

MASTER MATHS

STEVE PESCOTT

8

First published in 2016 by Leading Educational Resources
Produced in Australia by the publisher

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Cover Design by Damien Raggatt

National Library of Australia Cataloguing-in-Publication entry:

Creator: Pescott, S. J., author.

Title: Master Maths 8 : Australian Curriculum Edition / Steve Pescott

ISBN: 9780975783436 (ebook)

Target Audience: For secondary school age.

Subjects: Mathematics--Study and teaching (Secondary)--Australia Mathematics--Textbooks

Dewey Number: 510

Produced in Australia by
Leading Educational Resources

Website: www.leadedres.com.au

Email: info@leadedres.com.au

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Acknowledgments

The author would like to thank the following people.

Sharon Bird for proof-reading, assisting with answers and advice.

Chris Moloney for the hand drawn artwork.

Damien Raggatt for the cover design.

Sallyann Pescott for her support and encouragement.

Beryl Adcock for proof-reading the first edition of the book.

Photos

www.123rf.com - pp. 36, 49, 58, 67, 95, 96, 100, 103, 104, 112, 113, 115, 119, 123, 124, 129, 130, 131, 134, 143, 155, 174, 175, 179, 182, 202, 215, 232, 270, 272, 285, 292, 294, 300, 302, 367, 368, 377, 381, 393, 394, 398, 399, 400, 414, 421

Tim Pescott - pp. 137, 406

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Dedication

I would like to dedicate this book to my late father for his constant inspiration, support and encouragement.

John Watsford Pescott (26/2/1931 - 1/3/2001)

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Numbers

Numbers

EXERCISE 1A

1. Write the following numbers in numeral form.

Example Five thousand and eight in numeral form is **5008**

- (a) eighty seven
- (b) five hundred and thirty
- (c) seven hundred and one
- (d) three thousand and eighteen
- (e) nine thousand, two hundred and sixty-four
- (f) seven thousand, two hundred and seven
- (g) ten thousand and one
- (h) twenty-five thousand and thirty-three
- (i) one hundred and nine thousand, seven hundred and forty-six
- (j) three hundred and two million, fifty-seven thousand and nine

2. Write the following numbers in words.

- (a) 905
- (b) 3491
- (c) 8056
- (d) 207 090
- (e) 831 471
- (f) 1 010 101
- (g) 4 005 700
- (h) 20 020 020

3. Write the following numbers in order from the ***smallest*** to the ***largest***.

73 867	72 987	73 859	73 856	72 795
72 978	73862	72 985	72 975	73 589

4. (a) List all the numbers that can be formed using all the digits **8, 7** and **1**.

(b) From this list:

- (i) write the numbers which are ***even***.
- (ii) write the numbers which are ***odd***.
- (iii) write the numbers which are larger than 700.
- (iv) write the numbers which are smaller than 800.
- (v) write the numbers that are between 700 and 800.

5. Choose the correct symbol (< or >) to place between the following pairs of numbers.

Examples Remember the crocodile wants to eat the **larger** number.

1. 18 28



Answer: 18 < 28 18 < 28

2. 397 379

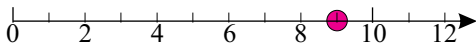


Answer: 397 > 379 397 > 379

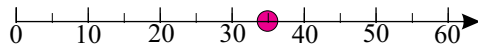
- (a) 399 405 (b) 87 59 (c) 1027 985 (d) 1257 1260
 (e) 3745 3766 (f) 1976 1967 (g) 2098 2103 (h) 5431 5433

6. Write the number shown by the dot on the number lines below.

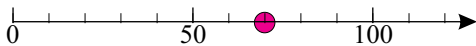
(a)



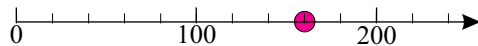
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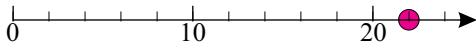
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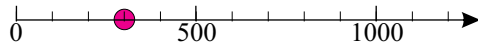
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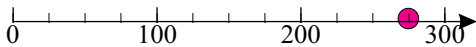
(e)



(f)



(g)



(h)



7. Round the following numbers to the nearest **ten**.

Examples

1. 58

Answer 60
 (58 is closer to 60 than 50)

2. 403

Answer 400
 (403 is closer to 400 than 410)

3. 885

Answer 890
 (When the number ends in 5 round **up**)

- (a) 8 (b) 52 (c) 87 (d) 196
 (e) 745 (f) 1723 (g) 2504 (h) 17 998

8. Round the numbers in question 7 to the nearest **hundred**.

Addition and Subtraction

EXERCISE 1B

1. Find the answers to the following calculations using *mental arithmetic*.

- | | | | |
|-----------------|-----------------|-----------------|-----------------|
| (a) $6 + 2$ | (b) $8 - 5$ | (c) $8 + 7$ | (d) $17 - 9$ |
| (e) $25 + 41$ | (f) $58 - 35$ | (g) $26 + 37$ | (h) $62 - 45$ |
| (i) $50 + 64$ | (j) $90 - 67$ | (k) $124 + 66$ | (l) $222 - 131$ |
| (m) $257 + 139$ | (n) $565 - 248$ | (o) $458 + 563$ | (p) $917 - 222$ |

2. Find the answers to the following calculations by:

- (i) carefully setting out your workings.
 (ii) checking your answers with a calculator.

- | | |
|------------------------------|--------------------------|
| (a) $6789 + 7053$ | (b) $12\,309 + 588 + 44$ |
| (c) $568 + 7891 + 53 + 6042$ | (d) $5689 - 4297$ |
| (e) $5703 - 946$ | (f) $35\,687 - 5778$ |

3. From the numbers below find all the pairs that:

(a) differ by 10.

(b) differ by 100.

1087, 1098, 1118, 1129, 1119, 998, 987, 1219, 1108, 1008, 977, 1019, 877

4. Each symbol or letter in the following calculations represents a different digit. Find the digits to make the calculations correct.

(a)

$$\begin{array}{r} \text{AA} \\ + \text{BB} \\ \hline \text{CBC} \end{array}$$

(b)

$$\begin{array}{r} \spadesuit \clubsuit 7 \diamondsuit \\ + \clubsuit \spadesuit 4 \clubsuit \\ \hline \diamondsuit 9 2 \spadesuit \end{array}$$

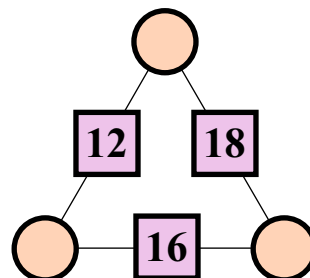
(c)

$$\begin{array}{r} \text{MN} 9 \\ - \text{PMN} \\ \hline \text{P} 5 \text{M} \end{array}$$

(d)

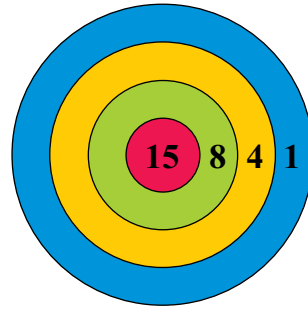
$$\begin{array}{r} \star \star \star 0 \\ - \star \star \star \star \\ \hline \star \star \star \end{array}$$

5. Complete the following diagram so that the numbers in the squares are the sum of the two adjoining numbers in the circles.



6. If five darts are thrown at this dart board (and they all hit the board) show what scores would add to the following totals.

(a) 5 (b) 15 (c) 20 (d) 25
(e) 35 (f) 40 (g) 50 (h) 75



7. Use seven 4's and addition signs to form a calculation that is equal to 100.
8. The sum of Russell's age and his father's age is 96.
Russell's father was 22 when Russell was born.
How old is Russell?
9. Find three consecutive numbers that add to 114.
10. What number is as much more than ten as it is less than half of what 30 is ten less than?
11. In Year 8 at Brainiac Secondary College there are 136 students.
There are eight more girls than boys. How many girls are in Year 8?
12. There were 78 926 people who lived in Muruparra and 65 725 people who lived in Timaroo.
A major industry moved from Muruparra to Timaroo and the population of Muruparra dropped to 72 691.
If all the people who left Muruparra moved to Timaroo, find the new population of Timaroo.
13. Complete the following patterns.
(a) 0, 1, 3, 6, 10, 15, __, __, __.
(b) 140, 135, 125, 110, 90, __, __, __.
(c) 1, 1, 2, 3, 5, 8, 13, __, __, __.
(d) 1000, 980, 940, 880, 800, __, __, __.
14. Using these numbers:
(a) find three that add to 100.
(b) find four that add to 100.
(c) find three that add to 75.

31 32 14 33
18 17 29 37

Multiplication and Division

EXERCISE 1C

1. Write the answers to the following multiplications.

- (a) 3×6 (b) 5×8 (c) 9×2 (d) 4×4 (e) 10×7
 (f) 2×12 (g) 8×11 (h) 3×8 (i) 7×5 (j) 6×9
 (k) 12×4 (l) 10×9 (m) 7×7 (n) 8×6 (o) 11×11
 (p) 9×8 (q) 4×9 (r) 8×7 (s) 9×12 (t) 6×6

2. Write the answers to the following divisions.

- (a) $10 \div 2$ (b) $66 \div 11$ (c) $80 \div 8$ (d) $20 \div 4$ (e) $42 \div 7$
 (f) $60 \div 5$ (g) $48 \div 12$ (h) $18 \div 3$ (i) $36 \div 6$ (j) $27 \div 9$
 (k) $18 \div 2$ (l) $110 \div 11$ (m) $80 \div 10$ (n) $56 \div 8$ (o) $63 \div 7$
 (p) $36 \div 4$ (q) $144 \div 12$ (r) $27 \div 3$ (s) $30 \div 6$ (t) $72 \div 9$

3. Find the missing numbers from the following calculations.

- (a) $8 \times \underline{\quad} = 24$ (b) $36 \div \underline{\quad} = 4$ (c) $5 \times \underline{\quad} = 25$ (d) $72 \div \underline{\quad} = 12$
 (e) $\underline{\quad} \div 8 = 2$ (f) $\underline{\quad} \times 7 = 77$ (g) $\underline{\quad} \div 9 = 10$ (h) $12 \times \underline{\quad} = 132$
 (i) $8 \times \underline{\quad} = 56$ (j) $81 \div \underline{\quad} = 9$ (k) $\underline{\quad} \div 3 = 7$ (l) $9 \times \underline{\quad} = 72$

4. Without using a calculator evaluate the following products.

- (a) 58×6 (b) 205×8 (c) 647×7 (d) 6058×4
 (e) 89×15 (f) 176×33 (g) 279×49 (h) 560×213

5. Without using a calculator evaluate the following divisions.

- (a) $192 \div 3$ (b) $413 \div 7$ (c) $4368 \div 8$ (d) $21\,474 \div 6$

6. Karley used a bucket to fill her fish tank. The bucket held 9 litres of water and it took 6 buckets to fill the tank.

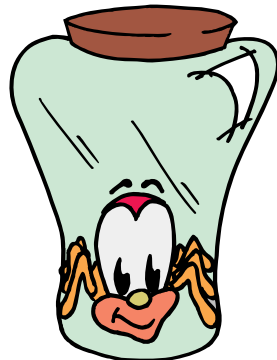
How many litres of water does the tank hold?

7. Zina collects spiders and beetles.

She has a total of 15 spiders and beetles in her collection.

Between them they have a total of 100 legs.

How many spiders and beetles does she have?



8. Ann is 28 years older than her son Daniel. If Daniel's age was multiplied by nine, the result would be the same as twice Ann's age. How old are Ann and Daniel?
9. The product of two consecutive whole numbers is 552. Find the two numbers.
10. The sum of two numbers is 27. The product of the numbers is 72. Find the two numbers.
11. The Earth travels through space at a speed of 72 360 km/hr.
 (a) How far does it travel in a day?
 (b) How far does it travel in a minute?
12. A year in a dog's life is equal to seven human years. If Peter's dog, Tess, was a human, she would be twice Peter's age. If Peter was a dog, he would be two years younger than Tess. How old are Tess and Peter?
13. Each symbol in these calculations represents a different digit. Find the digits to make the calculations correct.



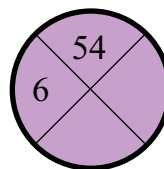
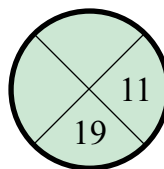
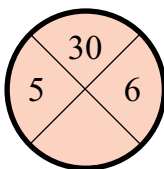
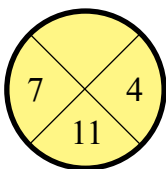
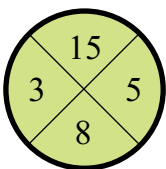
(a)

$$\begin{array}{r}
 \text{frowny} \ 5 \ \text{happy} \\
 \times \ \text{neutral} \ 5 \\
 \hline
 \text{neutral} \ \text{happy} \ \text{frowny} \ \text{skull} \\
 \text{happy} \ \text{skull} \ 5 \ \text{frowny} \ \text{skull} \\
 \hline
 \text{happy} \ \text{happy} \ 8 \ \text{happy} \ \text{skull}
 \end{array}$$

(b)

$$\begin{array}{r}
 9 \ \text{alien} \ \text{alien} \ 5 \\
 8 \ \text{spider} \ \text{spider} \ 3 \ \text{spider} \ 0
 \end{array}$$

14. Use links between the numbers in the first circle to complete the other circles.



BODMAS

When solving problems that involve **brackets**, **of** (eg. $\frac{1}{2}$ of 8) and/or the **four operations** ($\div$, $\times$, $+$, $-$) the following rules must be observed.

1. The order that the operations are performed follow BODMAS:

Brackets must be calculated first, followed by **Of's**, followed by **Divisions** and **Multiplications** and finally **Additions** and **Subtractions**.

BRACKETS
OF
{ **DIVISION**
{ **MULTIPLICATION**
{ **ADDITION**
{ **SUBTRACTION**

2. If the problem does not involve all the operations then the order remains the same ignoring the operations missing.
3. If there is a succession of division and multiplication operations these are performed in order from the left to the right.
4. If there is a succession of addition and subtraction operations these are performed in order from the left to the right.

Examples

$$\begin{aligned} 1. \quad & 6 + 5 \times 4 && \text{There are no } \textit{brackets} \text{ or } \textit{of's} \\ & = 6 + 20 && \text{The next operations are } \textit{division} \text{ or } \textit{multiplication} \\ & = 26 \end{aligned}$$

$$\begin{aligned} 2. \quad & 2 \times (8 - 5) \\ & = 2 \times 3 && \textit{Brackets} \text{ first} \\ & = 6 \end{aligned}$$

$$\begin{aligned} 3. \quad & 8 + (13 - 1) \div \frac{1}{2} \text{ of } 6 \\ & = 8 + 12 \div \frac{1}{2} \text{ of } 6 && \textit{Brackets} \text{ first} \\ & = 8 + 12 \div 3 && \textit{Of} \text{ next} \\ & = 8 + 4 && \textit{Division} \text{ next} \\ & = 12 \end{aligned}$$

$$\begin{aligned} 4. \quad & 10 - 8 + 4 + 3 && \text{When there is a succession} \\ & = 2 + 4 + 3 && \text{of } \textit{additions} \text{ and } \textit{subtractions} \\ & = 6 + 3 && \text{perform these in order from} \\ & = 9 && \text{left to right} \end{aligned}$$

Examples continued

$$\begin{aligned}
 5. \quad & 4 \times 6 \div 8 \times 12 \div 6 \div 3 \\
 &= 24 \div 8 \times 12 \div 6 \div 3 \\
 &= 3 \times 12 \div 6 \div 3 \\
 &= 36 \div 6 \div 3 \\
 &= 6 \div 3 \\
 &= 2
 \end{aligned}$$

When there is a succession of *divisions* and *multiplications* perform these in order from left to right

$$6. \quad 7 + 8 \div 4 - \frac{1}{2} \text{ of } 6 \times (5 - 3)$$

$$\begin{aligned}
 &= 7 + 8 \div 4 - \frac{1}{2} \text{ of } 6 \times 2 && \text{Brackets first} \\
 &= 7 + 8 \div 4 - 3 \times 2 && \text{Of next} \\
 &= 7 + 2 - 6 && \text{Division and Multiplication next} \\
 &= 9 - 6 && \text{Addition and Subtraction from} \\
 &= 3 && \text{left to right}
 \end{aligned}$$

$$7. \quad 6 \times (8 - 3) + (9 + 3) \times 2 - 10 \div 5$$

$$\begin{aligned}
 &= 6 \times 5 + 12 \times 2 - 10 \div 5 \\
 &= 30 + 24 - 2 \\
 &= 54 - 2 \\
 &= 52
 \end{aligned}$$

$$8. \quad (6 \times 7 - 2) - (\frac{1}{4} \text{ of } 20 + 7) \div 3 + 6 \times 2 - 7$$

$$\begin{aligned}
 &= (6 \times 7 - 2) - (5 + 7) \div 3 + 6 \times 2 - 7 \\
 &= (42 - 2) - 12 \div 3 + 6 \times 2 - 7 \\
 &= 40 - 12 \div 3 + 6 \times 2 - 7 \\
 &= 40 - 4 + 12 - 7 \\
 &= 36 + 12 - 7 \\
 &= 48 - 7 \\
 &= 41
 \end{aligned}$$

EXERCISE 1D

1. Solve the following problems without using a calculator.

- | | |
|---|--|
| (a) $16 + 10 \div 2$ | (b) $6 + \frac{1}{2}$ of 14 |
| (c) $5 + (8 - 2)$ | (d) $4 \times (3 + 5)$ |
| (e) $8 + 3 \times 2 - 5$ | (f) $10 \div 2 + 3 \times 4$ |
| (g) $7 + (6 - 3) \times 2$ | (h) $6 + \frac{1}{2}$ of $10 - 1$ |
| (i) $8 \times 6 - 4 \div 2 + 2$ | (j) $36 \div 9 + 6 \times 2$ |
| (k) $10 \times (5 - 3) \div 2 \div 5 \times 3$ | (l) $\frac{1}{2}$ of $(8 + 2) - 20 \div 4$ |
| (m) $3 + 6 \div 2 + 2 \times 5$ | (n) $4 \times (2 + 1) \div (10 - 6)$ |
| (o) $8 + 2 \times \frac{1}{2}$ of $16 - 4 \times (8 - 3)$ | (p) $3 \times (6 + 2) - \frac{1}{2}$ of $[(6 + 14) \div 5] \times 5$ |

2. Rewrite these equations and include the operations (+, -, $\times$ or $\div$) to make the equations correct.

Example

$$2*3*5 = 17$$

This equation would be **$2 + 3 \times 5 = 17$**

- | | |
|--------------------|-------------------|
| (a) $8*4*4 = 9$ | (b) $20*5*4 = 1$ |
| (c) $10*10*5 = 12$ | (d) $8*4*2 = 0$ |
| (e) $8*2*5 = 9$ | (f) $8*2*5 = 18$ |
| (g) $8*6*3 = 10$ | (h) $8*6*3 = 16$ |
| (i) $6*8*2*5 = 4$ | (j) $2*3*4*5 = 9$ |
| (k) $3*5*2*8 = 5$ | (l) $8*4*3*1 = 5$ |

3. Using the numbers 1, 2, 3 and 4 form different equations that equal all the numbers 0, 1, 2, ...20.

Any of the operations (+, -, $\times$ and/or $\div$) or brackets can be used and the numbers 1, 2, 3 and 4 must **all** be used but only **once**.

Examples

$$2 + 3 - 1 - 4 = 0$$

$$3 - 4 \div 2 - 1 = 0$$

Multiples of 10 / Rounding

EXERCISE 1E

1. Without using a calculator evaluate the following.

- | | | |
|----------------------|------------------------|-------------------------|
| (a) 500×10 | (b) 20×100 | (c) 300×100 |
| (d) 200×400 | (e) 7000×200 | (f) 500×500 |
| (g) $3000 \div 10$ | (h) $400 \div 100$ | (i) $80\,000 \div 1000$ |
| (j) $600 \div 20$ | (k) $20\,000 \div 200$ | (l) $90\,000 \div 3000$ |

2. Round the numbers in the following questions to the nearest 10 before multiplying.

Example 87×33

Round each number to the nearest 10 then evaluate the answer:

$$90 \times 30 = 2700$$

- | | | |
|--------------------|---------------------|---------------------|
| (a) 58×21 | (b) 93×48 | (c) 77×22 |
| (d) 86×78 | (e) 54×124 | (f) 264×98 |

3. Round the numbers in the following questions to the nearest 100 before multiplying.

- | | | |
|----------------------|-----------------------|-----------------------|
| (a) 688×111 | (b) 893×485 | (c) 777×283 |
| (d) 806×780 | (e) 1554×137 | (f) 2684×976 |

4. For the following questions, round the numbers, then choose the **best** answer without using a calculator.

- (a) Scientists wanted to find the number of rare wattle trees in a state park. They counted 87 trees in a square kilometre. The state park is 214 square kilometres.

Approximately how many wattle trees are in the state park?

- A** 16 000 **B** 18 000 **C** 24 000 **D** 27 000

- (b) A box of oranges weighed 58 kg (58 000 grams).

One orange weighed 220 grams.

Approximately how many oranges were in the box?

- A** 200 **B** 300 **C** 3000 **D** 12 000

Factors

EXERCISE 1F

1. Write *all* the factors of the following numbers.

Example 18

All the factors of 18 are **1, 2, 3, 6, 9, 18**

- (a) 12 (b) 36 (c) 27 (d) 80 (e) 112
(f) 56 (g) 300 (h) 23 (i) 144 (j) 171

2. Find the factors that are common to the following pairs of numbers.

Example 20 and 30

The factors of 20 are 1, 2, 4, 5, 10, 20

The factors of 30 are 1, 2, 3, 5, 6, 10, 15, 30

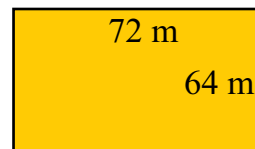
The **common factors** are **1, 2, 5, 10**

- (a) 12, 16 (b) 15, 27 (c) 16, 20 (d) 24, 36 (e) 56, 60

3. Write the highest common factor (H.C.F.) for each of the pairs of numbers in question 2.

Example The highest common factor of 20 and 30 is **10**

4. Neil is a farmer who wanted to fence one of the paddocks on his farm. The paddock is 72 metres long and 64 metres wide. Neil wanted the fence posts to be the same distance apart all around the paddock, with the gap between posts to be as large as possible.



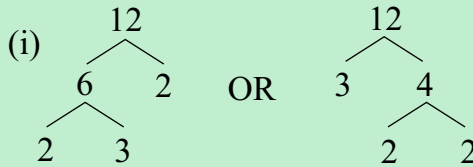
- (a) What is the maximum gap between the posts?
(b) How many posts will he need?
5. Hayley, Nathan and Jacqui work on Saturdays. On one Saturday they worked different hours. Hayley earned \$72, Nathan earned \$63 and Jacqui earned \$45. They all worked for the same hourly rate.
- (a) What was the hourly rate that they earned (dollars per hour)?
(b) How many hours did each person work?

Prime Numbers / Prime Factors

EXERCISE 1G

- Write all the factors of the following numbers.
(a) 7 (b) 17 (c) 29 (d) 61 (e) 163
- The numbers in question 1 are all **prime numbers**. Why?
- Find which of the following numbers are prime numbers.
5 9 39 59 91 137 207 667
- (i) Complete the factor trees for the following numbers.
(ii) Write each number as a product of its prime factors.

Example 12



Both these factor trees are correct.

(ii) The prime factors are $2 \times 3 \times 2$ or $3 \times 2 \times 2$

- (a) 24 (b) 18 (c) 56 (d) 64 (e) 224

- Write the products of the prime factors from question 4 in index form.

Examples $12 = 2 \times 3 \times 2 = 2 \times 2 \times 3 = 2^2 \times 3$

$360 = 2 \times 2 \times 2 \times 3 \times 3 \times 5 = 2^3 \times 3^2 \times 5$

- Find the numbers represented by the products of prime factors shown below.

Example $2^2 \times 3^4 = 2 \times 2 \times 3 \times 3 \times 3 \times 3 = 324$

- (a) $2^3 \times 3^2$ (b) $2^4 \times 3$ (c) $3^2 \times 5$ (d) $5^2 \times 7$
(e) 2×5^3 (f) $3^2 \times 5^2$ (g) $7^2 \times 11^2$ (h) $2^2 \times 3^2 \times 5^2$

Multiples

EXERCISE 1H

1. For the pairs of numbers below:

- list the first eight multiples of each number.
- underline the multiples common to both numbers.
- circle the lowest common multiple (L.C.M.).

Example 6, 8

6, 12, 18, 24, 30, 36, 42, 48
 8, 16, 24, 32, 40, 48, 56, 64

24 is the *lowest common multiple* of 6 and 8

- | | | | |
|----------|------------|----------|------------|
| (a) 3, 8 | (b) 6, 10 | (c) 4, 6 | (d) 8, 12 |
| (e) 6, 3 | (f) 10, 12 | (g) 5, 7 | (h) 12, 20 |

2. Find the lowest common multiple of the following groups of numbers.

- | | | | |
|----------|-----------|-------------|--------------|
| (a) 7, 8 | (b) 8, 20 | (c) 3, 4, 6 | (d) 5, 8, 12 |
|----------|-----------|-------------|--------------|

3. In the year 2050 the astrophysicist, Professor Talli Skope, discovers three comets in the skies over Australia. He calls them Skope I, Skope II and Skope III. He finds that Skope I reappears every 4 years, Skope II reappears every 5 years and Skope III reappears every 12 years.

In what year will the following events occur?

- Skope I next appears.
- Skope I and Skope II next both appear.
- Skope II and Skope III next both appear.
- Skope I and Skope III next both appear.
- Skope I, Skope II and Skope III next appear all together.



Powers and Square Roots

EXERCISE 11

1. Calculate the following.

- (a) 1^2 (b) 2^2 (c) 3^2 (d) 4^2 (e) 5^2

2. These are the first five square numbers. Without using a calculator evaluate the next five square numbers.

3. Use the x^2 button on your calculator to find the following.

- (a) 13^2 (b) 25^2 (c) 47^2 (d) 86^2 (e) 123^2

4. Use the $\sqrt{}$ button on your calculator to find the following.

- (a) $\sqrt{196}$ (b) $\sqrt{324}$ (c) $\sqrt{729}$ (d) $\sqrt{9801}$ (e) $\sqrt{44\,100}$

5. Without using a calculator find the following.

- (a) $\sqrt{16}$ (b) $\sqrt{25}$ (c) $\sqrt{49}$ (d) $\sqrt{100}$ (e) $\sqrt{144}$

6. Write the following numbers as powers of ten.

Example $10\,000 = 10 \times 10 \times 10 \times 10 = 10^4$

- (a) 1000 (b) 10 000 000 (c) one thousand million

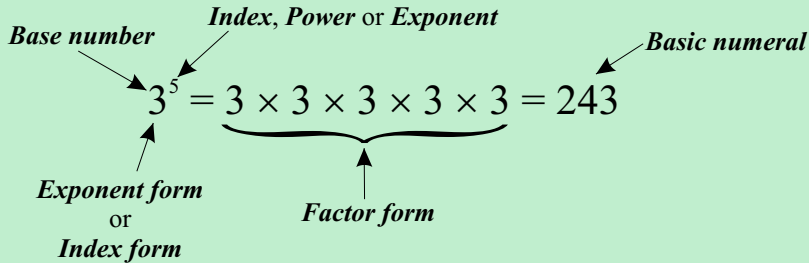
7. Write the following numbers in *scientific notation*.

Example $80\,000 = 8 \times 10\,000 = 8 \times 10^4$

- (a) 5000 (b) 700 000 (c) 6 000 000 000 000
 (d) The population of New York is 20 000 000.
 (e) The speed of light is 300 000 000 metres per second.
 (f) The mass of the sun is 2 000 000 000 000 000 000 000 000 kg.
 (g) The most eggs laid by an animal at one time is 30 000 000 by the ocean sunfish.
 (h) There are 50 000 000 000 000 000 000 000 000 atoms of carbon in a kilogram.
 (i) The closest star to our solar system is Proxima Centauri which is 40 000 000 000 000 km away.

Index Laws

Example



Note: the *plural* of *index* is *indices*

EXERCISE 1J

1. Write the following in factor form.

Examples

$$1. \quad 4^3 = 4 \times 4 \times 4$$

$$2. \quad 3^8$$
$$= 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3$$

(a) 2^4
(f) 3^2

(b) 6^7
(g) 13^5

(c) 10^2
(h) 2^{12}

(d) 9^8
(i) 4^6

(e) 8^{11}
(j) 1^{10}

(f) 3^2

(g) 13^5

(h) 2^{12}

(i) 4^6

(j) 1¹⁰

2. Write the following in index form.

Examples

1. $5 \times 5 \times 5$
 $= 5^3$

2. $3 \times 3 \times 3 \times 3 \times 3 \times 3$
 $= 3^6$

(a) $6 \times 6 \times 6 \times 6$

(b) $9 \times 9 \times 9 \times 9 \times 9 \times 9$

(c) $2 \times 2 \times 2 \times 2 \times 2$

(d) $12 \times 12 \times 12 \times 12 \times 12$

(e) 15×15

(f) $3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3$

(g) $5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5$

(h) $1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1$

3. Write the following in factor form then combine into index form.

Example

$$\begin{aligned}
 & 5^3 \times 5^4 \\
 & \swarrow \quad \searrow \\
 & \underbrace{5 \times 5 \times 5} \times \underbrace{5 \times 5 \times 5 \times 5} \\
 & = 5^7
 \end{aligned}$$

(a) $3^2 \times 3^4$

(b) $2^3 \times 2^2$

(c) $7^5 \times 7^3$

(d) $6^3 \times 6^5$

(e) $5^3 \times 5^3$

(f) $10^2 \times 10^6$

(g) $9^4 \times 9^3$

(h) $8^6 \times 8^5$

(i) $6^4 \times 6^4$

(j) $1^7 \times 1^3$

(k) $5^4 \times 5^5$

(l) $7^5 \times 7^2$

4. Can you think of a way of finding the answers in question 3 without writing the factors?

Index Law 1

Index Law 1 states:

If terms with the **same base number** are multiplied, the indices can be **added**.

Note: It is not necessary to show an index of 1.

$$8 = 8^1, \quad 4 = 4^1, \quad 2 = 2^1, \quad 12 = 12^1, \text{ etc}$$

Examples

$$\begin{aligned}
 1. \quad & 4^6 \times 4^7 \\
 & = 4^{(6+7)} \\
 & = 4^{13}
 \end{aligned}$$

$$\begin{aligned}
 2. \quad & 7^8 \times 7^6 \\
 & = 7^{(8+6)} \\
 & = 7^{14}
 \end{aligned}$$

$$\begin{aligned}
 3. \quad & 6^4 \times 6 \\
 & = 6^4 \times 6^1 \\
 & = 6^{(4+1)} \\
 & = 6^5
 \end{aligned}$$

$$\begin{aligned}
 4. \quad & 9 \times 9^{14} \\
 & = 9^1 \times 9^{14} \\
 & = 9^{(1+14)} \\
 & = 9^{15}
 \end{aligned}$$

5. Use Index Law 1 to find the answers to the following in index form.

(a) $6^3 \times 6^7$

(b) $5^4 \times 5^8$

(c) $4^9 \times 4^2$

(d) $8^6 \times 8$

(e) $2^{10} \times 2^5$

(f) $13^6 \times 13^8$

(g) 3×3^8

(h) $15^7 \times 15^4$

(i) $9^{14} \times 9^{13}$

(j) $17^8 \times 17^{14}$

(k) 11×11^{12}

(l) $26^{15} \times 26$

EXERCISE 1K

1. Write the following in factor form then simplify and write the answer in index form.

Example

$$\begin{aligned} & \frac{6^5}{6^2} \\ = & \frac{6 \times 6 \times 6 \times 6 \times 6}{6 \times 6} \\ = & \frac{6 \times 6 \times 6 \times \cancel{6} \times \cancel{6}}{\cancel{6} \times \cancel{6}} \\ = & \frac{6 \times 6 \times 6}{1} \\ = & 6 \times 6 \times 6 \\ = & 6^3 \end{aligned}$$

The two 6's on the denominator (bottom line) can be cancelled with two 6's on the numerator (top line).

(a) $\frac{4^5}{4^2}$

(b) $\frac{2^6}{2^4}$

(c) $\frac{7^7}{7^3}$

(d) $\frac{9^6}{9^2}$

(e) $\frac{5^8}{5^5}$

(f) $\frac{10^7}{10}$

(g) $\frac{3^6}{3^3}$

(h) $\frac{6^9}{6^2}$

(i) $\frac{8^8}{8^6}$

(j) $\frac{11^9}{11^5}$

(k) $\frac{2^5}{2}$

(l) $\frac{13^4}{13^3}$

(m) $\frac{3^5}{3^4}$

(n) $\frac{15^7}{15^5}$

(o) $\frac{20^4}{20}$

(p) $\frac{7^9}{7^7}$

2. Can you think of a way of finding the answers in question 1 without writing the factors?

Index Law 2

Index Law 2 states:

If terms with the **same base number** are divided, the index on the denominator (bottom line) is **subtracted from** the index on the numerator (top line).

Examples

$$\begin{aligned} 1. \quad & \frac{7^8}{7^6} \\ &= 7^{(8-6)} \\ &= \mathbf{7^2} \end{aligned}$$

$$\begin{aligned} 2. \quad & \frac{9^{12}}{9^5} \\ &= 9^{(12-5)} \\ &= \mathbf{9^7} \end{aligned}$$

$$\begin{aligned} 3. \quad & \frac{8^7}{8^6} \\ &= 8^{(7-6)} \\ &= 8^1 \\ &= \mathbf{8} \end{aligned}$$

$$\begin{aligned} 4. \quad & \frac{3^7}{3} \\ &= \frac{3^7}{3^1} \\ &= 3^{(7-1)} \\ &= \mathbf{3^6} \end{aligned}$$

3. Use Index Law 2 to find the answers to the following in index form.

(a) $\frac{5^7}{5^2}$

(b) $\frac{3^9}{3^5}$

(c) $\frac{4^8}{4^3}$

(d) $\frac{7^6}{7^4}$

(e) $\frac{6^{13}}{6^5}$

(f) $\frac{12^{15}}{12^9}$

(g) $\frac{2^8}{2}$

(h) $\frac{8^9}{8^8}$

(i) $\frac{9^{12}}{9^{11}}$

(j) $\frac{15^9}{15}$

(k) $\frac{9^5}{9}$

(l) $\frac{17^{19}}{17^{13}}$

4. Use Index Law 2 to find the answers to the following in index form.

(a) $9^8 \div 9^5$

(b) $12^9 \div 12^3$

(c) $7^{10} \div 7^7$

(d) $8^{13} \div 8^{11}$

(e) $10^8 \div 10^7$

(f) $6^8 \div 6$

(g) $5^{15} \div 5^9$

(h) $2^{21} \div 2^{13}$

(i) $3^9 \div 3$

(j) $20^{17} \div 20^{16}$

(k) $4^{13} \div 4^{12}$

(l) $17^{16} \div 17^5$

Example

$$\begin{aligned} & 6^7 \div 6^4 \\ &= \frac{6^7}{6^4} \\ &= 6^{(7-4)} \\ &= \mathbf{6^3} \end{aligned}$$

EXERCISE 1L

1. Write the following in factor form then simplify by cancelling.

(a) $\frac{5^4}{5^4}$

(b) $\frac{3^7}{3^7}$

(c) $\frac{4^3}{4^3}$

(d) $\frac{7^5}{7^5}$

2. Use Index Law 2 to find the answers to the problems in question 1.

3. Use the answers from questions 1 and 2 to complete the following:

(a) $5^0 = \underline{\hspace{1cm}}$

(b) $3^0 = \underline{\hspace{1cm}}$

(c) $4^0 = \underline{\hspace{1cm}}$

(d) $7^0 = \underline{\hspace{1cm}}$

Index Law 3

Index Law 3 states:

If a term has an index of **0** then the answer is **1**.

$$7^0 = 1, \quad 3^0 = 1, \quad 27^0 = 1, \quad 123^0 = 1, \text{ etc}$$

4. Evaluate the following.

Examples

$$\begin{aligned} 1. \quad & 6^0 + 8 \\ & = 1 + 8 \\ & = \mathbf{9} \end{aligned}$$

$$\begin{aligned} 2. \quad & 7^0 + 2^2 - 8^0 \\ & = 1 + 4 - 1 \\ & = \mathbf{4} \end{aligned}$$

$$\begin{aligned} 3. \quad & (7 + 5)^0 \\ & = 12^0 \\ & = \mathbf{1} \end{aligned}$$

$$\begin{aligned} 4. \quad & \frac{5^0 + 17}{2^3 + 9^0} \\ & = \frac{1 + 17}{8 + 1} \\ & = \frac{18}{9} \\ & = \mathbf{2} \end{aligned}$$

(a) $7 - 8^0$

(b) $12 + 7^0$

(c) $3^0 + 3^1 + 3^2$

(d) $(7 + 4)^0$

(e) $(4 + 8^0)^2$

(f) 5×4^0

(g) $(124 - 87)^0$

(h) $(7^5 + 9^4)^0$

(i) $\frac{9 + 18}{3^0}$

(j) $\frac{4^2 - 7^0}{2^2 - 2^0}$

(k) $\frac{(4 + 2)^2}{8^0 + 11}$

(l) $\frac{(6^2 + 3^2) \times 7^0}{(5 - 4^0)^2 - 6^0}$

EXERCISE 1M

1. Write the following in factor form then combine into index form.

Example

$$\begin{aligned}
 & (5^3)^4 \\
 &= 5^3 \times 5^3 \times 5^3 \times 5^3 \\
 &= \underbrace{5 \times 5 \times 5} \times \underbrace{5 \times 5 \times 5} \times \underbrace{5 \times 5 \times 5} \times \underbrace{5 \times 5 \times 5} \\
 &= 5^{12}
 \end{aligned}$$

(a) $(4^2)^4$

(b) $(8^3)^2$

(c) $(6^5)^2$

(d) $(3^2)^5$

(e) $(2^4)^4$

(f) $(9^2)^2$

(g) $(5^4)^3$

(h) $(10^3)^5$

(i) $(12^2)^6$

(j) $(7^7)^2$

(k) $(3^2)^7$

(l) $(2^3)^6$

2. Can you think of a way to find the answers in question 1 without writing the factors?

Index Law 4

Index Law 4 states:

If a term with an index is raised to an index, the indices are **multiplied**.

Examples

$$\begin{aligned}
 1. \quad & (9^5)^6 \\
 &= 9^{(5 \times 6)} \\
 &= 9^{30}
 \end{aligned}$$

$$\begin{aligned}
 2. \quad & (3^7)^5 \\
 &= 3^{(7 \times 5)} \\
 &= 3^{35}
 \end{aligned}$$

3. Use Index Law 4 to find the answers to the following in index form.

(a) $(5^6)^4$

(b) $(6^5)^5$

(c) $(2^7)^4$

(d) $(9^7)^8$

(e) $(7^8)^5$

(f) $(8^4)^9$

(g) $(10^5)^{10}$

(h) $(11^9)^6$

(i) $(13^7)^6$

(j) $(9^{12})^6$

(k) $(3^9)^7$

(l) $(8^{20})^8$

EXERCISE 1N

Use the Index Laws to simplify the following. Write the answers in index form.

<i>Example</i>	$\frac{(2^7 \times 2^5)^4}{(2^6 \times 2^9)^3}$ $= \frac{(2^{12})^4}{(2^{15})^3}$ $= \frac{2^{48}}{2^{45}}$ $= 2^3$
----------------	---

1. $\frac{(4^5 \times 4^6)^3}{(4^7 \times 4^3)^2}$

2. $\frac{(7^3 \times 7^4)^5}{(7^7 \times 7^0)^2}$

3. $\frac{8^{13}}{8^7} \times \frac{8^{19}}{8^{17}}$

4. $\frac{(3^7 \times 3^9)^3}{(3^{14} \times 3^{10})^2}$

5. $\frac{(5^8 \times 5^6)^4}{(5^{11} \times 5^{16})^0}$

6. $\frac{8^{13} \times 8^6}{(8^7)^2} \times \frac{8^{29}}{8^{13}}$

7. $\frac{(9^7)^8}{(9^{12} \times 9^3)^3} \times \frac{(9^7 \times 9^5)^9}{(9^{20})^5}$

8. $\frac{(6^7 \times 6^{13})^3}{(6^4 \times 6^{10})^4} \times \frac{(6^{15} \times 6)^5}{(6 \times 6^{10})^7}$

EXERCISE 1O

1. Evaluate the following (find the basic numeral) *without* using a calculator.

Example

5^3

Answer

$$5^3 = 5 \times 5 \times 5$$

$$= 125$$

(a) 2^2

(b) 2^3

(c) 2^4

(d) 2^5

(e) 2^6

(f) 2^7

(g) 2^8

(h) 2^9

(i) 2^{10}

(j) 2^{11}

(k) 3^2

(l) 3^3

(m) 3^4

(n) 5^2

(o) 5^3

(p) 10^2

(q) 10^3

(r) 10^4

(s) 10^5

(t) 10^6

2. Use the Index Laws to simplify the following then evaluate the answer (find the basic numeral) **without** using a calculator.

Example

$$2^3 \times 2^4$$

Answer

$$2^3 \times 2^4 = 2^7 \\ = 128$$

(a) $10^3 \times 10^2$

(b) $8^3 \times 8^0$

(c) $3^2 \times 3^3$

(d) $\frac{9^{13}}{9^{10}}$

(e) $\frac{(7^4)^5}{(7^3)^6}$

(f) $\frac{(6^7 \times 6^4)^4}{(6^5 \times 6^9)^3}$

3. Evaluate the following **without** using a calculator.

(a) $(2^2)^2 + 5^2 - 6^2$

(b) $(2^4 - 2^2)^2 - (3^3 - 5^2)^5$

(c) $(6^2 - 4^2)^2 + (7^2 - 3^2)^2$

(d) $\frac{4^3}{2^6}$

(e) $\frac{(6^2 - 2^5)^3}{(3^3 - 5^2)^5}$

(f) $8^2 + 4^3 + 2^6 - 9^2$

EXERCISE 1P

Use a calculator to evaluate the following problems.

1. 15^4

2. $13^5 - 21^4$

3. $\frac{25^4 - 40^3}{5^3}$

4. $(63^2 - 54^2)^2$

5. $\left(\frac{72^3}{3^6}\right)^2$

6. $\frac{93^2 - 15^2}{26}$

7. $\frac{85^3 - 13^5}{2^4} - 23^3$

8. $\left(\frac{474 - 118}{89}\right)^6$

9. $\frac{2^{13}}{8^4} + \frac{3^{13}}{27^4}$

10. $(5^2)^4 - (3^3)^3$

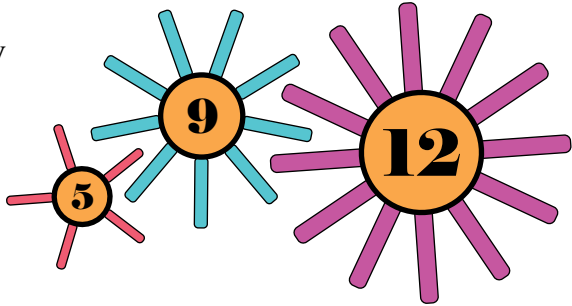
11. $\frac{(7^6)^7}{(7^4)^9}$

12. $(9^4)^2 - (17^2)^3 - (4^3)^4$

PROBLEM SOLVING

Three cogs are interlocked as shown. One cog has 5 teeth, one has 9 teeth and the other has 12 teeth. If one cog is turned the other cogs will also turn.

If the cogs are turned, how many revolutions would each cog rotate through before they return to the same position they started in?



PUZZLES

Find words from this chapter hidden in these sentences.

Example A keyboard is used for typing.

1. The vet had to weigh the guinea-pig before giving it some medicine.
2. A heron eats fish and other small marine animals.
3. Paula's umbrella blew away in the strong wind.
4. The water barrel eventually filled after the heavy rain.
5. Turmeric and ground cumin berries are used to make curry.
6. The flour mill I once worked in has closed down.
7. What you get out of your work depends on the effort you put in.
8. Through the haze Roland could see a car in the distance.
9. Barry's breath reeked of garlic after eating the lasagna.
10. Nerada knew she was going to have a bad day when she lost her key.
11. The carpenter sharpened his saw so he could cut wood easily.
12. Did the cat put on a brief act or was it going to attack?
13. Stephanie spent many hours shopping to find exactly what she wanted.
14. Justin started to feel a wind change while sailing on the bay.
15. A scientist in Antarctica wanted to find ice sheet movements to study.

CHAPTER REVIEW

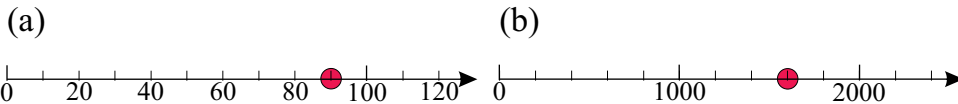
1. Write the following numbers in words.

- (a) 6048 (b) 105 709 (c) 634 250 (d) 10 005 059

2. Choose the correct symbol ($<$ or $>$) to place between the following pairs of numbers.

- (a) 31 57 (b) 92 78 (c) 959 1003 (d) 10 005 9762

3. State the number shown by the dot on each of the following number lines.



4. Round the following numbers to the nearest 10.

- (a) 17 (b) 62 (c) 459 (d) 3297

5. Round the numbers in question 4 to the nearest 100.

6. Find the answers to the following problems using *mental arithmetic*.

- (a) $8 + 15$ (b) $53 - 21$ (c) $123 + 148$ (d) $247 - 238$
 (e) 6×9 (f) 5×8 (g) 12×7 (h) 23×5
 (i) $72 \div 6$ (j) $36 \div 12$ (k) $48 \div 8$ (l) $189 \div 9$

7. Find the answers to the following problems by:

- (i) carefully setting out your workings.
 (ii) checking your answers with a calculator.

- (a) $12\,785 - 3794$ (b) $9476 + 2574$
 (c) 785×23 (d) $34\,068 \div 6$

8. (a) What is the product of 256 and 78?
 (b) What is the sum of 63 248 and 777?

9. A truck that weighed 3700 kg had 30 sheep loaded onto it. The average weight of each sheep was 140 kg.
 Another truck that weighed 4500 kg had 12 cattle loaded onto it. The average weight of each cow was 860 kg.
 Find the difference in weight between the two loaded trucks.

10. Remember BODMAS when evaluating the following problems.

- (a) $3 + 7 \times 2$ (b) $(6 + 8) \div (11 - 4)$
 (c) $\frac{1}{2}$ of $(18 + 8) - 2 \times 3$ (d) $5 \times 3 + 8 \div 4 - \frac{1}{2}$ of 6

11. Without using a calculator evaluate the following problems.

- (a) 400×100 (b) $7000 \div 100$ (c) $800 \div 40$

12. Find the highest common factor (H.C.F.) of the following pairs of numbers.

- (a) 30, 24 (b) 60, 30 (c) 16, 56

13. List the following numbers as products of their prime factors in index form.

- (a) 32 (b) 36 (c) 150

14. Find the lowest common multiple (L.C.M.) of the following sets of numbers.

- (a) 8, 10 (b) 6, 9 (c) 2, 3, 4

15. Without using a calculator find the following.

- (a) 5^2 (b) 8^2 (c) $\sqrt{81}$ (d) $\sqrt{100}$

16. Use a calculator to find the following.

- (a) 29^2 (b) 137^2 (c) $\sqrt{1225}$ (d) $\sqrt{66\ 049}$

17. Write the following numbers in scientific notation.

- (a) 8000 (b) 900 000 (c) 1 000 000 000

18. Write the following in index form.

- (a) $3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3$ (b) $6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6$

19. Use the Index Laws to simplify the following. Write answers in index form.

- (a) $5^3 \times 5^7$ (b) $9^{11} \times 9$ (c) $\frac{7^9}{7^4}$ (d) $\frac{3^{17}}{3^8}$
 (e) $(8^3)^6$ (f) $(14^9)^4$ (g) $\frac{(4^5 \times 4^4)^3}{(4^6 \times 4^4)^2}$ (h) $\frac{(6^5)^7}{(6^4)^6} \times \frac{(6^2)^9}{(6^4)^3}$

20. Evaluate the following.

- (a) 6^0 (b) $8^2 + 7^0$ (c) $7^2 - 3^0 + 3^3$ (d) $2^5 + 9^2 + 12^0$

Integers

Positive and Negative Numbers

Positive numbers are those numbers *greater than zero*.
Negative numbers are those numbers *less than zero*.

Integers are defined as all *positive numbers, negative numbers* and *zero*.

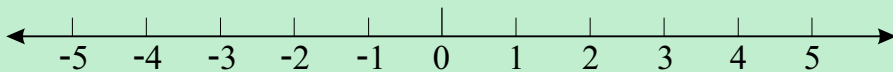
Negative numbers are written with a negative sign (-) in front of them.

Example negative 3 = -3

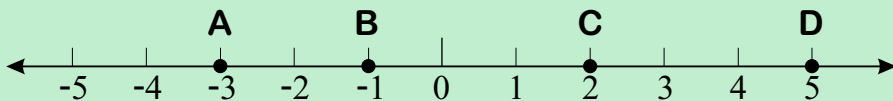
Positive numbers can be written with a positive sign (+) in front of them but this sign is not needed.

Example positive 6 = +6 = 6

Integers can be represented on a number line as shown below.



Examples



The points shown on this number line are:

A = -3

B = -1

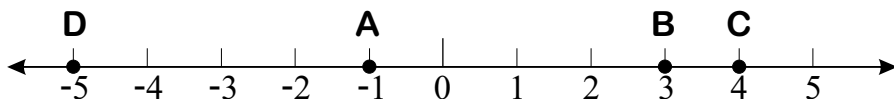
C = 2 (or +2)

D = 5 (or +5)

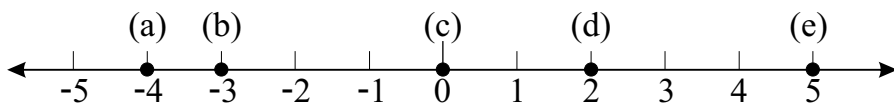
EXERCISE 2A

1. Which points on the number line below correspond to the following numbers.

- (a) -5 (b) 4 (c) 3 (d) -1



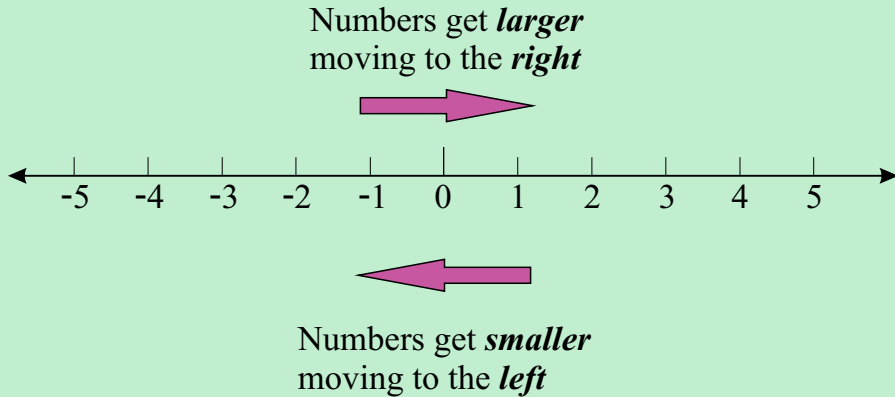
2. Write the number shown by each of the points on the number lines below.



3. Complete the following patterns.

- (a) -9, -8, -7, -6, -5, __, __, __, __, __.
 (b) -12, -10, -8, -6, -4, __, __, __, __, __.
 (c) -35, -30, -25, -20, -15, __, __, __, __, __.
 (d) 6, 5, 4, 3, 2, __, __, __, __, __.
 (e) 60, 50, 40, 30, 20, __, __, __, __, __.
 (f) -37, -32, -27, -22, -17, __, __, __, __, __.
 (g) 34, 28, 22, 16, 10, __, __, __, __, __.
 (h) 20, 19, 17, 14, 10, __, __, __, __, __.
 (i) 100, 95, 85, 70, 50, __, __, __, __, __.
 (j) -50, -48, -44, -38, -30, __, __, __, __, __.
 (k) -50, -47, -41, -32, -20, __, __, __, __, __.

Numbers get larger as you move to the right along a number line.
Numbers get smaller as you move to the left along a number line.



Examples

1. Arrange these numbers from *smallest* to *largest*.

-6, 8, -10, 0, 3, -2

Answer: -10, -6, -2, 0, 3, 8

2. Which of the following numbers is the *largest*?

-12, 0, 8, 5, -4, -9, 2

Answer: 8

EXERCISE 2B

1. Arrange the following numbers from *smallest* to *largest*.

(a) 6, -5, 9, 3, -4, 4, -8

(b) -14, -23, 0, 21, -11, 17, 9, -5

(c) -12, -8, -3, 0, -4, -10

(d) 8, 7, -6, 5, -4, 3, -2, -1, 0, 1

2. Which of the following numbers is the *largest*?

(a) -21, -45, 33, 18, -64, 27

(b) -8, -17, -23, 0, -4, -7, -35

3. Which of the following numbers is the *smallest*?

(a) 8, -13, 14, 0, -11, 7, 2, -3

(b) 15, 9, 7, 1, 0, 8, 12, -3, -1

4. Choose the correct symbol ($<$ or $>$) to place between the pairs of numbers below.

Examples Remember the crocodile wants to eat the **larger** number.

1. -6 4



Answer: $-6 < 4$

2. -3 -8



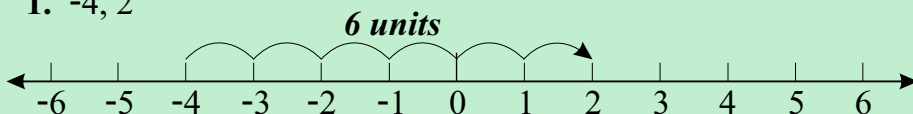
Answer: $-3 > -8$

- (a) -5 1 (b) -4 -7 (c) 9 4 (d) 4 -9 (e) 0 7
 (f) 7 12 (g) -8 -5 (h) 0 -7 (i) 6 -1 (j) -12 -1

5. Draw a number line between -6 and 6 in your books and use it to find the gap between the following pairs of numbers.

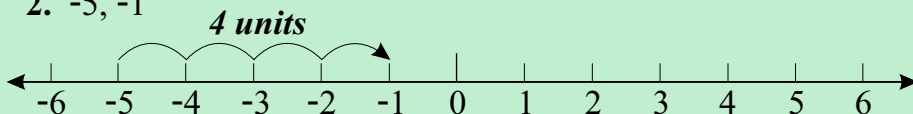
Examples

1. $-4, 2$



The gap between -4 and 2 is **6**.

2. $-5, -1$



The gap between -5 and -1 is **4**.

- (a) $-2, 3$ (b) $-5, -2$ (c) $-4, 3$ (d) $-3, 0$ (e) $2, 6$
 (f) $-4, 5$ (g) $-3, 6$ (h) $-6, -1$ (i) $-1, 5$ (j) $-5, -4$

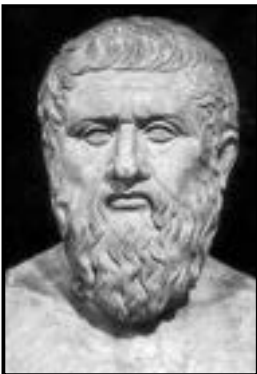
6. Find the gap between the following pairs of numbers.

- (a) $-8, 3$ (b) $-9, 5$ (c) $-10, 8$ (d) $-8, 23$ (e) $-18, -7$
 (f) $-15, 25$ (g) $-13, 29$ (h) $-34, -8$ (i) $-19, 37$ (j) $-23, 45$
 (k) $-34, -16$ (l) $-46, -7$ (m) $-29, 17$ (n) $-56, -17$ (o) $-78, -23$

7. The maximum temperature on a particular day in four cities is shown in this table. Find the difference in maximum temperature between:
- Beijing and Montreal
 - Montreal and London
 - Montreal and Oslo
 - Oslo and Beijing

City	Max. Temp.
Beijing	15°C
Montreal	-2°C
Oslo	-11°C
London	8°C

8. Jay and Stephanie are camping. One day they decide to hike east from their campsite 6 kilometres to see a bat cave. The next day they hike 8 kilometres west from their campsite to see a waterfall. How far is the waterfall from the bat cave?
9. (a) The temperature at Wellington dropped to a minimum of -11°C one night. The next day the maximum temperature was 15°C . By how many degrees did the temperature rise?
- (b) The temperature then dropped by 19°C from this maximum to the minimum the next night. What was the temperature on this night?
10. There have been many famous mathematicians over history. **Plato** (427 - 347 B.C.) believed that mathematics was the beginning of all knowledge. **Rene Descartes** (1596 - 1650) was one of the first mathematicians to use negative numbers. How many years after Plato died was Descartes born?



Plato (427 - 347 B.C.)



René Descartes (1596 - 1650)

Addition and Subtraction

EXERCISE 2C

1. Find the answers to the problems below by following these steps.

Step 1 Use the first number as the starting point on a number line.

Step 2 Move to the right or left by the amount shown.

Remember: $+$ means move to the *right*
 $-$ means move to the *left*

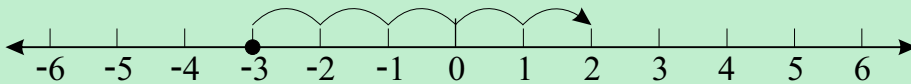
Examples

1. $-3 + 5$

$-3 + 5$

-3 is the starting
number

$+ 5$ means move to the *right*
by 5 units



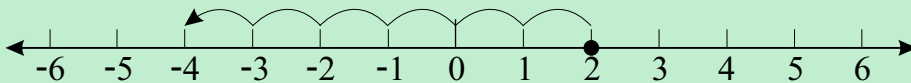
Answer = 2

2. $2 - 6$

$2 - 6$

2 is the starting
number

$- 6$ means move to the *left*
by 6 units



Answer = -4

(a) $-2 + 3$

(b) $3 - 4$

(c) $-3 + 1$

(d) $-1 - 3$

(e) $4 - 7$

(f) $5 - 6$

(g) $-6 + 8$

(h) $-3 + 9$

(i) $-5 + 3$

(j) $-4 + 4$

(k) $5 - 4$

(l) $4 - 8$

(m) $5 - 11$

(n) $-2 - 4$

(o) $4 - 5$

(p) $-4 + 7$

2. Find the answers to the following problems.

- (a) $-8 + 10$ (b) $1 - 10$ (c) $-12 + 7$ (d) $-9 - 3$
 (e) $-5 - 15$ (f) $7 - 20$ (g) $-8 + 14$ (h) $12 - 26$
 (i) $4 - 22$ (j) $-17 + 11$ (k) $-21 - 13$ (l) $-25 + 24$
 (m) $-9 + 16$ (n) $-8 - 7 - 5$ (o) $9 - 12 + 7$ (p) $-8 + 5 - 10$

3. Find the missing number in each of these equations.

- (a) $3 - \square = 1$ (b) $4 - \square = -2$ (c) $-2 + \square = 3$
 (d) $1 - \square = -4$ (e) $-8 + \square = -5$ (f) $-3 - \square = -10$
 (g) $-5 + \square = 7$ (h) $5 - \square = -4$ (i) $-4 - \square = -12$
 (j) $\square - 2 = -5$ (k) $\square + 4 = 1$ (l) $\square - 5 = -2$
 (m) $\square + 3 = -3$ (n) $\square - 4 = -10$ (o) $\square + 7 = 2$

4. Where two signs occur together, replace them with one sign before finding the answer. Use the guide and examples below.

Note: *Some positive (+) signs are shown on positive numbers in this question. This is not usually necessary.*

$+ + = +$	$+ - = -$
$- - = +$	$- + = -$

Examples

1. $2 + +3$

$2 \overset{+}{+} 3$
 Replace with +
 $= 2 + 3$
 $= 5$

2. $-2 + -4$

$-2 \overset{+}{-} 4$
 Replace with -
 $= -2 - 4$
 $= -6$

3. $5 - +3$

$5 \overset{-}{+} 3$
 Replace with -
 $= 5 - 3$
 $= 2$

4. $-3 - -4$

$-3 \overset{-}{-} 4$
 Replace with +
 $= -3 + 4$
 $= 1$

- (a) $3 - -4$ (b) $5 + -2$ (c) $7 - +5$ (d) $-2 + +6$
 (e) $-3 - -5$ (f) $4 - +7$ (g) $-4 + -5$ (h) $4 - -6$
 (i) $-1 + +5$ (j) $-5 + -6$ (k) $-6 - -6$ (l) $-8 + -4$
 (m) $7 + +5$ (n) $4 + -10$ (o) $-7 + +9$ (p) $-8 - -10$

5. Find the answers to the following problems.

- (a) $-12 - -20$ (b) $15 - +25$ (c) $16 - -18$ (d) $-30 + -20$
 (e) $-27 + -23$ (f) $35 + -45$ (g) $-20 + +25$ (h) $-37 - -23$
 (i) $38 + -23$ (j) $-24 - -27$ (k) $-58 - -42$ (l) $63 + -85$

6. Find the missing number in each of the following equations.

- (a) $5 + \square = 3$ (b) $-2 - \square = -6$ (c) $-3 - \square = -1$
 (d) $4 - \square = 7$ (e) $-2 + \square = -8$ (f) $-9 + \square = -3$
 (g) $\square + 2 = -2$ (h) $\square + 7 = 0$ (i) $\square - 5 = -11$
 (j) $\square + 1 = -5$ (k) $-6 - \square = 0$ (l) $-10 - \square = -5$

7. Find the missing operation $+$ or $-$ in the following equations.

Examples

1. $-5 \square -2 = -3$

$-5 - -2 = -3$

$-5 + 2 = -3$

Answer: -

2. $4 \square -5 = -1$

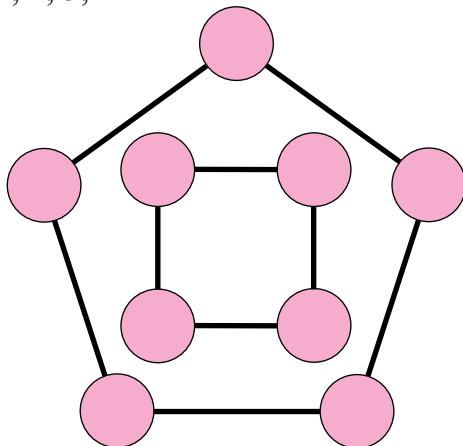
$4 + -5 = -1$

$4 - 5 = -1$

Answer: +

- (a) $5 \square -2 = 3$ (b) $-2 \square 7 = 5$ (c) $-4 \square 3 = -7$
 (d) $1 \square -5 = 6$ (e) $-2 \square -2 = 0$ (f) $-9 \square 6 = -3$
 (g) $-8 \square -5 = -3$ (h) $5 \square -6 = 11$ (i) $6 \square 11 = -5$

8. Place the numbers $-4, -3, -2, -1, 0, 1, 2, 3, 4$ in the circles so that the sum of the numbers around the square is equal to the sum of the numbers around the pentagon.



Multiplication and Division

When multiplying or dividing **two positive numbers** the answer is **positive**.
 When multiplying or dividing **two negative numbers** the answer is **positive**.
 When multiplying or dividing a **positive** and a **negative** number the answer is **negative**.

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

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

When multiplying or dividing integers:

- ♦ if the signs are the **same** the answer is **positive**
- ♦ if the signs are **different** the answer is **negative**

Remember - the positive sign does not need to be shown in front of positive numbers.

Examples

$$\begin{array}{l} 1. \quad 5 \times 6 \\ \quad = 30 \end{array}$$

$$\begin{array}{l} 2. \quad -2 \times -4 \\ \quad = 8 \end{array}$$

$$\begin{array}{l} 3. \quad 5 \times -3 \\ \quad = -15 \end{array}$$

$$\begin{array}{l} 4. \quad -3 \times 4 \\ \quad = -12 \end{array}$$

$$\begin{array}{l} 5. \quad 24 \div 6 \\ \quad = 4 \end{array}$$

$$\begin{array}{l} 6. \quad -20 \div -4 \\ \quad = 5 \end{array}$$

$$\begin{array}{l} 7. \quad 18 \div -3 \\ \quad = -6 \end{array}$$

$$\begin{array}{l} 8. \quad -36 \div 12 \\ \quad = -3 \end{array}$$

EXERCISE 2D

1. Find the answers to the following problems.

$$(a) \quad 7 \times 2$$

$$(b) \quad -3 \times 3$$

$$(c) \quad 4 \times -10$$

$$(d) \quad -2 \times -3$$

$$(e) \quad -5 \times -11$$

$$(f) \quad 2 \times -5$$

$$(g) \quad -10 \times 2$$

$$(h) \quad -3 \times -10$$

$$(i) \quad 5 \times 5$$

$$(j) \quad -11 \times 6$$

$$(k) \quad 8 \times -5$$

$$(l) \quad -2 \times 1$$

$$(m) \quad -6 \times 0$$

$$(n) \quad -1 \times -8$$

$$(o) \quad -1 \times -1$$

$$(p) \quad -2 \times 2$$

$$(q) \quad 8 \times -7$$

$$(r) \quad 6 \times 9$$

$$(s) \quad -12 \times 11$$

$$(t) \quad -5 \times -7$$

2. Find the answers to the following problems.

$$(a) \quad 12 \div -2$$

$$(b) \quad 30 \div 3$$

$$(c) \quad -14 \div -7$$

$$(d) \quad -24 \div 3$$

$$(e) \quad 55 \div -11$$

$$(f) \quad -30 \div -5$$

$$(g) \quad -10 \div 2$$

$$(h) \quad 40 \div 8$$

$$(i) \quad -5 \div 5$$

$$(j) \quad 36 \div -6$$

$$(k) \quad -27 \div -9$$

$$(l) \quad 49 \div 7$$

$$(m) \quad 63 \div -9$$

$$(n) \quad -144 \div 12$$

$$(o) \quad -8 \div -8$$

$$(p) \quad 0 \div -2$$

$$(q) \quad -84 \div 7$$

$$(r) \quad -72 \div -9$$

$$(s) \quad -108 \div 12$$

$$(t) \quad 54 \div -6$$

3. Find the answers to the following problems.

Examples

When solving problems with more than one multiplication and/or division, work from **left** to **right** solving one at a time.

$$\begin{aligned} 1. \quad & 5 \times -2 \times -1 \times 6 \\ & = -10 \times -1 \times 6 \\ & = 10 \times 6 \\ & = 60 \end{aligned}$$

$$\begin{aligned} 3. \quad & (-2)^3 \\ & = -2 \times -2 \times -2 \\ & = 4 \times -2 \\ & = -8 \end{aligned}$$

$$\begin{aligned} 2. \quad & -8 \times -3 \div -6 \times 10 \div -5 \times -2 \\ & = 24 \div -6 \times 10 \div -5 \times -2 \\ & = -4 \times 10 \div -5 \times -2 \\ & = -40 \div -5 \times -2 \\ & = 8 \times -2 \\ & = -16 \end{aligned}$$

(a) $4 \times -3 \times -2$

(c) $-3 \times -1 \times -5$

(e) $2 \times -1 \times 6 \times -2$

(g) $(-2)^6$

(i) $(-1)^9$

(k) $-3 \times -2 \times -1 \times 2 \times -4$

(m) $-4 \times 5 \div -2 \times 6 \div 3 \div -4$

(o) $-27 \div -9 \times 8 \div -12 \times -5 \times 4$

(b) $-12 \div 3 \div -2$

(d) $-48 \div -4 \div 3$

(f) $24 \div -6 \div -2 \div -2$

(h) $(-3)^3$

(j) $(-10)^4$

(l) $-36 \div -4 \div -1 \div 3 \div -3$

(n) $-3 \times -6 \div 9 \times -8 \div 4 \times -7$

(p) $72 \div -9 \times -6 \div -4 \div -3 \times 9 \div -6$

4. Use the values of a , b and c given below to solve the following problems.

$$a = -2 \quad b = 4 \quad c = -6$$

(a) abc

(c) $3bc$

(e) $\frac{2c}{3}$

(g) $\frac{bc}{8}$

(i) $\frac{9b}{ac}$

(b) $2ac$

(d) c^2

(f) $\frac{ac}{3}$

(h) $\frac{bc}{a}$

(j) $\frac{6ac}{b}$

Example

$$\begin{aligned} & \frac{3ab}{2} \\ & = \frac{3 \times a \times b}{2} \\ & = \frac{3 \times -2 \times 4}{2} \\ & = \frac{-24}{2} \\ & = -24 \div 2 \\ & = -12 \end{aligned}$$

Combined Operations

EXERCISE 2E

1. Remember BODMAS when answering the following questions.
Do not use a calculator.

Examples

1. $-4 + 2 \times -3$	2. $-5 \times -3 - 4 \times -2$	3. $-6 + (5 - -2) \times -5$
$= -4 + -6$	$= 15 - -8$	$= -6 + (5 + 2) \times -5$
$= -4 - 6$	$= 15 + 8$	$= -6 + 7 \times -5$
$= -10$	$= 23$	$= -6 + -35$
		$= -6 - 35$
		$= -41$

- | | |
|---|-------------------------------------|
| (a) $3 + -2 \times -4 - 1$ | (b) $-6 - 16 \div -2 - 5$ |
| (c) $3 \times -2 \times -4 \div -12$ | (d) $(6 - 8) \times (3 - 7)$ |
| (e) $(-6 + 10) \div (8 - 12)$ | (f) $-2 \times (-4 - -6) \times -3$ |
| (g) $\frac{1}{2}$ of $-8 + 3 \times -2$ | (h) $(-5)^2 - (-8 - -4)^2$ |
| (i) $(-3)^3 \div -9$ | (j) $(-2)^4 \div (-20 + 16)^2$ |

2. Use the values shown below for a , b and c to solve the following problems.

$$a = -3 \quad b = 4 \quad c = -1$$

Examples

1. $a + b + c$	2. $ab - c$	3. $4bc$
$= -3 + 4 + -1$	$= a \times b - c$	$= 4 \times b \times c$
$= 1 + -1$	$= -3 \times 4 - -1$	$= 4 \times 4 \times -1$
$= 1 - 1$	$= -12 - -1$	$= 16 \times -1$
$= 0$	$= -12 + 1$	$= -16$
	$= -11$	

- | | | | |
|-----------------|----------------|--------------|--------------------|
| (a) $b + c$ | (b) $a - c$ | (c) $2a + c$ | (d) $3b - a$ |
| (e) $a^2 + b^2$ | (f) bc | (g) $5ac$ | (h) $3ac + 2bc$ |
| (i) abc | (j) $6b + 2ac$ | (k) $8 - a$ | (l) $10 + ab - 4c$ |

Calculator Problems

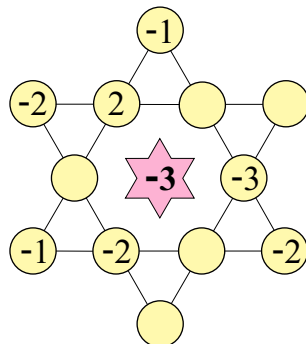
EXERCISE 2F

Use your calculator to answer the following questions.

- $-23 \times -81 \div -9 \times -124 \div -62 \div -46$
- $(-158 + -267) \div -25$
- $(-387 - 481) \div (-569 + 352)$
- $\sqrt{(-578 \times -8)}$
- $(-53)^3 \div (-356 + 3165)$
- $(-946 - 1863) \div (-53)^2$
- $\sqrt{(-48)^2 + (-14)^2} \times [(171 \div -57) - (-568 \div -1136)]$

PROBLEM SOLVING

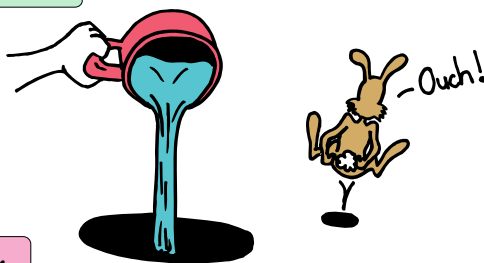
- Find the missing numbers from this diagram. The sum of the numbers in each line is equal to the number in the centre.



- Two numbers add to give -1 and multiply to give -72. Find the two numbers.
- Find x and y given that: $x + y = -6$ and $x \div y = -4$

PUZZLE

Find the answers to the problems below. Arrange the answers in order from the smallest to the largest along with their corresponding letters to find the answer to the riddle.



What do you get if you pour hot water down a rabbit burrow?

I	$-6 - -12 + 8 \div -4$
B	$-56 \times -2 \div -8$
*	$-5 \times -6 \times -1 - -1$
S	$(-8 - -3) \times (7 - 9)$
O	$(-8 - 9) \times 2$

S	$(-3)^2 \times -2$
H	$-39 - -5 - 3$
N	$(-2)^3$
O	$(9 \times 5 - 1) \div -2$
R	$(-5)^2$

T	$(-72 - -10) \div 2$
C	$-7 \times -4 \div -1$
S	$(-12 \times 4 - 3) \div 3$
*	$-1 \times (-9 + 5)^2$
U	$(-40 - -4) \div 3$
N	$-1 - 1 - 1 - 1 - 1$
E	$-35 \times -2 \div 10$

CHAPTER REVIEW

1. What numbers are shown by the points on this number line?



2. Complete the following patterns.

(a) -34, -28, -22, -16, __, __, __. (b) 15, 14, 12, 9, __, __, __.

3. List the following numbers from the smallest to the largest.

9 -26 5 -15 13 -19 -6 -21

4. Place the correct symbol (< or >) between these numbers.

(a) -1 7 (b) -9 -15 (c) 0 -5 (d) -6 -1

5. Find the gap between the following pairs of numbers.

(a) -3 7 (b) -10 -2 (c) -13 21 (d) -36 -9

6. The temperature at Hobart dropped from 17°C to -6°C .

By how many degrees did the temperature drop?

7. Find the answers to the following problems.

(a) $3 - 9$ (b) $-6 + 10$ (c) $-12 - 3$ (d) $8 - -5$
 (e) $-10 + -6$ (f) $-5 - -13$ (g) $-18 + 7$ (h) $12 - -10$
 (i) -6×4 (j) 8×-3 (k) -6×-5 (l) $-3 \times -7 \times -10$
 (m) $8 \div -2$ (n) $-36 \div -9$ (o) $-60 \div 10$ (p) $-24 \div -6 \div -2$

8. Remember BODMAS when answering the following problems.

(a) $-6 + 5 \times -2$ (b) $-4 - 6 \div -3 + 8$
 (c) $3 \times (2 - 10) \div -2$ (d) $(-1 - 2) \div -3 + 4 \times -5$
 (e) $(-4)^2 - (-2)^3$ (f) $(-3 - -5)^4 + (-6 + 5)^5$

9. Use the values shown for a , b and c to solve the following problems.

$$a = -5 \quad b = 2 \quad c = -3$$

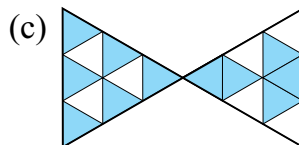
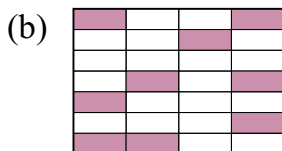
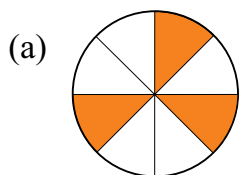
(a) $a + b$ (b) $c - b$ (c) $b - a$ (d) $a - c$
 (e) c^2 (f) $3a - 2b$ (g) ab (h) $2bc$

Fractions

Fractions

EXERCISE 3A

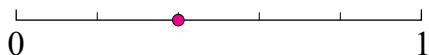
1. What fraction of each of the following diagrams is shaded?



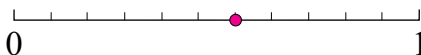
2. What fraction of each of the diagrams in question 1 is **not** shaded?

3. What fraction is shown by each dot on the following number lines?

(a)



(b)



4. In the fraction $\frac{5}{7}$, what number is the:

(a) denominator?

(b) numerator?

5. What fraction has a numerator of 10 and a denominator of 13?

6. In a tennis match, Lleyton had 29 first serves and hit 13 into play.

(a) What fraction of his first serves did he hit into play?

(b) What fraction of his first serves did **not** go into play?

7. In another tennis match, Venus hit 18 first serves into play and missed 13 of her first serves.

(a) What fraction of her first serves did she hit into play?

(b) What fraction of her first serves did **not** go into play?

Equivalent Fractions

EXERCISE 3B

1. Find the missing numbers in the following equivalent fractions.

Examples

1. $\frac{2}{3} = \frac{\square}{9}$

$\frac{2}{3} = \frac{\square}{9}$
 $\times 3$

$\frac{2}{3} = \frac{\square}{9}$
 $\times 3$

$\frac{2}{3} = \frac{6}{9}$

2. $\frac{8}{10} = \frac{4}{\square}$

$\frac{8}{10} = \frac{4}{\square}$
 $\div 2$

$\frac{8}{10} = \frac{4}{\square}$
 $\div 2$

$\frac{8}{10} = \frac{4}{5}$

- (a) $\frac{1}{2} = \frac{\square}{6}$ (b) $\frac{3}{4} = \frac{\square}{8}$ (c) $\frac{5}{6} = \frac{15}{\square}$ (d) $\frac{2}{5} = \frac{\square}{55}$
 (e) $\frac{2}{9} = \frac{\square}{18}$ (f) $\frac{6}{10} = \frac{\square}{5}$ (g) $\frac{15}{24} = \frac{\square}{8}$ (h) $\frac{16}{20} = \frac{8}{\square}$
 (i) $\frac{24}{36} = \frac{4}{\square}$ (j) $\frac{8}{9} = \frac{\square}{81}$ (k) $\frac{48}{64} = \frac{\square}{16}$ (l) $\frac{42}{60} = \frac{14}{\square}$

2. Complete the following equivalent fractions.

- (a) $\frac{2}{5} = \frac{\square}{10} = \frac{8}{\square} = \frac{\square}{45} = \frac{40}{\square} = \frac{\square}{150}$ (b) $\frac{12}{16} = \frac{\square}{32} = \frac{6}{\square} = \frac{\square}{4} = \frac{\square}{48} = \frac{144}{\square}$

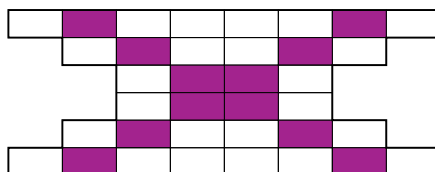
3. Write the following fractions in their simplest form.

Example $\frac{24}{30} = \frac{12}{15} = \frac{4}{5}$

- (a) $\frac{20}{30}$ (b) $\frac{32}{40}$ (c) $\frac{18}{24}$ (d) $\frac{15}{45}$ (e) $\frac{90}{108}$ (f) $\frac{124}{140}$

4. Write the answers to the following questions as fractions in their simplest form.

- (a) What fraction of this shape is shaded?
 (b) What fraction of this shape is **not** shaded?



5. Write the answers to the following questions as fractions in their simplest form.

(a) In year 12 at a school there were 80 students. Of these students 15 studied French and 32 studied physics.

- What fraction of the year 12 students studied French?
- What fraction of the year 12 students did not study French?
- What fraction of the year 12 students studied physics?
- What fraction of the year 12 students did not study physics?

(b) On a standard piano there are 88 keys of which 52 are white.

- What fraction of the keys are white?
- What fraction of the keys are black?

(c) Karen was reading a book that had 250 pages. She had read 100 pages.

- What fraction of the book has she read?
- What fraction of the book has she still to read?

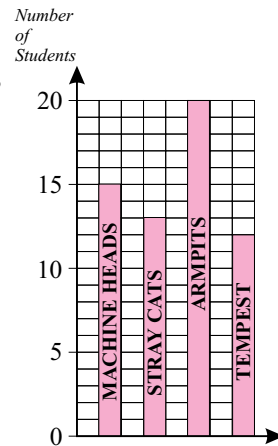
(d) Vladimir made some mortar by mixing 2 kg of cement and 6 kg of sand.

- What fraction of the mortar was cement?
- What fraction of the mortar was sand?

(e) A concert with four bands was held at a school. The bands were Machine Heads, Stray Cats, Armpits and Tempest. A number of students were asked which was their favourite band.

The results are shown on this column graph.

State what fraction of the students chose each band as their favourite.

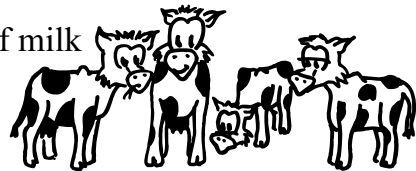


(f) Adam has four cows that he milks each day. The cows' names are Woneta, Meg, Swampy and Meryl.

One day he got a total of 120 litres of milk from the four cows.

He knows that Meg produces 10 litres of milk more than Woneta.

Meryl produces 10 litres less than Woneta. Woneta and Swampy give the same amount of milk.



- Find the amount of milk each cow produced.
- What fraction of the daily amount did each cow produce?

6. Find the lowest common denominator for the following pairs of fractions and change each fraction to have this denominator.

Example $\frac{2}{3}$ $\frac{3}{4}$ The lowest common denominator is 12.

$$\frac{2}{3} = \frac{8}{12} \quad \frac{3}{4} = \frac{9}{12}$$

- (a) $\frac{2}{3}$ $\frac{3}{5}$ (b) $\frac{5}{8}$ $\frac{3}{4}$ (c) $\frac{2}{5}$ $\frac{1}{6}$ (d) $\frac{7}{8}$ $\frac{5}{6}$ (e) $\frac{1}{2}$ $\frac{5}{9}$
- (f) $\frac{2}{3}$ $\frac{5}{7}$ (g) $\frac{8}{9}$ $\frac{9}{11}$ (h) $\frac{7}{8}$ $\frac{7}{9}$ (i) $\frac{5}{6}$ $\frac{7}{9}$ (j) $\frac{11}{12}$ $\frac{5}{6}$

7. Write the fractions from question 6 with the correct symbol (< or >) between them to show which is the larger fraction.

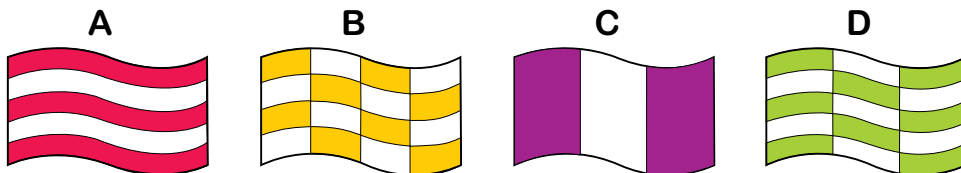
Example $\frac{2}{3}$ $\frac{3}{4}$ $\frac{2}{3} = \frac{8}{12}$ $\frac{3}{4} = \frac{9}{12}$

$$\frac{8}{12} < \frac{9}{12}$$

$$\frac{2}{3} < \frac{3}{4}$$

8. Find the fraction that is in the middle of $\frac{2}{3}$ and $\frac{4}{5}$.

9. (a) What fraction of each of the following flags is shaded?
 (b) Change these fractions to the same denominator and list the flags from the least shaded to the most shaded.



10. Elke achieved the following results on four tests at school.

Maths $\frac{34}{48}$

Italian $\frac{50}{80}$

Health $\frac{45}{60}$

Science $\frac{60}{90}$

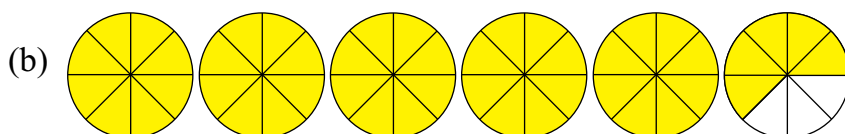
Write the marks in their simplest form then change them to a common denominator. List the subjects from the highest mark to the lowest.

Mixed Numbers and Improper Fractions

EXERCISE 3C

- From the fractions shown:
 - state which are proper fractions.
 - state which are improper fractions.
 - state which are mixed numbers.
- State the shaded portions of the diagrams below as:
 - mixed numbers.
 - improper fractions.

$\frac{3}{7}$ $\frac{25}{9}$ $8\frac{1}{3}$ $\frac{15}{23}$
 $\frac{6}{5}$ $2\frac{3}{7}$ $11\frac{7}{9}$ $\frac{37}{12}$ $\frac{23}{22}$



- Five oranges are all cut into quarters. How many quarters would there be?
 - Mrs. Raggatt is on orange duty for the local junior football team. She has to cut oranges into quarters for the players to eat at half time. She needs to cut 48 quarters. How many oranges will she need?
 - There are 30 people at a party. They decide to buy pizzas for a midnight snack. If they can each eat a third of a pizza, how many pizzas will they need?
- How many fifths are in 4?
 - How many sixths are in $5\frac{1}{2}$?
 - How many quarters are in $7\frac{3}{4}$?



- Change the following mixed numbers to improper fractions.

Example $3\frac{4}{5} = \frac{19}{5}$

- (a) $3\frac{2}{3}$ (b) $5\frac{3}{4}$ (c) $8\frac{1}{6}$ (d) $7\frac{4}{5}$ (e) $6\frac{3}{10}$ (f) $20\frac{8}{9}$

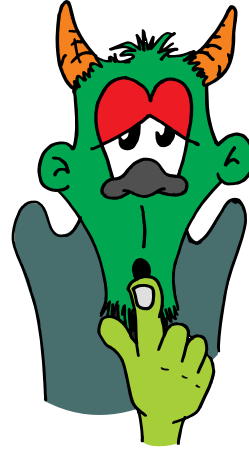
6. Change the following improper fractions to mixed numbers. Arrange the answers in order from the smallest to the largest to find the answer to the riddle.

What is a monster's favourite soup?

A	$\frac{11}{5}$
C	$\frac{57}{7}$
O	$\frac{28}{9}$
H	$\frac{44}{7}$
R	$\frac{4}{3}$
E	$\frac{31}{3}$

*	$\frac{25}{6}$
K	$\frac{43}{5}$
M	$\frac{5}{2}$
I	$\frac{53}{8}$
F	$\frac{18}{5}$
N	$\frac{43}{4}$

E	$\frac{11}{6}$
*	$\frac{35}{12}$
S	$\frac{1}{10}$
C	$\frac{3}{4}$
C	$\frac{39}{8}$



Addition and Subtraction

EXERCISE 3D

1. Complete the following calculations.

Examples

$$1. \quad \frac{2}{9} + \frac{3}{9} = \frac{5}{9}$$

$$2. \quad 5\frac{3}{5} - 4\frac{2}{5} = (5 - 4) + (\frac{3}{5} - \frac{2}{5}) = 1 + \frac{1}{5} = 1\frac{1}{5}$$

- (a) $\frac{2}{5} + \frac{1}{5}$ (b) $\frac{3}{7} + \frac{2}{7}$ (c) $\frac{6}{11} + \frac{5}{11}$ (d) $\frac{2}{13} + \frac{3}{13} + \frac{5}{13}$
 (e) $\frac{8}{9} - \frac{7}{9}$ (f) $\frac{4}{5} - \frac{2}{5}$ (g) $\frac{15}{23} - \frac{8}{23}$ (h) $\frac{13}{15} - \frac{7}{15} - \frac{6}{15}$
 (i) $1 - \frac{1}{3}$ (j) $1 - \frac{2}{5}$ (k) $1 - \frac{3}{7}$ (l) $1 - \frac{17}{25}$
 (m) $1\frac{1}{5} + 2\frac{3}{5}$ (n) $4\frac{2}{9} + 7\frac{5}{9}$ (o) $3\frac{5}{7} - 2\frac{2}{7}$ (p) $5\frac{1}{7} + 6\frac{4}{7} - 2\frac{3}{7}$

2. Nell bought 10 tonnes of wood. She sold $2\frac{1}{2}$ tonnes to her neighbour and $3\frac{1}{2}$ tonnes to her sister. How many tonnes of wood did Nell have left?

3. Solve this problem. $4\frac{3}{5} + 5\frac{4}{5} - 2\frac{1}{5} - 3\frac{2}{5} + 7\frac{3}{5} - 6\frac{4}{5} + 5\frac{1}{5} - 6\frac{3}{5} - 4\frac{1}{5}$

4. Convert the fractions in the following problems to common denominators before solving.

Write the answers in their simplest form.

Examples

$$\begin{aligned} 1. \quad & \frac{2}{3} - \frac{1}{6} \\ &= \frac{4}{6} - \frac{1}{6} \\ &= \frac{3}{6} \\ &= \frac{1}{2} \end{aligned}$$

$$\begin{aligned} 2. \quad & \frac{1}{4} + \frac{2}{3} \\ &= \frac{3}{12} + \frac{8}{12} \\ &= \frac{11}{12} \end{aligned}$$

(a) $\frac{3}{8} + \frac{1}{4}$

(b) $\frac{5}{12} - \frac{1}{6}$

(c) $\frac{3}{10} + \frac{2}{5}$

(d) $\frac{1}{2} + \frac{3}{8}$

(e) $\frac{5}{6} - \frac{2}{3}$

(f) $\frac{5}{9} - \frac{1}{3}$

(g) $\frac{3}{4} - \frac{1}{3}$

(h) $\frac{3}{5} + \frac{1}{4}$

(i) $\frac{2}{3} + \frac{1}{5}$

(j) $\frac{7}{8} - \frac{1}{6}$

(k) $\frac{3}{4} + \frac{1}{10}$

(l) $\frac{7}{9} - \frac{5}{12}$

(m) $\frac{2}{3} + \frac{1}{4} - \frac{1}{2}$

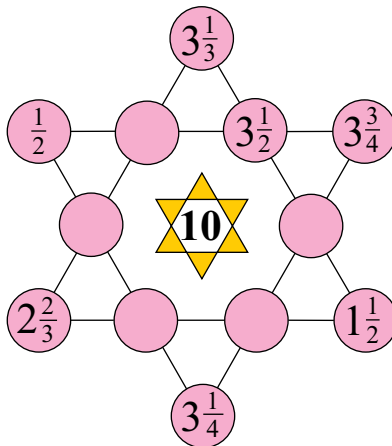
(n) $\frac{3}{5} + \frac{3}{4} - \frac{1}{2}$

(o) $\frac{2}{3} + \frac{2}{5} - \frac{5}{6}$

(p) $\frac{3}{4} + \frac{1}{12} + \frac{1}{6}$

5. Copy this diagram into your books.

Fill in the circles so that each line adds to the number in the centre.



6. Rose made her own muesli. She mixed $1\frac{1}{2}$ kg of oats, $\frac{3}{4}$ kg of wheat flakes, $\frac{1}{4}$ kg of coconut flakes, $\frac{1}{2}$ kg of sultanas and $\frac{1}{3}$ kg of sunflower seeds.

If she ate $\frac{1}{3}$ kg of the muesli each day, how many days will this recipe last?

7. Roger owns a fruit shop. He bought a 10 kg box of apricots. Frank bought $2\frac{1}{2}$ kg of the apricots, Carol bought $1\frac{3}{4}$ kg and Heather bought $3\frac{2}{3}$ kg. How many kilograms of the apricots did Roger have left?

8. Convert the fractions in the following problems to improper fractions before solving.

Write answers as mixed numbers in their simplest form.

Example

$$\begin{aligned} & 2\frac{3}{4} + 4\frac{2}{3} \\ &= \frac{11}{4} + \frac{14}{3} \\ &= \frac{33}{12} + \frac{56}{12} \\ &= \frac{89}{12} \\ &= 7\frac{5}{12} \end{aligned}$$

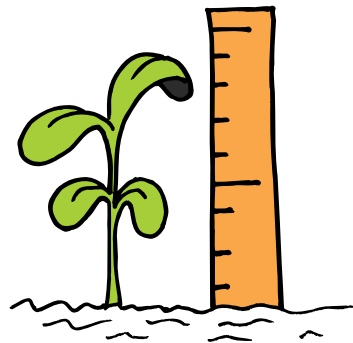
- (a) $1\frac{1}{2} + 2\frac{3}{4}$ (b) $3\frac{2}{3} - 2\frac{1}{6}$ (c) $3\frac{3}{8} + 2\frac{3}{4}$ (d) $2\frac{3}{5} - 1\frac{1}{10}$
 (e) $1 + \frac{3}{4}$ (f) $7 - \frac{5}{6}$ (g) $6 + 2\frac{1}{2}$ (h) $8 - 2\frac{5}{8}$
 (i) $2\frac{1}{3} + 6\frac{2}{3}$ (j) $3\frac{3}{5} + \frac{4}{5}$ (k) $5\frac{1}{2} + 2\frac{2}{3}$ (l) $2\frac{1}{3} + 1\frac{3}{5}$
 (m) $6\frac{2}{5} - 2\frac{3}{4}$ (n) $3\frac{1}{3} + \frac{2}{5}$ (o) $6\frac{1}{2} - 2\frac{3}{7}$ (p) $3\frac{3}{5} + 1\frac{1}{3} - 2\frac{5}{6}$

9. Complete the following patterns.

- (a) $\frac{1}{2}, 2, 3\frac{1}{2}, 5, _, _, _.$ (b) $\frac{1}{4}, 1\frac{7}{12}, 2\frac{11}{12}, 4\frac{1}{4}, _, _, _.$

10. Jack planted a bean and was told it would grow very quickly. He decided to measure the bean plant at the end of each week. The heights at the end of the first five weeks are shown below.

$$\frac{1}{4} \text{ m}, \frac{3}{4} \text{ m}, 1\frac{1}{2} \text{ m}, 2\frac{1}{2} \text{ m}, 3\frac{3}{4} \text{ m}$$



How tall will the bean plant be at the end of 8 weeks if it keeps growing in this pattern?

