 50 \text{ km/h}$
<p><b>sphere</b></p>	<ul style="list-style-type: none"> <li>• A <i>set of points</i> in space of equal distance from the central point.</li> </ul>	
<p><b>square</b></p>	<ul style="list-style-type: none"> <li>• A <i>rectangle</i> with all <i>sides</i> of equal length.</li> </ul>	
<p><b>square centimetre (cm<sup>2</sup>)</b></p>	<ul style="list-style-type: none"> <li>• A <i>unit of area</i> equal to 1 <i>centimetre</i> by 1 centimetre.</li> </ul>	
<p><b>square metre (m<sup>2</sup>)</b></p>	<ul style="list-style-type: none"> <li>• A <i>unit of area</i> equal to 1 <i>metre</i> by 1 metre.</li> </ul>	
<p><b>square number</b></p>	<ul style="list-style-type: none"> <li>• A number that results from multiplying another number by itself.</li> </ul>	<p>9, 6.25 and <math>\frac{4}{9}</math> are all square numbers.</p> $9 = 3 \times 3$ $6.25 = 2.5 \times 2.5$ $\frac{4}{9} = \frac{2}{3} \times \frac{2}{3}$
<p><b>square prism</b></p>	<ul style="list-style-type: none"> <li>• A <i>three-dimensional</i> shape. Two identical square <i>bases</i>. All the other faces are <i>rectangles</i>.</li> </ul>	
<p><b>square pyramid</b></p>	<ul style="list-style-type: none"> <li>• A <i>three-dimensional</i> shape. One square <i>base</i>. All the other faces are <i>triangles</i>.</li> </ul>	
<p><b>square root of a number (<math>\sqrt{\quad}</math>)</b></p>	<ul style="list-style-type: none"> <li>• A <i>number</i> which, when <i>multiplied</i> by itself, gives the original number. Finding the square root of a number is the <i>inverse operation</i> of squaring that number.</li> </ul>	$\sqrt{900} = 30$ <p>Square root of 900 is 30, because</p> $30 \times 30 = 900 \text{ or } 30^2 = 900$

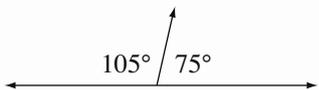
<b>square units</b>	<ul style="list-style-type: none"> <li>A <i>unit</i> of <i>area</i> equal to the area of a square with side lengths of 1 unit.</li> </ul>	$A = lw$ $= 3 \times 2$ $= 6$  2 units 3 units Area = 6 square units
<b>squared</b>	<ul style="list-style-type: none"> <li>Multiplied by itself.</li> <li>A number raised to the second <i>power</i>.</li> </ul>	4 squared is written as $4^2$ $4^2 = 4 \times 4 = 16$
<b>statistics</b>	<ul style="list-style-type: none"> <li>Numerical facts systematically collected, organised and analysed.</li> </ul>	Data is collected from a sample of the population, organised into a graph and interpreted to summarise some characteristic.
<b>stem-and-leaf plot</b>	<ul style="list-style-type: none"> <li>A diagram displaying <i>data</i> by <i>place value</i>.</li> <li>The data is in order from lowest to highest.</li> </ul>	

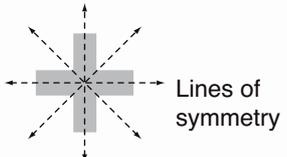
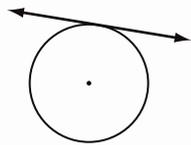
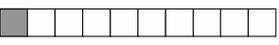
Data set of 13 elements: { **13, 18, 18, 19, 20, 21, 21, 22, 22, 22, 29, 30, 31** }

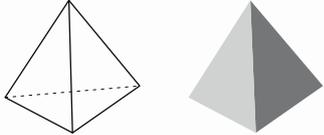
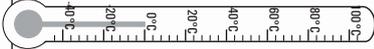
$\text{mode} = 22$   
 $\text{median (7th element)} = 21$   
 $\text{range}$

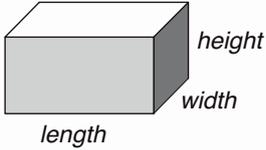
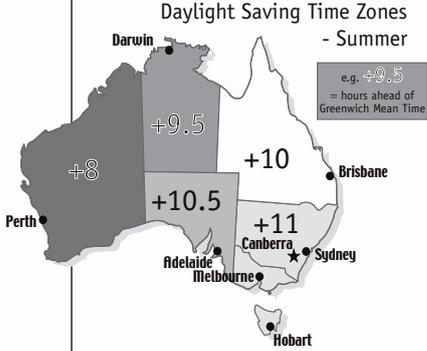
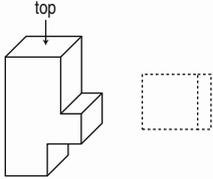
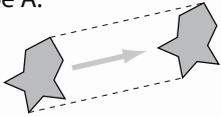
stem	leaves	lowest value = 13
1	3 8 8 9	median = 21
2	0 1 1 2 2 2 9	mode = 22
3	0 1	highest value = 31

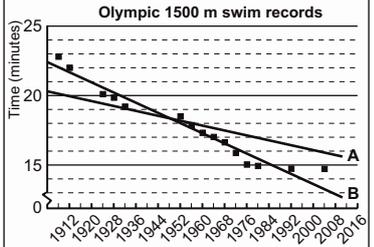
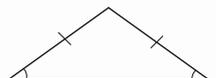
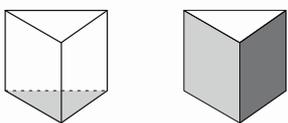
range = high - low  
 $= 31 - 13$   
 $= 18$   
 mean =  $286 \div 13$   
 $= 22$

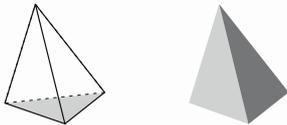
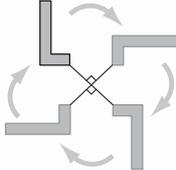
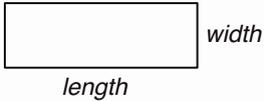
<b>straight angle</b>	<ul style="list-style-type: none"> <li>An <i>angle</i> measuring <math>180^\circ</math>.</li> </ul>	
<b>substitute</b>	<ul style="list-style-type: none"> <li>To replace a number or function with another.</li> <li>Often used in <i>algebra</i> when a <i>variable</i> (letter) is replaced by a number.</li> </ul>	If $x = 4$ , the value of $x + x$ is found by replacing the letter $x$ with 4: $4 + 4 = 8$
<b>subtract</b>	<ul style="list-style-type: none"> <li>To take away or <i>minus</i>.</li> </ul>	If you subtract 10 from 15 you are left with 5: $15 - 10 = 5$
<b>sum</b>	<ul style="list-style-type: none"> <li>The result when two or more numbers are added.</li> </ul>	The sum of 20 and 6 is 26: $20 + 6 = 6 + 20 = 26$
<b>supplement of an angle</b>	<ul style="list-style-type: none"> <li>An <i>angle</i> that, when added to an <i>adjacent</i> angle, makes a <i>straight angle</i> (or <math>180^\circ</math> in total).</li> </ul>	$75^\circ$ is the supplement of $105^\circ$ , because $75^\circ + 105^\circ = 180^\circ$ 

<b>survey</b>	<ul style="list-style-type: none"> <li>• A method of collecting a <i>sample</i> of <i>data</i> by getting people's responses.</li> </ul>	TV ratings are determined by surveying viewers.																												
<b>symmetry</b>	<ul style="list-style-type: none"> <li>• 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.</li> </ul>	<p>There are 3 kinds of symmetry: horizontal symmetry vertical symmetry rotational symmetry</p> 																												
<b>table</b>	<ul style="list-style-type: none"> <li>• <i>Data</i> organised in <i>columns</i> and <i>rows</i>.</li> </ul>	<p><b>Medal Tally - Beijing Olympics 2008</b></p> <table border="1" data-bbox="1125 593 1444 817"> <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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<b>table of values</b>	<ul style="list-style-type: none"> <li>• A list of numbers that are used to <i>substitute</i> one <i>variable</i> (<i>x</i>) in a <i>rule</i> or <i>function</i>, to find the <i>value</i> of the other variable (<i>y</i>).</li> </ul>	<p><math>y = x + 4</math></p> <table border="1" data-bbox="1157 929 1428 1153"> <thead> <tr> <th><i>x</i></th> <th><math>y = x + 4</math></th> <th><i>y</i></th> </tr> </thead> <tbody> <tr> <td>1</td> <td><math>1 + 4 = 5</math></td> <td>5</td> </tr> <tr> <td>2</td> <td><math>2 + 4 = 6</math></td> <td>6</td> </tr> <tr> <td>3</td> <td><math>3 + 4 = 7</math></td> <td>7</td> </tr> <tr> <td>4</td> <td><math>4 + 4 = 8</math></td> <td>8</td> </tr> <tr> <td>5</td> <td><math>5 + 4 = 9</math></td> <td>9</td> </tr> <tr> <td>6</td> <td><math>6 + 4 = 10</math></td> <td>10</td> </tr> </tbody> </table>	<i>x</i>	$y = x + 4$	<i>y</i>	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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<b>tangent to a circle</b>	<ul style="list-style-type: none"> <li>• A <i>line</i> that touches the <i>circle</i> at a <i>point</i> without crossing over.</li> </ul>																													
<b>tax</b>	<ul style="list-style-type: none"> <li>• A financial charge imposed by the state often calculated as a <i>percentage</i>.</li> </ul>	If a sales tax of 6% is applied on a purchase of \$100, the total amount that must be paid is \$106.																												
<b>temperature</b>	<ul style="list-style-type: none"> <li>• How hot or cold a thing is.</li> <li>• Temperature is measured in <i>degrees Celsius</i> (<math>^{\circ}\text{C}</math>) with a <i>thermometer</i>.</li> </ul>	99.97 $^{\circ}\text{C}$ is the temperature at which water boils.																												
<b>tens</b>	<ul style="list-style-type: none"> <li>• The <i>place value</i> between the <i>units</i> and <i>hundreds</i>.</li> </ul>	<p>1825.763 has 2 tens.</p> <table border="1" data-bbox="1109 1848 1468 2004"> <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														
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<b>tenth</b>	<ul style="list-style-type: none"> <li>• One part out of 10 parts of one whole.</li> </ul>																													

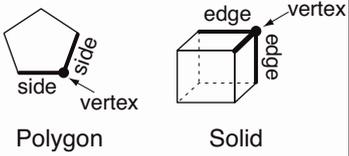
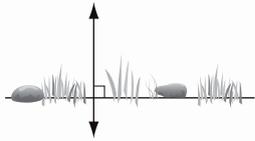
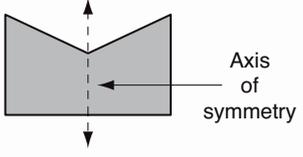
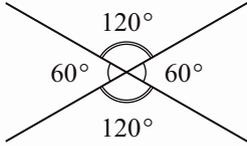
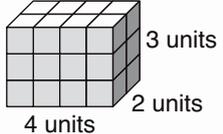
<p><b>tenths</b></p>	<ul style="list-style-type: none"> <li>The <i>place value</i> after the decimal point between the <i>units</i> and <i>hundredths</i>.</li> </ul>	<p>1825.763 has 7 tenths.</p> <table border="1" data-bbox="1182 125 1532 271"> <tr> <td>thousands</td> <td>hundreds</td> <td>tens</td> <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
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<p><b>term</b></p>	<ul style="list-style-type: none"> <li>Any part of an expression separated by “+” or “-” signs.</li> <li>A term can be a:                             <ol style="list-style-type: none"> <li>constant (number)</li> <li>single letter or variable</li> <li>product of a number and a variable</li> <li>product of a number and two or more variables</li> </ol> </li> </ul> <div style="display: flex; justify-content: space-around;"> <div data-bbox="466 689 783 880" style="border: 1px solid black; padding: 5px;"> <math display="block">a + a + a + a + a = \text{Five lots of } a</math> <math display="block">= 5 \times a</math> <math display="block">= 5a</math> <p>We simplify the writing by removing the "x" sign. We read this as "five a".</p> </div> <div data-bbox="799 689 1106 880" style="border: 1px solid black; padding: 5px;"> <math display="block">a = \text{One lot of } a</math> <math display="block">= 1 \times a</math> <math display="block">= 1a</math> <math display="block">= a</math> <p>We simplify the writing by removing the "1" and the "x" sign. We read this as "a".</p> </div> </div>	<ol style="list-style-type: none"> <li><math>7, \frac{1}{3}</math> or <math>-18</math></li> <li><math>a, b</math> or <math>-c</math></li> <li><math>7a, \frac{1}{b}, -18g</math> or <math>3x^2</math></li> <li><math>7ab, 5mn^3</math> or <math>-3jk^2</math></li> </ol> <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><b>terminating decimal</b></p>	<ul style="list-style-type: none"> <li>A <i>decimal</i> whose <i>digits</i> end. Every terminating decimal can be written as a <i>fraction</i> with a <i>denominator</i> of 10, 100 or 1000 etc.</li> </ul>	$0.765 = \frac{765}{1000}$														
<p><b>tetrahedron</b></p>	<ul style="list-style-type: none"> <li>A <i>triangular pyramid</i>.</li> </ul> <p>See also regular tetrahedron.</p>															
<p><b>thermometer</b></p>	<ul style="list-style-type: none"> <li>An instrument used to measure <i>temperature</i>.</li> </ul>															
<p><b>third</b></p>	<ul style="list-style-type: none"> <li>The <i>position</i> after <i>second</i>.</li> </ul>	<p>1st, 2nd, <b>3rd</b>.....</p>														
<p><b>thousands</b></p>	<ul style="list-style-type: none"> <li>The <i>place value</i> between <i>hundreds</i> and tens of thousands.</li> </ul>	<p>1825.763 has 1 thousand.</p> <table border="1" data-bbox="1182 1592 1532 1738"> <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
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<p><b>thousandth</b></p>	<ul style="list-style-type: none"> <li>One part out of 1000 parts of one whole.</li> </ul>	<p>One gram is a thousandth of a kilogram.</p>														
<p><b>thousandths</b></p>	<ul style="list-style-type: none"> <li>The <i>place value</i> after <i>hundredths</i>.</li> </ul>	<p>1825.763 has 3 thousandths.</p> <table border="1" data-bbox="1182 1955 1532 2101"> <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
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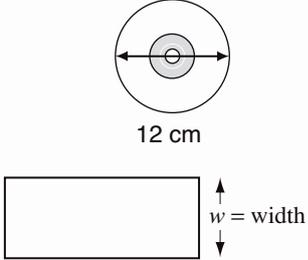
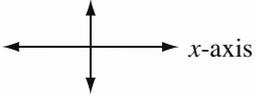
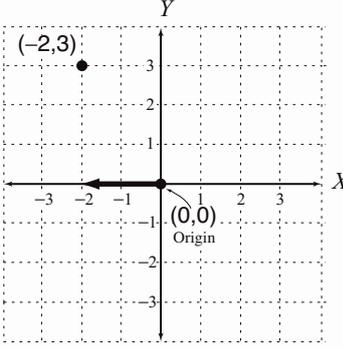
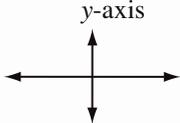
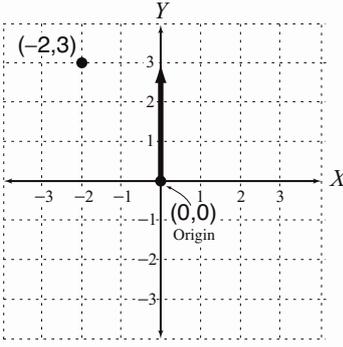
<b>three-dimensional (3D)</b>	<ul style="list-style-type: none"> <li>• Able to be measured in three directions namely <i>length</i>, <i>width</i> and <i>height</i>.</li> </ul>	
<b>time</b>	<ul style="list-style-type: none"> <li>• The continuum from past to present to future.</li> </ul>	The time is 9:25 am.
<b>time zone</b>	<ul style="list-style-type: none"> <li>• 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.</li> </ul>	NSW time is 3 hours ahead of WA time during daylight saving. Daylight Saving Time Zones - Summer 
<b>tip</b>	<ul style="list-style-type: none"> <li>• Optional payment given in addition to a required payment, usually to express appreciation for excellent service.</li> </ul>	The tip added an extra 5% to the cost of the meal.
<b>tonne (t)</b>	<ul style="list-style-type: none"> <li>• A <i>unit of measurement for mass equal to 1000 kilograms</i>.</li> </ul>	The humpback whale can weigh 58 tonnes.
<b>top view</b>	<ul style="list-style-type: none"> <li>• What you see of an object looking from a top <i>perspective</i>.</li> <li>• <i>Three-dimensional</i> objects have 3 views: front, top and side.</li> </ul>	
<b>total</b>	<ul style="list-style-type: none"> <li>• The whole lot.</li> <li>• The <i>sum</i> of two or more quantities.</li> </ul>	The total of 2 and 7 and 3 is 12: $2 + 7 + 3 = 12$
<b>transformation</b>	<ul style="list-style-type: none"> <li>• 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>.</li> </ul>	See <i>translation</i> , <i>reflection</i> and <i>rotation</i> .
<b>translation</b>	<ul style="list-style-type: none"> <li>• 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.</li> </ul>	Shape B is a translation of shape A. 
<b>trapezium</b>	<ul style="list-style-type: none"> <li>• A <i>quadrilateral</i>. Two <i>opposite sides</i> are <i>parallel</i>.</li> </ul>	