11. Danny grew two zucchinis. One was one kilogram heavier than the other and their total weight was $5\frac{1}{2}$ kg. What was the weight of each zucchini?

Multiplication

EXERCISE 3E

1. Complete the following multiplications.

Example $\frac{3}{4} \times \frac{5}{11}$
 $= \frac{15}{44}$

(a) $\frac{1}{3} \times \frac{1}{2}$ (b) $\frac{2}{5} \times \frac{3}{7}$ (c) $\frac{5}{6} \times \frac{5}{7}$ (d) $\frac{2}{3} \times \frac{5}{9}$
 (e) $\frac{3}{10} \times \frac{3}{10}$ (f) $\frac{11}{12} \times \frac{1}{2}$ (g) $\frac{1}{2} \times \frac{1}{3} \times \frac{1}{4}$ (h) $\frac{3}{4} \times \frac{5}{7} \times \frac{1}{2}$

2. Cancel the following problems to their simplest form before solving. Check that the answers are in their simplest form.

Example $\frac{9}{14} \times \frac{7}{12}$
 $= \frac{\overset{3}{\cancel{9}}}{14} \times \frac{7}{\underset{4}{\cancel{12}}_4}$
 $= \frac{3}{2} \times \frac{\cancel{7}^1}{4}$
 $= \frac{3}{2} \times \frac{1}{4}$
 $= \frac{3}{8}$

(a) $\frac{3}{5} \times \frac{5}{6}$ (b) $\frac{3}{4} \times \frac{8}{9}$ (c) $\frac{4}{5} \times \frac{15}{16}$ (d) $\frac{2}{9} \times \frac{9}{10}$
 (e) $\frac{24}{35} \times \frac{15}{32}$ (f) $\frac{30}{49} \times \frac{14}{15}$ (g) $\frac{28}{45} \times \frac{18}{35}$ (h) $\frac{10}{21} \times \frac{14}{25}$

3. Convert the mixed numbers to improper fractions in the following problems before cancelling and solving.

Write answers as mixed numbers in their simplest form.

Example $2\frac{1}{2} \times 2\frac{3}{5}$
 $= \frac{5}{2} \times \frac{13}{5}$
 $= \frac{\overset{1}{\cancel{5}}}{2} \times \frac{13}{\cancel{5}_1}$
 $= \frac{1}{2} \times \frac{13}{1}$
 $= \frac{13}{2}$
 $= 6\frac{1}{2}$

(a) $1\frac{1}{4} \times 1\frac{1}{5}$ (b) $3\frac{1}{3} \times 1\frac{7}{20}$ (c) $2\frac{2}{9} \times 2\frac{7}{10}$ (d) $4\frac{1}{2} \times 1\frac{1}{6}$
 (e) $4\frac{1}{6} \times 2\frac{1}{10}$ (f) $3\frac{5}{9} \times 2\frac{7}{10}$ (g) $11\frac{2}{3} \times 5\frac{2}{5}$ (h) $1\frac{7}{8} \times 4\frac{2}{3} \times 1\frac{5}{7}$

4. Complete the following calculations.

'Of' is the same as '×'

Whole numbers can be written as fractions.

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

Example

$$\begin{aligned} & \frac{3}{4} \text{ of } 20 \\ &= \frac{3}{4} \times 20 \\ &= \frac{3}{4} \times \frac{20}{1} \\ &= \mathbf{15} \end{aligned}$$

- (a) $\frac{1}{2}$ of 20 (b) $\frac{1}{5}$ of 40 (c) $\frac{1}{4}$ of 16 (d) $\frac{3}{4}$ of 16
 (e) $\frac{1}{2} \times 24$ (f) $\frac{1}{3} \times 18$ (g) $\frac{2}{3} \times 18$ (h) $\frac{2}{5} \times 30$
 (i) $\frac{3}{4}$ of 40 (j) $\frac{2}{3}$ of 66 (k) $\frac{2}{7}$ of 77 (l) $\frac{3}{5}$ of 25
 (m) $\frac{3}{10}$ of $\frac{5}{9}$ (n) $\frac{2}{3}$ of $\frac{3}{5}$ (o) $\frac{3}{4}$ of $\frac{8}{9}$ (p) $\frac{5}{6}$ of $\frac{12}{13}$
 (q) $\frac{1}{2}$ of $4\frac{2}{3}$ (r) $\frac{2}{3}$ of $9\frac{1}{2}$ (s) $\frac{3}{5}$ of $8\frac{1}{3}$ (t) $\frac{7}{10}$ of $9\frac{2}{7}$

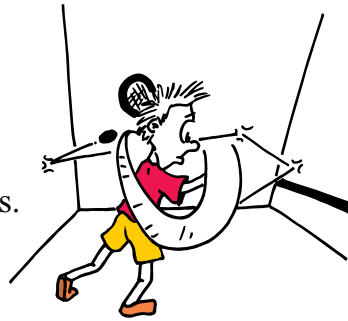
5. Complete the following calculations.

- (a) $\frac{1}{2}$ of 8 m (b) $\frac{3}{4}$ of 20 kg (c) $\frac{5}{8}$ of \$80 (d) $\frac{2}{3}$ of 300 mm
 (e) $\frac{2}{5}$ of 45 cm (f) $\frac{3}{10}$ of \$250 (g) $\frac{3}{8}$ of 400 m (h) $\frac{4}{5}$ of 1000 kg
 (i) $\frac{3}{4}$ of $9\frac{1}{3}$ g (j) $\frac{3}{5}$ of $2\frac{1}{2}$ m (k) $\frac{2}{3}$ of $2\frac{1}{4}$ m (l) $\frac{9}{10}$ of $6\frac{2}{3}$ kg

6. Complete the following calculations.

- (a) $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{5}{6}$ of $\frac{6}{7}$ of $\frac{7}{8}$ of $\frac{8}{9}$ of $\frac{9}{10}$
 (b) $\frac{1}{2}$ of $\frac{1}{2}$ of $\frac{1}{2}$ of $\frac{1}{2}$ of $\frac{1}{2}$ of \$320
 (c) $\frac{1}{2} \times \frac{3}{4} \times \frac{5}{6} \times 3\frac{1}{5}$
 (d) $\left(\frac{3}{4}\right)^2$ (e) $\left(\frac{2}{3}\right)^3$ (f) $\left(\frac{1}{2}\right)^5$ (g) $\left(1\frac{1}{2}\right)^2$ (h) $\left(2\frac{3}{4}\right)^2$

7. Gustavo had a petrol tank with a capacity of 80 litres. He noted that it was $\frac{3}{4}$ full.
- How many litres of petrol were in the tank?
 - How many litres of petrol were needed to fill the tank?
8. Elizabeth earned \$120. She spent $\frac{1}{3}$ of this amount, she put $\frac{1}{4}$ in the bank and put the rest in her purse.
- How much did she spend?
 - How much did she put in the bank?
 - How much did she put in her purse?
9. The amount of \$2400 was required by a squash club to organise a tournament. Three-quarters of this amount was to be donated by sponsors and the remaining money was to be contributed by the players.
- How much did the sponsors donate?
 - If there were 60 players participating, how much should each player pay?
10. Angelika owned a 1200 hectare farm. Three-fifths of the farm was an orchard and one-quarter of the farm was used to graze sheep. The remainder of the farm was used to grow crops.
- How many hectares was the orchard?
 - On how many hectares did the sheep graze?
 - How many hectares of crops did Angelika grow?
- If the orchard was equally planted with apple, pear and plum trees, find the following.
- How many hectares were planted with apple trees?
 - What fraction of the farm is planted in apple trees?
11. A group of 36 people were scuba diving on a coral reef. Two-thirds of the group were experienced divers and the others were beginners. Three-eighths of the experienced divers had their own equipment and one-quarter of the beginners had their own equipment.
- How many of the experienced divers had their own equipment?
 - How many of the beginners had their own equipment?



Division

EXERCISE 3F

1. Complete these problems by following the steps shown in the examples.

Examples

Step 1

Change the $\div$ to a $\times$ and turn the second fraction upside down.

Step 2

Cancel the problem to its simplest form.

Step 3

Multiply the fractions.

Step 4

Write the answer as a mixed number.

$$\begin{aligned} 1. \quad & \frac{3}{5} \div \frac{2}{3} \\ &= \frac{3}{5} \times \frac{3}{2} \\ &= \frac{9}{10} \end{aligned}$$

$$\begin{aligned} 2. \quad & \frac{4}{5} \div \frac{6}{7} \\ &= \frac{4}{5} \times \frac{7}{6} \\ &= \frac{\overset{2}{\cancel{4}}}{5} \times \frac{7}{\underset{3}{\cancel{6}}} \\ &= \frac{14}{15} \end{aligned}$$

$$\begin{aligned} 3. \quad & \frac{5}{8} \div \frac{3}{10} \\ &= \frac{5}{8} \times \frac{10}{3} \\ &= \frac{5}{\underset{4}{\cancel{8}}} \times \frac{\overset{10}{\cancel{10}}}{3} \\ &= \frac{25}{12} \\ &= 2\frac{1}{12} \end{aligned}$$

(a) $\frac{2}{3} \div \frac{3}{4}$

(b) $\frac{3}{7} \div \frac{5}{8}$

(c) $\frac{1}{3} \div \frac{1}{2}$

(d) $\frac{3}{10} \div \frac{5}{7}$

(e) $\frac{4}{5} \div \frac{8}{9}$

(f) $\frac{3}{10} \div \frac{3}{5}$

(g) $\frac{2}{3} \div \frac{11}{12}$

(h) $\frac{7}{15} \div \frac{3}{5}$

(i) $\frac{8}{9} \div \frac{16}{27}$

(j) $\frac{4}{5} \div \frac{2}{3}$

(k) $\frac{9}{10} \div \frac{3}{5}$

(l) $\frac{13}{15} \div \frac{4}{5}$

2. Convert the mixed numbers in the following problems to improper fractions before solving.

Use the steps shown in question 1 and write answers as mixed numbers where possible.

(a) $2\frac{1}{2} \div 1\frac{3}{4}$

(b) $3\frac{1}{3} \div 4\frac{4}{9}$

(c) $1\frac{5}{7} \div 5\frac{1}{7}$

(d) $8\frac{2}{5} \div 2\frac{1}{10}$

(e) $8\frac{1}{2} \div 6\frac{3}{8}$

(f) $7\frac{1}{3} \div 1\frac{2}{9}$

(g) $2\frac{1}{5} \div 9\frac{9}{10}$

(h) $2\frac{1}{8} \div 9\frac{7}{8}$

3. Write the answers to the following problems as fractions.

(a) How many 3's are in 31?

(b) How many 5's are in 52?

(c) How many 8's are in 3?

(d) How many 10's are in 7?

Example

How many 4's are in 11?

This can be written as $\frac{11}{4}$

Or as a mixed number

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

4. Write the answers to the following divisions as fractions in their simplest form.

Convert to mixed numbers where necessary.

- (a) $3 \div 5$ (b) $17 \div 22$
 (c) $16 \div 18$ (d) $5 \div 30$
 (e) $35 \div 20$ (f) $27 \div 4$

Examples

$$\begin{array}{ll} \text{1. } 5 \div 8 & \text{2. } 14 \div 6 \\ = \frac{5}{8} & = \frac{14}{6} \\ & = \frac{7\cancel{14}}{3\cancel{6}} \\ & = \frac{7}{3} \\ & = 2\frac{1}{3} \end{array}$$

5. (a) How many $\frac{1}{3}$'s are in 1? (b) How many $\frac{1}{5}$'s are in 2?
 (c) How many $\frac{1}{4}$'s are in 4? (d) How many $\frac{1}{10}$'s are in 3?
 (e) How many $\frac{1}{2}$'s are in $3\frac{1}{2}$? (f) How many $\frac{1}{5}$'s are in $2\frac{1}{5}$?
 (g) How many $\frac{1}{10}$'s are in $7\frac{3}{10}$? (h) How many $\frac{1}{6}$'s are in $2\frac{1}{6}$?

6. It may be necessary to change the whole numbers to fractions in the following problems before solving.

- (a) $3 \div \frac{3}{4}$ (b) $8 \div \frac{2}{7}$
 (c) $11 \div 1\frac{2}{9}$ (d) $2\frac{1}{2} \div 7$
 (e) $3\frac{3}{4} \div 5$ (f) $12 \div 3\frac{3}{7}$
 (g) $2 \div \frac{2}{3}$ (h) $5\frac{2}{9} \div 8$

Examples

$$\begin{array}{ll} \text{1. } 5 \div \frac{2}{3} & \text{2. } \frac{3}{4} \div 9 \\ = \frac{5}{1} \div \frac{2}{3} & = \frac{3}{4} \div \frac{9}{1} \\ = \frac{5}{1} \times \frac{3}{2} & = \frac{3}{4} \times \frac{1}{9} \\ = \frac{15}{2} & = \frac{1\cancel{3}}{4} \times \frac{1}{\cancel{9}_3} \\ = 7\frac{1}{2} & = \frac{1}{12} \end{array}$$

7. (a) How many $\frac{1}{2}$'s are in 10? (b) How many 10's are in $\frac{1}{2}$?
 (c) How many $\frac{2}{3}$'s are in 9? (d) How many 9's are in $\frac{2}{3}$?
 (e) How many $\frac{3}{4}$'s are in $7\frac{1}{2}$? (f) How many $\frac{1}{8}$'s are in $2\frac{1}{3}$?
 (g) How many 6's are in $2\frac{2}{5}$? (h) How many $\frac{3}{5}$'s are in $2\frac{1}{4}$?

8. Milo bought a 24 kg box of tiles. He weighed one tile and found it to be $\frac{1}{4}$ kg.
How many tiles were in the box?
9. Jedi had a container that held $2\frac{1}{2}$ litres of water. She used this container to fill her baby's bath. The bath had a capacity of 60 litres but Jedi only wanted to half fill the bath.
How many times would she need to empty into the bath the $2\frac{1}{2}$ litre container to half fill the bath?
10. Lia measured her pace when running to be $1\frac{1}{3}$ metres.
How many paces would she need to run 400 metres?

11. A computer technician was scanning discs to see if they contained any errors.
It took her $3\frac{1}{2}$ minutes to scan each disc.
How many discs could she scan in 35 minutes?



12. A builder needed to cut a number of pieces of wood that were $\frac{1}{3}$ metre long.
How many could he cut from a 6 metre length of timber?
13. Ingrid was shopping and noticed that 10 avocados weighed 2 kg.
(a) What was the weight of each avocado? (Write answer as a fraction)
(b) Ingrid bought 5 kg of the avocados to make guacamole.
How many avocados did she buy?
14. Alberto needed to take some medicine. He bought a 50 ml bottle of the medicine and had to take a $2\frac{1}{2}$ ml dose every 6 hours.
(a) How many $2\frac{1}{2}$ ml doses would be in the bottle?
(b) If he took the first dose at 6 p.m. on Monday, what time, and on what day, would he take the last dose in the bottle?

BODMAS

EXERCISE 3G

Solve the following problems. Remember BODMAS.
Give answers as mixed numbers in their simplest form where appropriate.

1. $\frac{1}{2} + \frac{1}{2} \times \frac{1}{2}$ 2. $\frac{1}{2} \times (\frac{1}{2} + \frac{1}{2})$

3. $\frac{1}{4}$ of $10 + \frac{1}{2}$ 4. $\frac{1}{2} \times \frac{1}{3} + \frac{2}{3}$

5. $1\frac{1}{2} \times (1\frac{1}{3} - \frac{4}{9})$ 6. $\frac{3}{5} - \frac{4}{15} \div \frac{2}{3}$

7. $\frac{2}{9} \times 1\frac{2}{7} + \frac{4}{5} \div 1\frac{4}{5}$

8. $\frac{1}{3} + \frac{1}{2}$ of $2\frac{1}{3} - 2 \div 1\frac{1}{3}$

Example

$$\begin{aligned} & \frac{1}{2} \times \frac{1}{2} + \frac{5}{8} \text{ of } (\frac{3}{5} + \frac{1}{5}) - \frac{1}{4} \\ &= \frac{1}{2} \times \frac{1}{2} + \frac{5}{8} \text{ of } \frac{4}{5} - \frac{1}{4} \\ &= \frac{1}{2} \times \frac{1}{2} + \frac{1}{2} - \frac{1}{4} \\ &= \frac{1}{4} + \frac{1}{2} - \frac{1}{4} \\ &= \frac{3}{4} - \frac{1}{4} \\ &= \frac{1}{2} \end{aligned}$$

Calculator Problems

EXERCISE 3H

Use the fraction key on your calculator to help you solve the following problems. Arrange the answers in order from the smallest to the largest to find the answer to this riddle.

Who invented fractions?

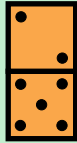
T	$3 \div (\frac{1}{4} + \frac{1}{4})$
*	$\frac{29}{4} + \frac{7}{4}$
H	$11\frac{1}{2} + 1\frac{1}{5} + \frac{3}{10}$
N	$\frac{17}{19} \times 2\frac{4}{17}$
E	$5\frac{1}{6} \div \frac{31}{48}$
Y	$6\frac{3}{8} - \frac{8}{9} - 1\frac{35}{72}$
I	$2\frac{1}{2} \div \frac{5}{22}$
E	$\frac{5}{6} + \frac{1}{9} + \frac{1}{18}$

H	$\frac{3}{8} - \frac{1}{4} - \frac{1}{8}$
*	$2\frac{1}{4} \times 2\frac{2}{9}$
H	$2\frac{1}{2} \div \frac{5}{6} + 3\frac{1}{4} \times 1\frac{3}{13}$
R	$3\frac{1}{4} \times \frac{10}{13} + \frac{1}{2}$
T	$3\frac{1}{4} \times 2\frac{1}{5} \times 1\frac{137}{143}$
G	$13\frac{1}{4} \times \frac{48}{53}$
H	$\frac{2}{7}$ of $52\frac{1}{2}$
E	$\frac{34}{3} - \frac{4}{3}$

PROBLEM SOLVING

1. What is a half of a third of a quarter of a fifth of a sixth of a seventh of an eighth of a ninth of a tenth of 3 628 800?
2. Consider a domino as a fraction.

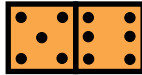
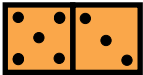
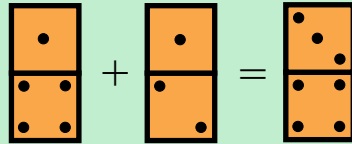
Example



This domino would be $\frac{2}{5}$.
It could also be turned upside down. The fraction would then be $\frac{5}{2}$.

Use the dominoes below and any of the operations $+$, $-$, $\times$ or $\div$ to form an equation.

Example



PUZZLES

1. Change **ZERO** into **HALF** in six steps by changing one letter at a time to form a new word.

Example

CAT can be changed to **DOG** in three steps

CAT
COT
DOT
DOG

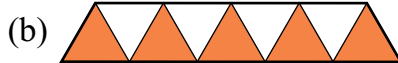
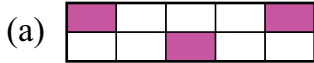
2. Find words from this chapter hidden in these sentences.

Example A keyboard is used for typing.

- (a) The man in the van had a plan to get a tan.
- (b) Sally needed a competent handyman to fix her windows.
- (c) Every Monday Rory had lunch alfresco style.
- (d) The fisherman had to weigh the fish he caught before he sold it.
- (e) The tennis event held every Thursday in Darby was very popular.
- (f) The farmer owned six thousand merino sheep.

CHAPTER REVIEW

1. What fraction of each of the following shapes is shaded?



2. Complete the following equivalent fractions.

(a) $\frac{3}{5} = \frac{\square}{10} = \frac{12}{\square} = \frac{\square}{45} = \frac{60}{\square} = \frac{\square}{150}$ (b) $\frac{10}{16} = \frac{\square}{32} = \frac{5}{\square} = \frac{\square}{48} = \frac{50}{\square} = \frac{\square}{240}$

3. Write the following fractions in their simplest form.

(a) $\frac{20}{40}$ (b) $\frac{32}{48}$ (c) $\frac{16}{24}$ (d) $\frac{15}{55}$ (e) $\frac{99}{108}$ (f) $\frac{105}{140}$

4. Change each pair of fractions to a common denominator.

(a) $\frac{2}{3}$ $\frac{4}{5}$ (b) $\frac{5}{8}$ $\frac{1}{4}$ (c) $\frac{2}{5}$ $\frac{5}{6}$ (d) $\frac{5}{8}$ $\frac{5}{6}$ (e) $\frac{1}{2}$ $\frac{7}{9}$

5. Change the following mixed numbers to improper fractions.

(a) $4\frac{2}{3}$ (b) $5\frac{1}{4}$ (c) $7\frac{5}{6}$ (d) $8\frac{4}{5}$ (e) $6\frac{9}{10}$ (f) $20\frac{5}{7}$

6. Change the following improper fractions to mixed numbers.

(a) $\frac{10}{3}$ (b) $\frac{35}{4}$ (c) $\frac{35}{6}$ (d) $\frac{48}{5}$ (e) $\frac{99}{10}$ (f) $\frac{127}{7}$

7. Complete the following calculations.

Write answers in their simplest form.

(a) $\frac{3}{5} + \frac{1}{5}$ (b) $\frac{5}{7} - \frac{2}{7}$ (c) $2\frac{3}{11} + 3\frac{4}{11}$ (d) $5\frac{6}{7} - 2\frac{3}{7}$

(e) $1 - \frac{3}{8}$ (f) $\frac{1}{2} + \frac{1}{4}$ (g) $\frac{7}{8} - \frac{1}{4}$ (h) $\frac{3}{5} + \frac{2}{3}$

(i) $\frac{5}{6} - \frac{3}{4}$ (j) $\frac{3}{7} + \frac{3}{8}$ (k) $\frac{1}{2} + \frac{1}{3} - \frac{1}{5}$ (l) $\frac{3}{7} - \frac{1}{10} + \frac{3}{5}$

8. Convert the fractions in the following problems to improper fractions before solving.

Write answers as mixed numbers in their simplest form.

(a) $2\frac{3}{5} + 1\frac{1}{4}$ (b) $3\frac{2}{3} - 1\frac{3}{4}$ (c) $3 - 1\frac{2}{7}$ (d) $6\frac{2}{7} + 3\frac{3}{4}$

9. Complete the following multiplications.

Write answers in their simplest form.

(a) $\frac{1}{4} \times \frac{1}{3}$ (b) $\frac{2}{5} \times \frac{3}{4}$ (c) $\frac{3}{7} \times \frac{14}{27}$ (d) $\frac{9}{10} \times \frac{14}{27}$

10. Convert the mixed numbers to improper fractions in the following problems before cancelling and solving.

Write answers as mixed numbers in their simplest form.

(a) $2\frac{1}{4} \times 1\frac{7}{9}$ (b) $8\frac{1}{3} \times 1\frac{1}{5}$ (c) $1\frac{9}{10} \times 6\frac{2}{3}$ (d) $12\frac{3}{5} \times 1\frac{1}{14}$

11. Complete the following calculations

(a) $\frac{1}{4}$ of \$80 (b) $\frac{2}{5}$ of 25 kg (c) $\frac{3}{4}$ of \$240 (d) $\frac{7}{10}$ of 120 m

12. At a college there were 800 students. Two-fifths of the students at the college could speak a second language.

(a) How many students could speak a second language?

(b) What fraction of the students at the school could **not** speak a second language?

13. What fraction is a third of a quarter of a fifth?

14. Complete the following divisions.

Write answers in their simplest form.

(a) $\frac{1}{4} \div \frac{1}{3}$ (b) $\frac{2}{5} \div \frac{7}{10}$ (c) $\frac{2}{9} \div \frac{14}{15}$ (d) $\frac{9}{20} \div \frac{15}{16}$

15. Convert the mixed numbers to improper fractions in the following problems before cancelling and solving.

Write answers as mixed numbers in their simplest form.

(a) $2\frac{4}{7} \div \frac{9}{14}$ (b) $1\frac{1}{14} \div 4\frac{2}{7}$ (c) $2\frac{7}{10} \div 1\frac{4}{5}$ (d) $2\frac{2}{15} \div 1\frac{5}{9}$

16. Dale makes ceramic models. He makes his own clay mix using the following ingredients.

$10\frac{1}{2}$ kg of clay, $5\frac{3}{4}$ kg of sand and $1\frac{3}{4}$ kg of cement

(a) If Dale makes 24 models what does each model weigh?

(b) If Dale wants to make 48 models, how much of each ingredient will he need in the clay mix?

Decimals

Decimal Numbers

EXERCISE 4A

1. Copy and complete the following table.

10 000	1000		10		$\frac{1}{10}$		$\frac{1}{1000}$	
Ten Thousands		Hundreds		Units		Hundredths		Ten Thousandths

2. Write the following decimals as:

(i) words

(ii) fractions

(a) 0.008

(b) 0.5

(c) 0.06

(d) 0.00009

(e) 0.0001

Example 0.03

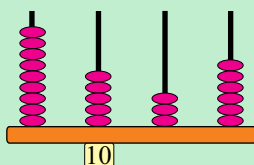
(i) three hundredths

(ii) $\frac{3}{100}$

3. What number is represented on each spike abacus below?

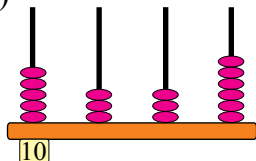
The place value of one of the spikes is given for each abacus.

Example

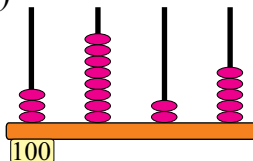


The number shown on this spike abacus is **953.6**

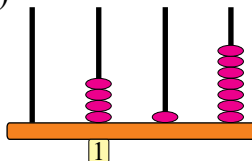
(a)



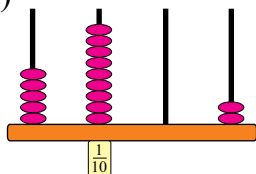
(b)



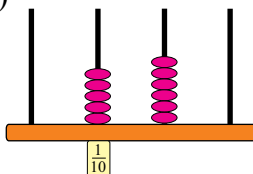
(c)



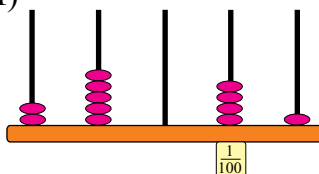
(d)



(e)



(f)



4. Find the following decimal numbers.

- (a) This three digit number has 6 tenths and 3 tens. The sum of its three digits is 10.
 (b) This number has two digits. The sum of the digits is 9 and there are twice as many units as tenths.
 (c) This three digit number is between 2 and 3. The sum of its digits is 5. It has the same number of hundredths as units.
 (d) This four digit number is between 5 and 10. It has twice as many thousandths as tenths. The sum of the thousandths and tenths is equal to the number of units. The sum of all its digits is 15.

5. Write the following fractions as decimal numbers.

Examples

1. $\frac{1}{10}$
= **0.1**

2. three hundredths
= **0.03**

3. $\frac{13}{1000}$
= **0.013**

4. $6\frac{21}{100}$
= **6.21**

5. $\frac{7215}{100}$
= **72.15**

- (a) $\frac{7}{100}$ (b) $\frac{2}{1000}$ (c) $\frac{9}{10}$ (d) $\frac{4}{10000}$ (e) five thousandths
 (f) eight hundred-thousandths (g) six hundredths
 (h) $\frac{18}{100}$ (i) $\frac{87}{1000}$ (j) $\frac{206}{1000}$ (k) $\frac{39}{10000}$ (l) $\frac{400}{1000}$
 (m) $2\frac{7}{10}$ (n) $15\frac{18}{100}$ (o) $6\frac{279}{1000}$ (p) $123\frac{82}{1000}$ (q) $7\frac{20}{100}$
 (r) $\frac{87}{10}$ (s) $\frac{163}{100}$ (t) $\frac{205}{10}$ (u) $\frac{7099}{1000}$ (v) $\frac{80501}{10}$

6. List the following numbers from smallest to largest to find the answer to the riddle.

What do sea monsters eat?

S	$\frac{87}{100}$
S	$\frac{85}{1000}$
N	$\frac{805}{1000}$
*	0.8005
S	$\frac{8500}{100}$
F	$\frac{8}{1000}$
A	$\frac{803}{1000}$

D	$\frac{8080}{10\ 000}$
*	0.855
I	$\frac{80}{10}$
H	0.8
P	$8\frac{5}{100}$
H	0.888
I	$\frac{8}{100}$



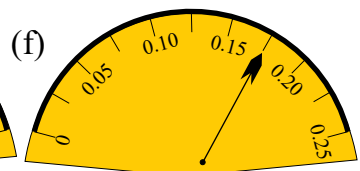
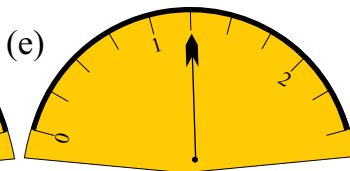
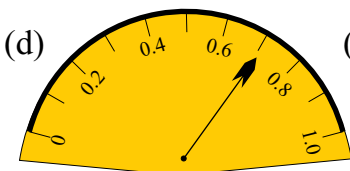
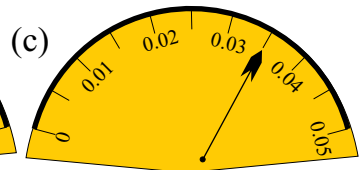
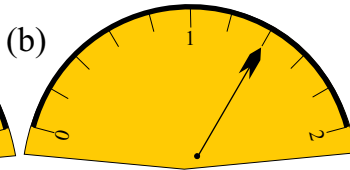
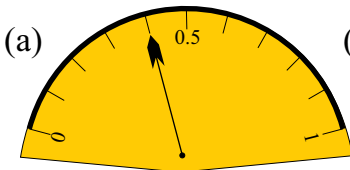
7. Five cyclists had the following times in a one kilometre sprint.
List the riders in order from the slowest to the fastest.

<i>Peter Peddals</i>	59.025 seconds
<i>Willy Weels</i>	59.250 seconds
<i>Harry Handels</i>	59.225 seconds
<i>Henry Helmut</i>	59.052 seconds
<i>Freddie Fraim</i>	59.202 seconds

8. Choose the correct symbol ($<$ or $>$) to place between the following pairs of numbers.

Examples $1.2 < 2.5$ $0.38 > 0.19$

- (a) 0.2 0.1 (b) 1.58 1.85 (c) 6.09 6.1
(d) 0.058 0.0567 (e) 2.0045 2.0201 (f) 56.09 56.0895
9. Add one hundredth to each of the following numbers.
(a) 2.58 (b) 0.5643 (c) 6.209 (d) 5.294 (e) 12.991
10. Add two thousandths to each of the following numbers.
(a) 2.58 (b) 0.5643 (c) 6.209 (d) 5.298 (e) 12.999
11. Find the number *midway* between the following pairs of numbers.
(a) 4 and 5 (b) 5.6 and 5.7 (c) 0.28 and 0.31
(d) 0.245 and 0.246 (e) 12 and 15 (f) 6.85 and 6.90
12. Read the number shown on the following meters.



Rounding

EXERCISE 4B

To round a price to the nearest 5 cents follow the steps below.

Step 1 Find the multiples of 5 cents below and above the price.

Step 2 Choose the multiple that the price is closer to.

Example \$4.78

The multiple of 5 cents below this price is \$4.75

The multiple of 5 cents above this price is \$4.80

\$4.78 is closer to \$4.80

Answer: \$4.80

1. Round the following prices to the nearest 5 cents.

- (a) \$8.51 (b) \$10.78 (c) \$15.33 (d) \$68.16 (e) \$22.22
 (f) \$21.98 (g) \$6.07 (h) \$1.02 (i) \$0.66 (j) \$0.33

2. Round the prices in question 1 to the nearest 10 cents.

3. Round the prices in question 1 to the nearest dollar.

The number of decimal places is defined as the number of digits after (to the right of) the decimal point.

Examples 75.621 has **three** decimal places (75.**621**)
 8.60175 has **five** decimal places (8.**60175**)
 5609.3 has **one** decimal place (5609.**3**)

4. How many decimal places are in the following numbers?

- (a) 3.7 (b) 18.971 (c) 0.0731 (d) 45.301 (e) 5.01856
 (f) 34.6692 (g) 5.66666 (h) 100.001 (i) 52890 (j) 0.000009

To round a decimal number off to a certain number of decimal places follow the steps below.

Step 1 Identify the number of decimal places being rounded off to.

Step 2 Look at the digit *after* this number of decimal places.

Step 3 - If this digit is *less than 5* round down to the existing number.
 - If this digit is *greater than or equal to 5* round up to the next number.

Examples

1. Round 56.7834 to *two* decimal places.

Step 1 Two decimal places means the two digits after the decimal point.

56.7834

Step 2 The next digit is 3 which is less than 5.

56.7834

Step 3 Round *down* to the existing number.

Answer: 56.78

2. Round 8.0976 to *three* decimal places.

Step 1 Three decimal places means the three digits after the decimal point.

8.0976

Step 2 The next digit is 6 which is greater than 5.

8.0976

Step 3 Round *up* to the next number.

Answer: 8.098

Examples continued

3. Round 12.7513 to **one** decimal place.

Step 1 One decimal place means the one digit after the decimal point.

12.7513

Step 2 The next digit is 5.

12.7~~5~~13

Step 3 Round **up** to the next number.

Answer: 12.8

4. Round 2.569973 to **four** decimal places.

Step 1 Four decimal places means the four digits after the decimal point.

2.569973

Step 2 The next digit is 7 which is greater than 5.

2.5699~~7~~3

Step 3 Round **up** to the next number.

Answer: 2.5700

5. Round the following numbers to **two** decimal places.

- | | | | | |
|------------|-------------|------------|-------------|--------------|
| (a) 9.748 | (b) 17.1613 | (c) 10.555 | (d) 0.7839 | (e) 120.5209 |
| (f) 10.399 | (g) 18.919 | (h) 9.008 | (i) 14.1987 | (j) 59.996 |

6. Round the numbers in question 5 to the nearest tenth (**one** decimal place).

7. Round the following numbers to **three** decimal places.

- | | | |
|-----------------|----------------|-----------------|
| (a) 18.76823 | (b) 0.0579671 | (c) 145.973493 |
| (d) 63.499621 | (e) 7.82019635 | (f) 19.999725 |
| (g) 127.2793108 | (h) 0.00793629 | (i) 6.09078135 |
| (j) 900.9162831 | (k) 0.18254816 | (l) 937.1739163 |

8. Round the numbers in question 7 to **four** decimal places.

9. Andre and Mandy go shopping and buy the following items.

A loaf of bread \$2.35	2 litres of milk \$3.20
1 can of baked beans \$1.35	500 grams of butter \$1.65
3 kg of apples \$2.69 per kg	5 kg of potatoes \$0.87 per kg

- They both estimated the total cost of the shopping list.
 Andre rounded the prices to the nearest 50 cents before adding them.
 Mandy rounded the prices to the nearest dollar before adding them.
- Find both Andre's and Mandy's estimate of the total cost.
 - Use a calculator to find the actual total cost of the shopping list.
 - Round the total cost to the nearest 5 cents and calculate the change Andre and Mandy should receive from \$50.

Converting Fractions to Decimals

EXERCISE 4C

1. Convert the following fractions to decimals.

- (a) $\frac{1}{10}$ (b) $\frac{3}{100}$ (c) $\frac{27}{100}$ (d) $\frac{9}{1000}$ (e) $\frac{81}{1000}$ (f) $\frac{451}{1000}$

2. Convert the following fractions to decimals.

<i>Examples</i>	1. $\frac{1}{4}$	2. $\frac{3}{8}$
	$= 1 \div 4$	$= 3 \div 8$
	$= 4 \overline{) 1.00}$	$= 8 \overline{) 3.000}$
	$= \mathbf{0.25}$	$= \mathbf{0.375}$

- (a) $\frac{1}{2}$ (b) $\frac{3}{4}$ (c) $\frac{1}{5}$ (d) $\frac{1}{8}$ (e) $\frac{9}{20}$ (f) $\frac{11}{4}$

3. Use the answer for question 2(c) to help convert the following fractions to decimals. (a) $\frac{2}{5}$ (b) $\frac{3}{5}$ (c) $\frac{4}{5}$

4. Convert the following numbers to decimals.
 (Try to find the decimals using your memory)

- (a) $3\frac{1}{2}$ (b) $8\frac{1}{4}$ (c) $10\frac{1}{5}$ (d) $6\frac{3}{4}$ (e) $25\frac{3}{5}$ (f) $17\frac{4}{5}$

Recurring Decimals

EXERCISE 4D

1. Use a dot or bar to indicate which digits are recurring (repeating) in the following decimals.

Examples 1. $0.2222\dots = 0.\dot{2}$ 2. $0.234234\dots = 0.\overline{234}$

(a) $0.7777\dots$ (b) $0.252525\dots$ (c) $0.61111\dots$ (d) $0.9712451245\dots$

2. Change the following fractions to decimals using a dot or bar as shown in question 1 to indicate the recurring digits.

(a) $\frac{1}{3}$ (b) $\frac{5}{6}$ (c) $\frac{7}{9}$ (d) $\frac{5}{12}$ (e) $\frac{3}{7}$ (f) $5\frac{11}{12}$

3. Find the fractions that when converted would give the following decimals (use the answers to question 2 to help).

(a) $0.\dot{6}$ (b) $0.\dot{1}$ (c) $0.\dot{8}$ (d) $0.1\dot{6}$ (e) $0.\overline{142857}$

Using the Calculator

EXERCISE 4E

1. Use the calculator to convert the following fractions to decimals. Arrange the answers from the smallest to the largest to find the answer to the following question.

Triskaidekaphobia is the fear of what?

H	$\frac{29}{35}$	N	$\frac{8}{9}$	E	$\frac{61}{69}$	T	$\frac{13}{16}$
E	$\frac{7}{8}$	T	$\frac{239}{276}$	R	$\frac{31}{36}$	I	$\frac{5}{6}$

Example $\frac{21}{29}$
 $= 21 \div 29$
 $= 0.724137931\dots$

2. Round all the answers to question 1 to one decimal place.
3. Round all the answers to question 1 to the nearest unit.

Addition

EXERCISE 4F

Find the answers to the following additions.

Examples

Remember these steps:

1. Line up all the decimal points.
2. Add zeros where necessary.

1. $3.7 + 2.8$

$$\begin{array}{r} 3.7 \\ + 2.8 \\ \hline 6.5 \end{array}$$

2. $16.7 + 4.85$

$$\begin{array}{r} 16.70 \\ + 4.85 \\ \hline 21.55 \end{array}$$

3. $25.6 + 0.804 + 8.57$

$$\begin{array}{r} 25.600 \\ + 0.804 \\ + 8.570 \\ \hline 34.974 \end{array}$$

1. $5.6 + 4.3$

2. $16.4 + 3.1$

3. $27.63 + 2.25$

4. $8.3 + 6.47$

5. $28.87 + 9.2$

6. $0.783 + 0.116$

7. $326.6 + 67.6$

8. $3.67 + 9.5$

9. $8.45 + 9.7 + 6.542$

10. $2.56 + 13.8$

11. $0.6 + 12.08$

12. $87.09 + 12.608$

13. $5.28 + 8.073$

14. $4.99 + 0.586$

15. $15.6 + 2.75 + 28.468$

Subtraction

EXERCISE 4G

Find the answers to the following subtractions.

Examples

Remember these steps:

1. Line up all the decimal points.
2. Add zeros where necessary.

1. $3.8 - 2.6$

$$\begin{array}{r} 3.8 \\ - 2.6 \\ \hline 1.2 \end{array}$$

2. $16.9 - 4.65$

$$\begin{array}{r} 16.90 \\ - 4.65 \\ \hline 12.25 \end{array}$$

3. $25.624 - 9.85$

$$\begin{array}{r} 25.624 \\ - 9.850 \\ \hline 15.774 \end{array}$$

1. $5.6 - 4.3$

2. $16.4 - 3.1$

3. $27.68 - 2.25$

4. $8.3 - 6.4$

5. $28.2 - 9.6$

6. $0.783 - 0.116$

7. $326.6 - 67.6$

8. $13 - 9.5$

9. $9.87 - 6.5$

10. $12.56 - 3.8$

11. $35.6 - 12.08$

12. $487.09 - 12.608$

13. $8.28 - 0.373$

14. $4.99 - 0.086$

15. $7815.624 - 209.7685$

Addition and Subtraction Problems

EXERCISE 4H

- Bill weighed 63.4 kg. He became ill and lost $4\frac{1}{2}$ kg in weight.
 - What did he weigh after his illness?
 - As he recovered he regained 3.8 kg. What did he then weigh?
- Rearrange the following sets of tiles to make equations.

Example

$$7 \ . \ 3 \ + \ 2 \ = \ 9 \ . \ 3$$

- $= \ . \ . \ + \ 2 \ 5 \ 8 \ 3 \ 9$
- $= \ . \ . \ - \ 7 \ 5 \ 1 \ 7 \ 4$

- Dorothy attempted to solve the following problem on her calculator.

$$34.807 - 14.16$$

The answer shown on her calculator was 20.71.

She immediately knew this answer was wrong.

- How did she know this?

She realised that one of the buttons on her calculator wasn't working.

- Which button on her calculator wasn't working?

If she used her calculator to solve the following problems, what would be the answers shown. (Remember the button that doesn't work)

- 5.01 + 6.4 (d) 7.08 + 6.07 (e) 30.09 - 2.8 (f) 6.208 - 4.019

- As a safety requirement at a warehouse, the workers were not permitted to lift loads more than 20 kg. The six boxes below needed to be packed into *two* bags so they could be safely lifted. How can this be done?

5.4 kg

7.8 kg

3.8 kg

7.3 kg

8.7 kg

6.6 kg

5. The level of a river was rising because of persistent rain.
The following heights were recorded on a water level gauge.

1.00 pm	0.28 m
2.00 pm	0.30 m
3.00 pm	0.34 m
4.00 pm	0.40 m

The river kept rising in this pattern till 6.00 am the next day.

- (a) Find the pattern in the river heights and use this pattern to find the river height at 6.00 am the next day.
(b) What was the total rise in the river level between 1.00 pm and 6.00 am the next day.

The river level then started to drop at a constant rate of 0.34 m every hour.

- (c) At what time will the river level return to 0.28 m?

6. Yvonne, Sharon, Charley and Christa competed in a high jump competition. Use the following information to find the height jumped by each competitor.

- ♦ Sharon jumped the highest which was one tenth of a metre higher than the lowest jump.
- ♦ Yvonne jumped six hundredths of a metre higher than Charley.
- ♦ Christa jumped 1.61 metres.
- ♦ Christa jumped four hundredths of a metre higher than Charley.



Multiplication - Decimal by Whole Number

EXERCISE 4I

- State the number of decimal places in the following numbers.
 (a) 6.8 (b) 0.25 (c) 185.3 (d) 4.578
 (e) 5.004 (f) 56.509 (g) 53 (h) 10.0506
- Find the answer to each of the following multiplications.

Example 23.46×51

$$\begin{array}{r}
 23.46 \quad \begin{array}{l} 2 \text{ decimal places} \\ 0 \text{ decimal places} \end{array} \\
 \times 51 \\
 \hline
 2346 \\
 117300 \\
 \hline
 \mathbf{1196.46}
 \end{array}$$

Remember:

The number of decimal places in the answer is the same as the total number of decimal places in the question.

Total of 2 decimal places in the question.
There must be 2 decimal places in the answer.

- | | | |
|------------------------|------------------------|------------------------|
| (a) 73.5×8 | (b) 6.05×9 | (c) 13.43×6 |
| (d) 1.783×7 | (e) 2.7×16 | (f) 5.21×28 |
| (g) 28.302×40 | (h) 47.721×15 | (i) 8.796×315 |

- Damien wanted to buy some blank CD's that cost \$3.65 each.

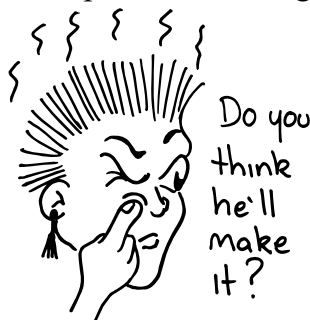
What would be the cost of the following number of CD's.

- (a) 3 CD's (b) 10 CD's (c) three dozen CD's

- The world record for kissing is 8001 people in 8 hours - one every 3.6 seconds. Alex, a year 8 student, wanted to break this record by averaging 3.5 seconds per kiss. He decided to practise on the girls at his school.

If he took 3.5 seconds a kiss, how long would it take him to kiss:

- (a) the 14 girls in his class?
 (b) the 340 girls at his school?
 (c) 8001 people?



Multiplication - Decimal by Decimal

EXERCISE 4J

1. Find the answer to each of the following multiplications.

Example 23.46×7.5

$$\begin{array}{r}
 23.46 \quad \begin{array}{l} 2 \text{ decimal places} \\ 1 \text{ decimal place} \end{array} \\
 \times 7.5 \\
 \hline
 11730 \\
 164220 \\
 \hline
 \underline{175.950}
 \end{array}$$

Remember:

The number of decimal places in the answer is the same as the total number of decimal places in the question.

Total of 3 decimal places in the question.
There must be 3 decimal places in the answer.

- | | | |
|--------------------------|-------------------------|------------------------------------|
| (a) 3.5×8.1 | (b) 6.5×9.3 | (c) 13.4×6.2 |
| (d) 0.34×7.6 | (e) 2.7×0.16 | (f) 0.52×0.8 |
| (g) 28.3×0.04 | (h) 1.001×1.5 | (i) 8.006×0.05 |
| (j) 0.005×2.01 | (k) 3.07×0.046 | (l) 12.05×2.04 |
| (m) 0.004×0.005 | (n) 0.1×0.1 | (o) $0.08 \times 0.08 \times 0.01$ |

2. (i) Estimate the answers to the following problems by rounding the decimals to whole numbers before multiplying.
(ii) Use a calculator to find the accurate answers.

Examples

$\approx$ means:
approximately equal to

1. 18.9×4.73

(i) 18.9×4.73
 $\approx 20 \times 5$
 $= 100$

(ii) 18.9×4.73
 $= 89.397$

2. 31.2×2.08

(i) 31.2×2.08
 $\approx 30 \times 2$
 $= 60$

(ii) 31.2×2.08
 $= 64.896$

- | | | |
|-------------------------|---------------------------|--------------------------|
| (a) 6.2×10.23 | (b) 39.7×9.78 | (c) 12.4×6.12 |
| (d) 82.5×19.66 | (e) 2.9×58.6 | (f) 4.09×7.87 |
| (g) 28.3×31.03 | (h) 1.001×69.98 | (i) 8.006×98.79 |
| (j) 198.5×2.09 | (k) 30.87×41.046 | (l) 12.05×11.88 |

Division by Whole Numbers

EXERCISE 4K

1. Find the answers to the following divisions.

Examples

1. $120.5 \div 5$

$$\begin{array}{r} 24.1 \\ 5 \overline{)120.5} \\ \underline{100} \\ 20 \\ \underline{20} \\ 0 \\ \underline{0} \\ 0 \end{array}$$

= 24.1

2. $2.8 \div 4$

$$\begin{array}{r} 0.7 \\ 4 \overline{)2.8} \\ \underline{28} \\ 0 \end{array}$$

= 0.7

(a) $6.5 \div 5$

(b) $12.8 \div 4$

(c) $73.8 \div 6$

(d) $146.7 \div 3$

(e) $90.3 \div 7$

(f) $123.75 \div 5$

(g) $290.16 \div 6$

(h) $229.14 \div 9$

(i) $10.494 \div 2$

(j) $7.524 \div 6$

(k) $0.182 \div 7$

(l) $0.0384 \div 8$

2. Find the answers to the following divisions.

Example

$9 \div 4$

$$\begin{array}{r} 2.25 \\ 4 \overline{)9.00} \\ \underline{8} \\ 10 \\ \underline{8} \\ 20 \\ \underline{20} \\ 0 \end{array}$$

= 2.25

Add enough zeros to make it possible to find the answer.

(a) $6 \div 4$

(b) $18 \div 4$

(c) $17 \div 5$

(d) $1.2 \div 8$

(e) $124 \div 8$

(f) $30 \div 8$

(g) $0.1 \div 8$

(h) $3.44 \div 5$

(i) $31.1 \div 8$

(j) $45.31 \div 5$

(k) $23.73 \div 4$

(l) $100.01 \div 4$

3. Find the answers to the following divisions. Work the answers out to 3 decimal places then round them to 2 decimal places.

Example

$9 \div 7$

$$\begin{array}{r} 1.285 \\ 7 \overline{)9.000} \\ \underline{7} \\ 20 \\ \underline{14} \\ 60 \\ \underline{56} \\ 40 \\ \underline{35} \\ 50 \\ \underline{49} \\ 10 \end{array}$$

= 1.285 (three decimal places)
= 1.29 (two decimal places)

(a) $6 \div 9$

(b) $18 \div 7$

(c) $17 \div 6$

(d) $1.2 \div 9$

(e) $124 \div 3$

(f) $10.7 \div 8$

(g) $0.15 \div 8$

(h) $23.44 \div 3$

(i) $51.1 \div 8$

(j) $45.31 \div 7$

(k) $21.4835 \div 5$

(l) $50.985 \div 3$

Division by Decimals

EXERCISE 4L

Find the answers to the following divisions.

Examples

Remember these steps:

1. Move the decimal point in the divisor to make it a whole number.
2. Move the decimal point in the dividend the same number of places.
3. Add zeros if necessary.

- | | Dividend | Divisor | |
|----|--|---------|---|
| 1. | 2.48 | 0.2 | Decimal point needs to move 1 place to make the divisor a whole number. Move the decimal point 1 place in the divisor and dividend. |
| | $\overset{\curvearrowright}{2.48} \div \overset{\curvearrowright}{0.2}$ | | |
| | $= 24.8 \div 2$ | | |
| | $= 12.4$ | | |
| 2. | 14.2 | 0.04 | Decimal point needs to move 2 places to make the divisor a whole number. Move the decimal point 2 places in the divisor and dividend. Add 1 zero to the dividend. |
| | $\overset{\curvearrowright}{14.2} \div \overset{\curvearrowright}{0.04}$ | | |
| | $= 1420 \div 4$ | | |
| | $= 355$ | | |
| 3. | 48 | 1.2 | Decimal point needs to move 1 place to make the divisor a whole number. Move the decimal point 1 place in the divisor and dividend. Add 1 zero to the dividend. |
| | $\overset{\curvearrowright}{48.} \div \overset{\curvearrowright}{1.2}$ | | |
| | $= 480 \div 12$ | | |
| | $= 40$ | | |

1. $3.6 \div 0.9$

2. $2.7 \div 0.3$

3. $0.24 \div 0.8$

4. $5.4 \div 0.06$

5. $12.3 \div 0.03$

6. $0.168 \div 0.4$

7. $0.008 \div 0.004$

8. $5.05 \div 0.5$

9. $0.24 \div 0.006$

10. $2 \div 0.05$

11. $7.38 \div 0.6$

12. $4.8 \div 0.06$

13. $24.15 \div 0.007$

14. $0.1 \div 0.01$

15. $20 \div 0.04$

Division Problems

EXERCISE 4M

1. Eight kittens weighed a total of 0.72 kg.
What was the weight of each kitten?
2. A school was holding a 35 km walk-a-thon. The walk consisted of laps around a park. The walking track around the park was 0.7 km.
How many laps of the park would be needed to complete the 35 km?
3. A stack of paper was 6 cm thick. If each sheet of paper was 0.02 cm thick, how many sheets of paper were in the stack?
4. Miranda wanted to try to beat the world record for the most number of skips with a skipping rope in an hour. She can average 0.3 seconds per skip.
 - (a) How many skips will she be able to complete in an hour if she can keep up this rate?
 - (b) The world record is 14 628.
Will Miranda set a new record?
5. At a disco there was a stroboscope (flashing light) that was flashing every 0.4 seconds. How many times will it flash in:
 - (a) one minute?
 - (b) one hour?
6. As part of the fund raising at a school fete, there was a competition to guess the number of chocolates in a jar. Joel weighed the full jar when no-one was watching and found it to weigh 6.898 kg. He then weighed one chocolate and a similar jar. One chocolate weighed 0.012 kg and the jar weighed 1.33 kg.
Using these figures, how many chocolates would Joel calculate to be in the jar?



Multiplication and Division by Powers of 10

EXERCISE 4N

1. Find the answers to the following multiplications.

When multiplying by a power of 10:

1. Move the decimal point to the right the same number of places as the number of zeros.

2. Add zeros if necessary.

Examples

1. 8.057×100

$\begin{array}{r} 8.057 \\ \curvearrowright \\ = 805.7 \end{array}$
 2 zeros-
move the decimal
point 2 places to
the right.

2. 3.65×1000

$\begin{array}{r} 3.65 \\ \curvearrowright \\ = 3650 \end{array}$
 3 zeros-
move the decimal
point 3 places.
Add 1 zero in
the blank space.

(a) 7.83×10

(b) 62.08×100

(c) 0.214×100

(d) 31×1000

(e) 0.0008×100

(f) $0.55 \times 10\ 000$

(g) 0.0278×1000

(h) $82.7 \times 100\ 000$

(i) $0.05 \times 100 \times 1000$

2. Find the answers to the following divisions.

When dividing by a power of 10:

1. Move the decimal point to the left the same number of places as the number of zeros.

2. Add zeros if necessary.

Examples

1. $284.7 \div 100$

$\begin{array}{r} 284.7 \\ \curvearrowleft \\ = 2.847 \end{array}$
 2 zeros-
move the decimal
point 2 places to
the left.

2. $94.6 \div 1000$

$\begin{array}{r} 94.6 \\ \curvearrowleft \\ = 0.0946 \end{array}$
 3 zeros-
move the decimal
point 3 places.
Add 1 zero in
the blank space.

(a) $35.2 \div 10$

(b) $657.3 \div 1000$

(c) $0.6 \div 10$

(d) $5000 \div 100$

(e) $793.5 \div 10\ 000$

(f) $891.3 \div 10$

(g) $22\ 000 \div 10\ 000$

(h) $3.8 \div 100\ 000$

(i) $5.9 \div 100 \div 10$

3. Ask a friend to race you to find the answers to the following problems. Tell your friend to use a calculator!

- | | | |
|-----------------------------|-------------------------|--------------------------------|
| (a) 9.83×10 | (b) $162.8 \div 100$ | (c) 0.804×100 |
| (d) $457 \div 1000$ | (e) 0.005×1000 | (f) $843.9 \div 100$ |
| (g) 0.0448×1000 | (h) $8270.2 \div 1000$ | (i) $0.05 \div 100$ |
| (j) $0.0016 \times 10\ 000$ | (k) 95.075×10 | (l) $2.967 \times 10 \div 100$ |

Scientific Notation

EXERCISE 40

1. Convert the following numbers into scientific notation.

Move the decimal point to after the first digit.

Examples

1. 6000
 $= 6 \times 1000$
 $= 6 \times 10^3$

2. 935 000
 $= 9.35 \times 100\ 000$
 $= 9.35 \times 10^5$

- | | | |
|-----------------|---------------------|-----------------|
| (a) 7000 | (b) 80 000 | (c) 500 000 000 |
| (d) 457 000 | (e) 230 000 | (f) 91 100 000 |
| (g) 165 080 000 | (h) 230 000 000 000 | (i) 50 001 |
| (j) 6587 | (k) 254.34 | (l) 1537.8 |

2. Convert the following numbers into scientific notation.

- The population of Japan is approximately 127 000 000.
- The area of Australia is approximately 7 682 000 square kilometres.
- The longest river in the world is a total of 6671 km long. (Do you know which river this is?)
- The Earth is approximately 150 000 000 km from the Sun.
- The Earth's orbit length around the Sun is 938 900 000 km.
- The Earth moves around this orbit at a speed of 106 000 km/hr.
- The total mass of all the oceans is 1 350 000 000 000 000 000 kg.



Prefixes

EXERCISE 4P

Table of Common Prefixes

Prefix	Symbol	Conversion
giga	G	$\times 1\,000\,000\,000$
mega	M	$\times 1\,000\,000$
kilo	k	$\times 1000$
centi	c	$\div 100$
milli	m	$\div 1000$
micro	μ	$\div 1\,000\,000$

1. Complete the following conversions.

Examples

1. 53.82 megalitres
 $= 53.82 \times 1\,000\,000$ litres
 $= \mathbf{53\,820\,000}$ litres

2. 6784 millimetres
 $= 6784 \div 1000$ metres
 $= \mathbf{6.784}$ metres

- | | |
|----------------------------------|------------------------------------|
| (a) 3 kilometres = __ metres | (b) 5.64 kilometres = __ metres |
| (c) 200 centimetres = __ metres | (d) 2540 centimetres = __ metres |
| (e) 2 megalitres = __ litres | (f) 0.056 megalitres = __ litres |
| (g) 21.5 kilograms = __ grams | (h) 0.785 kilograms = __ grams |
| (i) 5000 millimetres = __ metres | (j) 78 600 millimetres = __ metres |

2. Complete the following conversions.

- | | | |
|--------------------|---------------------------------|----------------------|
| (a) 7.5 kg = __ g | (b) 250 cm = __ m | (c) 350 mm = __ m |
| (d) 3.65 km = __ m | (e) 35 000 μm = __ m | (f) 0.6785 ML = __ L |
| (g) 250 mg = __ g | (h) 0.8 cm = __ m | (i) 6.25 mm = __ m |

3. A power station was producing 0.895 Gigawatts (GW) of electricity.
 How many watts (W) is this?

4. A scientist found 58.6 μg of radium in a rock sample.
 How many grams (g) is this?

Averages

EXERCISE 4Q

Use a calculator to help you find the following averages.
Remember to work out the top line first or use brackets.

To find the average of a group of numbers add them all and divide by how many numbers there are.

Example

Find the average height of five trees if their heights are 3.3 m, 3.6 m, 4.2 m, 3.1 m and 3.8 m.

$$\begin{aligned}
 \text{Average height} &= \frac{\text{all heights added}}{\text{number of trees}} \\
 &= \frac{3.3 + 3.6 + 4.2 + 3.1 + 3.8}{5} \\
 &= \frac{18}{5} \\
 &= 3.6 \text{ m}
 \end{aligned}$$

- The heights of the six players in a volleyball team were 2.06 m, 1.97 m, 1.83 m, 1.95 m, 1.78 m and 1.87 m.
Find the average height of the players in the team.

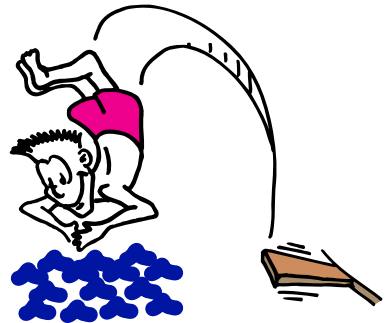
- The total score for a dive in a springboard competition was calculated using the following steps.

Step 1. Crossing off the highest and lowest scores.

Step 2. Finding the average of the other four scores.

Step 3. Multiplying this average by the degree of difficulty.

Find the total score for a dive with a degree of difficulty of 2.6 that records the following scores: 7.6, 8.1, 8.8, 7.8, 6.4, 8.2



- Find the average daily rainfall for a week with the following daily rainfall measurements:
 5.6 mm, 8.4 mm, 0 mm, 0 mm, 8.9 mm, 12.7 mm, 28.8 mm

Real Numbers

The number system that is commonly used is called the **Real Number System**.

Real Numbers can be divided into groups that have similar properties.

For example: whole numbers, integers, decimals, etc..

All of these groups fall under two categories:

Rational Numbers and **Irrational Numbers**.

Rational numbers can be expressed as fractions with the numerator and denominator whole numbers.

Rational numbers are whole numbers, numbers with a definite number of decimal places or recurring decimals.

Examples

$$15 (= \frac{15}{1})$$

$$\frac{13}{37}$$

$$8.5 (= 8 \frac{1}{2} = \frac{17}{2})$$

$$\sqrt{16} (= 4 = \frac{4}{1})$$

$$-\frac{7}{8}$$

$$0.\dot{3} (= \frac{1}{3})$$

$$0.0871 (= \frac{871}{10\,000})$$

$$0.41\dot{6} (= \frac{5}{12})$$

$$0.\overline{428571} (= \frac{3}{7})$$

Irrational numbers cannot be expressed as fractions with the numerator and denominator whole numbers.

Irrational numbers are infinitely non-recurring decimals.

Common irrational numbers are π (***pi***) and the square roots of non-square numbers.

Examples $\pi (= 3.14159265\dots)$ $\sqrt{7} (= 2.64575131\dots)$

Note: the dots indicate that the decimal number continues indefinitely and is non-recurring.

EXERCISE 4R

1. Which of the following numbers are:

(a) rational numbers (b) irrational numbers

$$9.76, \quad 0.5, \quad \sqrt{25}, \quad 0.\dot{6}, \quad \frac{7}{17}, \quad \frac{\pi}{2}, \quad 0.75\overline{32}, \quad -3.7311, \quad \sqrt{11}, \quad \sqrt{529}$$

2. Use a calculator to find the following irrational decimal numbers. Write the numbers to **five** decimal places then several dots to indicate they continue indefinitely.

Examples 1. $\frac{\pi}{4} = 0.78539\dots$ 2. $\sqrt{29} = 5.38516\dots$

- (a) 2π (b) $\sqrt{19}$ (c) $\frac{\pi}{3}$ (d) $\frac{\sqrt{47}}{2}$
 (e) $3\pi + 6$ (f) $\sqrt{83} - 2$ (g) $5\pi + \sqrt{71}$ (h) $(4 + 2\pi)^2$

3. Round the answers in question 2 **three** decimal places.

4. The number π is used to calculate the distance around a circle, called the **circumference** (C) of a circle, given the distance across a circle, called the **diameter** (D). The following formula is used:

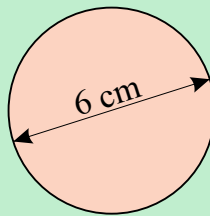
$$\text{circumference} = \pi \times \text{diameter}$$

$$C = \pi \times D$$

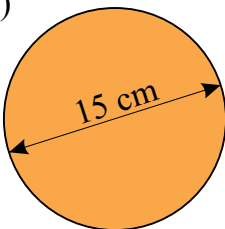
Find the circumference of each of the following circles. Give answers to **two** decimal places.

Example

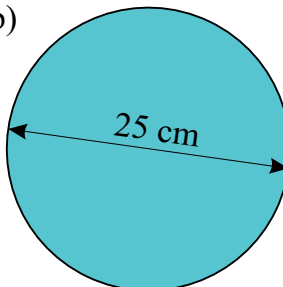
$$\begin{aligned} C &= \pi \times D \\ &= 3.14159\dots \times 6 \\ &= 18.84954\dots \\ C &= \mathbf{18.85 \text{ cm}} \text{ (two decimal places)} \end{aligned}$$



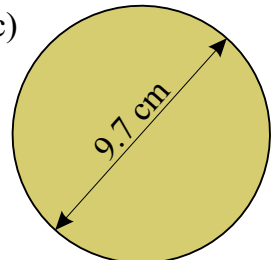
(a)



(b)



(c)

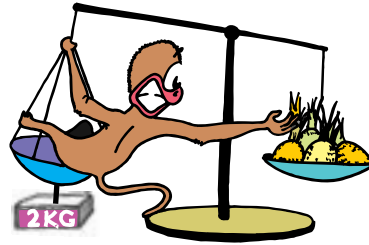


PROBLEM SOLVING

1. Two monkeys weighed the same as three paw-paws.



- One monkey and 2 kg weighed the same as four paw-paws.



Find the weight of a monkey and a paw-paw.

2. In 12 basketball games Yasuko averaged 12.5 points per game. She remembered her scores from 11 of the games:

6 8 12 13 15 9 10 21 11 10 19

Find how many points she scored in the other game.

PUZZLES

1. (a) Rearrange the letters **MAD LICE** to form a word from this chapter.
 (b) Using these letters form as many words as you can. The letters can be used any number at a time but each letter can only be used once in each word. (10 words - good, 20 words - excellent)

2. Each of the words in this puzzle contains the word **TEN**.

(*Example:* MOLTEN).

A clue for each word is given and when you find all the words the vertical word spells the unit for measuring sound.

— — — ■ — —

Soft

— — ■ — — — — —

Imposter

— ■ — — — — — —

Happy

— ■ — — — — —

Young rabbit

— ■ — — — — —

Defeated

— ■ — — — — — —

Leg of an octopus

— ■ — — — — —

Squash

CHAPTER REVIEW

1. Write the following fractions as decimal numbers.

(a) $\frac{33}{100}$ (b) $\frac{52}{1000}$ (c) $6\frac{73}{100}$ (d) $\frac{356}{100}$ (e) $\frac{8753}{10}$

2. Write the following numbers from the smallest to the largest.

0.6 $\frac{7}{10}$ $\frac{65}{100}$ $\frac{627}{1000}$ $\frac{64}{1000}$

3. Find the number midway between 3.46 and 3.47.

4. Round the following numbers to one decimal place.

(a) 6.83 (b) 17.062 (c) 8.97 (d) 0.829 (e) 79.97

5. Convert the following fractions to decimals.

(a) $\frac{3}{4}$ (b) $\frac{2}{5}$ (c) $\frac{17}{2}$ (d) $3\frac{3}{8}$ (e) $7\frac{3}{7}$

6. Complete the following calculations.

(a) $7.6 + 2.1$	(b) $15.72 + 8.5$	(c) $6.2 + 9.87 + 3.04$
(d) $10.7 - 8.5$	(e) $21.73 - 8.8$	(f) $147.13 - 59.77$
(g) 6.5×8	(h) 17.33×9	(i) 4.6×3.1
(j) 12.7×0.32	(k) $84.6 \div 4$	(l) $11.7 \div 8$
(m) $0.75 \div 0.5$	(n) $6.8 \div 0.02$	(o) 1.5×100
(p) 2.37×1000	(q) $378 \div 100$	(r) $16.2 \div 1000$

7. Write the following numbers in scientific notation.

(a) 20 000 (b) 78 300 (c) 12 105 000

8. Complete the following conversions.

(a) 2 kg = ____ g (b) 5.72 ML = ____ L (c) 56 000 mm = ____ m

9. Find the average of this group of numbers.

6.1 7.4 9.1 6.6 8.3

10. If a jelly bean weighs 0.008 kg, how many jelly beans would be in a 0.2 kg bag?

11. Dara ran 4.58 km every day. How far would she run in a week?

12. Which of these numbers are *irrational* numbers?

3π , $0.\dot{7}$, $\sqrt{13}$, 0.683, $\frac{2}{9}$, $0.85\overline{72}$, $\sqrt{81}$

Percentages

Percentages

Percentages are often used as a convenient way of representing a fraction or proportion of an object. The word **percent** originates from the Latin term **per centum** which means **per hundred**. The symbol for percentage is %.

Example 65% means **65 per 100** or **65 out of 100**

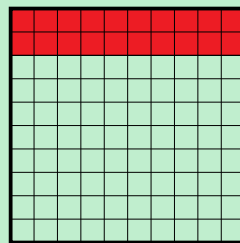
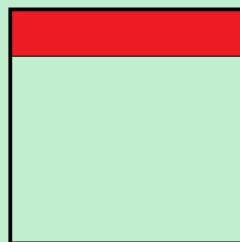
Examples

1. Find the percentage of this shape that is shaded.

This can be found by dividing the shape into 100 equal parts. Then find out how many of these parts are shaded.

It can be seen that 20 of the 100 equal parts are shaded. Therefore **20 percent** of the shape is shaded.

This can be written as **20%**.



2. What percentage of the above shape is **not** shaded?

The total number of equal parts is 100 so the number that is not shaded is $100 - 20 = 80$.

Therefore the percentage of the shape that is not shaded is **80%**.

Examples continued

3. George had 100 attempts at goal at basketball training and he scored 74 goals.
 (a) What percentage of his attempts scored a goal?
 (b) What percentage of his attempts missed?

Answers:

- (a) He scored goals with 74 out of 100 attempts = **74%**
 (b) He missed 26 of the 100 attempts = **26%**

4. Marvey made a tropical drink with 60% pineapple juice, 30% mango juice and the remainder coconut milk.
 What percentage of the drink was coconut milk?

Answer: The total percentage must be 100%.
 90% of the juice is pineapple and mango juice so the remainder was $100 - 90 = 10$.
10% of the drink was coconut milk.

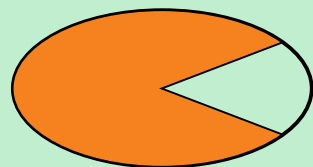
5. Brad and Hayley get paid for a job. Brad did 20% more work so will get paid 20% more than Hayley.
 What percentage of the pay should each receive?

Answer: The total of the percentages will add to 100%.
 The answer can be found by trial and error (guessing).
Brad - 60% of the pay
Hayley - 40% of the pay

6. Which of the following percentages is the best estimate of the shaded area of this shape?

A 20% **B 50%** **C 80%** **D 100%**

Answer: **C**



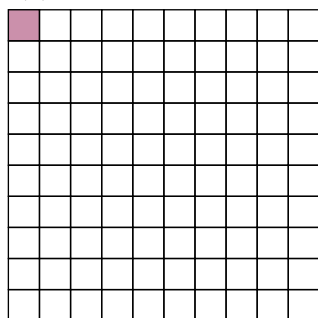
EXERCISE 5A

1. Each of the diagrams below consists of 100 small squares.

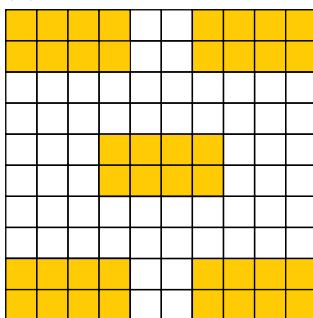
For each diagram state:

- the percentage that is shaded.
- the percentage that is not shaded.

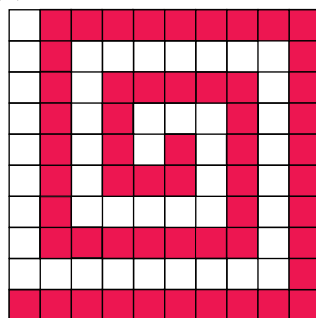
(a)



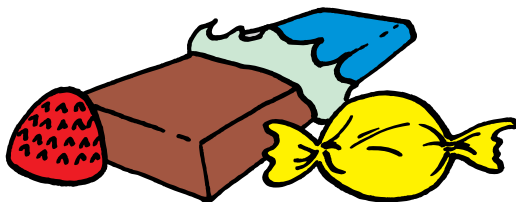
(b)



(c)

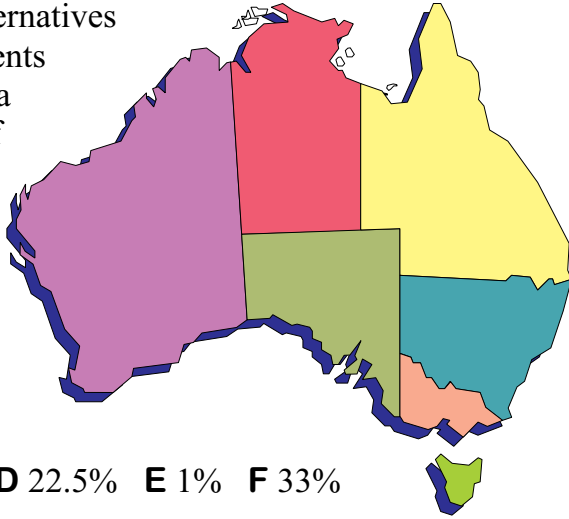


2. Catriona planted a number of beans in her vegetable garden.
85% of the beans grew. What percentage of the beans didn't grow?
3. A certain paint colour requires a mixture of 10% blue, 12% red,
22% yellow and the remainder white.
What percentage of the paint mixture is white?
4. Three students were trying to become school captain.
Quinton got 35% of the students' vote, Gemima got 29% of the vote
and Niki got the remainder of the vote.
(a) What percentage of the vote did Niki receive?
(b) Who will be the school captain?
5. A confectionary company makes chocolates, soft lollies and hard lollies.
45.6% of the sweets they produce are chocolates and 27.7% are hard
lollies.
What percentage of the
sweets are soft lollies?



6. (a) Choose which of the alternatives below (**A-F**) best represents the area of each state as a percentage of the area of Australia.

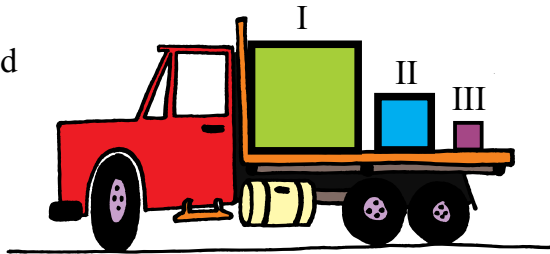
- (i) Victoria
- (ii) Tasmania
- (iii) Queensland
- (iv) South Australia
- (v) Western Australia
- (vi) New South Wales



A 10.5% **B** 3% **C** 13% **D** 22.5% **E** 1% **F** 33%

- (b) What percentage of the area of Australia is the Northern Territory?

7. Three boxes make up the load on the back of a truck. The weights of the boxes are proportional to their sizes as shown in the diagram.



From the alternatives

below (**A-G**) which would be the best estimate of the percentage of the total weight of the load that is:

- (a) box I (b) box II (c) box III

A 75% **B** 55% **C** 45% **D** 40% **E** 30% **F** 20% **G** 15%

8. Salvador made 1 litre of garden fertilizer using 2% liquid seaweed, 5% liquid manure and the remainder water.

- (a) What percentage of the fertilizer was water?
- (b) If Salvador wanted to make 2 litres of the fertilizer, what percentage of it should be liquid seaweed?

9. Anneke had a special recipe for making jam using mulberries, blackberries and strawberries. The recipe required the weight of mulberries to be the same as the weight of blackberries and twice the weight of strawberries. The weight of sugar added is equal to the total weight of all the berries.

What percentage of the total mixture is each ingredient?

Converting Fractions to Percentages

EXERCISE 5B

1. Convert the following fractions to percentages.

Example $\frac{3}{5}$ $\frac{3}{5} \times \frac{100}{1}$ *To convert a fraction to a percentage - multiply by 100.*

$$= \frac{3}{5} \times \frac{100}{1}$$

$$= \frac{60}{1}$$

$$= 60\%$$

- (a) $\frac{1}{10}$ (b) $\frac{3}{10}$ (c) $\frac{9}{10}$ (d) $\frac{1}{2}$ (e) $\frac{1}{5}$
- (f) $\frac{3}{4}$ (g) $\frac{7}{20}$ (h) $\frac{13}{50}$ (i) $\frac{12}{25}$ (j) $\frac{120}{200}$
- (k) $\frac{40}{80}$ (l) $\frac{60}{75}$ (m) $\frac{40}{160}$ (n) $\frac{240}{500}$ (o) $\frac{126}{210}$

2. 60 young people between the ages of 16 and 18 were surveyed and it was found that 45 of them had their learner's permit to drive a car.

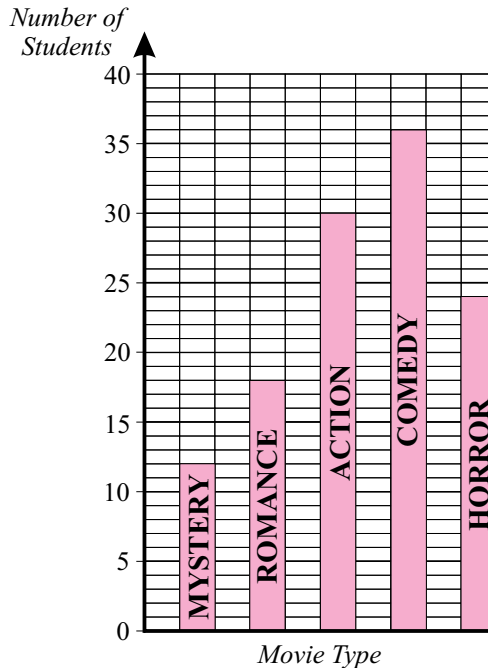
- (a) What percentage of the group had their learner's permit?
 (b) What percentage did not have their learner's permit?

3. All the year 8 students at a school were asked to state their favourite type of movie out of the following categories:

**Mystery Romance
 Action Comedy Horror**

The results are shown on this column graph.

- (a) How many students are in year 8 at the school?
 (b) Find the percentage of the students that chose each type of movie.



4. Jordan achieved the following marks on tests.

Science	$\frac{76}{95}$	Maths	$\frac{68}{80}$	German	$\frac{54}{72}$	English	$\frac{54}{75}$
---------	-----------------	-------	-----------------	--------	-----------------	---------	-----------------

Change each mark to a percentage.

5. Write the first quantity as a percentage of the second.

Examples

Make sure the units are the same.

1. 2 kg, 10 kg

$$= \frac{2}{10} \times \frac{100}{1}$$

$$= \mathbf{20\%}$$

2. 60 cents, \$2

$$= 60 \text{ cents, } 200 \text{ cents}$$

$$= \frac{60}{200} \times \frac{100}{1}$$

$$= \mathbf{30\%}$$

3. 85 cm, 5 m

$$= 85 \text{ cm, } 500 \text{ cm}$$

$$= \frac{85}{500} \times \frac{100}{1}$$

$$= \mathbf{17\%}$$

(a) 8 kg, 20 kg

(b) 75 mm, 300 mm

(c) \$45, \$500

(d) 40 cents, \$8

(e) 400 mm, 2 m

(f) 150 g, 3 kg

(g) 36 sec, 1 min

(h) 12 min, 2 hours

(i) 50 mm, 20 cm

(j) 240 mL, 3 L

(k) 380 kg, 2 tonnes

(l) 81 cm, 3 m

Converting Percentages to Fractions

EXERCISE 5C

1. Convert the following percentages to fractions.

Example 23% $23 \div 100$
 $= \frac{23}{100}$

To convert a percentage to a fraction - divide by 100.

(a) 1%

(b) 11%

(c) 19%

(d) 73%

(e) 99%

2. Convert the following percentages to fractions.

Write answers in their simplest form.

(a) 5% (b) 12% (c) 18%

(d) 25% (e) 35% (f) 50%

(g) 60% (h) 76% (i) 95%

(j) 100% (k) 150% (l) 600%

Example 45% $45 \div 100$
 $= \frac{45}{100}$
 $= \frac{9}{20}$

Converting Decimals to Percentages

EXERCISE 5D

Convert the following decimals to percentages.

Example $0.21 \quad 0.21 \times 100$
 $= 0.21 \downarrow$
 $= 21\%$

*To convert a decimal to a percentage - multiply by 100.
 Move the decimal point
 2 places to the right.*

1. 0.33 2. 0.19 3. 0.87 4. 0.06 5. 0.4
 6. 0.295 7. 0.056 8. 0.008 9. 2 10. 0.1057

Converting Percentages to Decimals

EXERCISE 5E

Convert the following percentages to decimals.

Example $37\% \quad 37 \div 100$
 $= \downarrow 37.$
 $= 0.37$

*To convert a percentage to a decimal - divide by 100.
 Move the decimal point
 2 places to the left.*

1. 59% 2. 24% 3. 76% 4. 30% 5. 8%
 6. 10% 7. 100% 8. 65.4% 9. 5.8% 10. 0.25%

Conversions

EXERCISE 5F

Copy and complete this table.
 Write all fractions in their
 simplest form.
 One line has been completed
 as an example.

Percentage	Fraction	Decimal
50%	$\frac{1}{2}$	0.5
10%		
	$\frac{1}{4}$	
		0.2
	$\frac{9}{10}$	
66%		
	$\frac{9}{50}$	
		0.32
	$\frac{17}{20}$	
9%		
	$\frac{3}{100}$	
		0.04

Percentages of Quantities

EXERCISE 5G

1. Copy and complete this table. You should remember all these!

Percentage	25%	50%	75%	$33\frac{1}{3}\%$	$66\frac{2}{3}\%$	10%	20%
Fraction							
Decimal							

2. Find the following quantities.

Try to solve these problems using mental arithmetic.

Example 50% of \$20
 $= \frac{1}{2}$ of \$20
 $= \text{\$10}$

- | | | |
|-------------------------------|-------------------------------|---------------------------------|
| (a) 50% of 8 m | (b) 25% of \$40 | (c) 10% of \$50 |
| (d) $33\frac{1}{3}\%$ of 9 kg | (e) $66\frac{2}{3}\%$ of 9 kg | (f) 75% of 12 m |
| (g) 50% of \$120 | (h) 25% of \$400 | (i) $33\frac{1}{3}\%$ of 30 km |
| (j) 10% of 250 kg | (k) 50% of \$8000 | (l) 20% of 500 kg |
| (m) 50% of \$5 | (n) 10% of \$3 | (o) $66\frac{2}{3}\%$ of \$3.90 |

3. Find the following quantities.

Example 20% of \$480
 $= \frac{20}{100} \times \frac{480}{1}$
 $= \text{\$96}$

- | | | |
|-------------------|-------------------|-------------------|
| (a) 60% of 200 kg | (b) 15% of 600 m | (c) 80% of \$120 |
| (d) 30% of \$700 | (e) 45% of 3000 m | (f) 55% of 80 m |
| (g) 85% of \$60 | (h) 5% of \$420 | (i) 8% of 350 km |
| (j) 16% of 250 kg | (k) 35% of \$90 | (l) 24% of 560 kg |
| (m) 2% of \$5 | (n) 19% of \$12 | (o) 12% of \$358 |

4. Use a calculator to find the following quantities.

- | | | |
|-------------------|---------------------|-----------------------|
| (a) 62% of 450 kg | (b) 19% of 850 m | (c) 23% of \$2580 |
| (d) 47% of \$2400 | (e) 82% of 3675 m | (f) 11% of 3.5 m |
| (g) 6.5% of \$750 | (h) 8.5% of \$42000 | (i) 12.75% of \$84700 |

5. Con the fruiterer found that 10% of the mangoes he bought were bruised. If he bought 80 mangoes, how many could he expect to be bruised?

6. About 10% of the population are left-handed. In a school of 800 students, how many students could be expected to be left-handed?
7. About 7% of men and 1% of women are colour blind. In a school of 800 students with an equal number of boys and girls:
- (a) how many of the boys could be expected to be colour blind?
 - (b) how many of the girls could be expected to be colour blind?
8. Use the statistics shown in questions 6 and 7 to help you answer this question. In an Arts College there were 500 students of which 60% were female.
- (a) How many of the female students would be expected to be left-handed?
 - (b) How many of the male students would be expected to be colour blind?
 - (c) What is the total number of students that would be expected to be left-handed?
 - (d) What is the total number of students that would be expected to be colour blind?
9. Fiona and Louise were the two goal shooters in a netball team. In one season Fiona had 440 shots at goal and scored 70% of these. Louise had 530 shots at goal and scored 60% of these.
- (a) Calculate how many goals each player scored in the season.
 - (b) Who do you think is the better player? Why?



10. Stefan's resting heart rate was 80 beats per minute. After exercise his heart rate had increased by 30%. What was his new heart rate?
11. A dairy farmer was getting an average of 4500 litres of milk a day from his herd. He was told that if he changed the feed for his cows he could expect a 5% increase in milk production. What would be the new average daily volume of milk if he changed to the new feed?

12. In a town where there were 6000 people of working age, the unemployment rate was 7%.

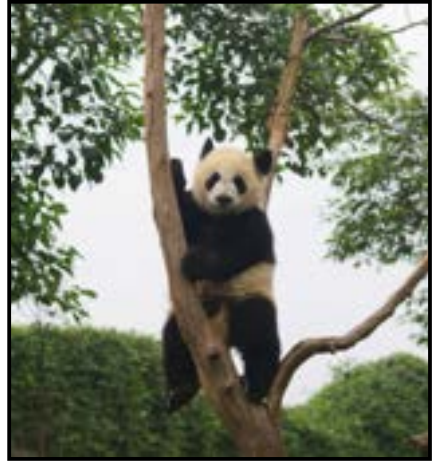
- (a) How many people were unemployed?
- (b) What was the percentage of people that had employment?
- (c) How many people had employment?

A new business opens in the town and the unemployment rate dropped to 5%.

- (d) How many people did the new business employ?

13. The population of Giant Pandas in the wild is about 1200.

- (a) If the population was to increase by 5% one year, what would be the population at the end of the year?
- (b) If the population was to increase by 5% of this amount in the following year, what would then be the population of Giant Pandas?



14. A conservation organisation bought a 20 000 hectare property that had been cleared for farming. The conservationists planned to revegetate 20% of the property each year.

- (a) How many years will it take to fully revegetate the property?
- (b) How many hectares will be revegetated each year?

15. Harry had \$6000 in a bank account that earned 5% interest each year.

- (a) How much interest will his investment earn in one year?
- (b) If he leaves this interest in the bank with the \$6000, how much interest will this total amount earn in the next year?

16. A farm had access to 250 megalitres (ML) of water.

- (a) The farmer was allowed to use 4% of this water each week for irrigating his farm. How many megalitres could he use each week?
- (b) For how many weeks could he irrigate his farm?
- (c) What percentage of the water had he used after twelve weeks?
- (d) How many megalitres had he used after twelve weeks?

Discounts

EXERCISE 5H

Example A 25% discount is offered on a \$40 shirt.
 What will you pay for the shirt?
 25% of \$40 is \$10
 The **discount** is **\$10**
 You will pay $\$40 - \$10 = \$30$

1. Bloom 'n' Gardens is a nursery that is having a sale on its plants.
 For the plants shown below find:
 - (i) the amount of the discount.
 - (ii) the amount you will pay.
 - (a) 30% discount on \$40 fruit trees.
 - (b) 25% discount on \$60 ornamental maples.
 - (c) 40% discount on \$30 native plants.
 - (d) 15% discount on \$60 flowering gums.
 - (e) 50% discount on \$85 palm trees.

2. Find the price that you will pay for the following items.

<i>Item and Price</i>	<i>Discount</i>
(a) Fishing Rod - \$80	20%
(b) CD - \$30	10%
(c) Electric Guitar - \$600	25%
(d) Car - \$25 000	5%
(e) TV - \$350	30%
(f) Washing machine - \$600	35%
(g) Caravan - \$3400	12%
(h) Antique clock - \$690	$33\frac{1}{3}\%$

Mark-ups

A **retailer** purchases its goods for a price called the **wholesale price**. It will then add on an amount (often a percentage of the wholesale price) to find the **retail price** (selling price). This amount added on is called the **mark-up**.

$$\text{retail price} = \text{wholesale price} + \text{mark-up}$$

A business that produces products will add an amount onto the cost to produce its products to find its selling price. This amount is also called the mark-up and is often a percentage of the cost to produce a product.

$$\text{selling price} = \text{production cost} + \text{mark-up}$$

Examples

1. Karryn owns a horse accessories shop. She can buy saddles for a wholesale price of \$1200 and decides to add a mark-up of 40%. What will be the retail price of the saddles?

$$\begin{aligned}\text{mark-up} &= 40\% \text{ of } \$1200 \\ &= 0.4 \times 1200\end{aligned}$$

$$\text{mark-up} = \$480$$

$$\begin{aligned}\text{retail price} &= \text{wholesale price} + \text{mark-up} \\ &= \$1200 + \$480\end{aligned}$$

$$\text{retail price} = \$1680$$

2. Aaron is a cabinet maker who makes and sells furniture. To make a chair it costs Aaron \$50 in materials and \$70 in labour. Aaron decides to add a mark-up of 30%. For what price should he sell his chairs?

$$\begin{aligned}\text{cost to produce chair} &= \$50 + \$70 \\ \text{cost to produce chair} &= \$120\end{aligned}$$

$$\begin{aligned}\text{mark-up} &= 30\% \text{ of } \$120 \\ &= 0.3 \times 120\end{aligned}$$

$$\text{mark-up} = \$36$$

$$\begin{aligned}\text{selling price} &= \text{production cost} + \text{mark-up} \\ &= \$120 + \$36\end{aligned}$$

$$\text{selling price} = \$156$$

EXERCISE 5I

1. A surf shop buys surf boards for a wholesale price of \$250 each. They decide to add a mark-up of 40%. For what price should they sell the surf boards?
2. A computer shop buys a particular laptop at a wholesale price of \$200. The mark-up they have on their computers is 80%. What will be the retail price of the laptops?
3. A potter makes clay pots and calculates it costs him \$30 to produce each pot. If he adds a mark-up of 50%, for what price should he sell his pots?
4. A bakery produces pies and they calculate it costs them \$600 to produce 300 pies. They mark-up their products by 70%. What should be the selling price for *each pie*?
5. A clothing store buys 200 T-shirts for \$500. They mark-up the wholesale price by 100%. What is the retail price of *each T-shirt*?

6. A car retailer bought new cars at a wholesale price of \$18 000 each. He used a mark-up of 15%. What was the retail price of the cars?

7. Manny makes mandolins and guitars. It costs him \$500 to make a mandolin and \$950 to make a guitar. He uses a mark-up of 30% when selling his instruments. What is the selling price of a mandolin and guitar?



8. An apiarist produces and bottles honey from his bee hives. He calculates that it costs him \$18 to produce a 1 kg jar of honey. He uses a mark-up of 40%. What will be his selling price for a jar of honey?

9. Kylie sells teddy bears at markets. She buys three different sizes and the wholesale prices of these are shown below.

Pappa Bear - \$32
Mamma Bear - \$25
Baby Bear - \$16



Kylie adds a mark-up of 60% onto the price of her teddy bears. What will be her selling price for the teddy bears at the markets?

10. Michael owns a bicycle shop. He bought a number of mountain bikes at the wholesale price of \$450. His mark-up is 40%. He had sold most of them but had two remaining and wanted to sell these quickly to buy a new model. He offered these two at a discount of 20% off retail price. What was the discounted price?



Profit and Loss

Profit in business is defined as the amount of financial gain over a period of time or from a number of transactions. It is the difference between the income and the expenses when the income is greater than the expenses.

*When the income is greater than the expenses:
profit = income - expenses*

Loss in business is defined as the amount of financial loss over a period of time or from a number of transactions. It is the difference between the income and the expenses when the income is less than the expenses.

*When the income is less than the expenses:
loss = expenses - income*

The profit or loss can be expressed as a percentage of the income.

$$\text{profit/loss as percentage of income} = \frac{\text{profit or loss}}{\text{income}} \times 100$$

Examples

1. Harriot buys a camera for \$200 and sells it for \$250.
 - (a) Did she make a profit or loss on the camera?
 - (b) What was the size of the profit or loss?
 - (c) What was the percentage profit/loss?

Answers

- (a) income = \$250
expenses = \$200
income is greater than expenses so she made a **profit**
- (b) profit = income - expenses
profit = \$250 - \$200
profit = \$50

continued next page

Example 1 answers continued

$$\begin{aligned}
 \text{(c) percentage profit} &= \frac{\text{profit}}{\text{income}} \times 100 \\
 &= \frac{50}{250} \times 100
 \end{aligned}$$

$$\text{percentage profit} = 20\%$$

2. A small art gallery sells artwork and has functions.

In one year the income and expenses for the gallery are shown in the table below.

- (a) Did the art gallery make a profit or loss for the year?
 (b) What was the size of the profit or loss?
 (c) What is the percentage profit/loss? Round to one decimal place.

<i>Income</i>		<i>Expenses</i>	
Sales	\$98 500	Artwork	\$35 500
Functions	\$28 500	Wages	\$75 000
Total	\$127 000	Other costs	\$20 500
		Total	\$131 000

Answers

- (a) The total income for the year was \$127 000.
 The total expenses were \$131 000.
 The income is less than the expenses so the gallery had a **loss**.

$$\begin{aligned}
 \text{(b) loss} &= \text{expenses} - \text{income} \\
 &= \$131\,000 - \$127\,000 \\
 \text{loss} &= \mathbf{\$4000}
 \end{aligned}$$

$$\begin{aligned}
 \text{(c) percentage loss} &= \frac{\text{loss}}{\text{income}} \times 100 \\
 &= \frac{4000}{127\,000} \times 100 \quad \text{Use calculator}
 \end{aligned}$$

$$\text{percentage loss} = \mathbf{3.1\%} \text{ (rounded to one decimal place)}$$

EXERCISE 5J

1. Kyle bought a broken lawn mower for \$120. He repaired it and sold it for \$200.
 - (a) Did he make a profit or loss on the lawn mower?
 - (b) What was the size of the profit or loss?
 - (c) What was the percentage profit/loss?

2. A farmer bought a number of calves for \$500. He sold them two years later for \$5000. He estimated he spent \$3500 on feed, etc..
 - (a) Did he make a profit or loss on the cows?
 - (b) What was the size of the profit or loss?
 - (c) What was the percentage profit/loss?

3. A lunch food outlet calculated their income for a month was \$16 000. Their expenses for the month were \$20 000.
 - (a) Did they make a profit or loss for the month?
 - (b) What was the size of the profit or loss?
 - (c) What was the percentage profit/loss?

4. A sports store bought cricket bat, ball and stumps kits for a wholesale price of \$300 and used a mark-up of 60%.
 - (a) Do they make a profit or loss on each cricket kit?
 - (b) What was the size of the profit or loss?
 - (c) What was the percentage profit/loss?



5. Jessie makes jewellery part time and sells it at markets and online. In one year she had a total income from her jewellery business of \$10 000. Her expenses for the year are shown in this table.

<i>Expenses</i>	
Materials	\$2000
Markets	\$500
Other	\$1500

- (a) Do she make a profit or loss for the year?
- (b) What was the size of the profit or loss?
- (c) What was the percentage profit/loss?

6. Ray's Reef Resort is a business on the Great Barrier Reef. He offers reef tours, hire of diving equipment, meals and accommodation. The tables below show the income and expenses for a year.

- (a) Did Ray make a profit or loss for the year?
- (b) What was the size of the profit or loss?
- (c) What was the percentage profit/loss?

Give answer rounded to *one* decimal place.

<i>Income</i>	
Tours	\$46 000
Equipment hire	\$18 500
Meals	\$35 500
Accommodation	\$90 000

<i>Expenses</i>	
New equipment	\$23 000
Equipment maintenance	\$12 500
Food and drinks	\$19 500
Wages	\$80 000
Other	\$25 000



7. The top six sellers from the Super Hero Costume Shop are listed below along with the wholesale price and retail price. List the costumes in order from the one with the largest percentage profit to the one with the smallest percentage profit.

<i>Costume</i>	<i>Wholesale Price</i>	<i>Retail Price</i>
Batman	\$35	\$60
Spider Man	\$26	\$50
Superman	\$25	\$45
Cat Woman	\$23	\$45
Hulk	\$24	\$40
Wonder Woman	\$20	\$35

GST

The Goods and Services Tax (GST) is a tax on most goods and services. In Australia the GST is 10%.

Examples

1. A cabinet maker builds a table and intends to make \$120 when he sells it. How much GST should he add to this price to find the retail price?

Answer: GST is 10%.

$$\begin{aligned} & 10\% \text{ of } \$120 \\ &= \frac{10}{100} \times \$120 \\ &= \$12 \end{aligned}$$

$$\begin{aligned} \text{The retail price} &= \$120 + \$12 \\ &= \mathbf{\$132} \end{aligned}$$

2. A plumber wants to make \$50 an hour for his labour costs. What GST should he add to this amount?

Answer: GST is 10%.

$$\begin{aligned} & 10\% \text{ of } \$50 \\ &= \frac{10}{100} \times \$50 \\ &= \$5 \end{aligned}$$

$$\begin{aligned} \text{Labour charge} &= \$50 + \$5 \\ &= \mathbf{\$55} \end{aligned}$$

3. A school magazine is printed for a total cost of \$880. How much of this cost is GST?

To find the GST paid, the amount needs to be divided by 11.

$$\mathbf{GST = \frac{\$880}{11} = \$80}$$

EXERCISE 5K

1. For the following items the prices shown are before the GST has been added. For these items:

- (i) find the GST that needs to be added.
- (ii) find the retail price.

	<i>Item</i>	<i>Price before GST is added</i>
(a)	Television	\$450
(b)	Car	\$18 500
(c)	Book	\$36
(d)	Calculator	\$105
(e)	Hammer	\$25
(f)	Jeans	\$68

2. An apprentice electrician plans to start his own business when he finishes his apprenticeship. He decides he wants to earn \$60 an hour.

- (a) How much GST should he add to this amount to find the hourly rate he should charge?
- (b) After starting his business how much GST will he charge on jobs that take the following times?
 - (i) 3 hours (ii) 7 hours (iii) 13 hours

3. The table below shows a number of items and their retail prices that include GST. Find the amount of GST included in each item's price.

	<i>Item</i>	<i>Price after GST is added</i>
(a)	Computer	\$660
(b)	Caravan	\$25 300
(c)	Basketball	\$61.60
(d)	Travel Ticket	\$3520
(e)	Antique Clock	\$412.50
(f)	Magazine	\$7.15

PROBLEM SOLVING

1. Complete the following pattern.

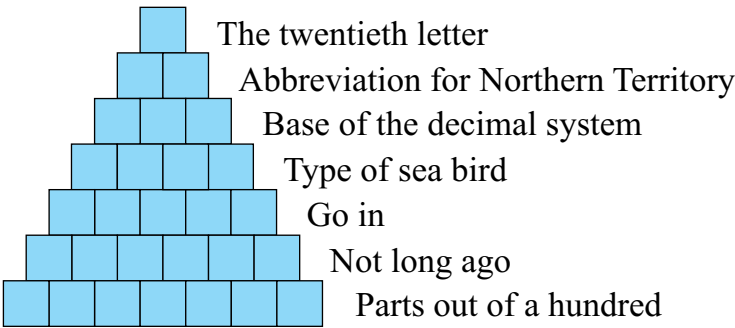
50%, $33\frac{1}{3}\%$, 25%, 20%, $16\frac{2}{3}\%$, __, __, __, __.

2. Lee won a prize in the lottery. He gave a quarter of the prize money to medical research, 30% to his family and 20% to his friends. He had \$300 000 left for himself.
How much did he win?

3. Emma bought a shirt that had been discounted by 20%. She paid \$40 for the shirt.
What was the price of the shirt before it was discounted?

PUZZLES

1. Complete the diagram below by finding the word on each line.
Each word can be found by adding one letter to the line above it and rearranging the letters.
A clue for each word is given.



2. Which of the alternatives below would be this 100% symbol after it was reflected in a mirror.

100%

A	%001	B	∅%100	C	∅%001
D	∅%001	E	100∅%	F	001∅%

CHAPTER REVIEW

1. (a) Barbara achieved 68 out of 100 for a science test.
What percentage is this?
(b) Quinton achieved 40 out of 50 for a mathematics test.
What percentage is this?

 2. Denzel made some two stroke fuel by mixing petrol and oil.
95% of the fuel is petrol.
(a) What percentage of the fuel is oil?
(b) What fraction of the fuel is oil?

 3. Teresa is a painter. She is going to paint a room with a paint mix that contains red, yellow and white.
10% of the mix is red and 20% is yellow.
(a) What percentage of the paint mix is white?
(b) If she wants to make 20 litres of paint, how much of each colour should she use?

 4. Copy and complete this table.
- | | | | | | | | |
|-------------------|-----|---------------|-----|---------------|----|---------------|-----|
| Percentage | 10% | | | | 1% | | |
| Fraction | | $\frac{1}{4}$ | | $\frac{1}{5}$ | | $\frac{1}{3}$ | |
| Decimal | | | 0.5 | | | | 0.7 |
5. Find the following quantities using mental arithmetic.

(a) 10% of \$80	(b) 25% of 200 m	(c) $33\frac{1}{3}\%$ of 90 kg
(d) 50% of \$180	(e) $66\frac{2}{3}\%$ of 3 m	(f) 75% of 16 kg

 6. Find the following quantities.

(a) 20% of \$300	(b) 70% of 580 m	(c) 85% of 300 kg
(d) 7% of \$8	(e) 23% of 300 m	(f) 55% of \$75

 7. The frog population of Shady Creek was decreasing at the rate of 10% each year. The population was estimated to be 5000.
What would be the expected population a year later?

 8. Find the price paid for the following items.

(a) \$150 wetsuit with a 20% discount.
(b) \$80 jumper with a 10% discount.

9. A hobby shop adds a 40% mark-up onto the wholesale price of their models. Find the retail price for the following models.

	<i>Model</i>	<i>Wholesale Price</i>
(a)	Car	\$40
(b)	Aeroplane	\$65
(c)	Ship	\$84

10. Leni bought an old antique doll for \$150. She spent \$120 repairing it and sold it for \$200.

- (a) Did Leni make a profit or loss on the doll?
 (b) What was the size of the profit or loss?
 (c) What was the percentage profit/loss?

11. Tim is a part time photographer. The income and expenses for his photography business for one year are shown below.

<i>Income</i>	
Sales of Photos	\$8000
Book Sales	\$4500
Functions	\$2500

<i>Expenses</i>	
Equipment	\$2000
Printing Costs	\$5000
Framing	\$2500
Other	\$1000

- (a) Did Tim make a profit or loss from his photography business?
 (b) What was the size of the profit or loss?
 (c) What was the percentage profit/loss?

12. For the following items the prices shown in brackets are before the GST has been added. For these items:

- (i) find the GST that needs to be added.
 (ii) find the retail price.

- (a) bicycle (\$400) (b) power saw (\$120) (c) board game (\$76)

13. For the following items the retail price including GST is shown in brackets. Find the amount of GST included in each item's price.

- (a) phone (\$385) (b) binoculars (\$148.50) (c) motorcycle (\$5940)

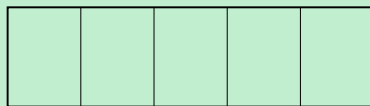
Ratio

Ratio

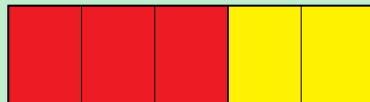
If an object is divided into a number of equal parts and those parts are grouped, the comparison of the size of those groups is called the *ratio* of those group sizes.

Example 1

This rectangle is divided into five equal parts.



Three of the parts are coloured red and two coloured yellow.



The ratio of those coloured red to those coloured yellow is 3 to 2.

This is written **3:2**

Example 2

\$70 is divided into two portions in the ratio of 4:3.
Find the size of each portion.

Step 1 The ratio of 4:3 means there are 7 equal parts ($4 + 3$).

Step 2 If \$70 is divided into 7 equal parts there are \$10 in each part.

Step 3 The first portion will have $4 \times \$10 = \$40$.

The second portion will have $3 \times \$10 = \$30$.

Answer: \$40, \$30

Example 3

The ratio of teachers to students on a school committee was to be 1:6. How many teachers and students should be on a committee of 14 people?

Note: *the order the groups are given in the information is the same as the order of the ratio.*

Therefore teachers to students will be 1:6.
(1 part teacher to 6 parts students)

Step 1 If 14 people are divided into 7 equal parts
there are 2 people in each part.

Step 2 1 part is teachers = 2 teachers
6 parts are students = 12 students

Answer: 2 teachers and 12 students

EXERCISE 6A

1. If the following quantities are divided into the given number of equal parts, find the size of each part.

Example

\$24 is divided into 6 equal parts.

Each part would be $\$24 \div 6 = \$4$

- (a) \$80 divided into 8 parts (b) 60 kg divided into 10 parts
(c) 48 m divided into 4 parts (d) \$20 divided into 5 parts
(e) \$300 divided into 3 parts (f) 72 litres divided into 9 parts
2. (a) \$36 was divided up between Marcus and Nicholas so that Marcus received 1 part and Nicholas received 2 parts (ratio of 1:2).
(i) What was the total number of parts the \$36 was divided into?
(ii) How much money was in each part?
(iii) How much money did each person receive?
(b) How much would Marcus and Nicholas each receive if the \$36 was divided up in the following ratios.
(i) 2:1 (ii) 1:3 (iii) 3:1 (iv) 1:5 (v) 8:1 (vi) 7:2 (vii) 5:4

3. Copy and complete the following table.

The amount in the first column is divided into two amounts using the given ratio.

The first line has been completed as an example.

<i>Amount to be Divided</i>	<i>Ratio</i>	<i>Total Number of Parts</i>	<i>Size of each Part</i>	<i>Size of First Amount</i>	<i>Size of Second Amount</i>
\$24	3:1	4	\$6	\$18	\$6
\$30	1:4				
28 m	4:3				
35 kg	2:3				
100 m	7:3				
80 km	3:5				

4. Tim and Jay are partners in a gardening business.

They get paid \$90 for a job and divide it in the ratio of 4:5.

How much does each of the partners receive?

5. Georgia owns a horse and feeds it a mixture of 2 parts oats and 5 parts lucerne.

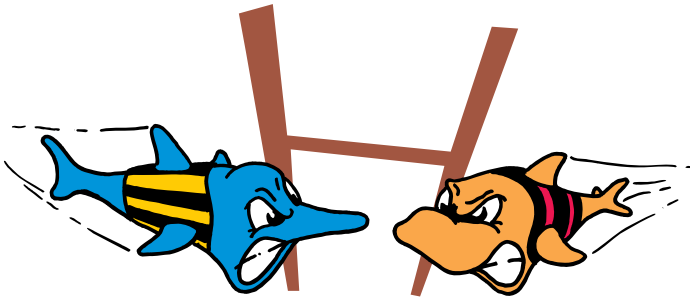
How much of each feed will she need to make up 35 bags of feed mix?



6. Petria and Rhiannon buy 20 cubic metres of mulch and share it in the ratio 2:3. How much should each person get?

7. As part of an inheritance, 40 hectares of land is to be divided between two brothers, Sebastian and Christian, in the ratio 5:3. How many hectares will each brother receive?

8. Jiang feeds her cats a mix of dry food and fresh meat in the ratio of 3:2. She feeds her cats 200 grams of food a day. How much dry food and fresh meat will she need to feed her cats for a *week*?
9. A crowd of 12 000 people watched a rugby game between the Sharks and the Dolphins. The ratio of Sharks supporters to Dolphins supporters was 1:3.
- What *fraction* of the crowd supported each team?
 - What *percentage* of the crowd supported each team?
 - How many of the crowd supported each team?



10. Ivan was laying bricks and made a mortar mix using cement and sand in the ratio 1:6.
- If he wanted to make 14 kg of mortar, how many kilograms of cement and sand would he need?
 - If he used 3 kg of cement, how much sand would he need?
11. Elvin wanted to make 20 litres of cordial drink using the ratio of 1 part cordial to 4 parts water.
- How much cordial should he use?
 - If he had 1 litre of cordial, how much drink could he make?

12. Biologists studying a herd of kangaroos found that the ratio of males to females was 7:9. Are there more males or females in the herd?



13. Chris and Terry are partners in a plumbing business.
- (a) For one job Chris and Terry shared the work load in the ratio of 2:3.
If they got paid a total of \$1200, how much should they each get paid?
 - (b) For another job Chris and Terry shared the work load in the ratio of 4:3.
If Chris received \$200 for this job, how much did Terry get?
 - (c) For another job Chris worked for 30 hours and Terry for 20 hours.
If they got paid a total of \$1000, how much should they each get paid?
14. Georgia sells bodyboards and surfboards. She sells three times as many bodyboards as surfboards.
- (a) What is the ratio of bodyboards to surfboards sold?
 - (b) What ***fraction*** of her sales are bodyboards?
 - (c) What ***percentage*** of her sales are surfboards?
 - (d) If, in one season, she sold 30 bodyboards,
how many surfboards did she sell?
 - (e) If, in another season, she sold
a total of 68 boards, how many of
these were surfboards?

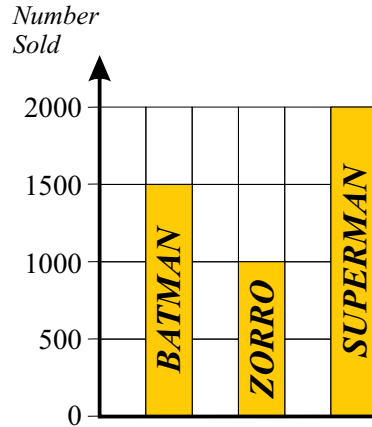


15. Concrete is made using cement, sand and stones in the ratio of 1:3:6.
- (a) If 2 kg of cement were used, how many kilograms of sand and stones should be added?
 - (b) If 40 kg of concrete is to be made, how many kilograms of each component should be used?
16. The Badboys Badminton team had a win-loss ratio over a season of 5:3. If they had 9 losses, how many games were in the season?

17. The Onsidars soccer team had a win-loss-draw ratio of 5:3:2.
If they had 4 draws for the season, how many games did they play?

18. The Capes-for-Kids company makes Batman, Zorro and Superman capes.

Their sales for a year are shown on this graph.



- (a) What is the ratio of Batman-Zorro-Superman capes sold?
(b) If the capes cost \$20 each, what is the value of the total sales for the year?

19. All the year 8 students at a school went on an excursion to the zoo.
They went in three buses.
There were 50 students in the first bus.
The ratio of boys to girls in the first bus was 2:3.
The ratio of boys in the first bus to boys in the second bus was 5:6.
40% of the students in the second bus were boys.
The ratio of girls in the second bus to girls in the third bus was 2:1.
One-third of the students in the third bus were girls.
How many students were in year 8?



Ratios in Their Simplest Form

Ratios are usually given in their simplest form.

This is done in a similar way to cancelling down fractions.

Example 1

Write the following ratios in their simplest form.

1. $8:6 = 4:3$

2. $25:15 = 5:3$

3. $10:30 = 1:3$

Write the following amounts as ratios in their simplest form.

4. $\$24 : \$60$
 $= 24:60$
 $= 2:5$

5. $32 \text{ kg} : 28 \text{ kg}$
 $= 32:28$
 $= 8:7$

6. $21 \text{ m} : 33 \text{ m}$
 $= 21:33$
 $= 7:11$

Example 2

8 cups of salt is dissolved in 20 cups of water.

What is the ratio of salt to water?

8 cups of salt : 20 cups of water
 $= 8:20$
 $= 2:5$

EXERCISE 6B

1. Write the following ratios in their simplest form.

(a) $8:4$ (b) $6:24$ (c) $10:8$ (d) $12:18$ (e) $36:28$ (f) $54:72$

2. Write the following amounts as ratios in their simplest form.

(a) $36 \text{ m} : 9 \text{ m}$ (b) $\$8 : \$48$ (c) $72 \text{ kg} : 48 \text{ kg}$
 (d) $56 \text{ g} : 72 \text{ g}$ (e) $24 \text{ L} : 84 \text{ L}$ (f) $63 \text{ mm} : 49 \text{ mm}$
 (g) $180 \text{ kg} : 270 \text{ kg}$ (h) $\$2000 : \$1500$ (i) $6400 \text{ km} : 7200 \text{ km}$

Write the following ratios in their simplest form

3. A painter mixes 85 mL of green paint and 25 mL of red paint.

What is the ratio of green paint to red paint?

4. In a university 3600 students were from Australia and 800 were from overseas. What is the ratio of Australian students to those from overseas?

Example

Tom mixed 12 buckets of pellets to 8 buckets of wheat as a feed for his chickens.

- What is the ratio of pellets to wheat?
- If he has a feed bin that holds 30 buckets of feed, how many buckets of pellets and grain would he need to fill the bin with feed in this ratio?
- If he uses 6 buckets of pellets, how many buckets of wheat should he add to make feed with this ratio?
- If he uses 10 buckets of wheat, how many buckets of pellets should he add to make feed with this ratio?

Answers:

- (a) 12 buckets : 8 buckets
= 12:8
= **3:2**

- (b) The ratio of 3:2 means 5 equal parts
 - 3 parts pellets and 2 parts wheat.
 30 buckets divided into 5 equal parts means 6 buckets in each part.
 $3 \times 6 = \mathbf{18 \text{ buckets of pellets}}$
 $2 \times 6 = \mathbf{12 \text{ buckets of wheat}}$

- (c) Find what the ratio is multiplied by to get to the amount required.

Ratio: 3:2

3 parts pellets:2 parts wheat

Amount required: 6 buckets of pellets : ? buckets of wheat

The ratio has been multiplied by 2

$\times 2$
 $\swarrow$
 3 parts pellets : 2 parts wheat
 6 buckets of pellets : ? buckets of wheat

Therefore **4 buckets of wheat** are required.

Example continued:

(d) Use the same method used in part (c).

Find what the ratio is multiplied by to get to the amount required.

Ratio: 3:2

3 parts pellets: 2 parts wheat

Amount required: ? buckets of pellets : 10 buckets of wheat

The ratio has been multiplied by 5

3 parts pellets : 2 parts wheat

↓ × 5

? buckets of pellets : 10 buckets of wheat

Therefore **15 buckets of pellets** are required.

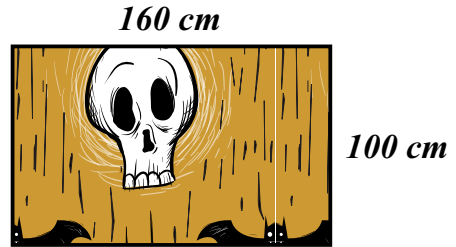
EXERCISE 6C

Write the ratios in the following questions in their simplest form

1. Bacchus the baker made meat and vegetable pasties. He used a mix of 6 kg of meat and 10 kg of vegetables.
 - (a) What is the ratio of meat to vegetables?
 - (b) He bought 15 kg of meat. How many kilograms of vegetables would he need?
 - (c) He was asked to cater for a function and would need 40 kg of meat/vegetable mix to make all the pasties. How many kilograms of each ingredient would he need?
2. A two stroke fuel required 10 mL of oil to be mixed with 240 mL of petrol.
 - (a) What is the ratio of oil to petrol?
 - (b) How many mL of petrol would be needed to mix with 25 mL of oil?
 - (c) How many mL of oil would be needed to add to 1200 mL of petrol?
 - (d) How many mL of oil and petrol would be needed to make 2000 mL of the two stroke fuel?

3. A bricklayer is mixing mortar using cement and sand.
He uses a mix of 2 parts cement to 8 parts sand.
- What is the ratio of cement to sand?
 - If he puts 4 shovels full of cement in the mixer, how many shovels full of sand should he add?
 - If he puts 12 shovels full of sand in the mixer, how many shovels full of cement should he add?
 - If a wheelbarrow holds 25 shovels full, how many shovels full each of cement and sand should he put in the mixer?
4. Angela was mixing some liquid fertilizer for her garden.
30 mL of the fertilizer needed to be mixed with 600 mL of water.
- What is the ratio of fertilizer to water?
 - How much water would be needed to mix with 75 mL of fertilizer?
 - How much fertilizer would be needed to be added to 2000 mL of water?
 - A container held 10.5 L (10 500 mL). How much fertilizer and water would be needed to fill this container?

5. An artist's painting is shown here.
The length of the painting is 160 cm
and the width is 100 cm.
The artist wanted to paint a series of
paintings with the same ratio of
length to width.



- What is the ratio of the length to the width?
 - What would be the width of a painting that was 200 cm long?
 - What would be the length of a painting that was 150 cm wide?
6. A bulb grower sold in one season 5400 tulips and 7200 daffodils.
- What is the ratio of tulips to daffodils that he sold?
 - He wanted to increase his sales in the next year to 35 000 bulbs.
How many of each bulb type should he grow to keep this ratio?
 - If he grew 16 000 daffodils, how many tulips should he grow to keep this ratio?



Ratios and Fractions

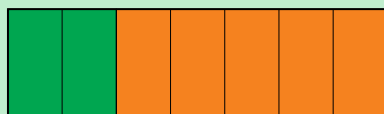
Example 1 $\frac{3}{5}$ of a rectangle is coloured red and $\frac{2}{5}$ is coloured yellow.
What is the ratio of red to yellow?

Answer: It can be easily seen using a diagram the ratio of red to yellow is **3:2**.



Example 2 A rectangle is coloured green and orange in the ratio of 2:5.
What fraction of the rectangle is each colour?

Answer: Using a diagram it can be seen that the rectangle will be divided into 7 sections and that:



$\frac{2}{7}$ is green and $\frac{5}{7}$ is orange

Example 3 In the town of Soggiton in the month of June there were 24 days when it rained and 6 days when it didn't rain.
(a) Find the fraction of days in June that it rained. Write the fraction in its simplest form.
(b) What is the ratio of rainy days to dry days?

Answer: (a) 24 rainy days out of 30 as a fraction is:

$$\text{in its simplest form } \frac{24}{30} = \frac{4}{5}$$

$$\begin{aligned} \text{(b) } \frac{4}{5} \text{ rainy} : \frac{1}{5} \text{ dry} \\ = \mathbf{4:1} \end{aligned}$$

EXERCISE 6D

Write all the fractions and ratios in the following questions in their simplest form.

- Amelie made a batch of biscuits using one third oats and the remainder flour. What is the ratio of oats to flour in this recipe?
- Jezza made a batch of biscuits using 300 g of oats and 500 g of flour.
 - What fraction of Jezza's recipe is oats?
 - What is the ratio of oats to flour in Jezza's recipe?
 - How many grams of flour would be needed if 240 g of oats were used using Jezza's recipe?
- The table below shows the approximate number of daylight hours on the longest and shortest days for a number of cities.

<i>City</i>	<i>Number of Daylight Hours</i>	
	<i>Longest Day</i>	<i>Shortest Day</i>
Sydney	14	10
New York	15	9
London	16	8
Stockholm	18	6
Singapore	12	12

- What fraction of the longest day is daylight hours in the cities?
 - Sydney
 - New York
 - London
 - Stockholm
 - Singapore
- What fraction of the shortest day is daylight hours in the cities?
 - Sydney
 - New York
 - London
 - Stockholm
 - Singapore
- What is the ratio of daylight hours to night-time hours on the longest day for the cities?
 - Sydney
 - New York
 - London
 - Stockholm
 - Singapore
- What is the ratio of daylight hours to night-time hours on the shortest day for the cities?
 - Sydney
 - New York
 - London
 - Stockholm
 - Singapore
- Find the ratio of daylight hours on the longest day between the following cities:
 - Sydney and London
 - Sydney and Singapore

Ratios and Percentages

Example 1 The ratio of boys to girls in a karate class was 3:2. What percentage of the class was boys and what percentage was girls?

Answer: To find the percentage of each group divide 100 in the same ratio as the question.
Divide 100 in the ratio 3:2.
Use the method from Exercise 6A.
100 in the ratio of 3:2 is 60:40.
So **60% of the class is boys and 40% was girls.**

Example 2 The recipe for a salad dressing consisted of 25% vinegar and the remainder olive oil. What is the ratio of vinegar to olive oil? Give the ratio in its simplest form.

Answer: 25% vinegar and 75% olive oil
This is a ratio of 25:75
In its simplest form **1:3**

EXERCISE 6E

- The ratio of cats to dogs in a lost animals home was 4:1.
 - What is the percentage of the cats in the home?
 - What is the percentage of the dogs in the home?
- The ratio of girls to boys in a dance class was 7:3.
What percentage of the dancers were girls?
- An acid solution consisted of 10% acid and the remainder water.
What is the ratio of acid to water? Give the ratio in its simplest form.
- Alvira swam in a long distance swim. She swam freestyle for 85% of the swim and breaststroke for the remainder.
What is the ratio of the distance Alvira swam freestyle to the distance she swam breaststroke?
Give the ratio in its simplest form.

Challenging Problems

EXERCISE 6F

Give answers to the following questions in their simplest form.

- An apartment block in a city contained 200 apartments.
80% of the apartments were owner occupied and all the others were rented.
 - How many of the apartments were owner occupied?
 - What fraction of the apartments were rented?
 - What is the ratio of those owner occupied to those rented?
 20 of the owner occupiers decided to rent their apartments.
 - What now is the ratio of owner occupied apartments to those rented?
 - What now is the percentage of owner occupied apartments?
- A painter was trying to create a certain shade of pink. She added 50 mL of red to 200 mL of white paint.
 - What percentage of red is in the mixture?
 - What fraction of the mixture is white?
 - What is the ratio of red to white paint in the mixture?
 The colour is not quite right so she adds another 50 mL of red.
 - What now is the ratio of red to white paint?

- The ratio of boys to girls in the four year 8 classes at a school are shown in this table. There are 24 students in each class.
 - How many students are in year 8 at the school?
 - How many boys are in year 8?

<i>Class</i>	<i>Ratio of Boys to Girls</i>
8 Green	5:3
8 Gold	1:2
8 Red	7:5
8 Yellow	1:3

- A set of five Matryoshka dolls (also known as Russians dolls) is shown here.
The ratio of the heights of two consecutive dolls is 5:4.
If the largest doll is 200 mm, find the height of the other four dolls.
Round answers to the nearest millimetre.



PROBLEM SOLVING

The mountain bike shown here has three gears on the rear wheel (back gears) and two gears on the pedals (front gears). The back gears have 16, 18 and 24 teeth. The front gears have 36 and 46 teeth.



- Calculate all the gear ratios between the back gears and the front gears. Use the abbreviations of B for back gears and F for front gears. B1 = 16, B2 = 18, B3 = 24, F1 = 36, F2 = 46.

Example The ratio between B1 and F1:
 $B1F1 = 16:36$
 $B1F1 = 4:9$

- Convert these ratios to have 1 on the back wheel.

Example $B1F1 = 4:9$
 $B1F1 = 1:2.25$

- List all the gear ratios in order from the smallest to the largest.

PUZZLE

Find the word **RATIO** in this grid. It may be vertical, horizontal, diagonal, forwards or backwards.

R	A	T	I	T	R	A	T	A	R	I	I	T	A	R
A	A	R	A	A	A	A	I	A	A	R	A	T	A	A
T	O	A	T	R	A	T	T	O	A	A	A	T	T	T
O	A	I	A	A	A	O	I	T	O	I	O	T	A	I
I	R	T	A	R	A	T	I	R	A	I	T	A	R	R
O	R	A	T	O	I	O	T	T	A	R	A	T	T	O

CHAPTER REVIEW

1. (a) Divide \$72 in the ratio of 2:7 (b) Divide 56 kg in the ratio of 5:3
(c) Divide 70 m in the ratio of 4:3 (d) Divide 4200 L in the ratio of 1:6
2. Garth and Mona divide 55 kg of tomatoes in the ratio of 2:3.
How many kg of tomatoes will they each receive?
3. Write the following ratios in their simplest form.
(a) 18:27 (b) 48:16 (c) 65:25 (d) 42:36
4. (a) A bird breeder mixed 48 kg of sunflower seeds and 36 kg of grain as a feed for his birds. What is the ratio of sunflower seeds to grain in its simplest form?
(b) If he had 20 kg of sunflower seeds, how many kg of grain would he need to keep the same ratio?
(c) If he wanted to make 140 kg of feed, how many kg of sunflower seeds and grain would he need?
5. In year 8 at a school there were 160 students and 72 were boys.
(a) What fraction of the year 8 was boys? Give answer in its simplest form.
(b) What is the ratio of boys to girls? Give answer in its simplest form.
6. Four fifths of a pie was eaten. What is the ratio of the amount eaten to the amount not eaten?
7. A drink is made with 40% orange juice and the rest soda water.
What is the ratio of orange juice to soda water? Give answer in its simplest form.
8. The ratio of water to milk in a hot chocolate was 1:9.
(a) What percentage of the drink is water?
(b) If a glass held 300 mL of drink how many mL of milk is required?
9. A liquid fertilizer needs to be mixed with water in the ratio of 1:20.
Don mixes 12 mL of the fertilizer with 200 mL of water. How much extra water needs to be added to made the correct ratio?

Rates

Examples

1. If 5 kg of potatoes cost \$8, find the cost of 12 kg of potatoes.

Step 1 Find the cost of 1 kg of potatoes.

$$5 \text{ kg} = \$8$$

$$1 \text{ kg} = \frac{\$8}{5}$$

$$1 \text{ kg} = \$1.60$$

Step 2 Find the cost of 12 kg

$$1 \text{ kg} = \$1.60$$

$$12 \text{ kg} = 12 \times \$1.60$$

$$\mathbf{12 \text{ kg} = \$19.20}$$

2. Find the best value from three bags of flour.

A 500 g for \$1.40 **B** 2 kg for \$5.50 **C** 5 kg for \$13.85

Step 1 Find the cost of 1 kg of each option.

A 500 g for \$1.40 **B** 2 kg for \$5.50 **C** 5 kg for \$13.85
1 kg for \$2.80 1 kg for \$2.75 1 kg for \$2.77

Step 2 Compare the three prices for 1 kg.

It can be seen that Option **B** is the better value.

3. A ship is travelling at a speed of 40 km/h (kilometres per hour).

- (a) How far will it travel in 12 hours?
- (b) How far will it travel in two days?
- (c) How long would it take to travel 600 km?

Answers

(a) It travels 40 km every hour so in 12 hours it will travel:

$$40 \times 12 = \mathbf{480 \text{ km}}$$

(b) Two days is $2 \times 24 = 48$ hours

In 48 hours it will travel:

$$40 \times 48 = \mathbf{1920 \text{ km}}$$

(c) It travels 40 km every hour so to travel 600 km it will take:

$$\frac{600}{40} = \mathbf{15 \text{ hours}}$$

4. It took Violet 12 minutes to read 8 pages of a book.

- (a) How long would it take her to read 50 pages?
- (b) How many pages could she read in one hour?

Step 1 Find out how long it would take Violet to read one page:

8 pages took 12 minutes

Each page takes $\frac{12}{8}$ minutes = 1.5 minutes

Step 2 (a) 50 pages will take $50 \times 1.5 = \mathbf{75 \text{ minutes}}$

(b) One hour = 60 minutes

In 60 minutes she would read:

$$\frac{60}{1.5} = \mathbf{40 \text{ pages}}$$

5. It is estimated that there are 5400 ring-tailed possums in a national park. The population is growing at the rate of 2.5% each year.

Find the size of the population after: (a) 1 year (b) 2 years

(a) In the first year the population will grow by:

$$5400 \times \frac{2.5}{100} = 135$$

At the end of the year the population = $5400 + 135$

$$= \mathbf{5535}$$

(b) In the second year the population will grow by:

$$5535 \times \frac{2.5}{100} = 138.375$$

= 138 (Rounded to nearest whole number)

At the end of the year the population = $5535 + 138$

$$= \mathbf{5673}$$

EXERCISE 7A

1. If 3 kg of cherries cost \$15, find the cost of the following amounts of cherries:

- (a) 1 kg (b) 2 kg (c) 6 kg (d) 20 kg

2. If 5 kg of apples cost \$10, find the cost of the following amounts of apples:

- (a) 1 kg (b) 6 kg (c) 9 kg (d) 50 kg

3. If 4 kg of oranges cost \$10, find the cost of the following amounts of oranges:

- (a) 1 kg (b) 3 kg (c) 5 kg (d) 12 kg

4. If 500 g of lentils cost \$3.50, find the cost of the following amounts of lentils:

- (a) 1 kg (b) 2 kg (c) 9 kg (d) 20 kg

5. If 4 kg of tomatoes cost \$12, how many kg of tomatoes could be bought for the following?
(a) \$15 (b) \$9 (c) \$27 (d) \$45
6. If 6 kg of sausages cost \$15, how many kg of sausages could be bought for the following?
(a) \$30 (b) \$10 (c) \$25 (d) \$12.50
7. Mary wanted to buy some birdseed. There were three sizes of packets as shown below. Which one is the best value?
A 500 g for \$2.00 **B** 1 kg for \$4.10 **C** 5 kg for \$19.50
8. Find the best value from the three packets of rice below.
A 500 g for \$1.05 **B** 2 kg for \$3.90 **C** 5 kg for \$9.90
9. 8 chocolates weighed 240 g. Find the weight of 20 chocolates.
10. 5 kg of dog food cost \$7. Find the cost of the following amounts of dog food.
(a) 20 kg (b) 30 kg (c) 65 kg (d) 75 kg
11. 2 bricks weigh 9 kg. Find the weight of 100 bricks.
12. A dozen eggs cost \$3.60. Find the cost of the following number of eggs.
(a) 6 (b) 10 (c) 18 (d) 48
13. The cheetah is the fastest animal. It can run at a maximum speed of 30 metres per second over short distances (up to 600 m).
(a) Running at this speed, how far could a cheetah run in:
(i) 2 seconds? (ii) 5 seconds? (iii) 10 seconds?
(b) How many seconds would it take a cheetah to run the following distances?
(i) 90 m
(ii) 120 m
(iii) 600 m



- 14.** A cheetah and a hyena had a race over 300 metres. The cheetah ran at its fastest speed (30 m/s). The hyena ran at 10 m/s. To make it more even, the cheetah gave the hyena a 180 metre start (the hyena only had to run 120 metres). Which animal won the race?

- 15.** The fastest bird in flight is a falcon that can swoop at speeds up to 80 metres per second.
- (a) Flying at this speed, how far could a falcon fly in the following times?
- (i) 2 seconds
(ii) 5 seconds
(iii) 12 seconds



- (b) If a falcon spotted its lunch flying 40 metres below it, how long would it take to reach its prey if it swooped at 80 metres per second?

- 16.** Stefan's car can travel 12 km on a litre of petrol.
- (a) How far could he travel on the following amounts of petrol?
- (i) 3 litres (ii) 15 litres (iii) a full tank of 60 litres
- (b) How many litres of petrol would Stefan use travelling the following distances?
- (i) 24 km (ii) 60 km (iii) 360 km

- 17.** Tessa drove 450 km in her car and used 30 litres of petrol. How many kilometres can she drive on one litre of petrol?

- 18.** Which of the following cars has the best fuel economy (gets more km per litre)?

Car A 500 km on 50 litres

Car B 480 km on 40 litres

- 19.** Which of the following cars has the best fuel economy (gets more km per litre)?

Car C 200 km on 15 litres

Car D 180 km on 12 litres

- 20.** Kelvin bought 100 metres of rope for \$18.00.
 (a) What would be the price for 50 metres of this rope?
 (b) What would be the price for 10 metres of this rope?
 (c) What would be the price for 1 metre of this rope?
- 21.** Meredith needs to give her cat some tablets. The directions describe doses of half a tablet for every kilogram. Meredith's cat weighs 4 kg. How many tablets should Meredith give to her cat?
- 22.** Noela has three children. They are all sick and need some medicine. The doses of the medicine are 4 mL for every 10 kg of body weight. How many millilitres (mL) should Noela give to each of her children?
 (a) Timothy - 20 kg (b) Judy - 30 kg (c) Stephen - 45 kg
- 23.** Dimitri was watering his garden. Using the garden hose he noted that it took 20 seconds to fill a 10 litre bucket.
 (a) Using this hose, how many litres would be used in the following times?
 (i) 40 seconds (ii) 1 minute (iii) 30 minutes
 (b) How long would it take Dimitri to fill a 300 litre fish pond?
- 24.** A knot is a unit used for the speed of ships.
 One knot = one nautical mile per hour
 (a) If a yacht is sailing at 6 knots, how far will the yacht travel in:
 (i) 2 hours (ii) 5 hours (iii) half an hour
 (b) How long would it take this yacht to travel 240 nautical miles?
- 25.** 1 nautical mile (NM) = 1.852 km
 How many km are the following distances?
 (a) 10 NM (b) 150 NM
 (c) 600 NM (d) 2500 NM
- 26.** Use the answers from questions 24 and 25 to find the following.
- (a) A yacht is sailing at an average speed of 10 knots. Convert this speed to km/h.
 (b) How far (in km) will the yacht sail in 20 hours?
 (c) How long will it take for the yacht to sail from Sydney to Hobart - a distance of 630 nautical miles? Give answer in hours.



27. Crosby ran 100 metres in 20 seconds.

(a) How far did Crosby run every second?

This is his speed in metres per second (m/s).

(b) How far would Crosby run if he ran at this speed for:

(i) 30 seconds? (ii) 2 minutes? (iii) 1 hour?

28. (a) Find the speed (in m/s) of each of the following runners.

Callum ran 200 metres in 50 seconds.
Annabelle ran 90 metres in 30 seconds.
Mitchell ran 120 metres in 20 seconds.
Clara ran 400 metres in 1 minute and 20 seconds.

(b) List the runners in order from the slowest to the fastest.

(c) How far would they each run in 10 minutes?

29. Scientists wanted to calculate the fastest speed of a number of animals.

The following measurements were taken when the animals were travelling at their fastest.

<i>Animal</i>	<i>Distance travelled</i>	<i>Time taken</i>
Elephant	1320 m	2 minutes
Bluefin tuna	72 km	1 hour
Dolphin	300 m	30 seconds
Kangaroo	380 m	20 seconds

(a) Calculate the fastest speed (in m/s) of each of the animals.

(b) List the animals from the slowest to the fastest.

(c) How far could each animal travel in one minute?

30. A farmer had three pumps for filling his water tanks.

Pump A filled a 500 litre tank in 50 seconds.
Pump B filled a 2400 litre tank in 3 minutes 20 seconds.
Pump C filled a 4000 litre tank in 8 minutes and 20 seconds.

(a) Find the rate, in litres per sec (L/s), that each pump pumps water.

(b) How many litres would each pump in:

(i) 10 minutes (ii) 1 hour

(c) How long would each take to pump 48 000 litres? Give answers in hours, minutes and seconds.

31. Scientists were studying sharks in a marine national park and recorded that the population was increasing by 40 each year. If the population was 2500, calculate the population 5 years later.
32. Marine conservationists were attempting to reduce the number of introduced starfish that were damaging coral. They estimated that there were 100 000 starfish on a particular reef. The population was increasing by 2000 each year and the conservationists were removing 8000 each year. How many starfish would be on the reef 10 years later?
33. An olive farmer was increasing his farm size. The amount of olives he produced was increasing by 10% each year.
In one year he produced 5000 kg of olives.
(a) How many kg of olives would he produce the following year?
(b) How many kg of olives would he produce the year after that?
34. The town of Groen had a population 800. The population was increasing by 5% each year.
Find the population two years later.
35. The town of Shrinken had a population of 10 000. The population was *decreasing* by 2% each year.
Find the population two years later.
36. The approximate population of several countries and their annual percentage rate of population increase are shown in the table below.
(a) Calculate the approximate increase in the population in one year for each of these countries.
(b) Calculate the approximate population of each country in one year.

<i>Country</i>	<i>Approximate Population</i>	<i>Annual Percentage Population Increase</i>
China	1 400 000 000	0.5%
Switzerland	8 000 000	1.1%
India	1 300 000 000	1.2%
Kenya	47 000 000	2.7%
Oman	3 500 000	9.2%

37. The approximate population of Germany is 83 000 000. Its percentage rate of population growth is -0.1%.
- (a) What does a **negative** percentage rate of population growth mean?
 - (b) Calculate the approximate change in population in one year.
 - (c) Calculate the approximate population of Germany in one year.
38. The approximate population of several countries and their annual percentage rate of population increase are shown in the table below.
- (a) Calculate the approximate change in the population in one year for each of these countries.
 - (b) Calculate the approximate population of each country in one year.

<i>Country</i>	<i>Approximate Population</i>	<i>Annual Percentage Population Increase</i>
Japan	127 000 000	-0.1%
Russia	143 000 000	-0.3%
Serbia	9 500 000	-0.4%
Lithuania	3 000 000	-0.3%
Ukraine	45 000 000	-0.7%



Calculating Percentage Changes

Examples

1. The population of kangaroos in a park was 8200. The following year the population was 8610.
Calculate the percentage increase in the population.

Step 1 Find the number of the increase.

$$\begin{aligned}\text{In this example the increase is: } & 8610 - 8200 \\ & = \mathbf{410}\end{aligned}$$

Step 2 Calculate the following:

$$\begin{aligned}\text{Percentage change} &= \frac{\text{size of the change}}{\text{initial population}} \times 100 \\ &= \frac{410}{8200} \times 100 \\ &= \mathbf{5\%}\end{aligned}$$

The percentage increase is **5%**.

2. The population of a town in one year changed from 5670 to 5285.
(a) Was the change an increase or decrease?
(b) Find the percentage change. Give answer correct to one decimal place.

- (a) The change was a **decrease** in population.
(b) The size of the change is $5670 - 5285 = \mathbf{385}$.

$$\begin{aligned}\text{Percentage change} &= \frac{\text{size of the change}}{\text{initial population}} \times 100 \\ &= \frac{385}{5670} \times 100 \\ &= 6.790\% \\ &= \mathbf{6.8\%} \text{ (one decimal place)}\end{aligned}$$

EXERCISE 7B

- The population of wombats in a national park in one year changed from 750 to 765.
 - Was the change an increase or decrease?
 - Find the percentage change in the year.
- The amount earned by a plumber changed from \$55 600 one year to \$64 200 the following year.
 - Did he have an increase or decrease in earnings?
 - Find the percentage change in his earnings. Give answer correct to one decimal place.
- A potato farmer produced 34 600 kg of potatoes one year and 32 800 kg the following year.
 - Did he have an increase or decrease in his potato crop?
 - Find the percentage change in his potato production. Give answer correct to one decimal place.

- Two brothers, Liam and Sean, recorded their heights on January 1st and December 31st one year.

The heights are shown in this table.

- Guess which brother had the higher percentage growth rate for the year.
- Calculate the percentage growth rate for each brother.

	<i>Height on 1st Jan.</i>	<i>Height on 31st Dec.</i>
<i>Liam</i>	135 cm	144 cm
<i>Sean</i>	178 cm	188 cm

Give answers correct to one decimal place.

- The approximate population of several counties at the beginning and end of last year are shown in the table below.
 - Guess which country had the largest percentage population growth.
 - Calculate the percentage population growth for each country.

Give answers correct to one decimal place.

<i>Country</i>	<i>Population at beginning of year</i>	<i>Population at end of year</i>
Australia	24 000 000	24 300 000
Philippines	100 000 000	101 700 000
Indonesia	254 000 000	257 000 000

PROBLEM SOLVING

Charlotte and Adam are having holidays near a beach. One day they both decide to go surfing. Charlotte starts walking to the beach with her surfboard. She knows she walks at a speed of 100 metres per minute. Adam spent a while looking for his towel and left two minutes after Charlotte. He jogs at a speed of 300 metres per minute. They both arrive at the beach at the same time. How far is the beach from where they were staying?



PUZZLE

Fit the jigsaw together to spell five words from this chapter.
Hint: Two of the words are countries.

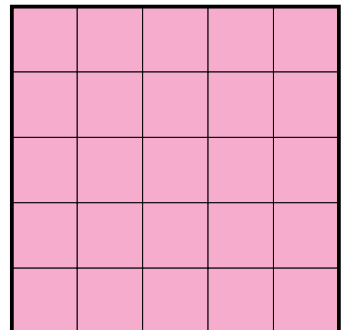
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A	L	U	E
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E	D
	A
	S
	A

C	H
R	A
I	
V	

		N
		E
N	D	I



CHAPTER REVIEW

1. If 12 kg of mandarins costs \$30 find the cost of the following amounts:
(a) 8 kg (b) 10 kg (c) 5 kg (d) 13 kg
2. If 50 bricks weighed 150 kg:
(a) what would be the weight of 220 bricks?
(b) how many bricks would be in a load of 1200 kg?
3. Find the best value from these three packets of flour:
A 500 g for \$1.35 **B** 2 kg for \$5.50 **C** 5 kg for \$13.55
4. Hilde timed her cat as it ran across her yard. It took 4 seconds to run 20 m.
Running at this speed:
(a) how far would the cat run in: (i) 5 seconds? (ii) 1 minute?
(b) how long would it take the cat to run: (i) 30 m? (ii) 75 m?
5. Joe drove 360 km in his car and used 30 litres of petrol.
(a) How many litres of petrol would Joe's car use travelling 1200 km?
(b) How far could Joe drive on a full tank of 50 litres of petrol?
6. Hervey wanted to put 120 litres of water into his fish tank. He filled a 10 litre bucket using the hose and it took 40 seconds. How long will it take to put the 120 litres into his fish tank?
7. Who is the fastest of the following two runners?
A Adam can run 200 metres in 50 seconds
B Beatrice can run 270 metres in a minute
8. A rainforest was 2500 hectares in area. It was growing at the rate of 75 hectares each year. What would be the area of the rainforest in 5 years?
9. During summer the volume of water in a dam was decreasing by 5% each week. If at the start of a week it held 2 000 000 litres, what would the dam hold at the end of the week?
10. The population of a town grew from 8400 to 8950 in a year.
(a) What was the percentage population growth? Give answer to 1 dec. pl..
(b) If the town grew at the same percentage rate what would be the population at the end of the next year? Round to whole number.

Algebra

Using Symbols

EXERCISE 8A

1. Find the answers to the following statements.
 - (a) The sum of 12 and 4.
 - (b) The product of 12 and 4.
 - (c) The difference between 12 and 4.
 - (d) 12 divided by 4.
 - (e) 8 more than 20.
 - (f) 8 less than 20.
 - (g) 8 less than half of 20.
 - (h) 8 more than half of 20.
 - (i) Twice 8.
 - (j) 6 more than twice 8.
 - (k) Half the sum of 8 and 6.
 - (l) 6 more than half the difference between 8 and 20.
 - (m) The square of 5.
 - (n) The square root of 64.
 - (o) The square root of half of 18.
 - (p) The sum of 20 and half of 8.
 - (q) Three times the sum of 4 and 5.
 - (r) The square root of the sum of 12 and 4.
2. Match the worded statements in question 1 with the mathematical statements below.

A $\frac{1}{2}(8 + 6)$

D $12/4$

G $12 + 4$

J $20 + 8$

M $\sqrt{\frac{1}{2} \times 18}$

P $\sqrt{12 + 4}$

B 2×8

E $\frac{1}{2} \times 20 + 8$

H $\sqrt{64}$

K $\frac{1}{2}(20 - 8) + 6$

N $20 + \frac{1}{2} \times 8$

Q 12×4

C $20 - 8$

F $3(4 + 5)$

I $\frac{1}{2} \times 20 - 8$

L $12 - 4$

O 5^2

R $2 \times 8 + 6$

3. Match the following worded statements with the mathematical statements.

- (a) The sum of a and b .
- (b) The product of a and b .
- (c) The difference between a and b .
- (d) a divided by b .
- (e) 3 more than a .
- (f) 3 less than a .
- (g) a divided by 3.
- (h) a multiplied by 3.
- (i) Twice the sum of a and b .
- (j) b divided by a .
- (k) a squared.
- (l) The square root of a .
- (m) The square of the sum of a and b .
- (n) The square root of the sum of a and b .

- A** $a - 3$
- B** $2(a + b)$
- C** a/b
- D** $\sqrt{a}$
- E** b/a
- F** $a + b$
- G** $a/3$
- H** $(a + b)^2$
- I** $b - a$
- J** ab
- K** $\sqrt{a + b}$
- L** $a + 3$
- M** $3a$
- N** a^2

Equations and Formulae

EXERCISE 8B

1. Match the following worded equations with the mathematical equations below.

- (a) a is equal to 3 more than b .
- (b) a is equal to 3 less than b .
- (c) a is equal to the 3 times b .
- (d) a is equal to one third of b .
- (e) a is equal to 3.
- (f) a is equal the sum of b and c .
- (g) a is equal to the square of c .
- (h) a is equal to the sum of b , c and 3
- (i) a is equal to twice the sum of b and c .

A $a = c^2$

D $a = 2(b + c)$

G $a = b - 3$

B $a = 3b$

E $a = b + 3$

H $a = b/3$

C $a = b + c$

F $a = 3$

I $a = b + c + 3$

2. Write the following statements as mathematical equations.

Examples

1. F is equal to the sum of G and H .

$$F = G + H$$

2. M is equal to the product of P and Q .

$$M = PQ$$

Remember: There is no need to include the '×' sign in algebra.

- (a) y is equal to the sum of x and w .
- (b) K is equal to the product of L and M .
- (c) p is equal to 4 more than q .
- (d) D is equal to F subtracted from J .
- (e) B is equal to the product of A^2 and Z .
- (f) Y is equal to the square of the sum of T and U .
- (g) e is equal to 7 less than d .
- (h) L is equal to 5 more than the product of P and Q .
- (i) h is equal to j divided by k .

3. Write the following statements as mathematical equations.

Example

Force (F) is equal to the product of mass (m) and acceleration (a).

$$F = ma$$

- (a) Velocity (v) is equal to the product of acceleration (a) and time (t).
- (b) Weight (W) is equal to the product of mass (m) and gravity (g).
- (c) The perimeter (P) of a rectangle is equal to the sum of twice the width (w) and twice the length (l).
- (d) Energy (E) is equal to the product of the speed of light (c) squared and mass (m).
- (e) The volume (V) of a cuboid is equal to the product of the length (l), width (w) and height (h).
- (f) The diameter (D) of a circle is equal to the circumference (C) divided by pi (π).
- (g) The gradient (m) is equal to the rise (y) divided by the run (x).
- (h) The hypotenuse (h) is equal to the square root of the sum of the base (b) squared and the altitude (a) squared.

4. Use the following symbols in the questions below.

b = the weight of a banana
 a = the weight of an apple
 p = the weight of a plum

Examples Find the weight of the following quantities of fruit.

- | | | |
|--------------|---------------------------|------------------------|
| 1. 6 bananas | 2. 3 bananas and 2 apples | 3. 5 apples and 1 plum |
| = $6b$ | = $3b + 2a$ | = $5a + p$ |

Find the weight of the following quantities of fruit.

- | | |
|--------------------------------------|--------------------------|
| (a) 2 bananas and 6 apples | (b) 5 apples and 8 plums |
| (c) 7 plums and 10 bananas | (d) 1 apple and 1 plum |
| (e) 1 banana, 2 apples and 3 plums | |
| (f) 6 plums, 9 apples and 15 bananas | |

5. Use the following symbols in the questions below.

c = the cost of a canary
 b = the cost of a budgerigar

Examples Find the following amounts of money.

- The cost of 2 canaries and 4 budgerigars.
 = $2c + 4b$
- The change from \$50 if 3 canaries and 5 budgerigars are bought.
 = $50 - (3c + 5b)$

- Find the cost of 6 canaries and 7 budgerigars.
- Find the cost of 4 budgerigars and 6 canaries.
- Find the cost of a budgerigar and 2 canaries.
- Find the change from \$20 if 2 canaries are bought.
- Find the change from \$40 if 3 budgerigars are bought.
- Find the change from \$50 if 4 budgerigars and 2 canaries are bought.
- Find the change from \$100 if 4 canaries and 5 budgerigars are bought.
- Find the cost of buying 2 budgerigars, 5 canaries and a cage worth \$40.
- Find the cost of buying 4 budgerigars, 6 canaries and \$15 of feed.

6. Martin wanted to buy some CDs through an internet music company. The CDs will cost \$40 each and there will be a \$10 postal charge (for any number of CDs).

(a) Which of the following formulae could be used to calculate the **total** cost (C) of buying n CDs?

A $C = 10n + 40$

B $C = n + 40 + 10$

C $C = 40n + 10$

D $C = 40n$

(b) Find the cost of buying the following numbers of CDs.

(i) 1 CD (ii) 3 CDs (iii) 10 CDs

7. In a National Park there were 100 wombats. It was calculated that this population was increasing by 5 every year.

(a) Which of the following formulae could be used to calculate the total number (n) of wombats after x years?

A $n = 100x + 5$

B $n = 5x + 100$

C $n = 5 + x + 100$

D $n = 100 + x$

(b) Find the number of wombats after the following number of years.

(i) 2 years

(ii) 5 years

(iii) 20 years

(c) After how many years will there be 600 wombats?



8. A tank holds 200 litres of water. The water is be drained off at the rate of 2 litres every minute to water some plants.

(a) Which of the following formulae could be used to calculate the volume of water (V) remaining in the tank after it has been draining for t minutes?

A $V = 200 + 2t$

B $V = 200 - t$

C $V = 200 - (2 + t)$

D $V = 200 - 2t$

(b) Find how many litres of water are in the tank after it has been draining for the following number of minutes.

(i) 5 minutes (ii) 20 minutes (iii) 50 minutes

(c) After how many minutes will the tank be empty?

9. Lara wanted to buy some tickets for a concert. The tickets cost \$30 each and there was a booking fee of \$10.

Examples

1. The cost of buying 3 tickets
 $= 3 \times \$30 + \$10$
 $= \$100$

2. The cost of buying 8 tickets
 $= 8 \times \$30 + \$10$
 $= \$250$

- (a) Write a formula that could be used to find the total cost (C) of buying n tickets.
 (b) Find the cost of buying the following number of tickets.
 (i) 2 tickets (ii) 5 tickets (iii) 10 tickets
 (c) How many tickets could be bought with \$220?
10. Caitlin has \$500 in the bank. She works weekends and puts \$50 in the bank each week.
 (a) Write a formula that could be used to calculate the amount of money (A) Caitlin has in the bank after w weeks.
 (b) How much money will she have in the bank after the following number of weeks?
 (i) 2 weeks (ii) 5 weeks (iii) 12 weeks
 (c) How many weeks will it take Caitlin to have \$1000 in the bank?
11. Khaled bought 300 logs of wood to burn over winter. He finds that he burns 5 logs every day.
 (a) Write a formula that could be used to calculate the number of logs of wood (N) he has remaining after d days of burning.
 (b) Calculate how many logs he has remaining after burning wood for the following number of days.
 (i) 5 days (ii) 10 days (iii) 15 days (iv) 20 days
 (c) Copy and complete the following table showing the number of logs of wood remaining after burning for the days shown.

Number of days burning (d)	5	10	15	20	25	30	35	40
Number of logs remaining (N)								

- (d) How many days will it take to burn all the wood?

12. Tomas can run at a speed of 2 metres every second.

- (a) Write a formula that can be used to calculate the distance he can run (d) in t seconds.
 (b) Calculate how far he can run in the following times.
 (i) 10 seconds (ii) 30 seconds (iii) 1 minute (iv) 1 hour
 (c) Copy and complete the following table showing how far Tomas can run in a given number of seconds.

Number of seconds (t)	10	20	30	40	50	60	70	80
Distance (metres) run (d)								

13. Use the following formula to answer the questions below.

$$A = B + 3$$

- (a) Find A when B is:
 (i) 0 (ii) 1 (iii) 8 (iv) 10 (v) 20
 (b) Copy and complete the following table.

B	0	1	2	3	4	5	6	7	8	9	10
A											

14. For each of the formulae below, copy and complete the table shown in question 13.

(a) $A = 4B$

(b) $A = 2B + 1$

(c) $A = 3B + 4$

15. For each of the formulae below, copy and complete the following table.

N	2	4	6	8	10	12	14	16	18	20	22
M											

(a) $M = N - 2$

(b) $M = 2N - 3$

(c) $M = 4N - 8$

16. For each of the formulae below, copy and complete the following table.

x	1	4	7	12	15	30					
y							13	25	37	49	61

(a) $y = 2x + 3$

(b) $y = 3x - 5$

(c) $y = 4x + 5$

Addition and Subtraction

EXERCISE 8C

1. Simplify the following additions.

Examples

$$\begin{array}{l} 1. \quad a + a + a \\ \quad = 3a \end{array}$$

$$\begin{array}{l} 2. \quad t + t + t + t + u + u \\ \quad = 4t + 2u \end{array}$$

(a) $c + c + c + c + c$

(b) $x + x$

(c) $y + y + z + z + z + z$

(d) $m + m + m + m + m + n$

(e) $p + q + p + q + p + q$

(f) $f + f + f + g + f + f + f$

(g) $A + A + B + B + B + A$

(h) $a + b + c + a + b + c + a + b + c$

2. Simplify the following expressions.

Examples

$$\begin{array}{l} 1. \quad 5a + 2a \\ \quad = 7a \end{array}$$

$$\begin{array}{l} 2. \quad 7t + t - 4t \\ \quad = 8t - 4t \\ \quad = 4t \end{array}$$

(a) $2x + 3x$

(b) $4c + 5c$

(c) $5p + p$

(d) $2q + 3q + 4q$

(e) $v + 6v + 2v$

(f) $9w - 3w$

(g) $8a - 6a$

(h) $7g - 6g$

(i) $10j - 3j - 2j$

(j) $3p + 7p - 5p$

(k) $4s - 3s + 5s$

(l) $6r - 4r - 2r$

(m) $6y - y + 7y$

(n) $7d - 7d + 2d$

(o) $5e + 7e - 12e$

3. Simplify the following expressions.

Examples

$$\begin{array}{l} 1. \quad 5a - 8a \\ \quad = -3a \end{array}$$

$$\begin{array}{l} 2. \quad 4t - 7t + 9t \\ \quad = -3t + 9t \\ \quad = 6t \end{array}$$

$$\begin{array}{l} 3. \quad -3k - 5k \\ \quad = -8k \end{array}$$

(a) $6x - 9x$

(b) $5c - 9c$

(c) $p - 3p$

(d) $-2q - 3q$

(e) $-4v + 5v + 2v$

(f) $6w - 10w + 2w$

(g) $-a - 5a$

(h) $3g - 7g - 6g$

(i) $5j - 2j - 6j$

(j) $-3p + 3p - 5p$

(k) $2s + 3s - 8s$

(l) $-6r - 4r - 2r$

4. Match the **like terms** in the following list of terms.

Like terms have the same **pronumerals (letters)**

Example

$2a$ $3b$ $6a^2$ b $-\frac{1}{2}a$ $-ab$ $12a^2$ $12ab$ $6a$ $2b$

The groups of **like terms** are:

$2a, -\frac{1}{2}a, 6a$

$3b, b, 2b$

$6a^2, 12a^2$

$-ab, 12ab$

$2m$ $4n^2$ $6mn$ n $-4m$ $6m^2$ $\frac{1}{4}n^2$ $4n$ $\frac{1}{4}mn$ $4m^2n$ $3m^2$ $-3m^2n$

5. Simplify the following expressions by collecting the **like terms**.

Examples 1. $5x + 3y + 8x - y$

$$= (5x + 3y + 8x - y)$$

$$= 13x + 2y$$

2. $4a + 7 + 1 - 3a$

$$= (4a + 7 + 1 - 3a)$$

$$= a + 8$$

(a) $2a + 3b + 5a + 4b$

(b) $6m + 5n - 2n - 3m$

(c) $8p + 5q - 7p - 5q$

(d) $6t + 7u + t - 6u$

(e) $7 + 5a + 2 + 3a$

(f) $6c + 7d - d + c$

(g) $2g + 5m + m - 2g$

(h) $5v + 7y + 2y - 3y$

(i) $3n^2 + 2n + 2n^2 - n$

(j) $2p + 3r - 3r - 2p$

6. Simplify the following expressions by collecting the **like terms**.

Examples 1. $5a + 3b - a - 5b$

$$= (5a + 3b - a - 5b)$$

$$= 4a - 2b$$

2. $5x - 7 - 1 - 8x$

$$= (5x - 7 - 1 - 8x)$$

$$= -3x - 8$$

(a) $5x + 2y - 3x - 5y$

(b) $3a + 4b - 5a - 2b$

(c) $3p - 2q - p - 3q$

(d) $2d - 6f - 4d + 8f$

(e) $-3m + 2 - m - 4$

(f) $-a - b - a - b$

(g) $-3p + 4 - 5p + 6$

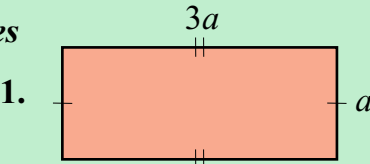
(h) $2q - 4q + 6q - 8q$

(i) $-2y - 2y - 2y - 2y - 2y$

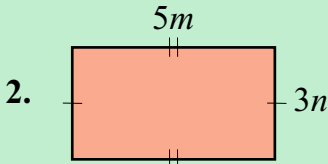
(j) $-2k + 3m + 6k - 9m$

7. Find the perimeters of the following shapes.

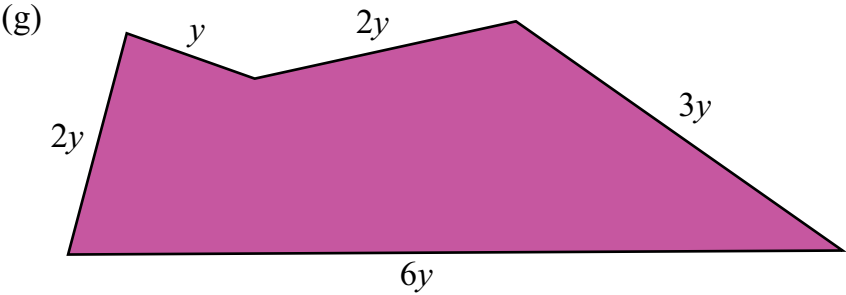
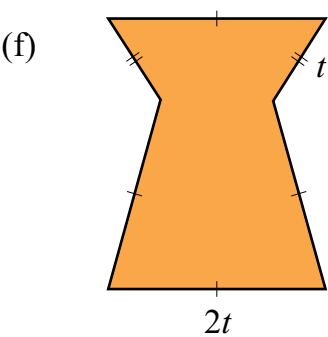
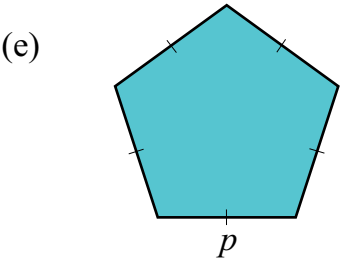
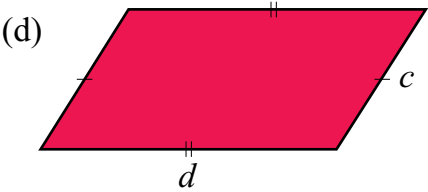
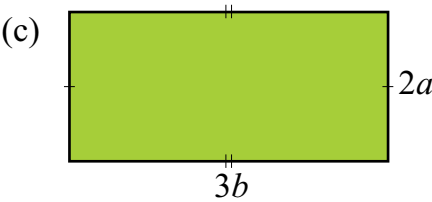
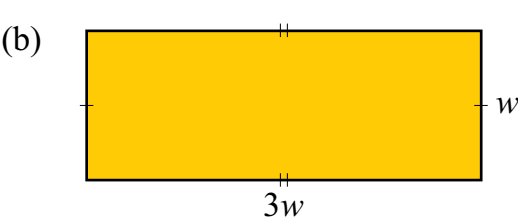
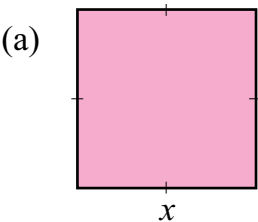
Examples



Perimeter = all the side lengths added
= $3a + a + 3a + a$
= $8a$



Perimeter = all the side lengths added
= $5m + 3n + 5m + 3n$
= $10m + 6n$



8. (a) If a banana weighs b , find the weight of the following bunches of bananas:
 (i) 4 bananas (ii) 8 bananas (iii) 12 bananas
 (b) If these three bunches of bananas are put into a bag, what is the total weight of the bag of bananas?
9. Sinead saves x dollars in the first month after starting a job. She then saves $2x$ dollars in the next month and $3x$ in the following month.
 (a) What is the total amount Sinead saved in the three months?
 (b) If Sinead had $8x$ dollars in the bank before starting the job, how much has she in her bank after the three months?
 (c) Sinead then withdraws $5x$ dollars from her bank account.
 How much does she now have in her bank account?
10. Duncan, Tina, Emily and Peter went fishing and all caught one fish.
 Duncan's fish weighed x kg.
 Tina's fish weighed twice the weight of Duncan's fish.
 Emily's fish weighed 2 kg more than Duncan's fish.
 Peter's fish weighed 1 kg less than Duncan's fish.
 (a) Find an expression for the weight of:
 (i) Tina's fish (ii) Emily's fish (iii) Peter's fish
 (b) Find an expression for the total weight of the four fish.
 (c) If the total weight of the four fish is 16 kg, find the weight of Duncan's fish.
11. Hamish, Imogen, Caz and Dean were abseiling down a rock face.
 Hamish took t minutes to abseil down the rocks.
 Imogen took 10 minutes longer than Hamish.
 Caz took twice as long as Hamish.
 Dean took 10 minutes less than Caz.
 (a) Find an expression for the time taken to abseil down the rock face by:
 (i) Imogen (ii) Caz (iii) Dean
 (b) Find an expression for the total time taken by the four rock climbers to abseil down the rock face.
 (c) If it took a total of 2 hours for the four rock climbers to abseil down the rock face, how long did Hamish take?



Multiplication and Division

EXERCISE 8D

1. Simplify the following expressions.

Examples	1. $2 \times 6 \times m$ $= 12m$	2. $5 \times a \times 3 \times b$ $= 15ab$	3. $4x \times 7y$ $= 28xy$
-----------------	-------------------------------------	---	-------------------------------

- | | | |
|------------------------------------|------------------------------------|--|
| (a) $3 \times 4 \times a$ | (b) $m \times n$ | (c) $4 \times v \times 5 \times w$ |
| (d) $3 \times 7 \times g \times h$ | (e) $8 \times d \times c \times 6$ | (f) $10 \times m \times 3 \times n \times p$ |
| (g) $6a \times 3b$ | (h) $2x \times 11y$ | (i) $4a \times 3b \times 2c$ |

2. Simplify the following expressions.

Examples	1. $\frac{20m}{5}$ $= \frac{4 \cancel{20}m}{1 \cancel{5}}$ $= 4m$	2. $18k \div 2$ $= \frac{18k}{2}$ $= \frac{9 \cancel{18}k}{1 \cancel{2}}$ $= 9k$
-----------------	---	---

- | | | | |
|---------------------|---------------------|---------------------|----------------------|
| (a) $\frac{16p}{8}$ | (b) $\frac{24s}{3}$ | (c) $\frac{30t}{6}$ | (d) $\frac{48ab}{6}$ |
| (e) $28m \div 7$ | (f) $15n \div 5$ | (g) $27p \div 9$ | (h) $32xyz \div 8$ |

3. There are x metres of material on a roll.

- (a) How many metres of material would be on 12 rolls?
 (b) The material from the 12 rolls is divided into 6 equal portions.
 How long is each of these portions of material?

4. Callista takes t minutes to run a lap of the local park.

- (a) How long would it take Callista to run 6 laps of the park?
 (b) Callista runs 6 laps of the park every night for a week.
 How many minutes does she run in the week?

5. A school hall has rows of seats set up for a concert.

- (a) If there are x seats in each row and 20 rows in the hall, how many seats are in the hall?
 (b) How much money does the school make if the hall is booked out and each ticket cost \$4?

Indices

EXERCISE 8E

1. Simplify the following terms.

Examples

$$1. a \times a \times a \times a \\ = a^4$$

$$2. 3 \times m \times m \times m \times 5 \times n \times n \\ = 15m^3n^2$$

$$3. 5a \times 2a \\ = 10a^2$$

$$(a) b \times b \times b$$

$$(b) 2 \times t \times t \times t \times t \times t \times t \times t \times t$$

$$(c) 4 \times p \times 3 \times p$$

$$(d) 8 \times q \times q \times q \times 2 \times q \times q$$

$$(e) 2w \times 2w \times 2w \times 2w \times 2w$$

$$(f) 3 \times c \times c \times c \times c \times 2 \times c \times c \times 5$$

$$(g) 3 \times a \times b \times 2 \times a \times b \times 2 \times a$$

$$(h) d \times 4d \times e \times 3e \times 2d \times 2d \times de$$

2. Simplify the following terms.

Examples

$$1. a^3 \times a^2 \\ = \underbrace{a \times a \times a}_{a^3} \times \underbrace{a \times a}_{a^2} \\ = a^5$$

$$2. 2m^2 \times 6m^5 \\ = 2 \times \underbrace{m \times m}_{m^2} \times 6 \times \underbrace{m \times m \times m \times m \times m}_{m^5} \\ = 12m^7$$

A quicker way is to **add** the indices.

$$1. a^{\overset{3}{\textcircled{3}}} \times a^{\overset{2}{\textcircled{2}}} \\ = a^5$$

$$2. 2m^{\overset{2}{\textcircled{2}}} \times 6m^{\overset{5}{\textcircled{5}}} \\ = 12m^7$$

$$3. p^7 \times p^3 \\ = p^{10}$$

$$4. 4n^2 \times 6n^9 \\ = 24n^{11}$$

$$5. 3k^6 \times 2k \\ = 6k^7$$

$$(a) m^6 \times m^2$$

$$(b) q^5 \times q^5$$

$$(c) b^3 \times b^2 \times b^4$$

$$(d) 3g^4 \times 2g^7$$

$$(e) h^4 \times h$$

$$(f) 2k^3 \times 2k^3 \times 3k^3$$

$$(g) 2n^3 \times 6n^5$$

$$(h) 3c^7 \times c$$

$$(i) 2p^7 \times 3p \times p^4$$

$$(j) 4w^3 \times 2w^6 \times w$$

$$(k) 5y^6 \times y^2 \times y^3 \times y$$

$$(l) a^x \times a^y$$

3. Simplify the following terms.

Examples

A quicker way is to **multiply** the indices.

$$\begin{aligned}(x^3)^4 \\&= x^3 \times x^3 \times x^3 \times x^3 \\&= x^{12}\end{aligned}$$

$$\begin{array}{c} 3 \times 4 = 12 \\ \swarrow \searrow \\ 1. \quad (x^{\overset{3}{\underset{4}{\text{---}}}}) \\ = x^{12} \end{array}$$

$$\begin{aligned}2. \quad (a^2b^3c)^5 \\&= a^{10}b^{15}c^5\end{aligned}$$

(a) $(g^4)^2$

(b) $(m^3)^3$

(c) $(v^7)^2$

(d) $(p^3)^5$

(e) $(q^2)^3 \times (q^3)^4$

(f) $(a^2b^3)^4$

(g) $(fg^4)^5$

(h) $(c^2e^4)^6$

(i) $(a^3)^4 \times (a^2)^5$

(j) $(ab^2c^3)^4$

(k) $(n^{10})^{10}$

(l) $(3a^4)^2$

4. Simplify the following terms.

Examples

Anything to the power of 0 equals 1

$$\begin{aligned}1. \quad w^0 \\&= 1\end{aligned}$$

$$\begin{aligned}2. \quad (ab)^0 \\&= 1\end{aligned}$$

$$\begin{aligned}3. \quad (6u)^0 \\&= 1\end{aligned}$$

$$\begin{aligned}4. \quad 7m^0 \\&= 7 \times 1 \\&= 7\end{aligned}$$

(a) g^0

(b) $(m^3)^0$

(c) $(u^2v^7)^0$

(d) $h^0 + k^0$

(e) $(24t)^0$

(f) $5a^0$

(g) $(2h)^0 + 2h^0$

(h) $5p^0 - 2k^0$

(i) $3k^0 \times 2m^0$

(j) $(4e)^0 \times r^0$

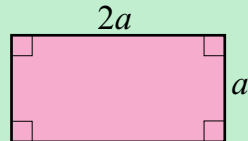
(k) $5^0 - 3^0$

(l) $5x^3y^0$

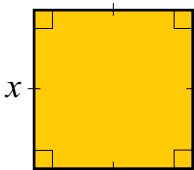
5. Write expressions for the **shaded area** in each of the following shapes.

Example

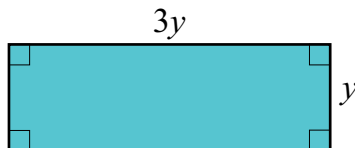
$$\begin{aligned}\text{Area} &= \text{length} \times \text{width} \\&= 2a \times a \\&= 2a^2\end{aligned}$$



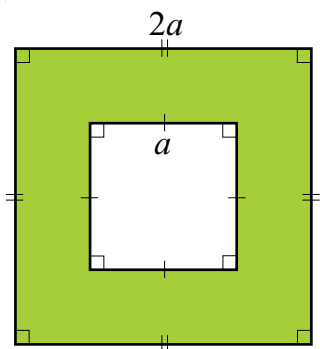
(a)



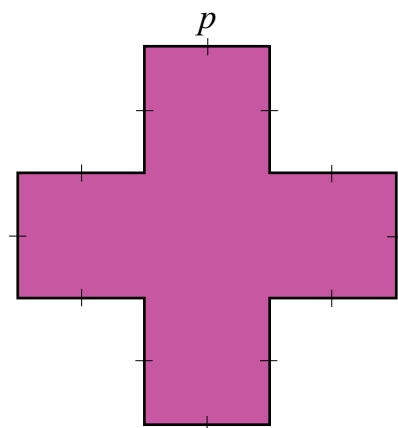
(b)



(c)



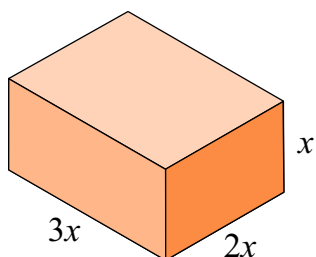
(d)



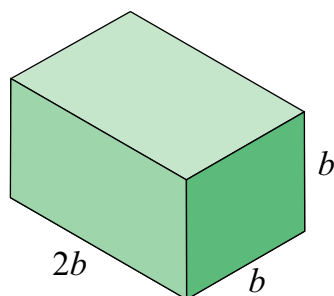
6. Write an expression for the volume of each of the following objects.

Volume of a rectangular prism = length $\times$ width $\times$ height

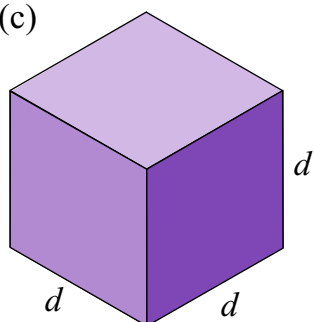
(a)



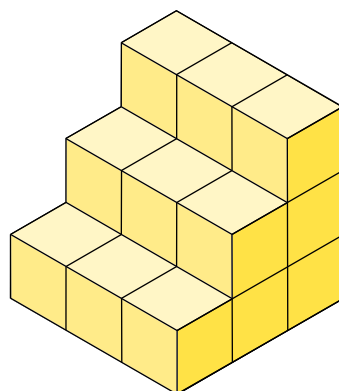
(b)



(c)



(d)



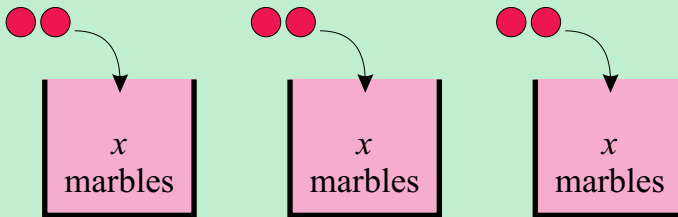
Each small cube in this object has side length m .

Expanding Algebraic Expressions

Example

Three boxes each have x marbles in them.

If 2 marbles are added to each box, what is the total number of marbles?
Write answer *two ways*.



First Way

Step 1 Before the two marbles are added to each box there is a total of $3x$ marbles in the boxes.

Step 2 If 2 marbles are added to each box, then 6 marbles have been added.

Step 3 There is a total of $3x + 6$ marbles.

Second Way

Step 1 After the 2 marbles are added to each box there are $(x + 2)$ marbles in each box.

Step 2 There are 3 boxes so the total number of marbles is $3(x + 2)$.

The two answers are: $3x + 6$ and $3(x + 2)$

EXERCISE 8F

Write the answers to the following problems *two ways*.

1. Jayne is organising a birthday party for her four year old son.
She has 8 bags with y sweets in each bag.
If she adds another 3 sweets to each bag, what is the total number of sweets?
2. A tennis coach has 5 bags of tennis balls. There are b balls in each bag and she adds another 4 balls to each bag.
What is the total number of tennis balls?
3. Kellie has 6 containers of raspberries that each weigh r grams.
If she adds 20 grams of raspberries to each container, what will be the total weight of the raspberries?
4. Thommo has 3 bags of Easter eggs each with e eggs in them.
If he eats 4 from each bag, how many Easter eggs will he have left?
5. A pet shop has 7 puppies that each cost p dollars. If the price is *reduced* by \$5 on each puppy, how much money will the pet shop make if it sells the 7 puppies?

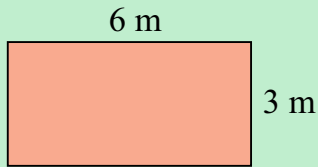


6. A golfing expert has 12 bags of golf balls that he uses for practice.
Each bag contains g golf balls. If 5 balls are *lost* from each bag, how many golf balls has he got left?

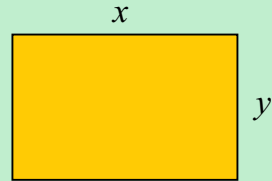
Example

The area of a rectangle is equal to its length multiplied by its width.

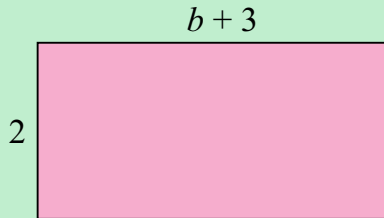
$$\text{Area} = \text{length} \times \text{width}$$



$$\begin{aligned}\text{Area} &= 6 \times 3 \\ &= 18 \text{ m}^2\end{aligned}$$

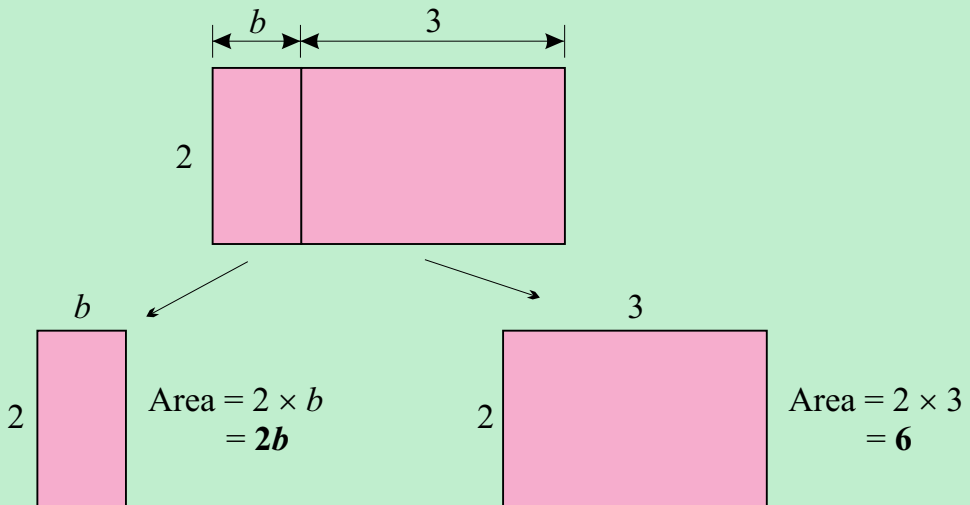


$$\begin{aligned}\text{Area} &= x \times y \\ &= xy\end{aligned}$$



$$\begin{aligned}\text{Area} &= 2 \times (b + 3) \\ &= 2(b + 3)\end{aligned}$$

This rectangle can be divided into two rectangles:



The area of the total rectangle equals the sum of the area of the two smaller rectangles:

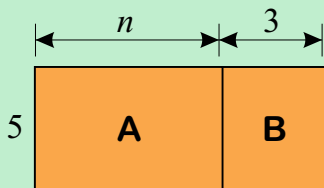
$$2(b + 3) = 2b + 6$$

EXERCISE 8G

1. For the following rectangles:

- write the area of each of the smaller rectangles
- write the total area of the larger rectangle

Example



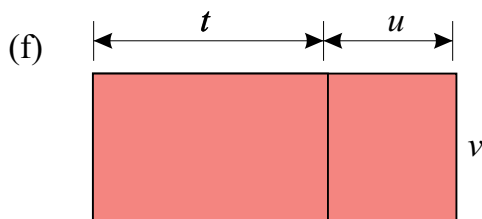
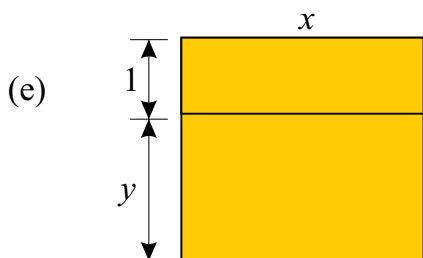
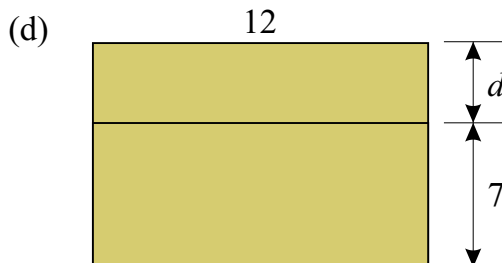
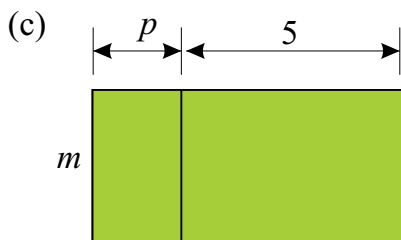
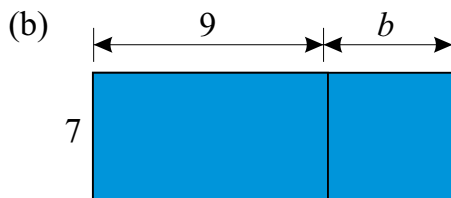
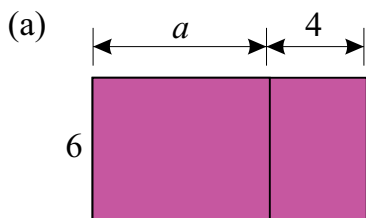
(i) Area of smaller rectangles:

$$\mathbf{A} \quad 5 \times n = \mathbf{5n}$$

$$\mathbf{B} \quad 5 \times 3 = \mathbf{15}$$

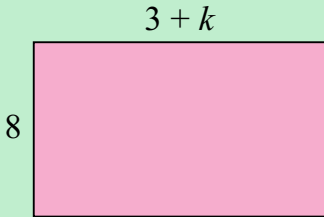
(ii) Area of larger rectangle:

$$5 \times (n + 3) = \mathbf{5(n + 3)}$$



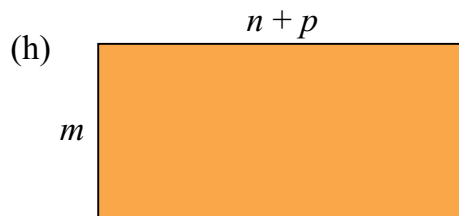
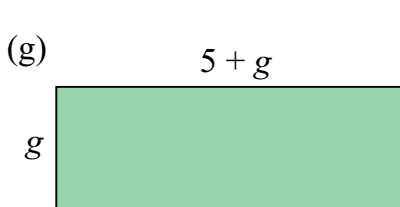
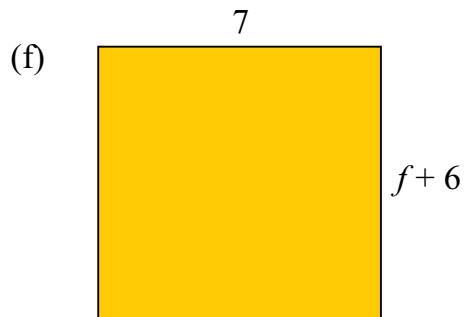
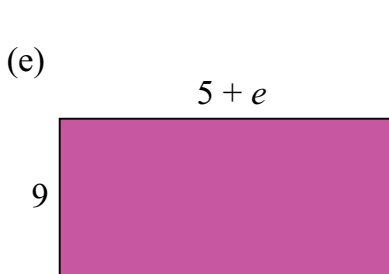
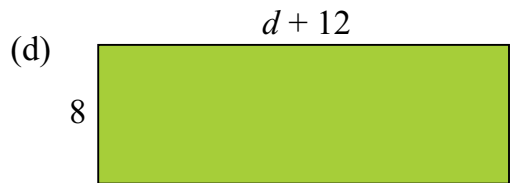
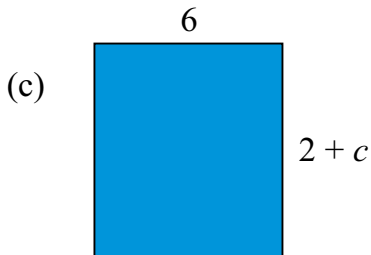
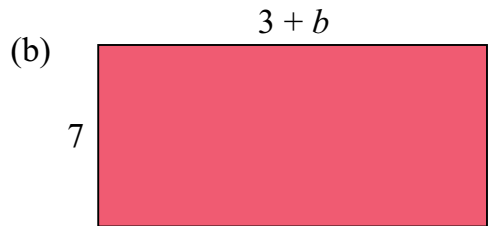
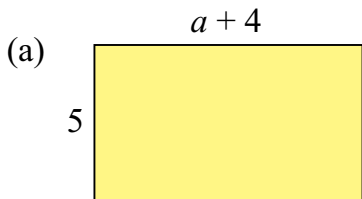
2. Write the area of the following rectangles two ways.

Example



First way: Area = $8 \times (3 + k)$
 $= 8(3 + k)$

Second way: Area = $8 \times 3 + 8 \times k$
 $= 24 + 8k$



Example

Expand the following algebraic expression.

$$4(n + 5)$$

A simple way of doing this is to multiply each term in the bracket by the term in front of the bracket.

$$\begin{aligned}
 & \begin{array}{c} \times \\ \swarrow \quad \searrow \\ 4 \times (n + 5) \end{array} \\
 &= 4 \times n + 4 \times 5 \\
 &= \mathbf{4n + 20}
 \end{aligned}$$

This is called the *distributive law*.

EXERCISE 8H

1. Expand the following algebraic expressions.

Examples

1. $3(x + 5)$

$$= 3 \times (x + 5)$$

$$= 3 \times x + 3 \times 5$$

$$= \mathbf{3x + 15}$$

2. $2(4a - 3b)$

$$= 2 \times (4a - 3b)$$

$$= 2 \times 4a + 2 \times -3b$$

$$= \mathbf{8a - 6b}$$

3. $3m(5m - 2n)$

$$= 3m \times (5m - 2n)$$

$$= 3m \times 5m + 3m \times -2n$$

$$= \mathbf{15m^2 - 6mn}$$

(a) $4(a + 2)$

(d) $6(3c + 1)$

(g) $3(4 - 2t)$

(j) $a(a + 2)$

(m) $5t(4t + 5u)$

(p) $3a(b - c)$

(s) $7a(2a + 3b)$

(v) $8y(3x + 2y)$

(b) $3(x - 4)$

(e) $2(e + 2f)$

(h) $4(3a - 2b)$

(k) $2m(m + 1)$

(n) $3p(p + 4q)$

(q) $6x(5y - 3z)$

(t) $5t(4t - 7u)$

(w) $10g(g - 3h)$

(c) $2(m + p)$

(f) $5(3 - g)$

(i) $x(y + 2)$

(l) $3v(2v - 3w)$

(o) $2a(3a + 6b)$

(r) $7k(6m - 5n)$

(u) $2p(4p - 5q)$

(x) $9x(2xy - 3yz)$

2. Expand the following algebraic expressions.

Remember: if two negative numbers are multiplied the answer is a positive number.

Examples

1. $-5(2 - 6a)$

$$= -5(2 - 6a)$$

$$= -5 \times 2 + -5 \times -6a$$

$$= -10 + 30a$$

2. $-2m(4m - 3n)$

$$= -2m(4m - 3n)$$

$$= -2m \times 4m + -2m \times -3n$$

$$= -8m^2 + 6mn$$

(a) $-4(a + 2)$

(b) $-3(x + 7)$

(c) $-3(2y + 9)$

(d) $-3(m - n)$

(e) $-3(r - 8)$

(f) $-k(m - n)$

(g) $-2(7a + 3b)$

(h) $-7(4t - 5u)$

(i) $-2p(5p - 2q)$

(j) $-8y(3x + 4y)$

(k) $-10g(2g - 3h)$

(l) $-9x(2xy - 4z)$

3. Expand and simplify the following expressions.

Examples

1. $3(x + 5) + 2(x - 4)$

$$= 3(x + 5) + 2(x - 4)$$

$$= 3x + 15 + 2x - 8$$

$$= 5x + 7$$

2. $4(a + 6) - 2(a - 5)$

$$= 4(a + 6) - 2(a - 5)$$

$$= 4a + 24 - 2a + 10$$

$$= 2a + 34$$

(a) $3(2x + 3) + 2(3x + 1)$

(b) $4(3m + 4) + 2(2m - 5)$

(c) $4(3t + 2) + 2(2t - 3)$

(d) $3(2g - 3) + 2(3g + 4)$

(e) $5(2t - 1) + 3(3t - 4)$

(f) $2(3z - 2) + 6(4z - 2)$

(g) $2(2w + 2) - 3(w + 2)$

(h) $3(2p + 4) - 2(2p + 3)$

(i) $4(3h - 3) - 2(2h - 3)$

(j) $5(3q + 2) - 4(3q - 5)$

Factorisation

EXERCISE 8I

1. Write *all* the factors of the following numbers.

Example 18

All the factors of 18 are **1, 2, 3, 6, 9, 18**

- | | | | | |
|--------|---------|--------|---------|---------|
| (a) 12 | (b) 36 | (c) 27 | (d) 80 | (e) 112 |
| (f) 56 | (g) 300 | (h) 23 | (i) 144 | (j) 171 |

2. Find the factors that are common to the following pairs of numbers.

Example 20, 30

The factors of 20 are 1, 2, 4, 5, 10

The factors of 30 are 1, 2, 3, 5, 6, 10, 15

The *common factors* are **1, 2, 5, 10**

- | | | | | |
|------------|------------|------------|------------|------------|
| (a) 12, 16 | (b) 15, 27 | (c) 16, 20 | (d) 24, 36 | (e) 56, 60 |
|------------|------------|------------|------------|------------|

3. Write the highest common factor (H.C.F.) for each of the pairs of numbers in question 2.

Example The highest common factor of 20 and 30 is **10**

4. Find the highest common factor of the following pairs of numbers.

- | | | | | |
|------------|------------|------------|------------|------------|
| (a) 4, 12 | (b) 30, 6 | (c) 8, 12 | (d) 18, 27 | (e) 21, 14 |
| (f) 24, 32 | (g) 35, 45 | (h) 48, 36 | (i) 36, 72 | (j) 84, 49 |

5. Find the highest common factor of the following terms.

Examples

1. $3a, ab$

$$3a = 3 \times \textcircled{a} \quad ab = \textcircled{a} \times b$$

highest common factor = a

2. $2x^2, 3xy$

$$2x^2 = 2 \times \textcircled{x} \times x \quad 3xy = 3 \times \textcircled{x} \times y$$

highest common factor = x

(a) $4m, mn$

(b) $6b, ab$

(c) $pq, 3p$

(d) $8u, 3uv$

(e) $2ab, 3ac$

(f) $4xy, 5yz$

(g) $6mp, 7mq$

(h) $2de, 5ef$

(i) a^2, ac

(j) $m^2, 8m$

(k) $5p, 2p^2$

(l) $xy, 2y^2$

(m) $9h^2, 5h$

(n) $2a^2, 3abc$

(o) $m^2n, 5n$

(p) $3x^2y, 5yz$

Find the highest common factor of the following terms.