<p><b>tree diagram</b></p>	<ul style="list-style-type: none"> <li>• A tree diagram displays all the possible <i>outcomes</i> of an <i>event</i>.</li> </ul>	<p><b>Event: Tossing 2 coins</b></p> <pre>       Event: Tossing 2 coins       /   \     1st Coin H   T       / \   / \     2nd coin H T H T     </pre> <p>When tossing 2 coins there are 4 possible outcomes (branches): HH, HT, TH, TT - sample space</p>	
<p><b>trend line</b></p>	<ul style="list-style-type: none"> <li>• 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.</li> <li>• 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>.</li> </ul>	<p>Line B is a line of best fit, being closest to all the data points.</p> 	
<p><b>tri</b></p>	<ul style="list-style-type: none"> <li>• Prefix meaning three.</li> </ul>	<p>A tricycle has 3 wheels.</p> 	
<p><b>trial and error</b></p>	<ul style="list-style-type: none"> <li>• To try repeatedly and learn from mistakes.</li> </ul>	<p>This sum can be solved using trial and error.</p> $\begin{array}{r} \text{TWO} \\ + \text{TWO} \\ \hline \text{FOUR} \end{array}$	
<p><b>triangle</b></p>	<ul style="list-style-type: none"> <li>• A <i>polygon</i> with 3 straight <i>sides</i>.</li> </ul>		
<p><b>triangle</b></p>	<p>Interior angles</p>	<p>Sides</p>	<p>Diagram</p>
<p>Right-angled triangle</p>	<p>1 right angle</p>		
<p>Scalene triangle</p>	<p>0 equal angles</p>	<p>0 sides of equal length</p>	
<p>Isosceles triangle</p>	<p>2 equal angles</p>	<p>2 sides of equal length</p>	
<p>Equilateral triangle</p>	<p>3 equal angles</p>	<p>3 sides of equal length</p>	
<p><b>triangular prism</b></p>	<ul style="list-style-type: none"> <li>• A <i>three-dimensional</i> shape. Two identical triangular <i>bases</i>. Three rectangular faces.</li> </ul>		

<p><b>triangular pyramid</b></p>	<ul style="list-style-type: none"> <li>• A <i>three-dimensional</i> shape.</li> <li>One triangular <i>base</i>.</li> <li>The other three faces are <i>triangles</i>.</li> </ul>																						
<p><b>triple</b></p>	<ul style="list-style-type: none"> <li>• Multiply by three.</li> </ul>	<p>Children <math>\times 3 =</math> triplets!</p> 																					
<p><b>turn</b></p>	<ul style="list-style-type: none"> <li>• To <i>rotate</i> about a point.</li> </ul>																						
<p><b>twenty-four hour time</b></p>	<ul style="list-style-type: none"> <li>• Time told in 24 hour lots using 4 <i>digits</i>.</li> </ul>	<p>Nine thirty am is 0930 or 09:30 Two thirty pm is 1430 or 14:30</p>																					
<p><b>twice</b></p>	<ul style="list-style-type: none"> <li>• Two times.</li> </ul>	<p>Sam has \$5 and Jo has \$10. Jo has twice as much as Sam.</p>																					
<p><b>two-dimensional (2D)</b></p>	<ul style="list-style-type: none"> <li>• Able to be measured in 2 <i>directions</i> (<i>length</i> and <i>width</i>).</li> </ul>																						
<p><b>two-way table</b></p>	<ul style="list-style-type: none"> <li>• A table that shows the combinations of possible outcomes and their values.</li> </ul>	<p>Possible outcomes when spinning a spinner labelled 1, 2, 3, 4 and flipping a coin.</p>  <table border="1" data-bbox="979 1469 1469 1637"> <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><b>unit</b></p>	<ul style="list-style-type: none"> <li>• One.</li> </ul>	<p>The unit of measurement for length is metre (m).</p>																					
<p><b>units</b></p>	<ul style="list-style-type: none"> <li>• The <i>place value</i> before the decimal point between the <i>tens</i> and <i>tenths</i>.</li> </ul>	<p>1825.763 has 5 units.</p> <table border="1" data-bbox="1110 1933 1469 2078"> <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																	

<b>units of measurement</b>	• Standard amount or quantity.		See <i>cubic unit</i> and <i>square unit</i> .
<b>metric units</b>	Abbreviation	Examples	Used for measuring.....
• millimetre	mm	thickness of a plank of wood	LENGTH distance - length, width, height, diameter, perimeter
• centimetre	cm	width of a photo frame	
• metre	m	length of a lap of a stadium	
• kilometre	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	
• millilitre	mL	liquid in a can	CAPACITY (Liquid Volume) quantity - liquids
• litre	L	liquid in a bucket	
• square centimetre	cm <sup>2</sup>	area of a Math book cover	AREA surface - objects, territories (countries, continents, oceans)
• square metre	m <sup>2</sup>	area of the gym floor	
• square kilometre	km <sup>2</sup>	area of Texas	
• cubic centimetre	cm <sup>3</sup>	volume of water in a fish tank	VOLUME quantity - air, water
• cubic metre	m <sup>3</sup>	volume of air in a warehouse	
<b>unlike terms</b>	• 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 not like terms. $5w$ , $\frac{6}{w}$ and $-18w^2$ are not like terms.
<b>valid</b>	• 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.
<b>variable</b>	• 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.		Opposite to a <i>constant</i> . In $y = x + 5$ 5 is constant x and y are variables.
<b>Venn diagram</b>	• A diagram using circles to show the relationship between <i>sets</i> of objects.		

<b>vertex</b>	<ul style="list-style-type: none"> <li>• (pl. <b>vertices</b>) The point at which two <i>sides</i> (of a <i>polygon</i>) or three <i>edges</i> (of a <i>solid</i>) meet.</li> </ul>	 <p>Polygon      Solid</p>
<b>vertical line</b>	<ul style="list-style-type: none"> <li>• A <i>line</i> at a <i>right angle</i> to the horizon.</li> </ul>	
<b>vertical symmetry</b>	<ul style="list-style-type: none"> <li>• A shape has vertical symmetry if an <i>axis of symmetry</i> is vertical.</li> </ul>	
<b>vertically opposite angles</b>	<ul style="list-style-type: none"> <li>• <i>Angles</i> on opposite sides of a <i>pair of intersecting lines</i>.</li> <li>• Vertical angles are <i>congruent</i>.</li> </ul>	<p>All vertical angles are equal in a pair of intersecting lines.</p> 
<b>volume</b>	<ul style="list-style-type: none"> <li>• The amount of space that a <i>solid</i> occupies. Volume is measured in <i>cubic units</i>. e.g. cubic centimetres (cm<sup>3</sup>) or cubic metres (m<sup>3</sup>).</li> </ul>	<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> 
<b>week</b>	<ul style="list-style-type: none"> <li>• A <i>unit of time</i> equal to 7 days; Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday.</li> </ul>	<p>Roger was on holidays for one week (seven days).</p>
<b>weight</b>	<ul style="list-style-type: none"> <li>• 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.</li> </ul>	<p>A 3 kg brick weighs: 3 kg on Earth, about 0.5 kg on the moon, 0 kg in outer space.</p>
<b>west</b>	<ul style="list-style-type: none"> <li>• A <i>compass direction</i>.</li> </ul>	<p>The sun sets in the west.</p> 
<b>whole numbers</b>	<ul style="list-style-type: none"> <li>• The <i>counting numbers</i> from zero to <i>infinity</i>.</li> </ul>	<p>0, 1, 2, 3, 4, 5, ..... are whole numbers.</p>

<b>width</b>	<ul style="list-style-type: none"> <li>• How wide an object is. The sideways <i>dimension</i>.</li> </ul>	<p>The width of the CD is 12 cm.</p> 
<b>x-axis</b>	<ul style="list-style-type: none"> <li>• The <i>horizontal</i> axis.</li> </ul>	
<b>x-coordinate</b>	<ul style="list-style-type: none"> <li>• The <i>first</i> number in an ordered pair. The position of a <i>point</i> along the <i>x-axis</i>.</li> </ul>	<p>The x-coordinate of the ordered pair <math>(-2,3)</math> is <math>-2</math>.</p> 
<b>y-axis</b>	<ul style="list-style-type: none"> <li>• The <i>vertical</i> axis.</li> </ul>	
<b>y-coordinate</b>	<ul style="list-style-type: none"> <li>• The <i>second</i> number in an ordered pair. The position of a <i>point</i> along the <i>y-axis</i>.</li> </ul>	<p>The y-coordinate of the ordered pair <math>(-2,3)</math> is <math>3</math>.</p> 
<b>year</b>	<ul style="list-style-type: none"> <li>• A <i>unit of time</i> equal to 365 days. (366 in a leap year).</li> </ul>	<p>1st of January to the 31st of December.</p>



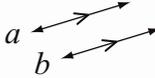
# MATHS FACTS

## SYMBOLS

### Number

+	plus or add
−	minus or subtract
×	multiplied by, times, lots of
÷	divided by, into groups of
=	equals, is equal to
≠	is not equal to
≈	is approximately equal to
<	is less than, $4 < 6$
>	is greater than, $8 > 5$
≤	is less than or equal to
≥	is greater than or equal to
( )	brackets, a grouping symbol
%	percentage, $12\% = \frac{12}{100}$
.	decimal point as in 7.9
−3	negative 3
$6^3$	6 raised to the 3 <sup>rd</sup> 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 $b$
$2.\dot{4}$ or $2.\dot{1}\dot{3}$	recurring decimal

### Geometry

$\pi$ (pi)	$\approx 3.14$ or $\frac{22}{7}$
°	degree (a right angle measures $90^\circ$ )
$\equiv$	is congruent to,  $\equiv$ 
$\sim$	is similar to,  $\sim$ 
	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

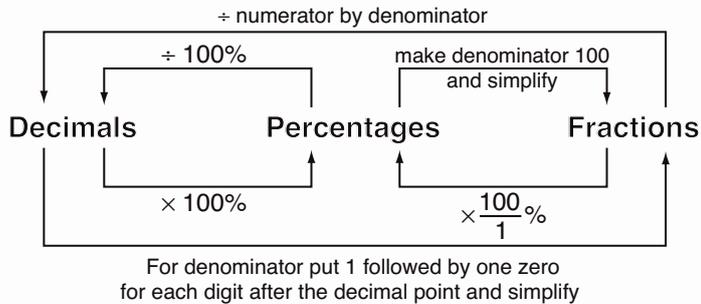
$3x$	3 times $x$ , 3 lots of $x$ , $3 \times x$ , $3x$
$x^2$	$x$ raised to the 2 <sup>nd</sup> power, $x \times x$
$-x$	opposite of $x$
$\frac{1}{x}$	reciprocal of $x$
$(x,y)$	coordinates in a Cartesian plane