Examples

Find the highest common factor of the **numbers** in each term and using this write the factors.

1. $3ab, 12bc$

Highest common factor of 3 and 12 is 3.

$$3ab = \textcircled{3} \times a \times \textcircled{b} \quad 12bc = \textcircled{3} \times 4 \times \textcircled{b} \times c$$

highest common factor = $3 \times b$
= $3b$

2. $10mn, 8m^2$

Highest common factor of 10 and 8 is 2.

$$10mn = \textcircled{2} \times 5 \times \textcircled{m} \times n \quad 8m^2 = \textcircled{2} \times 4 \times \textcircled{m} \times m$$

highest common factor = $2 \times m$
= $2m$

6. Find the highest common factor of the following terms.

- | | | |
|-------------------|-------------------|-------------------|
| (a) $4xy, 8x$ | (b) $5ab, 15ac$ | (c) $12pq, 6qr$ |
| (d) $7cd, 28de$ | (e) $36yz, 4z$ | (f) $45ab, 20bd$ |
| (g) $18mn, 27m$ | (h) $32x^2, 24x$ | (i) $54ac, 24cd$ |
| (j) $18xy, 36y^2$ | (k) $12mn, 36m^2$ | (l) $28hg, 35hi$ |
| (m) $26fg, 14g^2$ | (n) $72st, 54tu$ | (o) $56kl, 88l^2$ |

7. Find the highest common factor of the following terms.

- | | | |
|-------------------|------------------|------------------|
| (a) $10y, 8$ | (b) $36c, 24a$ | (c) $5p, 6pq$ |
| (d) $12d, 9de$ | (e) $48yz, 20xz$ | (f) $30ab, 49bd$ |
| (g) $16mn, 20m^2$ | (h) $18x, 72y$ | (i) $14ac, 24cd$ |
| (j) $15xy, 36y^2$ | (k) $18n, 36m^2$ | (l) $24hi, 35hg$ |
| (m) $28fg, 16g^2$ | (n) $27tu, 63vw$ | (o) $65kl, 85l$ |

Factorisation is the *opposite* of **expansion** of algebraic expressions.

To factorise an algebraic expression the **highest common factor** of all the terms must be found first.

Example 1

Factorise the following algebraic expression.

$$3x + 6$$

Step 1 Find the highest common factor of each term.

In this example the highest common factor of $3x$ and 6 is **3**.

Step 2 Write each term as a product of two factors with one being the highest common factor.

$$\begin{aligned} 3x + 6 \\ = 3 \times x + 3 \times 2 \end{aligned}$$

Step 3 Take the highest common factor out of each term.

Write the highest common factor outside a bracket with the remaining factors inside the bracket.

$$\begin{aligned} & \curvearrowright 3 \times x + 3 \times 2 \\ & = 3(x + 2) \end{aligned}$$

Example 2

Factorise the following algebraic expression.

$$8a + 12b$$

Highest common factor (H.C.F.) of $8a$ and $12b$ is **4**

$$= 4 \times 2a + 4 \times 3b$$

$$= \mathbf{4(2a + 3b)}$$

Example 3

Factorise the following algebraic expression.

$$24mn - 18n$$

$$= 6n \times 4m - 6n \times 3 \quad (\text{H.C.F. of } 24mn \text{ and } 18n \text{ is } \mathbf{6n})$$

$$= \mathbf{6n(4m - 3)}$$

Example 4

Factorise the following algebraic expression.

$$4x + 20x^2$$

$$= 4x \times 1 + 4x \times 5x \quad (\text{H.C.F. of } 4x \text{ and } 20x^2 \text{ is } \mathbf{4x})$$

$$= \mathbf{4x(1 + 5x)}$$

Example 5

Factorise the following algebraic expression.

$$18d - 25de$$

$$= d \times 18 - d \times 25e \quad (\text{H.C.F. of } 18d \text{ and } 25de \text{ is } \mathbf{d})$$

$$= \mathbf{d(18 - 25e)}$$

Example 6

Factorise the following algebraic expression.

$$\begin{aligned} & 32pq + 16qr \\ &= 16q \times 2p + 16q \times r \text{ (H.C.F. of } 32pq \text{ and } 16qr \text{ is } \mathbf{16q}) \\ &= \mathbf{16q(2p + r)} \end{aligned}$$

8. Factorise the following algebraic expressions.

- | | | |
|-------------------|------------------|-------------------|
| (a) $6m + 8p$ | (b) $5x - 2xy$ | (c) $9 - 18a$ |
| (d) $3ab + a$ | (e) $10d - 15e$ | (f) $6ab + 12a$ |
| (g) $x^2 + 7x$ | (h) $8u - 20u^2$ | (i) $14bc - 21de$ |
| (j) $32ab + 24b$ | (k) $m - 8mn$ | (l) $9c^2 - 6cd$ |
| (m) $24pq + 36qr$ | (n) $12r^2 - 6r$ | (o) $21kl + 49lr$ |
| (p) $36xy - 30yz$ | (q) $20gh + 9gi$ | (r) $45ab - 72bd$ |

Example 7

Factorise the following algebraic expression.

$$8m^2n + 16mn - 32mn^2p$$

The H.C.F. of these three terms is **$8mn$** .

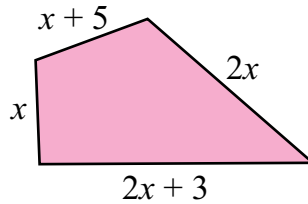
$$\begin{aligned} &= 8mn \times m + 8mn \times 2 - 8mn \times 4np \\ &= \mathbf{8mn(m + 2 - 4np)} \end{aligned}$$

9. Factorise the following algebraic expressions.

- | | |
|----------------------------------|--|
| (a) $3x^2y - 6xy + 12xy^2$ | (b) $16m - 12mp + 24m^2$ |
| (c) $15abc + 24b^2c - 9bcd$ | (d) $8ghi + 6hij + 12fhi$ |
| (e) $36pqr^2 - 24qrs + 30prt$ | (f) $72m^2np - 45mnp + 63mn^2p$ |
| (g) $42xyz^2 + 35yz^2 - 14x^2yz$ | (h) $32cd^2e + 24c^2de - 8cde^2$ |
| (i) $18ab^2c - 9abc + 45abc^2$ | (j) $10x^2y^2z^2 + 12xy^2z - 4x^2yz^2$ |

PROBLEM SOLVING

1. The perimeter of this shape is 80 metres.
Find x .



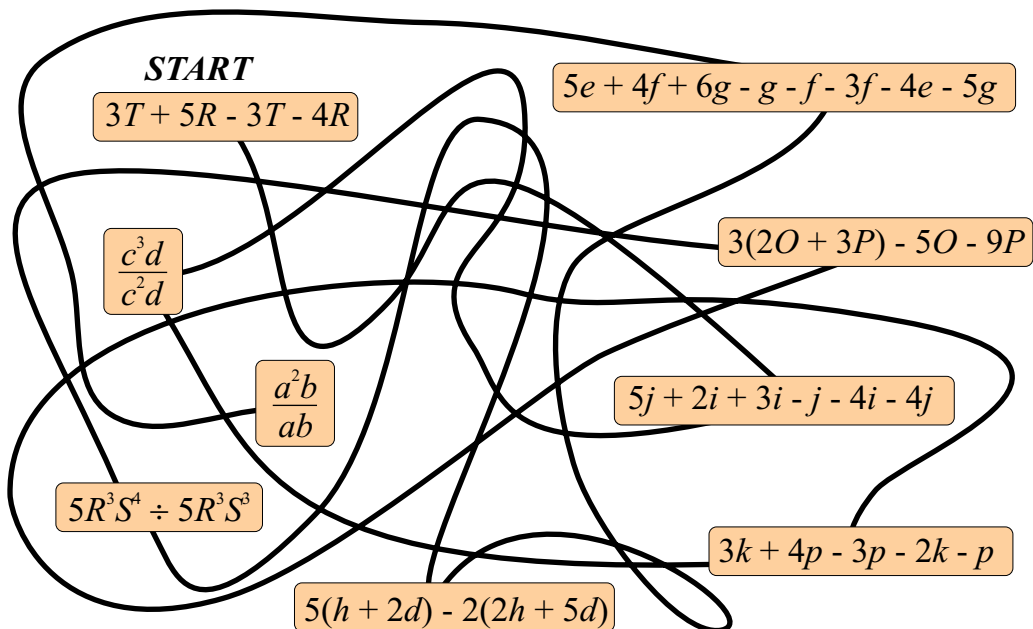
2. Hans had \$3905 in the bank. He wanted to build his bank account to \$8000 to buy a car, so he decided to save some money each month. In the first month he saved x dollars. Each month after that, he put into the bank **double** the amount he banked in the previous month. What amount does he need to save in the first month (x) so he has \$8000 in his bank account after a **year**?

PUZZLE

Follow the path below (beginning at the **START**) simplifying the expressions in the order that you find them on the path.

The solutions will spell the answer to this riddle.

Who was the Irishman who bounced off the wall?



CHAPTER REVIEW

1. Simplify the following expressions.

- | | | |
|---------------------|-------------------------|--------------------------|
| (a) $x + x + x + x$ | (b) $7p + 8p$ | (c) $3y - 3y$ |
| (d) $4a + a$ | (e) $5m + 6n - 4m - 2n$ | (f) $-3a + 5b - 2a - 3b$ |

2. An apple costs d dollars.

- (a) Write an expression for the cost of a bag of 8 apples.
 (b) Write an expression for the cost of 4 of these bags of apples.

3. Sam is y years old. Sam's brother, Dion, is 3 years older than Sam. Sam's sister, Anthea, is 2 years younger than Sam. Sam's mother, Nea, is three times Sam's age and his father, Ernie, is 1 year younger than Sam's mother.

- (a) Write an expression for the age of each of the members of Sam's family.
 (b) Write an expression for the sum of all their ages.

4. Simplify the following expressions.

- | | | |
|--|------------------------------------|---|
| (a) $2 \times a \times 3$ | (b) $3 \times n \times 4 \times m$ | (c) $n \times n \times n \times n \times n$ |
| (d) $3x \times 4y \times 2x \times 6x$ | (e) $m^5 \times m^4$ | (f) $3j^2 \times 5j^3$ |
| (g) $(e^4)^2$ | (h) $(u^2v^3)^5$ | (i) $(c^2)^3 \times (c^4)^2$ |
| (j) b^0 | (k) $(2h)^0$ | (l) $3g^0 + 5g^0$ |

5. Expand the following expressions.

- | | | |
|-------------------|------------------|--------------------|
| (a) $5(x + 3)$ | (b) $4(n - 2)$ | (c) $3(2a + 5b)$ |
| (d) $4m(2m + 3n)$ | (e) $-3(2 + 5v)$ | (f) $-3x(2x - 5y)$ |

6. Expand and simplify: $2(x + 7) + 3(4x - 3)$

7. Factorise the following algebraic expressions.

- | | | |
|-------------------|------------------|-------------------|
| (a) $8m + 4p$ | (b) $7a - 3ab$ | (c) $12 - 24x$ |
| (d) $5xy + y$ | (e) $12e - 18f$ | (f) $8ab + 24a$ |
| (g) $2x + x^2$ | (h) $9u - 15u^2$ | (i) $18mn - 24mp$ |
| (j) $36ab + 24b$ | (k) $m - 7mn$ | (l) $10c^2 - 8cd$ |
| (m) $24pq + 48qr$ | (n) $18r^2 - 8r$ | (o) $27kl + 54lr$ |

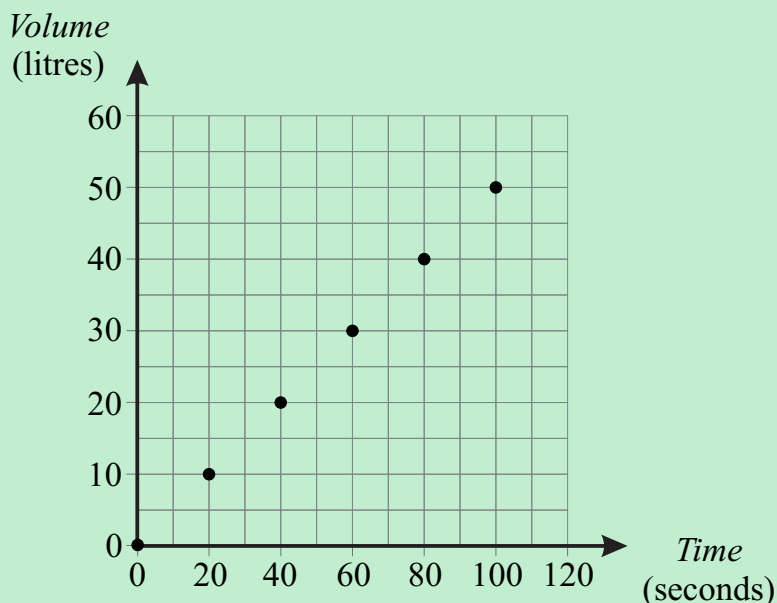
Linear Graphs

Example

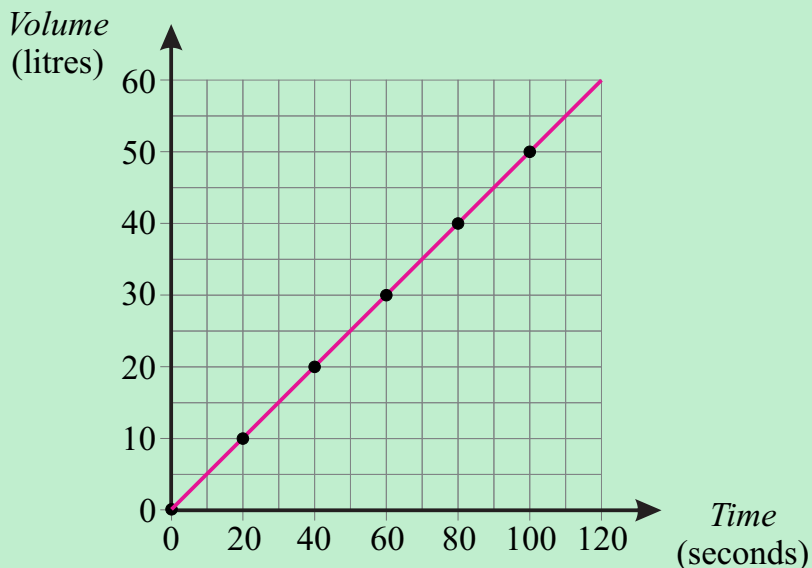
Charles used a hose to put water into a fish tank. There were marks on the side of the tank every 10 litres. Charles timed how long it took for the water level to reach each 10 litre mark. The table below shows these times.

<i>Time</i> (seconds)	0	20	40	60	80	100
<i>Volume</i> (litres)	0	10	20	30	40	50

This information can be displayed on a graph.

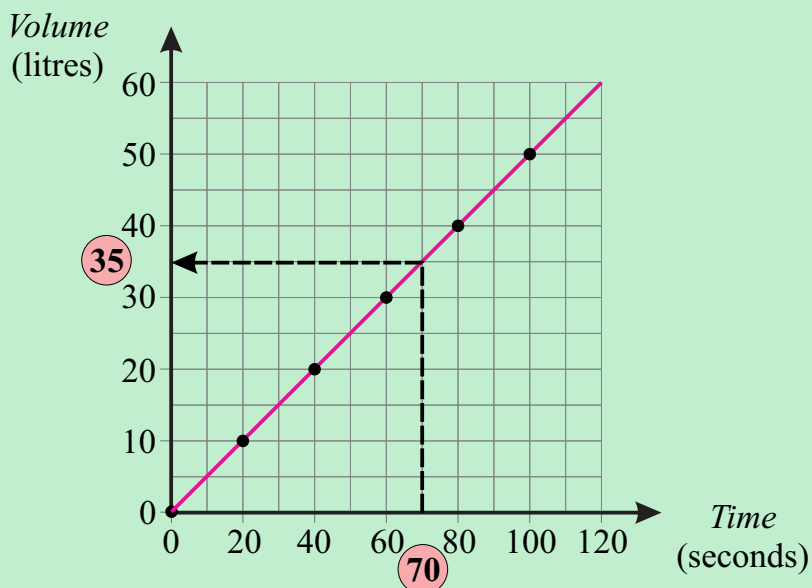


The points on this graph can be connected by a straight line.



This line can be used to find the volume of water in the tank at other times.

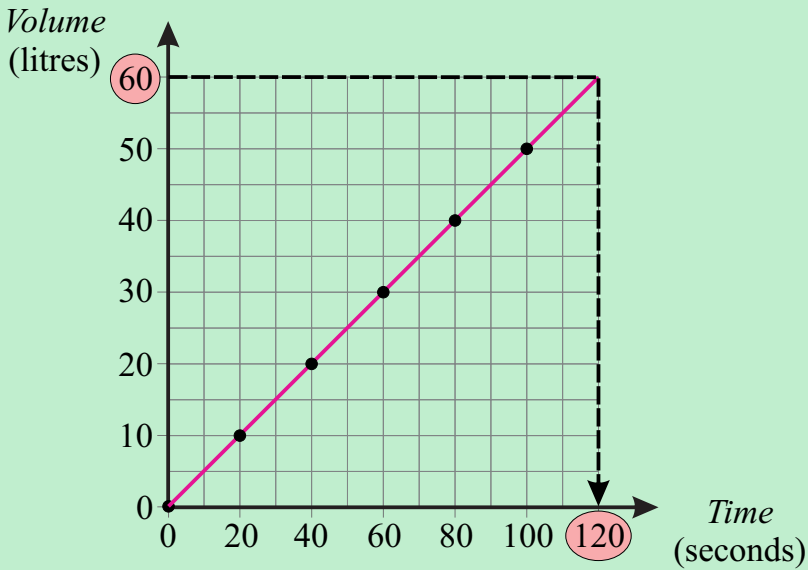
Example Find the volume of water in the tank after 70 seconds.



After **70 seconds** there were **35 litres** of water in the tank.

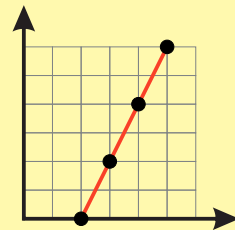
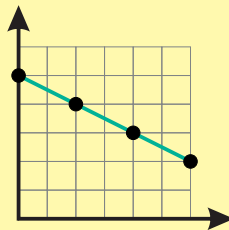
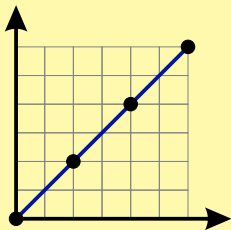
This line can also be used to find the time taken for a certain volume of water to have been added to the tank.

Example Find the time for 60 litres of water to have been added to the tank.



After **120 seconds** there were **60 litres** of water in the tank.

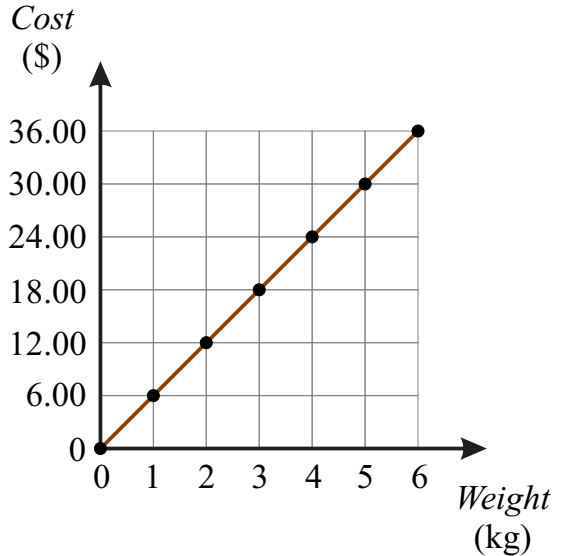
The line connecting the points in the example above is a straight line. If the line connecting the points on a graph is a **straight line** it is called a **linear graph**. The graphs below are all **linear graphs**.



EXERCISE 9A

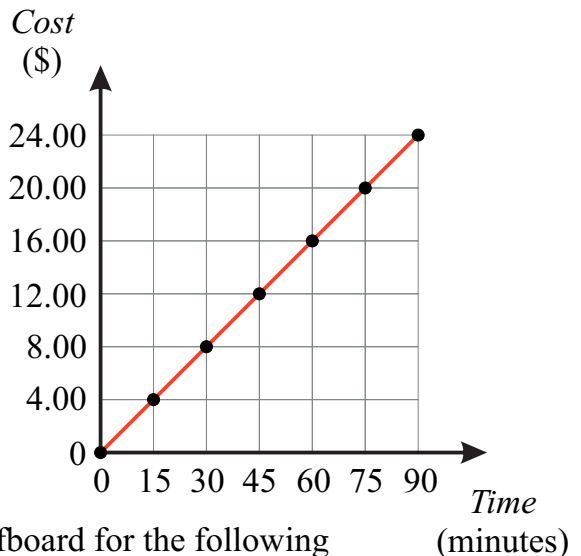
1. The cost of chestnuts bought from a farmer are shown on the graph below.

- (a) Find the cost of the following amounts of chestnuts:
- 3 kg
 - 5 kg
 - 4.5 kg
 - 8 kg
- (b) How many kilograms of chestnuts could be bought for the following amounts of money?
- \$12
 - \$36
 - \$15
 - \$120

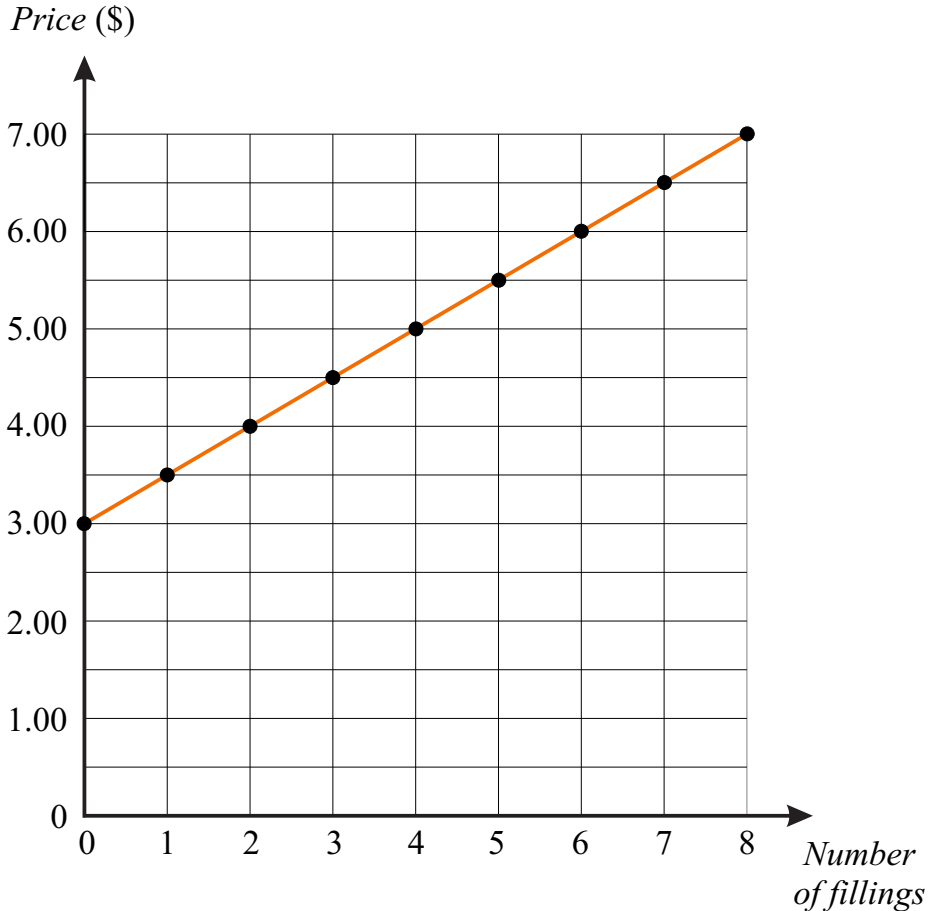


2. The cost to hire a surfboard at a holiday resort is shown on the graph below.

- (a) Find the cost to hire a surfboard for:
- 30 minutes
 - 1 hour
 - $2\frac{1}{2}$ hours
- (b) Cam took a surfboard at 10:00 am and returned it at 2:30 pm. How much would it have cost him?
- (c) Tamzyn took a surfboard at 11:45 am and returned it at 3:15 pm. How much would it have cost her?
- (d) How long could you hire a surfboard for the following amounts of money?
- \$12
 - \$20
 - \$60
- (e) Bryce took a surfboard at 12:30 pm and wanted to spend \$24 on hiring it. When would he need to return the surfboard?



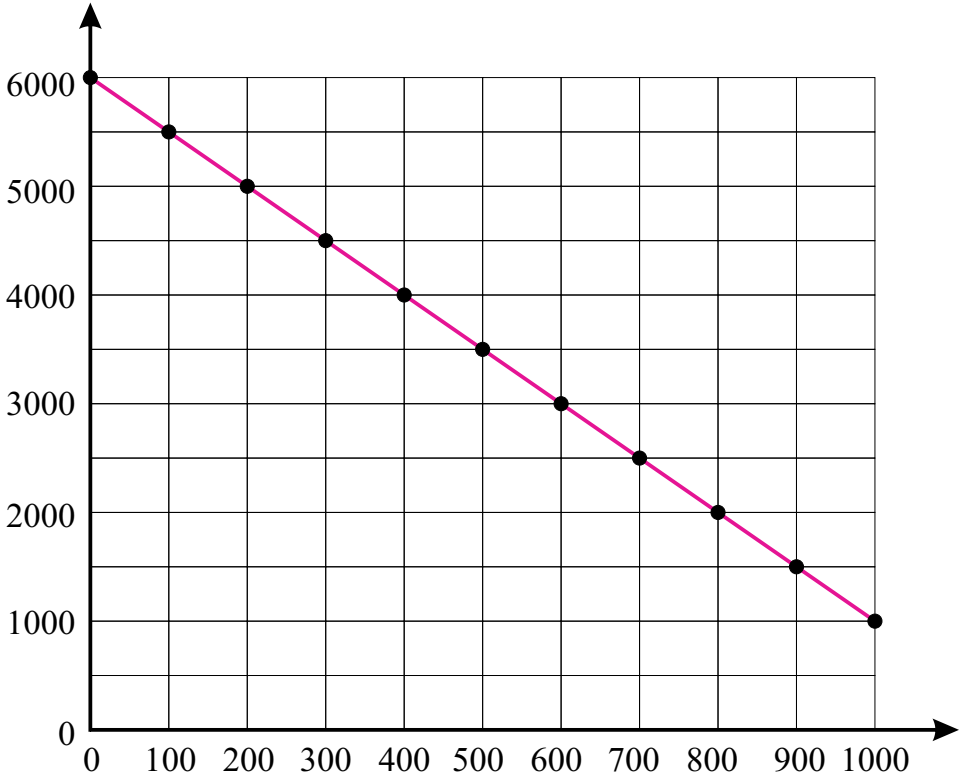
3. Sandy sells healthy sandwiches. She has a graph on the wall of her food van showing the price of her sandwiches depending on how many fillings are required (ham, chicken, lettuce, cheese, etc.)



- (a) What would it cost to buy a sandwich with four fillings?
- (b) What would it cost to buy a sandwich with seven fillings?
- (c) How many fillings would be included if a sandwich cost \$4?
- (d) How many fillings would be included if a sandwich cost \$5.50?
- (e) What would be the cost of a sandwich with chicken, avocado, tomato, grated carrot, grated beetroot, cheese and lettuce?

4. The graph below shows the amount of fuel in a Boeing 737 on a flight.

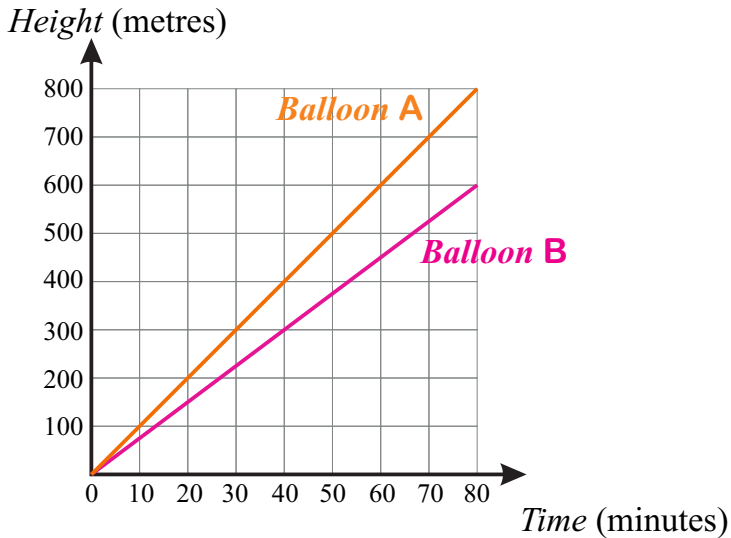
*Amount of fuel
in fuel tank
(litres)*



*Distance travelled
(km)*

- (a) How many litres of fuel were on the aeroplane when it took off?
- (b) How many litres of fuel were on the aeroplane when it landed?
- (c) How many litres of fuel had it used on the flight?
- (d) How many litres of fuel had been used when it had flown 300 km?
- (e) How far had it flown when it had used 1000 litres of fuel?

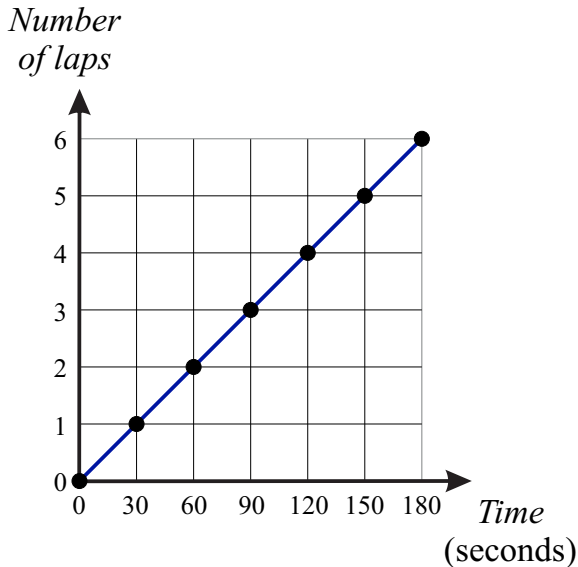
5. Two hot air balloons lifted off at the same time and the height of each was recorded as they ascended. Graphs showing the height, in metres, of each over a period of time, in minutes, are shown below.



- (a) Which balloon rose faster?
- (b) How long did it take each balloon to reach a height of 600 m?
- (c) At what height was each balloon after 40 minutes?
- (d) At what height would each balloon have reached if those both rose for another 40 minutes?



6. Grace swims six laps of a 25 metre swimming pool and her sister records the time after each lap she has been swimming. This information is shown on the graph below.



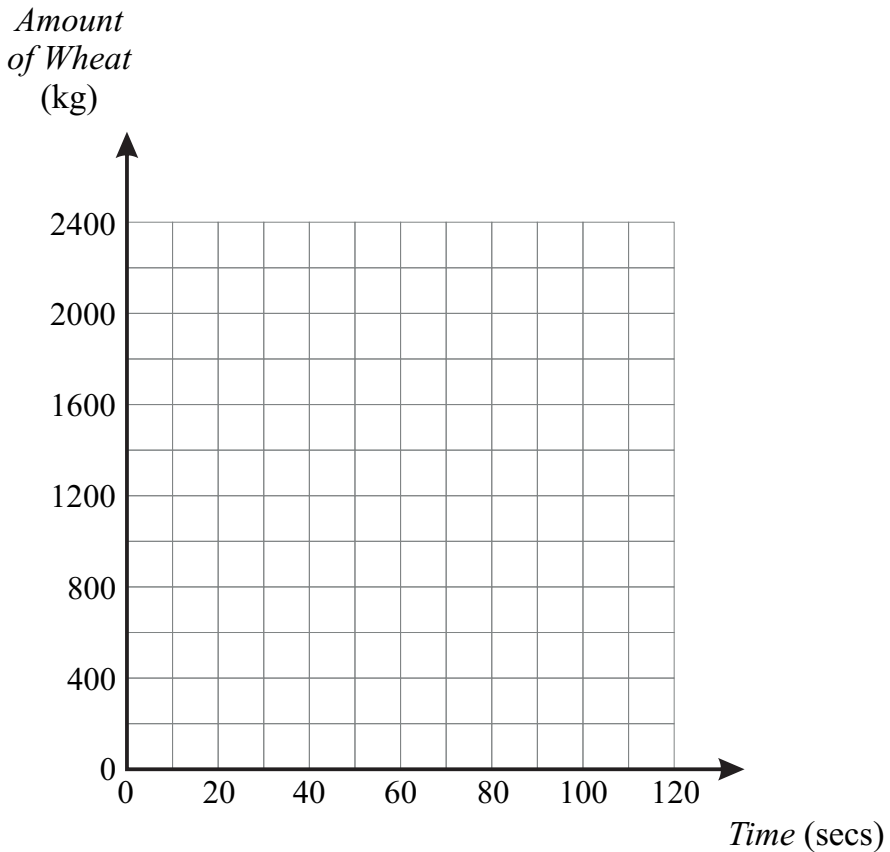
- (a) How long did it take Grace to swim one lap?
- (b) How many laps did Grace swim in one minute?
- (c) If she kept swimming at the same speed, how long would it take her to swim 10 laps?
- (d) How many laps would Grace swim in 10 minutes?
- (e) How far, in metres, did Grace swim in one minute?
- (f) How long would it take Grace to swim one kilometre?



7. Wheat is being loaded into a truck. The weight of the wheat loaded is recorded every twenty seconds and the table below shows this information.

<i>Time</i> (seconds)	0	20	40	60	80	100	120
<i>Amount of wheat</i> (kg)	0	400	800	1200	1600	2000	2400

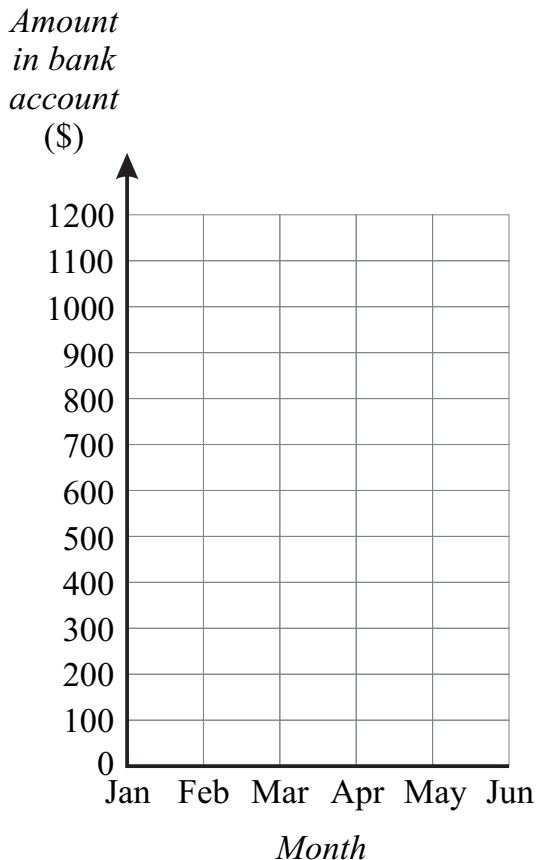
- (a) Copy the graph shown below and plot the information from the table above.
 (b) Is this a linear graph?
 (c) How much wheat had been loaded after 90 seconds?
 (d) How long did it take for 1000 kg of wheat to be loaded?



8. Four people recorded the amount of money they each had in their bank account at the **beginning** of each month for six months. These amounts are shown in the table below.

	Amount in bank accounts (\$)					
<i>Name</i>	Jan	Feb	Mar	Apr	May	Jun
Jerome	200	400	600	800	1000	1200
Natalie	0	100	200	300	400	500
Nick	100	200	400	600	700	1000
Rae	1100	1000	900	800	700	600

- (a) Copy the graph shown below and plot the information from the table on the graph. Connect the points for each person.
- (b) The graphs for which people were linear graphs.



9. Max is running on a treadmill that shows how far he has run. The table below shows how far, in metres, Max had run each two minutes for ten minutes.

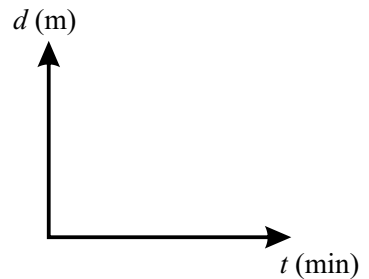
Time (min)	0	2	4	6	8	10
Distance (m)	0	160	320	480	640	800

Danni is also running on a treadmill. The table below shows how far, in metres, Danni had run each five minutes for 30 minutes.

Time (min)	0	5	10	15	20	25	30
Distance (m)	0	300	600	900	1200	1500	1800

- (a) Draw a graph, similar to the one shown here, for each runner.

- (b) How far did Max run each minute?
 (c) How far did Danni run each minute?
 (d) How long did it take Max to run 400 m?
 (e) How long did it take Danni to run 720 m?
 (f) How far would Max run in 15 minutes?
 (g) How far would Danni run in one hour?
 (h) Who is running the fastest?



10. The amount of energy (in kWh) produced by a domestic solar system was recorded every hour over a five hour period on a sunny day. This information is shown on the table below.

Time (hours)	0	1	2	3	4	5
Amount of energy (kWh)	0	3.0	6.0	9.0	12.0	15.0

- (a) Display this information on a graph.
 (b) Is the graph a linear graph?
 (c) How much energy had been produced after $2\frac{1}{2}$ hours?

11. Laboratory technicians were testing two different types of devices for heating liquids. They measured the temperature at two minute intervals while each device heated water to 50°C . The results are shown in the tables below.

Device A

Time (min)	0	2	4	6	8	10	12	14	16	18
Temp. ($^{\circ}\text{C}$)	14	18	22	26	30	34	38	42	46	50

Device B

Time (min)	0	2	4	6	8	10	12
Temp. ($^{\circ}\text{C}$)	14	20	26	32	38	44	50

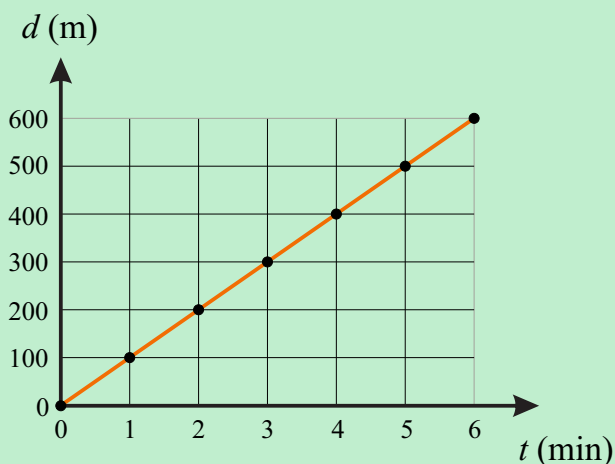
- Display this information on one graph clearly showing the line for each device.
- Which device heated the water faster?
- What was the temperature of the water after 5 minutes heated by:
 - device **A**?
 - device **B**?
- What would be the temperature of the water after *another* 10 minutes of heating by:
 - device **A**?
 - device **B**?



Linear Relationships

Example

The distance (d), in metres (m), travelled by a person jogging after t minutes is shown on the graph below.



1. How far had the person jogged after 3 minutes?
2. How long did it take the person to jog 500 metres?
3. Complete the equation below showing the relationship between distance jogged, d , and time taken, t .

$$d = \underline{\hspace{1cm}} \times t$$

4. How far would the person jog in: (i) 20 minutes? (ii) 1 hour?

Answers

1. From the graph, after 3 minutes the person has jogged **300 metres**.
2. From the graph, the person would take **5 minutes** to jog 500 metres.
3. It can be seen that:

$$d = 100 \times t$$

or

$$d = 100t$$

4. Using this relationship:

(i) after 20 minutes the person has jogged $100 \times 20 = 2000$ m

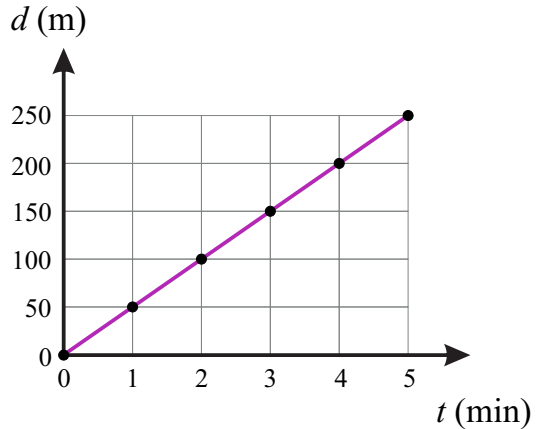
(ii) after 1 hour (60 minutes) the person has jogged $100 \times 60 = 6000$ m

EXERCISE 9B

1. A person was walking around a park. The graph below shows the distance, d , in metres (m) they had walked after t minutes.

- (a) How far had the person walked after 4 minutes?
 (b) How long did it take the person to walk 100 metres?
 (c) Complete the equation below showing the relationship between distance walked, d , and time taken, t .

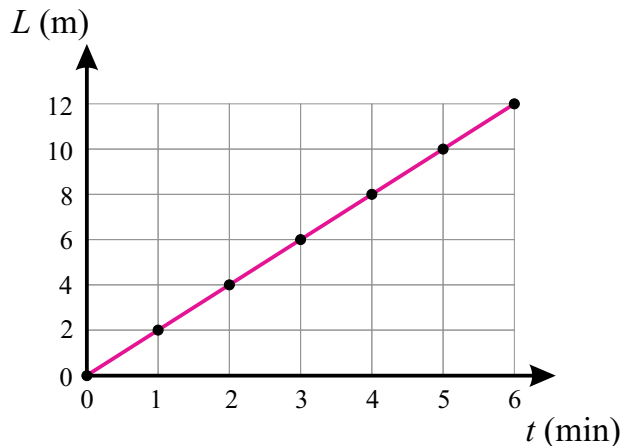
$$d = \underline{\hspace{1cm}} \times t$$



- (d) How far did the person walk in:
 (i) 10 minutes? (ii) 25 minutes? (iii) 1 hour?
 (e) How long did it take the person to walk:
 (i) 800 metres? (ii) 1 kilometre?

2. The length of material, L , in metres, produced by a fabric machine was recorded every minute and displayed on this graph.

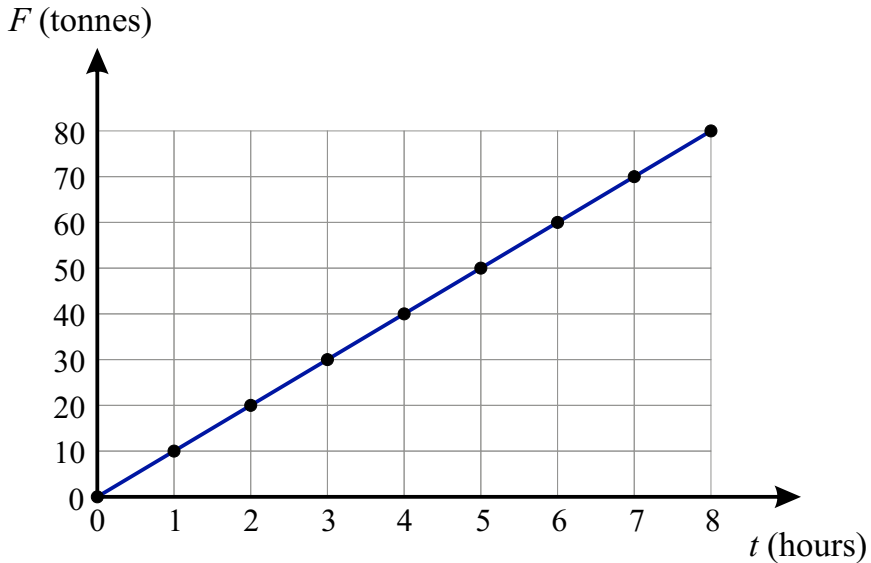
- (a) How many metres of material were produced in:
 (i) 2 minutes?
 (ii) 5 minutes?
 (b) How long did it take the machine to produce 8 metres of material?
 (c) Complete the equation showing the relationship between the length of material produced, L , in metres, and the time taken, t , in minutes.



$$L = \underline{\hspace{1cm}} \times t$$

- (d) How many metres of material would be produced in: (i) 10 minutes? (ii) 1 hour? (iii) 8 hours?
 (e) How long would it take to produce 200 metres of material?

3. The fuel used by a container ship, F , in tonnes, was measured every hour on a long trip and the results are shown on the graph below.



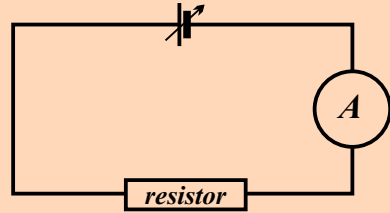
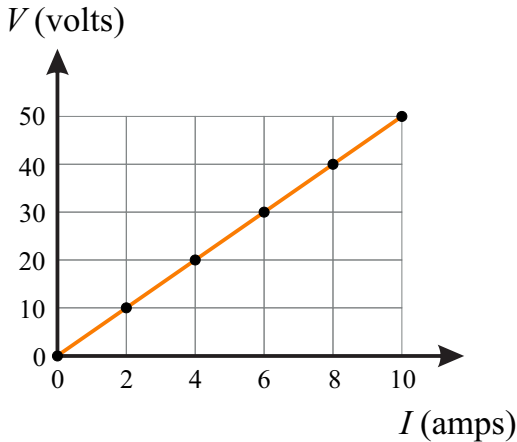
- (a) How many tonnes of fuel were used in: (i) 5 hours? (ii) 8 hours?
 (b) How long did it take to use 60 tonnes of fuel?
 (c) Complete the following equation showing the relationship between the amount of fuel used, F , in tonnes, and time, t , in hours:

$$F = \underline{\hspace{1cm}} \times t$$

- (d) How much fuel would be used in: (i) 10 hours? (ii) 1 day?
 (e) How long could the ship travel if it used the following amounts of fuel? (i) 70 tonnes (ii) 150 tonnes (iii) 280 tonnes of fuel



4. Students were studying electricity in a science class. They set up an electrical circuit with a resistor and measured the current, I , measured in amps, for different voltages, V , measured in volts. The results are shown on the graph below.



Note: The symbol for current is I because it was called the *Intensity of current*.

- (a) What was the voltage, V , when the current was:
 (i) 4 amps? (ii) 10 amps? (iii) 7 amps? (iv) 1 amp?
- (b) What was the current, I , when the voltage was:
 (i) 30 volts? (ii) 40 volts? (iii) 45 volts? (iv) 25 volts?
- (c) Complete the following equation showing the relationship between voltage, V , and current, I .

$$V = \underline{\hspace{1cm}} \times I$$

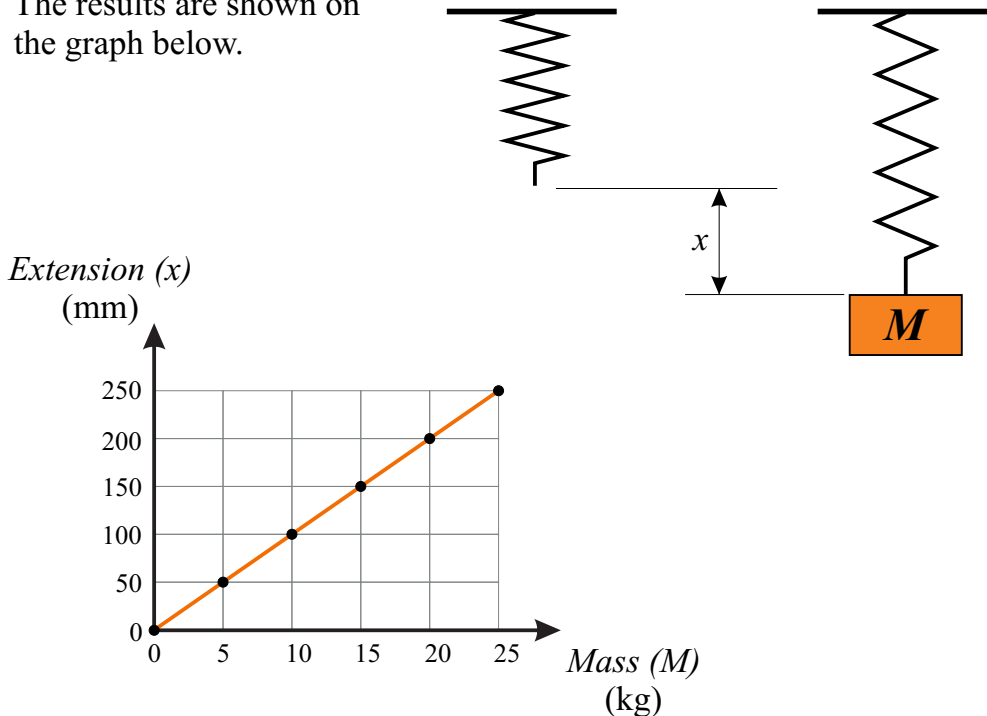
- (d) What would be the voltage for the following currents?
 (i) 20 amps (ii) 15 amps (iii) 12 amps (iv) 42 amps (v) 57 amps
- (e) What would be the current for the following voltages?
 (i) 55 volts (ii) 90 volts (iii) 200 volts (iv) 240 volts (v) 305 volts

5. In another science class, students were investigating how much a spring is extended when different masses are attached to it.

The diagram below shows their experiment.

A spring is hung vertically and different masses, M , measured in kilograms, are attached. The extension, x , measured in millimetres, is recorded.

The results are shown on the graph below.



- What was the extension of the spring when the following masses were added? (i) 10 kg (ii) 25 kg
- What mass caused an extension of 150 mm?
- Complete the following equation showing the relationship between extension, x , and mass, M .

$$x = \underline{\hspace{1cm}} \times M$$

- What would be the extension if the following masses were attached to the spring?
(i) 2 kg (ii) 12 kg (iii) 24 kg (iv) 30 kg (v) 45 kg
- What mass would cause the following extensions?
(i) 40 mm (ii) 70 mm (iii) 180 mm (iv) 340 mm (v) 420 mm

EXERCISE 9C

1. Eli owned a number of budgerigars. He recorded the amount of feed, F , in grams, they had eaten each day for four days. The results are shown in the table below.

Number of days	0	1	2	3	4
Amount of feed (g)	0	40	80	120	160

- (a) Complete the following equation showing the relationship between the amount of feed, F , and the number of days, n .

$$F = \underline{\hspace{1cm}} \times n$$

- (b) Find how many grams of feed would be needed in the following:
 (i) 6 days (ii) 1 week (iii) 10 days (iv) 6 weeks
 (c) How many days would it take for the budgerigars to eat the following amount of feed?
 (i) 200 grams (ii) a 1 kg bag of feed (iii) a 12 kg bag of feed

2. The distance, D , in metres, jogged by a person is recorded every minute and the results are shown in the table below.

Time (min)	0	1	2	3	4	5
Distance (m)	0	120	240	360	480	600

- (a) Complete the following equation showing the relationship between distance, D , and time, t .

$$D = \underline{\hspace{1cm}} \times t$$

- (b) Find the distance that the person would jog in the following times:
 (i) 10 minutes (ii) 25 minutes (iii) 1 hour
 (c) How long would it take the person to jog the following distances?
 (i) 720 m (ii) 2400 m (iii) 6 km (iv) 24 km

3. Lily had a water purifier. She noted the amount of water, A , that had been filtered and recorded these amounts, in millilitres (mL), every 10 seconds. These measurements are shown in the table below.

<i>Time</i> (sec)	0	10	20	30	40	50
<i>Amount of filtered water</i> (mL)	0	50	100	150	200	250

- (a) Complete the following equation showing the relationship between the amount of filtered water, A , and time, t .

$$A = \underline{\hspace{1cm}} \times t$$

- (b) Find the amount of water that had been filtered after the following times:

(i) 2 seconds (ii) 15 seconds (iii) 1 minute (iv) 1 hour

- (c) How long would it take to filter the following amounts of water?
(There are 1000 mL in a litre)

(i) 60 mL (ii) 170 mL (iii) 1 litre (iv) 20 litres

4. A fuel tank is being filled and the amount of fuel in the tank, A , measured in litres, is measured every 5 seconds. These measurements are shown in the table below.

<i>Time</i> (sec)	0	5	10	15	20	25
<i>Amount of fuel</i> (L)	0	10	20	30	40	50

- (a) Complete the following equation showing the relationship between the amount of fuel, A , and time, t .

$$A = \underline{\hspace{1cm}} \times t$$

- (b) Find the amount of fuel in the tank after the following times:

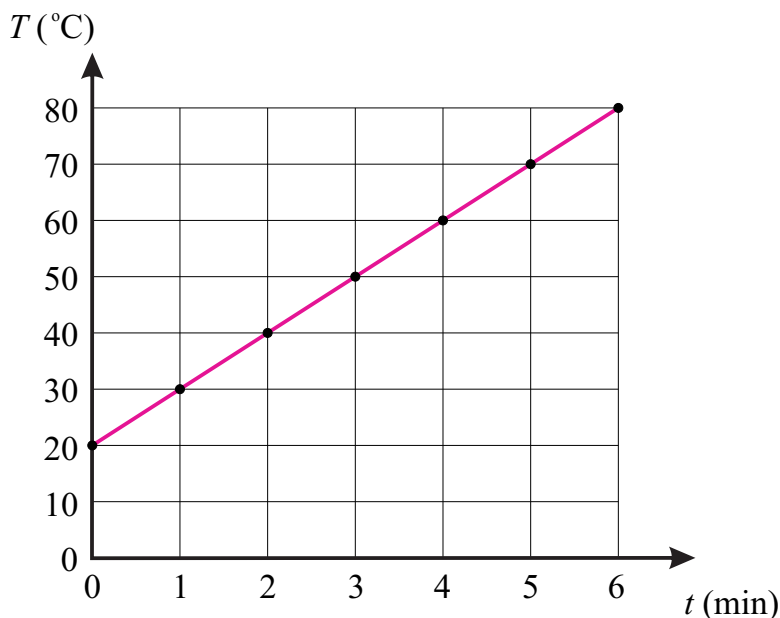
(i) 2 seconds (ii) 30 seconds (iii) 45 seconds

- (c) How long would it take to fill the fuel tank if it held 200 litres?

EXERCISE 9D

1. The water in a container is heated and the temperature is recorded every minute.

A graph of temperature (T), in $^{\circ}\text{C}$, against time (t), in minutes, is shown below.



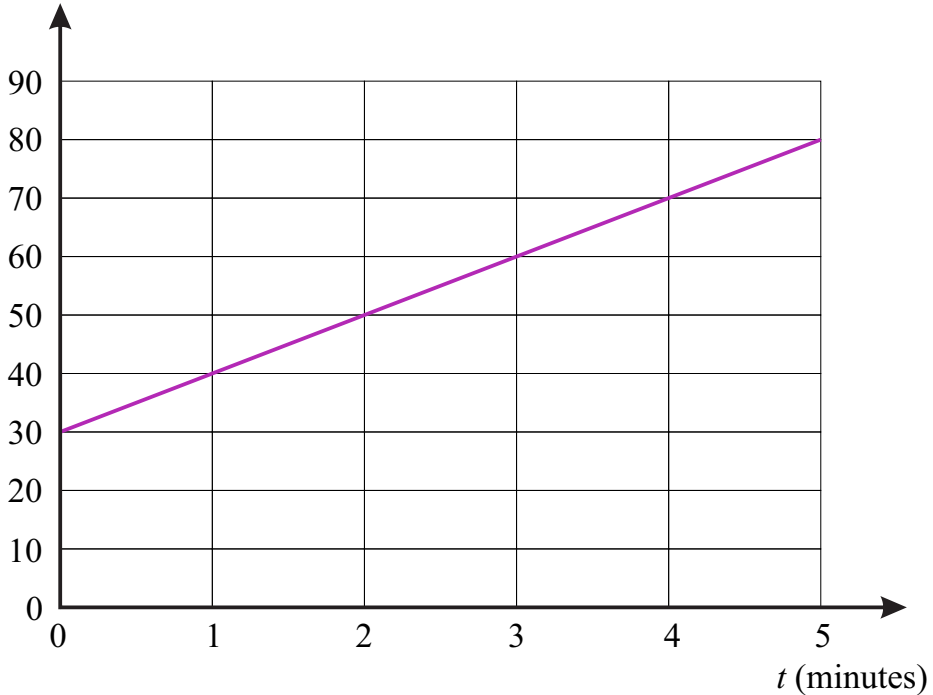
- (a) What was the temperature after the following times of heating?
 (i) 2 minutes (ii) 5 minutes
- (b) After how many minutes was the water at the following temperatures?
 (i) 30°C (ii) 50°C
- (c) What was the temperature of the water when the heating starting?
- (d) Which of the following equations is the relationship between temperature (T) and time (t)?
 (Use trial and error to find which equation fits all points on the graph)

A $T = 10t$ **B** $T = t + 20$ **C** $T = 10t + 20$ **D** $T = 20t + 10$

- (e) Use this equation to find the water temperature after 8 minutes of heating.

2. A hose is used to add water to a fish tank. A graph showing the volume of water, V , in litres, in the tank against time, t , in minutes, as the water is added is shown below.

V (litres)



- What was the volume of water in the tank before water was added?
- What was the volume of water in the tank after the following times?
 - 1 minute
 - 4 minutes
- After how many minutes were 60 litres of water in the tank?
- Which of the following equations is the relationship between volume of water (V) and time (t)?

A $V = t + 30$ **B** $V = 10t + 30$ **C** $V = 30t + 10$ **D** $V = 10t + 20$

Use this equation to find the following:

- How many litres of water will be in the tank after the following times?
 - 6 minutes
 - 10 minutes
 - 1 hour
- How long would it take for the following volumes of water to be in the tank?
 - 110 litres
 - 200 litres
 - 330 litres

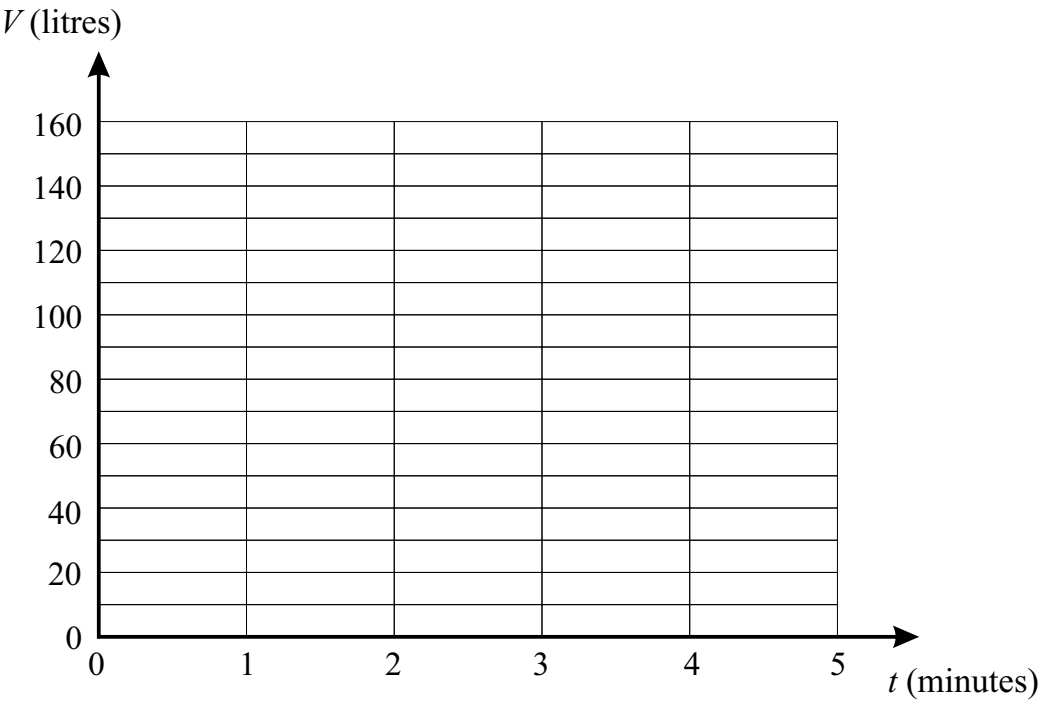
3. Water was flowing into a tank. The relationship between the volume of water in the tank, V , in litres, and time, t , in minutes, is shown below.

$V = 20t + 60$

(a) Copy and complete the table below.

t (minutes)	0	1	2	3	4	5
V (litres)						

(b) Copy the graph below and display the points from this table.
Draw a straight line through the points.



4. For each of the following relationships complete a table similar to the table in question 3 and display the points on the same graph from question 3. Connect each set of points with a straight line.

(a) $V = 10t + 60$

(b) $V = 20t + 40$

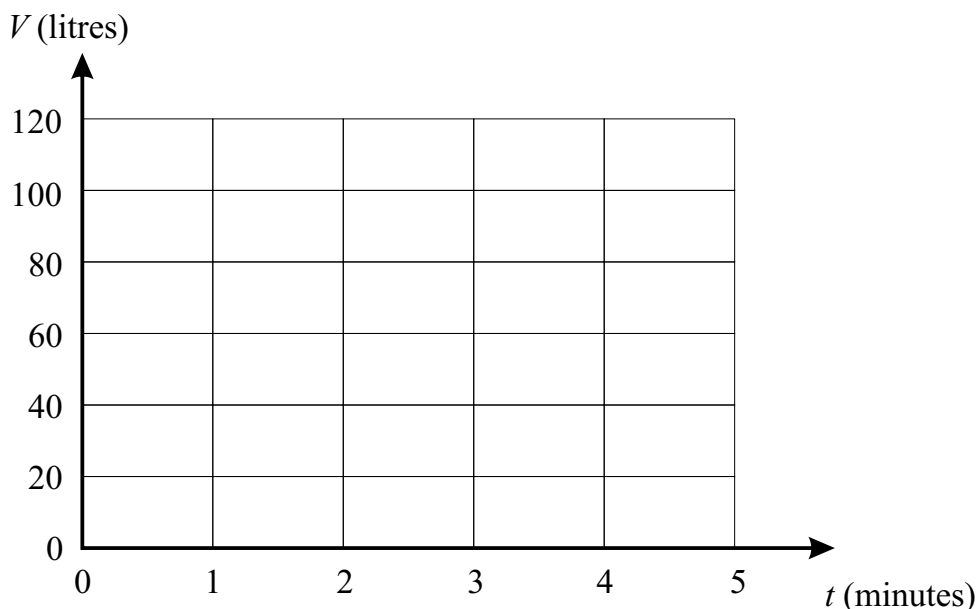
(c) $V = 30t + 10$

(d) $V = 10t + 80$

5. Water is being drained from a fish tank so it can be cleaned. The volume of water in the tank, V , in litres, for five minutes of draining it is shown in the table below.

t (minutes)	0	1	2	3	4	5
V (litres)	120	100	80	60	40	20

- (a) Copy and complete the graph below displaying this information. Connect the points with a straight line.



- (b) Which of the following equations is the relationship between V and t .

A $V = 120 + 20t$ **B** $V = 120 - 10t$ **C** $V = 120 - 20t$ **D** $V = 120 - t$

6. Another fish tank is being drained and the table below shows the volume of water in this tank for five minutes of draining.

t (minutes)	0	1	2	3	4	5
V (litres)	100	90	80	70	60	50

- (a) Display this information on the same graph from question 5.

- (b) Which of the following equations is the relationship between V and t ?

A $V = 100 + 10t$ **B** $V = 100 - 10t$ **C** $V = 100 - 20t$ **D** $V = 100 - t$

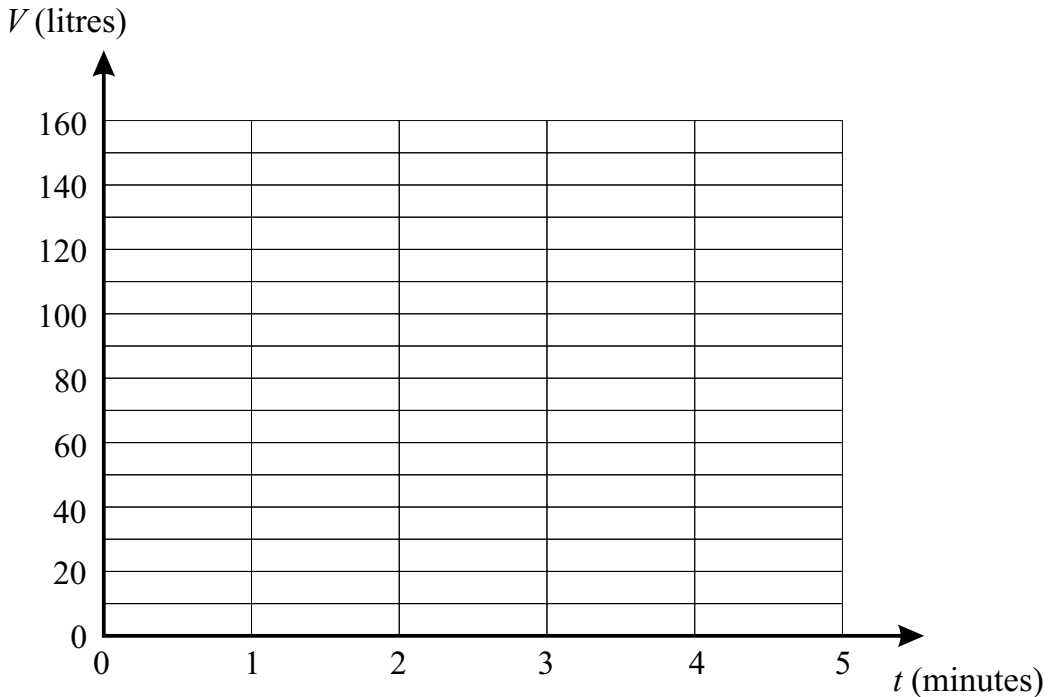
7. Water was flowing out of a tank. The relationship between the volume of water in the tank, V , in litres, and time, t , in minutes, is shown below.

$$V = 160 - 20t$$

- (a) Copy and complete the table below.

t (minutes)	0	1	2	3	4	5
V (litres)						

- (b) Copy the graph below and display the points from this table. Draw a straight line through the points.



8. For each of the following relationships complete a table similar to the table in question 7 and display the points on the same graph from question 7. Connect each set of points with a straight line.

(a) $V = 160 - 10t$

(b) $V = 140 - 20t$

(c) $V = 120 - 10t$

(d) $V = 160 - 30t$

The Cartesian Plane

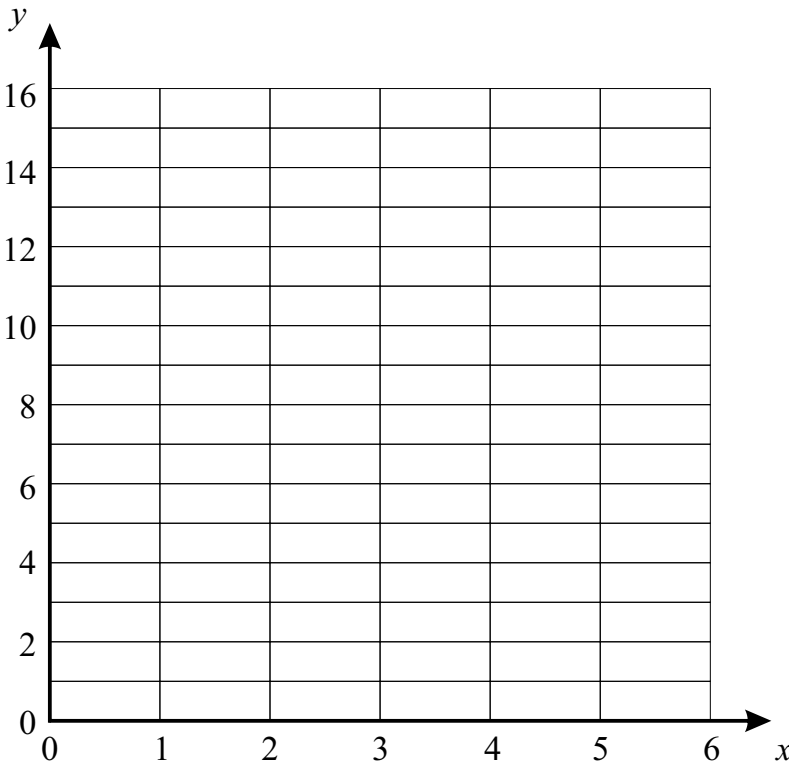
EXERCISE 9E

1. (a) For this relationship, copy and complete the table of values below.

$$y = 2x$$

x	0	1	2	3	4	5	6
y							

- (b) Copy the graph below (x -axis and y -axis) and display the points from the table of values. Join the points with a straight line.



2. For each of the following relationships complete a table similar to the table in question 1 and display the points on the same graph from question 1. Connect each set of points with a straight line.

(a)

$$y = 2x + 3$$

(b)

$$y = 10 - x$$

(c)

$$y = 2x + 1$$

(d)

$$y = x + 5$$

(e)

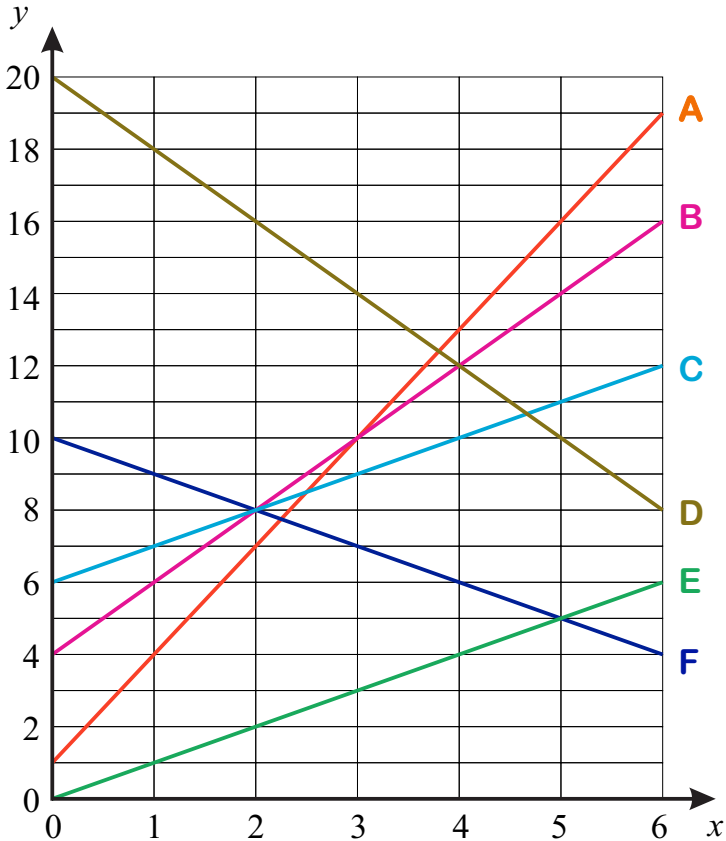
$$y = 2x + 4$$

(f)

$$y = 16 - 2x$$

3. Match the lines on the graph below with the following relationships.

- (a) $y = 3x + 1$
- (b) $y = 10 - x$
- (c) $y = x$
- (d) $y = 2x + 4$
- (e) $y = x + 6$
- (f) $y = 20 - 2x$



4. Match the following relationships with the tables of values below.

- (a) $y = 5x + 6$
- (b) $y = 30 - 2x$
- (c) $y = 4x + 8$
- (d) $y = 3x + 6$
- (e) $y = 5x + 8$
- (f) $y = 30 - 4x$

A

x	0	1	2	3	4
y	8	13	18	23	28

B

x	0	1	2	3	4
y	30	28	26	24	22

C

x	0	1	2	3	4
y	30	26	22	18	14

D

x	0	1	2	3	4
y	6	11	16	21	26

E

x	0	1	2	3	4
y	6	9	12	15	18

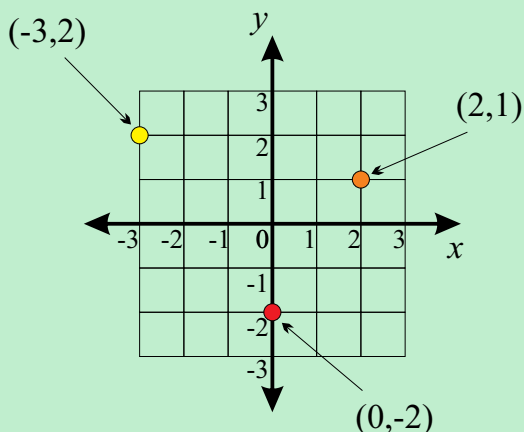
F

x	0	1	2	3	4
y	8	12	16	20	24

When plotting points on a Cartesian Plane, each point is located by its x -value and y -value. These are called the **coordinates**. The x -ordinate is stated first then the y -ordinate.

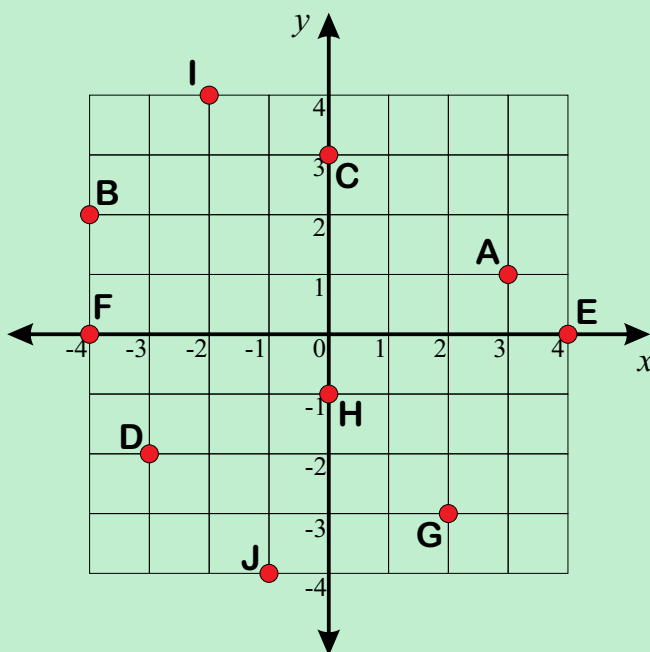
Examples

The points $(2,1)$, $(-3,2)$ and $(0,-2)$ are shown on this Cartesian Plane.



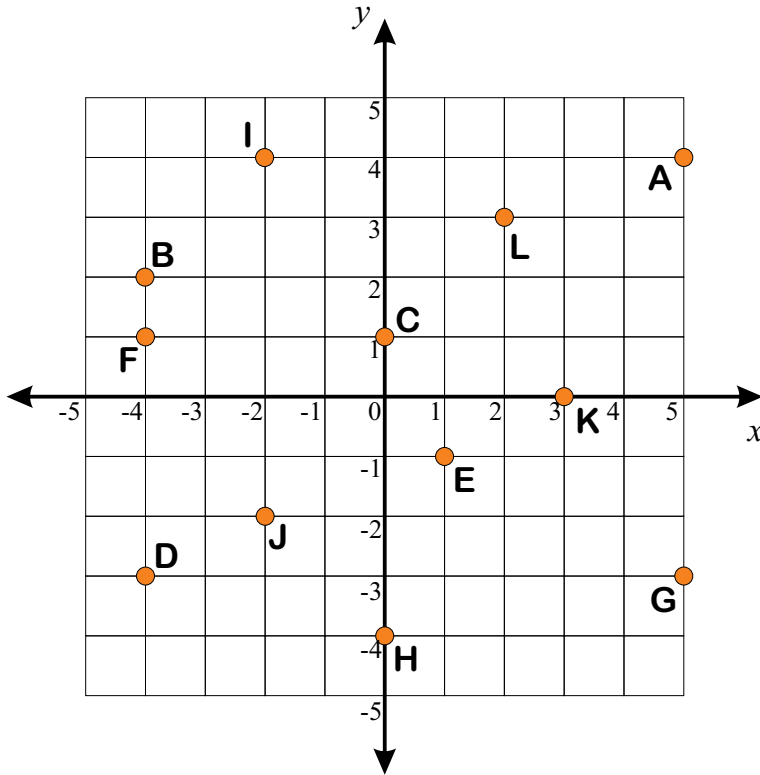
The following points are shown on the Cartesian Plane below.

A = $(3, 1)$ **B** = $(-4, 2)$ **C** = $(0, 3)$ **D** = $(-3, -2)$ **E** = $(4, 0)$
F = $(-4, 0)$ **G** = $(2, -3)$ **H** = $(0, -1)$ **I** = $(-2, 4)$ **J** = $(-1, -4)$



EXERCISE 9F

1. Write the coordinates of the points shown on this Cartesian Plane.



2. Draw a Cartesian Plane with both axes from -5 to 5 as shown in question 1. Mark on this Cartesian Plane the following points.

A = (3,5)	B = (-2,-5)	C = (0,1)	D = (0,-1)	E = (2,-1)
F = (-4,0)	G = (4,-4)	H = (0,-5)	I = (-2,5)	J = (5,0)
K = (2,1)	L = (3,3)	M = (-5,4)	N = (0,3)	

Connect the following points with a continuous line.

I - A - L - N - C - K - E - D - H - B - I

Colour the shape that is made to find something that is used to start fires.

Example

For the following relationship:

(a) complete the table of values

(b) plot these points on the Cartesian Plane shown

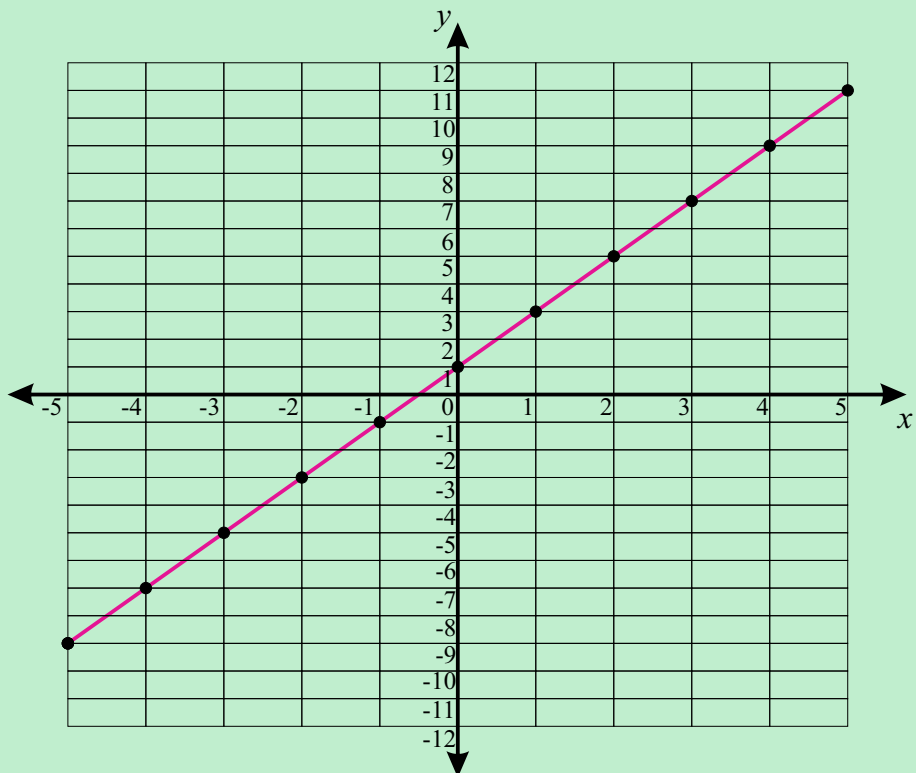
(c) connect these points with a straight line

$$y = 2x + 1$$

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
y											

Answer

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
y	-9	-7	-5	-3	-1	1	3	5	7	9	11



EXERCISE 9G

1. For each of the following relationships copy and complete the table of values shown below.

(a) $y = 3x + 5$

(b) $y = x - 4$

(c) $y = 2x - 3$

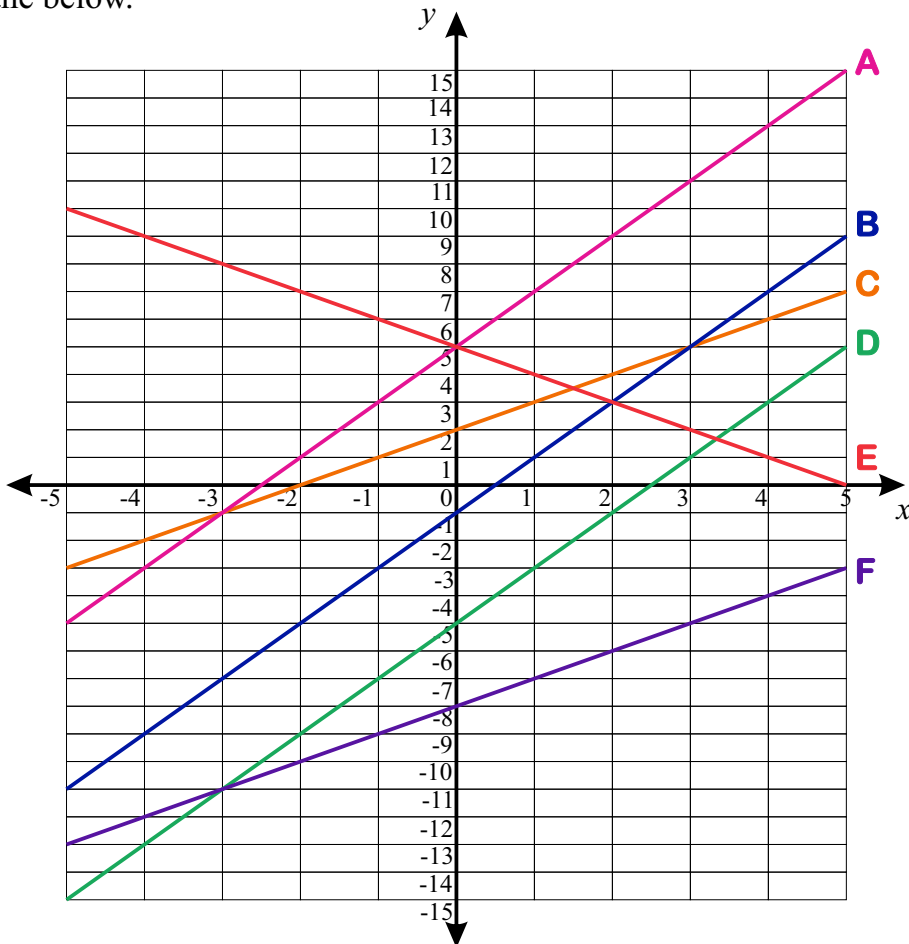
(d) $y = 2x + 4$

(e) $y = 3x - 5$

(f) $y = 6 - x$

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
y											

2. Draw a Cartesian Plane with x -axis from -5 to 5 and y -axis from -20 to 20. Plot the points from each of the relationships from question 1 on this Cartesian Plane and join the points for each relationship.
3. Find the relationship for each of the straight lines shown on the Cartesian Plane below.



PROBLEM SOLVING

Tamzyn and Jana are runners and train with each other by running around an 800 metre track.

One training session they both started at the same point on the track but ran in opposite directions.

Tamzyn ran at a speed of 5 m/s and Jana ran at 3 m/s.

They ran for 20 minutes.

1. How many times did they pass each other?
2. How many laps of the track did each runner complete?

PUZZLE

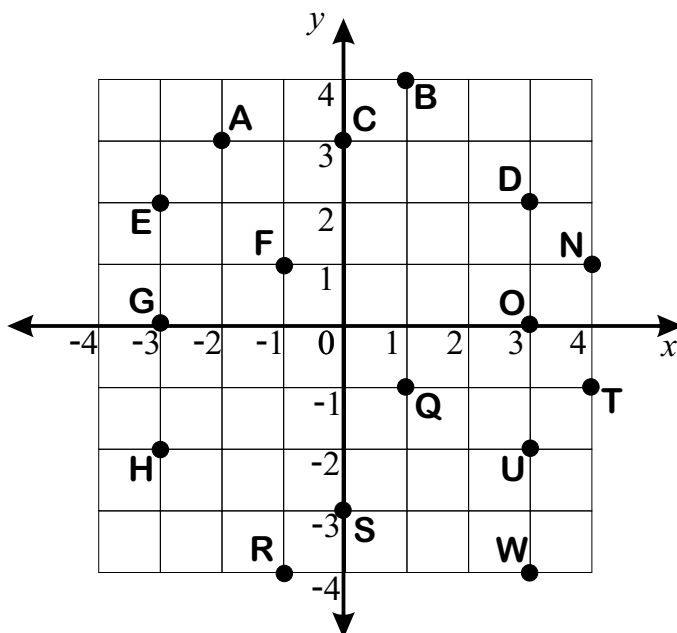
Use the points on the graph below to find the answers to the following riddles. The letters to the answers can be found by using the list of coordinates under each riddle.

Doctor, doctor, I think I'm a billiard ball!

$(-3,0)(3,0)$ $(4,-1)(3,0)$ $(4,-1)(-3,-2)(-3,2)$ $(-3,2)(4,1)(3,2)$ $(3,0)(-1,1)$
 $(4,-1)(-3,-2)(-3,2)$ $(1,-1)(3,-2)(-3,2)(3,-2)(-3,2)$

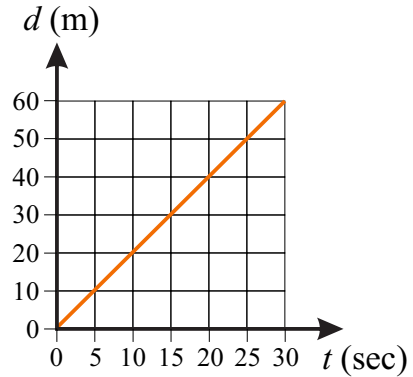
What do you call a crazy spaceman?

$(-2,3)(4,1)$ $(-2,3)(0,-3)(4,-1)(-1,-4)(3,0)(4,1)(3,-2)(4,-1)$



CHAPTER REVIEW

1. The graph here shows the distance, d , in metres, against time, t , in seconds, run by a jogger.



- (a) How far had the jogger run after:
 (i) 10 seconds? (ii) 25 seconds?
 (b) Which of the following formulae represents the relationship between distance, d , and time, t ?

A $d = 10t$ **B** $d = t$ **C** $d = \frac{t}{2}$ **D** $d = 2t$

- (c) How far would the jogger run in the following times?
 (i) 40 seconds (ii) 1 minute (iii) 1 hour

2. A fuel tank is being filled and the amount of fuel in the tank, A , measured in litres, is measured every 10 seconds. These measurements are shown in the table below.

<i>Time (sec)</i>	0	10	20	30	40	50
<i>Amount of fuel (L)</i>	0	30	60	90	120	150

- (a) Complete the following equation showing the relationship between the amount of fuel, A , and time, t .

$A = \underline{\hspace{1cm}} \times t$

- (b) Find the amount of fuel in the tank after the following times:
 (i) 5 seconds (ii) 70 seconds (iii) 2 minutes
 (c) How long would it take to fill the fuel tank if it held 1200 litres?

3. Water was flowing into a tank. The relationship between the volume of water in the tank, V , in litres, against time, t , in minutes, is shown here.

$V = 10t + 50$

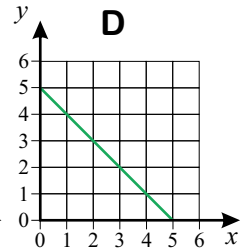
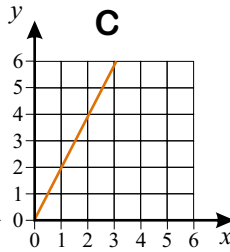
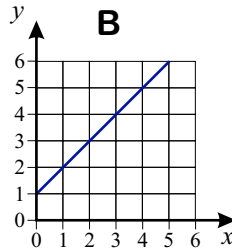
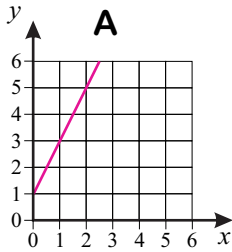
- (a) Copy and complete this table of values.

t (minutes)	0	1	2	3	4	5
V (litres)						

- (b) Draw a graph displaying the points from this table and connect them with a straight line.

4. Match the following formulae with the graphs below.

(a) $y = 2x$ (b) $y = 5 - x$ (c) $y = x + 1$ (d) $y = 2x + 1$



5. Copy and complete the table of values shown for each of the following relationships.

(a) $y = 2x$ (b) $y = x + 1$ (c) $y = 2x - 1$ (d) $y = 3x + 2$ (e) $y = 4 - x$

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
y											

6. Plot the points for each of the relationships in question 5 on a Cartesian Plane and connect them with straight lines.

Equations

Solving Equations

EXERCISE 10A

1. Find the following numbers.
 - (a) If this number was doubled the answer would be 10.
 - (b) When 3 is added to this number the answer is 7.
 - (c) If 5 is subtracted from this number the answer is 8.
 - (d) If this number is divided by 3 the answer is 6.
 - (e) When 18 is divided by this number the answer is 2.
 - (f) 6 more than this number is 15.
 - (g) 7 less than this number is 21.
 - (h) If 2 is added to this number and the result multiplied by 5, the answer is 30.
 - (i) If 4 is subtracted from this number and the result multiplied by 2, the answer is 12.
 - (j) 6 more than 4 times this number is 18.
 - (k) If 6 is added to this number and the result divided by 4, the answer is 5.
 - (l) If this number is multiplied by 3, then 5 is subtracted from the result and then this answer is divided by 2, the result is 8.
2.
 - (a) My brother is five years older than me. The sum of our ages is 35. How old am I?
 - (b) The sum of two numbers is 8 and their product is 15. Find the two numbers.
 - (c) Adam caught two fish. One was twice the weight of the other and the total weight of the two fish was 9 kg.
Find the weight of the two fish.
 - (d) Junko made six vases out of a block of clay. Each vase weighed half a kilogram and there was 2 kg of the block remaining.
What was the weight of the original block of clay?
 - (e) My cat is 5 years younger than me. I am 3 years younger than my brother who is half my father's age. My father was 21 when my brother was born. How old is my cat?

3. (i) Write the following worded problems as equations.
 (ii) Find the value of the unknown quantity.

Examples

1. When 12 is added to this number the answer is 15.

Let the unknown number = n .

As an equation: $n + 12 = 15$

Answer: $n = 3$

2. Fred found that six identical blocks and 8 kg weighed the same as a 50 kg rock. Find the weight of one of the blocks.

Let the weight of a block = b .

As an equation: $6b + 8 = 50$

Answer: $b = 7$ kg

- (a) When 8 is subtracted from this number (n) the answer is 5.
 (b) When this number (m) is divided by 3 the answer is 4.
 (c) When this number (x) is multiplied by 3 the answer is 18.
 (d) When this number (a) is multiplied by 4, then 6 is added to the result the answer is 26.
 (e) When this number (y) is multiplied by 3, then 7 subtracted from the result the answer is 17.
 (f) A bag of sand weighing 24 kg is divided into 8 equal smaller bags. What is the weight of each smaller bag?
 (g) Two identical marble tiles and a bag of cement that weighs 10 kg all weigh the same as a 40 kg rock. Find the weight of each marble tile.
 (h) To find the weight of my cat I stood on scales with my cat and our total weight was 58 kg. I weigh 49 kg. What is the weight of my cat (c)?



There are three methods that can be used to solve equations:

Method 1 - Backtracking

Method 2 - Balance Model - Doing the Same to Both Sides

Method 3 - Trial and Error

Backtracking

In **backtracking** the equation is firstly written as a **flowchart**. Then **backtracking** starts at the 'answer' and works back to the unknown quantity using **opposite operations** to those used in the **flowchart**.