## 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	1 000	100	10	1		$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$

### Decimals / Fractions / Percentages



Fraction	Decimal	Percentage
$\frac{1}{1}$	1	100%
$\frac{1}{2}$	0.5	50%
$\frac{1}{3}$	$0.\dot{3}$	33.33%
$\frac{2}{3}$	$0.\dot{6}$	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%
$\frac{1}{9}$	$0.\dot{1}$	11.11%

### 0

Subtraction  $a - 0 = a$

Multiplication  $a \times 0 = 0$  and  $0 \times a = 0$

Division  $0 \div a = 0$

### 1

Multiplication  $a \times 1 = a$  and  $1 \times a = a$

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  $a \times 1 = 1 \times a = a$

### Commutative properties

Addition  $a + b = b + a$

Multiplication  $a \times b = b \times a$

### Associative properties

Addition  $(a + b) + c = a + (b + c)$

Multiplication  $(a \times b) \times c = a \times (b \times c)$

### 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  $a \times \frac{1}{a} = \frac{1}{a} \times a = 1, a \neq 0$

## MEASUREMENT FACTS (1)

### CONVERSIONS

#### Length

10 millimetres (mm) = 1 centimetre (cm)

$$\left. \begin{array}{l} 100 \text{ cm} = \\ 1000 \text{ mm} = \end{array} \right\} 1 \text{ metre (m)}$$

1000 m = 1 kilometre (km)

#### Temperature - degrees Celsius (°C)

0°C = freezing point of water

37°C = human body temperature

100°C = boiling point of water

#### Mass

1000 milligrams (mg) = 1 gram (g)

1000 g = 1 kilogram (kg)

1000 kg = 1 tonne (t)

#### Area

100 square mm (mm<sup>2</sup>) = 1 square cm (cm<sup>2</sup>)

10 000 cm<sup>2</sup> = 1 square metre (m<sup>2</sup>)

1 000 000 m<sup>2</sup> = 1 square km (km<sup>2</sup>)

#### Liquid capacity

$$\left. \begin{array}{l} 1000 \text{ millilitres (mL)} = \\ 1000 \text{ cm}^3 = \end{array} \right\} 1 \text{ litre (L)}$$

1000 L = 1 kilolitre (kL)

#### Volume

1000 cubic mm (mm<sup>3</sup>) = 1 cubic cm (cm<sup>3</sup>)

1 000 000 cm<sup>3</sup> = 1 cubic metre (m<sup>3</sup>)

#### Time

60 seconds (s) = 1 minute (min)

60 minutes (min) = 1 hour (h)

24 hours = 1 day

7 days = 1 week

4 weeks (approx.) = 1 month

$$\left. \begin{array}{l} 365 \text{ or } 366 \text{ days} = \\ 52 \text{ weeks (approx.)} = \\ 12 \text{ months} = \end{array} \right\} 1 \text{ year}$$

10 years = 1 decade

100 years = 1 century

#### Conversion factors: capacity ↔ volume

1 millilitre (mL) = 1 cubic centimetre (cm<sup>3</sup>)

1000 litre (L) = 1 cubic metre (m<sup>3</sup>)

### METRIC PREFIXES

**giga (G)** = 1 billion = 1 000 000 000

**mega (M)** = 1 million = 1 000 000

**kilo (k)** = 1 thousand = 1000

**hecto (h)** = 1 hundred = 100

**deca (da)** = 1 ten = 10

**micro (μ)** = 1 millionth =  $\frac{1}{1\,000\,000}$

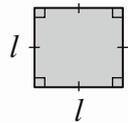
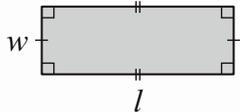
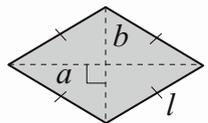
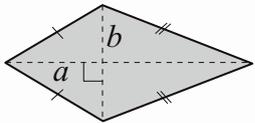
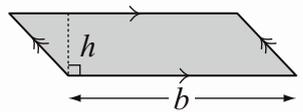
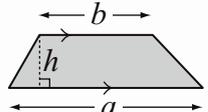
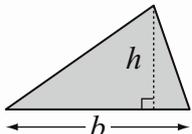
**milli (m)** = 1 thousandth =  $\frac{1}{1000}$

**centi (c)** = 1 hundredth =  $\frac{1}{100}$

**deci (d)** = 1 tenth =  $\frac{1}{10}$

## MEASUREMENT FACTS (2)

### 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		$P = \text{Sum of all sides}$	$A = b \times h$ $= bh$
Trapezium		$P = \text{Sum of all sides}$	$A = \frac{1}{2}(a + b)h$
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

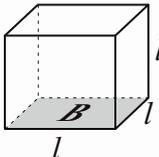
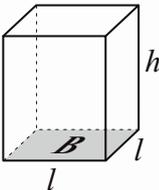
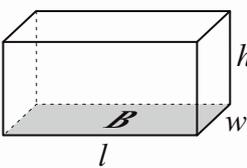
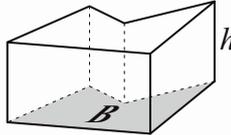
**mono** - one  
**bi** or **di** - two  
**tri** - three  
**quad** or **tetra** - four  
**penta** - five  
**hexa** - six  
**hepta** - seven  
**octa** - eight  
**nona** - nine  
**deca** - ten

#### Abbreviations

*l* length  
*w* width  
*h* height  
*b* base length  
*P* perimeter  
*r* radius  
*C* circumference  
*A* area

## MEASUREMENT FACTS (3)

### 3D shapes - Formulae

Name	Shape	Volume
Cube		$V = l^3$ <b>or</b> $= Bh$
Square Prism		$V = l^2h$ <b>or</b> $= Bh$
Rectangular Prism		$V = lwh$ <b>or</b> $= Bh$
Prism - (All)		$V = Bh$

### Abbreviations

*l* **length**

*w* **width**

*h* **height**

*b* **base length**

*r* **radius**

*A* **area**

*P* **perimeter**

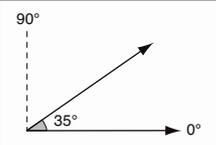
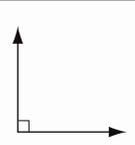
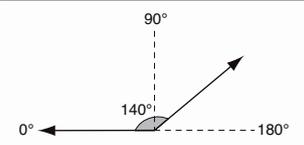
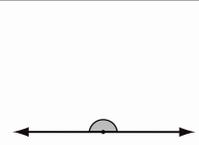
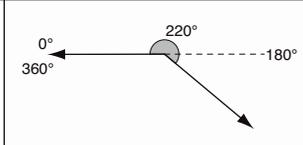
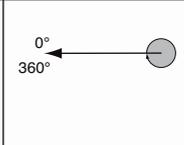
*V* **volume**

*B* **base area**

*C* **circumference**

# GEOMETRY FACTS

## 2D shapes

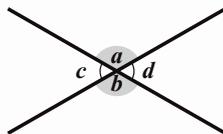
Acute $< 90^\circ$	Right $90^\circ$	Obtuse more than $90^\circ$ less than $180^\circ$	Straight $180^\circ$	Reflex more than $180^\circ$ less than $360^\circ$	Revolution $360^\circ$
					

## Properties of angles

### Vertically opposite angles

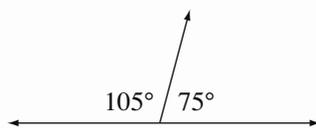
Are equal

$$\angle a = \angle b, \angle c = \angle d$$



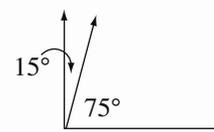
### Supplementary angles

Add to  $180^\circ$



### Complementary angles

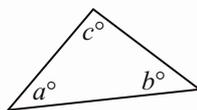
Add to  $90^\circ$



### Properties of angles in a triangle

The sum of interior angles of a triangle is  $180^\circ$ .

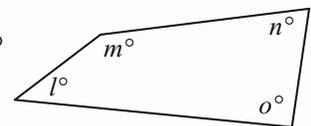
$$a^\circ + b^\circ + c^\circ = 180^\circ$$



### Properties of angles in a quadrilateral

The sum of interior angles of a quadrilateral is  $360^\circ$ .

$$l^\circ + m^\circ + n^\circ + o^\circ = 360^\circ$$



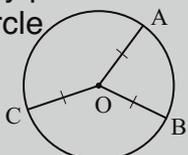
## Triangle types

Sides and angles	Triangle type
no equal sides/angles	<b>scalene</b>
two equal sides/angles	<b>isosceles</b>
three equal sides/angles	<b>equilateral</b>

Angles	Triangle type
all acute angles	<b>acute-angled</b>
one right angle	<b>right-angled</b>
one obtuse angle	<b>obtuse-angled</b>

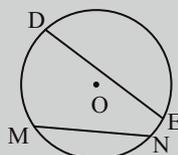
## Properties of circles

**Radius** - joins the centre with any point on the circle

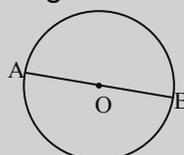


$$OA = OB = OC$$

**Chord** - joins any two points on the circle

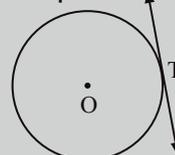


**Diameter** - a chord passing through the centre

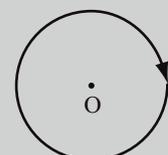


$$AB = 2OA$$

**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, -6, 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) 4869, f) 1862  
g) 9647, h) 5779, i) 4869, j) 8745, k) 6892, l) 6998
- Skill 5.2** a) 2261, b) 1171, c) 1123, d) 5101, e) 2452, f) 5372  
g) 3006, h) 5342, i) 3411, j) 3072, k) 2541, l) 2130
- Skill 5.3** a) 3524, b) 5010, c) 1645, d) 8574, e) 6312, f) 5910  
g) 9194, h) 5245, i) 8096, j) 50304, k) 49618, l) 72101

- Skill 5.4** a) 3824, b) 3209, c) 2368, d) 2890, e) 805, f) 4847, g) 6065  
h) 7622, i) 2016, j) 6854, k) 2126, l) 4114, m) 3551  
n) 1888, o) 3279, p) 7868, q) 6586, r) 2557, s) 58081  
t) 25828, u) 67477, v) 55168, w) 38785, x) 50237

- Skill 5.5** a) 5133, b) 1685, c) 1386, d) 1806, e) 8276, f) 3948  
g) 2626, h) 5143

## 6. [Large Number ×, ÷] page 15

- Skill 6.1** a) 3180, b) 50900, c) 90800, d) 46700, e) 701500  
f) 461900, g) 179000, h) 412000, i) 905000, j) 506000  
k) 803000, l) 248000

- Skill 6.2** a) 46, b) 33, c) 109, d) 58, e) 27, f) 820, 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) 3717  
h) 12348, i) 10075, j) 7254, k) 15642, l) 17528

- Skill 6.4** a) 156, b) 79, c) 95, d) 91, e) 37, f) 43, g) 577, h) 842  
i) 817, j) 1269, k) 341, l) 687, m) 902, n) 447, o) 1021

- Skill 6.5** a) 4560, b) 1800, c) 12380, d) 17300, e) 19080, f) 16110  
g) 130800, h) 88800, i) 163800, j) 103000, k) 570500  
l) 695600, m) 150000, n) 84000, o) 120000

- Skill 6.6** a) 280, b) 160, c) 117, d) 147, e) 161, f) 131, g) 45, h) 44  
i) 155, j) 162, k) 34, l) 135

- Skill 6.7** a) 4674, b) 6935, c) 1540, d) 11666, e) 31941, f) 12818  
g) 37336, h) 19768, i) 13248, j) 60300, k) 14896  
l) 41670, m) 30438, n) 98064, o) 68508, p) 135675  
q) 177306, r) 119991, s) 146657, t) 138644, u) 123772

- Skill 6.8** a) 29, b) 57, c) 79, d) 387, e) 216, f) 364, g) 370, h) 735  
i) 640, j) 518, k) 192, l) 214, m) 238, n) 430, o) 247  
p) 3072, q) 2416, r) 738

- Skill 6.9** a) 38880, b) 107400, c) 27520, d) 152160, e) 98560  
f) 243350, g) 291200, h) 1170700, i) 2582400

- Skill 6.10** a) 743.5, b) 1503.5, c) 512.8, d) 1486.25, e) 445.5  
f) 3519.5, g) 980.6, h) 341.5, i) 1452.6, j) 1452.6, 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) 4.11, f) 71.0, 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) 38.25, z) 21.725  
A) 49.752

- 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) 31.7, i) 6.0, 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) 8.51, s) 17.76, t) 15.76  
u) 45.78, v) 85.95, w) 75.87, x) 17.87, y) 7.98, z) 46.69  
A) 47.36

- Skill 7.3** a) 1.73, b) 4.3, c) 1.25, d) 2.84, e) 3.62, f) 4.75, g) 13.58  
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) 8.1, f) 5.4, g) 15.3, h) 25.8  
i) 10.8, j) 7.6, k) 9.5, l) 49.6, m) 1.26, n) 4.26, o) 12.48  
p) 8.36, q) 18.75, 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,  
A) 6.123

- Skill 8.2** a) 0.7, b) 0.3, c) 0.5, d) 0.9, e) 2.4, f) 1.4, g) 1.7, h) 0.37  
i) 4.7, j) 1.18, k) 0.16, l) 0.34, m) 2.6, n) 0.49, o) 2.6

- Skill 8.3** a) 27, b) 8, c) 53, d) 5.4, e) 32.9, f) 80.4, g) 960, h) 17.7  
i) 3.8, j) 13200, k) 7540, l) 9060, m) 24800, n) 1020  
o) 7690

## 8. [Decimal $\times, \div$ ] (cont.)

- Skill 8.4** a) 4.56, b) 3.08, c) 9.43, d) 0.658, e) 0.022, f) 0.173  
g) 0.275, h) 0.186, i) 0.013, j) 0.013, k) 0.074, l) 0.098  
m) 4.089, n) 6.237, o) 2.405, p) 0.9272, q) 0.1035  
r) 0.4487
- Skill 8.5** a) 0.12, b) 0.12, c) 0.4, d) 0.42, e) 0.27, f) 1.04, g) 0.98  
h) 2.07, i) 1.14, j) 0.03, k) 0.048, l) 0.963
- Skill 8.6** a) 6, b) 2, c) 7, d) 38, e) 23, f) 1.90, g) 0.3, h) 0.7, i) 10.7  
j) 250, k) 30, l) 90, m) 160, n) 90, o) 160,
- Skill 8.7** a) 10, b) 20, c) 15, d) 80, e) 25, f) 10, g) 30, h) 200, i) 175  
j) 200, k) 40, l) 100

## 9. [Fraction $+, -$ ] page 41

- Skill 9.1** a)  $\frac{1}{2}$ , b)  $\frac{1}{2}$ , c)  $\frac{14}{15}$ , d)  $\frac{6}{7}$ , e)  $\frac{7}{11}$ , f)  $\frac{4}{5}$ , 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)  $\frac{4}{21}$ , b)  $\frac{7}{9}$ , c)  $\frac{2}{13}$ , d)  $1\frac{2}{3}$ , e) 1, f)  $2\frac{4}{7}$ , g)  $\frac{1}{3}$ , h)  $\frac{1}{3}$ , i)  $\frac{3}{4}$   
j)  $\frac{2}{7}$ , k)  $\frac{5}{11}$ , l)  $\frac{1}{7}$ , m)  $\frac{1}{4}$ , n)  $\frac{3}{10}$ , o)  $\frac{1}{2}$
- Skill 9.3** a)  $4\frac{5}{6}$ , b)  $5\frac{4}{5}$ , c)  $3\frac{5}{9}$ , d)  $3\frac{9}{11}$ , e)  $7\frac{7}{9}$ , f)  $2\frac{6}{7}$ , g)  $2\frac{1}{2}$ , 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)  $5\frac{1}{5}$   
y) 8, z)  $9\frac{1}{6}$ , A)  $3\frac{3}{13}$
- Skill 9.4** a)  $1\frac{1}{2}$ , b)  $1\frac{5}{7}$ , c)  $1\frac{3}{5}$ , d)  $3\frac{1}{2}$ , e)  $2\frac{5}{9}$ , f)  $\frac{6}{11}$ , g)  $1\frac{3}{5}$ , h)  $1\frac{1}{2}$   
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)  $4\frac{7}{10}$ , c)  $2\frac{5}{6}$ , d)  $2\frac{2}{7}$ , e)  $1\frac{5}{5}$ , 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)  $1\frac{1}{8}$ , c)  $\frac{5}{6}$ , d)  $\frac{2}{3}$ , e)  $\frac{3}{8}$ , f)  $\frac{17}{20}$ , g)  $\frac{2}{3}$ , h)  $\frac{3}{4}$ , i)  $\frac{4}{9}$   
j)  $1\frac{1}{15}$ , k)  $3\frac{1}{4}$ , l)  $1\frac{1}{12}$
- Skill 9.7** a)  $\frac{31}{40}$ , b)  $1\frac{5}{12}$ , c)  $1\frac{2}{15}$ , d)  $\frac{29}{36}$ , e)  $1\frac{1}{14}$ , f)  $\frac{13}{15}$ , g)  $1\frac{7}{20}$ , h)  $\frac{17}{30}$   
i)  $1\frac{7}{15}$
- Skill 9.8** a)  $\frac{1}{9}$ , b)  $\frac{1}{4}$ , c)  $\frac{1}{6}$ , d)  $\frac{1}{8}$ , e)  $\frac{4}{21}$ , f)  $\frac{4}{27}$ , g)  $\frac{1}{5}$ , h)  $\frac{1}{4}$ , i)  $\frac{6}{25}$
- Skill 9.9** a)  $\frac{7}{24}$ , b)  $\frac{1}{6}$ , c)  $\frac{10}{36}$ , d)  $\frac{23}{90}$ , e)  $\frac{5}{12}$ , f)  $\frac{7}{40}$ , g)  $\frac{17}{42}$ , h)  $\frac{4}{35}$   
i)  $\frac{11}{30}$ , j)  $\frac{1}{40}$ , k)  $\frac{23}{42}$ , l)  $\frac{17}{45}$

## 10. [Fraction $\times, \div$ ] page 55

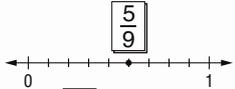
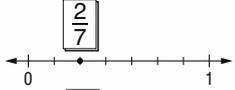
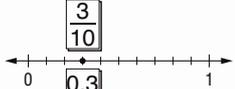
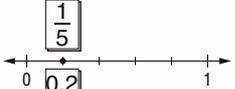
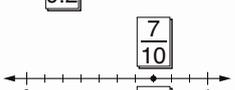
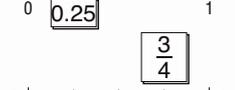
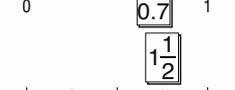
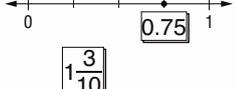
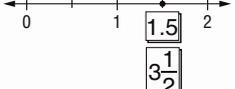
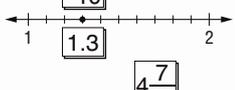
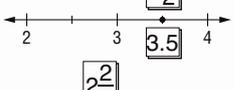
- Skill 10.1** a)  $5\frac{1}{4}$ , b)  $3\frac{1}{5}$ , c)  $1\frac{5}{7}$ , d)  $2\frac{2}{5}$ , e)  $1\frac{7}{8}$ , f)  $\frac{4}{9}$ , g)  $1\frac{2}{3}$ , h)  $1\frac{1}{4}$   
i)  $2\frac{1}{4}$ , j)  $2\frac{1}{2}$ , k) 6, l) 18, m)  $1\frac{1}{2}$ , n) 4, o) 9
- Skill 10.2** a) 12 mL, b) 35 kg, c) 16 km, d) 70 L, e) 120 m, f) \$50  
g) 90 L, h) 20 cm, i) 45 m, j) 80 g, k) 36 mL, l) 30 kg
- Skill 10.3** a) 5, b) 8, c) 7, d) 10, e) 9, f) 11, g) 24, h) 18, 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) 14, q) 9, r) 12  
s) 8, t) 10, u) 15, v) 28, w) 21, x) 22
- Skill 10.4** a)  $\frac{2}{35}$ , b)  $\frac{9}{20}$ , c)  $\frac{3}{32}$ , d)  $\frac{4}{33}$ , e)  $\frac{9}{32}$ , f)  $\frac{12}{35}$ , g)  $\frac{4}{15}$ , h)  $\frac{5}{12}$ , i)  $\frac{7}{18}$   
j)  $\frac{1}{8}$ , k)  $\frac{5}{7}$ , l)  $\frac{2}{5}$ , m)  $\frac{2}{9}$ , n)  $\frac{2}{9}$ , o)  $\frac{1}{10}$ , p)  $\frac{1}{12}$ , 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)  $\frac{2}{7}$ , x)  $\frac{1}{15}$ , y)  $\frac{1}{6}$ , z)  $\frac{2}{5}$ , A)  $\frac{1}{12}$

- 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)  $\frac{3}{33}$ , p)  $\frac{3}{16}$ , q)  $\frac{3}{10}$ , r)  $\frac{7}{60}$
- Skill 10.6** a)  $1\frac{7}{8}$ , b)  $\frac{7}{30}$ , c)  $\frac{10}{21}$ , d)  $\frac{20}{27}$ , e)  $\frac{44}{63}$ , f)  $1\frac{11}{24}$ , g)  $\frac{8}{9}$ , h)  $1\frac{1}{15}$   
i)  $1\frac{7}{20}$ , j)  $\frac{5}{9}$ , k)  $1\frac{1}{6}$ , l)  $1\frac{1}{4}$ , m)  $\frac{1}{2}$ , n)  $\frac{1}{8}$ , o)  $2\frac{1}{4}$ , p)  $2\frac{1}{2}$   
q)  $\frac{1}{2}$ , r)  $1\frac{1}{3}$ , s)  $2\frac{2}{3}$ , t)  $2\frac{1}{2}$ , u)  $4\frac{2}{3}$

## 11. [Percentages] page 67

- Skill 11.1** a) 60%, b) 32%, c) 46%, d) 57%, e) 5%, f) 8%, g) 61%  
h) 29%, i) 4%, j) 7%, k) 37%, l) 91%, m) 28%, n) 79%
- Skill 11.2** a) 49%, b) 40%, c) 35%, d) 20%, e) 33%, f) 13%, g) 28%  
h) 62.5%, i) 2%, j) 8%, k) 9%, l) 34.4%
- Skill 11.3** a) 24, b) 35, c) 69, d) \$9, e) \$7, f) \$50, g) \$150, h) \$90  
i) \$320, 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¢, A) 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) \$9.00, b) \$30, c) \$225, d) \$32, e) \$2400, f) \$300  
g) \$55, h) \$216, i) \$280, j) \$22 500, k) \$360, l) \$255  
m) B, n) A, o) B, p) B
- Skill 11.6** a) 60, b) 240, c) 280, d) 80, e) 99, f) 75, g) 100, h) 70  
i) 102, j) 78, k) 84, l) 140
- Skill 11.7** a) 20%, b) 89%, c) 40%, d) 40%, e) 4%, f) 20%
- Skill 11.8** a) 12.5%, b) 30%, c) 30%, d) 50%, e) 25%, f) 33.3%  
g) 12.5%, h) 25%

## 12. [Dec. / Frac. / Percentages] page 79

- 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) 40%, g) 25%, h) 20%
- Skill 12.2** a)  $\frac{2}{3}$ , 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)  $\frac{2}{5}$ , 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)  $\frac{5}{8}$ , A)  $\frac{5}{8}$
- Skill 12.3** a)  b)   
c)  d)   
e)  f)   
g)  h)   
i)  j)   
k)  l)   
m)  n)   
o)  p) 

## 12. [Dec. / Frac. / Percentages] (cont.)

- Skill 12.4** a) 0.5, b) 0.4, c) 1.25, d) 1.2, e) 2.25, f) 3.6, g) 3.5, h) 4.8  
i) 0.25, j) 0.015, k) 0.25, l) 0.045, m) 0.45, n) 0.035
- Skill 12.5** a)  $\frac{24}{30} = \frac{4}{5}$ , b)  $\frac{2}{7} = \frac{24}{84}$ , c)  $\frac{3}{8} = \frac{27}{72}$ , d)  $\frac{13}{15} = \frac{39}{45}$ , e)  $\frac{9}{10} = \frac{54}{60}$   
f)  $\frac{32}{56} = \frac{8}{14}$ , 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 12.6** a) 40%, b) 20%, c) 10%, d) 50%, e) 70%, f) 12%, g) 95%  
h) 48%, i) 29%, j) 45%, k) 4%, l) 5%, m) 6%, n) 38%  
o) 40%, p) 75%, q) 12.5%, r) 34.5%
- Skill 12.7** a) 0.06, b) 0.02, c) 0.88, d) 0.88, e) 0.7, f) 0.9, g) 0.005  
h) 0.018, i) 0.72, j) 0.068, k) 0.97, l) 0.99, m) 0.1, n) 0.73
- Skill 12.8** a)  $\frac{7}{10}$ , b)  $\frac{11}{100}$ , c)  $\frac{3}{10}$ , d)  $\frac{1}{10}$ , e)  $\frac{2}{25}$ , f)  $\frac{6}{50}$ , g)  $\frac{1}{2}$ , h)  $\frac{7}{25}$ , i)  $\frac{9}{20}$ , j)  $\frac{2}{5}$
- Skill 12.9** a) 0.7, b) 0.15, c) 0.36, d) 0.5, e) 1.8, f) 3.75, g) 2.9, h) 1.44  
i) 4.68
- Skill 12.10** a)  $\frac{61}{100}$ , b)  $\frac{7}{100}$ , c)  $\frac{11}{20}$ , d)  $\frac{3}{10}$ , e)  $\frac{2}{25}$ , f)  $\frac{3}{50}$ , g)  $\frac{21}{25}$ , h)  $\frac{67}{100}$ , i)  $\frac{2}{5}$   
j)  $\frac{13}{50}$ , k)  $\frac{14}{25}$ , l)  $\frac{2}{5}$
- Skill 12.11** a) 10%, b) 42%, c) 28%, d) 86%, e) 50%, f) 40%, g) 60%  
h) 75%, i) 33.3%, j) 70%, k) 1%, l) 66.6%
- Skill 12.12** a) 

Decimal	Fraction	Percentage
0.05	$\frac{1}{20}$	5%

 b) 

Decimal	Fraction	Percentage
0.45	$\frac{45}{100} = \frac{9}{20}$	45%

  
c) 

Decimal	Fraction	Percentage
0.6	$\frac{6}{10} = \frac{3}{5}$	60%

 d) 

Decimal	Fraction	Percentage
0.35	$\frac{7}{20}$	35%

  
e) 

Decimal	Fraction	Percentage
0.07	$\frac{7}{100}$	7%

 f) 

Decimal	Fraction	Percentage
0.7	$\frac{7}{10}$	70%

  
g) 

Decimal	Fraction	Percentage
0.1	$\frac{1}{10}$	10%

 h) 

Decimal	Fraction	Percentage
0.3	$\frac{3}{10}$	30%

  
i) 

Decimal	Fraction	Percentage
0.4	$\frac{4}{10} = \frac{2}{5}$	40%

 j) 