<i>Operation</i>	<i>Opposite</i>
Addition (+)	Subtraction (-)
Subtraction (-)	Addition (+)
Multiplication ($\times$)	Division ($\div$)
Division ($\div$)	Multiplication ($\times$)

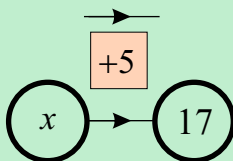
Example 1

Find the value of x in the following equation.

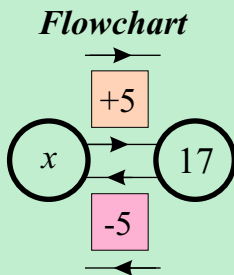
$$x + 5 = 17$$

Step 1 Write the equation as a flowchart.

Flowchart

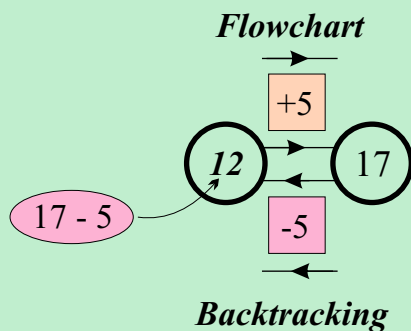


Step 2 Show the backtracking operations that are opposite to the operations in the flowchart.



Backtracking
(-5 is the opposite to +5)

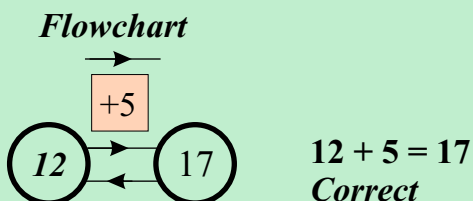
Step 3 Start at the answer and complete the backtracking operations.



Step 4 Write the answer.

$$x = 12$$

Step 5 Check the answer by substituting it into the flowchart.

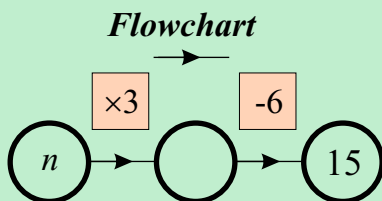


Example 2

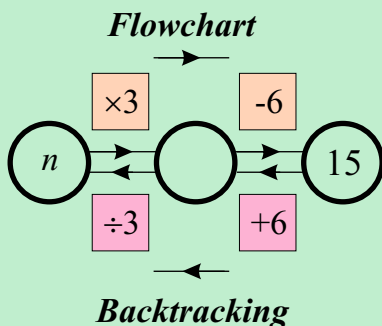
Find the value of n in the following equation.

$$3n - 6 = 15$$

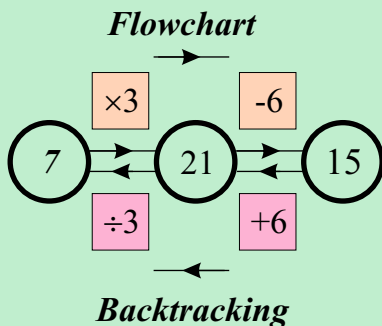
Step 1 Write the equation as a flowchart.



Step 2 Show the backtracking operations.



Step 3 Start at the answer and complete the backtracking operations.



Step 4 Write the answer.

$$n = 7$$

Step 5 Check the answer by substituting into the flowchart.

Important note

When there is more than one operation, the order of the flowchart must be the same as the order that the operations are being performed.

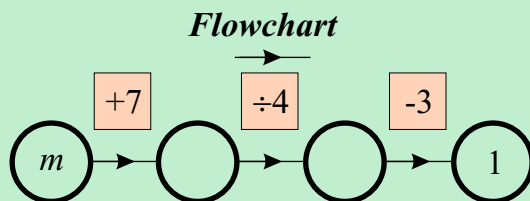
In this example n is firstly multiplied by 3 then 6 is subtracted.

Example 3

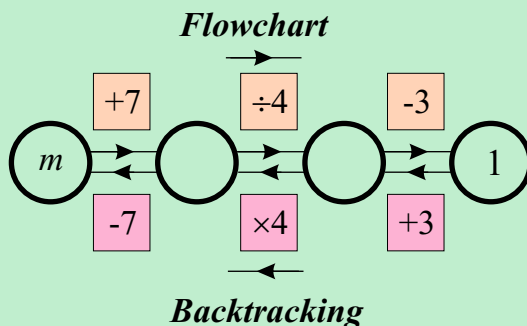
Find the value of m in the following equation.

$$\frac{m+7}{4} - 3 = 1$$

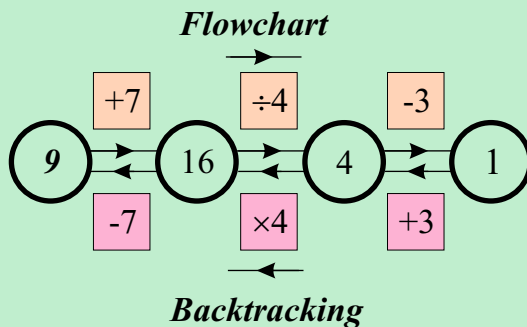
Step 1 Write the equation as a flowchart.



Step 2 Show the backtracking operations.



Step 3 Start at the answer and complete the backtracking operations.



Step 4 Write the answer.

$$m = 9$$

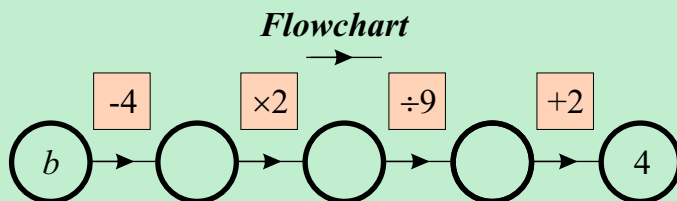
Step 5 Check the answer by substituting into the flowchart.

Example 4

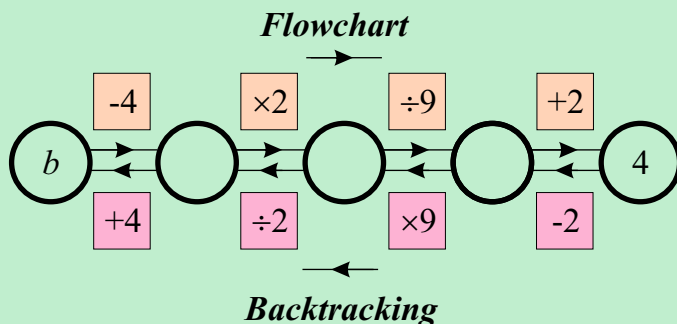
Find the value of b in the following equation.

$$\frac{2(b - 4)}{9} + 2 = 4$$

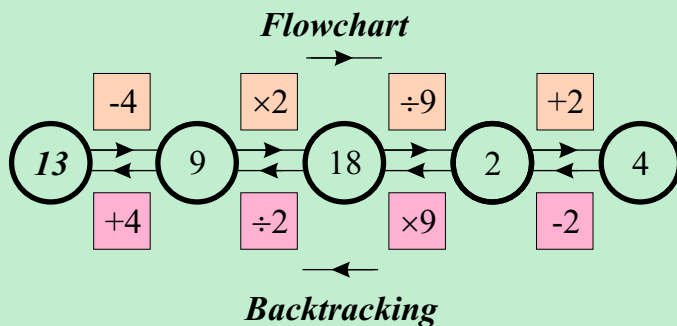
Step 1 Write the equation as a flowchart.



Step 2 Show the backtracking operations.



Step 3 Start at the answer and complete the backtracking operations.



Step 4 Write the answer.

$$b = 13$$

Step 5 Check the answer by substituting into the flowchart.

EXERCISE 10B

Use the *backtracking method* to solve for the unknown quantity in the following equations.

1. (a) $5a = 20$

(b) $3b = 18$

(c) $7c = 35$

(d) $d + 8 = 20$

(e) $e + 5 = 14$

(f) $9 + f = 25$

(g) $g - 7 = 11$

(h) $h - 9 = 13$

(i) $i - 4 = 18$

(j) $\frac{j}{6} = 3$

(k) $\frac{k}{4} = 7$

(l) $\frac{l}{3} = 9$

2. (a) $2a + 7 = 13$

(b) $4b - 6 = 14$

(c) $3c + 5 = 26$

(d) $5(x + 4) = 25$

(e) $3(y - 7) = 12$

(f) $6m - 24 = 0$

(g) $\frac{n}{3} + 4 = 6$

(h) $\frac{k}{2} - 8 = 5$

(i) $\frac{e + 2}{5} = 4$

(j) $\frac{a - 6}{4} = 3$

(k) $\frac{c + 7}{5} = 8$

(l) $\frac{2d}{3} = 6$

3. (a) $\frac{n + 4}{2} + 3 = 9$

(b) $\frac{x - 6}{5} + 1 = 2$

(c) $\frac{m - 2}{3} - 4 = 0$

(d) $\frac{5n}{4} + 1 = 11$

(e) $\frac{3(a - 6)}{5} = 6$

(f) $\frac{2(u + 4)}{3} = 8$

(g) $\frac{3(m - 2)}{4} + 1 = 7$

(h) $\frac{4n - 3}{5} + 5 = 6$

(i) $\frac{4(d + 6)}{7} - 3 = 1$

(j) $\frac{2n - 5}{3} + 7 = 12$

(k) $\frac{5l + 12}{6} + 8 = 15$

(l) $\frac{8(e + 7)}{3} - 7 = 41$

Balance Model
Doing the Same to Both Sides

Another way to solve equations is by using a method called the ***Balance Model*** or ***Doing the Same to Both Sides***.

In this method it is important to remember that whatever happens to one side of the equals sign (=) of the equation must also happen to the other side for the two sides to remain equal.

It is also important to remember the ***opposite operations***.

<i>Operation</i>	<i>Opposite</i>
Addition (+)	Subtraction (-)
Subtraction (-)	Addition (+)
Multiplication (×)	Division (÷)
Division (÷)	Multiplication (×)

This method of solving equations involves eliminating everything from the left side of the equation except the unknown quantity being solved for by 'undoing' the operations. This is done by performing the opposite operations.

Example 1

Find the value of x in the following equation.

$$x - 5 = 7$$

Step 1 To eliminate -5 from the left side of the equation the opposite operation $+5$ is used.

If $+5$ is used on the left side of the equation it must also be used on the right side for the two sides to remain equal.

Then simplify.

$$x - 5 + 5 = 7 + 5$$

$$x = 12$$

Answer: $x = 12$

Step 2 Substitute the answer into the original equation to check that it is correct.

Left side of the equation = $12 - 5$

= 7

= right side of the equation

Example 2

Find the value of x in the following equation.

$$2x + 3 = 11$$

Step 1 When there is more than one operation, note the order of operations on x .

$$x \times 2 + 3$$

Step 2 Eliminate these numbers (undo these operations) by working in the **opposite order** and using the **opposite operations**.

$+3$ first by doing -3 to both sides of the equation.

$\times 2$ next by doing $\div 2$ to both sides of the equation.

Step 3 Perform these eliminations.

(a) Subtract 3 from both sides of the equation.

$$2x + 3 - 3 = 11 - 3$$

$$2x = 8$$

(b) Divide both sides of this equation by 2.

$$\frac{2x}{2} = \frac{8}{2}$$

$$x = 4$$

Answer: $x = 4$

Step 4 Always check that this answer is correct by substituting it into the left side of the original equation.

$$2x + 3 = 11$$

$$\text{Left side} = 2x + 3$$

$$\text{Substitute } x = 4$$

$$\text{Left side} = 2 \times 4 + 3$$

$$= 8 + 3$$

$$= 11$$

$$= \text{right side of the equation}$$

So the answer is correct.

Example 3

Find the value of m in the following equation.

$$\frac{3(m+2)}{4} - 7 = 2$$

Step 1 Note the order of the operations.

$$m + 2 \times 3 \div 4 - 7$$

Step 2 Undo these operations in the opposite order and doing the same to both sides.

$$\frac{3(m+2)}{4} - 7 + 7 = 2 + 7$$

$$\frac{3(m+2)}{4} = 9$$

$$\frac{3(m+2)}{4} \times 4 = 9 \times 4$$

$$\frac{3(m+2)}{\cancel{4}} \times \cancel{4} = 9 \times 4$$

$$3(m+2) = 36$$

$$\frac{3(m+2)}{3} = \frac{36}{3}$$

$$\frac{\cancel{3}(m+2)}{\cancel{3}} = \frac{36}{3}$$

$$m + 2 = 12$$

$$m + 2 - 2 = 12 - 2$$

$$m = 10$$

Answer: $m = 10$

Example 3 continued**Step 3** Check the answer.

$$\begin{aligned}
 & \frac{3(m+2)}{4} - 7 = 2 \\
 \text{Left side} &= \frac{3(m+2)}{4} - 7 \\
 &= \frac{3(10+2)}{4} - 7 \\
 &= \frac{3 \times 12}{4} - 7 \\
 &= \frac{36}{4} - 7 \\
 &= 9 - 7 \\
 &= 2 \\
 &= \text{right side of the equation} \\
 &\text{So the answer is correct.}
 \end{aligned}$$

EXERCISE 10C

Use the **balance method** to solve for the unknown quantity in the following equations.

1. (a) $3x = 15$ (b) $n + 9 = 14$ (c) $m - 5 = 8$
 (d) $\frac{k}{3} = 6$ (e) $2d + 7 = 15$ (f) $3r - 4 = 17$
 (g) $2p + 8 = 20$ (h) $\frac{c}{4} + 1 = 9$ (i) $4(y + 5) = 32$

2. (a) $\frac{x+3}{5} + 1 = 4$ (b) $\frac{c-2}{7} + 3 = 9$ (c) $2(m - 8) - 4 = 2$
 (d) $\frac{3(m-5)}{2} + 3 = 9$ (e) $\frac{3n-4}{5} + 5 = 9$ (f) $\frac{2(d+7)}{5} - 1 = 3$

Trial and Error

The third method to solve equations is by **Trial and Error**.

Guess an answer for the unknown quantity and if it is not correct try again. Keep trying until the answer is found.

Examples

The left side of the equals sign(=) must be equal to the right side.

1. $x + 6 = 10$

Guess for x	Left side $x + 6$	Right side 10
5	$5 + 6 = 11$	10
3	$3 + 6 = 9$	10
4	$4 + 6 = 10$	10

Answer $x = 4$

2. $2x + 7 = 19$

Guess for x	Left side $2x + 7$	Right side 19
3	$2 \times 3 + 7 = 13$	19
4	$2 \times 4 + 7 = 15$	19
5	$2 \times 5 + 7 = 17$	19
6	$2 \times 6 + 7 = 19$	19

Answer $x = 6$

EXERCISE 10D

Solve the following equations using the **Trial and Error** method.

1. (a) $x + 7 = 9$ (b) $x + 9 = 23$ (c) $x - 5 = 2$
 (d) $x - 8 = 15$ (e) $3x = 12$ (f) $5x = 35$
 (g) $\frac{x}{2} = 8$ (h) $\frac{x}{7} = 9$ (i) $3x + 1 = 7$
 (j) $2x + 5 = 17$ (k) $5x - 3 = 7$ (l) $4x - 1 = 23$
 (m) $\frac{x}{4} + 1 = 5$ (n) $\frac{x}{3} - 5 = 0$ (o) $2(x + 1) = 12$
 (p) $3(x + 2) = 36$ (q) $5(x - 1) = 30$ (r) $3(2x + 3) = 27$

2. (a) $\frac{3(x + 4)}{2} - 6 = 15$

(b) $\frac{2(x - 5)}{3} + 7 = 11$

Example

Find the value of n in the following equation using Trial and Error.

$$3n + 7 = 5n - 5$$

Guess for n	Left side $3n + 7$	Right side $5n - 5$
3	$3 \times 3 + 7 = 16$	$5 \times 3 - 5 = 10$
4	$3 \times 4 + 7 = 19$	$5 \times 4 - 5 = 15$
5	$3 \times 5 + 7 = 22$	$5 \times 5 - 5 = 20$
6	$3 \times 6 + 7 = \mathbf{25}$	$5 \times 6 - 5 = \mathbf{25}$

Answer: $n = 6$

EXERCISE 10E

1. Find the value of n in the following equations using Trial and Error.

(a) $3n - 4 = 2n - 1$

(b) $5n + 8 = 7n - 2$

(c) $4n + 3 = 5n - 4$

(d) $6n + 5 = 9n - 13$

(e) $\frac{3n}{2} + 4 = 5n - 10$

(f) $4(n + 3) = \frac{2n}{3} + 32$

2. Find the value of x in the following equations using Trial and Error.

(a) $4x - 1 = 3x + 5$

(b) $5x + 4 = 4x + 7$

(c) $7x - 3 = 4x + 9$

(d) $6x - 10 = 4x - 2$

(e) $5x - 9 = 4x$

(f) $6x - 8 = 4x$

(g) $4x - 6 = 2x + 2$

(h) $7x - 2 = 3x + 6$

(i) $5x - 3 = x + 5$

(j) $4x - 6 = 3x + 1$

(k) $3(x - 3) = 2x$

(l) $5(x - 3) = 2x$

(m) $2(x - 5) = x + 3$

(n) $5(x + 3) = 2x + 21$

(o) $4(2x - 3) = 2(x + 6)$

(p) $3(3x + 4) = 4(2x + 3)$

3. (a) If b represents the weight of a box of oranges, write an expression for the weight of 8 boxes of oranges.
(b) In terms of b , write an expression for the weight of 5 boxes of oranges plus 30 kg.
A fruiterer found that 8 boxes of oranges weighed the same as 5 boxes of oranges plus 30 kg.
(c) Write an equation representing this information.
(d) Solve this equation to find the weight of a box of oranges, b .
4. Ryan and Bennie each had the same amount of money to spend at a theme park. Ryan went on 8 rides and had \$18 left. Bennie went on 5 rides and had \$30 left. Let c represent the cost of each ride.
(a) In terms of c , write an expression for the amount of money that Ryan had when he went into the park.
(b) In terms of c , write an expression for the amount of money that Bennie had when he went into the park.
(c) Write an equation representing this information.
(d) Solve this equation to find the cost of each ride at the park.
(e) How much money did they each have when they went to the park?



EXERCISE 10F

1. Find the value of x in the following equations using whichever method is most convenient.

(a) $x + 5 = 8$

(b) $x - 7 = 9$

(c) $3x = 21$

(d) $\frac{x}{4} = 5$

(e) $2x + 3 = 9$

(f) $3x - 4 = 2$

(g) $4x + 2 = 22$

(h) $5x - 6 = 9$

(i) $2x + 5 = 19$

(j) $\frac{x}{2} + 3 = 7$

(k) $\frac{x}{5} - 4 = 1$

(l) $\frac{x}{3} + 7 = 11$

(m) $\frac{x+4}{2} = 5$

(n) $\frac{x-3}{4} = 2$

(o) $\frac{x+5}{3} = 8$

(p) $\frac{3x}{4} = 6$

(q) $\frac{2x}{5} = 4$

(r) $\frac{3x+2}{4} = 5$

(s) $\frac{4x-1}{3} = 5$

(t) $\frac{4x}{3} + 1 = 9$

(u) $\frac{5x}{2} - 3 = 7$

2. Solve the following equations.

(a) $\frac{2x}{3} + 4 = 10$

(b) $\frac{3a}{4} - 5 = 1$

(c) $\frac{2m}{11} - 2 = 0$

(d) $\frac{3n}{5} + 3 = 9$

(e) $\frac{2e}{7} - 1 = 1$

(f) $\frac{3b}{8} + 5 = 8$

(g) $\frac{3e+2}{7} = 2$

(h) $\frac{4x-3}{3} = 7$

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

(j) $\frac{2n+6}{8} = 2$

(k) $\frac{7e-1}{8} = 6$

(l) $\frac{10w+4}{6} = 4$

(m) $2(x+3) = 14$

(n) $3(h-5) = 12$

(o) $6(x+1) = 60$

(p) $4(2g+3) = 20$

(q) $5(3u+4) = 50$

(r) $3(2p-5) = 57$

3. Solve the following equations. The answers may be negative numbers.

(a) $x + 7 = 4$

(b) $a + 6 = 1$

(c) $b - 3 = -8$

(d) $d + 2 = -5$

(e) $3f + 1 = -5$

(f) $2g + 7 = 5$

(g) $5h - 6 = -1$

(h) $3y - 2 = -17$

(i) $2p + 3 = -5$

(j) $2(d+1) = 0$

(k) $5(k-2) = -15$

(l) $4(m+7) = -12$

(m) $\frac{x}{3} + 4 = 2$

(n) $\frac{a}{4} - 6 = -8$

(o) $\frac{c}{4} - 7 = -5$

(p) $\frac{e+3}{2} = -1$

(q) $\frac{x+5}{4} = 1$

(r) $\frac{m-6}{3} = -3$

4. Solve the following equations. You may need a calculator as the answers are decimals.

(a) $4x = 1$	(b) $5m = 2$	(c) $3k = 4.5$
(d) $10k = 3$	(e) $6g = 32.4$	(f) $8u = 52$
(g) $3y + 1 = 17.8$	(h) $5j + 2 = 33$	(i) $4d - 5 = 16$
(j) $2t - 3 = 22$	(k) $4m - 2 = 100$	(l) $6z + 3 = 120$
(m) $\frac{3x}{4} = 8.4$	(n) $\frac{2u}{5} = 3.44$	(o) $\frac{3m}{8} = 2.175$

5. Write the following statements as equations then solve them.

- If 8 is added to x the answer is 17.
- If 5 is subtracted from p the result is 13.
- If b is multiplied by 2 and then 3 added to the result, the answer is 11.
- If m is multiplied by 3 and then 5 is subtracted from the result, the answer is 13.
- If d is divided by 5 and then 1 is added to the result, the answer is 4.
- If y is divided by 4 and then 6 is subtracted from the result, the answer is 0.
- If 5 is added to n and the result is divided by 6, the answer is 3.

6. Josephine knitted a scarf that was y metres long. Joseph knitted a scarf that was 2 metres longer than Josephine's. The two scarves were a total of 10 metres long.

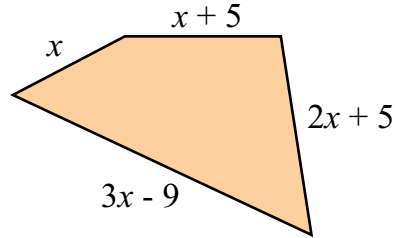
- Write an expression for the length of Joseph's scarf.
- Write an equation for the sum of the two scarves.
- Solve this equation to find the length of the scarves.

7. Four friends painted their faces to raise money for cancer research. Dylan raised x dollars. Jackson raised \$5 more than Dylan. Cecilia raised twice as much as Dylan. Georgia raised \$5 more than Cecilia. Together they raised \$130.

- In terms of x , write an expression for the amount of money raised by: (i) Jackson (ii) Cecilia (iii) Georgia.
- Write an expression, in its simplest form, for the total amount raised by the four friends.
- Write an equation showing the total amount raised by the friends.
- Solve this equation and state the amount raised by:
 - Dylan
 - Jackson
 - Cecilia
 - Georgia.

8. The perimeter of this shape is 57 metres.

- Write an equation for the perimeter of this shape.
- Solve this equation to find x .



9. Naomi bought 4 shirts and received \$2 change from \$50.
- Write this problem as an equation using p as the price of each shirt.
 - Solve the equation to find the price of each shirt.
10. Andrea had a piece of ribbon that was 20 metres long. She cut 8 equal lengths, each x metres long, from the ribbon and there was 4 metres of ribbon left.
- Write this problem as an equation.
 - Solve the equation to find the length of each of the small lengths.
11. Frederico grew a huge pumpkin. He cut it into 3 equal parts.
- If the pumpkin weighed x kg, write an expression for the weight of each of the three parts.
 - One of the smaller parts has 2 kg cut off it. Write an expression for the weight of the piece of pumpkin after the 2 kg is cut off.
 - This piece weighed 10 kg. Write an equation that could be used to find x .
 - Solve this equation to find the weight of the pumpkin.
12. Vanessa bought a bag of beads to make necklaces. She used 20 beads on the first necklace.
- If there were x beads in the bag when she bought it, write an expression for the number of beads left after she made the first necklace.
 - She divided the remaining beads into 4 equal piles. Write an expression using x for the number of beads in each pile.
 - If each pile contained 30 beads, write an equation using this information.
 - Solve this equation to find the number of beads in the bag that Vanessa bought.

Transposing Equations

EXERCISE 10G

1. Transpose the following equations to make the term in the brackets the subject. Use the same steps that are used in the Balance Method.

Examples

1. $y = x + 3$ (x)

$$\boxed{-3} \quad \boxed{-3}$$

$$y - 3 = x$$

$$x = y - 3$$

2. $m = 2np - 5q$ (n)

$$\boxed{+5q} \quad \boxed{+5q}$$

$$m + 5q = 2np$$

$$\boxed{\div 2p} \quad \boxed{\div 2p}$$

$$\frac{m + 5q}{2p} = n$$

$$n = \frac{m + 5q}{2p}$$

(a) $a = b - 6$

(b)

(b) $m = \frac{k}{8}$ (k)

(c) $G = H + 7$

(H)

(d) $p = 3q$ (q)

(e) $y = x + z$

(x)

(f) $m = np$ (p)

(g) $h = k - j$

(k)

(h) $w = \frac{v}{y}$ (v)

(i) $y = 2x + 5$

(x)

(j) $M = 3N - 4$ (N)

(k) $a = 4b + c$

(b)

(l) $w = 3v + 5z$ (v)

(m) $y = 2xz$

(x)

(n) $m = 5np - q$ (n)

(o) $m = \frac{n}{3} + p$

(n)

(p) $a = 2bc + 3d$ (d)

(q) $y = x^2$

(x)

(r) $A = \sqrt{B}$ (B)

(s) $k = \frac{m + 4}{3}$

(m)

(t) $y = \frac{2x + z}{3}$ (x)

2. Gravitational force (F) on a mass (m)

can be found using the formula:

$$F = 10m$$

- (a) Transpose this equation to make m the subject.

- (b) Find the mass (m) if the force is 200.

3. Electric power (P) can be found by dividing the work (W) by time (t).

- (a) Write an equation with P , W and t .

- (b) Find the power if the work is 400 and time is 10.

- (c) Transpose the equation to make work (W) the subject.

- (d) Find the work (W) if power is 50 and time is 6.

Substitution

EXERCISE 10H

1. If $y = 3x + 1$, find the value of y for the following values of x .

Example $x = 4$ $y = 3x + 1$
 $= 3 \times 4 + 1$
 $= 12 + 1$
 $y = 13$

(a) $x = 1$ (b) $x = 5$ (c) $x = 10$ (d) $x = 12$ (e) $x = 100$

2. If $b = 5a - 4$, find the value of b for the following values of a .

(a) $a = 2$ (b) $a = 6$ (c) $a = 11$ (d) $a = 20$ (e) $a = 100$

3. Find the value of y in the following equations if $x = 5$.

(a) $y = 2x$ (b) $y = 4x + 5$ (c) $y = x^2$ (d) $y = \frac{x+3}{2}$
 (e) $y = 3(x+2)$ (f) $y = \sqrt{x+4}$ (g) $y = x^2 + 3x$ (h) $y = \sqrt{2x^2 - \frac{x}{5}}$

4. Solve the following equations for the values given.

Example $m = 3n^2 - \frac{Q}{3}$ ($n = 4, Q = 9$)
 $= 3 \times 4^2 - \frac{9}{3}$
 $= 3 \times 16 - 3$
 $= 48 - 3$
 $= 45$

(a) $y = 5x + 6z$ ($x = 4, z = 2$)
 (b) $a = b^2 + c^2$ ($b = 5, c = 7$)
 (c) $m = 3n - np$ ($n = 6, p = 2$)
 (d) $F = mg - 5m$ ($m = 10, g = 12$)
 (e) $v = ut + 2ut^2$ ($u = 2, t = 3$)
 (f) $k = 2n^2m - 3mn$ ($m = 4, n = 2$)
 (g) $V = \frac{3qk}{5h} + \frac{q^2h}{k}$ ($q = 10, k = 8, h = 4$)

5. Solve the following equations for the values given.

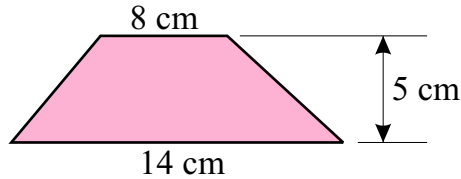
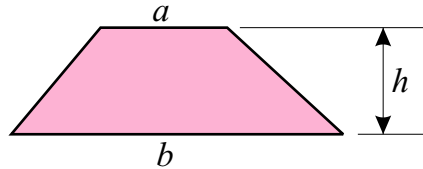
You may need a calculator.

- (a) $y = 3x + 8z$ ($x = 4.8, z = 3.7$)
 (b) $a = 3b - 2c$ ($b = -5.2, c = 7.6$)
 (c) $m = 3n - np$ ($n = -6.5, p = 2.4$)
 (d) $F = mg - 5m$ ($m = \frac{2}{5}, g = \frac{3}{8}$)
 (e) $v = ut + 2ut^2$ ($u = 27.8, t = 3.5$)
 (f) $k = 2n^2m - 3mn$ ($m = 0.5, n = 0.35$)

(g) $V = \frac{2k^2h + 3h^2k}{3q^2}$ ($q = 10, k = 8.2, h = 4.5$)

6. The area (A) of a trapezium can be calculated using this formula.

$$A = \frac{1}{2}(a + b)h$$



Find the area of this trapezium.

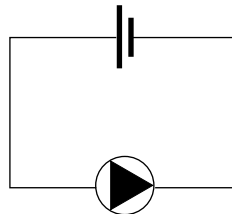
7. The volume (V) of a sphere with radius r , can be calculated using this formula.

$$V = \frac{4}{3} \pi r^3$$

Calculate the volume of a sphere with a radius of 4.1 cm.

8. The voltage (V) in an electric circuit can be found by multiplying the current (I) and the resistance (R).

- (a) Write an equation with V , I and R .
 (b) Find the voltage in a circuit that has a current of 8 and a resistance of 10.5.



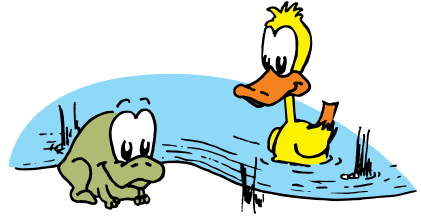
9. The velocity (v) of a ball dropped from a height h , can be found using this formula.

$$v = \sqrt{2gh} \quad \text{where } g = 10$$

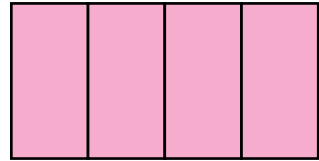
Find the velocity of a ball that is dropped from a height of 11.25 metres.

PROBLEM SOLVING

1. Lavinia has pet frogs and ducks.
 She has three more ducks than frogs.
 She worked out that between them
 her pets have 60 legs.
 How many of each pet does she have?



2. A large block of land is twice as long
 as it is wide. The block is to be divided
 into four equal smaller blocks as shown.
 The perimeter of each of the smaller
 blocks is 180 metres.
 What are the dimensions of the large block?



PUZZLE

Copy and complete the diagram below by finding the word on each line.
 One letter has been added or subtracted from each word and the
 letters rearranged to form the next word.
 A clue for each word is given.

E	Q	U	A	T	I	O	N	
								Very old object (particularly furniture)
								Your mother's sister
								Join together
								One
								A silvery, white metal
								Information Technology (abbreviation)
								How a person would refer to themselves
								Roman 51
								Liquid from which petrol is made
								Substance in which plants grow
								Large felines
								One of the two small organs in the throat
								Creams applied to the skin
S	O	L	U	T	I	O	N	

CHAPTER REVIEW

1. Write the following statements as equations and solve them.
 - (a) If 6 is added to m the answer is 9.
 - (b) If n is multiplied by 2 and 5 subtracted from the result, the answer is 7.
2. Solve the following equations.
 - (a) $x - 3 = 6$
 - (b) $2x + 5 = 13$
 - (c) $3m - 2 = -5$
 - (d) $2(x + 4) = 14$
 - (e) $\frac{a}{4} + 3 = 5$
 - (f) $\frac{c + 4}{2} = 1$
3. Katrina is x years old. Her brother is 5 years older than Katrina. Her sister is 2 years younger than Katrina. Her mother is three times Katrina's age. The sum of their ages is 105. How old is Katrina?
4. Solve for x .
 - (a) $3x + 1 = 2x + 7$
 - (b) $5x - 2 = 2x + 10$
5. Transpose the following equations to make the term in the brackets the subject.
 - (a) $m = 3n + 1$ (n)
 - (b) $p = \frac{q}{4} - 4r$ (q)
6. Solve the following equations for the values given.
 - (a) $y = 2x + 3z$ ($x = 3, z = 5$)
 - (b) $m = 3n^2 - p$ ($n = 3, p = 5$)
7. Velocity (v) is equal to the product of acceleration (a) and time (t).
 - (a) Write this statement as an equation.
 - (b) Find the velocity when the acceleration is 5 and the time is 8.

Length and Perimeter

Length and Units

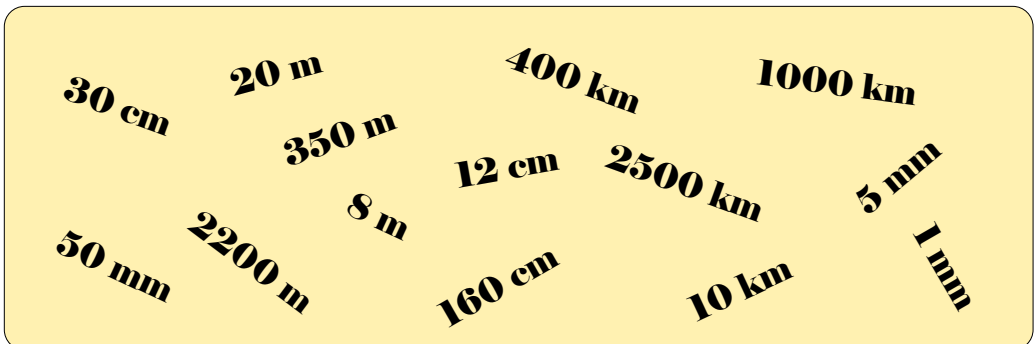
EXERCISE 11A

1. Which of the following units would be best to use when making the measurements below.

A millimetres **B** centimetres **C** metres **D** kilometres

- (a) The width of a computer screen.
- (b) The length of a netball court.
- (c) The distance from London to Paris.
- (d) The distance from Dubbo to Darwin.
- (e) The height of Uluru above the surrounding land.
- (f) The length of your eye lash.
- (g) The length of your thumb.
- (h) The length of a human intestine.
- (i) The thickness of a CD.
- (j) The diameter of a CD.
- (k) The deepest part of the Pacific Ocean.
- (l) The height of Mt. Kosciusko above sea level.
- (m) The height of your mathematics teacher.
- (n) The distance from Adelaide to Sydney.

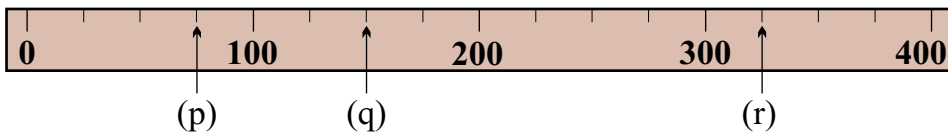
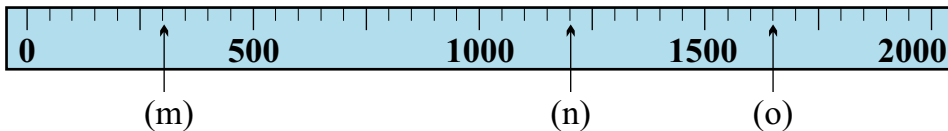
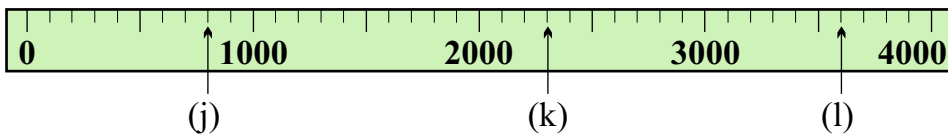
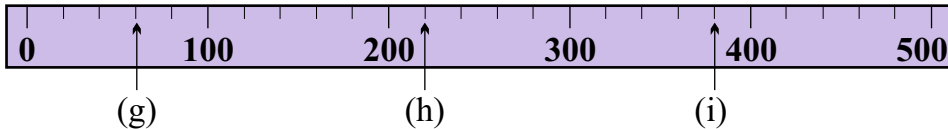
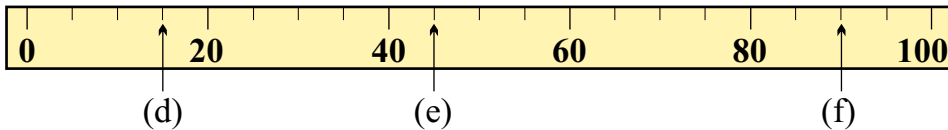
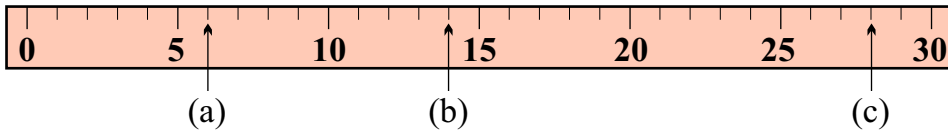
2. Choose which length below **best** indicates each of the measurements in question 1.



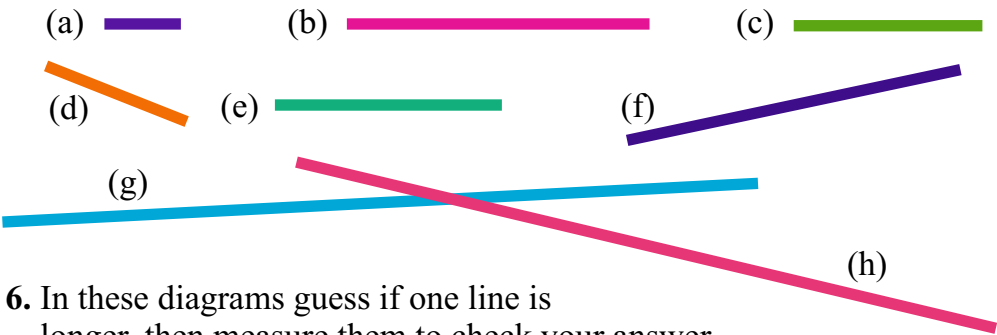
3. Estimate the following measurements.

- (a) The diameter of a \$2 coin.
- (b) The length of a \$10 note.
- (c) The distance from Melbourne to Brisbane.
- (d) The distance from Brisbane to Cairns.
- (e) The world record throw of a discus.
- (f) The world record for the longest human hair.
- (g) The height of the Sydney Tower.
- (h) The length of a cricket pitch.

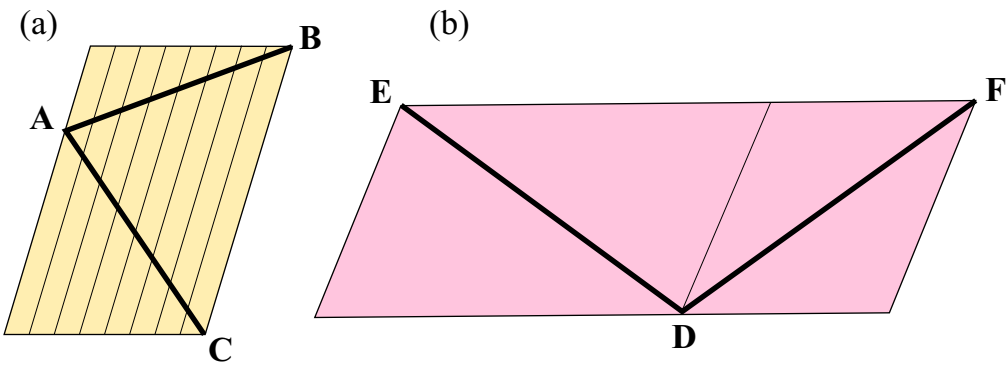
4. Read the measurements shown on the scales below.



5. Use a ruler to measure the length of the following lines.
Give lengths in centimetres.

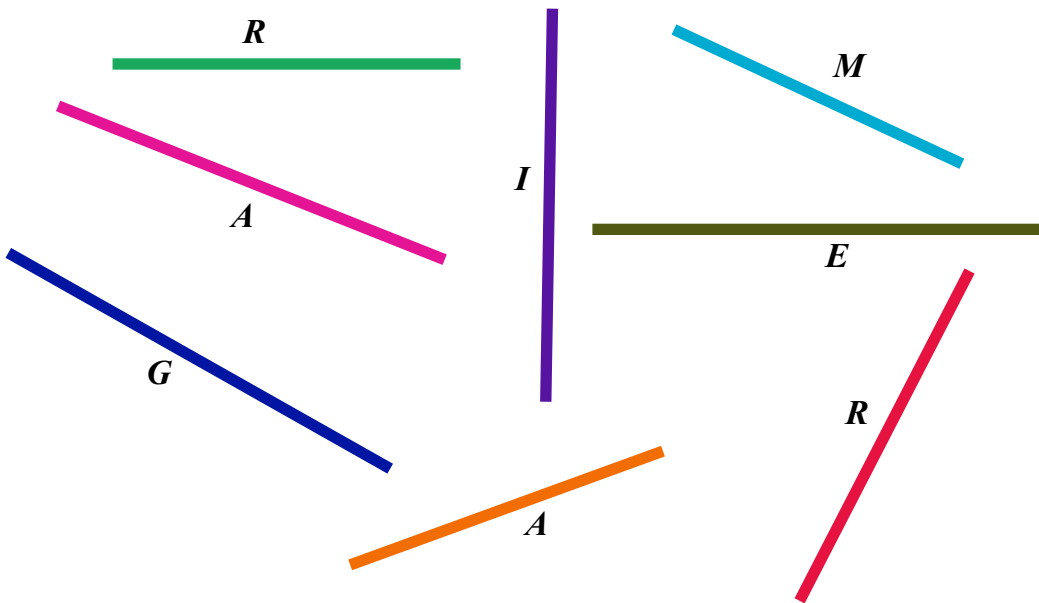


6. In these diagrams guess if one line is longer, then measure them to check your answer.



7. Use a ruler to measure the length of the following lines in millimetres.
Arrange the lengths and accompanying letters in order from the smallest to the largest to find the answer to this question.

Gamophobia is the fear of what?



Conversions

The standard unit of length is the *metre*.

The abbreviation for metre is *m*.

Other common units used are either multiples or fractions of a metre.

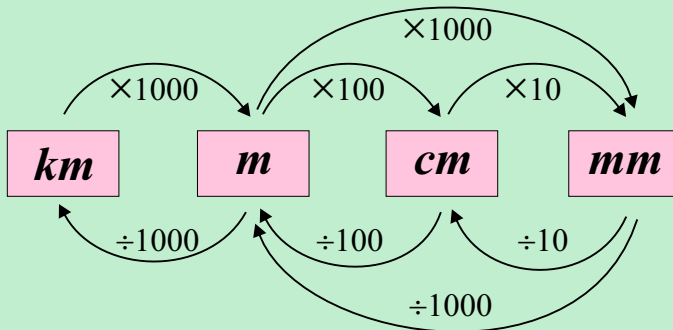
The most common are *kilometres*, *centimetres* and *millimetres*.

1 kilometre (km) = 1000 metres

1 metre = 100 centimetres (cm)

1 metre = 1000 millimetres (mm)

This diagram can be used to find the conversion factor when changing from one unit to another.



Examples

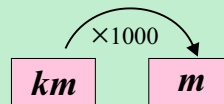
Change the following lengths to the units shown in the brackets.
Use the diagram above to find the conversion factors.

1. 3 km (m)

To change from km to m: $\times 1000$

$$= 3 \times 1000$$

$$= \mathbf{3000\ m}$$



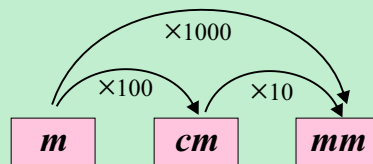
Examples continued

2. 26 m (mm)

To change from m to mm: $\times 1000$

$$= 26 \times 1000$$

$$= \mathbf{26\ 000\ mm}$$

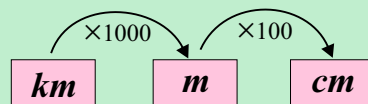


3. 4 km (cm)

To change from km to cm: $\times 1000$ then $\times 100 = \times 100\ 000$

$$= 4 \times 100\ 000$$

$$= \mathbf{400\ 000\ cm}$$



Remember - When *multiplying* by a power of 10 move the decimal point to the *right* the same number of decimal places as the number of zeros.

4. 9.705 m (cm)

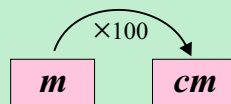
To change from m to cm: $\times 100$

$$= 9.705 \times 100$$

Move the decimal point two places to the right (100 has two zeros)

$$= 9.705$$

$$= \mathbf{970.5\ cm}$$



5. 37.8 km (m)

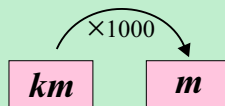
To change from km to m: $\times 1000$

$$= 37.8 \times 1000$$

Move the decimal point three places to the right (1000 has three zeros)
Add zeros where necessary.

$$= 37.8$$

$$= \mathbf{37\ 800\ m}$$



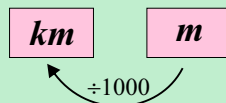
Examples continued

6. 9000 m (km)

To change from m to km: $\div 1000$

$$= 9000 \div 1000$$

$$= \mathbf{9 \text{ km}}$$



Remember - When *dividing* by a power of 10 move the decimal point to the **left** the same number of decimal places as the number of zeros.

7. 138.5 cm (m)

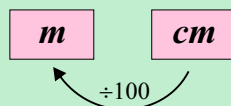
To change from cm to m: $\div 100$

$$= 138.5 \div 100$$

Move the decimal point two places to the left (100 has two zeros)

$$= \overset{\curvearrowleft}{\overset{\curvearrowleft}{138.5}}$$

$$= \mathbf{1.385 \text{ m}}$$



8. 37.8 mm (m)

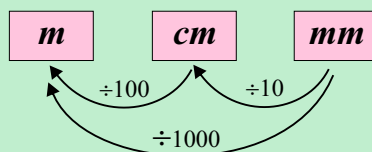
To change from mm to m: $\div 1000$

$$= 37.8 \div 1000$$

Move the decimal point three places to the left (1000 has three zeros)
Add zeros where necessary.

$$= \overset{\curvearrowleft}{\overset{\curvearrowleft}{\overset{\curvearrowleft}{37.8}}} \div 1000$$

$$= \mathbf{0.0378 \text{ m}}$$



EXERCISE 11B

1. Change the following lengths to the units shown in the brackets.

- | | | |
|------------------|-------------------|-------------------|
| (a) 6 cm (mm) | (b) 8 m (cm) | (c) 20 km (m) |
| (d) 23 m (mm) | (e) 40 cm (mm) | (f) 59 km (m) |
| (g) 8.9 cm (mm) | (h) 3.75 m (cm) | (i) 2.3 km (m) |
| (j) 0.1 m (mm) | (k) 0.07 km (m) | (l) 27.6 cm (mm) |
| (m) 0.003 m (cm) | (n) 2.357 cm (mm) | (o) 0.578 km (m) |
| (p) 0.3 km (cm) | (q) 0.43 km (mm) | (r) 0.0017 km (m) |

2. Change the following lengths to the units shown in the brackets.

- | | | |
|------------------|--------------------|--------------------|
| (a) 50 mm (cm) | (b) 200 cm (m) | (c) 7000 m (km) |
| (d) 9000 mm (m) | (e) 800 mm (cm) | (f) 930 000 m (km) |
| (g) 6 mm (cm) | (h) 33 cm (m) | (i) 58 m (km) |
| (j) 0.3 cm (m) | (k) 58 mm (cm) | (l) 380 cm (m) |
| (m) 350.2 mm (m) | (n) 785.1 cm (m) | (o) 3.7 mm (m) |
| (p) 500 cm (km) | (q) 30 000 mm (km) | (r) 872 100 mm (m) |

3. Change the following lengths to the units shown in the brackets.

- | | | |
|-----------------|------------------|--------------------|
| (a) 10 mm (cm) | (b) 3.2 m (cm) | (c) 82 cm (mm) |
| (d) 35 cm (m) | (e) 0.09 m (mm) | (f) 0.0475 km (m) |
| (g) 0.4 mm (cm) | (h) 2.35 cm (m) | (i) 123.456 m (km) |
| (j) 2.2 cm (mm) | (k) 12.5 mm (cm) | (l) 0.008 m (cm) |
| (m) 0.03 mm (m) | (n) 0.5 m (km) | (o) 2.35 mm (m) |

4. Change the following lengths to the units shown in the brackets.

- | | | |
|-----------------|---|---|
| Examples | 1. 3 m 2 cm (m)
= 3 m + 2 cm
= 3 m + 0.02 m
= 3.02 m | 2. 2 m 18 mm (m)
= 2 m + 18 mm
= 2 m + 0.018 m
= 2.018 m |
|-----------------|---|---|

- | | |
|------------------------|------------------------|
| (a) 2 m 11 cm (m) | (b) 3 cm 2 mm (cm) |
| (c) 6 m 6 cm (m) | (d) 20 m 20 cm (m) |
| (e) 5 km 20 m (km) | (f) 18 m 5 cm (m) |
| (g) 5 m 8 cm (m) | (h) 6 m 23 cm 8 mm (m) |
| (i) 4 m 7 mm (m) | (j) 20 cm 4 mm (cm) |
| (k) 3 m 88 cm 2 mm (m) | (l) 10 m 57 mm (m) |

5. Round the following lengths to the nearest metre.

- | | | |
|-----------------|----------------|-----------------|
| (a) 2.8 m | (b) 66.2 m | (c) 14.09 m |
| (d) 29.7 m | (e) 15.56 m | (f) 20.199 m |
| (g) 3 m 15 cm | (h) 2 m 80 cm | (i) 15 m 56 cm |
| (j) 4 m 4 cm | (k) 8 m 9 cm | (l) 10 m 89 mm |
| (m) 11 m 256 mm | (n) 5 m 780 mm | (o) 48 m 458 mm |

6. Round the following lengths to the nearest centimetre.

- | | | |
|---------------|----------------|----------------|
| (a) 3.4 cm | (b) 2.8 cm | (c) 15.9 cm |
| (d) 1 cm 1 mm | (e) 13 cm 8 mm | (f) 25 cm 6 mm |
| (g) 9 mm | (h) 7 cm 2 mm | (i) 19 cm 9 mm |

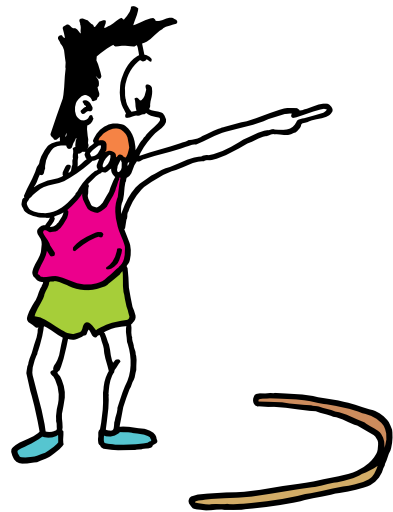
7. Three competitors in a shot putt competition had the following throws:

Mustafa - 8 m 35 cm

Klete - 8.09 m

Dale - 829 cm

List the competitors from the one who threw the furthest to one who threw the least.



8. Courtney's car has a luggage-rack. The height of the luggage-rack is 145 cm above the ground. Courtney has to take a cupboard of width 750 mm to her friend's house. She decides to put the cupboard on her luggage-rack but has to pass under a tree branch that is 2.1 m above the road.

Will Courtney be able to drive under the branch with the cupboard on her car's luggage-rack?

9. William wants to 'dunk' a basketball. He needs to be able to get his finger tips 250 mm above the basketball ring to do this. The ring is 3.1 m above the court and William measured the height of his outstretched fingers while standing to be 240 cm.

How high does William need to jump to be able to 'dunk' the ball?



10. Sophia had hair that was 1.2 m long. In a moment of madness she had her hair cut to 12 cm. She hated it and wanted to go into hiding until it grew back to 1.2 m. She measured that her hair grew at a rate of 15 mm per month.

If Sophia is 15 years old, how old will she be when she comes out of hiding?

11. A 10 cent piece is 24 mm across.

- (a) If five 10 cent pieces are placed in a line next to each other, how long is the line?



- (b) How many 10 cent pieces would be required to make a line 60 cm long?

- (c) What is the value of a line of 10 cent pieces 60 cm long?

As a fund raising activity, the Scouts were conducting a raffle.

First prize was enough 10 cent pieces to form a line from your house to your school.

Second prize was enough 10 cent pieces to form a line the same length as your height.

Find the value of the following prizes.

- (d) Sue wins first prize and lives 7.2 km from her school.
 (e) Oscar, who is 192 cm tall, wins second prize.

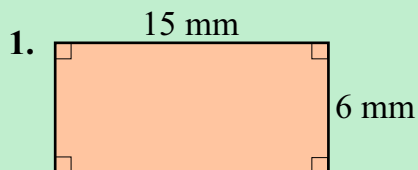
Perimeter

EXERCISE 11C

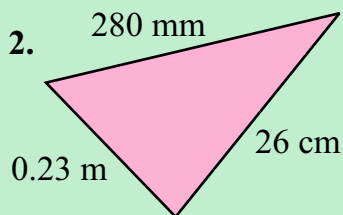
1. Find the perimeter of the following shapes.

Examples

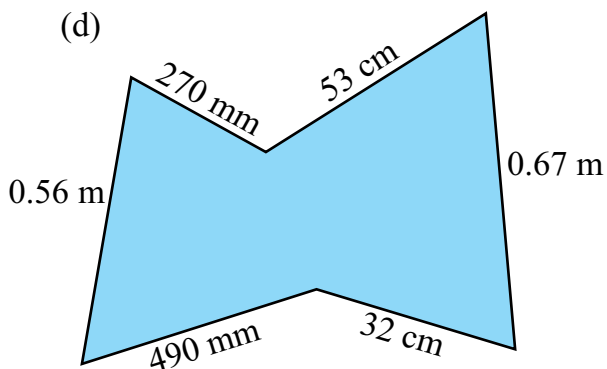
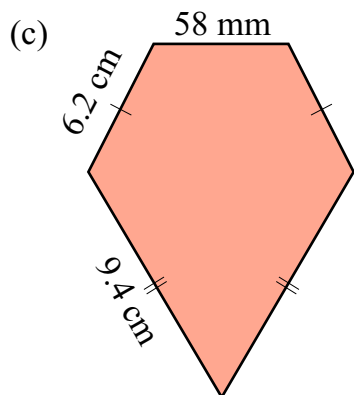
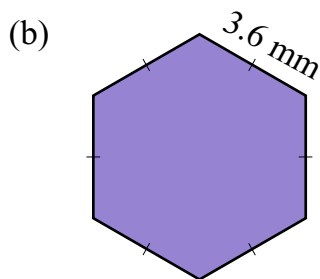
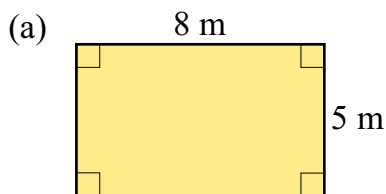
Remember to convert all lengths to the same units



$$\begin{aligned}\text{Perimeter} &= 15 + 6 + 15 + 6 \\ &= \mathbf{42 \text{ mm}}\end{aligned}$$



$$\begin{aligned}\text{Perimeter} &= 0.23 \text{ m} + 280 \text{ mm} + 26 \text{ cm} \\ &= 230 \text{ mm} + 280 \text{ mm} + 260 \text{ mm} \\ &= \mathbf{770 \text{ mm}}\end{aligned}$$

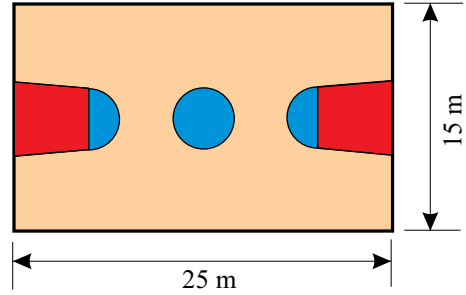


2. James was training with his basketball team. His coach told the players to run 20 laps of the court.

(a) What is the total distance run by the players in running 20 laps of the court?

(b) The players ran at an average speed of 5 metres per second.

How long did it take the players to complete the 20 laps?



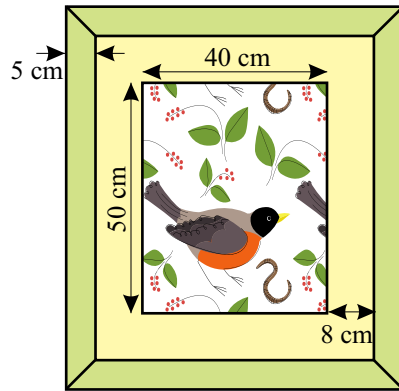
3. John wanted to make a frame for a painting.

The dimensions of the painting were $50\text{ cm} \times 40\text{ cm}$.

There was to be an 8 cm space between the outside of the painting and the inside of the frame.

The frame was 5 cm wide.

What length of framing material is required?



4. Jana rode her bike around a park. The park was in the shape of a square and she measured the total distance around the park to be 1.2 km.

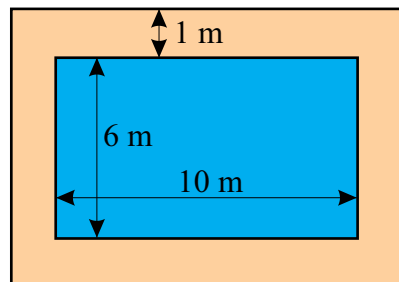
(a) What is the length (in metres) of the side of the park?

(b) Jana completed 10 laps of the park in 30 minutes. What was her average speed (in km per hour)?

5. Caleb owned a block of land. Its length was twice its width and it had a perimeter of 240 metres.

Find the length and width of Caleb's block of land.

6. Brigitte wants to put one metre of paving around her swimming pool. The swimming pool is $10\text{ m} \times 6\text{ m}$ and the paving blocks are squares with side length of 50 cm. How many of the paving blocks will Brigitte need?



Circles

ACTIVITY

Remember - Diameter = distance across a circle
Circumference = distance around a circle

Step 1 Choose a few circular objects with a variety of diameters:
- drinking glass, mug, bowl, etc.

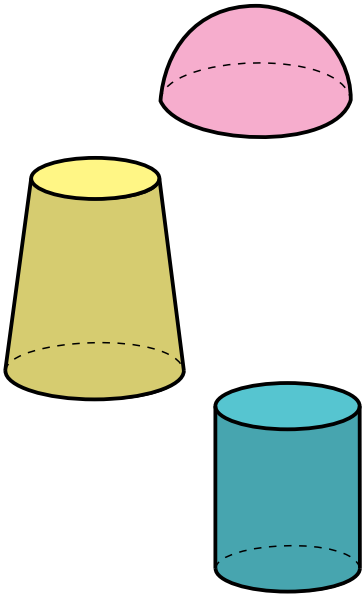
Step 2 Measure the diameter of the circle for each of the objects.

Step 3 Measure the circumference of each of the circles.

Step 4 Copy and complete the table below showing the diameter (*D*), circumference (*C*) and the circumference

divided by the diameter ($\frac{C}{D}$)

<i>C</i>	<i>D</i>	$\frac{C}{D}$



Step 5 What do you notice about the value of $\left(\frac{C}{D}\right)$?

Step 6 What should be the value of $\left(\frac{C}{D}\right)$ correct to five decimal places?

Step 7 What is the symbol given to this?

Step 8 Complete these equations using this symbol:

$$\frac{C}{D} = \square$$
$$C = \square \times D$$

The *perimeter* of a circle is called its *circumference*.

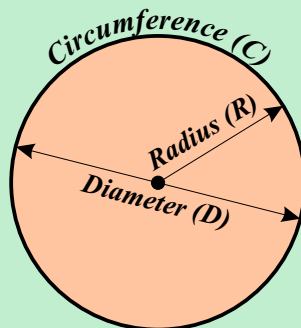
The *circumference* (C) of a circle is found by multiplying the circle's diameter (D) by π (pi).

$$C = \pi \times D$$

Remember: $D = 2 \times R$

π is equal to 3.141592654...

This can be found by using the π button on your calculator.

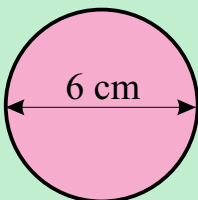


EXERCISE 11D

1. Find the circumference of the following circles.
Give answers to one decimal place.

Examples

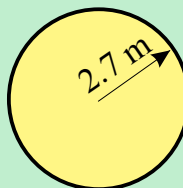
1.



The diameter = 6 cm

$$\begin{aligned} C &= \pi \times D \\ &= \pi \times 6 \\ &= 18.84955 \\ &= \mathbf{18.8 \text{ cm}} \text{ (1 dec. place)} \end{aligned}$$

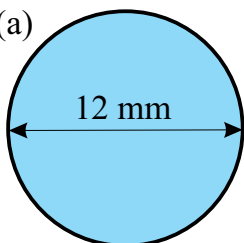
2.



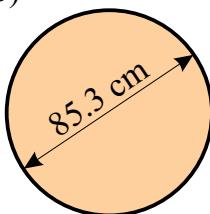
The radius = 2.7 m
The diameter = 5.4 m

$$\begin{aligned} C &= \pi \times D \\ &= \pi \times 5.4 \\ &= 16.96460 \\ &= \mathbf{17.0 \text{ m}} \text{ (1 dec. place)} \end{aligned}$$

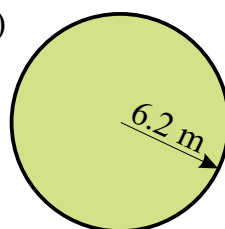
(a)



(b)



(c)



2. Find the circumference of the circles with the following *diameters*.

Give answers to one decimal place.

- (a) 8 mm (b) 11.8 m (c) 5.6 km (d) 200 cm
(e) 0.58 m (f) 1.589 km (g) 11.97 mm (h) 65.89 m

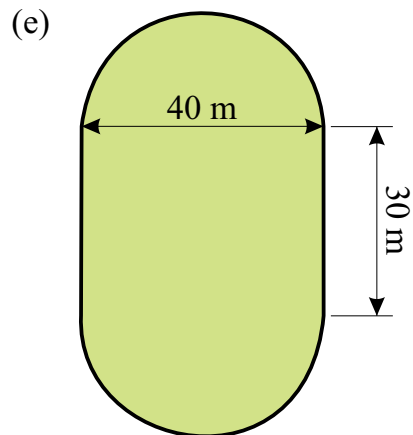
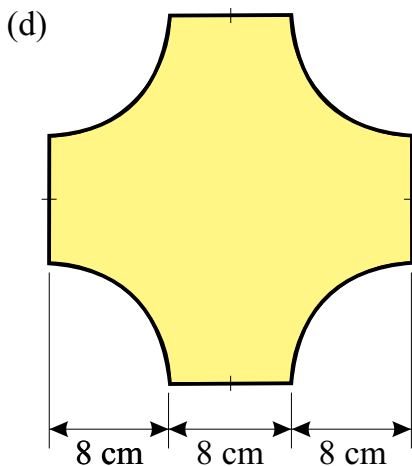
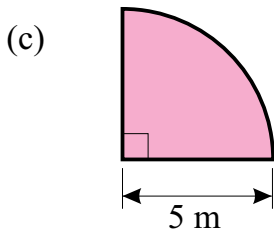
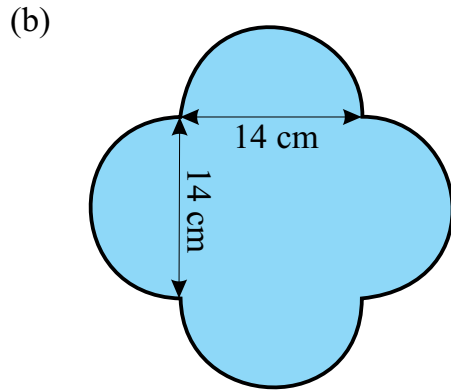
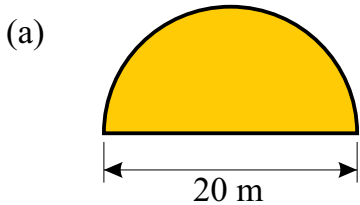
3. Find the circumference of the circles with the following *radii*.

Give answers to one decimal place.

- (a) 15 mm (b) 25.8 m (c) 7.6 km (d) 500 cm
(e) 2.59 m (f) 0.589 km (g) 10.97 mm (h) 165.89 m

4. Find the perimeter of each of the following shapes.

Give answers to one decimal place.



5. The diameter of each wheel on Maxine's bike is 60 cm.
- How far will the bike move forward for each complete revolution of a wheel?
 - Maxine has a counter on one wheel of her bike. She rode to her friend's house and the counter showed that the wheel had turned 400 times. How far is it to Maxine's friend's house?
Give answer to the nearest metre.

6. Amelia has a pet mouse called Gonzo.
Gonzo has a mouse-wheel in which he enjoys running.

The diameter of the mouse wheel is 130 mm.

Give all answers to one decimal place.

- How far does Gonzo run if the wheel turns once?

Amelia timed Gonzo while he was running in the wheel. It took 3 seconds for each revolution of the wheel.

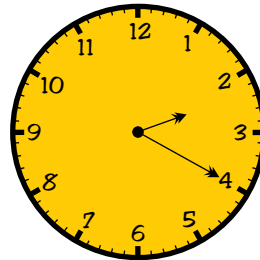
- How far does Gonzo run in 6 seconds?
- How far does Gonzo run in half a minute?
- What is Gonzo's speed (in metres per minute)?



7. Eric made a clock. The radius of the clock face was 25 cm.

Give the following answers to one decimal place.

- What is the circumference of the clock face?
- Find the distance between the minute marks around the clock face.



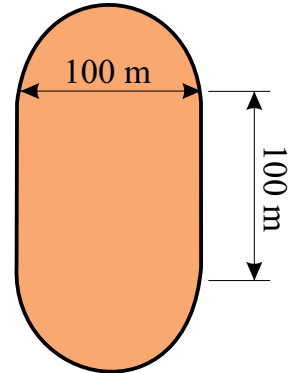
8. Ruth wanted to find the diameter of a huge tree near her house.
She wrapped a string around the tree. The string measured 565.5 cm.
What was the diameter of the tree?

9. Without calculating the answer, choose which of the following alternatives would be the best estimate of the circumference of a CD - diameter 120 mm.

A 36 mm **B** 36 cm **C** 72 mm **D** 72 cm

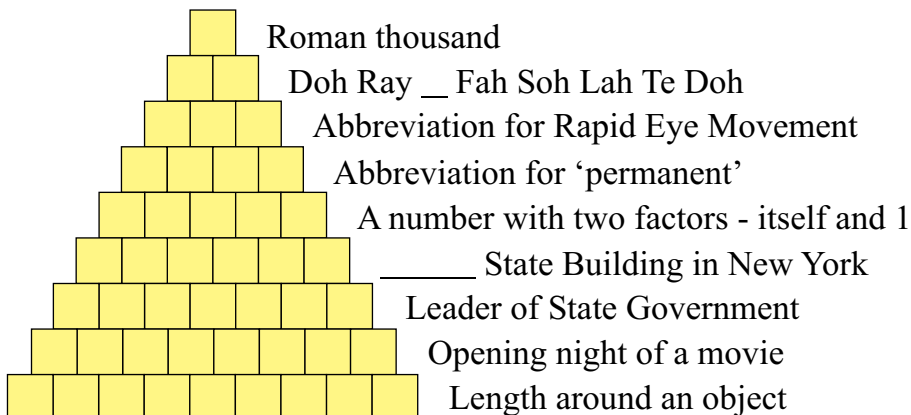
PROBLEM SOLVING

1. The pen for Dana's pet lamb is made from wire mesh. The pen is in the shape of a circle with diameter 7 metres. If the same wire mesh is formed into a square pen, what would be the side length of the pen? (Give answer to one decimal place).
2. Lachlan regularly runs around the athletics track with dimensions shown here.
 - (a) How far would he run if he completed six laps of the track? (Give answer to the nearest metre).
 - (b) If Lachlan wanted to run at least 10 kilometres, how many laps would he need to complete?

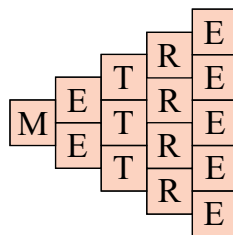


PUZZLES

1. Complete the diagram below by finding the word on each line. Each word can be found by adding one letter to the line above it and rearranging the letters. A clue for each word is given.



2. Starting from the M on the left side of this diagram and moving to an adjoining letter, how many different ways can the word METRE be formed?



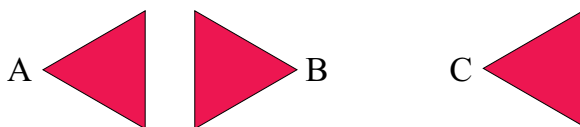
3. The letters from each of the following phrases can be rearranged to form words from this chapter. Each phrase forms one word.

- | | | |
|--------------------|-----------------|--------------------|
| (a) time miller | (b) raid us | (c) a nurse met me |
| (d) milk or tee | (e) cement tier | (f) prime tree |
| (g) mercuric fence | (h) see a rum | (i) a red mite |

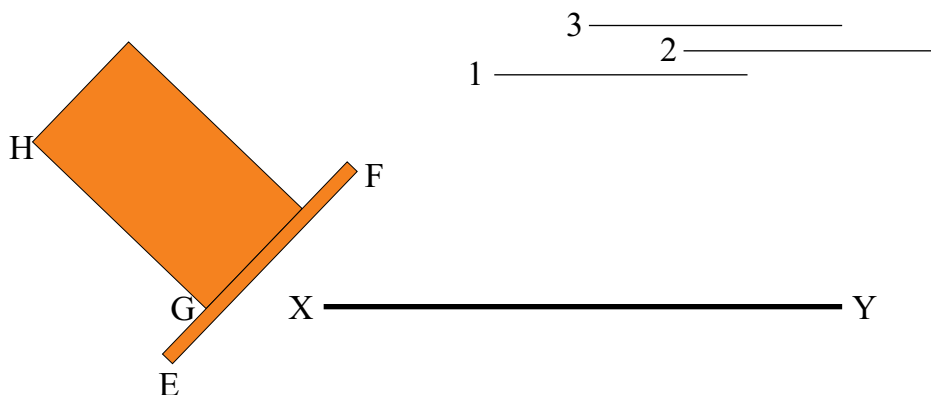
4. Estimate which of the following distances are longer.

Check by measuring.

- (a) AB or BC.

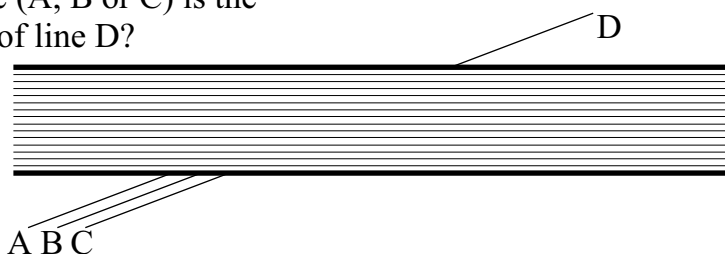


- (b) EF or GH.



5. If this object was turned so that side EF was on XY, which of the lines (1, 2 or 3) would the top touch.

6. Which line (A, B or C) is the extension of line D?



CHAPTER REVIEW

1. Choose the alternative which is the best estimate of the following lengths.

(a) The diameter of an orange.

A 7 mm **B** 70 mm **C** 700 mm **D** 7000 mm

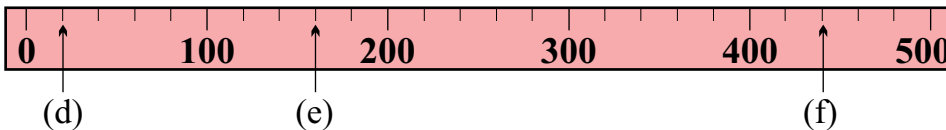
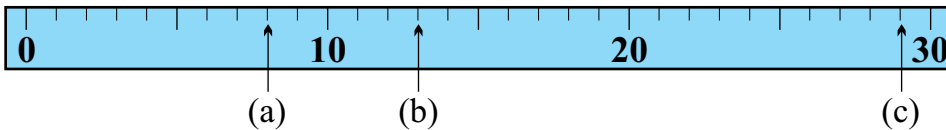
(b) The height of a soccer goal.

A 250 mm **B** 250 cm **C** 250 m **D** 250 km

(c) The distance from Brisbane to Sydney.

A 1000 mm **B** 1000 cm **C** 1000 m **D** 1000 km

2. Read the measurements shown on these scales.



3. Estimate the length of the following lines (in cm) then measure them.

(a)



(b)



4. Change the following lengths to the units shown in the brackets.

(a) 7 cm (mm)

(b) 1 km (m)

(c) 20 m (cm)

(d) 6000 cm (m)

(e) 850 mm (cm)

(f) 6 mm (cm)

(g) 970 cm (m)

(h) 0.03 m (cm)

(i) 0.5 mm (cm)

(j) 4 cm (m)

(k) 0.7105 km (m)

(l) 210 mm (m)

5. Change the following lengths to the units shown in the brackets.

(a) 3 m 67 cm (m)

(b) 8 cm 9 mm (cm)

(c) 10 m 7 cm (m)

(d) 5 km 300 m (km)

(e) 1 km 50 m (km)

(f) 7 m 6 cm (m)

(g) 1 cm 1 mm (cm)

(h) 8 m 34 cm 2 mm (m)

6. Round the following lengths to the nearest metre.

(a) 6.2 m

(b) 37.8 m

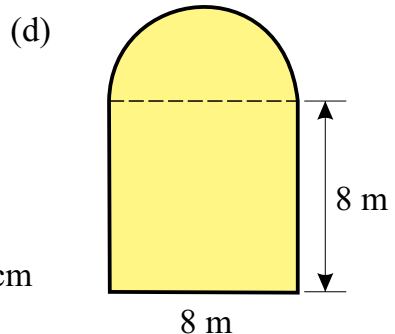
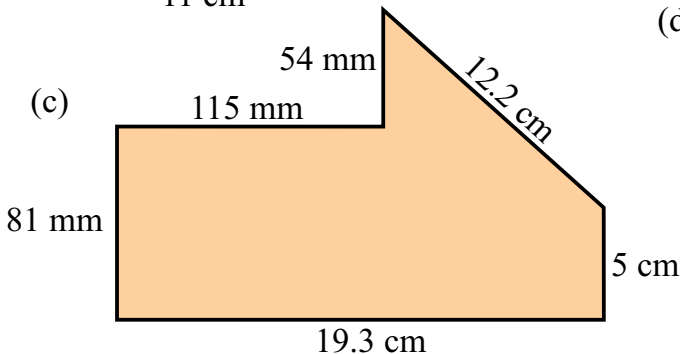
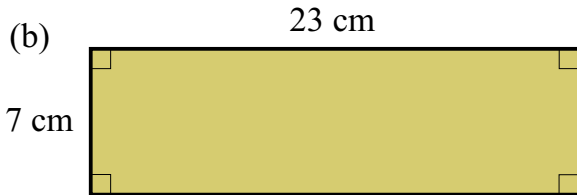
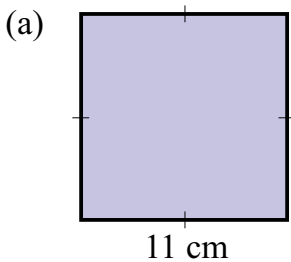
(c) 99.7 m

(d) 1 m 25 cm

(e) 14 m 80 cm

(f) 5 m 8 cm

7. Round the following lengths to the nearest centimetre.
 (a) 6.2 cm (b) 10.8 cm (c) 9.09 cm
 (d) 1 cm 8 mm (e) 3 cm 2 mm (f) 35 cm 7 mm
8. Phaedra is a runner. She measured each of her strides to be 50 cm.
 How many strides would she take to sprint 100 metres?
9. A rectangle has a perimeter of 44 cm. Its length is 12 cm.
 Find the width of the rectangle.
10. The perimeter of a **square** paddock is 1.6 km.
 Find the side length (in metres) of the paddock.
11. Find the circumference of the circles with the following diameters.
 Give answers to one decimal place.
 (a) 5 cm (b) 6.3 mm (c) 18.5 m
12. Find the circumference of the circles with the following radii.
 Give answers to one decimal place.
 (a) 12 cm (b) 15.6 mm (c) 120 m
13. Find the perimeter of the each of the following shapes.



Area

The size of a surface or the amount of space of a flat or two-dimensional shape is called its **area**.

Common units of area are: square millimetres (mm^2)
 square centimetres (cm^2)
 square metres (m^2)
 hectares
 square kilometres (km^2)

The unit used would depend on the size of the area.

1 mm^2 is the area equal to a square with a side length of 1 mm.

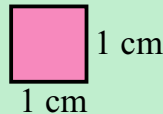
1 cm^2 is the area equal to a square with a side length of 1 cm.

1 m^2 is the area equal to a square with a side length of 1 m.

1 hectare is the area equal to a square with a side length of 100 m.

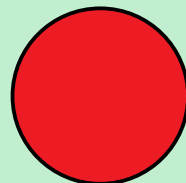
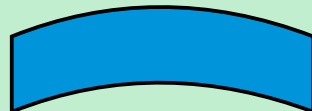
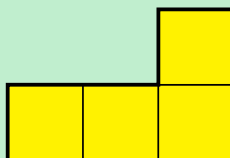
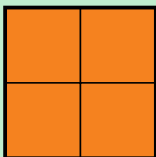
1 km^2 is the area equal to a square with a side length of 1 km.

This square has an area of 1 cm^2 .



But many shapes would have the same area.

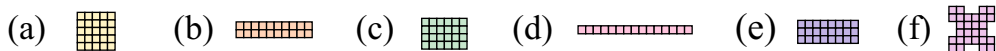
Examples All the shapes below have an area of 4 cm^2 .



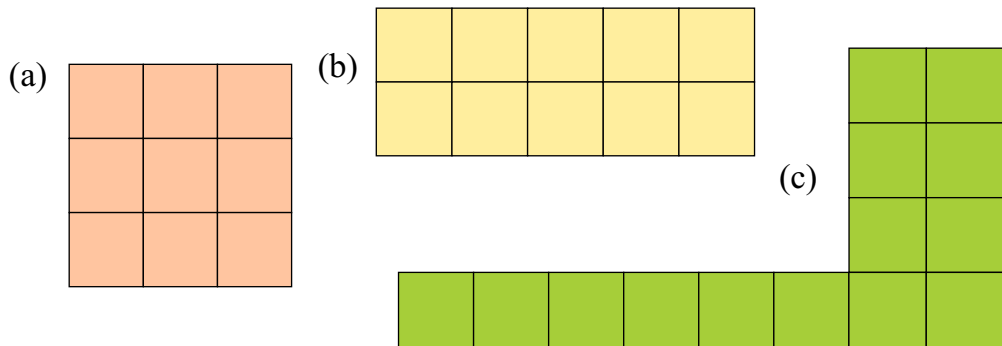
Area

EXERCISE 12A

1. Each of the small squares in the following shapes is 1 mm^2 .
How many mm^2 are in each shape?



2. Each of the squares in the following shapes is 1 cm^2 .
How many cm^2 are in each shape?



3. How many mm^2 are in one cm^2 ?



4. Choose the alternative which is the best estimate of the area of each of the following objects.

(a) The display of your calculator.

A 1 mm^2

B 10 mm^2

C 10 cm^2

D 100 cm^2

(b) A page of this book.

A 4 cm^2

B 40 cm^2

C 400 cm^2

D 4000 cm^2

(c) A squash court.

A 50 m^2

B 500 m^2

C 5000 m^2

D $50\,000 \text{ m}^2$

(d) New South Wales

A 8000 km^2

B $80\,000 \text{ km}^2$

C $800\,000 \text{ km}^2$

D $8\,000\,0000 \text{ m}^2$

(e) Your foot print.

A 16 cm^2

B 160 cm^2

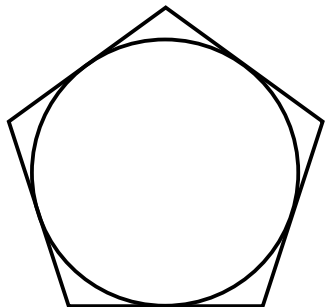
C 1600 cm^2

D $16\,000 \text{ cm}^2$

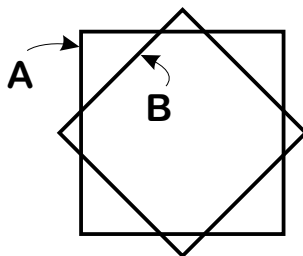
5. State which one of the following pairs of objects has the larger area.

(a) A square with side length 10 cm or a circle with diameter 10 cm.

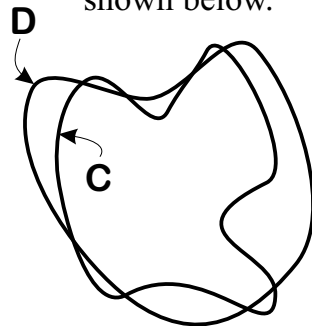
(b) The circle or pentagon shown below.



(c) Square **A** or **B** shown below.

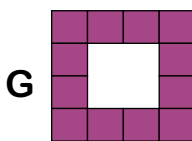
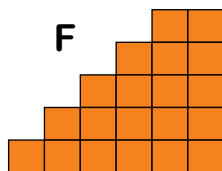
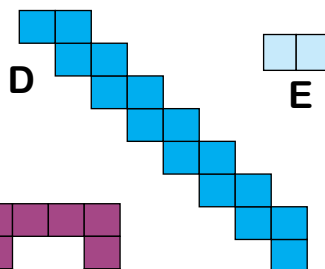
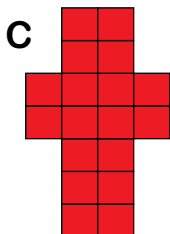
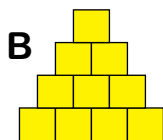
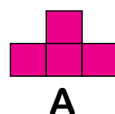


(d) Shape **C** or **D** shown below.



6. If the area of shape **A** is 1 unit, match the shapes below with the following areas.

- (a) 3 units (b) 5 units (c) 4.5 units
(d) $\frac{1}{2}$ unit (e) 2.5 units (f) $3\frac{3}{4}$ units



7. Four matches can be formed into a square with area of 1 unit.

Six matches can be formed into a shape with an area of 2 units.



(a) Use 8 matches to form a shape with an area of 2 units.

(b) Use 8 matches to form a shape with an area of 3 units.

(c) Use 8 matches to form a shape with an area of 4 units.

(d) Use 10 matches to form a shape with an area of 4 units.

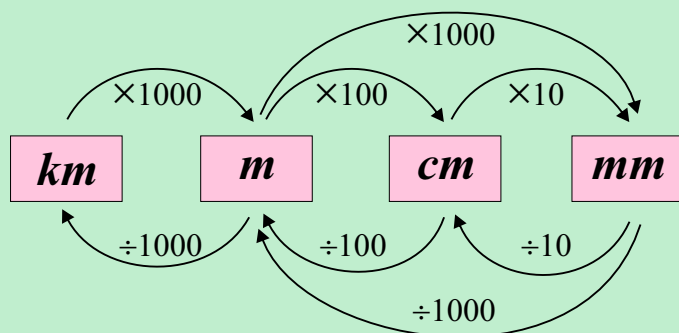
(e) Use 12 matches to form a shape with an area of 5 units (2 ways).

(f) Use 12 matches to form a shape with an area of 6 units.

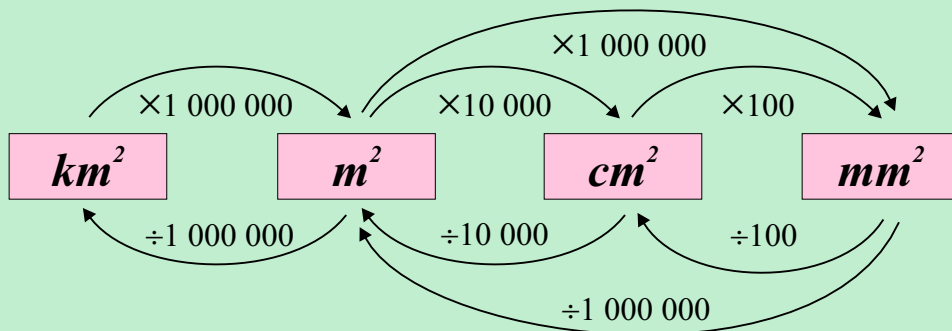
(g) Use 12 matches to form a shape with an area of 9 units.

Conversions

Remember the conversion factors for changing from one unit of *length* to another:



The conversion factors for changing from one unit of *area* to another are the square of these as shown below.



Convert the following areas to the units shown in the brackets.

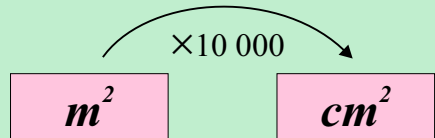
Examples

1. $3 \text{ m}^2 \text{ (cm}^2\text{)}$

To change from m^2 to cm^2 : $\times 10\,000$

$$= 3 \times 10\,000$$

$$= \mathbf{30\,000 \text{ cm}^2}$$

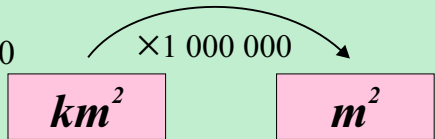


2. $4.935 \text{ km}^2 \text{ (m}^2\text{)}$

To change from km^2 to m^2 : $\times 1\,000\,000$

$$= 4.935 \times 1\,000\,000$$

$$= \mathbf{4\,935\,000 \text{ m}^2}$$

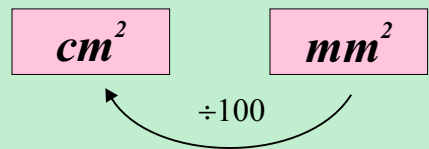


3. $820 \text{ mm}^2 \text{ (cm}^2\text{)}$

To change from mm^2 to cm^2 : $\div 100$

$$= 820 \div 100$$

$$= \mathbf{8.2 \text{ cm}^2}$$

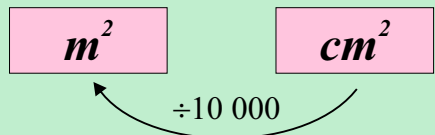


4. $795 \text{ cm}^2 \text{ (m}^2\text{)}$

To change from cm^2 to m^2 : $\div 10\,000$

$$= 795 \div 10\,000$$

$$= \mathbf{0.0795 \text{ m}^2}$$



EXERCISE 12B

1. Change the following areas to the units shown in the brackets.

- | | |
|--|---|
| (a) 5 km^2 (m^2) | (b) 9 m^2 (cm^2) |
| (c) 2 cm^2 (mm^2) | (d) 2.7 km^2 (m^2) |
| (e) 5.391 m^2 (cm^2) | (f) 0.058 cm^2 (mm^2) |
| (g) 0.0092 m^2 (mm^2) | (h) 0.00041 km^2 (m^2) |
| (i) 23.8 cm^2 (mm^2) | (j) 0.00579 m^2 (mm^2) |

2. Change the following areas to the units shown in the brackets.

- | | |
|---|--|
| (a) 6000 mm^2 (cm^2) | (b) $95\,000 \text{ cm}^2$ (m^2) |
| (c) $780\,000 \text{ m}^2$ (km^2) | (d) $107\,800 \text{ cm}^2$ (m^2) |
| (e) $410\,000 \text{ mm}^2$ (cm^2) | (f) $35\,280\,000 \text{ m}^2$ (km^2) |

3. Change the following areas to the units shown in the brackets.

- | | |
|--|---|
| (a) 43 cm^2 (mm^2) | (b) 7500 m^2 (km^2) |
| (c) 8.3 mm^2 (cm^2) | (d) 2.32 cm^2 (m^2) |
| (e) $76\,000 \text{ mm}^2$ (cm^2) | (f) $5\,380\,000 \text{ m}^2$ (km^2) |
| (g) 7.2 cm^2 (mm^2) | (h) 8.3 m^2 (km^2) |

4. (a) The floor area of a room was calculated to be $90\,000 \text{ cm}^2$.

Convert this area to m^2 .

(b) Which of these units is more convenient? Why?

5. (a) The area of a computer screen was calculated to be $60\,000 \text{ mm}^2$.

Convert this area to mm^2 .

(b) Which of these units is more convenient? Why?

6. Choose which unit of area would be most convenient to measure the following areas.

A km^2 **B** m^2 **C** cm^2 **D** mm^2

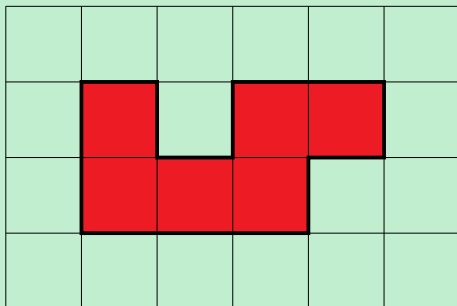
- The area of a football ground.
- The area of a paddock on a farm.
- The area of Kakadu National Park.
- The area of a piece of paper.
- The area of a finger nail.
- The floor area of a house.

Using a Grid

Use the 1 cm square grid to find the area of the shapes below.

Examples

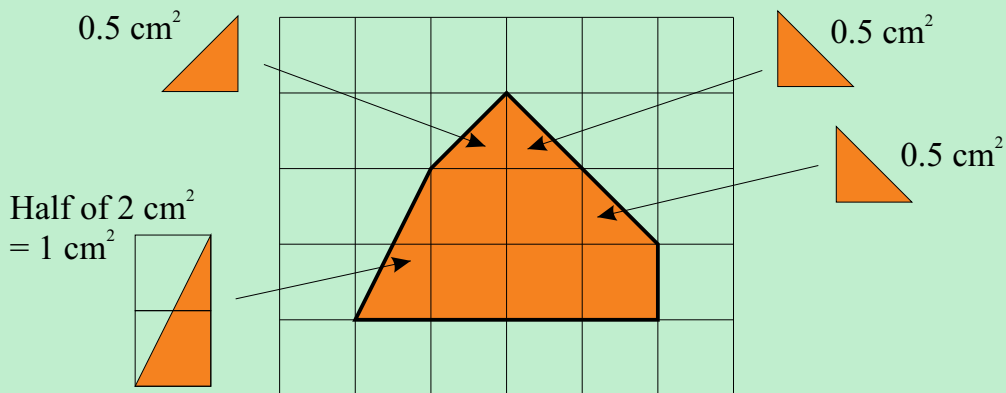
1.