Decimal	Fraction	Percentage
0.55	$\frac{55}{100} = \frac{11}{20}$	55%

  
k) 

Decimal	Fraction	Percentage
0.9	$\frac{9}{10}$	90%

 l) 

Decimal	Fraction	Percentage
0.34	$\frac{17}{50}$	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 97

- Skill 13.1** a) C, b) A, c) A, d) B, e) B, f) C, g) A, h) A  
i) -6, -2, -1, 0, 2, j) 8, 6, 0, -4, -9, k) 7, 5, 3, -7, -9  
l) -6, -3, -2, 0, 5, m) -5°C, -3°C, 2°C, 4°C  
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) 26°C, b) 5, c) 9, d) 8, e) 11, f) 13, g) 50°C, h) 64°C, i) 8 h  
j) 8 h
- Skill 13.4** a) 17 m, b) 3780 m, c) 310 m, d) 51°C, e) 61°C, f) 52°C  
g) 9257 m, h) 7000 m
- Skill 13.5** a) basement, b) ground, c) oncology, d) 6 m  
e) homewares, f) 16 m
- Skill 13.6** a) -\$550, b) \$70, c) -\$140, d) -99°C, e) 449 BC  
f) 1332 BC, g) -218°C, h) -272°C, i) \$740, j) 61 kg
- 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) -11, f) 3, g) 7, h) -4, i) 0  
j) -13, k) 15, l) -4, m) -9, n) -2, o) -6, p) 5, q) -8, r) -10  
s) 7, t) 6, u) 17, v) -16, w) -6, x) -9, y) -12, z) 7, A) -9
- 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 109

- Skill 14.1** a) 5 : 6, b) 1 : 2, c) 4 : 9, d) 5 : 7, e) 5 : 1, f) 2 : 3, g) 4 : 1  
h) 4 : 1, i) 1 : 4, j) 5 : 9, k) 4 : 5, l) 3 : 2, m) 4 : 1, n) 2 : 3
- Skill 14.2** a) 5 : 2, b) 2 : 5, c) 10 : 3, d) 6 : 7, e) 8 : 3, f) 1 : 3  
g) 40 : 1, h) 10 : 1, i) 5 : 1, j) 6 : 1
- Skill 14.3** a) 7.5 km, b) 9 km, c) 2.5 h, d) 14 km, e) 29 100 km  
f) 2 h 30 min, g) 500 km/h, h) 520 km/h, i) 45 km/h  
j) 15 min, k) 95 km, l) 9600 km, m) 27 000 km, n) 5 km  
o) 0.75 s, p) 2 h 15 min
- Skill 14.4** a) 9 : 2 : 5, b) 1 : 2 : 5, c) 1 : 3 : 9, d) 3 : 5 : 8, e) 7 : 3 : 2  
f) 2 : 4 : 3, g) 5 : 3 : 2, h) 5 : 20 : 7, i) 3 : 1 : 5, j) 2 : 3 : 6  
k) 6 : 2 : 3, l) 2 : 3 : 4
- Skill 14.5** a) true, b) true, c) B, d) C, e) A, f) C
- Skill 14.6** a) 5 : 8 = 20 : 32 b) 42 : 12 = 14 : 4 c) 7 : 9 = 56 : 72  
d) 6 : 3 = 120 : 60 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)  $\frac{63}{18} = \frac{7}{2}$   
n)  $\frac{11}{5} = \frac{33}{15}$
- Skill 14.7** a) A, b) B, c) B, d) A, e) B, f) A, g) B, h) A, i) A, j) B, k) B  
l) A, m) A, n) B, o) A, p) A
- Skill 14.8** a) 11 : 9, b) 6 : 5, c) 1 : 3, d) 10 : 1, e) 1 : 4, f) 3 : 4, g) 5 : 4  
h) 7 : 8, i) 13 : 37, j) 31 : 100, k) 2 : 3, l) 19 : 16, m) 11 : 18  
n) 11 : 39
- Skill 14.9** a) 41 600 g, b) 225 m, c) 2 m/week, d) 60 L/min, e) 17.5 L  
f) 42, g) 9 L, h) \$207.50

## 15. [Indices / Square Roots] page 123

- Skill 15.1** a)  $10^5$ , b)  $2^3$ , c)  $5^2$ , d)  $3^6$ , e)  $6 \times 6 \times 6 \times 6$ , f)  $11 \times 11 \times 11$   
g)  $2 \times 2 \times 2 \times 2 \times 2 \times 2$ , h)  $9 \times 9 \times 9$ , i)  $1^8$ , j)  $7^3$ ,  
k)  $6 \times 6 \times 6 \times 6$ , l)  $2^8$
- 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) 1, c) 9, 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) 216, b) 16, c) 256, d) 1, e) 32, f) 256, g) 81, h) 0, i) 64,  
j) 1, k) 27, l) 343, m) 729, n) 512, o) 1024, p) 1, q) 256,  
r) 729
- Skill 15.6** a) 8 and 9, b) 4 and 5, c) 2 and 3, d) 7 and 8, e) 5 and 6  
f) 4 and 5, g) 8 and 9, h) 8 and 9, i) 7 and 8, j) 9 and 10  
k) 6 and 7, l) 9 and 10
- Skill 15.7** 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 131

- Skill 16.1** a) 14, b) 7, c) 11, d) 4, e) 3, f) 18, g) 20, h) 2, i) 20, j) 6  
k) 24, l) 4, m) 16, n) 11, o) 30, p) 12, q) 70, r) 18
- Skill 16.2** a) 17, b) 9, c) 5, d) 30, e) 8, f) 18, g) 0, h) 10, i) 19, j) 17  
k) 25, l) 13, m) 16, n) 9, o) 7, p) 4, q) 16, r) 23, s) 23  
t) 16, u) 16
- Skill 16.3** a) 3, b) 7, c) 8, d) 8, e) 4, f) 16, g) 14, 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) 50, b) 9, c) 2, d) 3, e) 1, f) 4, g) 48, h) 30, i) 55, j) 4, k) 7  
l) 108, m) 12, n) 50, o) 10, p) 18, q) 37, r) 28, s) 7  
t) 15, u) 8
- Skill 16.5** a) 170, b) 14, c) 23, d) 30, e) 59, f) 288, g) 4, 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

- 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) 2, e) 6, f) 9, g) 3, h) 5, i) 80, j) 100  
k) 7000, l) 500, m) 5000, n) 1, o) 20000, p) 700, q) 0.02  
r) 0.006, s) 0.8, t) 0.03, 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) 12600, k) 714, l) 14063, m) 60540  
n) 31007, o) 403200, p) 800050, q) 1900026  
r) 7600040
- Skill 17.4** a) two hundred and sixteen, b) ninety-five, c) ninety  
d) four hundred and thirteen, e) seven hundred and six  
f) five hundred and twenty, g) eight hundred  
h) six hundred and nine, i) five hundred and seventy  
j) three thousand, eight hundred  
k) four thousand, two hundred, l) two thousand and four  
m) five thousand and seven  
n) three thousand and twelve, o) eight thousand and 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 and ninety  
v) seventeen thousand and eight  
w) nine hundred and three thousand  
x) four hundred and six thousand  
y) one hundred and two thousand  
z) nine hundred and five thousand
- Skill 17.5** a) 12000, b) 920, c) 8600, d) 410, e) 660, f) 49000  
g) 1700, h) 21000, i) 2310, j) 1400, k) 11000, l) 3700  
m) 170, n) 5600
- Skill 17.6** a) 0.24, 0.204, 0.042, 0.04 b) 0.059, 0.095, 0.509, 0.95  
c) 0.06, 0.063, 0.306, 0.36 d) 0.87, 0.847, 0.478, 0.407  
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 17.7** a)  $\frac{3}{10}$ , b)  $\frac{7}{8}$ , c)  $\frac{7}{8}$ , d)  $\frac{1}{2}$ , e)  $\frac{1}{2}, \frac{3}{5}, \frac{5}{8}$  f)  $\frac{2}{3}, \frac{7}{10}, \frac{3}{4}$
- Skill 17.8** a) 13, b) 52, c) 80, d) 6, e) 0.431, f) 27.90, g) 0.6, h) 9.8  
i) 7.84, j) 0.086, k) 0.5, l) 0.197
- Skill 17.9** 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 17.10** 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

- 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) 7, 14, 21, 28, 35  
j) 12, 24, 36, 48, 60
- 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) 36, b) 21, c) 44, d) 40, e) 18, f) 20, g) 36, h) 24, i) 40  
j) 45
- Skill 18.4** a) no, b) yes, c) no, d) yes, e) 1, 2, 3, 4, 6, 8, 12, 24  
f) 1, 2, 3, 4, 6, 9, 12, 18, 36, g) 4, h) 36, i) 49, j) 18
- Skill 18.5** a) 1, 2, 4, b) 1, 2, 3, 6, c) 1, 2, 5, 10, d) 1, 2, 3, 6,  
e) 1, 5, 9, 15, f) 1, 5, g) 1, 2, 3, 4, 6, 12, h) 1, 2, 7, 14
- Skill 18.6** a) 8, b) 3, c) 5, d) 20, e) 24, f) 16, g) 6, h) 25, 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)  $120 = 3 \times 4 \times 2 \times 5 = 3 \times 2 \times 2 \times 2 \times 2 \times 5$
- b)  $105 = 3 \times 5 \times 7$
- c)  $68 = 2 \times 34 = 2 \times 2 \times 17$
- d)  $42 = 6 \times 7 = 2 \times 3 \times 7$
- e)  $75 = 3 \times 25 = 3 \times 5 \times 5$
- f)  $100 = 10 \times 10 = 2 \times 5 \times 2 \times 5$
- g)  $84 = 4 \times 21 = 2 \times 2 \times 3 \times 7$
- h)  $150 = 6 \times 25 = 2 \times 3 \times 5 \times 5$
- i)  $80 = 8 \times 10 = 2 \times 4 \times 2 \times 5 = 2 \times 2 \times 2 \times 2 \times 5$
- j)  $36 = 3 \times 12 = 3 \times 3 \times 4 = 3 \times 3 \times 2 \times 2$
- k)  $64 = 8 \times 8 = 2 \times 4 \times 2 \times 4 = 2 \times 2$
- l)  $160 = 8 \times 20 = 2 \times 4 \times 5 \times 4 = 2 \times 2 \times 2 \times 2 \times 5 \times 2 \times 2$
- m)  $144 = 9 \times 16 = 3 \times 3 \times 4 \times 4 = 3 \times 3 \times 2 \times 2 \times 2 \times 2$
- n)  $280 = 4 \times 70 = 2 \times 2 \times 7 \times 10 = 2 \times 2 \times 7 \times 2 \times 5$
- Skill 18.9** a)  $110 = 2 \times 5 \times 11$ , b)  $65 = 5 \times 13$ , c)  $69 = 3 \times 23$   
d)  $27 = 3 \times 3 \times 3$ , e)  $124 = 2 \times 2 \times 31$ , f)  $198 = 2 \times 3 \times 3 \times 11$   
g)  $81 = 3 \times 3 \times 3 \times 3$ , h)  $40 = 2 \times 2 \times 2 \times 5$
- Skill 18.10** a)  $450 = 2 \times 3^2 \times 5^2$ , b)  $200 = 2^3 \times 5^2$ , c)  $360 = 2^3 \times 3^2 \times 5$   
d)  $64 = 2^6$ , e)  $900 = 2^2 \times 3^2 \times 5^2$ , f)  $576 = 2^6 \times 3^2$

## 19. [Number Patterns]

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- Skill 19.1** a) 16, 20, b) 25, 31, c) 29, 34, d) 16, 18, e) 21, 25, f) 42, 50  
g) 35, 43, h) 30, 37, i) 46, 57, j) 41, 50
- Skill 19.2** a) 34, 30, b) 6, 4, c) 5, 2, d) 10, 5, e) 10, 6, f) 14, 8,  
g) 40, 31, h) 10, 3, i) 32, 22, j) 14, 5
- Skill 19.3** a) 1.4, 1.7, b) 3.2, 2.6, c) 2.5, 2.7, d) 3, 3.5, e) 4.1, 4.8  
f) 1.5, 1.2, g) 3.4, 3.0, h) 5.4, 6.5, i) 3.2, 3.8, j) 1.3, 0.9
- Skill 19.4** a)  $\frac{9}{7}, \frac{11}{7}$  b)  $\frac{14}{8}, \frac{17}{8}$  c)  $\frac{14}{11}, \frac{17}{11}$  d)  $\frac{22}{10}, \frac{19}{10}$  e)  $\frac{33}{11}, \frac{31}{11}$  f)  $\frac{17}{12}, \frac{15}{12}$   
g)  $\frac{20}{9}, \frac{15}{9}$  h)  $\frac{17}{15}, \frac{13}{15}$
- Skill 19.5** a) 

lingonail	2	4	6	8	10
toenail	0.5	1	1.5	2	2.5

 b) 

White roses	2	4	6	8	10
Red roses	3	6	9	12	15
- c) 

No. of days	1	2	3	4	5	6
Length of worms (m)	4	8	12	16	20	24

 d) 

calories (hundreds)	17	34	51	68	85
day	1	2	3	4	5
- e) 

Number of bedrooms	1	2	3	4	5
Cost per week (\$)	200	275	350	425	500

 f) 

No. of days	10	20	30	40	50	60
Teeth regenerated	3	3.6	4.2	4.8		6
- g) 