To find the area add all the 1 cm^2 squares in the shape.

$$\text{Area} = 6 \text{ cm}^2$$

2. In this example there are several parts of squares and 5 whole 1 cm^2 squares to be added to find the total area.

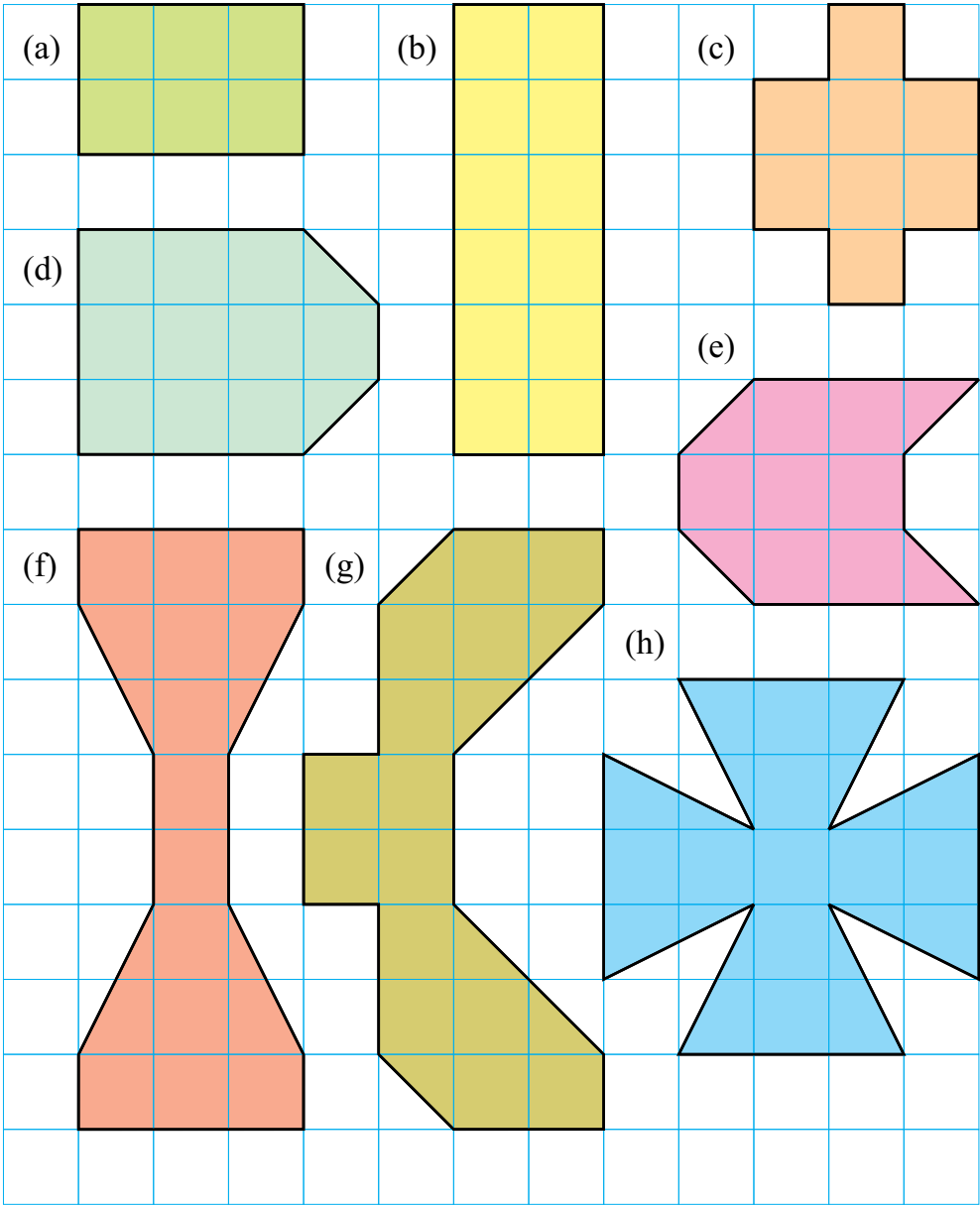


$$\text{Area} = 5 \text{ squares} + 0.5 + 0.5 + 0.5 + 1$$

$$\text{Area} = 7.5 \text{ cm}^2$$

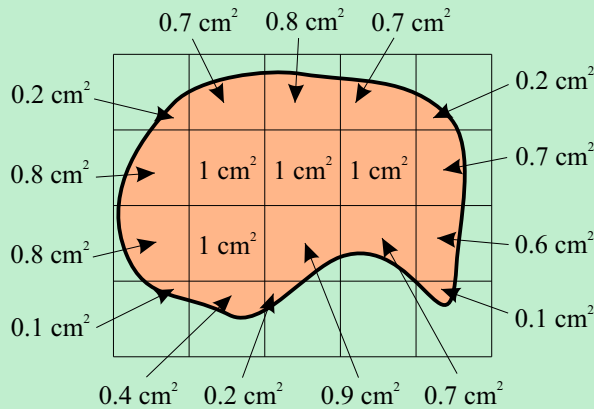
EXERCISE 12C

1. Use the 1 cm grid to find the area of the shapes below.



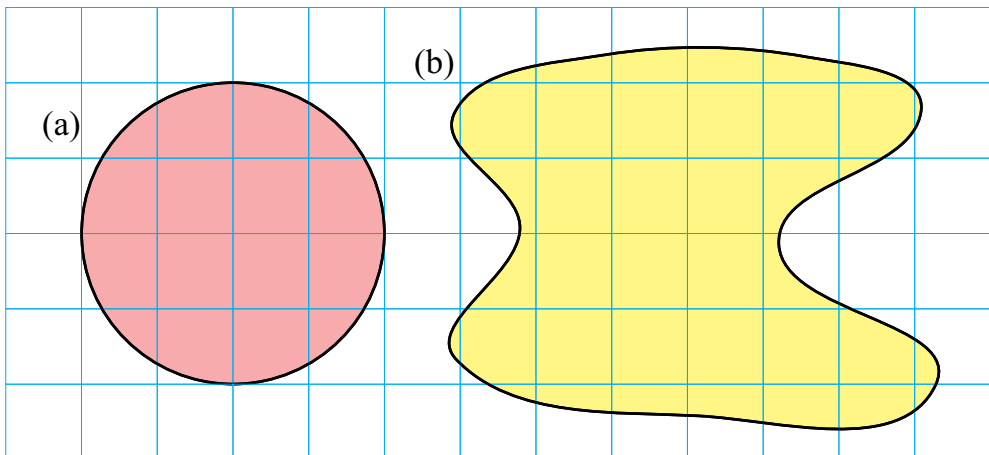
Example

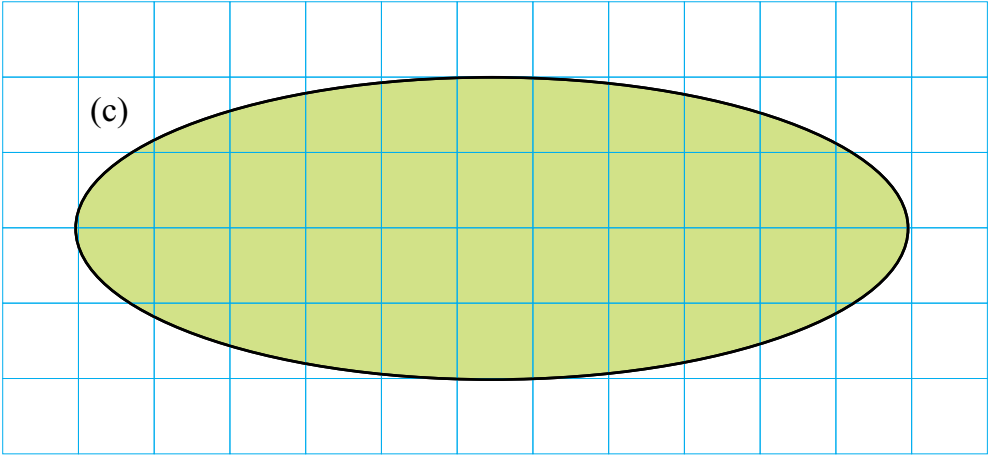
It is only possible to find an approximate area of a shape with curves when using a grid. Estimate the area of the shape in each square then add all these to find the approximate total area.



$$\begin{aligned} \text{Area} &= 0.1 + 0.8 + 0.8 + 0.2 + 0.7 + 0.8 + 0.7 + 0.2 + 0.7 \\ &\quad + 0.6 + 0.1 + 0.7 + 0.9 + 0.2 + 0.4 + 1 + 1 + 1 + 1 \\ \text{Area} &= 11.9 \text{ cm}^2 \end{aligned}$$

2. Use the 1 cm grid to find the approximate area of the shapes below.

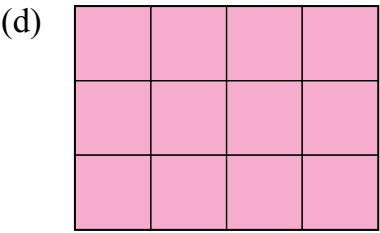
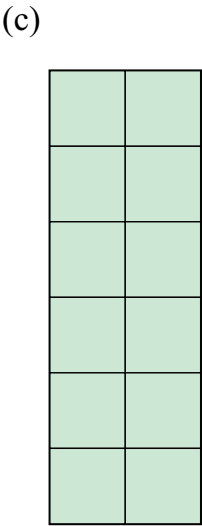
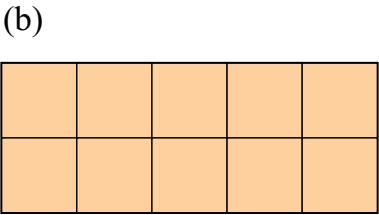
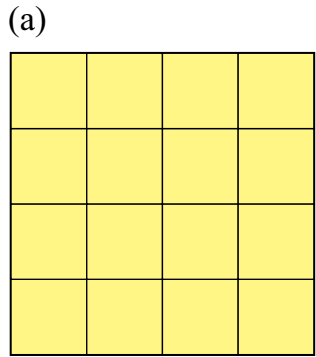




Squares and Rectangles

EXERCISE 12D

1. Find the area of each of the following shapes if each small square is 1 cm^2 .



2. Use the dimensions shown to find the area of each of the following rectangles.

Example

Area of a rectangle = length $\times$ width



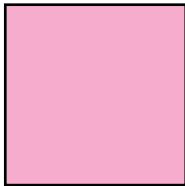
6 m

8 m

$$\begin{aligned}\text{Area} &= 8 \times 6 \\ &= 48 \text{ m}^2\end{aligned}$$

(a) 6 cm

6 cm



(b) 10 m

4 m



(c)

9 mm



3 mm

(d)

20 m

4 m



(e)

12 mm



15 mm

(f)

42 cm

24 cm



(g)

8.5 mm

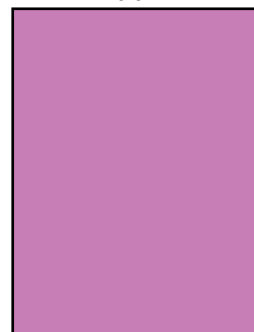
12.5 mm



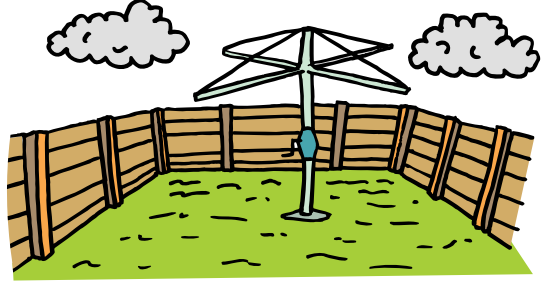
(h)

200 m

350 m



3. (a) Find the area of a square with 9 metre sides.
 (b) Find the area of a $9\text{ cm} \times 12\text{ cm}$ rectangle.
4. Lin wants to plant lawn in her yard. The dimensions of her yard are $30\text{ metres} \times 40\text{ metres}$.
 (a) What is the area of Lin's yard?
 (b) The amount of lawn seed required is 1 kg for every 100 m^2 .
 How many kilograms of lawn seed will Lin need?
 (c) Lin's lawn seed grew well.
 She now has to cut it. Lin's lawn mower has a width of 40 cm.
 How far will Lin walk if she mows all the lawn in her yard?

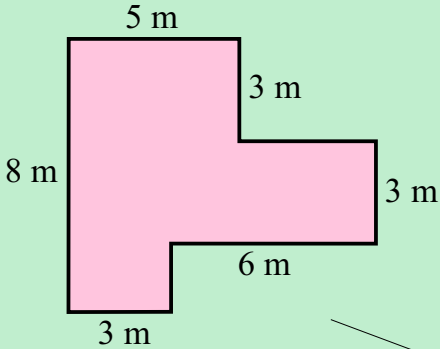


5. The perimeter of a paddock is 300 metres.
 The length of the paddock is 30 metres longer than the width.
 What is the area of the paddock?
6. (a) List the dimensions (whole numbers only) of all the rectangles that can be formed having perimeters of 16 metres.
 (b) Find the area of each of these rectangles.
 (c) What are the dimensions of the rectangle with the largest area?
 (d) What is the name given to this type of rectangle?
 (e) Use this information to find the area of the largest rectangle that could be formed having a perimeter of 40 metres.
7. A small area of bush land is in the shape of a rectangle that is 300 metres long and 200 metres wide.
 A community group wants to increase the size of the bush land to encourage the native animal and bird life. Each year, for three years, they plant trees and increase the length and width of the bush land by 50 metres.
 (a) What is the area of the bush land before the tree planting began?
 (b) What is the area of the bush land at the end of the first year of tree planting?
 (c) What is the increase in the area of the bush land in the first year?
 (d) By how much did the area of the bush land increase in the three years of tree planting?

Composite Shapes

Find the area of the shaded region in each of the following shapes.

Example 1



To find the area of this shape:

Step 1 - Find all the unknown lengths.

Step 2 - Divide the shape into squares and/or rectangles.

Step 3 - Find the area of all these and add them to find the total area.

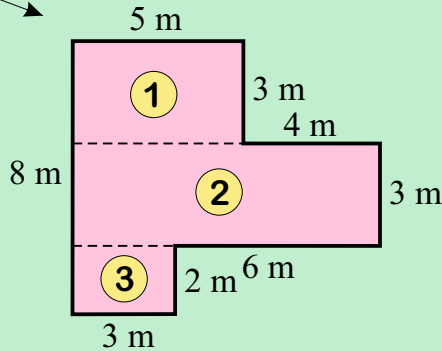
$$\text{Area 1} = 5 \times 3 = 15 \text{ m}^2$$

$$\text{Area 2} = 9 \times 3 = 27 \text{ m}^2$$

$$\text{Area 3} = 3 \times 2 = 6 \text{ m}^2$$

$$\text{Total area} = 15 + 27 + 6$$

$$\text{Total area} = 48 \text{ m}^2$$



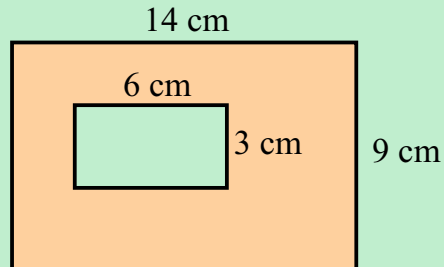
Example 2

The area of the shaded region is equal to the area of the larger rectangle minus the area of the smaller rectangle.

$$\text{Area} = (14 \times 9) - (6 \times 3)$$

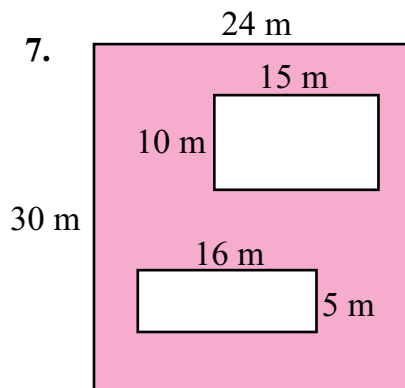
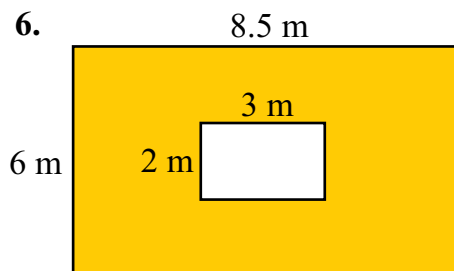
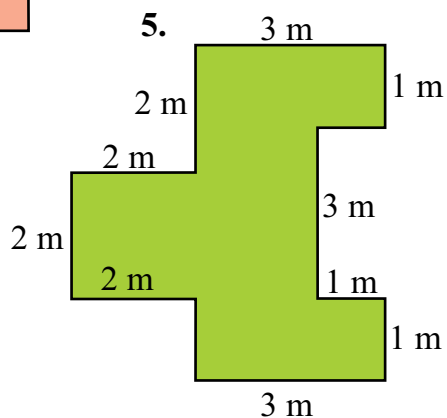
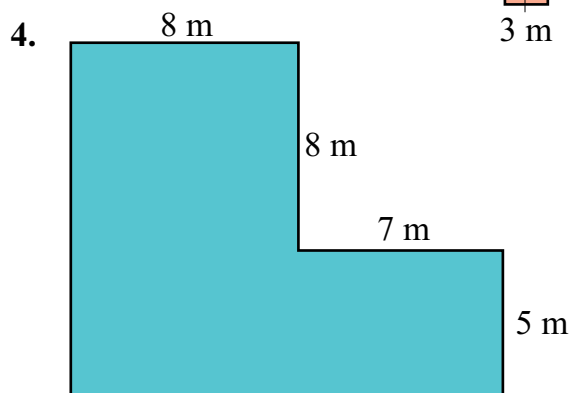
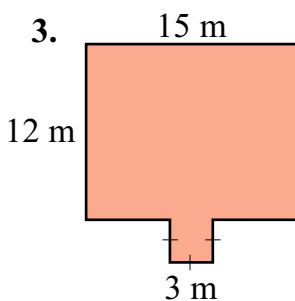
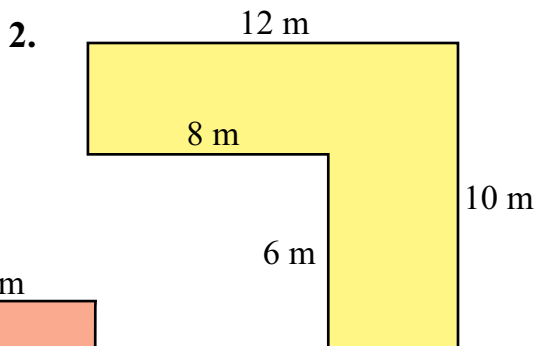
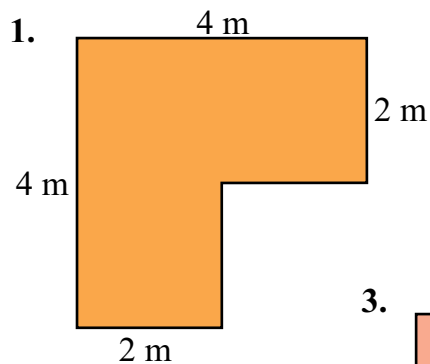
$$= 126 - 18$$

$$\text{Area} = 108 \text{ cm}^2$$



EXERCISE 12E

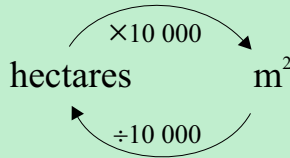
Find the area of each of the shaded regions below.



Hectares

EXERCISE 12F

$$1 \text{ hectare} = 10\,000 \text{ m}^2$$

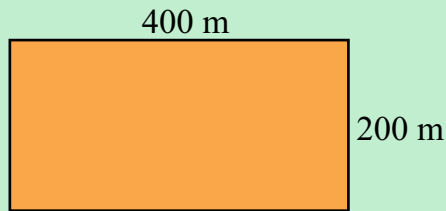


Examples

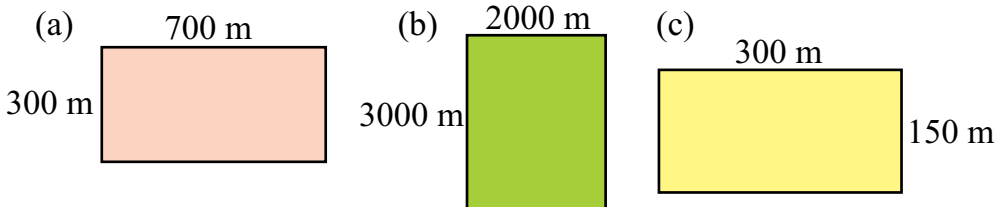
1. Change $400\,000 \text{ m}^2$ to hectares. $400\,000 \div 10\,000 = \mathbf{40 \text{ hectares}}$
2. How many m^2 are in 0.5 hectares? $0.5 \times 10\,000 = \mathbf{5000 \text{ m}^2}$

3. Find the area, in hectares, of the shape shown.

$$\begin{aligned} \text{Area} &= 400 \times 200 \\ &= 80\,000 \text{ m}^2 \\ &= \mathbf{8 \text{ hectares}} \end{aligned}$$



1. Find the area, in hectares, of the following shapes.

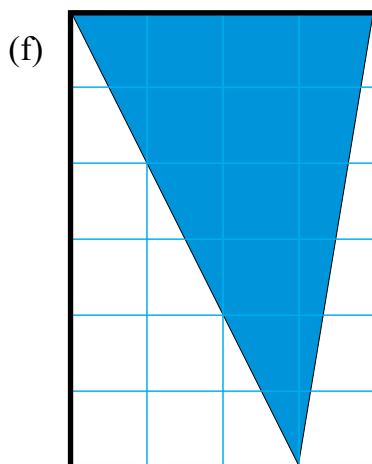
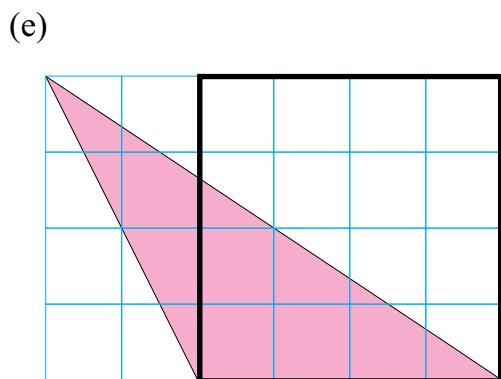
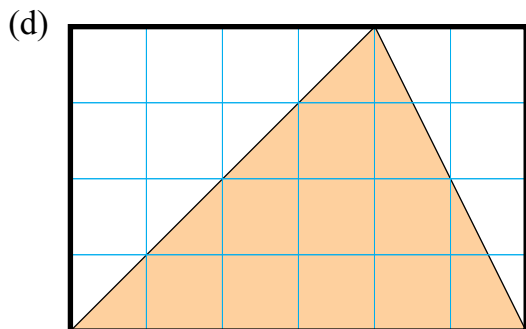
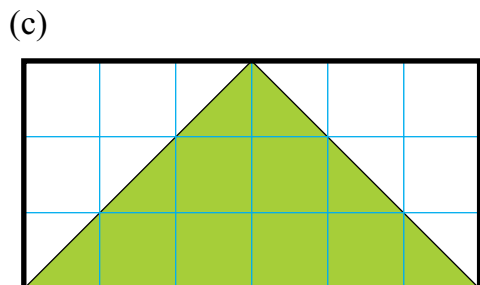
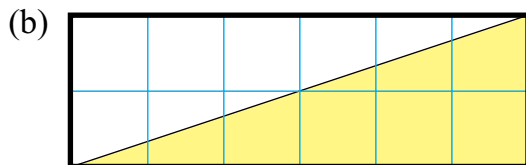
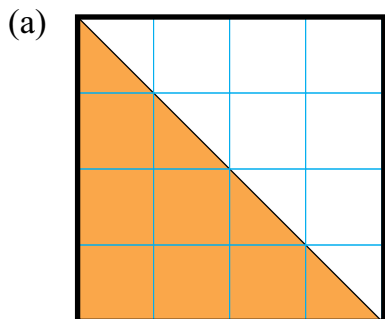


2. Change the following areas to m^2 .
 (a) 6 hectares (b) 15 hectares (c) 5.75 hectares (d) 0.3 hectares
3. Dulte owned a block of land that was 4 hectares. Find the length of this block of land if it is 100 metres wide.
4. Cameron worked on a cattle farm in Queensland that was 5 km long and 4 km wide. How many hectares is this farm?
5. A *square* property is 1764 hectares. Find the side length of the property.

Triangles

EXERCISE 12G

1. Use the 1 cm square grids in each of the following diagrams to:
- find the area of the rectangle indicated with the dark line.
 - find the area of the shaded triangle.

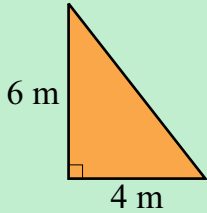


2. Is there any relationship between the area of the rectangle and the area of the triangle in each diagram?
If there is, state this relationship.

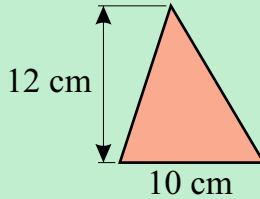
3. Find the area of each of the following triangles.

Examples

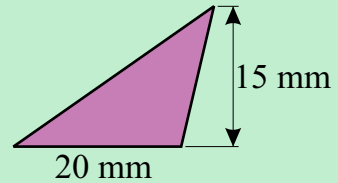
$$\text{Area of triangle} = \frac{1}{2} \times \text{base} \times \text{height}$$



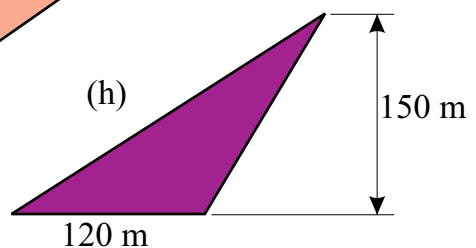
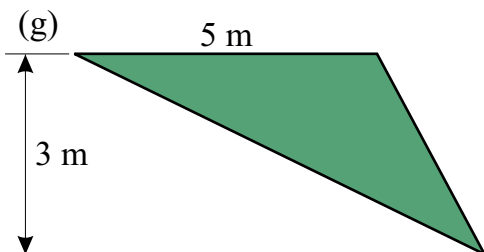
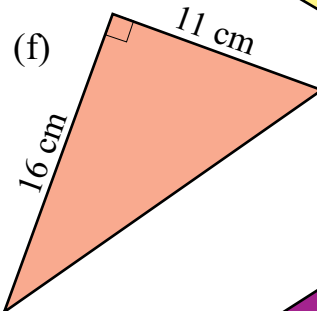
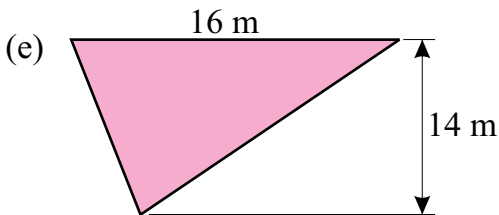
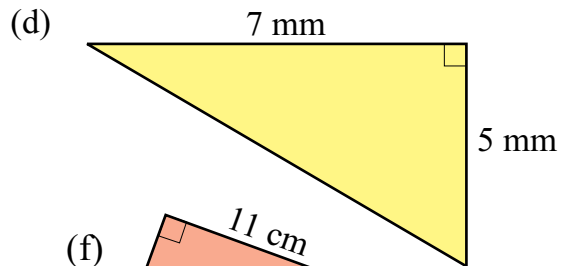
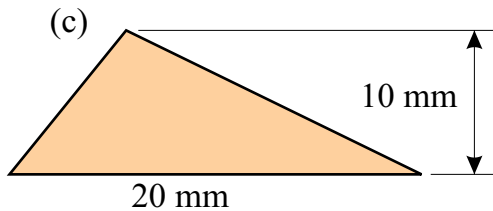
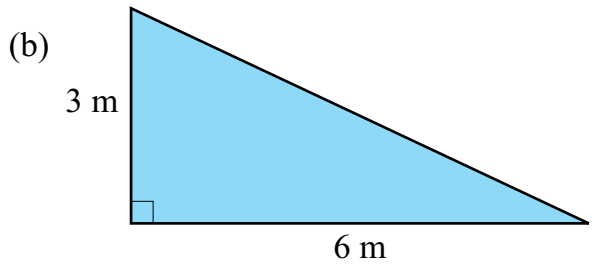
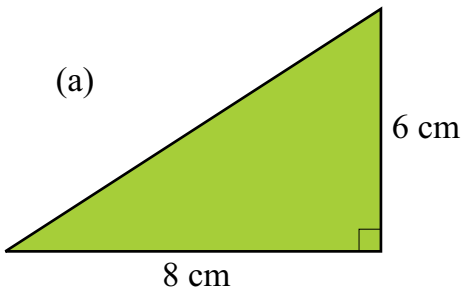
$$\begin{aligned}\text{Area} &= \frac{1}{2} \times 4 \times 6 \\ &= 12 \text{ m}^2\end{aligned}$$



$$\begin{aligned}\text{Area} &= \frac{1}{2} \times 10 \times 12 \\ &= 60 \text{ cm}^2\end{aligned}$$



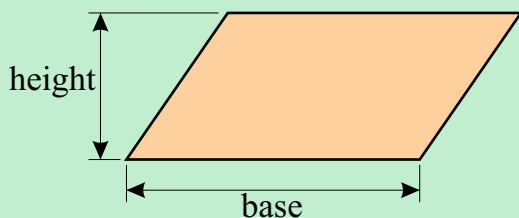
$$\begin{aligned}\text{Area} &= \frac{1}{2} \times 20 \times 15 \\ &= 150 \text{ mm}^2\end{aligned}$$



Parallelograms

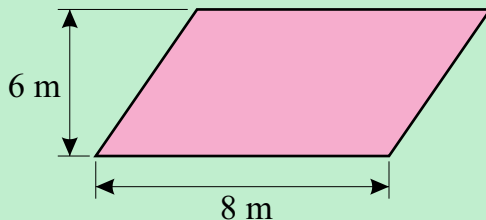
EXERCISE 12H

Area of a parallelogram = base $\times$ height



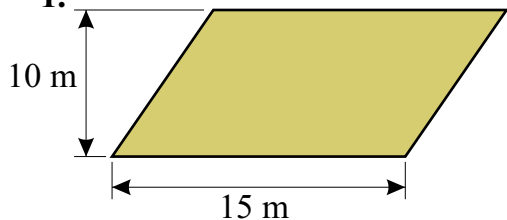
Example

$$\begin{aligned}\text{Area} &= 8 \times 6 \\ &= 48 \text{ m}^2\end{aligned}$$

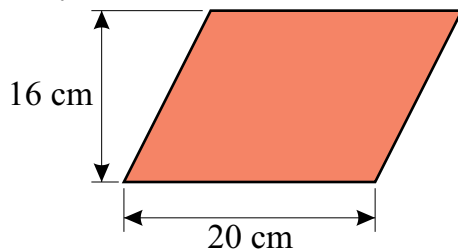


Find the area of each of the following parallelograms.

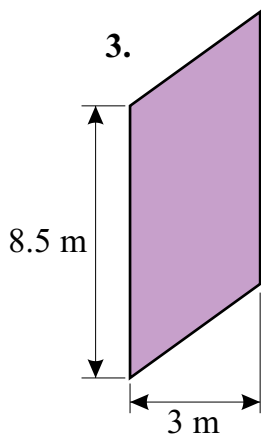
1.



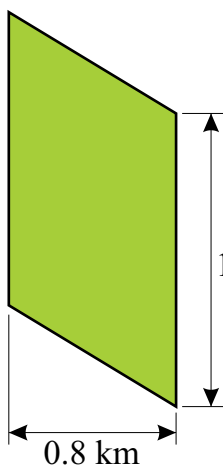
2.



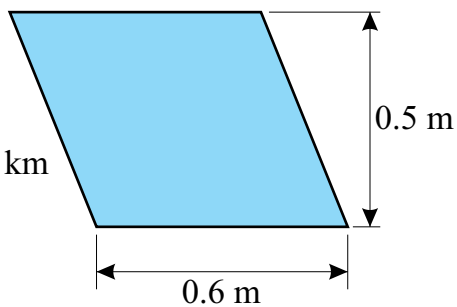
3.



4.



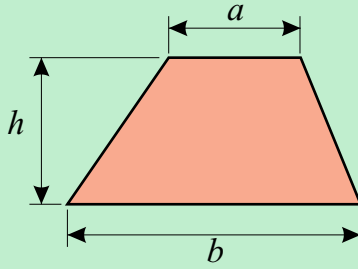
5.



Trapeziums

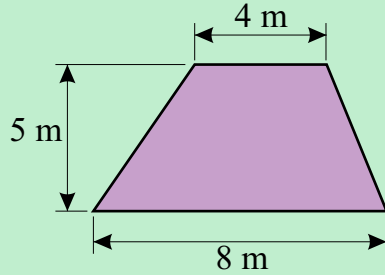
EXERCISE 12I

$$\text{Area of a trapezium} = \frac{1}{2} (a + b) \times h$$

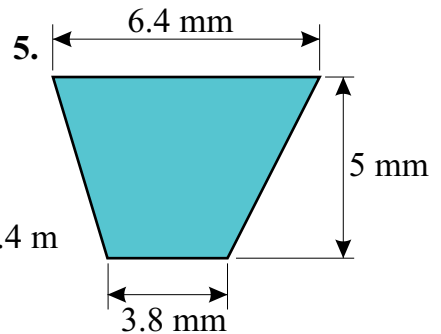
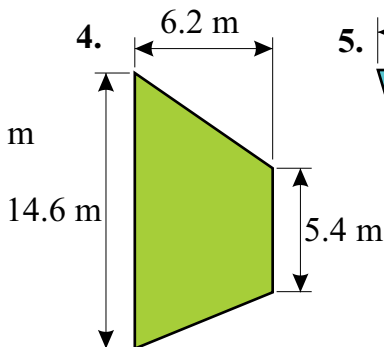
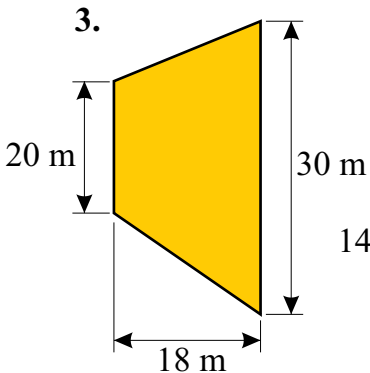
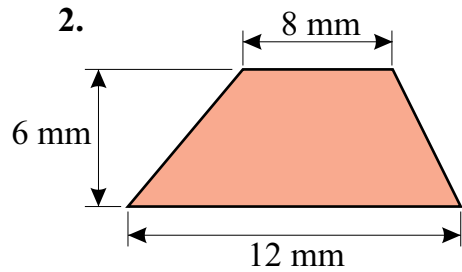
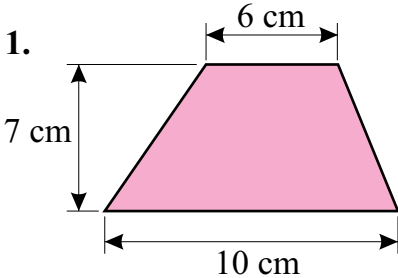


Example

$$\begin{aligned} \text{Area} &= \frac{1}{2} (4 + 8) \times 5 \\ &= \frac{1}{2} \times 12 \times 5 \\ &= 6 \times 5 \\ &= 30 \text{ m}^2 \end{aligned}$$



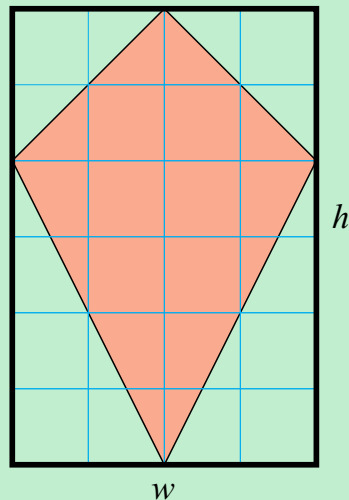
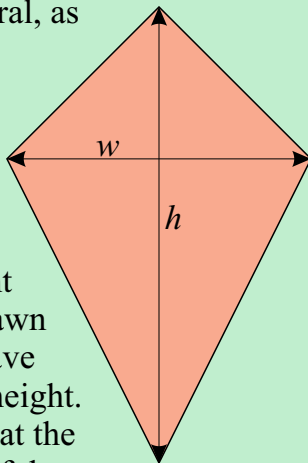
Find the area of each of the following trapeziums.



Kites

EXERCISE 12J

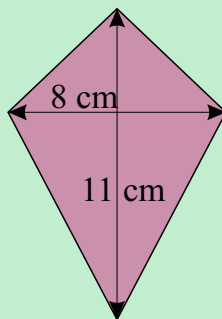
A kite is a quadrilateral, as shown here, that has diagonals that are perpendicular and is symmetrical about one diagonal. If the kite has a width of w and height of h the rectangle drawn about the kite will have the same width and height. It can also be seen that the area of the kite is half the area of the rectangle.



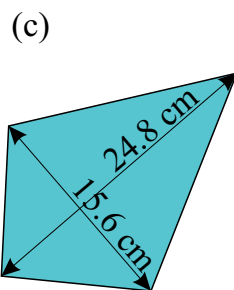
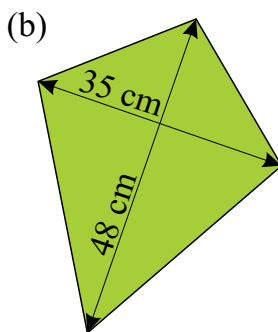
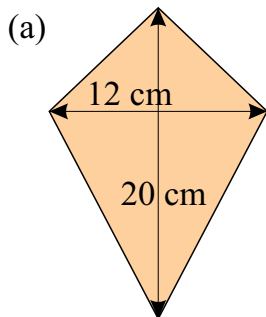
$$\text{Area of a kite} = \frac{1}{2} (w \times h)$$

Example

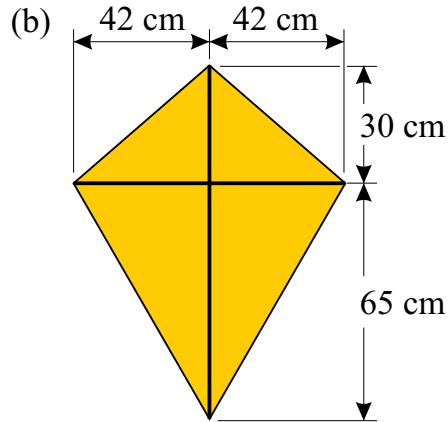
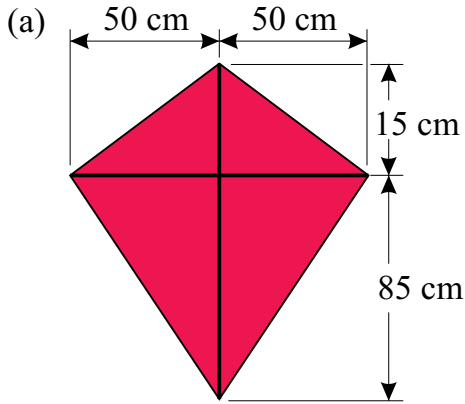
$$\begin{aligned} \text{Area} &= \frac{1}{2} (8 \times 11) \\ &= \frac{1}{2} \text{ of } 88 \\ &= 44 \text{ cm}^2 \end{aligned}$$



1. Find the area of each of the following kites.

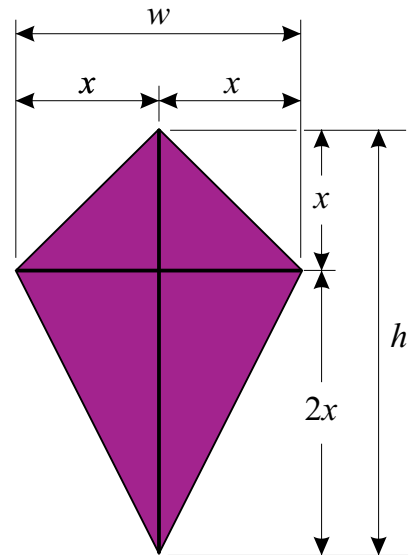


2. Shaun wants to make a kite to fly. He found the dimensions of two different kites and these are shown here. What is the area of each of these kites?

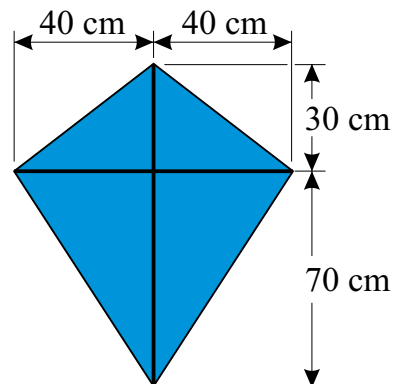


3. Jorga found the following plans to make a kite.

- (a) If Jorga wanted to make a kite that had a width (w) of 60 cm, find:
- the height (h) of the kite.
 - the area of the kite.
- (b) If Jorga wanted to make a kite that had a height (h) of 1.2 metres, find:
- the width (w) of the kite.
 - the area of the kite.



4. Marlee wanted to make the kite shown here. He wanted to make it without wasting material. Describe how he could make this kite without wasting any material by cutting pieces out from one piece of material. Show clearly the size of the piece of material.

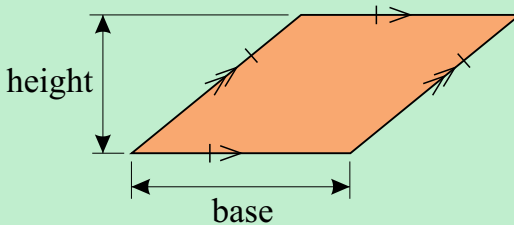


Rhombuses

A rhombus is a parallelogram that has all four sides of equal length. There are two ways to calculate the area of a rhombus depending on which dimensions are given.

Method 1

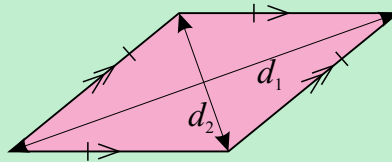
If the base length and height are given, the area can be calculated the same way as for a parallelogram.



$$\text{Area of a rhombus} = \text{base} \times \text{height}$$

Method 2

If the length of the diagonals are given, the area can be calculated the same way as for a kite. This is because the diagonals of a rhombus are perpendicular as for a kite.



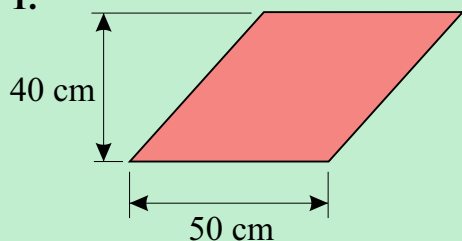
$$\text{Area of a rhombus} = \frac{1}{2} (d_1 \times d_2)$$

EXERCISE 12K

Examples

Find the area of each of the following rhombuses.

1.

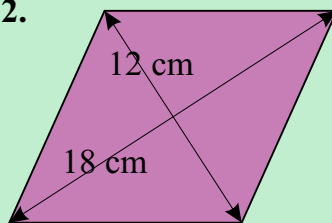


In this example the base and height are known so the following formula for area is used:

$$\text{Area of a rhombus} = \text{base} \times \text{height}$$

$$\begin{aligned} \text{Area} &= 50 \times 40 \\ &= \mathbf{2000 \text{ cm}^2} \end{aligned}$$

2.



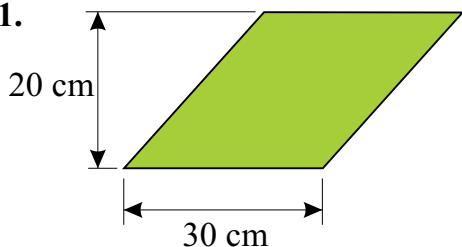
In this example the length of the two diagonals are known so the following formula for area is used:

$$\text{Area of a rhombus} = \frac{1}{2} (d_1 \times d_2)$$

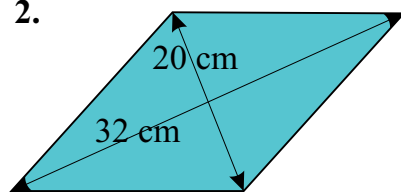
$$\begin{aligned} \text{Area} &= \frac{1}{2} (18 \times 12) \\ &= \frac{1}{2} \text{ of } 216 \\ &= \mathbf{108 \text{ cm}^2} \end{aligned}$$

Find the area of each of the following rhombuses.

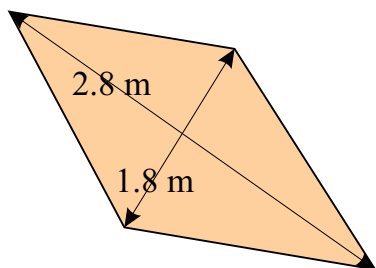
1.



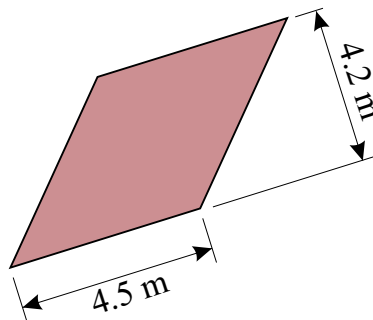
2.



3.



4.

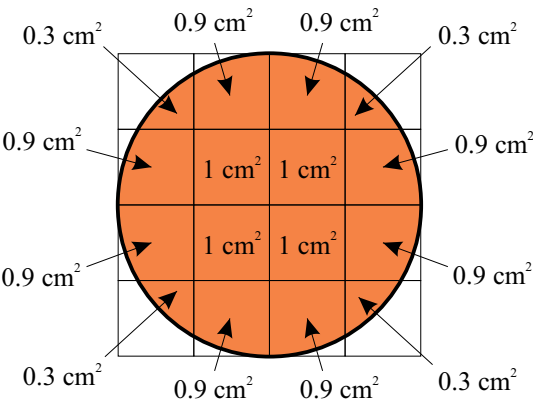


Circles

ACTIVITY

Step 1 Using a compass, or otherwise, draw a circle of known radius on a 1 cm grid.
In the example shown here the circle has a radius of 2 cm.

Step 2 Find an approximate area of the circle by adding all the 1 cm² squares and parts of squares.
Note: estimate the area of the sections that are not complete squares.
In this example the approximate area of the circle is:



approximate area = 0.3 + 0.9 + 0.9 + 0.3 + 0.9 + 0.9 + 0.3 +
0.9 + 0.9 + 0.3 + 0.9 + 0.9 + 1 + 1 + 1 + 1
= 12.4 cm²

Step 3 Copy and complete this table for different radii. The example of $R = 2$ cm is shown.

R	R^2	A	$\frac{A}{R^2}$
2	4	12.4	3.1

- Step 5** What do you notice about the value of $\left(\frac{A}{R^2}\right)$?
- Step 6** What should be the value of $\left(\frac{A}{R^2}\right)$ correct to five decimal places?
- Step 7** What is the symbol given to this?
- Step 8** Complete these equations using this symbol:

$\frac{A}{R^2} = \square$
 $A = \square \times R^2$

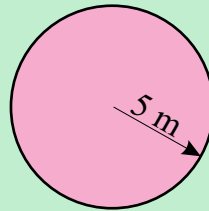
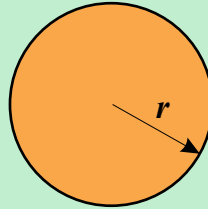
EXERCISE 12L

*Area of a circle = $\pi \times r^2$
(where r = the radius)*

$$A = \pi r^2$$

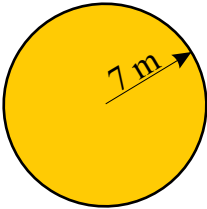
Example

$$\begin{aligned} \text{Area} &= \pi r^2 \\ &= \pi \times 5^2 \\ &= \pi \times 25 \\ &= \mathbf{78.5 \text{ m}^2} \text{ (1 dec. place)} \end{aligned}$$

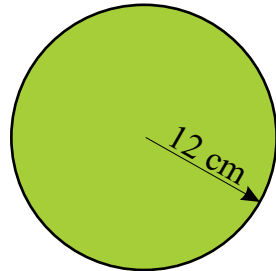


Find the area of each of the following circles.
Give answers to one decimal place.

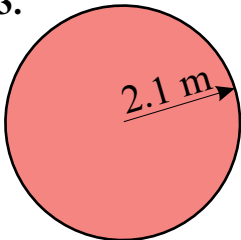
1.



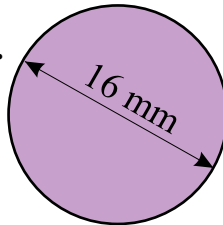
2.



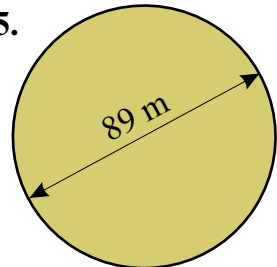
3.



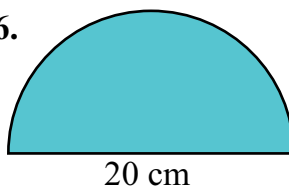
4.



5.



6.

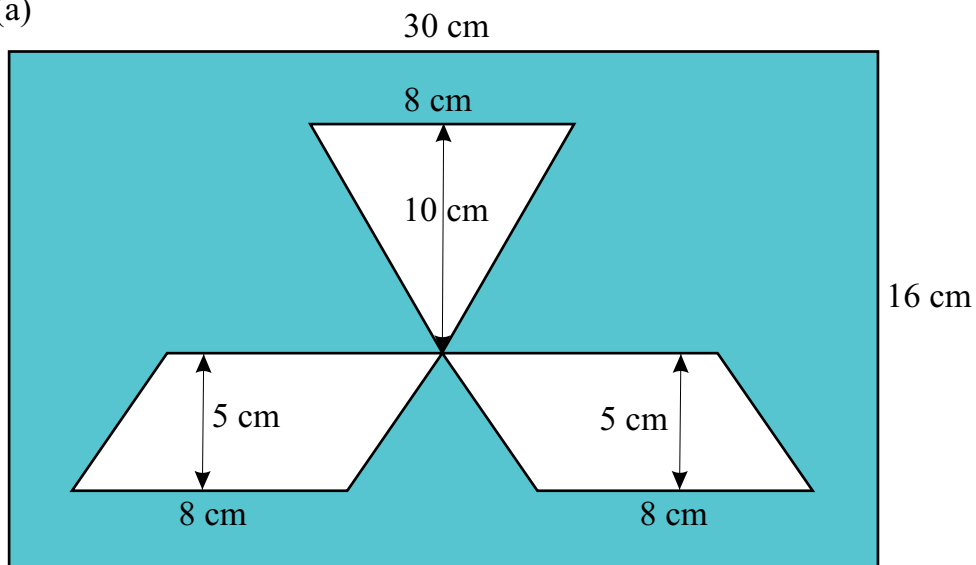


Problems on Area

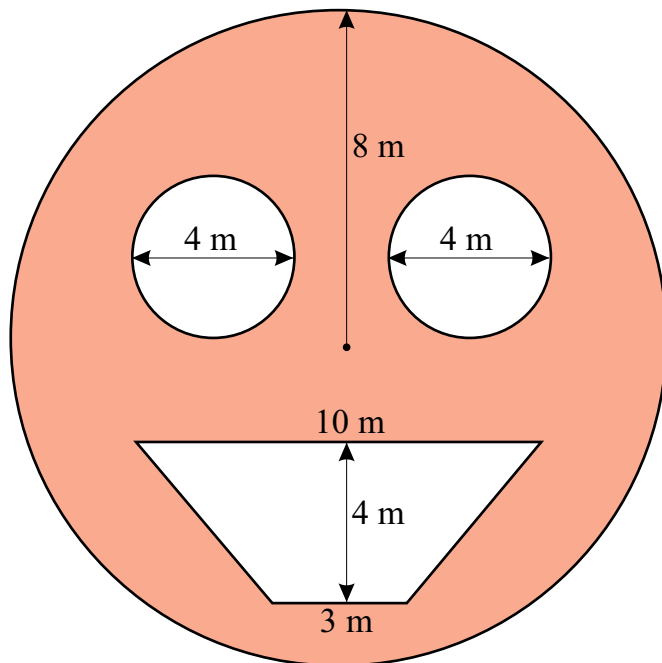
EXERCISE 12M

1. Find the area of the shaded regions below.

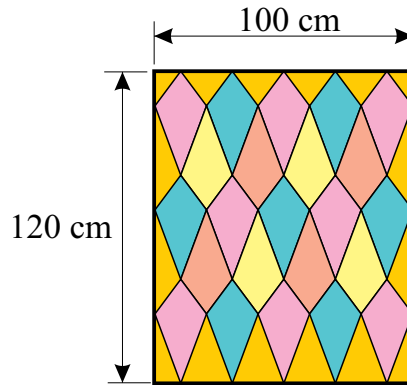
(a)



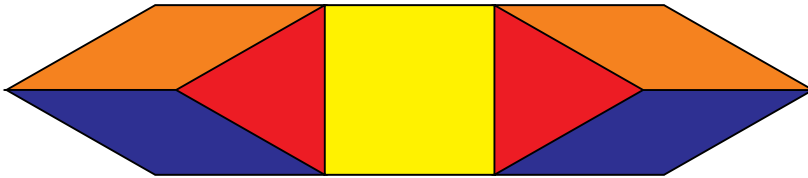
(b)



2. The pattern shown here is made with kites and triangles. What is the area of one of the kites?



3. A rhombus has an area of 3200 cm^2 . The height of the rhombus is half the base length. What is the height of the rhombus?
4. A rhombus has an area of 1200 cm^2 . One diagonal is 20 cm longer than the other. Find the lengths of the diagonals.
5. The symmetric drawing below is made of a square, two triangles and four rhombuses. The side length of each rhombus is the same as the side length of the square. The area of the square is 1600 cm^2 .
- (a) What is the name given to the type of triangles?
- (b) What is the area of each of the rhombuses?



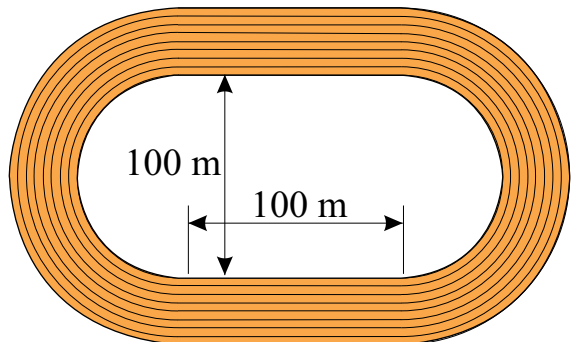
6. Saffy used mosaic tiles to decorate items of furniture. The mosaic tiles she used were **square** with side length of 20 mm. How many of these tiles would she need to decorate the following items?
- (a) A drink coaster that was 100 mm square.
- (b) A rectangular board that was 20 cm long and 10 cm wide.
- (c) A rectangular coffee table that was 1.5 m long and 50 cm wide.
- (d) A square piece of artwork that had an area of 1600 cm^2 .
- (e) A circular table that had a diameter of 80 cm. (Assume she can neatly break the tiles so there is no wasted tiles)
- (f) A wall in her bedroom that had an area of 6.5 m^2 .



7. A piece of wire is in the shape of a circle with radius 10 cm. What length of wire would be needed to form a square that has the same area as the circle? Give answer to one decimal place.
8. A farmer is harvesting all the wheat from his farm. The farm is 64 hectares and is in the shape of a square. He is using a harvester that is 20 metres across and can travel at an average speed of 100 metres per minute.
- What are the dimensions of the farm?
 - How long would it take the harvester to travel the length of the farm?
 - How many times will the farmer need to drive the harvester the length of the farm to harvest all the wheat?
 - How long will it take to harvest all the wheat?
9. Cheryl is a photographer. She has a photo that is $16\text{ cm} \times 8\text{ cm}$ that she wants to enlarge to be twice as long and twice as wide.
- What is area of the original photo?
 - What is the difference between the area of the enlarged photo and the area of the original photo?
 - How many copies of the original photo would have the same area as the enlarged photo?

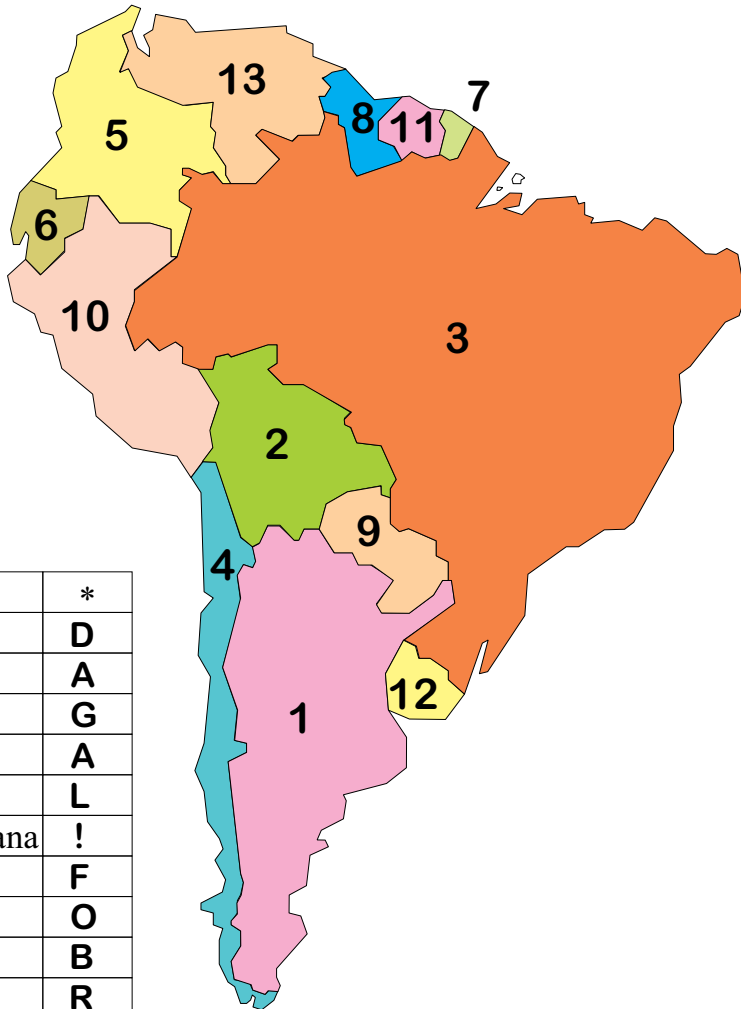


10. Rodney was given the task of painting all the lanes around an athletics field. The dimensions of the field are shown here and there are 8 lanes that are 1 metre wide.



- What is the area to be painted?
Give answer to the nearest m^2 .
- If each litre of paint covers 10 m^2 , how many litres of paint will Rodney need?

11. A map of South America is shown below. There are 13 countries in South America and these are all coloured and listed alphabetically.



1. Argentina	*
2. Bolivia	D
3. Brazil	A
4. Chile	G
5. Colombia	A
6. Ecuador	L
7. French Guiana	!
8. Guyana	F
9. Paraguay	O
10. Peru	B
11. Suriname	R
12. Uruguay	E
13. Venezuela	*

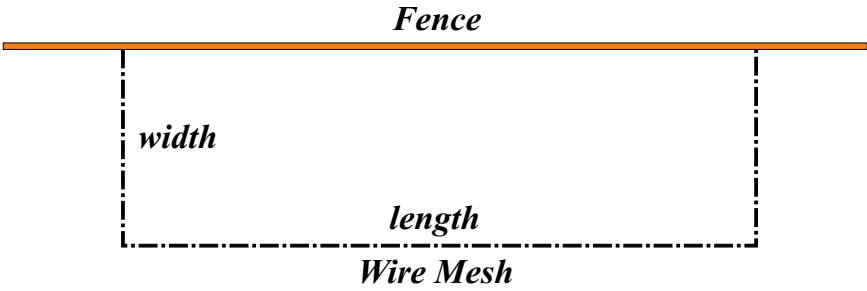
By comparing the sizes of the countries, arrange them in order from the largest to the smallest.

With the countries arranged in the correct order, match the letters next to the countries to spell the answer to this riddle.

What goes putt-putt-putt-putt-putt?

PROBLEM SOLVING

1. Xanda owned a **square** block of land that had an area of 4 hectares. He wanted to divide the block into eight equal rectangular blocks to sell.
- (a) Describe two ways he could divide the land into eight equal rectangular blocks.
- (b) What would be the dimensions of each small block in each of these two subdivisions?
2. Hilda wants to build a pen for her rabbits in the backyard. She buys 12 metres of wire mesh that she is going to use as a border. Hilda decides to use the fence in the backyard as one side of the pen and the wire mesh to make the other three sides of the rectangular pen.



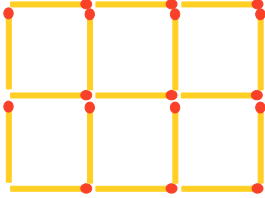
- (a) Guess which values for the length and width would give the largest area of the rabbit pen.
- (b) Copy and complete the table below showing all the possible values for the length and width (use only whole numbers) if all of the wire mesh is used.
- Calculate the area for each.



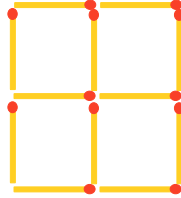
Length (m)	Width (m)	Area (m ²)

PUZZLES

1. Remove 6 matches to leave exactly 2 squares.

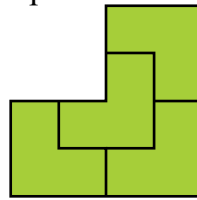
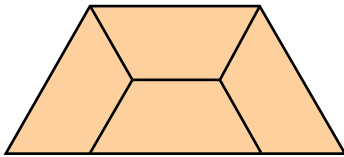


2. (a) Rearrange 4 matches to make exactly 3 squares.
(b) Rearrange 2 matches to make exactly 7 squares.

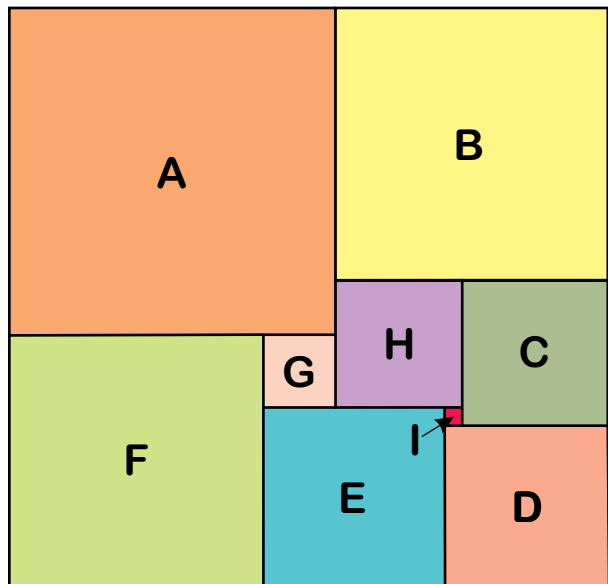


3. (a) Form 2 equilateral triangles using 7 matches.
(b) Form 4 equilateral triangles using 9 matches.
(c) Form 5 equilateral triangles using 9 matches.
(d) Form 8 equilateral triangles using 6 matches.
(e) Form 4 equilateral triangles using 6 matches.

4. Each of the shapes below are divided into 4 identical parts.
Can you divide a *square* into 5 identical parts?

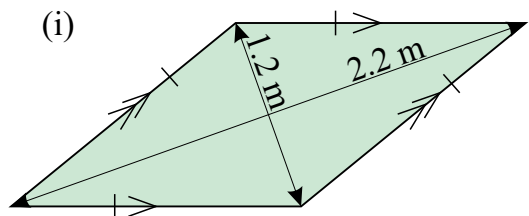
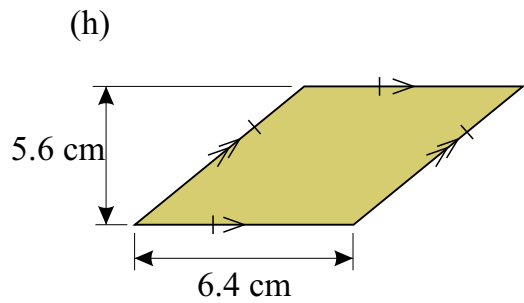
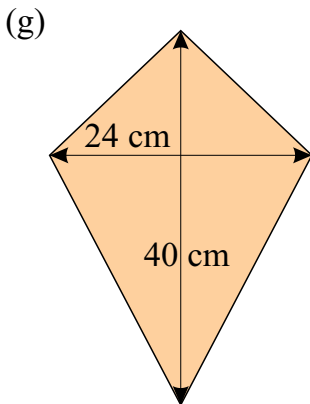
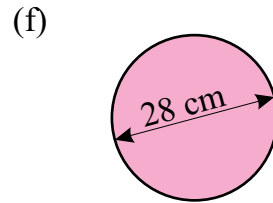
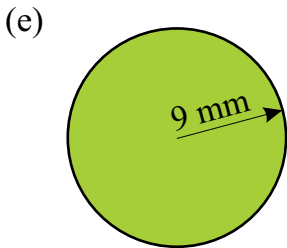
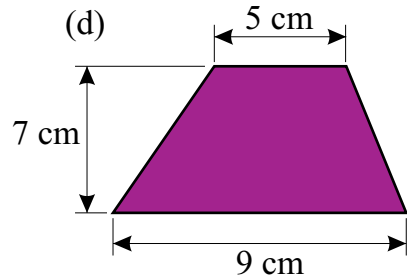
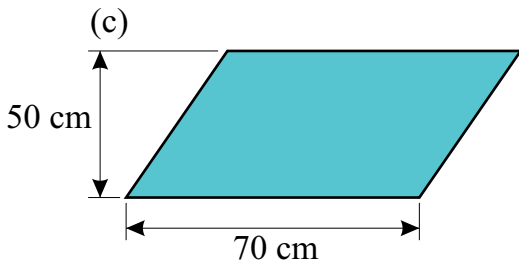
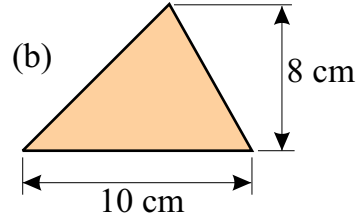
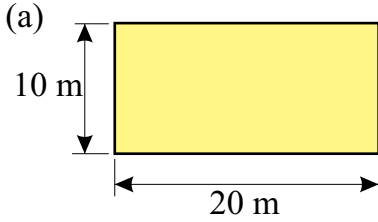


5. All sections of this shape are squares.
The area of **C** = 64 cm^2
The area of **D** = 81 cm^2
(a) Find the area of all of the other squares.
(b) Is the total shape a square?



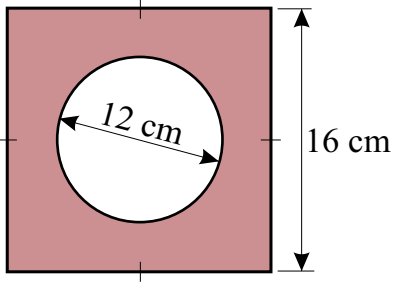
CHAPTER REVIEW

1. Find the areas of the shapes below.

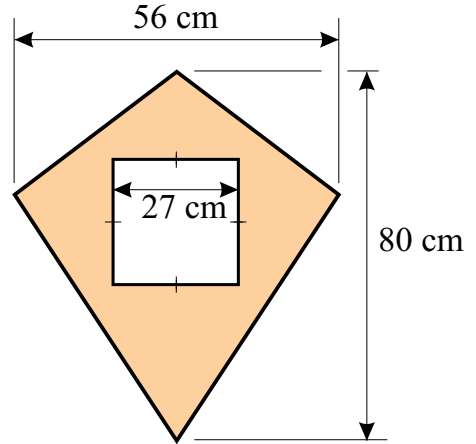


2. Find the area of the shaded regions below.

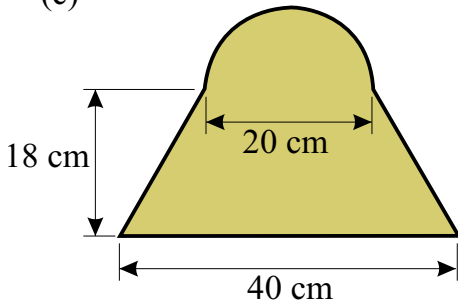
(a)



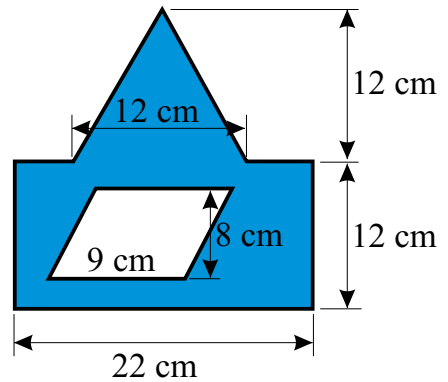
(b)



(c)



(d)



3. Find the area of a $0.5 \text{ m} \times 0.2 \text{ m}$ rectangle giving the answer in:

(a) m^2 (b) cm^2 (c) mm^2

4. A farm is in the shape of a rectangle and is 2.5 km long and 3 km wide. Find the area of the farm in hectares.

Surface Area

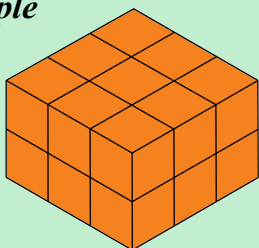
Surface Area

EXERCISE 13A

1. The objects below are made from small cubic blocks. If the objects are painted all over, how many of the small blocks from each object have:

- (i) 4 faces painted?
- (ii) 3 faces painted?
- (iii) 2 faces painted?
- (iv) 1 face painted?
- (v) no faces painted?

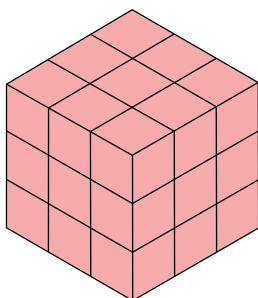
Example



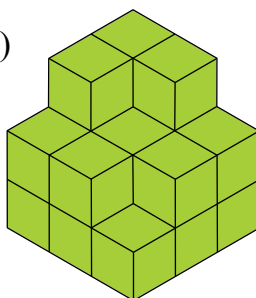
This object would have:

- (i) no blocks with 4 faces painted
- (ii) 8 blocks with 3 faces painted
- (iii) 8 blocks with 2 faces painted
- (iv) 2 blocks with 1 face painted
- (v) no blocks with no faces painted

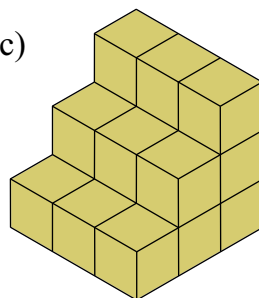
(a)



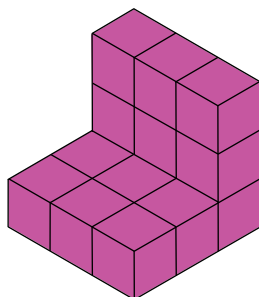
(b)



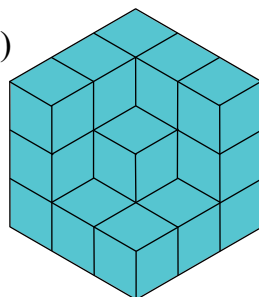
(c)



(d)



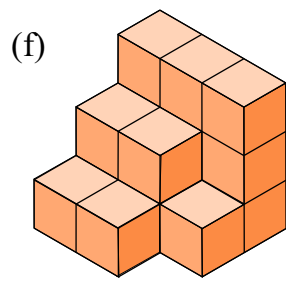
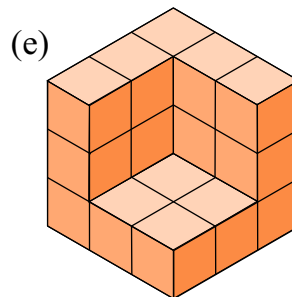
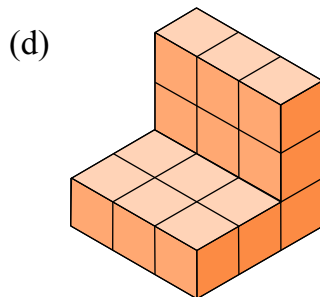
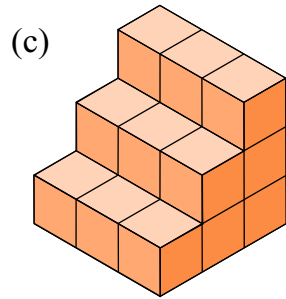
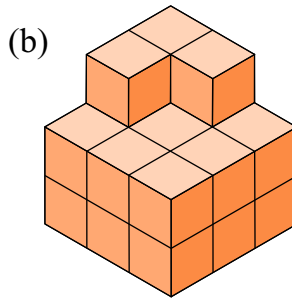
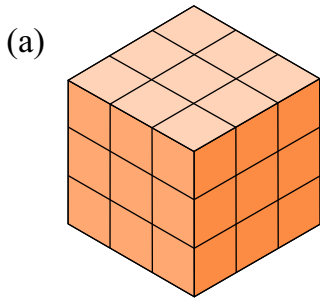
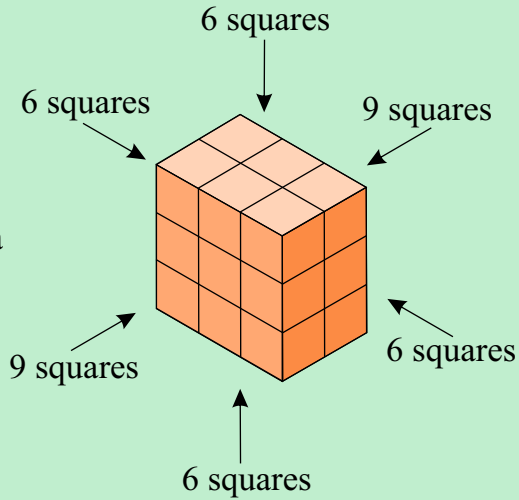
(e)



2. The objects below are made with 1 cm^3 blocks. Each square on the surface of the objects will have an area of 1 cm^2 .
Add all the squares to find the surface area of each object.

Example

Add all the squares
to find the surface area
 $6 + 9 + 6 + 6 + 9 + 6$
 $= 42 \text{ cm}^2$



Prisms

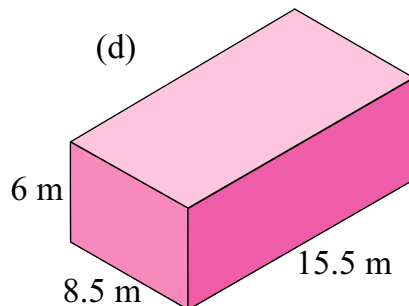
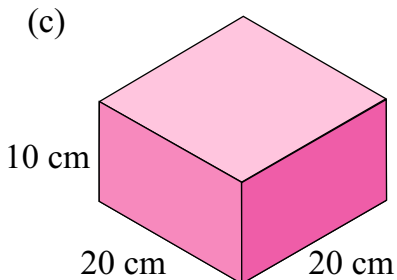
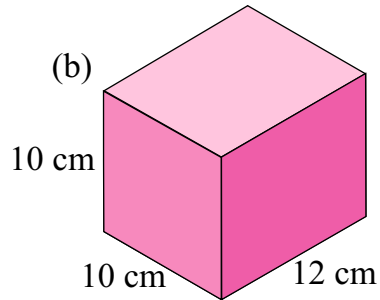
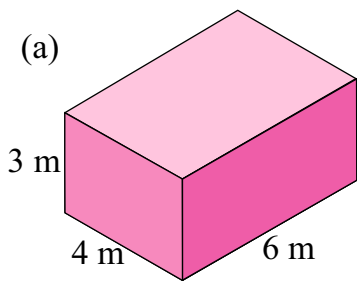
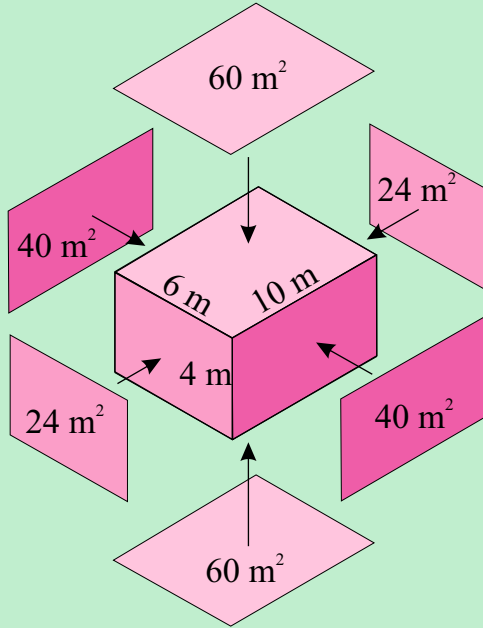
EXERCISE 13B

1. Find the surface area of the following prisms.

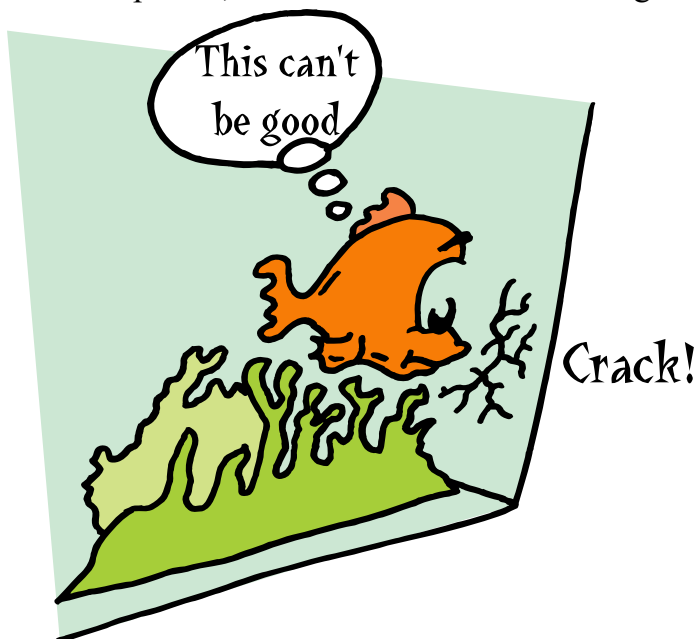
Example

Find the area of each face of the prism.
Add the areas of the faces to find the surface area of the object.

$$40 + 60 + 24 + 40 + 60 + 24 = 248 \text{ m}^2$$



2. Find the surface area of a cube with side length 5 cm.
3. Leah wanted to make a feed box for her llamas. The feed box was to be 3 metres long, 2 metres wide and 1 metre high with a lid.
- (a) What is the surface area of the feed box?
 - (b) Leah planned to make the feed box out of sheet metal that costs \$20 per m^2 . What will be the cost of the sheet metal required to make the box?
4. Dominik wants to make a fish tank. He is going to buy the glass and construct the tank himself. The tank is to be 80 cm long, 40 cm wide and 30 cm high. It is to have a removable lid.
- (a) Find the total area of glass needed to make the tank.
 - (b) Dominik is an experienced glass-cutter and is going to buy the glass in one piece and cut it himself. Which of the following sheets of glass could Dominik use to cut all the pieces needed to make the fish tank, with no wastage?
A 80 cm $\times$ 80 cm **B** 120 cm $\times$ 80 cm
C 200 cm $\times$ 70 cm **D** 170 cm $\times$ 80 cm
 - (c) Use a diagram to show how this sheet of glass could be cut into the pieces needed for the fish tank.
 - (d) How many m^2 is this sheet of glass?
 - (e) If glass costs \$100 per m^2 , find the cost of this sheet of glass.



Cylinders

EXERCISE 13C

Find the surface area of each of the following cylinders.
Give answers to one decimal place.

The surface area of a cylinder can be found by using the formula:

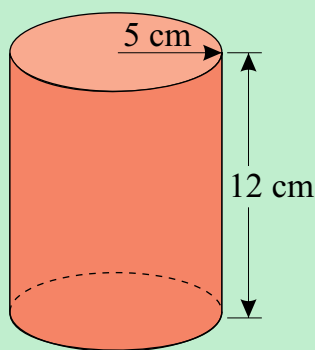
$$\text{Surface area} = 2\pi r(r + h)$$

where r = the radius of the cylinder

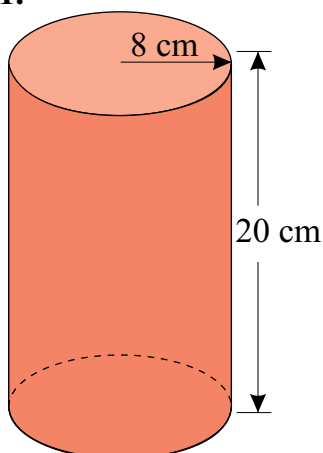
h = the height of the cylinder

Example

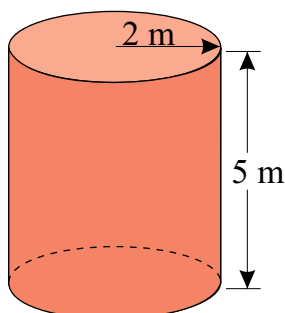
$$\begin{aligned} \text{Surface area} &= 2\pi r(r + h) \\ &= 2 \times \pi \times r \times (r + h) \\ &= 2 \times \pi \times 5 \times (5 + 12) \\ &= 2 \times \pi \times 5 \times 17 \\ &= 534.07075 \text{ cm}^2 \\ &= \mathbf{534.1 \text{ cm}^2} \text{ (1 dec. place)} \end{aligned}$$



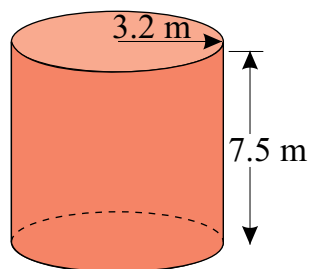
1.



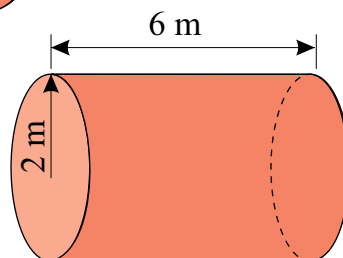
2.



3.



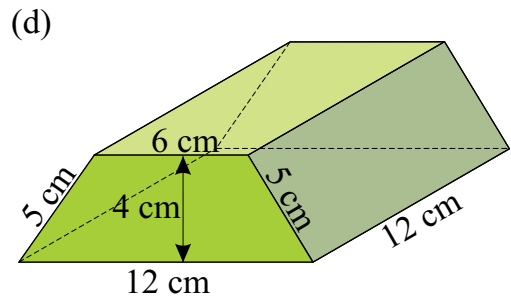
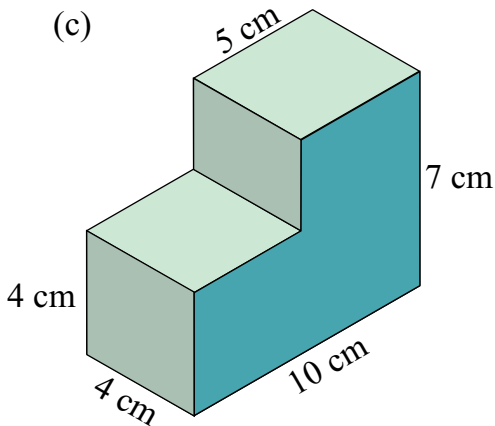
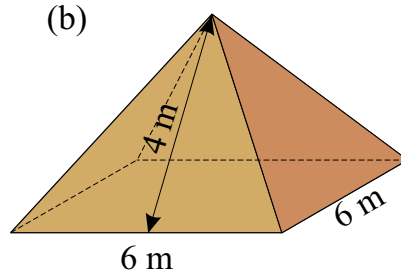
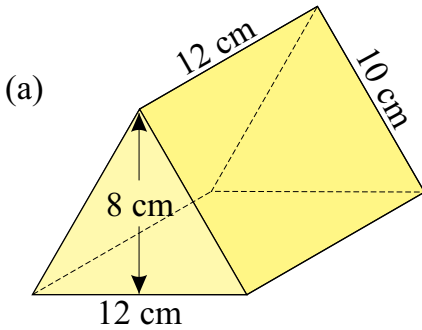
4.



Other Objects

EXERCISE 13D

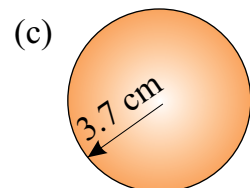
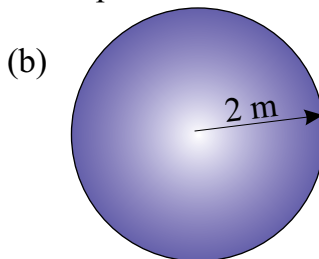
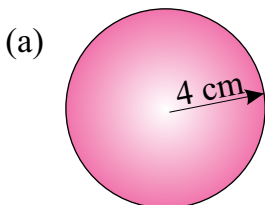
1. Find the surface area of each of the following objects.



2. The surface area of a sphere (ball) is found by using the formula:

Surface area = $4\pi r^2$ where r = the radius of the sphere

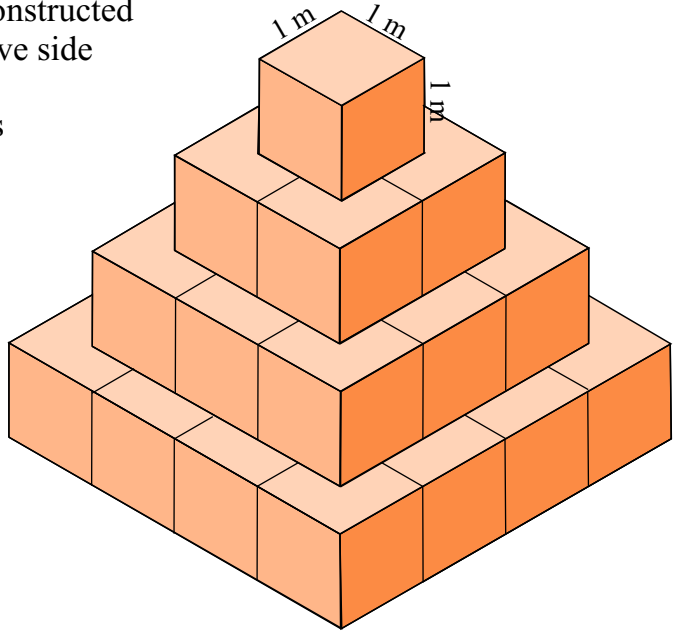
Find the surface area of the following spheres.
Give answers to one decimal place.



PROBLEM SOLVING

The object shown here is constructed with concrete cubes that have side lengths of 1 m.

Find the surface area of this object (do not include the under side of the base).



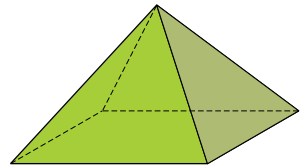
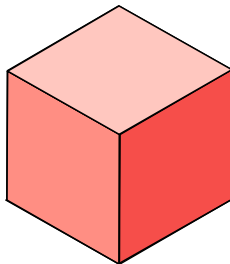
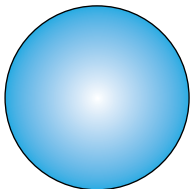
PUZZLE

Two balls weigh the same as one cube.

Three pyramids weigh the same as two cubes.

One cube is two kilograms heavier than one pyramid.

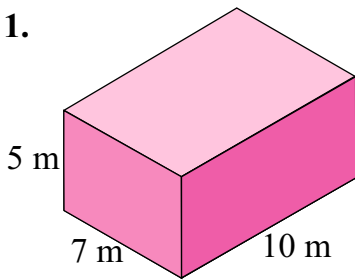
What do each of the objects weigh?



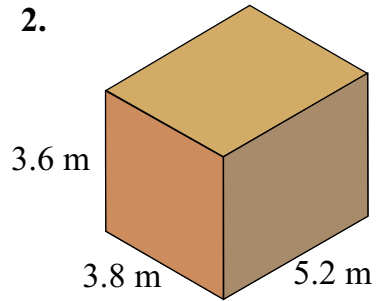
CHAPTER REVIEW

Find the surface area of each of the following objects.

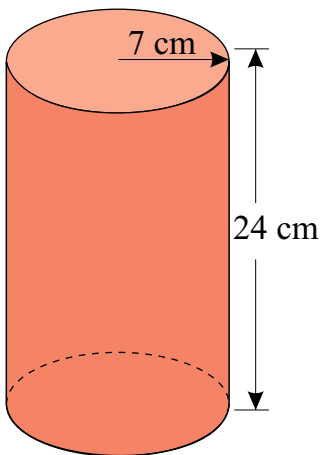
1.



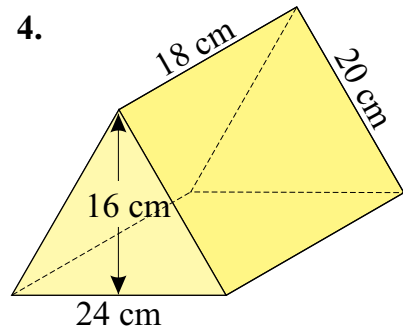
2.



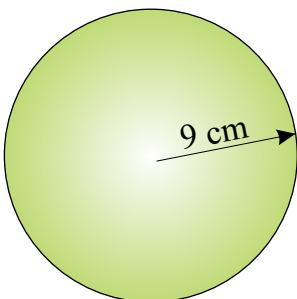
3.



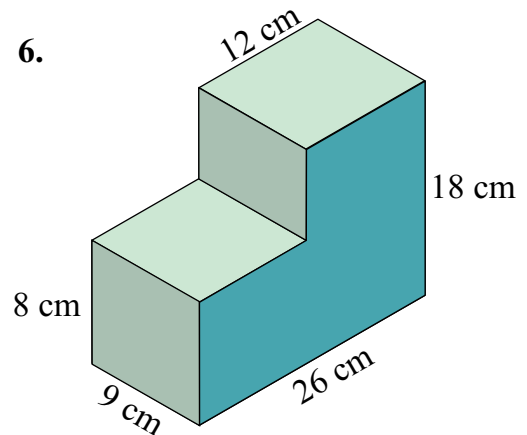
4.



5.



6.



Volume

The amount of three-dimensional space occupied by an object is called its **volume**.

Common units of volume are: cubic millimetres (mm^3)
 cubic centimetres (cm^3)
 litres
 cubic metres (m^3)

The unit used would depend on the size of the volume.

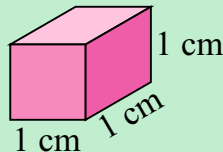
1 mm^3 is the volume equal to a cube with a side length of 1 mm.

1 cm^3 is the volume equal to a cube with a side length of 1 cm.

1 litre is the volume equal to 1000 cm^3 .

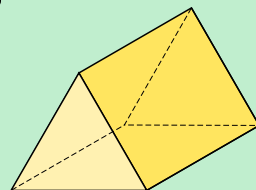
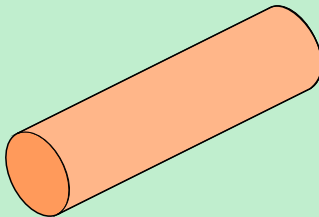
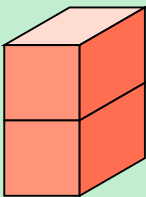
1 m^3 is the volume equal to a cube with a side length of 1 m.

This cube has an volume of 1 cm^3 .



But many shapes would have the same volume.

Examples All the shapes below have a volume of 2 cm^3 .



EXERCISE 14A

1. Choose the alternative which is the best estimate of the volume of each of the following objects.

(a) The volume of water a drinking cup could hold.

A 20 mm³ **B** 100 mm³ **C** 20 cm³ **D** 200 cm³

(b) A football.

A 60 cm³ **B** 600 cm³ **C** 6000 cm³ **D** 60 000 cm³

(c) A person who weighs 70 kg.

A 70 000 mm³ **B** 7000 cm³ **C** 70 000 cm³ **D** 7000 m³

(d) A refrigerator.

A 800 cm³ **B** 8000 cm³ **C** 800 litres **D** 8 m³

(e) A car's fuel tank.

A 500 cm³ **B** 5000 cm³ **C** 50 litres **D** 500 litres

2. Choose which unit would be the most appropriate when measuring the volume of the following objects.

A mm³ **B** cm³ **C** litres **D** m³

(a) A drop of water.

(b) The water in a reservoir.

(c) The size of a bucket.

(d) The amount of water used by a person in one day.

(e) The amount of medicine in a teaspoon.

(f) One scoop of ice-cream.

(g) The amount of concrete needed for a house slab.

(h) The amount of paint needed to paint a house.

(i) A piece of paper.

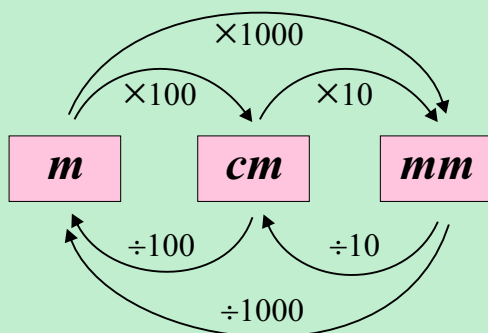
(j) A shipping container.

(k) The amount of sand needed to make the sand sculpture shown here.

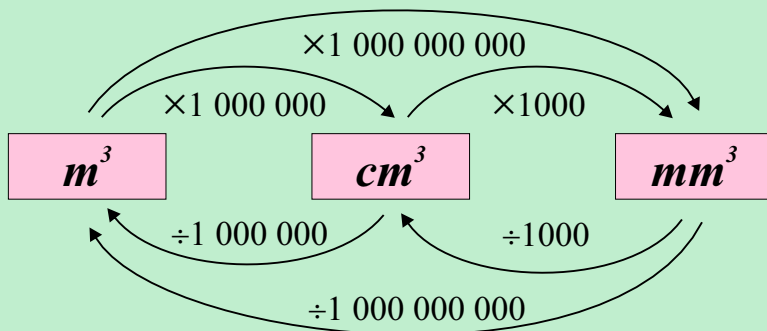


Conversions

Remember the conversion factors for changing from one unit of *length* to another:

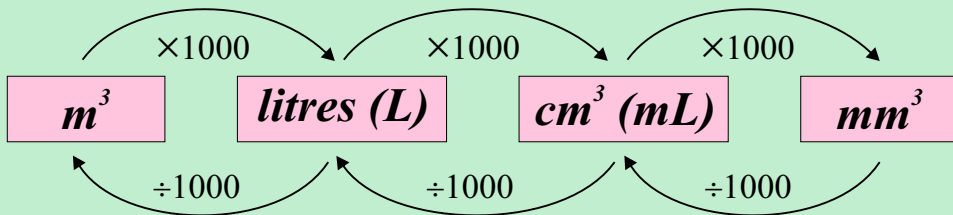


The conversion factors for changing from one unit of *volume* to another are the cube of these as shown below.



Because litres (L) and millilitres (mL) are often used as units of volume, converting to these units should also be known. Millilitres are the same size as cubic centimetres.

$$1 \text{ mL} = 1 \text{ cm}^3$$

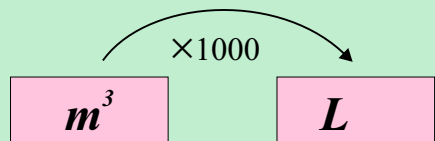


Convert the following volumes to the units shown in the brackets.

Examples

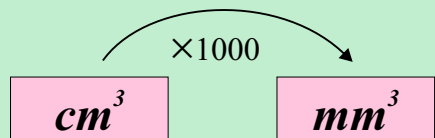
1. 3 m^3 (L)

To change from m^3 to L: $\times 1000$
 $= 3 \times 1000$
 $= 3000 \text{ L}$



2. 5.87 cm^3 (mm^3)

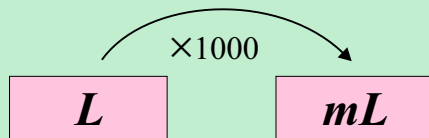
To change from cm^3 to mm^3 : $\times 1000$
 $= 5.87 \times 1000$
 $= 5870 \text{ mm}^3$



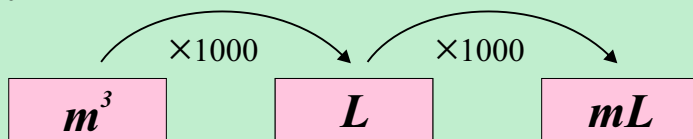
Examples continued

3. 0.29 L (mL)

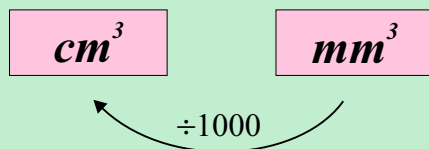
To change from L to mL: $\times 1000$
 $= 0.29 \times 1000$
 $= \mathbf{290 \text{ mL}}$

4. 0.043 m³ (mL)

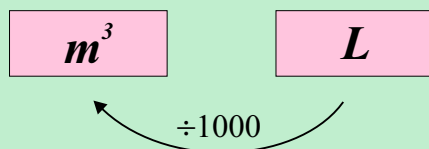
To change from m³ to mL: $\times 1\,000 \times 1\,000 (\times 1\,000\,000)$
 $= 0.043 \times 1\,000\,000$
 $= \mathbf{43\,000 \text{ mL}}$

5. 670 mm³ (cm³)

To change from mm³ to cm³: $\div 1000$
 $= 670 \div 1000$
 $= \mathbf{0.67 \text{ cm}^3}$

6. 98.3 L (m³)

To change from L to m³: $\div 1000$
 $= 98.3 \div 1000$
 $= \mathbf{0.0983 \text{ m}^3}$



EXERCISE 14B

1. Convert the following volumes to *litres (L)*.

- | | | |
|----------------------------|----------------------------|-----------------------------|
| (a) 8000 cm ³ | (b) 12 000 cm ³ | (c) 200 000 cm ³ |
| (d) 500 cm ³ | (e) 9600 cm ³ | (f) 35 700 cm ³ |
| (g) 410 cm ³ | (h) 20 cm ³ | (i) 85 cm ³ |
| (j) 3976.5 cm ³ | (k) 13.4 cm ³ | (l) 258.7 cm ³ |
| (m) 1 cm ³ | (n) 8.5 cm ³ | (o) 0.7 cm ³ |

2. Convert the following volumes to *cubic centimetres (cm³)*.

- | | | |
|--------------|--------------|---------------|
| (a) 2 L | (b) 7 L | (c) 13 L |
| (d) 80 L | (e) 4.1 L | (f) 7.15 L |
| (g) 12.685 L | (h) 10.08 L | (i) 5.5555 L |
| (j) 0.9 L | (k) 0.6752 L | (l) 5.0008 L |
| (m) 0.0052 L | (n) 0.01 L | (o) 0.00007 L |

3. Convert the following volumes to *litres (L)*.

- | | | |
|---------------------------|--------------------------|----------------------------|
| (a) 5 m ³ | (b) 19 m ³ | (c) 200 m ³ |
| (d) 0.4 m ³ | (e) 12.6 m ³ | (f) 4.512 m ³ |
| (g) 0.02 m ³ | (h) 523.6 m ³ | (i) 0.00569 m ³ |
| (j) 3976.5 m ³ | (k) 13.4 m ³ | (l) 258.7 m ³ |

4. Convert the following volumes to *cubic metres (m³)*.

- | | | |
|------------|--------------|-------------|
| (a) 2000 L | (b) 15 000 L | (c) 5879 L |
| (d) 688 L | (e) 42 100 L | (f) 500 L |
| (g) 61 L | (h) 650.5 L | (i) 30 L |
| (j) 0.8 L | (k) 10.56 L | (l) 825.6 L |

5. Convert the following volumes to the units shown in the brackets.

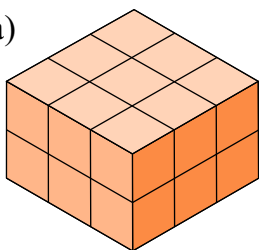
- | | | | |
|----------------------------|-------------------|---------------------------|--------------------|
| (a) 6.7 L | (m ³) | (b) 0.049 cm ³ | (mm ³) |
| (c) 32.8 cm ³ | (L) | (d) 75 mL | (mm ³) |
| (e) 9.1 L | (mL) | (f) 0.028 m ³ | (mL) |
| (g) 73 900 cm ³ | (L) | (h) 105 825 mL | (mm ³) |
| (i) 89 000 mm ³ | (L) | (j) 0.0081 L | (mm ³) |

Rectangular Prisms

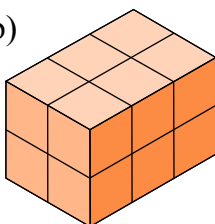
EXERCISE 14C

1. Each of the following objects are made with centimetre cubes.
 The volume of each of the cubes is 1 cm^3 .
 Add the number of centimetre cubes to find the volume (in cm^3)
 of each of the objects.

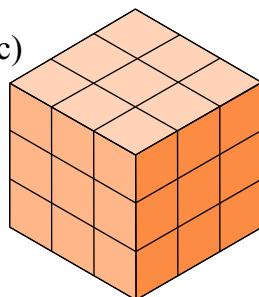
(a)



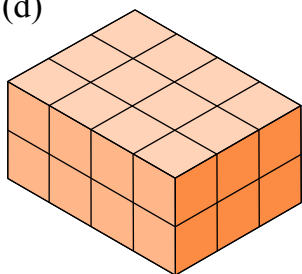
(b)



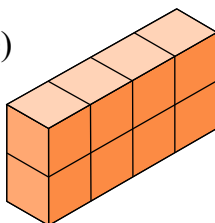
(c)



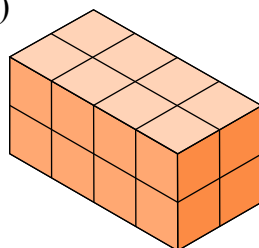
(d)



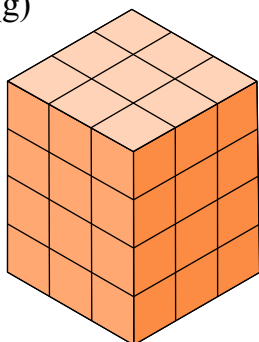
(e)



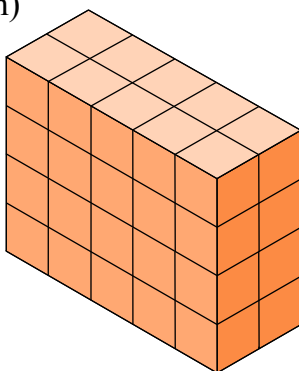
(f)



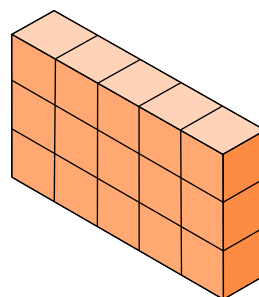
(g)



(h)



(i)



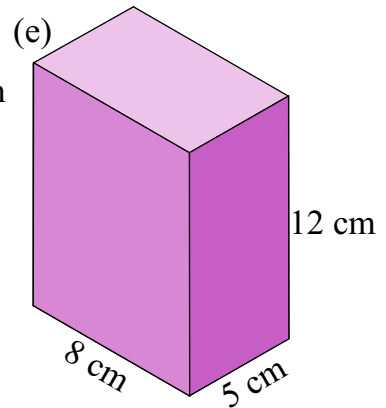
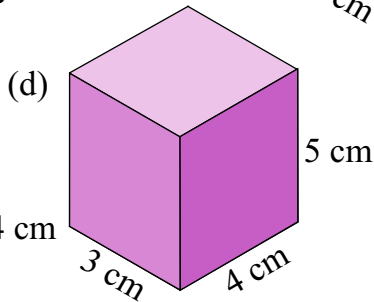
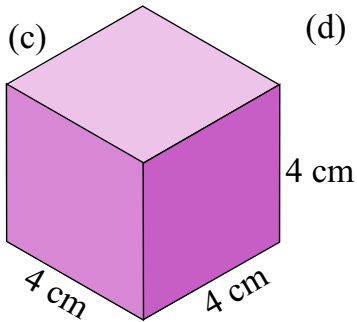
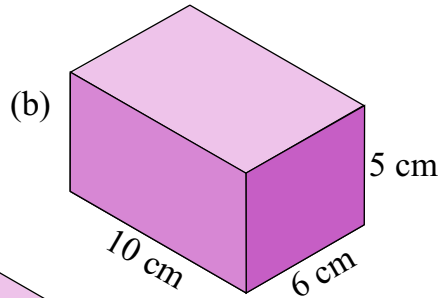
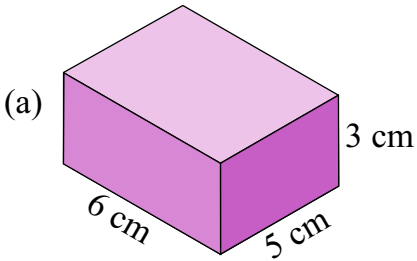
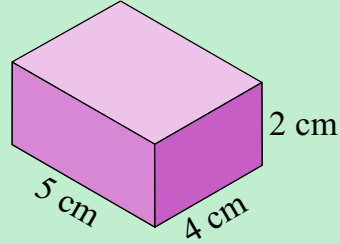
2. In each of the above objects count the number of blocks on each edge.
 Can you find a relationship between the number of blocks on the edges
 of the objects and their volumes?

3. Find the volume of each of the rectangular prisms below.

Volume of rectangular prism = length $\times$ width $\times$ height

Example

$$\begin{aligned}\text{Volume} &= \text{length} \times \text{width} \times \text{height} \\ &= 5 \times 4 \times 2 \\ &= 40 \text{ cm}^3\end{aligned}$$



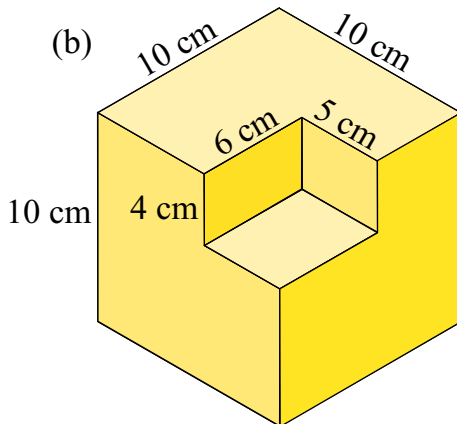
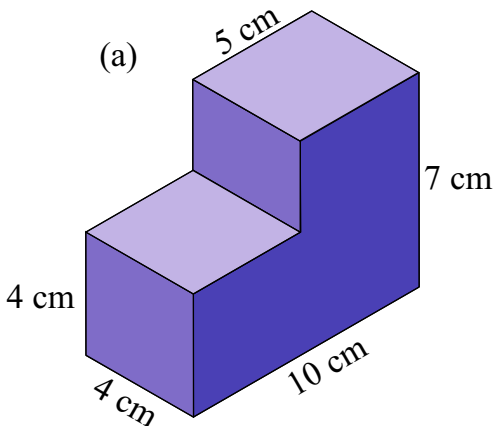
4. Find the volume of the rectangular prisms with the dimensions shown in this table.

	<i>Length (cm)</i>	<i>Width (cm)</i>	<i>Height (cm)</i>
(a)	30	50	20
(b)	10	10	4
(c)	12	5	2
(d)	25	38	16
(e)	18	29	26

5. A tip truck has a carrying compartment that is 6 metres long, 3 metres wide and 2 metres high.
- What is the capacity, in m^3 , of the tip truck?
 - The tip truck is being loaded with sand by an excavator that has a scoop that can lift 2 m^3 ? How many scoops from the excavator would be needed to completely fill the tip truck with sand?

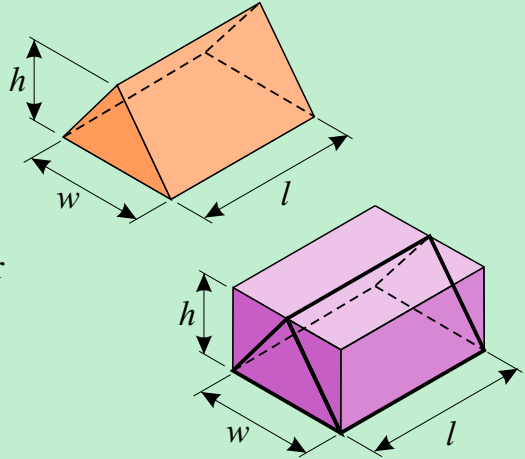


6. A cardboard carton is used to pack boxes of breakfast cereal. The carton is in the shape of a cube with side length 100 cm, and the boxes of breakfast cereal are 20 cm long, 10 cm wide and 25 cm high.
- What is the capacity, in cm^3 , of the packing carton?
 - What is the volume of a box of cereal?
 - How many boxes of the breakfast cereal could be packed into the carton?
7. Find the volume of each of the following objects.



Triangular Prisms

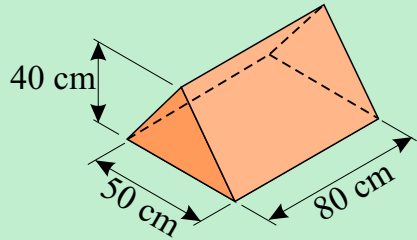
It can be seen that in the same way that the area of a triangle is half the area of a rectangle with the same base and height, the volume of a triangular prism is half the volume of a rectangular prism with the same length, l , width, w , and height, h .



$$\text{Volume of triangular prism} = \frac{1}{2} (\text{length} \times \text{width} \times \text{height})$$

Example

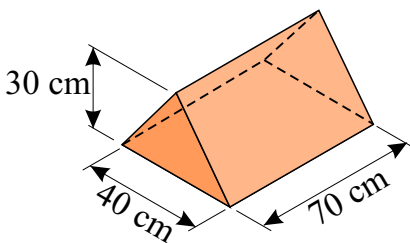
$$\begin{aligned} \text{volume} &= \frac{1}{2} (\text{length} \times \text{width} \times \text{height}) \\ &= \frac{1}{2} (80 \times 50 \times 40) \\ &= \mathbf{80\,000\,cm^3} \end{aligned}$$



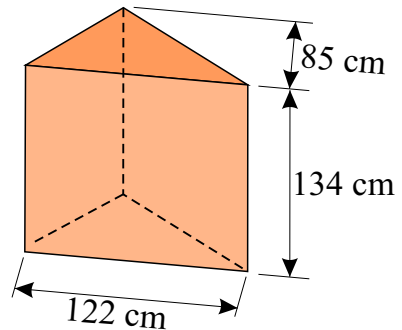
EXERCISE 14D

Find the volume of the following triangular prisms.

1.



2.

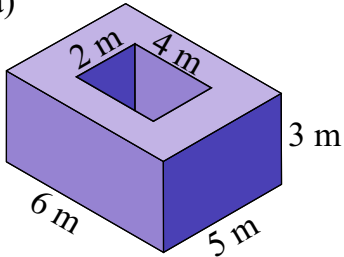


Volume Problems

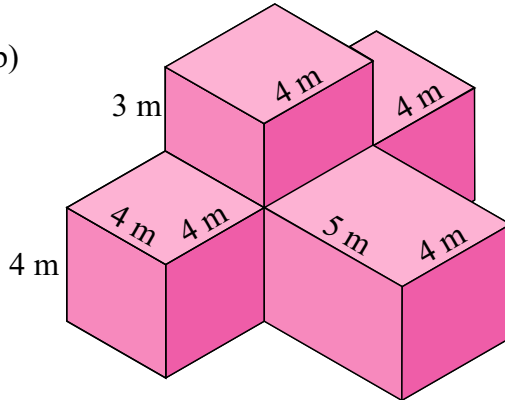
EXERCISE 14E

1. Find the volume of the following objects, giving your answer in: (i) m^3 (ii) litres

(a)



(b)



2. Eugene owns a swimming pool that is 25 metres long, 10 metres wide and 2 metres deep.

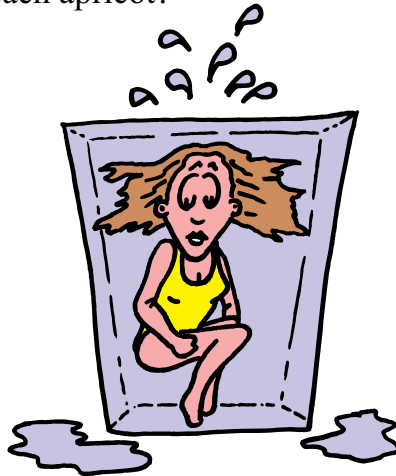
- (a) How many litres of water are in the swimming pool?
 (b) The swimming pool was filled using a hose that delivered 50 000 litres per hour. How long would it have taken to fill the swimming pool?



3. A concrete slab was to be poured for a house. The rectangular house was 30 metres long and 14 metres wide. The concrete slab was to be 10 cm thick.

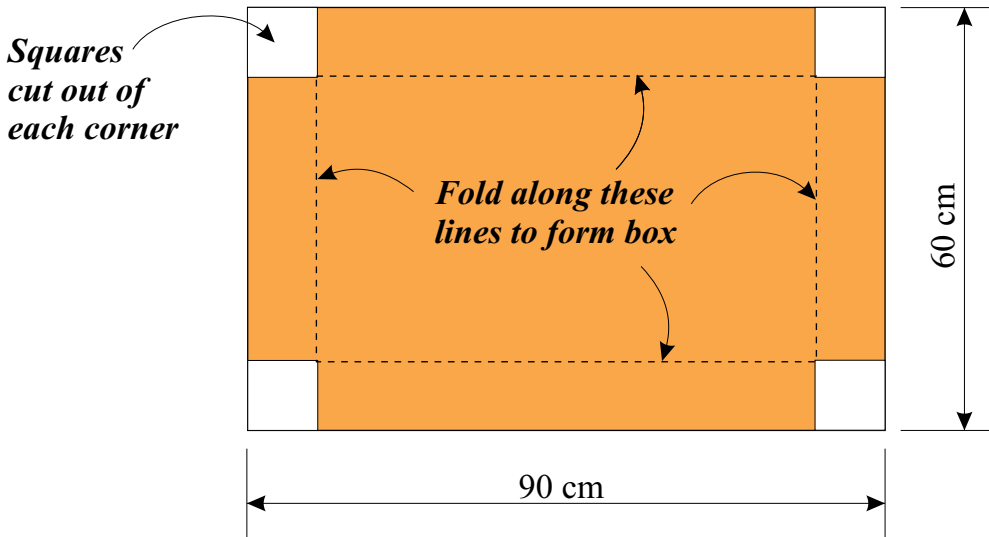
How many cubic metres of concrete were needed for the slab?

4. A bottle contained 1 litre of medicine. If the doses of the medicine were 25 cm^3 , how many doses were in the bottle?
5. Alanna had a cough and bought some cough medicine. The bottle contained 200 mL. Alanna had to take one teaspoon of the medicine four times a day. If a teaspoon holds 5 cm^3 , how many days will the bottle last?
6. How many 375 mL glasses could be filled from a 1.5 litre bottle of milk?
7. Philipa bottled some apricots. She put 20 apricots in a 1 litre bottle and noted that she needed to add another 400 mL of water to fill up the bottle. What is the volume of each apricot?
8. Ruxandra wanted to calculate the volume of her body. She did this by almost filling a large tank with water. The tank was in the shape of a cube with side length of 2 metres. She then jumped into the tank and noted that when she was fully under the water the water level had risen 2 cm. What is the volume (in litres) of Ruxandra's body?
9. There are 10 reservoirs that hold the water for Melbourne. The largest of these is the Thomson that can hold 1 068 000 megalitres. The total capacity of all the reservoirs is 1 787 500 megalitres. (1 megalitre = 1 000 000 litres)
There are about 4 million people using water from these reservoirs. In one day the people of Melbourne used 1000 megalitres of water. How many litres of water, on average, did each person use?



PROBLEM SOLVING

1. Soeren wants to make a box, without a lid, that holds 20 litres. He decides to make this box by cutting square corners out of a rectangular piece of board and folding the sides up to make the box (see diagram below). The board is 90 cm long and 60 cm wide. Find the size of the square cut-outs from each corner so the box formed has a capacity of 20 litres. (There are two answers)



2. Kristen decides to put a water tank at the side of her house to collect rain water off the roof for drinking. The roof of her house has an area of 40 m^2 . The water tank holds 2000 litres.
- If 10 mm of rain fell on the roof, how many litres of water would flow into the tank?
 - How many millimetres of rain would need to fall to fill the tank?

PUZZLE

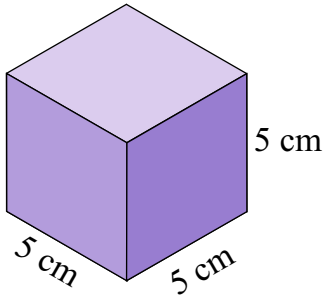
Describe how a 7 litre and a 4 litre container could be used to measure the following volumes.

1. 1 litre 2. 6 litres 3. 2 litres 4. 5 litres

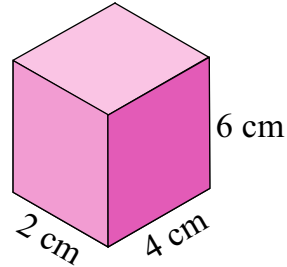
CHAPTER REVIEW

1. Find the volume (in cm^3) of the objects below.

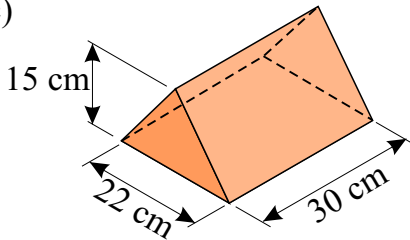
(a)



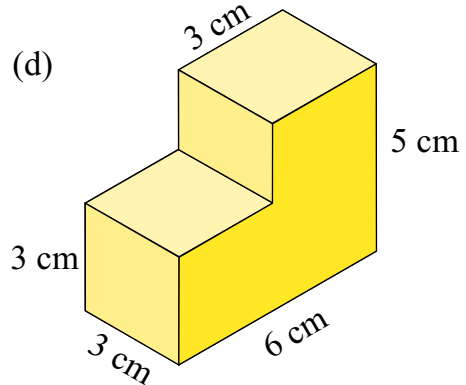
(b)



(c)



(d)



2. Find the volume (in litres) of the rectangular prisms with the following dimensions.

(a) $4 \text{ m} \times 1 \text{ m} \times 1 \text{ m}$

(b) $3 \text{ m} \times 2 \text{ m} \times 3.5 \text{ m}$

(c) $80 \text{ cm} \times 30 \text{ cm} \times 10 \text{ cm}$

(d) $180 \text{ cm} \times 150 \text{ cm} \times 20 \text{ cm}$

3. Find the volume of a triangular prism that has a length of 45 cm, width of 50 cm and a height of 42 cm. Give answer in litres.

4. Convert 25.5 litres into: (a) m^3 (b) cm^3

5. A rectangular prism has a volume of 12 cm^3 . How high is the prism if it is 3 cm long and 2 cm wide?

6. How many litres of petrol would be in a tank that is 25 cm long, 30 cm wide and 24 cm high?

7. How many 200 mL glasses could be filled from a 2 litre bottle?

Time

Units of Time

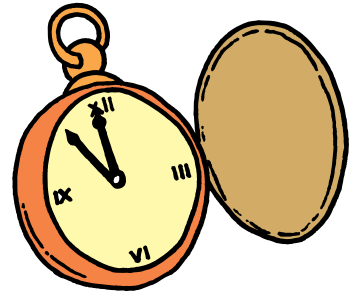
EXERCISE 15A

1. Arrange the units of time shown below from the shortest to the longest, along with their accompanying letters. The letters will spell the answer to this riddle.

Which animal keeps the best time?

<i>Week</i>	C
<i>Decade</i>	D
<i>Month</i>	H
<i>Year</i>	-
<i>Millennium</i>	G
<i>Minute</i>	W

<i>Millisecond</i>	A
<i>Second</i>	*
<i>Century</i>	O
<i>Day</i>	T
<i>Hour</i>	A



2. Rearrange the letters in the following phrases to form units of time. Each phrase forms one word.
 (a) *in cold slime* (b) *emu tin* (c) *cry tune* (d) *menu in mill*
3. Find units of time hidden in these sentences.

Example A keyboard is used **for typing**.

- (a) After a heavy rain, the course condition for the cross country run was very poor.
 (b) We tried to get home early to watch our favourite T.V. program.
 (c) After the storm, there was a lot of foam on the surf beach.
 (d) Georgina was excited before her first netball game and woke up very early.
 (e) On the first session of training, the team leader made cadets run twenty kilometres.
 (f) Frieda yelled at her dog to stop it chewing her shoes.
 (g) The gardener picked up the loam in utensils used for cooking.

4. The words for eleven units of time have been broken up and rearranged. Copy all these word parts into your book. Find the eleven words, crossing them out in your books as you find them. There will be three parts of a word remaining. Rearrange them to find the word for a simple device used to run some clocks.

fort enn mon mill y ek du da we dec
lum pen sec ute ury th ar cent ond ho e
ade night ur min ium

5. Copy and complete the words in the following statements. All statements refer to units of time.

Example 12 = m_n_hs in a y_r
12 = *months* in a *year*

- (a) 7 = a__ in a w__k
(b) 60 = __u__s in an h__r
(c) 10 = e__s in a d__a__e
(d) 30 = d__s in __p__i__
(e) 60 = __c__s in a __i__t__
(f) 14 = __y__ in a f__n__g__
(g) 168 = o__s in a e__k
(h) 3 = m__t__s in s__m__r
(i) 1000 = y__rs in a __i__l__n__u__
(j) 24 = o__s in a __
(k) 31 = d__s in __a__u__y
(l) 10 = d__es in a __t__
(m) 366 = a__s in a __e__p__y__a__
(n) 1440 = i__u__ in a __a__
(o) 1800 = e__n__ in h__l__ an __u__
(p) 15 = i__t__s in __u__r__e__ of an __ur
(q) 1000 = m__l__i__e__o__s in a __e__o__d

Conversions

EXERCISE 15B

1. How many minutes are in the following?
(a) 2 hours (b) 10 hours (c) 2 days (d) $5\frac{1}{2}$ hours
2. How many seconds are in the following?
(a) 5 minutes (b) 2 hours (c) 1 day (d) $8\frac{1}{2}$ minutes
3. How many days are in the following?
(a) 1 fortnight (b) July (c) Winter (d) the year 2019
4. How many hours are in the following?
(a) 2 weeks (b) $3\frac{1}{2}$ days (c) between 6 am and 10 pm
5. How many years are in the following?
(a) 6 decades (b) $\frac{1}{2}$ a century (c) 3 centuries (d) $\frac{1}{4}$ of a millennium
6. How many milliseconds are in the following?
(a) 2 seconds (b) $\frac{1}{2}$ a minute (c) 0.5 seconds (d) 25.75 seconds
7. Luther can jog at 2 metres per second (2 m/s).
(a) How far could he jog in the following times?
(i) 40 seconds (ii) half an hour (iii) 45 minutes (iv) 6 hours
(b) How long would it take Luther to jog the following distances?
(Give answers in minutes)
(i) 120 metres (ii) 2.4 kilometres
8. The flashing light at a disco flashed once every 100 milliseconds.
How many times would the light flash in the following times?
(a) 1 second
(b) 1 minute
(c) 1 hour



Clocks

EXERCISE 15C

1. Convert the following times to 24 hour times.

Examples 1. 6:15 am = 06:15 2. 10:30 pm = 22:30

- | | | | |
|-------------|--------------|--------------|--------------|
| (a) 8:00 am | (b) 5:00 pm | (c) 1:30 pm | (d) 9:15 am |
| (e) 3:45 pm | (f) 12:40 am | (g) 12:55 pm | (h) 7:28 pm |
| (i) 4:52 am | (j) 11:02 pm | (k) 10:21 am | (l) 10:11 pm |

2. Convert the following times to 12 hour times.

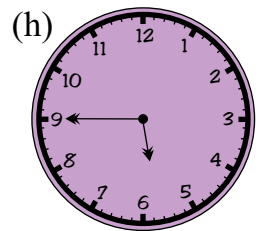
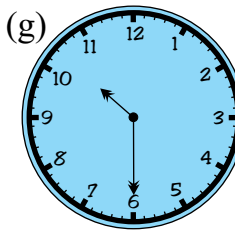
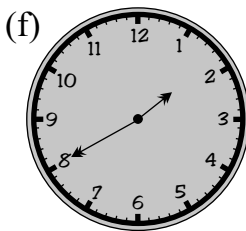
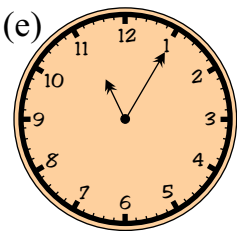
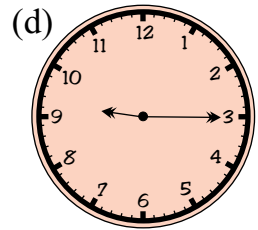
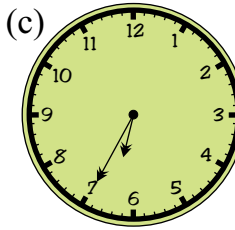
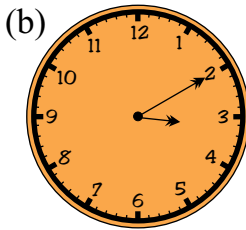
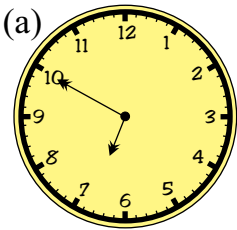
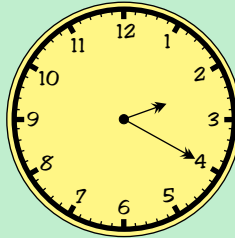
- | | | | |
|-----------|-----------|-----------|-----------|
| (a) 02:00 | (b) 10:35 | (c) 14:20 | (d) 22:38 |
| (e) 11:09 | (f) 21:42 | (g) 09:05 | (h) 00:10 |
| (i) 12:12 | (j) 10:01 | (k) 03:30 | (l) 15:48 |

3. Write the times shown on the clocks below three different ways.

Example

The time shown here could be written as:

- (i) two-twenty
- (ii) twenty past two
- (iii) 2:20



4. How many minutes are between the following times?

- | | |
|---------------------------|---------------------------|
| (a) 7:30 am and 7:50 am | (b) 8:10 pm and 8:53 pm |
| (c) 3:12 am and 3:53 am | (d) 6:08 pm and 6:23 pm |
| (e) 2:31 am and 2:49 am | (f) 10:17 pm and 10:54 pm |
| (g) 7:50 pm and 8:20 pm | (h) 1:40 pm and 2:20 pm |
| (i) 3:10 am and 4:05 am | (j) 6:05 pm and 7:00 pm |
| (k) 2:00 am and 3:15 am | (l) 11:30 am and 12:45 pm |
| (m) 11:20 pm and 12:35 am | (n) 3:15 am and 4:55 am |
| (o) 2:16 am and 3:21 am | (p) 8:27 pm and 9:06 pm |
| (q) 4:22 am and 5:38 am | (r) 10:27 pm and 11:52 pm |
| (s) 12:21 am and 2:03 am | (t) 6:47 pm and 9:03 pm |

5. How many minutes are between the following times?

- | | |
|---------------------|---------------------|
| (a) 21:20 and 22:37 | (b) 09:46 and 10:25 |
| (c) 15:39 and 17:44 | (d) 09:07 and 12:29 |
| (e) 22:51 and 01:39 | (f) 08:59 and 11:04 |
| (g) 03:45 and 08:50 | (h) 07:20 and 09:05 |
| (i) 11:54 and 15:18 | (j) 11:27 and 18:52 |

6. Zara was watching a short movie that went for 43 minutes. She started watching the movie at 7:48 pm. At what time would the movie finish?

7. The flight time from Perth to Manila is 6 hours and 56 minutes. If an aeroplane leaves Perth at 08:42, at what time will it land in Manila? Perth and Manila are in the same time zone.

8. Harry wanted to see how long it would take him to complete a Rubik's Cube? He started at 10:25 and finished at 12:17.

How long did it take Harry to complete the Rubik's Cube?



9. A tank was being filled with water at the rate of 100 litres every minute. The pump was started at 3:25 pm and the tank was full at 5:13 pm. How many litres of water were in the tank?

10. Kerrie makes shirts and it takes her 22 minutes to sew one shirt. If she had five minutes rest between sewing shirts and she started sewing at 9:25 am, at what time would she finish making six shirts?

Calendars

EXERCISE 15D

1 year = 365 days 1 leap year = 366 days

Leap years are those years that are divisible by 4 except years at the turn of a century that are not divisible by 400 (eg 1900, 2100).

- Which of the following years are leap years.
1600 1664 1800 1962 1992 2004 2016 2030 2080 2500 2800
- How many days are in the following years?
(a) 1992 (b) 2016 (c) 2030 (d) 2500

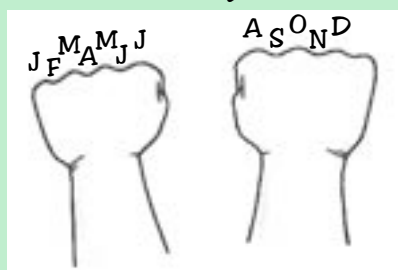
Two ways can be used to find the number of days in each month.

- This poem can be used.

*30 days has September,
April, June and November.
All the rest have 31,
Except February which has 28,
And 29 in a Leap Year.*

- Using your fists.

**The 'knuckle months'
have 31 days.**



- Graham went on a holiday on Wednesday 26th of March and returned 15 days later. What day and date did Graham return?
- It is recommended that people learning to drive a car have 120 hours of driving practice before they sit for their licence.
Bill wants to go for his licence on the 21st of December (his birthday).
Bill reckons that he can average half an hour of driving practice a day.
On what date should he start practising, if he wants to complete 120 hours of driving before he goes for his licence?



Timetables

EXERCISE 15E

A section of the train timetable from Melbourne to Geelong is shown below.

MELBOURNE	11:10	11:30	11:50	12:10	12:30	12:50	13:10	13:21
Footscray	11:18	11:38	11:58	12:18	12:38	12:58	13:18	13:29
Sunshine	11:24	11:44	12:04	12:24	12:44	13:04	13:24	. .
Deer Park	11:28	. .	12:08	. .	12:48	. .	13:28	. .
Tarneit	11:35	11:54	12:15	12:34	12:55	13:14	13:35	13:47
Wyndham Vale	11:42	12:01	12:22	12:41	13:02	13:21	13:42	13:55
Little River	11:49	. .	12:29	. .	13:09	. .	13:49	. .
Lara	11:55	12:13	12:35	12:53	13:15	13:33	13:55	14:11
Corio	11:59	. .	12:39	. .	13:19	. .	13:59	. .
North Shore	. .	12:19	. .	12:59	. .	13:39	. .	. .
North Geelong	12:03	12:22	12:43	13:02	13:23	13:42	14:03	14:22
GEELONG	12:07	12:26	12:47	13:06	13:27	13:46	14:07	14:26

- How many trains are listed in this timetable?
- How long does it take the trains that leave at the following times from Melbourne to travel from Melbourne to Geelong?
(a) 11:10 (b) 12:50 (c) 13:21
- Jenny is staying at Sunshine. What is the latest time she could leave Sunshine by train to get to Geelong before 2:00 pm?
- Jose wants to travel by train from Deer Park to Corio. He wants to leave after 11:30 am and before 1:00 pm. How many trains leave Deer Park between these times?
- Tara works at Tarneit and lives in Lara. She finishes work at 1:00 pm and it takes her 20 minutes to walk to the station at Tarneit.
(a) What is the time of the next train she could catch at Tarneit to go home?
(b) How long does it take for that train to get from Tarneit to Lara?

Time Zones

EXERCISE 15F

The table below can be used to compare times in several cities around the world. It shows the times in all the cities when it is:

- (i) 10 pm on Monday in Melbourne
- (ii) Noon on Tuesday in Melbourne

Los Angeles	Dublin	Athens	Perth	Melbourne	Fiji
4 am Mon	Noon Mon	2 pm Mon	8 pm Mon	10 pm Mon	Midnight
6 pm Mon	2 am Tues	4 am Tues	10 am Tues	Noon Tues	2 pm Tues

1. Use the table to complete the following sentences.

Examples 1. Melbourne is two hours *ahead of* Perth.
2. Athens is eight hours *behind* Melbourne.

- (a) Fiji is two hours _____ Melbourne.
- (b) Dublin is two hours _____ Athens.
- (c) Perth is eight hours ahead of _____.
- (d) Los Angeles is eight hours _____ Dublin.
- (e) Melbourne is _____ ahead of Dublin.
- (f) Fiji is _____ ahead of Athens.

2. Copy and complete the following table.

Los Angeles	Dublin	Athens	Perth	Melbourne	Fiji
				6 pm Wed	
		5 pm Fri			
	9 pm Mon				

3. Alex and Xavier live in Melbourne and are going on holidays.

Alex is going to Fiji and Xavier is going to Athens.

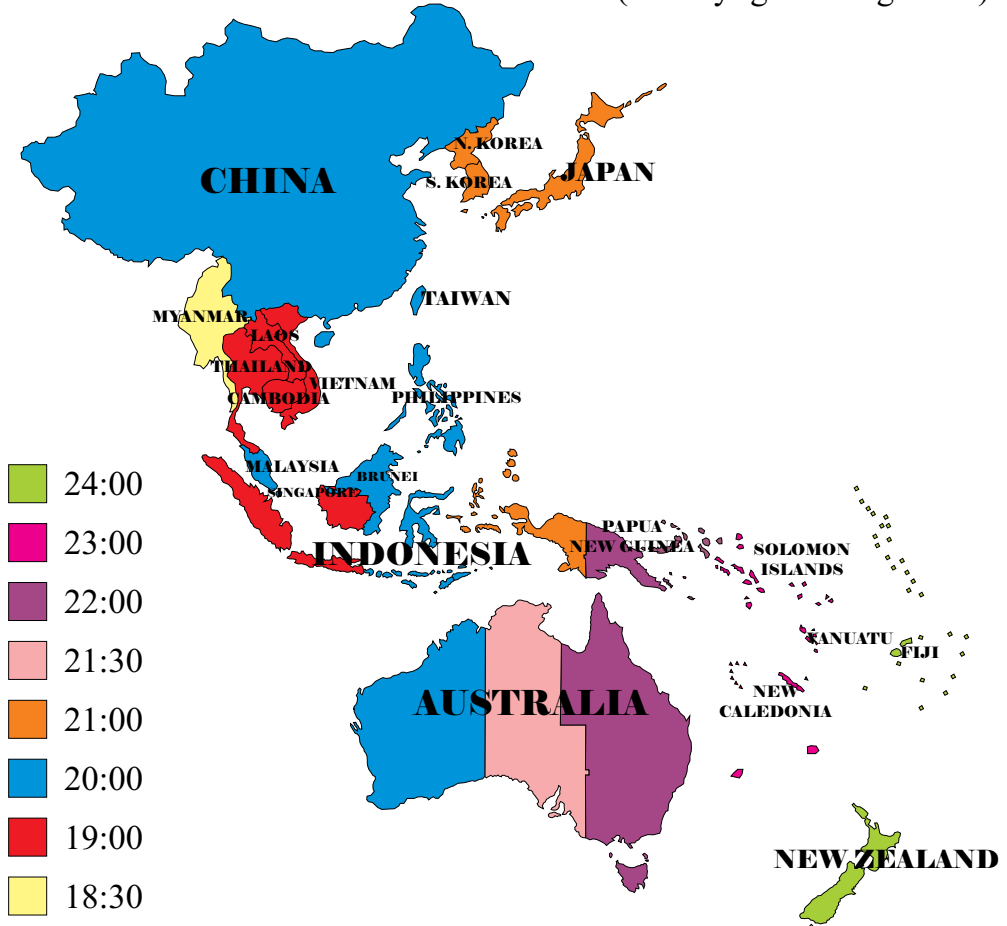
Alex's plane leaves Melbourne at 8:00 pm Tuesday and his flight takes 5 hours.

Xavier's plane leaves Melbourne at 9:00 pm Tuesday and his flight takes 12 hours.

Two hours after Xavier arrives in Athens he telephones Alex.

How long after Alex arrived in Fiji did he get Xavier's phone call?

4. A map of Australia and Asia is shown below. The different time zones are shown with different colours. The time in each time zone is shown in the key below for 24:00 in New Zealand.
- Note the times in Australia are standard times (not daylight saving times).



- (a) Name a country that is in the same time zone as Sydney.
- (b) Name three countries that in the same time zone as Perth.
- (c) How many time zones are there in Indonesia?
- (d) How many times zones are there in China?
- (e) Name three countries that are one hour behind China's time zone.
- (f) What is the time in Beijing when it is:
 - (i) 03:00 in Perth?
 - (ii) 04:00 in Melbourne?
 - (iii) 05:00 in Tokyo?
- (g) If a plane left Melbourne at 6:00 am and took 10 hours to fly to Bangkok, at what time, in Bangkok, would it land?
- (h) If a plane left Kuala Lumpur at 8:00 am and took 9 hours to fly to Sydney, at what time, in Sydney, would it land?

Problems Involving Time

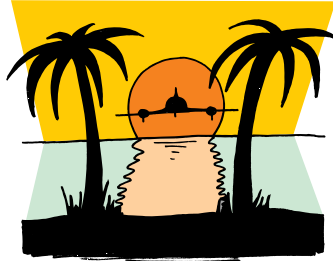
EXERCISE 15G

1. Chloe and Rhiannon were flying to Vanuatu for a holiday.

As the plane took off from Melbourne the pilot said that the flight time is four and a half hours and the estimated arrival time is 14:15.

What time did their plane leave?

(There is no time difference between Melbourne and Vanuatu).



2. Antonio wanted to record a movie on TV. The movie started at 8:30 pm and went for 2 hours 45 minutes. His recording device is set on 24 hour time. What times should he set his movie recorder to start and finish?

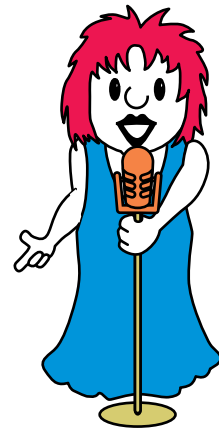
3. Salonika has written six songs that she plans to record.

The length of the songs (in minutes:seconds) are as followings:

Song 1 (3:32) Song 2 (3:48) Song 3 (3:27)

Song 4 (3:37) Song 5 (4:33) Song 6 (3:12)

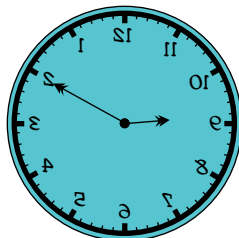
- (a) If there are three seconds between songs, what will be the total time (in minutes:seconds) between the start of the first song and the end of the last song?
- (b) Salonika wants to pick several of the songs as the background music to a short film. If the film is exactly 15 minutes long, which songs could she use?
- (There will be no time between them)



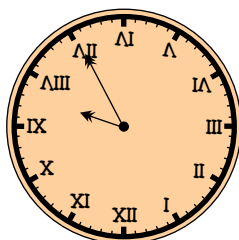
4. Andre is organising a basketball competition between four teams to be played in one day. Each team is to play each other team once. There is one court. The games are to have two 20 minute halves, with two minutes at half time and five minutes between games. The first game is to start at 9:30 am.
- (a) How many games will there be?
- (b) List the starting times for all of the games.
- (c) At what time will the last game finish?

5. 10 students can pick 20 kg of strawberries in 30 minutes.
How long would it take 5 students to pick 40 kg of strawberries?

6. Cecil looked at a clock in a mirror and it appeared as shown here.
What time is it?



7. The clock shown has been reflected upside down in a mirror.
What is the time?



8. Jebriel and Oscar catch the 8:00 am train to school.
Jebriel's clock is 5 minutes fast but he thinks it is 5 minutes slow.
Oscar's clock is 5 minutes slow but he thinks it is 5 minutes fast.
Who misses the train and by how much?
9. Denice's watch did not work properly. It gained one minute every hour. She set it to the correct time at 8 o'clock Monday morning.
- Will she be early or late for school the next day and by how many minutes?
 - If Denice does not adjust her watch for a week what time would her watch show at 8 o'clock the following Monday morning?

10. Hasene is a runner whose favourite event is the 800 metres.
In her last four races her times were (in minutes:seconds):

2:23 2:31 2:34 2:24

Find the average time for these four races.

11. Elton is a marathon runner. He wants to average 2 hours 30 minutes for the four marathons he runs in a year. For the first three marathons his times have been (in hours:minutes:seconds):

2:32:15 2:25:30 2:29:56

What time does Elton need to run in his last marathon to have an average time of 2 hours 30 minutes for the four races?

PROBLEM SOLVING

1. Alissa's watch gains one minute every hour.
Alissa set her watch to the correct time at 10 am on Monday.
 - (a) What time will her watch show at 6 pm Tuesday?
 - (b) What is the correct time when her watch shows 11 pm Wednesday?

2. How many times in a day will the hour hand, minute hand and second hand of a clock align with each other?

PUZZLES

1. (a) Change **WEEK** into **YEAR**
in three steps by changing
one letter at a time to form
a new word.
(b) Change **YEAR** into **TIME**
in six steps.

Example

CAT can be changed
to **DOG** in three steps

CAT
COT
DOT
DOG

2. What am I?

My first is in watch,
And also in wrist.
My second's in minute,
And also in fist.
My third is in month,
But not in an hour,
My last is in year,
Week, second and flower.
I am something,
That really flies,
When fun you are having,
A glint in your eyes.

CHAPTER REVIEW

1. (a) How many seconds are in 3 minutes?
(b) How many minutes are in 7 hours?
(c) How many hours are in 8 days?
(d) How many milliseconds are in 1 minute?
(e) How many years are in 7 decades?
(f) How many years are in 4 centuries?
2. Convert the following times to 24 hour times.
(a) 8:15 am (b) 7:24 pm (c) 11:03 pm (d) 1:28 am
3. Convert the following times to 12 hour times.
(a) 15:51 (b) 08:20 (c) 22:39 (d) 11:28
4. How many minutes are between the following times?
(a) 5:28 am and 7:03 am (b) 9:18 pm and 11:11 pm
5. How many minutes are between the following times?
(a) 19:36 and 21:13 (b) 07:15 and 10:28
6. A train left Darwin at 9:25 am. It arrived in Katherine 1:05 pm.
How long did it take to travel from Darwin to Katherine?
7. Heidi runs marathons. She wanted to run a marathon in 2 hours and 45 minutes. If she started the marathon at 14:35 at what time should she finish?
8. Emmy and Bill went on a holiday to the Great Barrier Reef. They left on Tuesday the 27th of August and came home 16 days later.
What day and date did they return?
9. A junior basketball tournament involved 6 games being played.
Each game consisted of two 20 minute halves with a 5 minute break at half time.
There was 10 minutes between games.
The first game started at 10:30 am.
At what time would the last game finish?

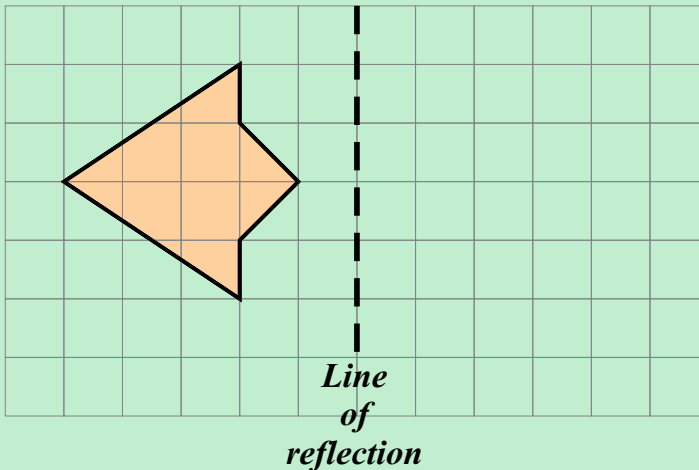
Shapes

Reflections

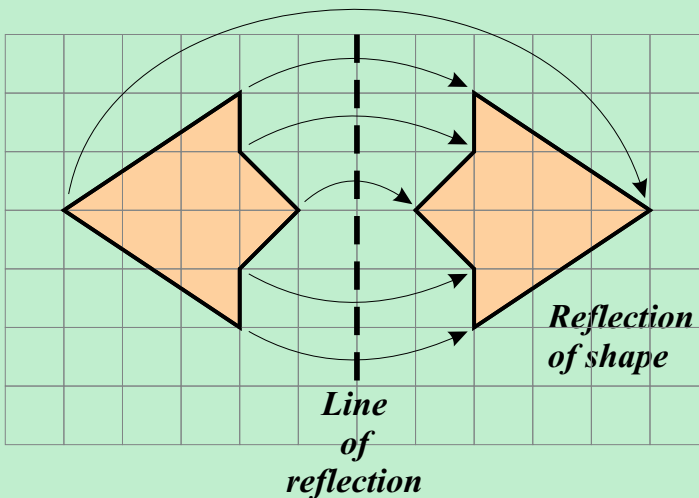
Find the reflection of the following shapes about the line shown.

Examples

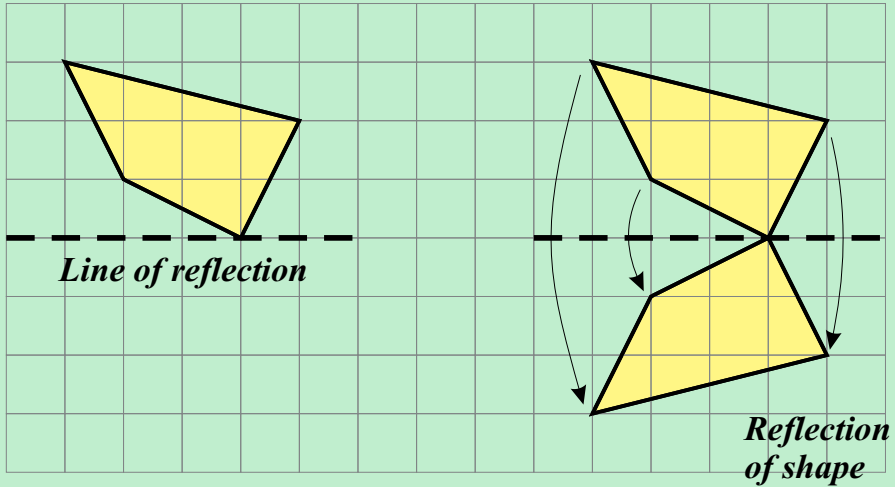
1.



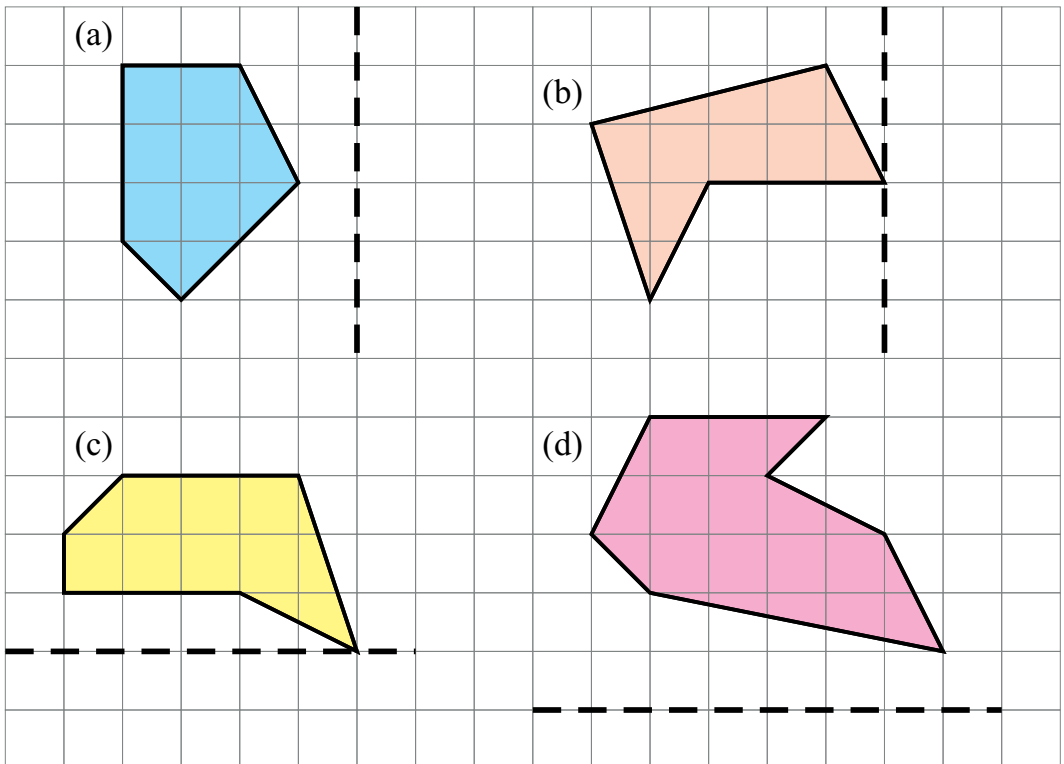
Each vertex of the shape is reflected about the line of reflection to find the reflection of the shape.

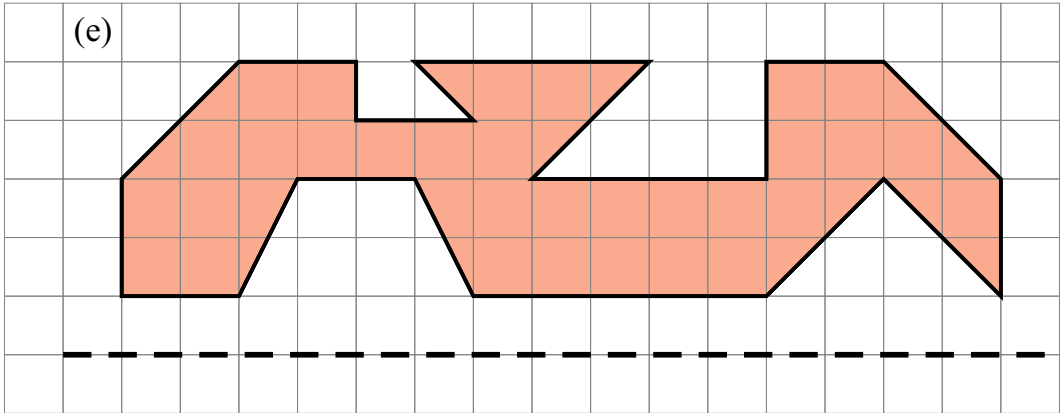


2.

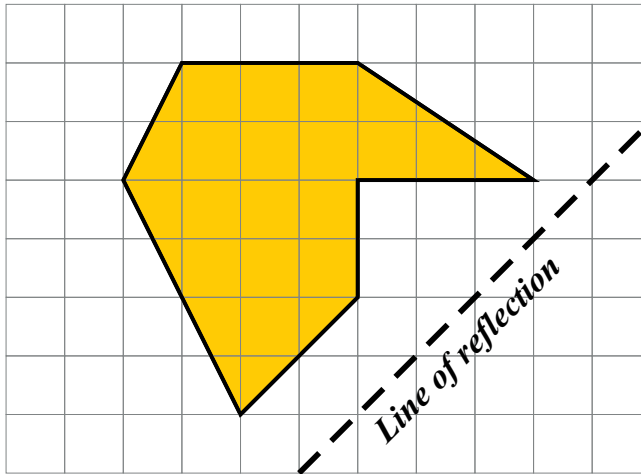
**EXERCISE 16A**

1. Copy the following shapes onto graph paper and draw the reflection of these shapes about the lines of reflection shown.

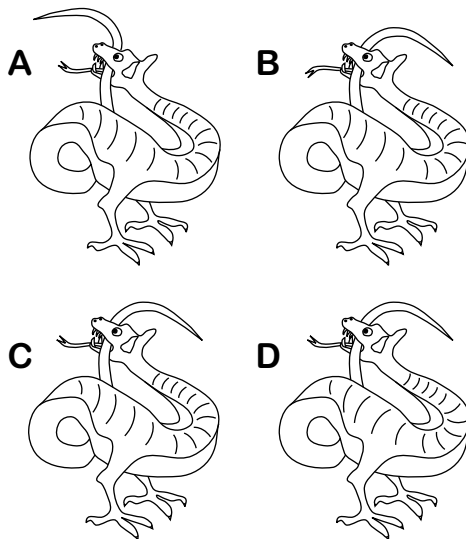
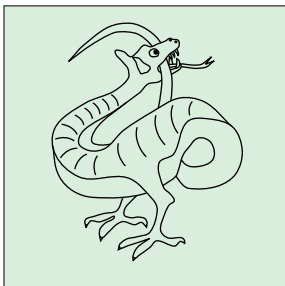




2. Copy the shape shown below onto graph paper and draw its reflection about the line of reflection shown.



3. Which of the drawings **A-D** is the reflection of the drawing below.

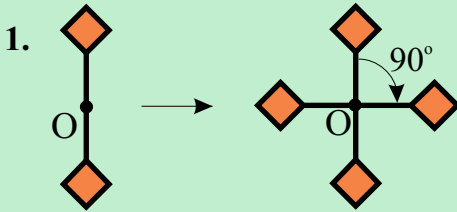


Rotations

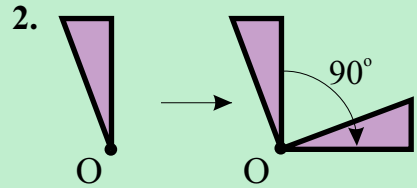
EXERCISE 16B

1. Copy the following shapes into your books or onto graph paper and redraw them after they have been rotated 90° clockwise about O.

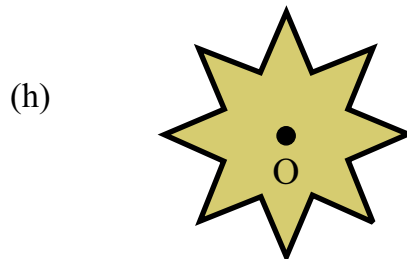
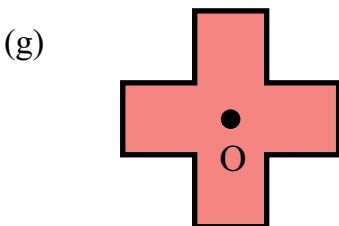
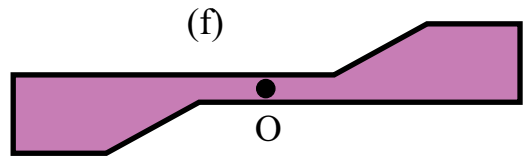
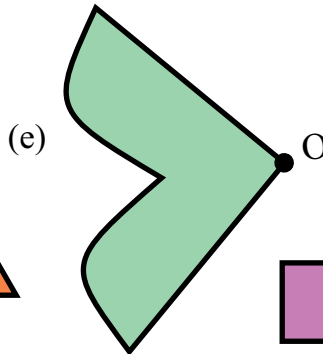
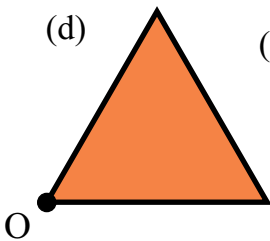
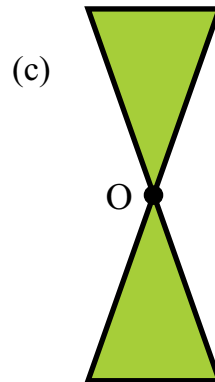
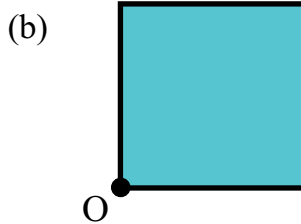
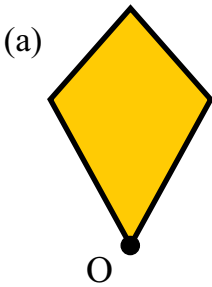
Examples



Original shape

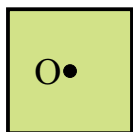


Original shape



2. Comment on how the redrawn shapes in parts (g) and (h) compare with the original shapes.

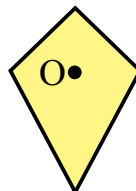
3. Which of the following shapes would appear the same after being rotated by 90° in a clockwise direction about O?



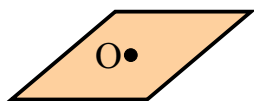
Square



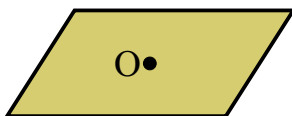
Rectangle



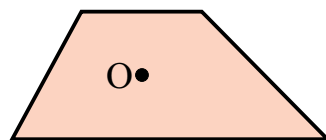
Kite



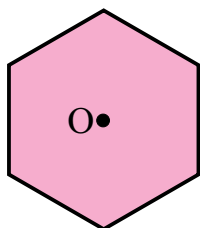
Rhombus



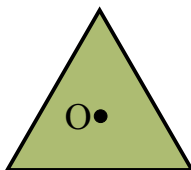
Parallelogram



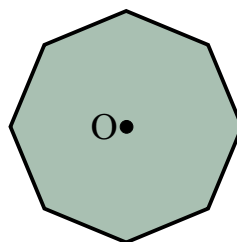
Trapezium



Regular Hexagon



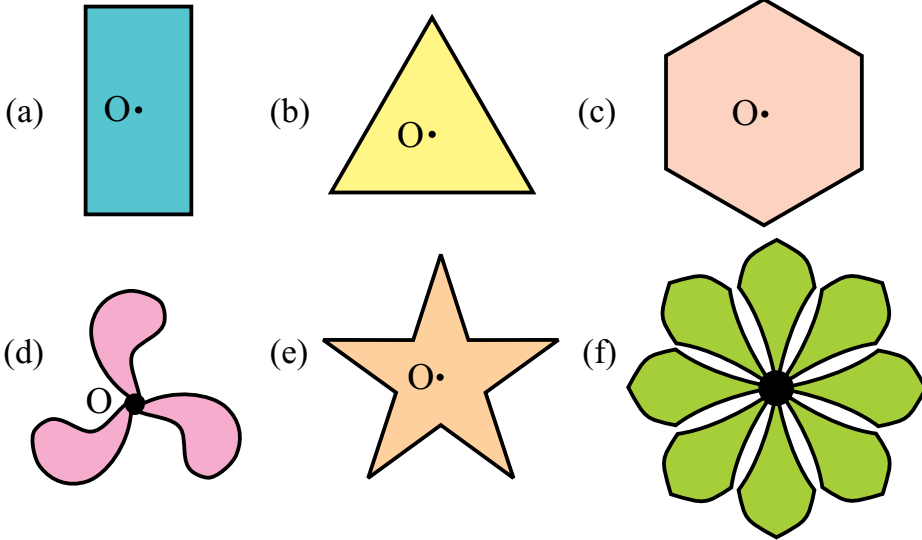
Equilateral Triangle



Regular Octagon

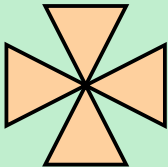
4. Which of the shapes in question 3 would appear the same after being rotated 180° about O?
5. Choose the correct answer for the following statements.
- (a) A clockwise rotation of 180° is the same as an anticlockwise rotation of:
- A** 90° **B** 180° **C** 270° **D** 360°
- (b) A clockwise rotation of 90° is the same as an anticlockwise rotation of:
- A** 90° **B** 180° **C** 270° **D** 360°
- (c) A clockwise rotation of 45° is the same as an anticlockwise rotation of:
- A** 45° **B** 135° **C** 225° **D** 315°

6. What is the **minimum** angle of clockwise rotation about O for these shapes to appear the same.

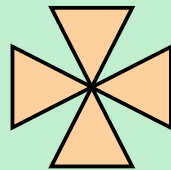
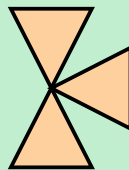
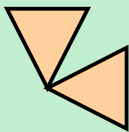


7. Many shapes can be constructed by using a starting shape that has been rotated and copied a number of times.

Example

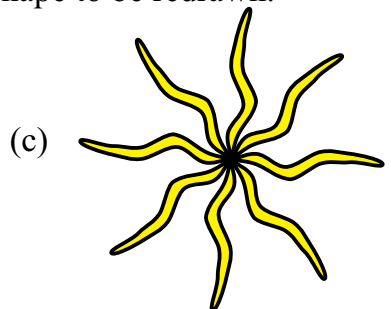
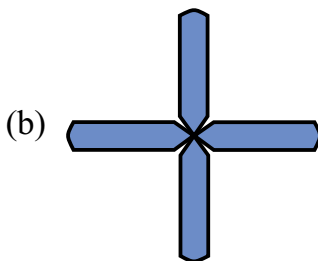
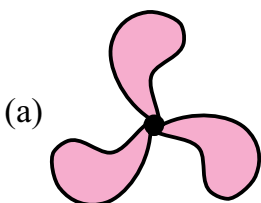


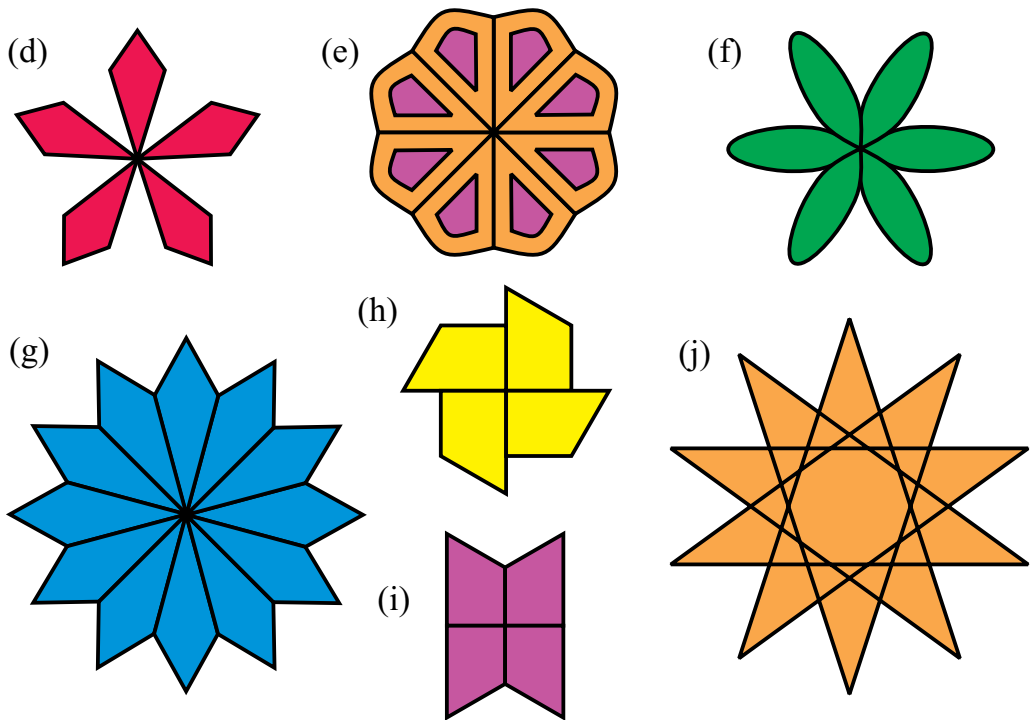
This shape can be constructed by following these steps. The starting shape is rotated clockwise 90° each time and redrawn.



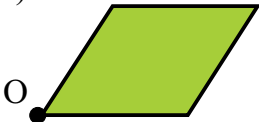
Starting Shape

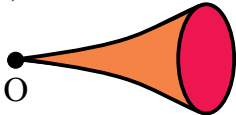
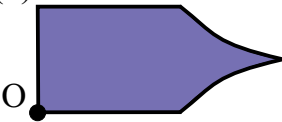
Draw the starting shape for each of the following shapes and state the angle of clockwise rotation for the starting shape to be redrawn.





8. Using the starting shapes and angles of clockwise rotations shown below draw the complete shapes. Rotate the starting shapes about O until you get back to the original shape.

Starting Shape	Angle of Rotation
(a) 	120°
(b) 	90°

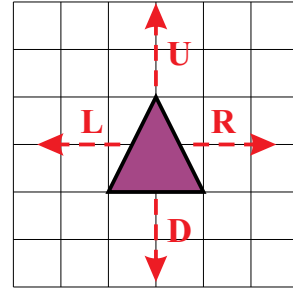
Starting Shape	Angle of Rotation
(c) 	60°
(d) 	90°

Translations

Shapes can be translated (moved) on a grid to the right (R), left (L), up (U) or down (D).

The size of a translation is defined by the number of grid squares it is moved.

Abbreviations can be used to show the direction and size of a translation.

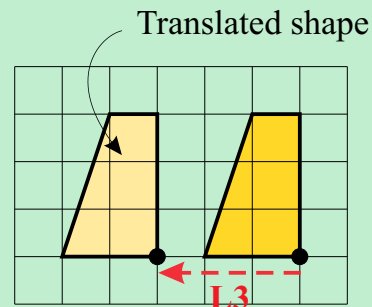
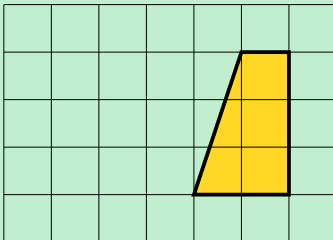


Examples

1. A translation to the right of four units = R4
2. A translation up of six units = U6
3. Translation to the left of three units followed by down two units = L3, D2

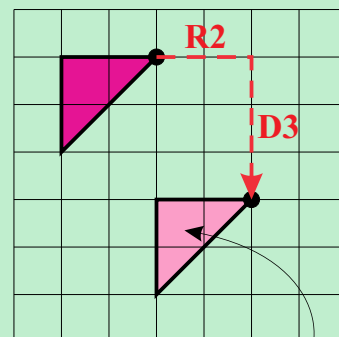
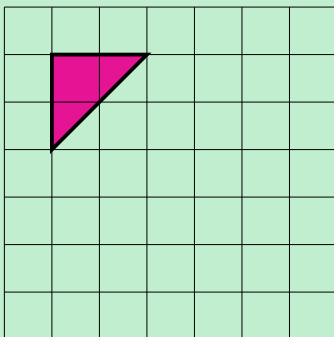
Examples

1. Translate the shape below left three units (L3).



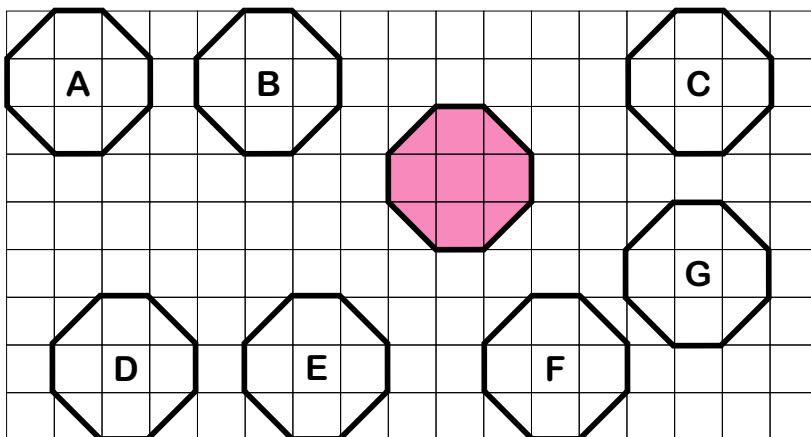
Any point on the shape can be used to translate the shape.

2. Translate the shape below right two units then down three units (R2, D3).



EXERCISE 16C

1. (a) The shaded shape on the grid below is translated to the left three units and down four units (L3, D4). Which of the shapes (**A-G**) would be the position of the shaded shape after it has been translated?



- (b) State the translation required to get from the shaded shape to each of the other shapes.

2. Copy the shapes shown below onto a grid.

Translate the shapes by the amounts shown to form a polygon.
What is the name of the polygon and a type of bird?

Shape **A** - R5, D2

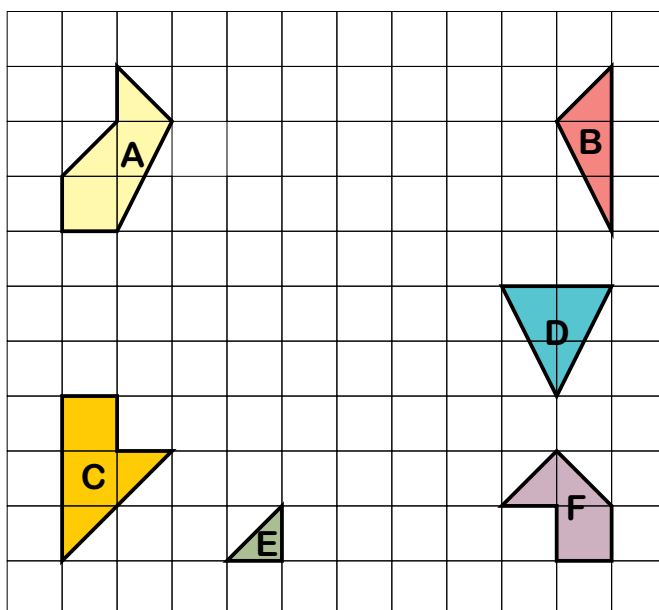
Shape **B** - L6, D2

Shape **C** - R4, U4

Shape **D** - L4, D1

Shape **E** - R1, U4

Shape **F** - L4, U6

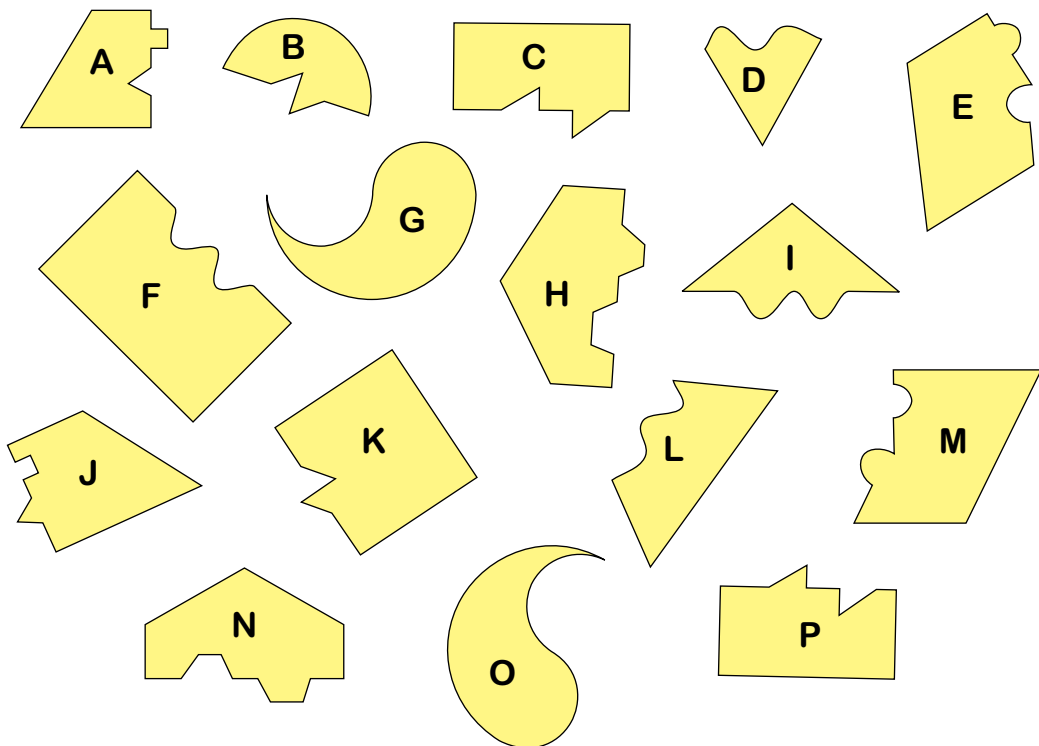


Combinations

EXERCISE 16D

1. Eight shapes have each been cut into two parts. All the parts have been rearranged and are shown below.

Match the pairs to form the eight shapes and draw each shape.



2. The letters shown below are cut out of cardboard.

List all the words you could make using two or more of these letters.

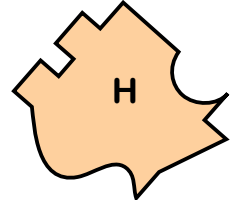
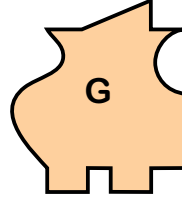
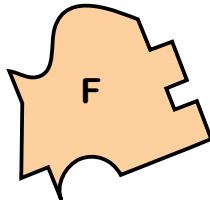
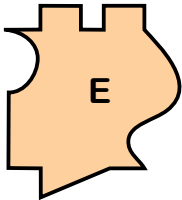
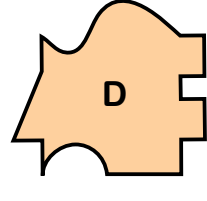
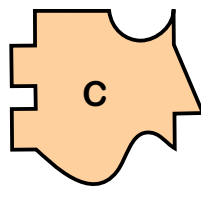
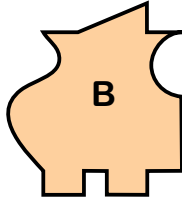
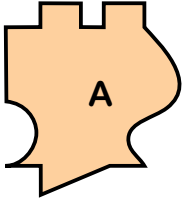
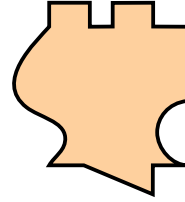
The cardboard letters can be rotated or turned upside-down.

There are two words that use all the letters.

See if you can get 20 words.

p i u e t

3. Five of the shapes below match this shape after being rotated, reflected or a combination of both. Which are they?

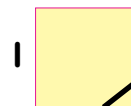
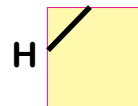
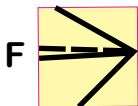
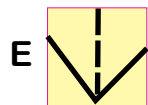
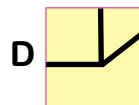
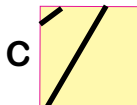
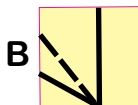
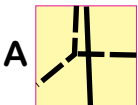
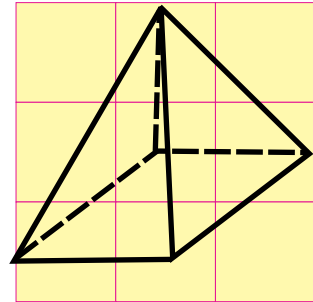


4. The drawing shown is on a 3×3 grid.

The grid is cut into nine squares, rearranged and labelled as shown below. The squares may have been rotated.

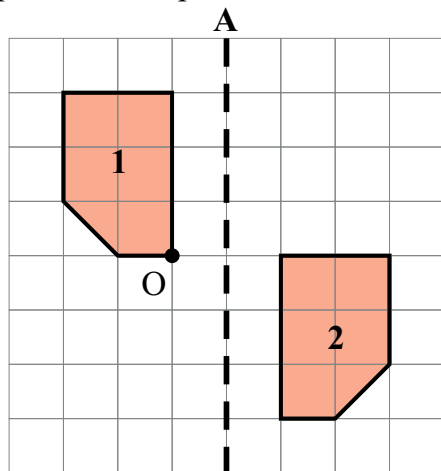
Draw a 3×3 grid and locate the labels of the squares (A-I) on the grid to form the original drawing.

State if each square needs to be rotated 90° clockwise (90° C), 90° anticlockwise (90° AC), 180° or not rotated (NR) before being placed on the grid.

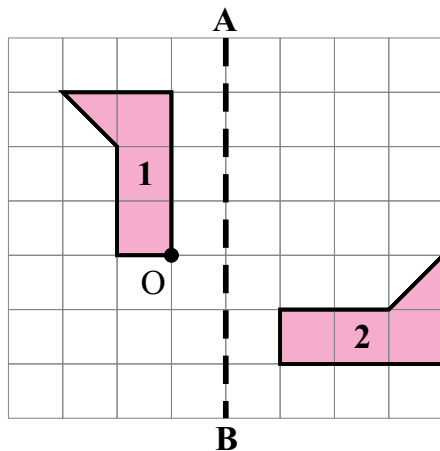


5. Which of the following alternatives describes the transformations required to move the shape below from position 1 to position 2.

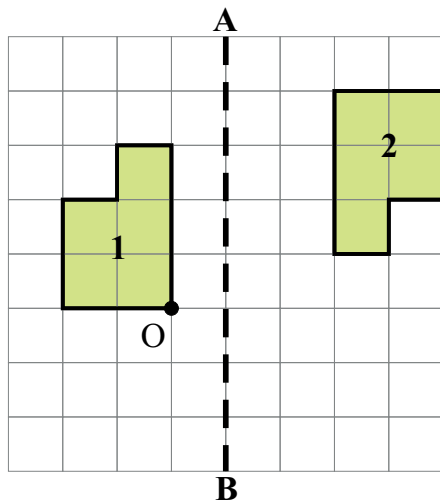
- A** Rotation of 180° about O then reflection about line AB.
- B** Reflection about line AB then translation of three units up.
- C** Rotation of 90° clockwise about O then translation of two units right and three units down.
- D** Translation of three units down and four units right.
- E** Reflection about line AB then translation of three units down.



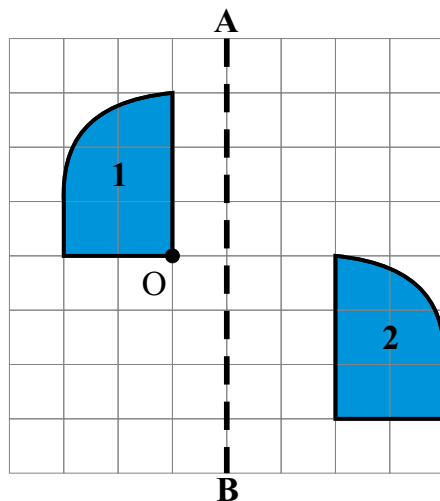
6. Describe the transformations required to move the shape shown here from position 1 to position 2.



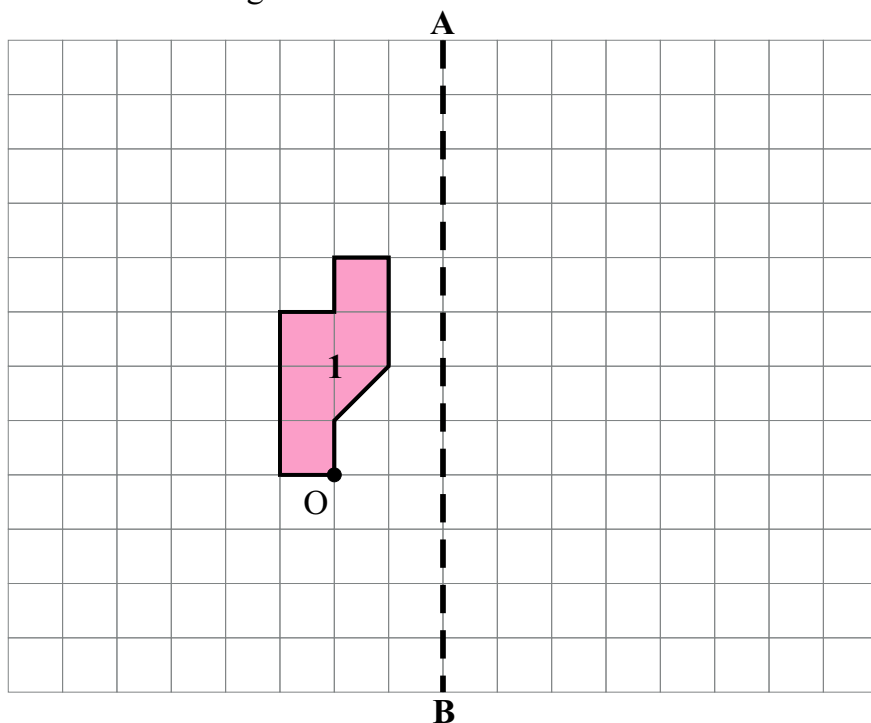
7. Describe the transformations required to move the shape shown here from position 1 to position 2.



8. Describe the transformations required to move the shape shown here from position 1 to position 2.



9. On graph paper draw the shape shown below in position 1. On the same graph paper draw the shape after the following transformations. Note the abbreviations for translations of left (L), right (R), up (U) and down (D). For example U2 means a translation up of two units.
- Position 2 - after being reflected about line AB and translated U3.
- Position 3 - after being rotated 90° anticlockwise about O, reflected about line AB and translated U7.
- Position 4 - after being reflected about line AB and translated R3 and D2.
- Position 5 - after being rotated 180° about O and translated L3 and U6.



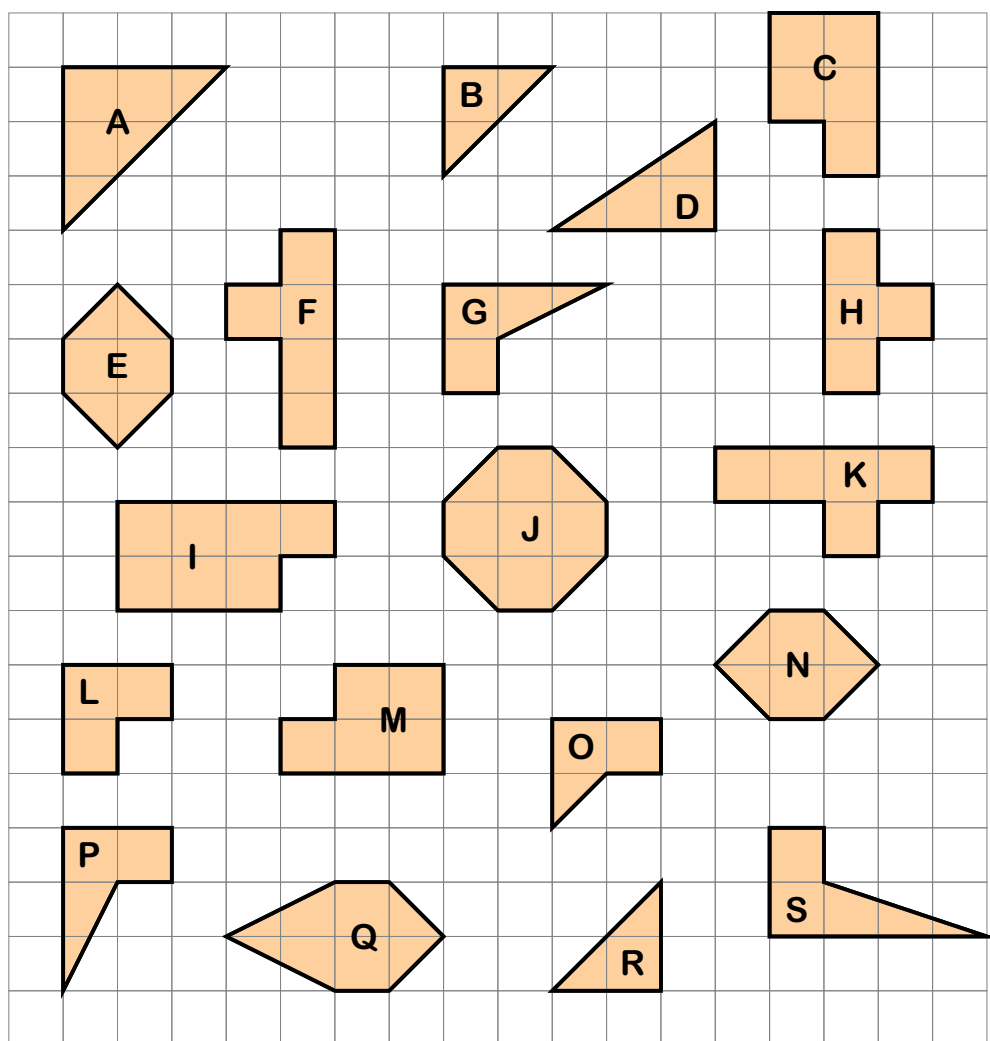
Congruent Shapes

Any shapes that exactly the same size and shape are called ***congruent shapes***.

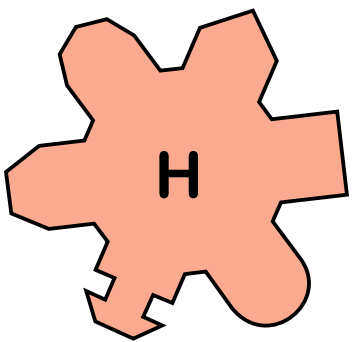
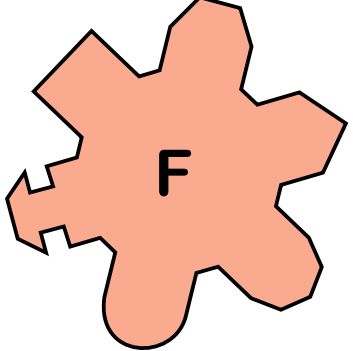
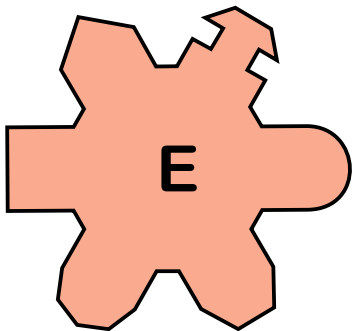
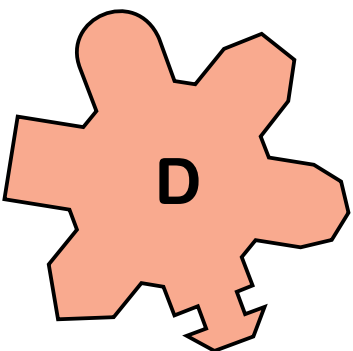
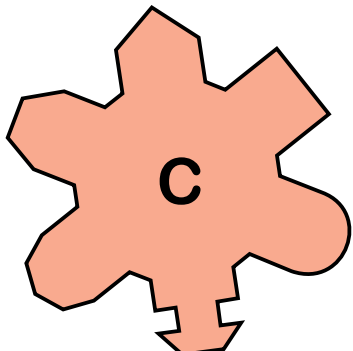
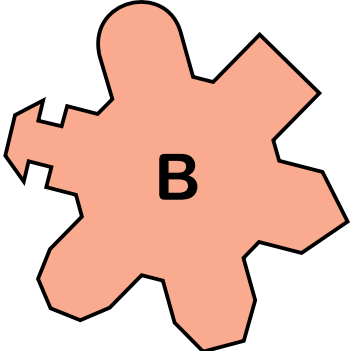
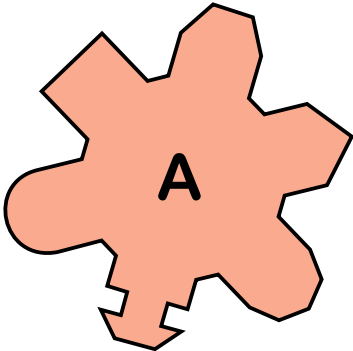
The shapes may have been rotated, reflected or translated, but if they are the same size and shape they are called ***congruent***.

EXERCISE 16E

- Find the ***five*** pairs of congruent shapes on the grid below.



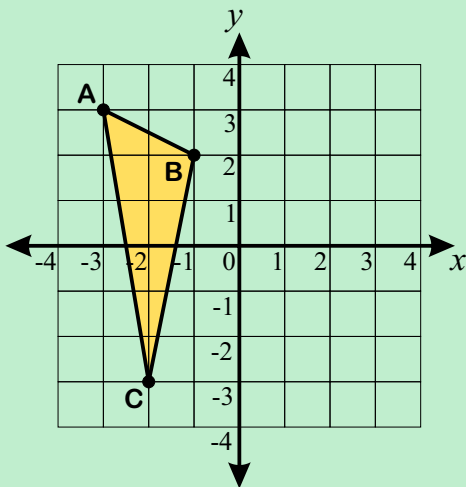
2. Find the *three* shapes below that are congruent.



The Cartesian Plane

Example 1

1. List the coordinates of the vertices of the following shape.
2. Draw the reflection of the shape about the **y-axis** and list the coordinates of the vertices of the reflected shape.