Time (min)	10	15	20	25	30
Energy (cal)	240	280	320	360	400

 h) 

men	1	2	3	4	5	6
women	2	4	6	8	10	12
- Skill 19.6** a) 256, 1024, b) 243, 729, c) 80, 160, d) 1250, 6250,  
e) 6, 12, f) 700, 7000, g) 1, 2, h) 18, 54, i) 12.5, 62.5,  
j) 180, 1080
- Skill 19.7** a)  $32, \frac{32}{5}$ , b) 4, 1, c) 18, 6, d) 150, 50, e) 0.01, 0.001, f) 9, 3  
g) 0.9, 0.45, h) 0.5, 0.1, i)  $7, \frac{1}{7}$ , j)  $2, \frac{1}{2}$
- Skill 19.8** a) 48, 60, b) 32, 30, c) 19, 4, d) 17, 23, e) 5, 2, f) 15, 19  
g) 47, 65, h) 16, 4, i) 81, 121, j) 27, 8
- Skill 19.9** a) -11, -19, b) 0, 4, c) 3, 9, d) -7, -10, e) -7, -12  
f) 11, 17, g) -19, -28, h) 5, 12, i) -9, -13, j) 9, 17
- Skill 19.10** a) 27, b) 13, c) 120, d) 120, e) 184, f) 1000, g) 31, h) 35  
i) 43, j) 50, k)  $\frac{1}{20}$ , l)  $\frac{1}{256}$
- Skill 19.11** a) 6, b) 25, c) 5, d) 24, e) 41, f) 20, g) 52, h) 2, i) 101, j) 70

## 20. [Expressions]

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- Skill 20.1** a)  $4n$ , b)  $2a$ , c)  $2u$ , d)  $3t$ , e)  $4w$ , f)  $5z$ , g)  $x$ , h)  $2m$ , i)  $2e$ , j)  $2k$   
k)  $p$ , l)  $2d$ , m)  $2ab$ , n)  $3pq$ , o)  $4fg$ , p)  $4xy$ , q)  $5tu$ , r)  $2lm$   
s)  $ab$ , t)  $3wx$ , u)  $2de$
- Skill 20.2** a)  $5m$ , b)  $6h$ , c)  $7g$ , d)  $4j$ , e)  $6z$ , f)  $2b$ , g)  $4q$ , h)  $a$ , i)  $2k$ , j)  $4r$   
k)  $7f$ , l)  $6a$ , m)  $11z$ , n)  $7m$ , o)  $9h$ , p)  $5j$ , q)  $3c$ , r)  $6s$ , s)  $6op$   
t)  $xy$ , u)  $6kl$ , v)  $7mn$ , w)  $ij$ , x)  $6bc$
- Skill 20.3** a)  $n + 14$ , b)  $b + c$ , c)  $7 + g$ , d)  $x + y$ , e)  $w - 9$ , f)  $v - 5$ , g)  $3m$   
h)  $2d$ , i)  $2d$ , j)  $3m$ , k)  $11p$ , l)  $7z$ , m)  $2y$  cm, n)  $4b$ , o)  $a + b$   
p)  $6m$ , q)  $400 - d$ , r)  $200 - r$ , s)  $x - 70$ , t)  $h - 5$ , u) B, v) A  
w) B, x) B
- Skill 20.4** 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)  $4a$ ,  $a$ , j)  $cd$ ,  $2cd$ , k)  $2w$ ,  $w$ , l)  $2g$ ,  $5g$   
m)  $-x$ ,  $3x$ , n)  $4y$ ,  $-y$ , o)  $-pq$ ,  $2pq$ , p)  $2no$ ,  $no$ , q)  $3j$ ,  $-3j$   
r)  $3st$ ,  $st$
- Skill 20.5** a)  $2s + r$ , b)  $2d + e$ , c)  $2h + i$ , d)  $2a + 2b$ , e)  $2l + 2m$   
f)  $3r + s$ , g)  $2x + 3y$ , h)  $3e + 2f$ , i)  $m + 2n$ , j)  $t + 2u$   
k)  $jk + 2kl$ , l)  $2qr + rs$ , m)  $2cd + de$ , n)  $5h + i$ , o)  $3j + 5k$   
p)  $4g + 3$ , q)  $4l + 1$ , r)  $x + y$ , s)  $5p + 6q$ , t)  $3a + 2b$   
u)  $3j + 2k$

## 21. [Substitution]

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- 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) 3, n) 20, o) 12, p) 15, q) 21, r) 18
- Skill 21.2** a) 54, b) 12, c) 10, d) 21, e) 32, f) 42, g) 30, h) 18, i) 35, j) 8  
k) 6, l) 6, m) 9, n) 8, o) 7, p) 8, q) 8, r) 12
- Skill 21.3** a) 2, b) 11, c) 11, d) 37, e) 22, f) 23, g) 40, h) 28, i) 6, j) 7  
k) 11, l) 5, m) 9, n) 1, o) 4
- Skill 21.4** a) 7, b) -27, c) -16, d) -1, e) 17, f) 2, g) 10, h) -13, i) 2  
j) -36, k) 24, l) 30, m) -3, n) -3, o) -4, p) -10, q) -26  
r) -26
- Skill 21.5** a) 17, b) 10, c) 14, d) 12, e) 8, f) 6, g) 23, h) -3, i) -10  
j) -7, k) -17, l) -15, 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) 10, h) 40, i) 0, j) 6  
k) 5, l) -8, m) 9, n) 14, o) 9, p) 0, q) -140, r) 105
- Skill 21.7** a) 19, b) 11, c) 7, d) 90, e) 0, f) 11, g) 8, h) -90, i) -18, j) -9  
k) 3, l) -1
- Skill 21.8** a) 1600, b) 26, c) 62.8, d) 81, e) 50, f) 190, g) 28, h) 72  
i) 30, j) 100, k) 512, l) 154
- Skill 21.9** a) 15, b) 64, c) 24, d) 100, e) 14, f) 1, g) 40, h) 210, i) 20  
j) 55, k) -128, l) 20
- Skill 21.10** a) 30, b) 12, c) 20, d) 60, e) 12, f) 99, g) 90, h) -16, i) -28  
j) 90, k) -24, l) 80, m) -9, n) -3, o) 30
- Skill 21.11** a) 20, b) 77, c) 70, d) 48, e) 36, f) 40, g) 28, h) 21, i) 40  
j) 5, k) 4, l) 28

## 22. [Equations]

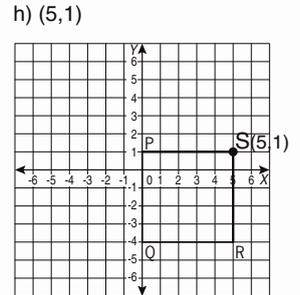
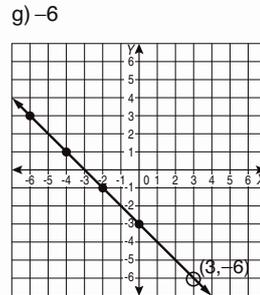
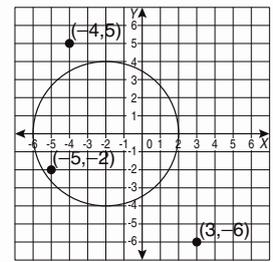
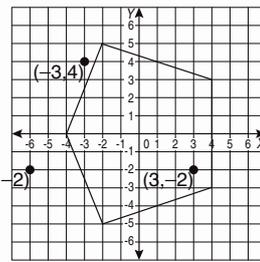
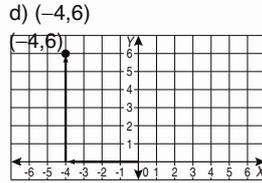
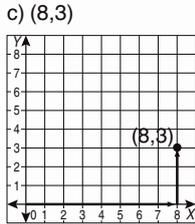
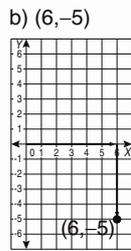
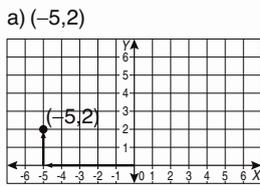
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- Skill 22.1** a) 7, b) 8, c) 6, d) 9, e) 7, f) 13, g) 12, h) 7, i) 21, j) 9, k) 27  
l) 5, m) 17, n) 16, o) 11, p) 14, q) 18, r) 20, s) 25, t) 33  
u) 27, v) 35, w) 9, x) 7, y) 15, z) 24, A) 20
- Skill 22.2** a) 15, b) 4, c) 8, d) 6, e) 5, f) 8, g) 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, A) -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) 10, 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, A) 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) 12, q) -2, r) 7, s) -8  
t) -3, u) -10, v) 36, w) 30, x) 24, y) 21, z) 96, A) 60, B) 72  
C) 90, D) 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

Skill 23.5

a) M(-4,1) N(4,-3), b) A(0,-3) B(-4,2) C(1,4), c) M, d) G e) C f) B

Skill 23.1



Skill 23.2

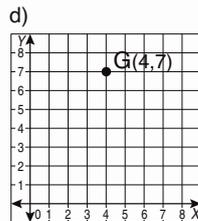
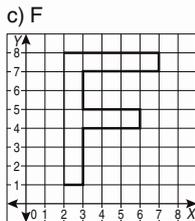
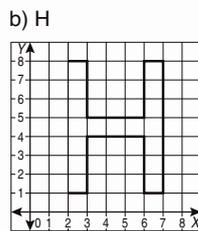
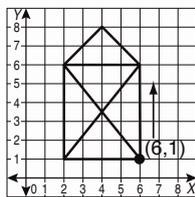
a) Egypt, b) South America, c) scientist, d) Española e) Mount Orto, f) I3, g) J6, h) G7, i) E1, j) C2

Skill 23.3

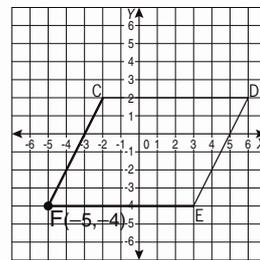
a) (4,1), b) Christchurch, c) (7,3), d) (4,3)

Skill 23.4

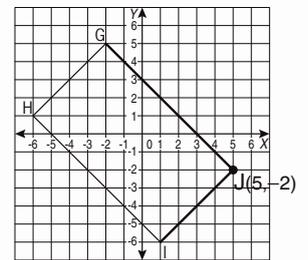
a) house



i) (-5,-4)



j) (5,-2)



Skill 23.6

a)

Houses sold (x)	Earnings (2000x)
1	2000 × 1 = 2000
2	2000 × 2 = 4000
3	2000 × 3 = 6000
4	2000 × 4 = 8000
5	2000 × 5 = 10 000
6	2000 × 6 = 12 000

b)

No. of guests (x)	Dinner cost in dollars (15x)
4	15 × 4 = 60
8	15 × 8 = 120
12	15 × 12 = 180
16	15 × 16 = 240
20	15 × 20 = 300
24	15 × 24 = 360

c)

No. of days (x)	Records entered (90x)
1	90 × 1 = 90
2	90 × 2 = 180
3	90 × 3 = 270
4	90 × 4 = 360
5	90 × 5 = 450
6	90 × 6 = 540

d)

No. of days (x)	Number of T-shirts sold (16x)
1	16 × 1 = 16
2	16 × 2 = 32
3	16 × 3 = 48
4	16 × 4 = 64
5	16 × 5 = 80
6	16 × 6 = 96

e)

No. of hours worked (x)	Pay in dollars (8x)
2	8 × 2 = 16
4	8 × 4 = 32
6	8 × 6 = 48
8	8 × 8 = 64
10	8 × 10 = 80
12	8 × 12 = 96

f)

No. of s (x)	Distance travelled in metres (18x)
10	18 × 10 = 180
20	18 × 20 = 360
30	18 × 30 = 540
40	18 × 40 = 720
50	18 × 50 = 900
60	18 × 60 = 1080

g)

x	y = x + 5	y
0	y = 0 + 5 = 5	5
1	y = 1 + 5 = 6	6
2	y = 2 + 5 = 7	7
3	y = 3 + 5 = 8	8
4	y = 4 + 5 = 9	9
5	y = 5 + 5 = 10	10

h)

x	y = 8 - x	y
3	y = 8 - 3 = 5	5
4	y = 8 - 4 = 4	4
5	y = 8 - 5 = 3	3
6	y = 8 - 6 = 2	2
7	y = 8 - 7 = 1	1
8	y = 8 - 8 = 0	0

i)

x	y = 7 + x	y
0	y = 7 + 0 = 7	7
2	y = 7 + 2 = 9	9
4	y = 7 + 4 = 11	11
6	y = 7 + 6 = 13	13
8	y = 7 + 8 = 15	15
10	y = 7 + 10 = 17	17

j)

x	y = x - 4	y
0	y = 0 - 4 = -4	-4
1	y = 1 - 4 = -3	-3
2	y = 2 - 4 = -2	-2
3	y = 3 - 4 = -1	-1
4	y = 4 - 4 = 0	0
5	y = 5 - 4 = 1	1

# 23. [Coordinates] (cont.)

## Skill 23.10

### Skill 23.6

k)

x	y = 3x	y
0	$y = 3 \times 0 = 0$	0
1	$y = 3 \times 1 = 3$	3
2	$y = 3 \times 2 = 6$	6
3	$y = 3 \times 3 = 9$	9
4	$y = 3 \times 4 = 12$	12
5	$y = 3 \times 5 = 15$	15

l)

x	y = x - 6	y
1	$y = 1 - 6 = -5$	-5
2	$y = 2 - 6 = -4$	-4
3	$y = 3 - 6 = -3$	-3
4	$y = 4 - 6 = -2$	-2
5	$y = 5 - 6 = -1$	-1
6	$y = 6 - 6 = 0$	0

m)

x	y = 100 ÷ x	y
5	$y = 100 \div 5 = 20$	20
10	$y = 100 \div 10 = 10$	10
20	$y = 100 \div 20 = 5$	5
25	$y = 100 \div 25 = 4$	4
50	$y = 100 \div 50 = 2$	2
100	$y = 100 \div 100 = 1$	1

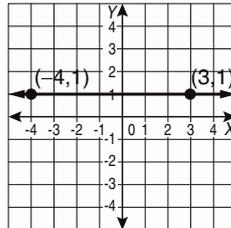
n)

x	y = 2 - x	y
0	$y = 2 - 0 = 2$	2
1	$y = 2 - 1 = 1$	1
2	$y = 2 - 2 = 0$	0
3	$y = 2 - 3 = -1$	-1
4	$y = 2 - 4 = -2$	-2
5	$y = 2 - 5 = -3$	-3

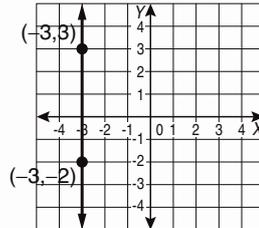
### Skill 23.7

a) C, b) B, c) A, d) B

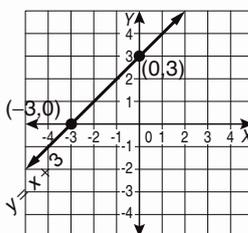
e)



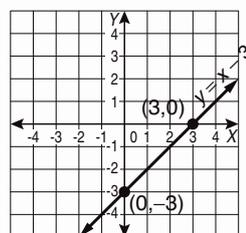
f)



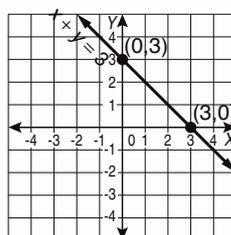
g)



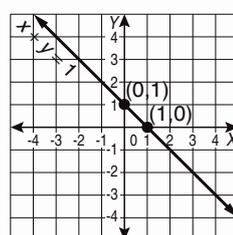
h)



i)



j)



### Skill 23.8

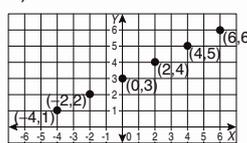
a) 1400 m, b) 4:45 pm, c) 2 h 20 min, d) 40°C, e) 200 min  
f) 4:45 pm, g) 14 min, h) 2, i) Lavinia, j) 3:40 pm, k) C

- l) A) ~~Stopped for lunch~~  
B) ~~Driving on a dirt road~~  
C) ~~Driving on a freeway~~

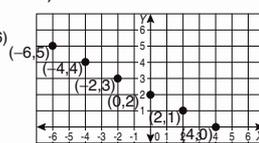
m) 4:20 pm, n) 5 km

### Skill 23.9

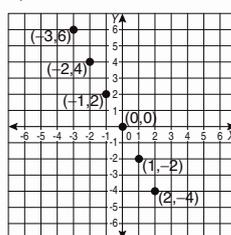
a)



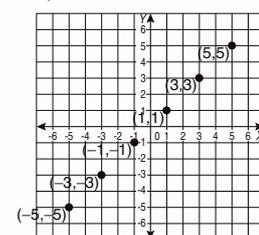
b)



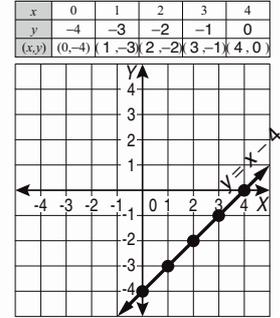
c)



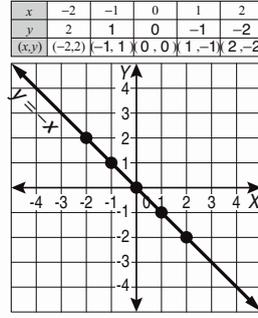
d)



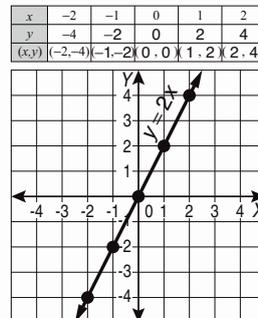
b)



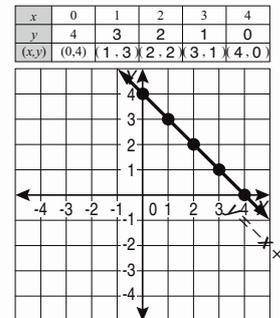
a)



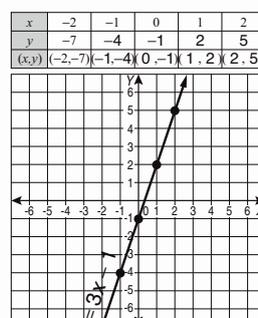
c)



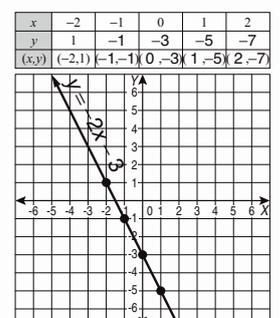
d)



e)



f)



# 24. [Units of Measurement / Time] page 227

### Skill 24.1

a) 8 min, b) 420 min, c) 180 s, d) 3 min, e) 540 min, f) 4 h  
g) 5 h, h) 300 s, i) 96 h, j) 21 days, k) 120 months, l) 120 h  
m) 1.5 h, n) 4.5 h, o) 215 min, p) 330 s, q) 32 days  
r) 170 min, s) 145 s, t) 370 min, u) 56 h, v) 195 min  
w) 18 h, x) 150 min

### Skill 24.2

a) 150 mm, b) 6 cm, c) 2000 mm, d) 7000 m, e) 9 km  
f) 400 cm, g) 13000 mm, h) 40 cm, i) 55000 m, j) 11 km  
k) 8200 mm, l) 270 cm, m) 3 km, n) 50 m, o) 4.6 cm  
p) 45 mm, q) 9.1 m, r) 3000 cm, s) 0.7 m, t) 3800 m  
u) 1600 mm, v) 0.6 km, w) 200 m, x) 3700 mm

### Skill 24.3

a) 6000 kg, b) 9 kg, c) 7 tonnes, d) 9300 g, e) 4.5 kg  
f) 16 kg, g) 2000 kg, h) 1900 g, i) 20 kg, j) 30 t

### Skill 24.4

a) 1500 mL, b) 8000 mL, c) 22000 mL, d) 4 L  
e) 70000 mL, f) 20300 mL, g) 900 mL, h) 6400 mL, i) 20 L  
j) 15300 mL, k) 0.1 L, l) 0.95 L

### Skill 24.5

a) 6655000 m, b) 9000 mL, c) 120000 kg, d) 100 cm  
e) 238 s, f) less than, g) 1.3 tonnes, h) 4500 mL  
i) 45000 g, j) 0.33 L

### Skill 24.6

a) 8 h 20 min, b) 2 h 30 min, c) 2 h 55 min, d) 5 h 20 min  
e) 10 h 35 min, f) 8 h 40 min

### Skill 24.7

a) 1:15 pm, b) 1:30 pm, c) 5:00 pm, d) 8:00 pm, e) 3 h  
f) 7 h 50 min

## 25. [Perimeter]

page 237

- Skill 25.1** a) 8 cm, b) 160 mm, c) 12 cm, d) 18 cm, e) 150 mm  
f) 170 mm.
- Skill 25.2** a) 140 mm, b) 16 cm, c) 14 cm, d) 89 mm, e) 150 mm  
f) 10.5 cm, g) 17 cm, h) 108 mm, i) 12 cm, j) 98 mm  
k) 14 cm, l) 126 mm, m) 123 mm, n) 135 mm
- Skill 25.3** a) 70 mm, b) 92 mm, c) 90 mm, d) 88 mm, e) 14.5 cm  
f) 134 mm
- Skill 25.4** a) 48 m, b) 1420 cm, c) 118 mm, d) 120 mm, e) 108 m  
f) 160 km
- Skill 25.5** a) 164 mm, b) 17 cm, c) 90 mm, d) 12.5 cm, e) 152 mm  
f) 16.2 cm
- Skill 25.6** a) 30 mm, b) 1.5 cm, c) 47 mm, d) 45 mm
- Skill 25.7** a) 18.84 cm, b) 6.28 cm, c) 88 mm, d) 132 mm  
e) 125.6 mm, f) 62.8 mm, g) 157 mm, h) 176 mm, i) 44 mm  
j) 94.2 mm
- Skill 25.8** a) 15 cm, b) 18 cm, c) 180 mm, d) 27 cm, e) 122 mm  
f) 124 mm

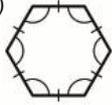
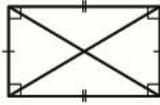
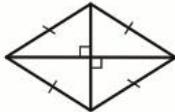
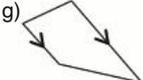
## 26. [Area / Volume]

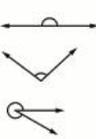
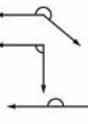
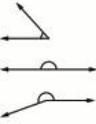
page 247

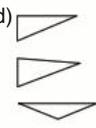
- Skill 26.1** a) 4.5 cm<sup>2</sup>, b) 6 cm<sup>2</sup>, c) 21 cm<sup>2</sup>, d) 12 cm<sup>2</sup>, e) 10 cm<sup>2</sup>  
f) 6 cm<sup>2</sup>, g) 12 cm<sup>2</sup>, h) 11 cm<sup>2</sup>, i) 8 cm<sup>2</sup>, j) 13 cm<sup>2</sup>  
k) 12 cm<sup>2</sup>, l) 8 cm<sup>2</sup>, m) 9 cm<sup>2</sup>, n) 12 cm<sup>2</sup>
- Skill 26.2** 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 26.3** a) 9 sq. units, b) 10 sq. units, c) 21 sq. units, d) 14 sq. units
- Skill 26.4** a) 14 cm<sup>2</sup>, b) 6 cm<sup>2</sup>, c) 9 cm<sup>2</sup>, d) 8 cm<sup>2</sup>, e) 8 cm<sup>2</sup>  
f) 600 mm<sup>2</sup>, g) 100 mm<sup>2</sup>, h) 6.25 cm<sup>2</sup>, i) 9 cm<sup>2</sup>  
j) 1200 mm<sup>2</sup>, k) 640 mm<sup>2</sup>, l) 5.25 cm<sup>2</sup>, m) 1100 mm<sup>2</sup>  
n) 720 mm<sup>2</sup>
- Skill 26.5** a) 5 cm<sup>2</sup>, b) 10.5 cm<sup>2</sup>, c) 7.5 cm<sup>2</sup>, d) 625 mm<sup>2</sup>, e) 3 cm<sup>2</sup>  
f) 520 mm<sup>2</sup>, g) 7.5 cm<sup>2</sup>, h) 400 mm<sup>2</sup>, i) 135 mm<sup>2</sup>  
j) 825 mm<sup>2</sup>
- Skill 26.6** a) 72 cm<sup>3</sup>, b) 1200 cm<sup>3</sup>, c) 30 cm<sup>3</sup>, d) 200 cm<sup>3</sup>, e) 90 cm<sup>3</sup>  
f) 60 cm<sup>3</sup>, g) 160 cm<sup>3</sup>, h) 72 cm<sup>3</sup>, i) 180 cm<sup>3</sup>, j) 150 cm<sup>3</sup>  
k) 108 cm<sup>3</sup>, l) 105 cm<sup>3</sup>
- Skill 26.7** a) 16800 mm<sup>3</sup>, b) 12 cm<sup>3</sup>, c) 6.25 cm<sup>3</sup>, d) 1000 mm<sup>3</sup>  
e) 3 m<sup>3</sup>, f) 10800 mm<sup>3</sup>, g) 3375 mm<sup>3</sup>, h) 22.5 cm<sup>3</sup>  
i) 13.5 cm<sup>3</sup>, j) 18000 mm<sup>3</sup>
- Skill 26.8** a) 4.5 cm<sup>2</sup>, 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 cm<sup>2</sup>, h) 7 cm<sup>2</sup>, i) 770 mm<sup>2</sup>, j) 11 cm<sup>2</sup>
- Skill 26.9** a) 392 mm<sup>2</sup>, b) 750 mm<sup>2</sup>, c) 10 cm<sup>2</sup>, d) 625 mm<sup>2</sup>
- Skill 26.10** a) 20.13 cm<sup>2</sup>, b) 1386 mm<sup>2</sup>, c) 6.28 cm<sup>2</sup>, d) 8.56 cm<sup>2</sup>
- Skill 26.11** a) 2500 mm<sup>3</sup>, b) 17 cm<sup>3</sup>, c) 2.1 m<sup>3</sup>, d) 9900 mm<sup>3</sup>, e) 15 cm<sup>3</sup>  
f) 9000 mm<sup>3</sup>

## 27. [Shapes]

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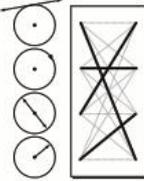
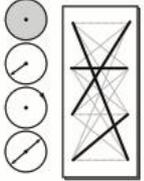
- Skill 27.1** a) 55°, b) 50°, c) 90°, d) 60°, e) 155°, f) 20°, g) 140°  
h) 35°, i) 85°, j) 125°, k) 40°, l) 160°
- Skill 27.2** a) 120°, b) 75°, c) 30°, d) 170°, e) 100°, f) 145°, g) 45°  
h) 30°, i) 110°, j) 120°, k) 130°, l) 15°
- Skill 27.3** a)  b)  c)   
d)  e)  f)   
g)  h) 

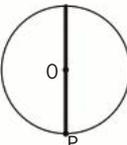
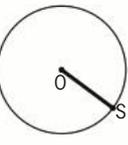
- Skill 27.4** a)  obtuse  
 reflex  
straight  
obtuse  
b)  reflex  
straight  
obtuse  
c)  straight  
right  
reflex  
d)  acute  
reflex  
straight  
e)  reflex  
straight  
obtuse  
f)  reflex  
straight  
obtuse  
g)  reflex  
straight  
obtuse  
h)  reflex  
straight  
obtuse

- Skill 27.5** a)  obtuse-angled  
right-angled  
acute-angled  
b)  obtuse-angled  
right-angled  
acute-angled  
c)  equilateral  
scalene  
isosceles  
d)  obtuse-angled  
right-angled  
acute-angled

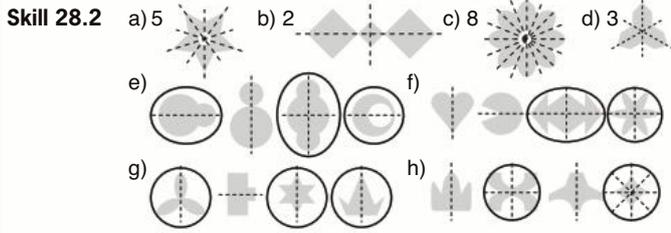
- e) C, f) D
- Skill 27.6** a) B, b) C, c) D, d) C, e) B, f) C, g) D, h) C
- Skill 27.7** a) B, b) C

- c)  d)  e)  f)   
g)  h)  i)  j)   
k)  l)  m)  n)   
o)  p) 
- Skill 27.8** a) rectangular pyramid  b) cube   
c) triangular prism  d) pentagonal prism   
e) octagonal prism  f) hexagonal pyramid 

- Skill 27.9** a) 24°, b) 145°, c) 18°, d) 21°, e) 63°, f) 39°, g) 17°, h) 20°
- Skill 27.10** a) 113°, b) 48°, c) 40°, d) 55°, e) 90°, f) 20°  
g)  $x^\circ = 115^\circ$ ,  $y^\circ = 75^\circ$ , h)  $x^\circ = 40^\circ$ ,  $y^\circ = 140^\circ$
- Skill 27.11** a) 35°, b) 56°, c) 25°, d) 102°, e) 55°, f) 48°, g) 108°, h) 75°
- Skill 27.12** a) 96°, b) 62°, c) 100°, d) 45°, e) 105°, f) 83°
- Skill 27.13** a)  diameter  
circumference  
radius  
tangent  
b)  circumference  
radius  
diameter  
area

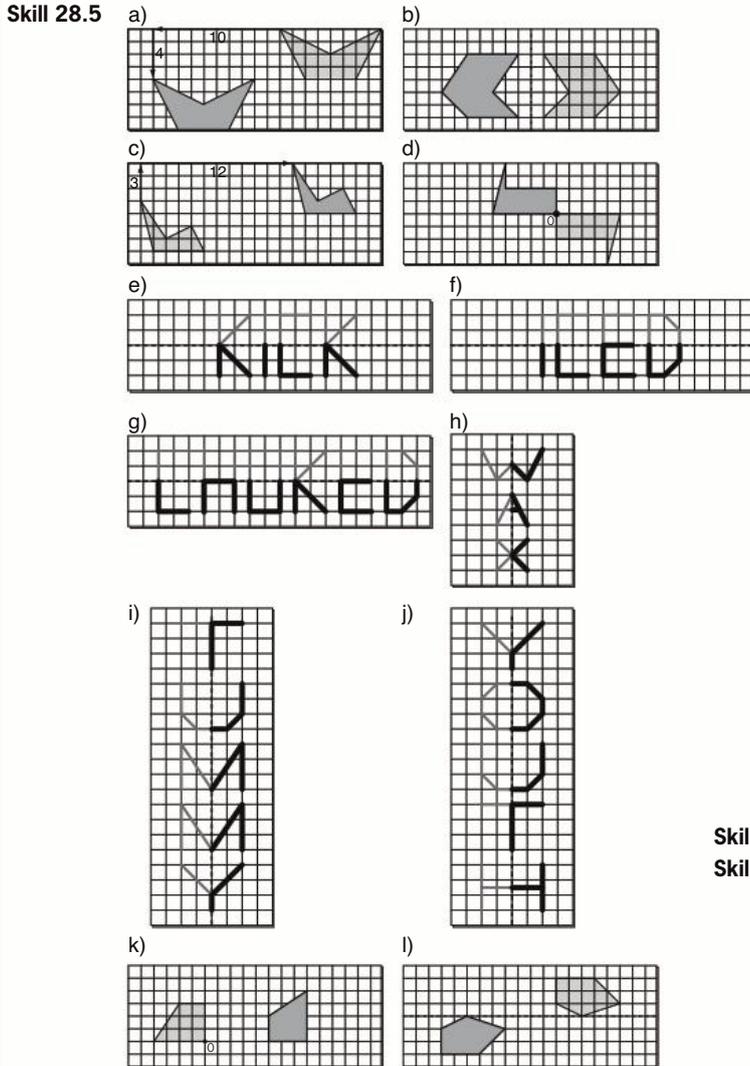
- c) B, d) D, e),  f) 

Skill 28.1 a) Dean Street, b) west, c) 2, d) Dodge Hall

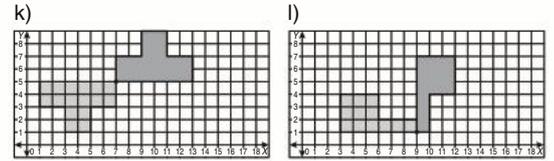
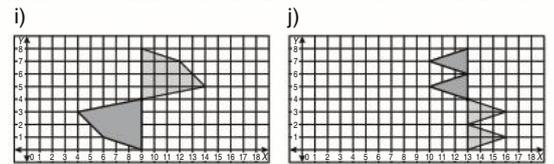
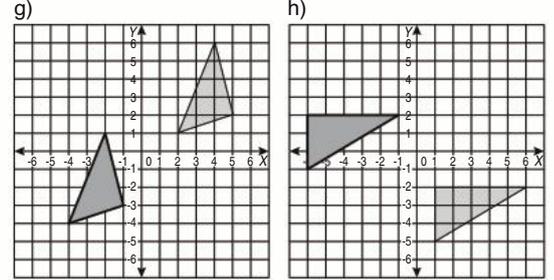
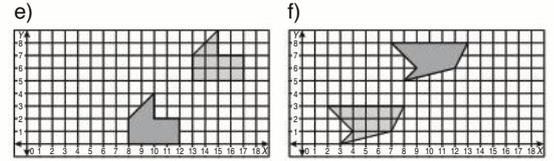
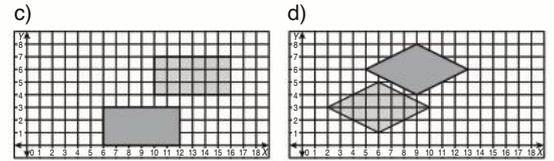
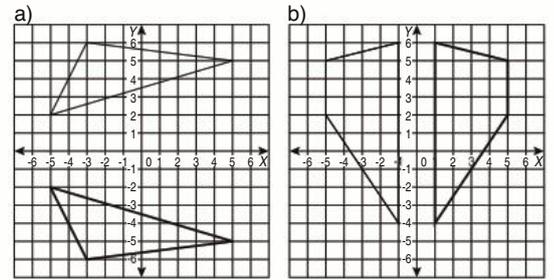
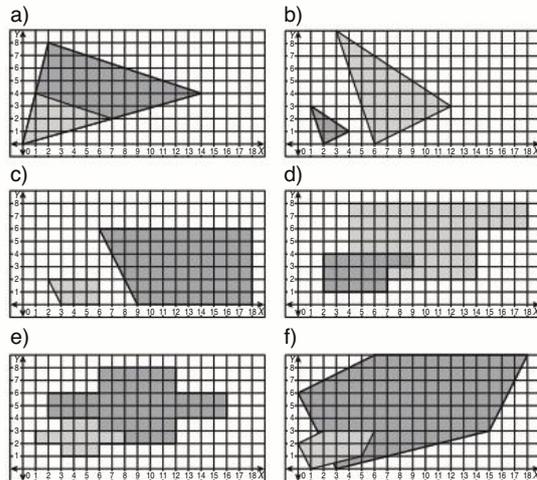


Skill 28.3 a) 1250 m, b) 4500 km, c) 700 m, d) 2 km

Skill 28.4 a) 180°, b) 90°, c) 45°, d) 180°, e) 30°, f) 270°, g) 135°  
h) 225°, i) 90°, j) 135°

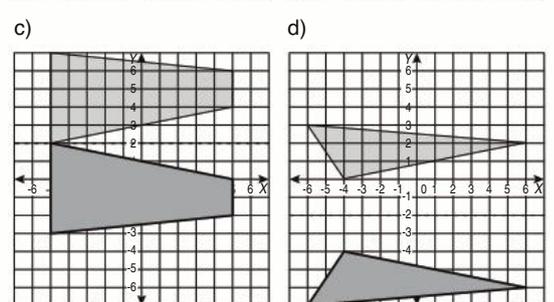
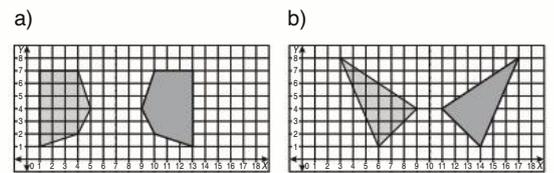


Skill 28.6



Skill 28.8 a) A, b) C, c) B, d) B

Skill 28.9



## 29. [Statistics] page 293

- Skill 29.1** a) 8, b) 25, c) 9, d) 6  
**Skill 29.2** a) Queen Victoria, b) Porsche (Taycan), c) England, d) hydro-electric  
**Skill 29.3** a) stork, b) anthracite, c) writing, d) 5, e) Mt Buller, f) flea  
**Skill 29.4** a) 3, b) 4, c) bottle-nosed dolphin, d) gorilla  
 e) 1983, 1987 and 1989, f) Haiti, g) 55%, h) U10  
 i) 1, j) 1 kg cheese  
**Skill 29.5** a) Emerson, b) Court, c) 80%, d) 30 - 44 yr, e) UK  
 f) National Book Critics Circle Award, g) WA  
 h) Shooting, i) harp seal, j) Germany  
**Skill 29.6** a) 5, b) 6.5, c) 11.5, d) 22°C, e) 16, f) 4, g) 120, h) 4.7  
 i) mean = 5, median = 5, j) mean = 27, median = 26.5  
**Skill 29.7** a) mode = 4, range = 33, b) mode = 1, range = 9  
 c) mode = 5, range = 28, d) mode = 40, range = 55  
**Skill 29.8** a) 1.5%, b) 5 am, c) 1860 - 1870, d) 5 h, e) 4.5%  
 f) 2012 - 2013, g) Saturday, h) 2010, i) Australia, j) 6  
**Skill 29.9** a) OECD, b) hydrogen, c) B, d) dogs & cats, e) C, f) no  
**Skill 29.10** a) 

Stem	Leaf
1	2 2 9
2	1 4
3	1 7 8 8 9
4	0 1 4 5

 b) 

Stem	Leaf
18	4
19	3 3 3 6 6 6 6 8
20	0 2 4

 Key: 2|1 = 21, 19|5 = 195 cm  
 c) median = 19, range = 9, d) median = 119.5, range = 59  
 e) median = 15, range = 26, f) median = 118, range = 99  
**Skill 29.11** a) fit, b) bituminous, c) glass bottle, d) elephant, e) urine  
 f) bat, g) 8, h) more, i) shorter, j) B, k) B, l) A

## 30. [Probability] page 311

- 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		Primary colour		
		R	G	B
Coin	H	R,H	G,H	B,H
	T	R,T	G,T	B,T

c) 12

Possible outcomes		Die					
		1	2	3	4	5	6
Coin	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		Spinner				
		1	2	3	4	5
Coin	H	1,H	2,H	3,H	4,H	5,H
	T	1,T	2,T	3,T	4,T	5,T

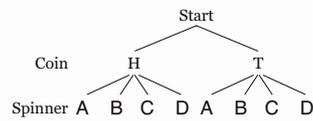
e) 6

Outcomes (sample space)	
silver	convertible
silver	hardtop
red	convertible
red	hardtop
purple	convertible
purple	hardtop

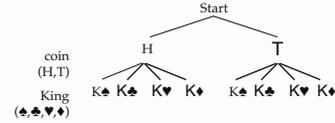
f) 8

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

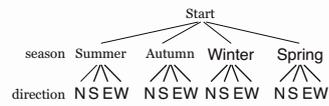
**Skill 30.4** a) 8



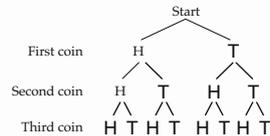
b) 8



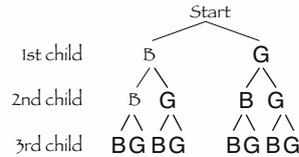
c) 16



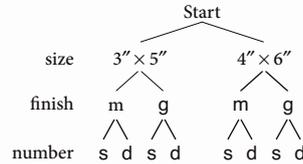
d) 8



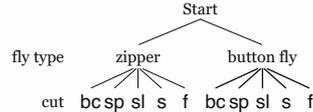
e) 8



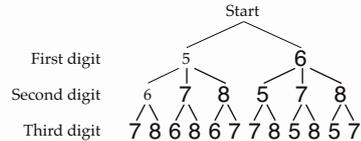
f) 8



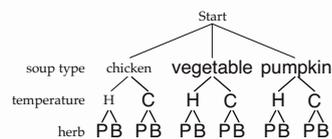
g) 10



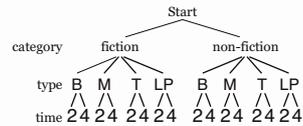
h) 12



i) 12



j) 16



- Skill 30.5** a)  $\frac{6}{13}$ , b)  $\frac{1}{2}$ , c)  $\frac{1}{2}$ , d)  $\frac{1}{8}$ , e)  $\frac{1}{2}$ , f)  $\frac{2}{11}$ , g)  $\frac{1}{13}$ , h)  $\frac{1}{15}$ , i)  $\frac{1}{6}$   
 j)  $\frac{1}{4}$ , k)  $\frac{1}{2}$ , l)  $\frac{1}{4}$ , m)  $\frac{1}{2}$ , n)  $\frac{7}{10}$ , o)  $\frac{1}{6}$ , p)  $\frac{2}{5}$ , q)  $\frac{3}{10}$ , 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)  $\frac{1}{6}$

**Skill 30.8** a) 98%, b)  $\frac{2}{3}$ , c)  $\frac{3}{5}$ , d)  $\frac{7}{10}$ , e)  $\frac{16}{25}$ , f) 23%

**Skill 30.9** a)  $\frac{3}{4}$ , b)  $\frac{1}{3}$ , c)  $\frac{3}{4}$ , d) 1

**Skill 30.10** a) 60, b) 120, c) 12, d) 24, e) 20, f) 720, g) 30, h) 36, i) 20  
 j) 120