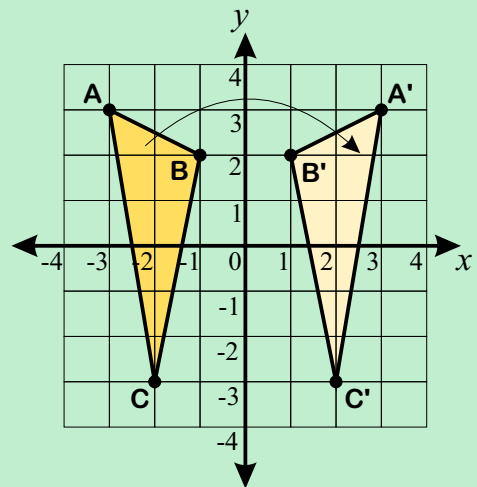


Coordinates of the original
shape:

$$\mathbf{A} = (-3, 3)$$

$$\mathbf{B} = (-1, 2)$$

$$\mathbf{C} = (-2, -3)$$



Coordinates of the reflected
shape:

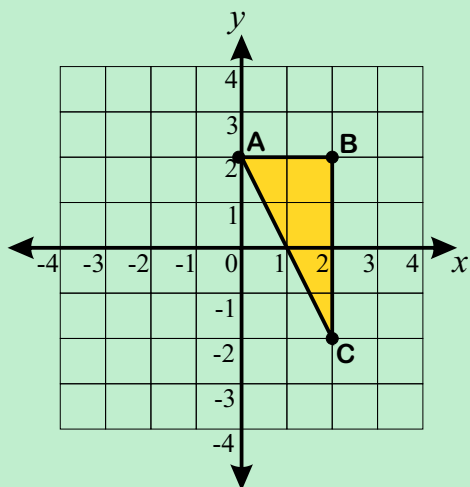
$$\mathbf{A'} = (3, 3)$$

$$\mathbf{B'} = (1, 2)$$

$$\mathbf{C'} = (2, -3)$$

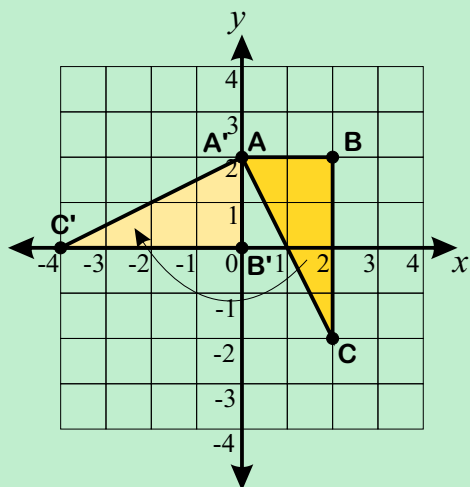
Example 2

1. List the coordinates of the vertices of the following shape.
2. Find the coordinates of the vertices of the shape after it has been rotated 90° *clockwise* about **A**.



Coordinates of the vertices of the shape:

$$\begin{aligned} \mathbf{A} &= (0, 2) \\ \mathbf{B} &= (2, 2) \\ \mathbf{C} &= (2, -2) \end{aligned}$$

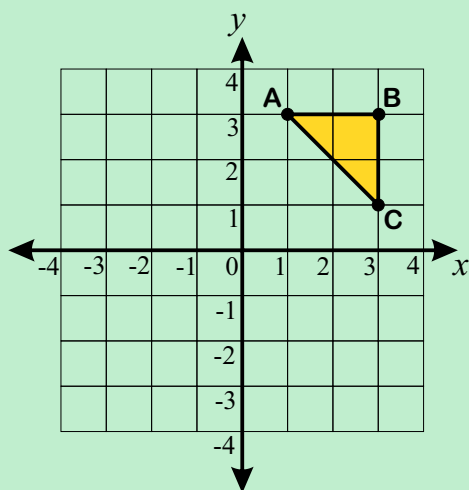


Coordinates of the vertices of the rotated shape:

$$\begin{aligned} \mathbf{A'} &= (0, 2) \\ \mathbf{B'} &= (0, 0) \\ \mathbf{C'} &= (-4, 0) \end{aligned}$$

Example 3

1. List the coordinates of the vertices of the following shape.
2. Find the coordinates of the vertices of the shape after it has been translated to the left three units and down four units (L3, D4).

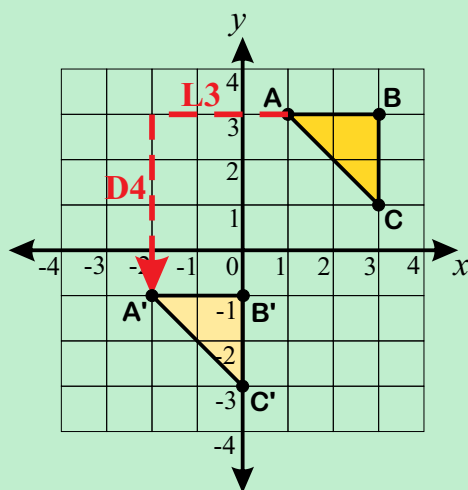


Coordinates of the vertices of the shape:

$$\mathbf{A} = (1, 3)$$

$$\mathbf{B} = (3, 3)$$

$$\mathbf{C} = (3, 1)$$



Coordinates of the vertices of the translated shape:

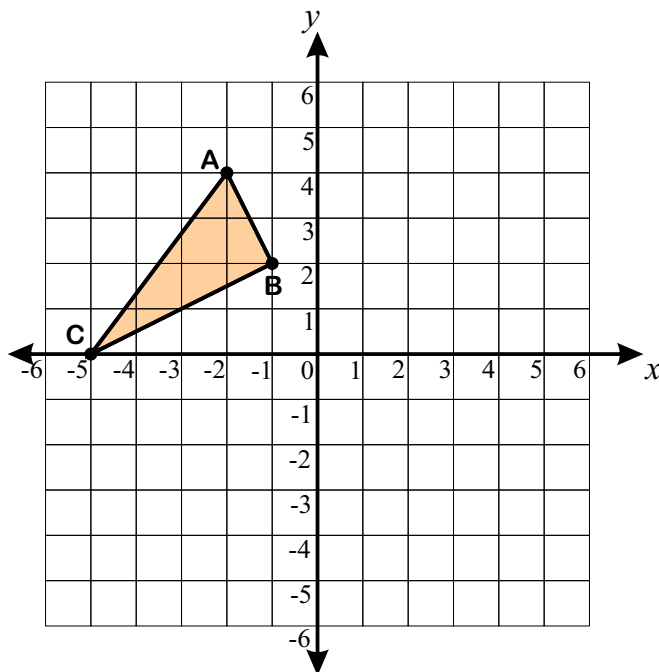
$$\mathbf{A'} = (-2, -1)$$

$$\mathbf{B'} = (0, -1)$$

$$\mathbf{C'} = (0, -3)$$

EXERCISE 16F

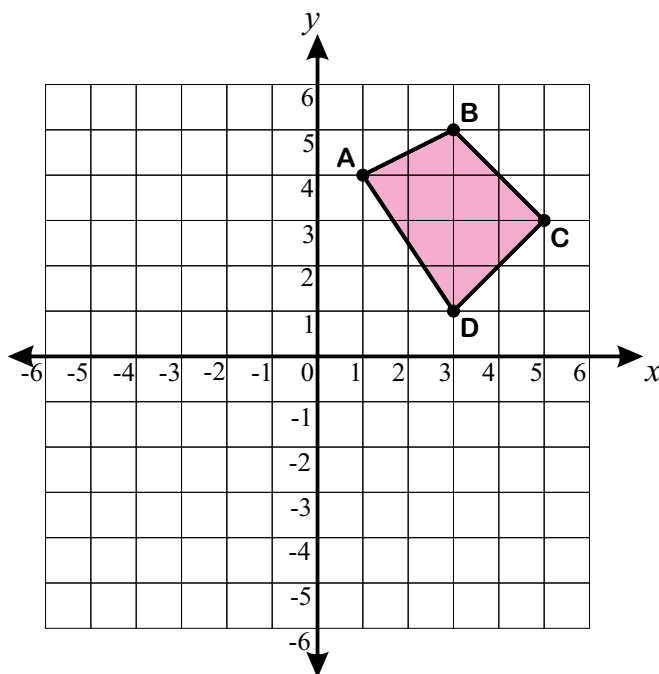
1. (a) State the coordinates of the vertices of the shape shown below.



(b) State the coordinates of the vertices of the shape after the following transformations.

- (i) Reflection about the y -axis.
- (ii) Reflection about the x -axis.
- (iii) Rotation of 90° clockwise about **C**.
- (iv) Rotation of 180° about **B**.
- (v) Translation right of six units (R6).
- (vi) Translation down of three units (D3).

2. (a) State the coordinates of the vertices of the shape shown below.



- (b) State the coordinates of the vertices of the shape after the following combinations of transformations.
- (i) Reflection about the y -axis then translated down four units (D4).
 - (ii) Reflection about the x -axis then translated left three units (L3).
 - (iii) Rotation of 90° clockwise about **A** then reflected about the x -axis.
 - (iv) Rotation of 90° anticlockwise about **D** then translated down two units (D2).
 - (v) Translation left of five units then down four units (L5, D4).
 - (vi) Translation down of three units then reflected about the y -axis.

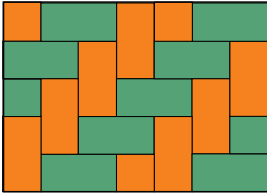
Tessellations

EXERCISE 16G

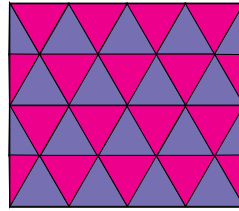
A tessellation is a pattern of shapes that fit together perfectly with no gaps. A tessellation can be made using one or more shapes that are reflected, translated and/or rotated.

1. State the shapes that form the following tessellations.

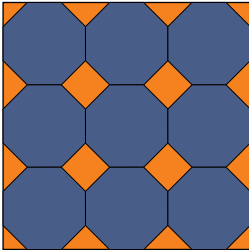
(a)



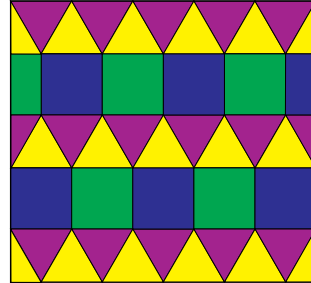
(b)



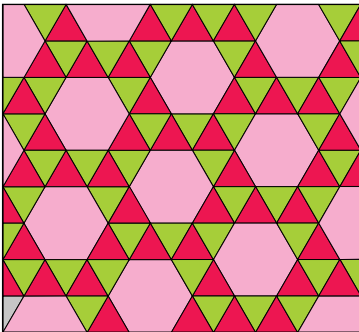
(c)



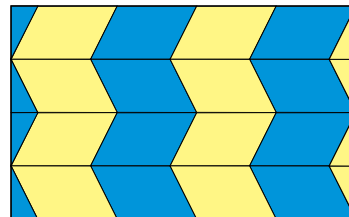
(d)



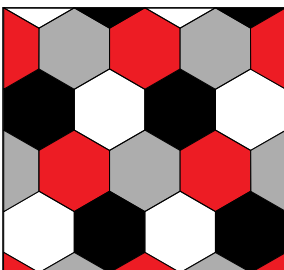
(e)



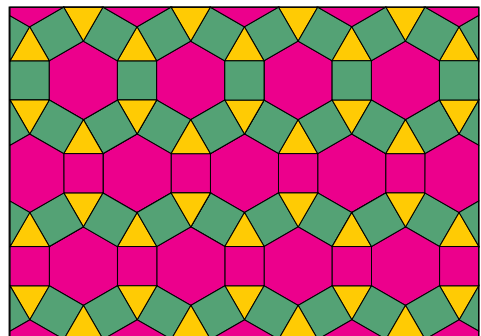
(f)

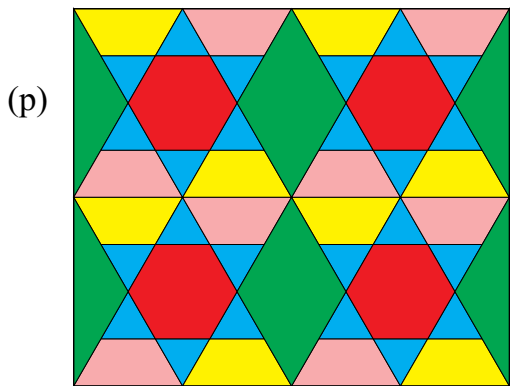
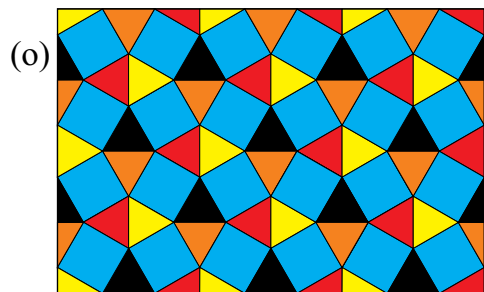
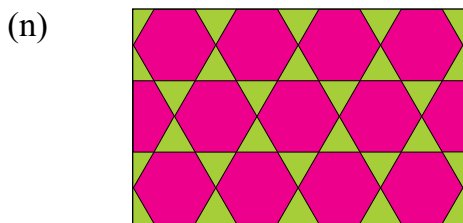
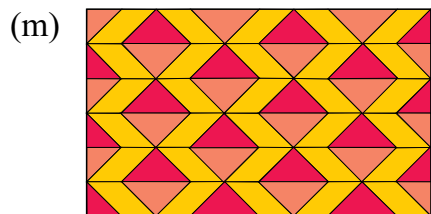
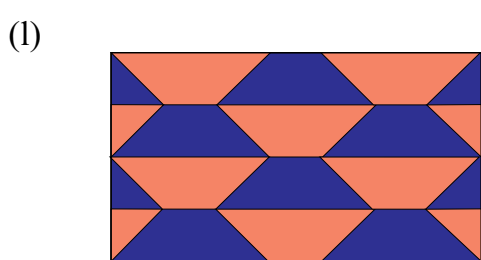
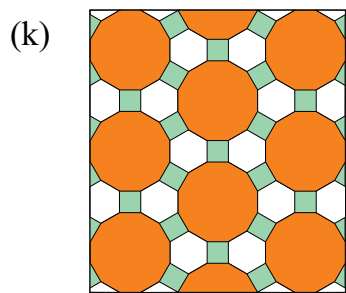
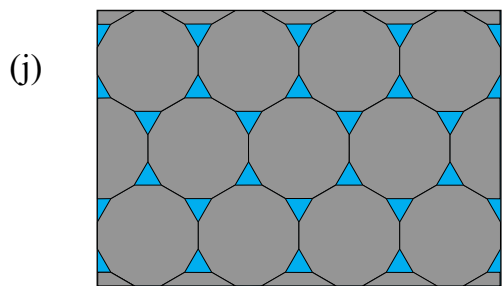
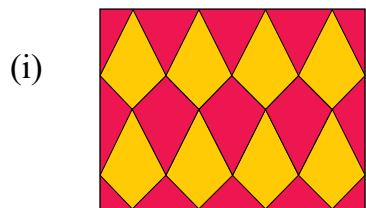


(g)



(h)



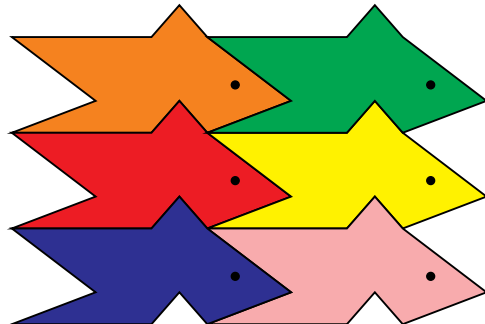
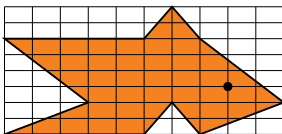
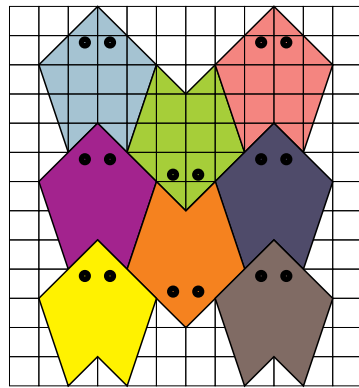
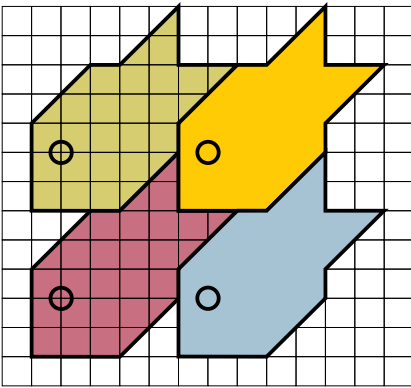
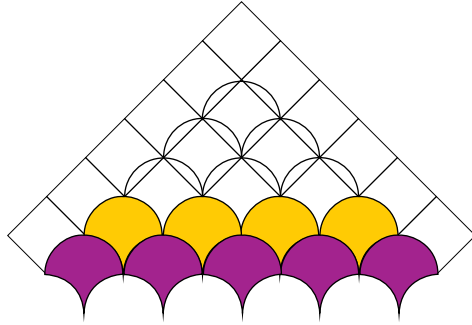
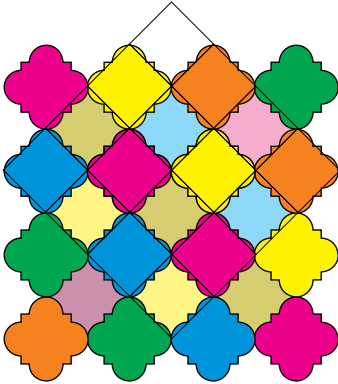


2. Tessellations can also be created using other congruent shapes.

Some examples are shown below.

Try drawing some of these, create some of your own or find other tessellations to draw.

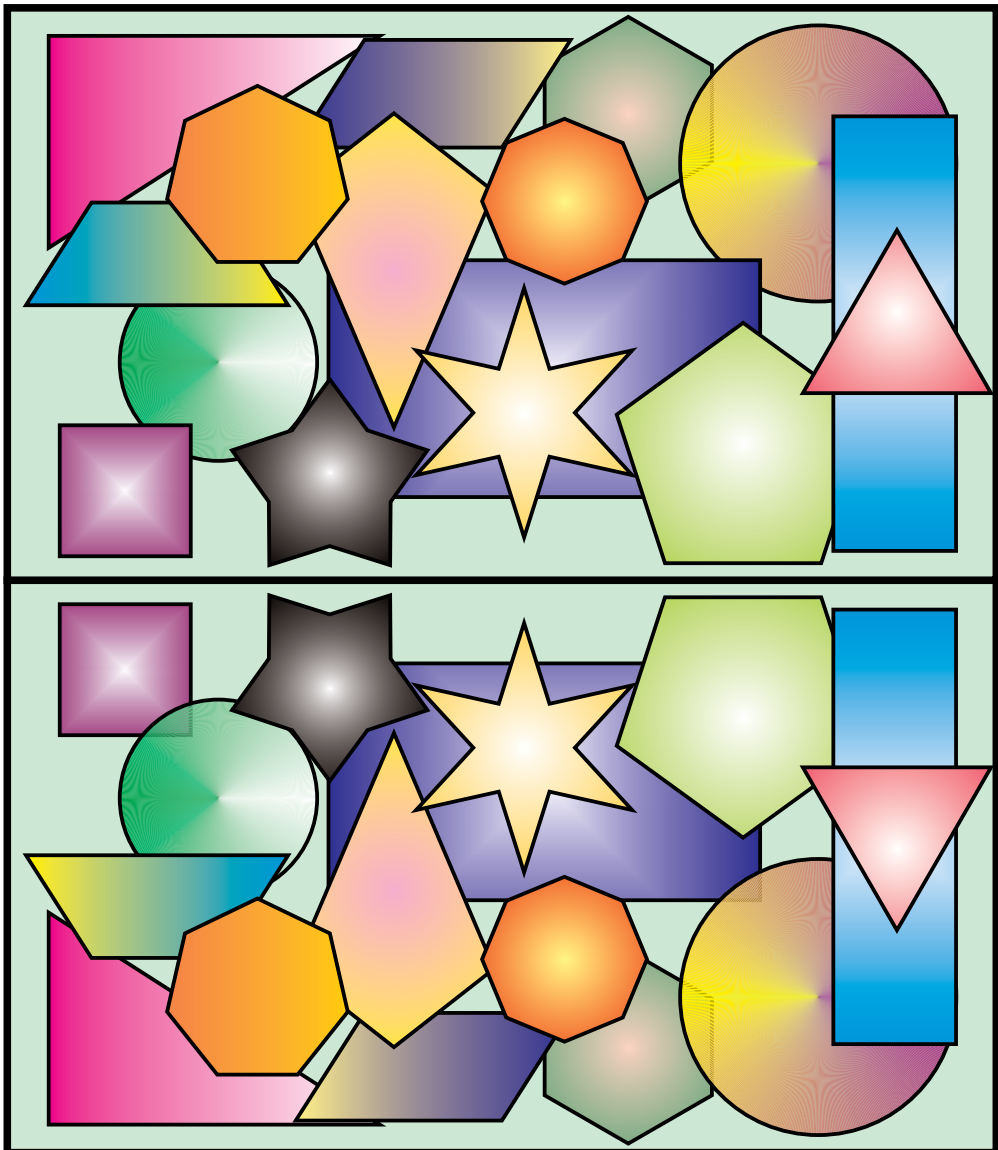
An artist famous for his tessellations is M. C Escher. Research Escher's work.



PROBLEM SOLVING

The artwork below is called '*Reflection on Shapes*'.

The bottom half is a reflection of the top half. But the artist has made five mistakes. Can you find them?



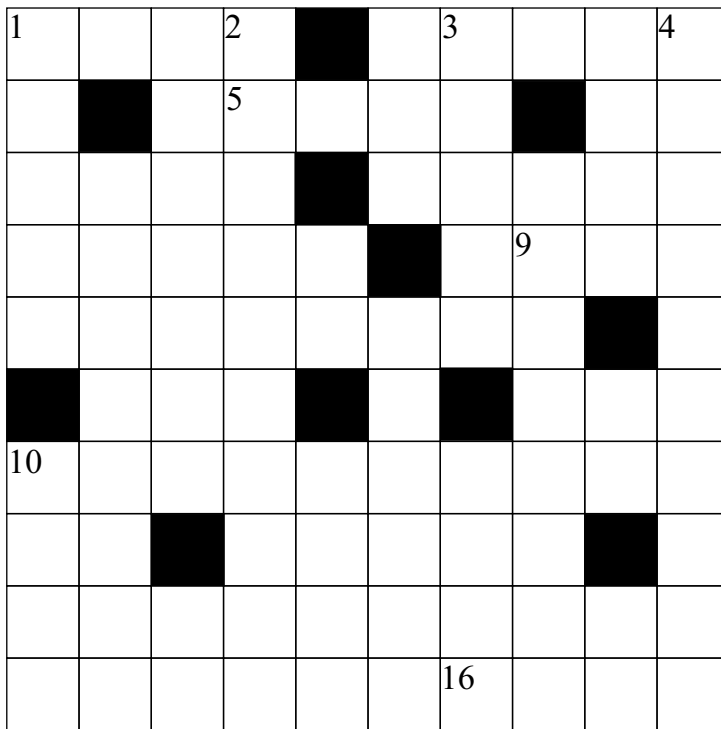
PUZZLE

Crossword puzzles are usually symmetrical.

Copy the crossword below onto graph paper. Fill in the black squares so that the right half of the crossword is a reflection of the left half and the bottom half is a reflection of the top half.

Complete the crossword by using the clues - some of the numbers are given. You will need to find the others.

All answers are four letter words.



Across

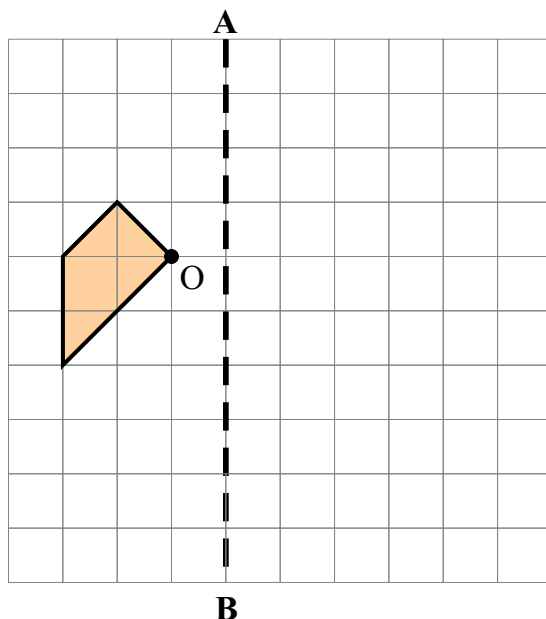
1. $24 \div 6$
3. Information shown on graphs or tables.
5. Eight sided figure - _ _ _ _ GON.
6. Opposite direction to west.
8. Six sided figure - _ _ _ _ GON.
10. Rearrange VEEN to form a type of number.
12. Parts of a circle.
14. A fraction is one number _ _ _ _ another.
15. Opposite of closed.
16. Triangle with equal side lengths -
_ _ _ _ LATERAL.

Down

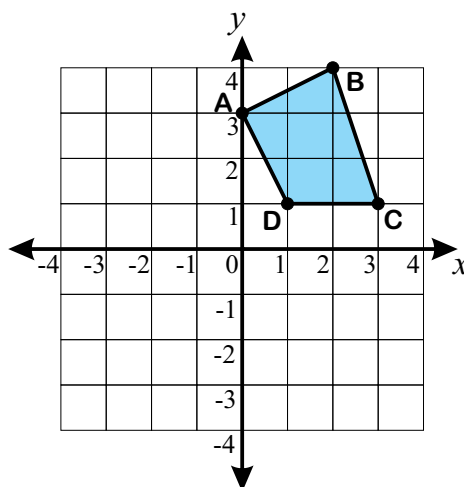
1. $\sqrt{25}$
2. The symbol in 1 down represents a square _ _ _ _.
3. One of the symbols used in Morse code.
4. Size of a 2-dimensional region.
7. A triangle has three of these.
9. Infinity goes on for _ _ _ _.
10. Reflected sound.
11. 12 o'clock in the middle of the day.
12. An old unit of land area.
13. Half a circle is called a _ _ _ _ circle.

CHAPTER REVIEW

1. Draw the shape shown on this grid after the following transformations.
- Reflection about the line AB.
 - Rotation of 90° anticlockwise about O.
 - Translation right of four units (R4).
 - Translation of D2 then R5.
 - Rotation of 180° about O then translation of D5.
 - Reflection about line AB then translation of U2 then L1.



2. (a) State the coordinates of the vertices of the shape shown on this graph.



- (b) State the coordinates of the vertices of the shape after the following transformations.
- Reflection about the y -axis.
 - Reflection about the x -axis.
 - Rotation of 90° clockwise about A.
 - Rotation of 180° about D.
 - Translation left of three units (L3).
 - Translation down of two units (D2).
 - Translation left of three units (L3), then reflected about the x -axis.

Polygons

Triangles

EXERCISE 17A

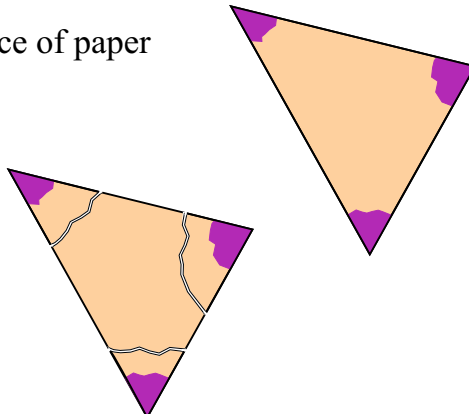
1. Copy and complete the sentences below using the words from the following list to fill in the spaces.

isosceles right-angled scalene equilateral

- (a) A triangle with side lengths and angles that are all different is called a ____ triangle.
- (b) A triangle with two side lengths and angles that are the same is called an ____ triangle.
- (c) A triangle that has one of its angles equal to 90° is called a ____ triangle.
- (d) A triangle that has all its side lengths and angles equal is called an ____ triangle.

2. (a) Cut a triangle out of a piece of paper and colour in the corners.

- (b) Tear off the corners.



- (c) Join the three corners together and glue them into your book.

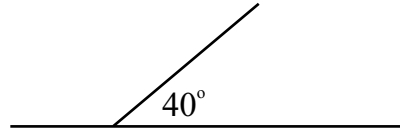


- (d) You will find that the three angles form a straight line.
- (e) What is the angle formed along a straight line?
- (f) What is the sum of the three angles in a triangle?

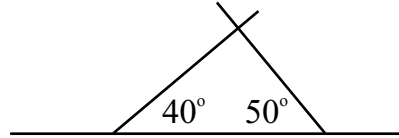


3. (a) Draw a straight line in your book.

(b) Use a protractor to draw another line that makes an angle of 40° to the first line.



(c) Draw a third line so that it makes an angle of 50° with the first line as shown in diagram.

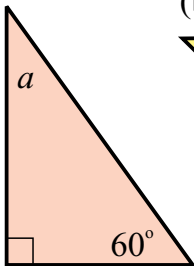


(d) Use the answer from question 2(f) to find the third angle in the triangle you have formed.

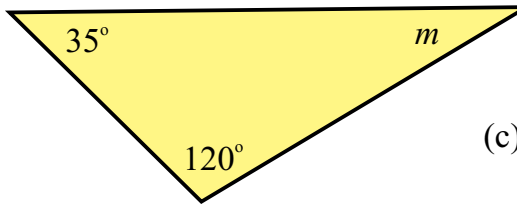
(e) Measure the angle to see if you are correct.

4. Calculate the unknown angles in the following triangles. Remember all the angles in a triangle add to 180° .

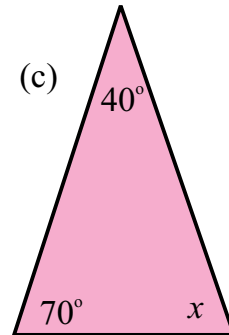
(a)



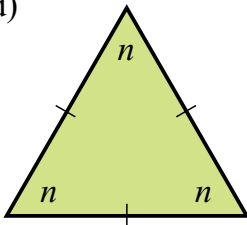
(b)



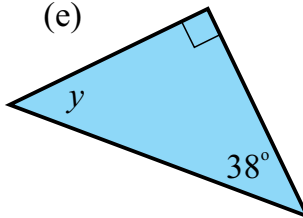
(c)



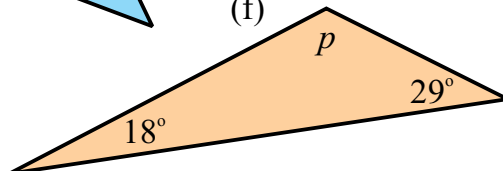
(d)



(e)



(f)

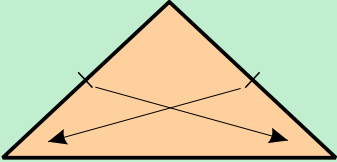


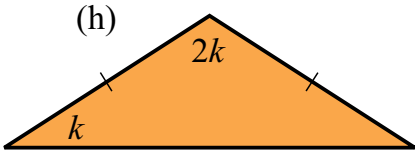
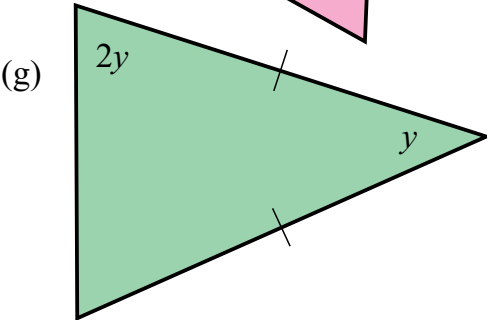
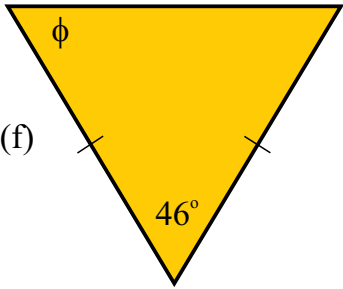
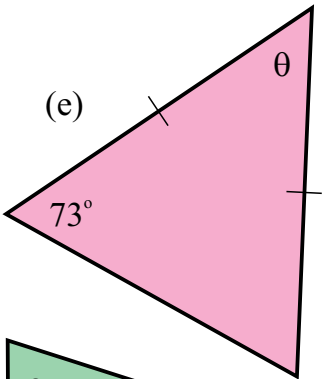
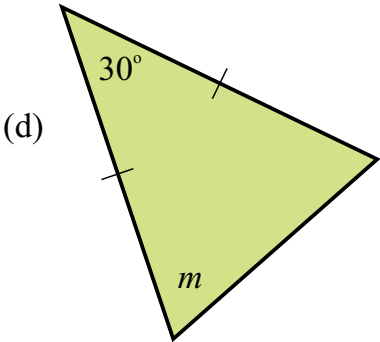
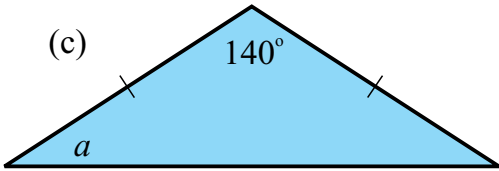
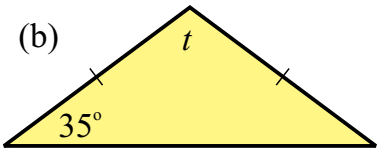
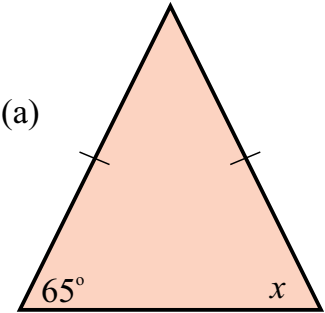
5. Which of the triangles in question 4 are:

- (i) scalene triangles?
- (ii) isosceles triangles?
- (iii) equilateral triangles?
- (iv) right-angled triangles?

6. All the following triangles are isosceles triangles. Find the unknown angle in each triangle.

Remember -
the angles opposite
the equal sides are
the two angles that
are equal.



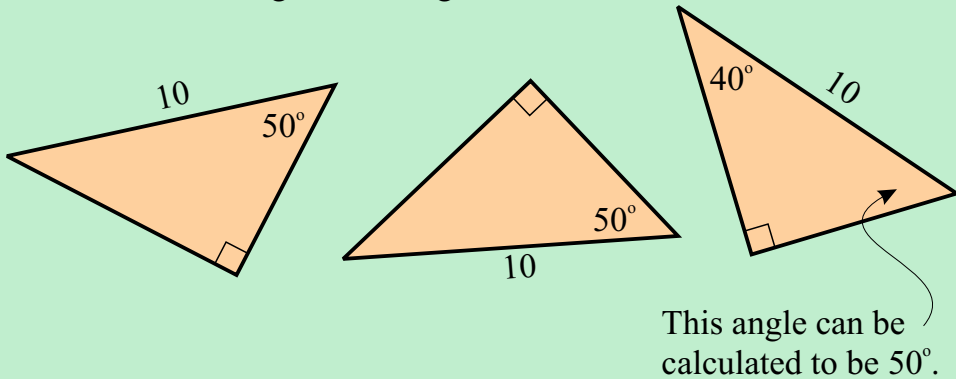


Congruent Triangles

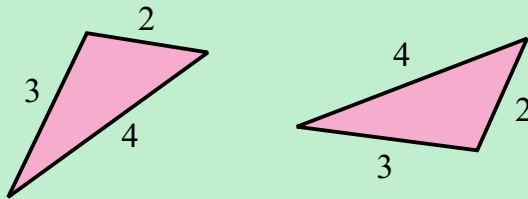
Congruent triangles are triangles that are *exactly equal to each other*. All corresponding angles and side lengths are the same. They may be rotated and/or reflected.

Examples

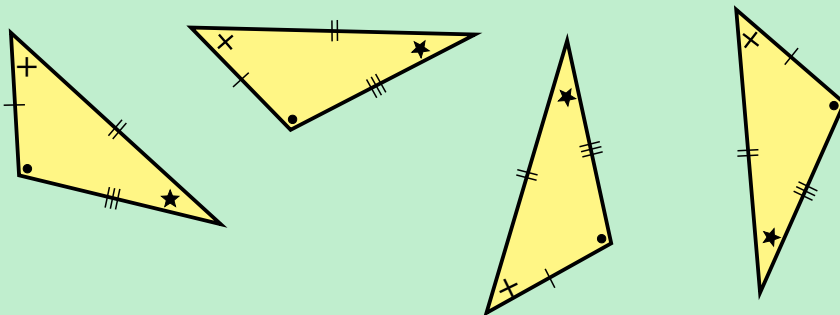
1. These three triangles are congruent.



2. These two triangles are congruent.



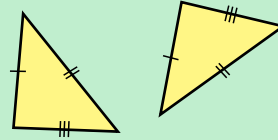
3. All these triangles are congruent.



One of three tests can be used to identify congruent triangles.

1. Side-side-side (SSS)

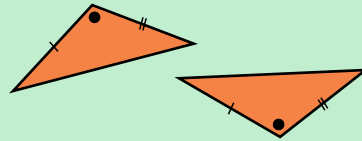
If two triangles have the same side lengths they are congruent.



OR

2. Side-angle-side (SAS)

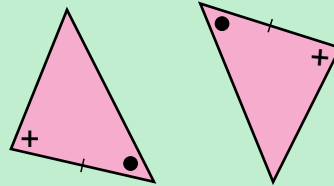
If two side lengths and the contained angle are the same.



OR

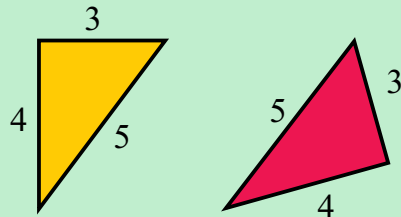
3. Angle-side-angle (ASA)

If two angles and the contained side length are the same.

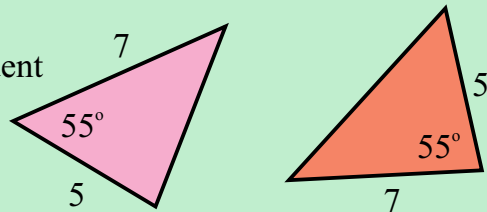


Examples

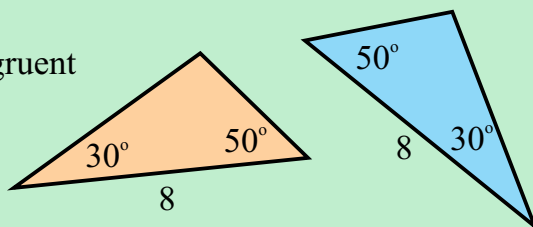
1. These two triangles are congruent using the **SSS** test.



2. These two triangles are congruent using the **SAS** test.

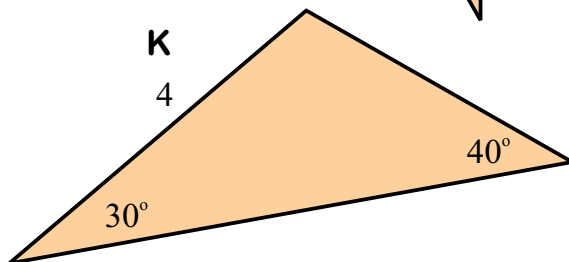
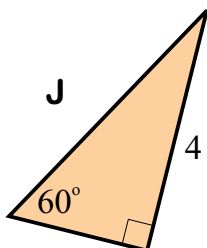
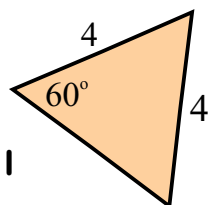
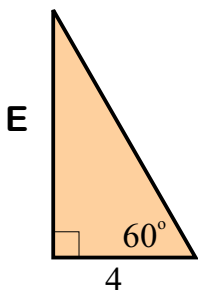
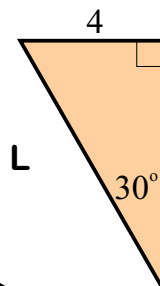
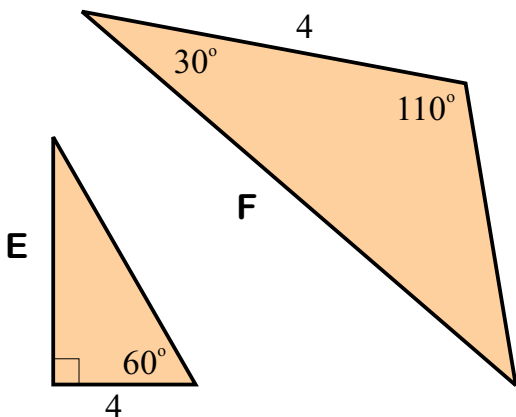
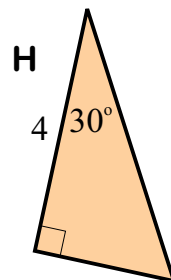
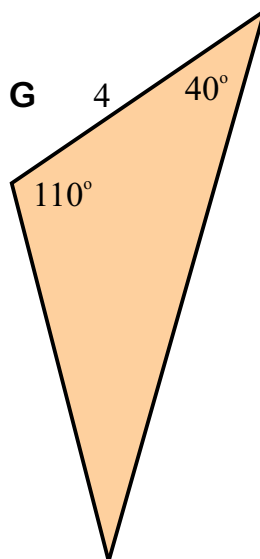
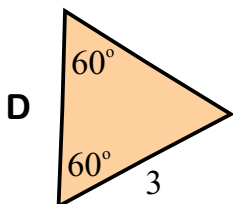
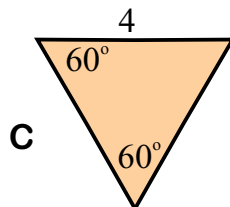
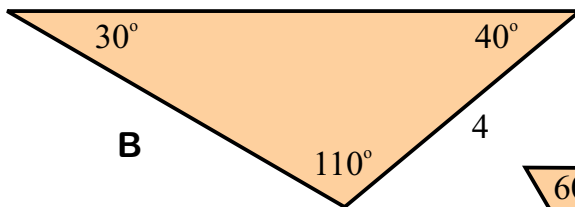
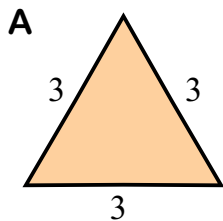


3. These two triangles are congruent using the **ASA** test.

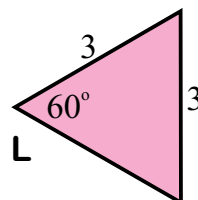
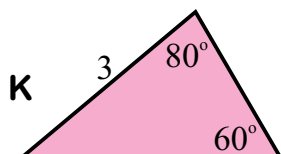
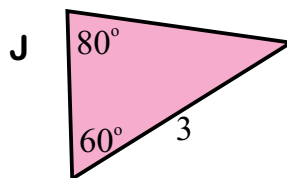
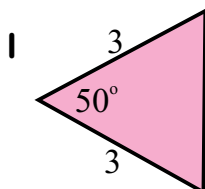
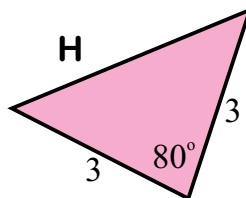
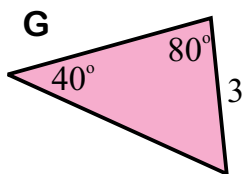
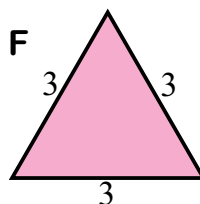
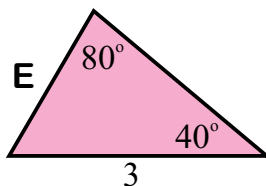
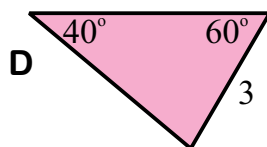
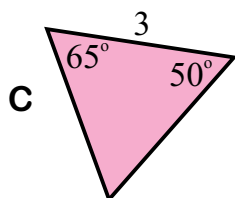
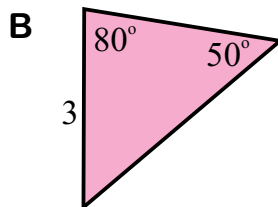
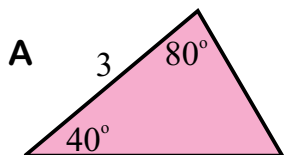


EXERCISE 17B

1. Match the pairs of congruent triangles below.
They are *not* drawn to scale.

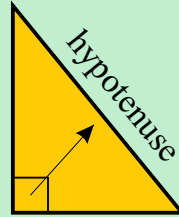


2. Match all the pairs of congruent triangles from the following triangles.



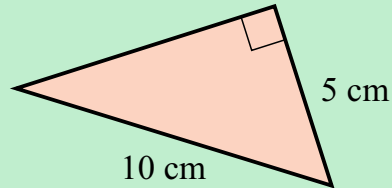
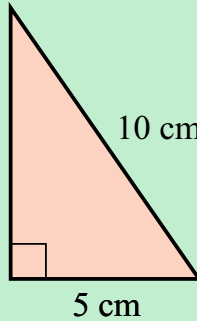
Right-angled Triangles

A separate test can be used to identify congruent right-angled triangles. It is called the ***RHS*** test (***R***ight-angle, ***H***ypotenuse and ***S***ide). If the hypotenuse and another side of two triangles are of equal length then the two triangles are congruent. Remember the hypotenuse is the side opposite the right-angle.



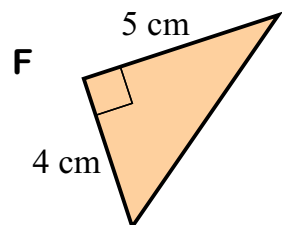
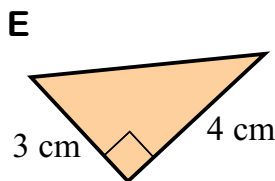
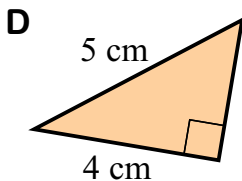
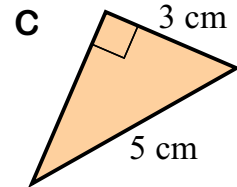
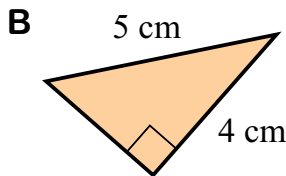
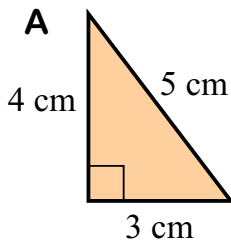
Example

These two triangles are congruent.



EXERCISE 17C

Which of the following triangles are congruent? (More than two)



Constructing Triangles

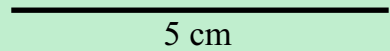
1. Constructing a Triangle When Three Sides Lengths are Known (SSS)

The following steps can be used to construct a triangle knowing the lengths of the three sides using a compass.

The example below describes constructing a triangle with side lengths of 3 cm, 4 cm, and 5 cm.

Step 1

Choose one of the side lengths and draw this line.



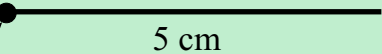
Step 2

Open a compass to a radius of one of the other side lengths.

With the point on one end of the first line draw an arc as shown.

Arc drawn with a radius of 4 cm

Compass point here

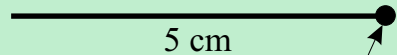


Step 3

Open the compass to a radius of the third side length.

With the point at the other end of the first line draw an arc that crosses the first arc.

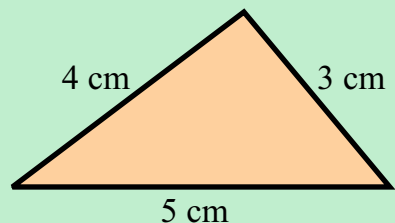
Arc drawn with a radius of 3 cm



Compass point here

Step 4

Connect the ends of the first line with the point where the arcs cross to form the triangle.



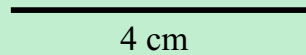
2. Constructing a Triangle When Two Side Lengths and Contained Angle are Known (SAS)

The following steps can be used to construct a triangle knowing the length of two sides and the size of the contained angle using a protractor.

The example below describes constructing a triangle with two side lengths of 4 cm and 6 cm and the contained angle of 30° .

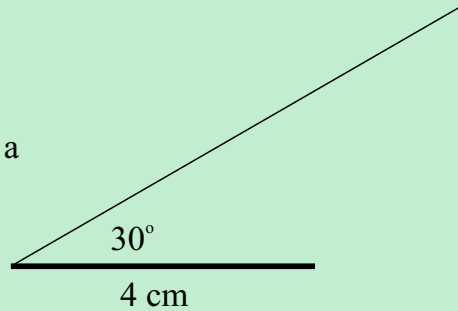
Step 1

Choose one of the side lengths and draw this line.



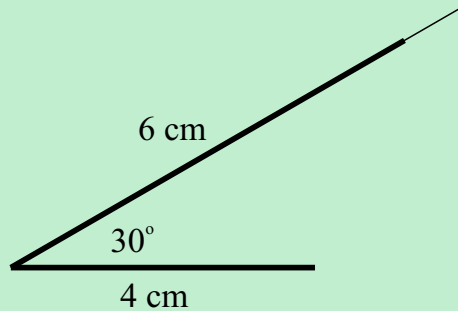
Step 2

From one end of this line and using a protractor, draw a line at the known angle.



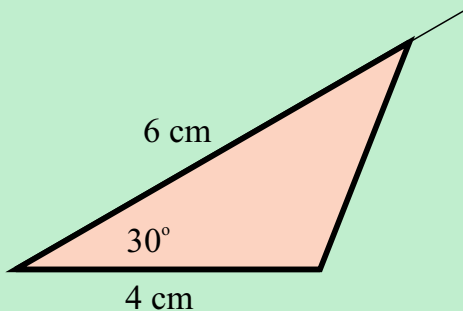
Step 3

Along this line measure the other known side length.



Step 4

Connect the ends of the two lines to complete the triangle.



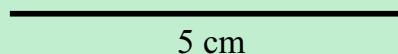
3. Constructing a Triangle When Two Angles and Contained Side Length are Known (ASA)

The following steps can be used to construct a triangle knowing the size of two angles and the length of the contained line using a protractor.

The example below describes constructing a triangle with two angles of 35° and 45° and contained side length 5 cm.

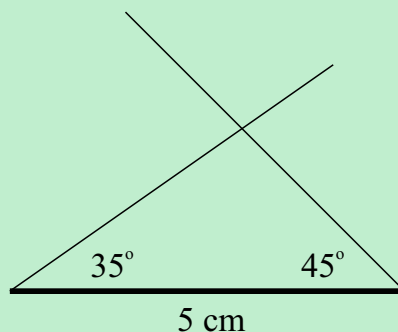
Step 1

Draw a line of the known side length.



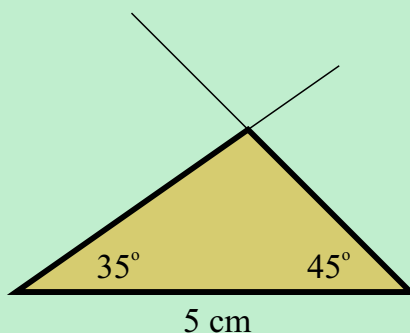
Step 2

Using a protractor draw lines at the known angles from the ends of this line.



Step 3

Complete the triangle.



EXERCISE 17D

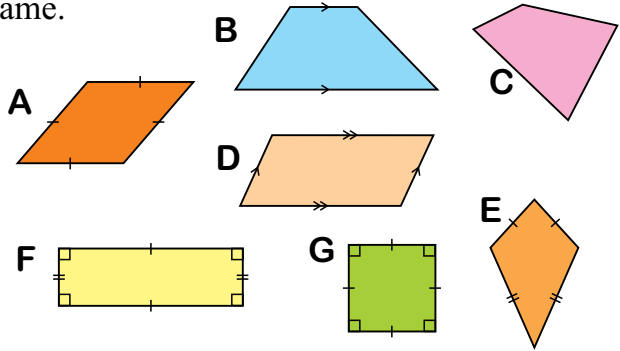
1. Using a ruler and compass construct triangles with the following side lengths.
 - (a) 5 cm, 6 cm and 7 cm
 - (b) 4 cm, 4 cm and 4 cm
 - (c) 6 cm, 8 cm and 10 cm
 - (d) 5 cm, 12 cm and 13 cm
2. (a) Which of the triangles in question 1 is/are equilateral triangles?
(b) Which of the triangles in question 1 is/are right-angled triangles?
3. Using a ruler and protractor construct the following triangles.
 - (a) Two side lengths of 5 cm and 7 cm and contained angle of 40° .
 - (b) Two side lengths of 6 cm and 6 cm and contained angle of 75° .
 - (c) Two side lengths of 7 cm and 7 cm and contained angle of 60° .
 - (d) Two side lengths of 4.5 cm and 6 cm and contained angle of 80° .
4. What is the length of the third side in the triangle in question 3(c)?
5. Using a ruler and protractor construct the following triangles.
 - (a) Two angles of 30° and 40° and contained side length of 8 cm.
 - (b) Two angles of 50° and 50° and contained side length of 6 cm.
 - (c) Two angles of 30° and 60° and contained side length of 7 cm.
 - (d) Two angles of 45° and 105° and contained side length of 5 cm.
6. (a) What is the name given to the triangle constructed in question 5(b)?
(b) What is the name given to the triangle constructed in question 5(c)?
(c) What is the size of the third angle in the triangle in question 5(d)?
7. (a) Construct a right-angled triangle that has a hypotenuse of 8 cm and one of the other sides of 5 cm.
(b) Construct a right-angled triangle that has its two shorter sides of 6 cm and 9 cm.
(c) Construct a right-angled triangle that has its two shorter sides of 7 cm and 7 cm.
8. What is the size of the other two angles in the triangle in question 7(c)?

Quadrilaterals

EXERCISE 17E

1. Match the shape with its name.

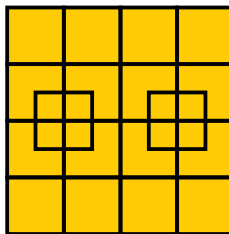
- (a) square
- (b) rectangle
- (c) parallelogram
- (d) rhombus
- (e) trapezium
- (f) kite
- (g) irregular quadrilateral



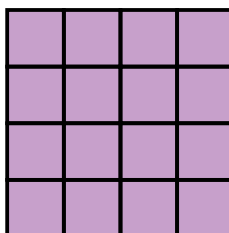
2. State whether the following statements are **TRUE** or **FALSE**.

- (a) A square is a type of parallelogram.
- (b) A square could be formed by joining two equilateral triangles.
- (c) The diagonals of a square are perpendicular.
- (d) The diagonals of a kite are perpendicular.
- (e) The diagonals of parallelogram are perpendicular.
- (f) A kite is formed by joining two isosceles triangles.
- (g) All the angles in a kite are different.
- (h) A trapezium has one pair of parallel lines.
- (i) A parallelogram with all its interior angles equal to 90° would be called a square.

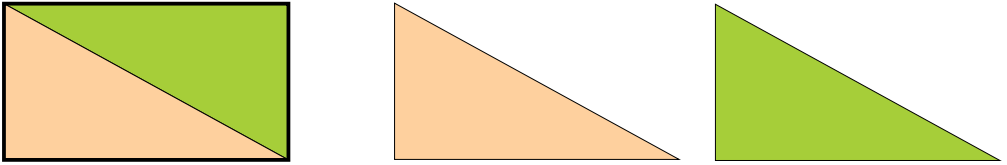
3. How many squares are in this drawing?



4. How many rectangles are in this drawing?



5. It can be seen that a rectangle can be formed by two congruent triangles.



Which of the following quadrilaterals could be formed by two congruent triangles?

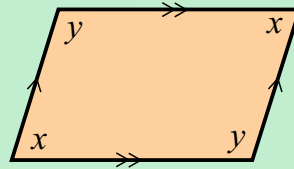
- A** Square **B** Parallelogram **C** Rhombus **D** Kite

6. Draw a trapezium that could be formed by three isosceles triangles.

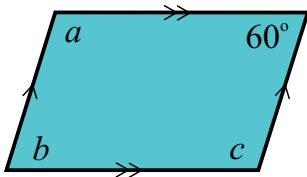
7. Use the information below to find the following unknown angles.

In a *parallelogram*:

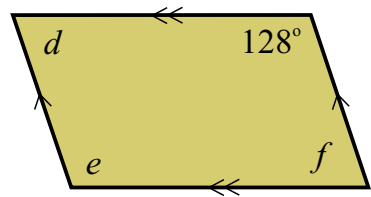
- the two angles along any side add to 180°
 $x + y = 180^\circ$
- opposite angles are equal



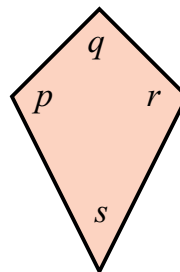
(a)



(b)



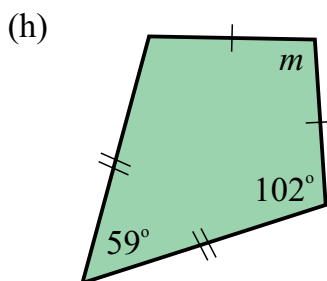
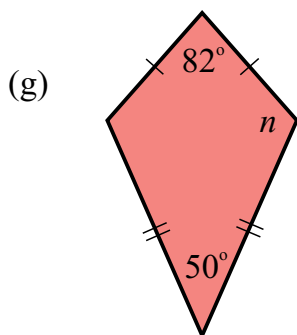
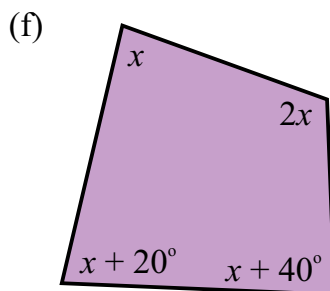
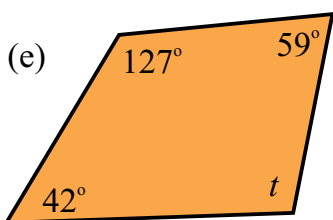
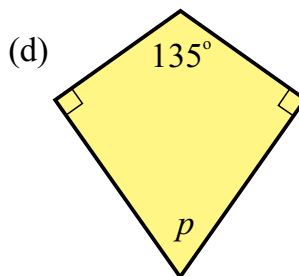
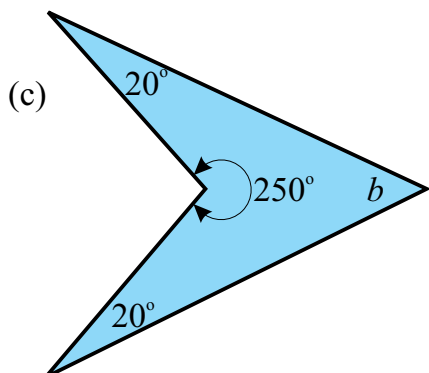
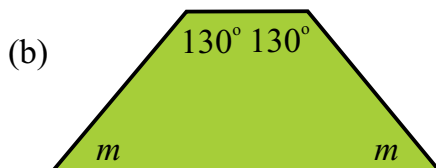
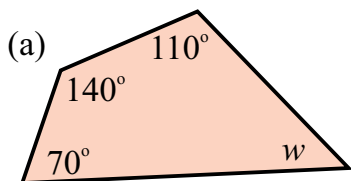
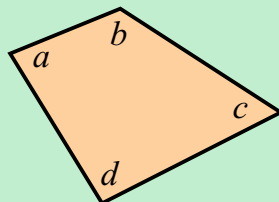
8. Which angles in this kite are equal?



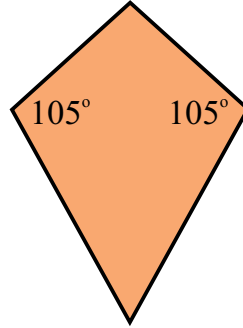
9. Use the information below to find the following unknown angles.

The **sum** of the angles in a **quadrilateral** is 360° .

$$a + b + c + d = 360^\circ$$



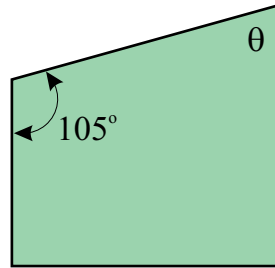
10. The kite shown has its two equal angles of 105° each and its top angle equal to twice the bottom angle. Find the top and bottom angles in the kite.



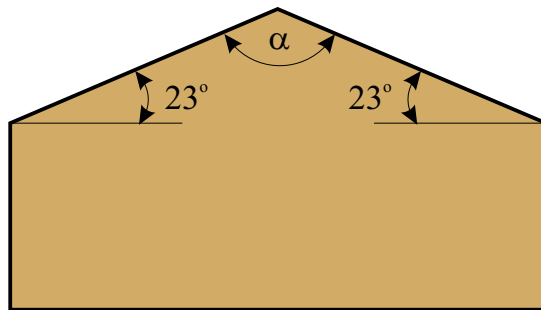
11. Another kite has a top angle which is twice the size of the bottom angle. Its equal angles are each three times the size of the bottom angle. Find all the angles in the kite.

12. The side view of a shed is shown.

- (a) Find angle θ .
(b) What is the angle that the roof makes with the horizontal?



13. The side view of another building is shown here. The pitch (angle) of each side of the roof is 23° . Find angle α .



14. Rearrange the letters from the phrases below to find words from this chapter. The letters from each phrase will form **one** word.

(a) *mob rush*
(d) *large cent*

(b) *a large map roll*
(e) *cedar in purple*

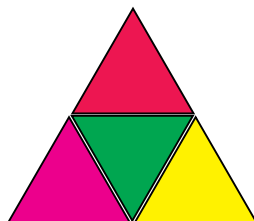
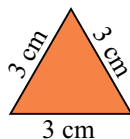
(c) *mature zip*
(f) *real iraq adult*

EXERCISE 17F

Steve makes mosaic patterns using tiles in the shape of equilateral triangles with side length 3 cm.

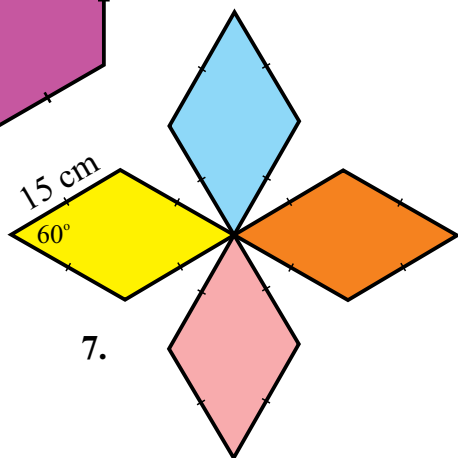
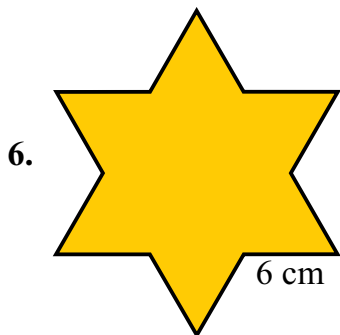
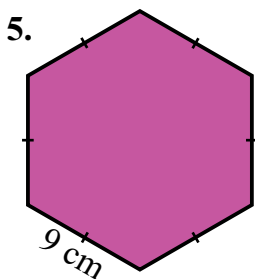
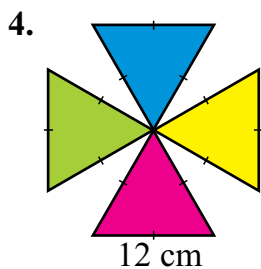
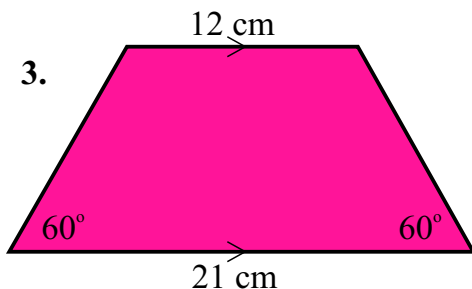
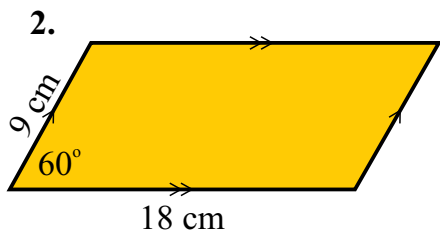
He can make a variety of shapes using a number of these tiles.

An example of a shape he can make is an equilateral triangle with side length 6 cm. This would require 4 tiles.



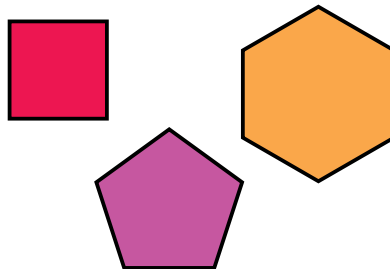
How many tiles would be needed to make the following shapes?

1. An equilateral triangle with side length 9 cm.



PROBLEM SOLVING

1. How many diagonals could be drawn in a square?
2. How many diagonals could be drawn in a regular pentagon?
3. How many diagonals could be drawn in a regular hexagon?
4. Copy and complete this table.
5. Look for a pattern in the table and use this pattern to find the number of diagonals in a 20-sided polygon?

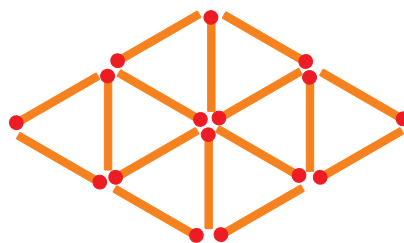


<i>Number of sides of polygon</i>	<i>Number of diagonals</i>
4	
5	
6	
7	
8	

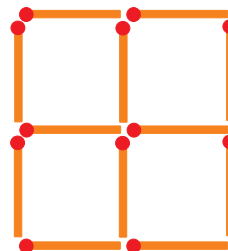
PUZZLES

The patterns below can be made with matches.

1. Using this pattern remove four matches to leave exactly four triangles.

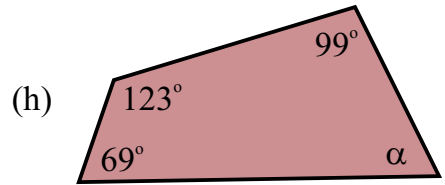
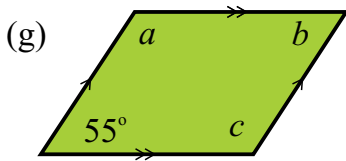
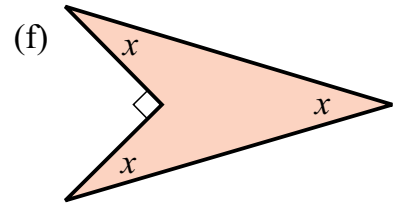
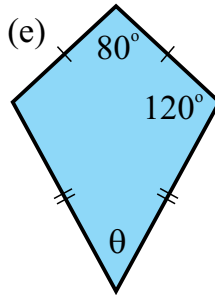
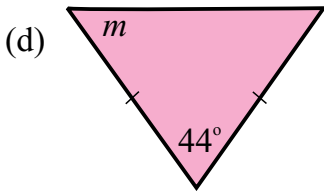
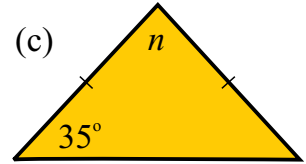
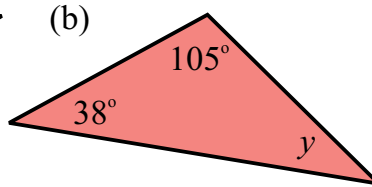
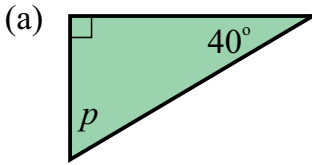


2. Using this pattern:
 - (a) remove four matches to leave exactly two squares.
 - (b) remove four matches to leave exactly one square.
 - (c) remove two matches to leave exactly two squares.
 - (d) move four matches to leave exactly three squares.

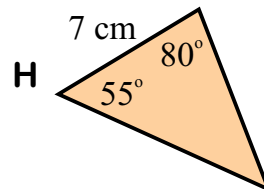
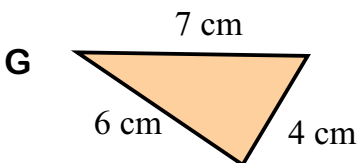
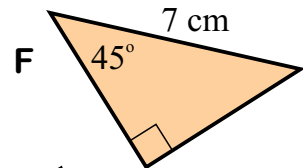
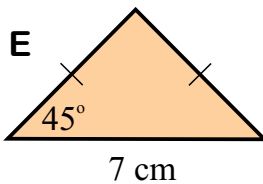
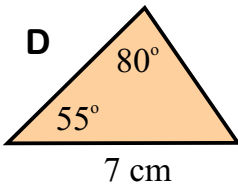
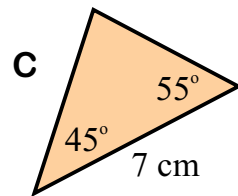
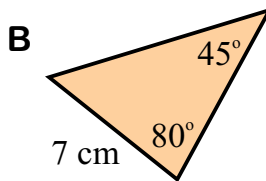
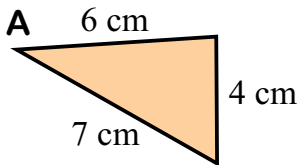


CHAPTER REVIEW

1. Calculate the unknown angles below.



2. Match the pairs of congruent triangles below.



Probability

Probability

Probability is defined as the chance or likelihood of something occurring. We often talk about the probability of certain events occurring.

Examples

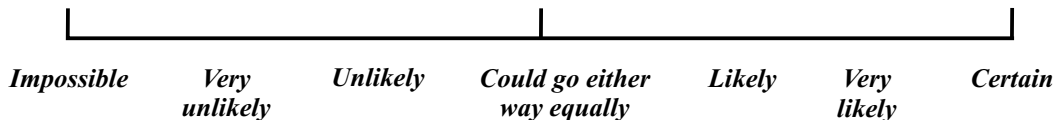
What is the chance of rain tomorrow?

What is the likelihood of meeting someone you know at a party?

What is the chance of a player kicking a goal?

What is the chance of tossing a coin and turning up heads?

Whenever probability is discussed the likelihood of the event occurring ranges on a scale from impossible to certain. The diagram below shows this scale.



Examples

It is very unlikely that it will snow in summer.

It is certain that Wednesday will follow Tuesday.

It is impossible to be born on the 30th of February.

It is likely that someone in a class likes chocolate.

In all situations when probability is discussed, there will be a number of possible **outcomes**.

Examples

When tossing a coin either heads or tails will be the outcome.

The temperature tomorrow will less than 20°, 20° or greater than 20°.

When a baby is born it will be a boy or a girl.

It is equally possible to roll a 1, 2, 3, 4, 5 or 6 on a die.

In the mathematics of probability there are several other terms that are often used.

Equally likely outcomes

When all the possible outcomes of an event have the same probability.

Examples

1. Tossing a coin.

There are two possible outcomes - heads and tails.

There is the same probability of either outcome occurring.

2. Rolling a die.

There are six possible outcomes - 1, 2, 3, 4, 5 or 6.

There is the same probability of any number being rolled.

Outcomes that are not equally likely

When the probability of possible outcomes of an event are not equal.

Examples

1. The winner of a sporting contest.

In many sporting contests the probabilities of the teams/opponents winning are different. There is often a favourite.

2. A class has an uneven number of boys and girls. If a student is chosen randomly the probability of a boy being chosen will be different to that of a girl being chosen.

Sample space

The sample space is the list of all possible outcomes.

Note - { } these brackets are used for a sample space.

Examples

1. Tossing a coin.

Sample space = {heads, tails}

2. Rolling a die.

Sample space = {1, 2, 3, 4, 5, 6}

3. Picking a card from a deck of cards and observing the colour.

Sample space = {red, black}

Chance Events

Chance events are events that occur by accident.

Examples

1. Weather events.
2. Car accidents.

Trials and Experiments

To find the probability that a certain outcome will occur, an experiment can be performed that consists of a number of trials.

Example

A company that produces balloons wants to find the probability of a balloon bursting before it reaches a diameter of 40 cm. It could conduct an experiment involving inflating 1000 balloons (1000 trials). If, for example, 13 balloons burst, the company could then state that, based on this experiment, the probability of a balloon bursting before reaching 40 cm in diameter is 13 in 1000.

Favourable Outcomes

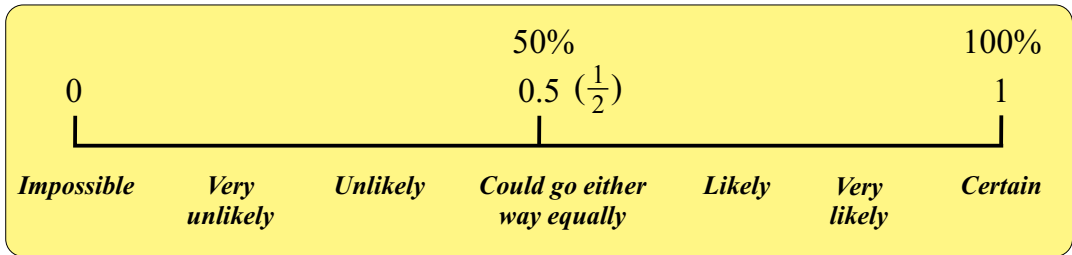
A favourable outcome is that outcome for which the probability is being calculated.

Example

A bag contains 11 balls. Three of the balls are black. What is the probability of randomly choosing a black ball?

In this example the favourable outcome is ***choosing a black ball***.

It has been discussed that probability is often referred to in descriptive terms - impossible, unlikely, likely, certain, etc. In mathematics, probability is given a value that can be a decimal, fraction or percentage. As a decimal or fraction, probability will range from 0 (impossible) to 1 (certain). As a percentage it will range from 0 (impossible) to 100% (certain). This can be shown on the scale from earlier.



The higher the value of the probability (closer to 1) the more likely it is to occur.

The lower the value of the probability (closer to 0) the less likely it is to occur.

Examples

Rate the probability of the following events occurring.
Give answers as decimals, fractions and percentages when not 0 or 1.

1. Rolling a 7 on a standard die.

There is **no chance** of rolling a 7 on a standard die.

The probability = **0**

2. You will get wet if you fall into the sea.

You will **definitely** get wet if you fall into the sea.

The probability = **1**

3. The maximum temperature on New Year's Day in Perth will be above 20°.

It is **very likely** that the maximum temperature will be above 20° in Perth on New Year's Day.

The probability would be about 0.9. (This is an estimate)

$$0.9 = \frac{9}{10} = 90\%$$

Examples continued

4. The maximum temperature on Christmas Day in Sydney will be below 20°.

The maximum temperature is less likely to be below 20° than above 20°.

The probability would be about 0.2. (This is an estimate)

$$0.2 = \frac{2}{10} = \frac{1}{5} \text{ (simplest form)} = 20\%$$

5. When a baby is born it will be a boy.

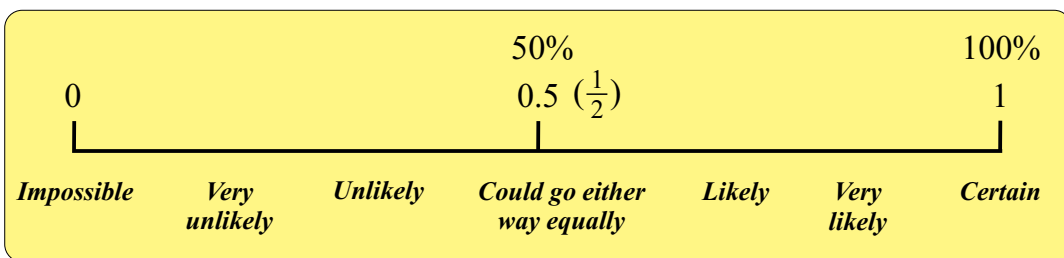
There is usually a 50-50 chance that a baby will be a boy.

The probability = 0.5.

$$0.5 = \frac{5}{10} = \frac{1}{2} \text{ (simplest form)} = 50\%$$

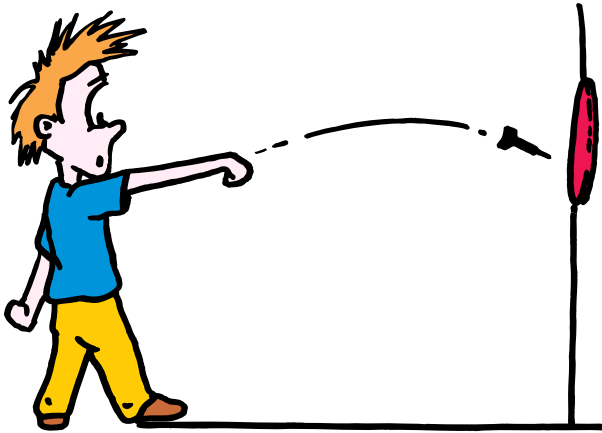
EXERCISE 18A

1. Rate the probability of the following events according to the scale below. For several of the events the answers will vary depending on circumstances. Give answers as decimal numbers.

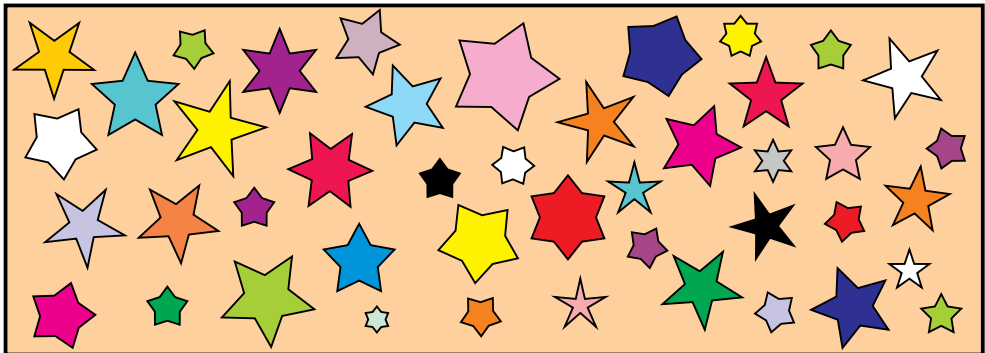


- (a) It will be cloudy tomorrow.
- (b) It will rain every day in January.
- (c) It will rain every day in July.
- (d) It will rain on Melbourne Cup day.
- (e) The temperature will be 30°C on Christmas Day.
- (f) You will buy a tattsлото ticket and win first division.
- (g) Your mathematics teacher will tell a joke today.

- (h) If you had one free throw in basketball you will score.
- (i) Your mathematics teacher would score from a free throw.
- (j) You could throw a cricket ball from 10 metres from the stumps and hit them.
- (k) If you threw an egg up into the air and caught it again without it breaking.
- (l) You could throw a dart at a dart board and score a bull's-eye.
- (m) You could throw a dart at a dart board and hit the board!



- (n) March will be the month after February.
- (o) Next year will be 2030.
- (p) You can guess how many stars are in the box below.
(Count them to see if your guess is correct).



2. List two events (not listed in question 1) that have the following probabilities of occurring:
- (a) 0 (b) 0.1 - 0.3 (c) 0.5 (d) 0.6 - 0.8 (e) 1

Finding Probabilities

Write the following probabilities as fractions in their simplest form.

Examples

1. What is the probability of tossing tails on a coin?

There are two possible outcomes - {*heads, tails*}.

Tossing tails is one of these two outcomes.

The probability of tossing tails = $\frac{1}{2}$

↖ *Tails* is **one** of the outcomes

↖ There are **two** possible outcomes

The probability of tossing tails = $\frac{1}{2}$

2. What is the probability of rolling a 6 on a die?

There are six possible outcomes - {*1, 2, 3, 4, 5, 6*}

Rolling a 6 is one of these outcomes

The probability of rolling a 6 = $\frac{1}{6}$

↖ **6** is **one** of the outcomes

↖ There are **six** possible outcomes

The probability of rolling a 6 = $\frac{1}{6}$

3. What is the probability of rolling a number less than 3 on a die?

There are six possible outcomes - {1, 2, 3, 4, 5, 6}

There are two ways of rolling a number less than 3 - {1, 2}

The probability of rolling a number less than 3 = $\frac{2}{6}$

There are **two** ways of rolling a number less than 3

There are six possible outcomes

The probability of rolling a number less than 3 = $\frac{2}{6} = \frac{1}{3}$ (Simplest form)

4. In a year 8 class of 25 students there are 15 boys.

What is the probability of randomly choosing a boy?

There are 25 possible outcomes (25 students in the class).

There are 15 ways of choosing a boy.

The probability of choosing a boy = $\frac{15}{25}$

There are **15 boys**

There are **25 students**

The probability of choosing a boy = $\frac{15}{25} = \frac{3}{5}$ (Simplest form)

5. In an outdoor activity group there are 10 boys and 12 girls. All their names are put in a hat and one drawn to be the group leader. What is the probability the leader will be a girl?

There are 22 possible outcomes (10 boys + 12 girls).

There are 12 ways a girl could be chosen.

The probability of choosing a girl = $\frac{12}{22}$

↖ There are **12 girls**

↖ There are **22** in the group

The probability of choosing a girl = $\frac{12}{22} = \frac{6}{11}$ (Simplest form)

6. Damon was practising free throw shooting at basketball training. He had 40 free throws and 28 went in.
- (a) Based on these figures what is the probability that when Damon shoots a free throw he scores?
- (b) If Damon attempted 30 free throws, based on this probability, how many would be expected to go in?

Answers

(a) The probability of scoring a free throw = $\frac{28}{40}$

↖ 28 scored

↖ 40 attempts

The probability of scoring a free throw = $\frac{28}{40} = \frac{7}{10}$ (Simplest form)

- (b) If Damon had 30 free throws he would expect to score:

$$\begin{aligned} & \frac{7}{10} \times 30 \\ &= \mathbf{21 \text{ scores}} \end{aligned}$$

7. A box contains 8 black balls and 6 white balls.

- (a) A ball is chosen at random. What is the probability that it is a white ball?
 (b) This white ball is not placed back in the box and another ball is randomly chosen. What is the probability that it is also white?

Answers

(a) There are 14 possible outcomes (8 black balls + 6 white balls).

There are 6 ways a white ball could be chosen.

The probability of choosing a white ball = $\frac{6}{14}$

There are **6 white balls**
 There are **14 balls** in the box

The probability of choosing a white ball = $\frac{6}{14} = \frac{3}{8}$ (Simplest form)

(b) With one white ball already chosen there are only 5 white balls remaining.

There are now 13 possible outcomes (8 black balls + 5 white balls).

There are 5 ways a white ball could be chosen.

The probability of choosing a white ball = $\frac{5}{13}$

There are **5 white balls**
 There are **13 balls** in the box

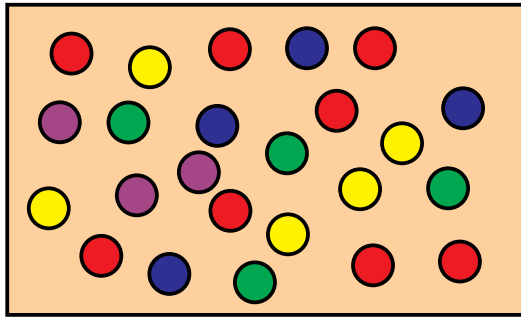
The probability of choosing a white ball = $\frac{5}{13}$ (Simplest form)

EXERCISE 18B

Give answers to the following problems as fractions in their simplest form.

1. Find the probability of:

- (a) rolling a number greater than 4 on a die.
- (b) rolling a number less than 6 on a die.
- (c) rolling a number greater than 6 on a die.
- (d) rolling a number less than 5 on a die.
- (e) rolling a number less than 7 on a die.
- (f) tossing tails on a coin.
- (g) randomly choosing a red ball from this box.
- (h) randomly choosing a white ball from this box.
- (i) randomly choosing a yellow ball from this box.



2. Sachin bought a bag of sweets that contained 10 chocolates and 8 caramels, all wrapped in paper. Sachin chooses a sweet at random.

- (a) What is the probability that the sweet will be a:
 - (i) chocolate? (ii) caramel?
- (b) After eating 2 chocolates he offers the bag to a friend who chooses a sweet at random. What is the probability that the sweet that Sachin's friend chooses is a:
 - (i) chocolate? (ii) caramel?

3. Jonas has 10 pairs of socks - 6 black and 4 brown.

- (a) One Monday morning he chooses a pair at random. What is the probability that the pair is:
 - (i) black? (ii) brown?
- (b) If he chose a brown pair on Monday, what is the probability that on Tuesday he will choose a:
 - (i) black pair? (ii) brown pair?
- (c) He ended up wearing brown socks on Monday, Tuesday, Wednesday and Thursday. What is the probability that on Friday the pair he chooses is:
 - (i) black? (ii) brown?

4. Sandie and Celine were practising their goal shooting at netball. Sandie had 80 shots at goal and 60 went in. Celine had 60 shots and 45 went in.

(a) Use these statistics to find the probability that each player will score a goal.

(b) If Sandie had 100 shots at goal, how many would be expected to score a goal?



5. Find the probability that in any year your birthday will be:
- (a) on a Thursday.
 - (b) on a weekend.
 - (c) on a week day.
 - (d) in March.
6. What is the probability that a letter chosen at random from the alphabet will be a:
- (a) vowel?
 - (b) consonant?
7. As part of the fund raising for the local library there was a raffle with 500 tickets that each cost \$2. There were three prizes to be won.
- (a) Trevor bought one ticket.
 - (i) What is the probability that Trevor won first prize?
 - (ii) What is the probability that Trevor won a prize?
 - (b) Ed bought 10 tickets. What is the probability that Ed won first prize?
 - (c) Gwen really wanted to win the first prize. She bought \$100 worth of tickets. What is the probability that Gwen won first prize?
 - (d) John wanted to buy enough tickets to have a one in four chance of winning first prize (probability of $\frac{1}{4}$). How much will he need to spend on tickets?

8. Taomi went to a circus where there was a game that required balls to be thrown into boxes. There were 15 blue boxes, 4 red boxes and 1 white box. Every ball that was thrown landed in a box. If a ball lands in the white box you win two cinema tickets. If a ball lands in a red box you win a teddy bear. If a ball lands in a blue box you don't win a prize. If Taomi throws one ball randomly:

- what is the probability that she wins the cinema tickets?
- what is the probability that she wins a teddy bear?
- what is the probability that she wins a prize?



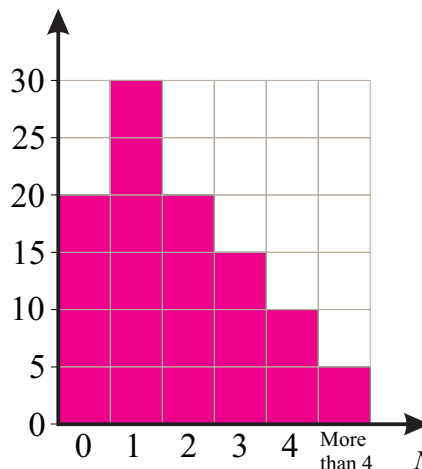
9. The Choc-a-Lot company produces boxes of Easter eggs. People who bought the boxes of Easter eggs were asked how many of the eggs were broken in the box they bought.

The information from these people is shown in this graph.

Use this information to find the probability that in a box of the Easter eggs there will be:

- none broken.
- one broken.
- more than one broken.
- less than 4 broken.

*Number
of People*



*Number of
Broken Eggs*

As discussed earlier, probabilities can be expressed as fractions, decimals or percentages.

Example

Kate has five keys on her key ring and in the dark she randomly tries one to open her front door.

What is the probability that she chooses the correct key?

$$\text{Probability} = \frac{1}{5}$$

↖ There is one correct key.

↖ There are five from which to choose.

This probability could also be expressed as a decimal and a percentage.

As a decimal the probability of choosing the correct key = **0.2**

As a percentage the probability of choosing the correct key = **20%**

EXERCISE 18C

Write the following probabilities as:

(a) fractions (b) decimals (c) percentages

1. What is the probability of rolling a number **less than 4** on a die?
2. Liam is sitting a multiple choice test where there are four answers for each question - **A, B, C** and **D**. He doesn't know one question so he guesses the answer. What is the probability of guessing the **correct** answer?
3. Jenny, Harry, James, Olive and Eve all want to be captain of their netball team. They put their names in a hat and choose one randomly. What is the probability the captain will be a **boy**?
4. From a litter of 10 puppies three were males. Kylie chooses one randomly. What is the probability it will be a **male**?
5. What is the probability of rolling a **3** on a die? Round the decimal and percentage correct to one decimal place.

Complementary Events

Example

In a deck of cards there are four suits - hearts, diamonds, clubs and spades. If a card is chosen randomly, what is the probability it will be a heart?

Probability of choosing a heart = $\frac{1}{4}$, **0.25** or **25%**

The probability of **not** choosing a heart is called the **complementary probability**.

In all situations the probability of an event occurring plus the probability of the complementary event occurring equals one.

$$\text{The probability of an event occurring} + \text{The probability of the complementary event occurring} = 1$$

In the above example the complementary event would be randomly choosing a card that is **not a heart**.

Probability of **not** choosing a heart = $\frac{3}{4}$, **0.75** or **75%**

EXERCISE 18D

The following questions are the complementary events for the questions in Exercise 18C. Write the probabilities as:

(a) fractions (b) decimals (c) percentages

1. What is the probability of rolling a number **4**, **5** or **6** on a die?
2. Liam is sitting a multiple choice test where there are four answers for each question - **A**, **B**, **C** and **D**. He doesn't know one question so he guesses the answer. What is the probability of **not** guessing the correct answer?

3. Jenny, Harry, James, Olive and Eve all want to be captain of their netball team. They put their names in a hat and choose one randomly. What is the probability the captain will be a *girl*?
4. From a litter of 10 puppies three were males. Kylie chooses one randomly. What is the probability it will be a *female*?
5. What is the probability of *not* rolling a 3 on a die? Round the decimal and percentage correct to one decimal place.

EXERCISE 18E

1. The weather forecast predicted a 30% probability of rain. What is the probability it will *not* rain?
2. Sharon had calculated that she had a 65% probability of scoring a free throw in basketball. Based on this figure, what is the probability she will miss a free throw?
3. In a deck of cards there are 52 cards. Of these there are four aces.
 - (a) If a card is drawn at random, what is the probability it is an ace?
Give answer as a fraction in its simplest form.
 - (b) If a card is drawn at random, what is the probability it is *not* an ace?
Give answer as a fraction in its simplest form.
4. In a group of 20 people there were two left-handers.
 - (a) If a person is chosen at random, what is the probability they will be left-handed? Give answer as a decimal.
 - (b) If a person is chosen at random, what is the probability they will be right-handed? Give answer as a decimal.
5. A potter found that for every 50 vases that he made, 4 cracked in the kiln.
 - (a) Based on these figures, what is the probability that a vase will crack when placed in the kiln to dry? Give answer as:
 - (i) fraction in its simplest form
 - (ii) decimal
 - (iii) percentage
 - (b) Based on these figures, what is the probability that a vase will *not* crack when placed in the kiln to dry? Give answer as:
 - (i) fraction in its simplest form
 - (ii) decimal
 - (iii) percentage

Listing Outcomes

In some situations it is convenient to list all possible outcomes when finding the probability of a certain outcome.

Example

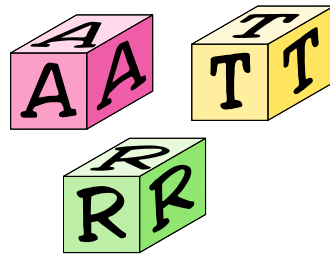
- List all the numbers that can be formed using the digits 1, 2 & 3?
- What is the probability that if one of these is chosen at random it is an even number?

Answers

- 123, 132, 213, 231, 312, 321
- 132 and 312 are the only even numbers = 2 out of 6 = $\frac{2}{6} = \frac{1}{3}$

EXERCISE 18F

- A child is playing with the three blocks shown here and arranges them in a line.
 - List all the different combinations of the three letters that could be formed.
 - What is the probability that the child could form an actual word?



- A game at a show involved putting two balls, one at a time, into the mouth of a clown machine. The balls would then drop into numbered boxes. The boxes were numbered 1, 5, 7 and 10.
 - List all the combinations of numbers that could be achieved with the two balls.
(Note - 1,5 is different from 5,1)

The two numbers are added and the following totals receive the prizes shown.
 An even total receives a chocolate bar.
 An odd total receives an ice-cream.
 A total over 15 receives a show bag.

- Find the sum of the numbers for each pair in part (a).
- What is the probability of someone winning a chocolate bar?
- What is the probability of someone winning an ice-cream?
- What is the probability of someone winning a show bag?



3. Herchelle was a contestant on the game show 'Guess It - Win It'.
If he correctly guessed the cost of a holiday he would win the holiday.
He was given three clues for the cost.

1. *It was between \$3000 and \$7000.*
2. *It was an odd number.*
3. *It contained the digits 2, 3, 5 and 7.*

- (a) Using these clues, list all the possible combinations of numbers for the cost of the holiday.
- (b) What is the probability that Herchelle won the holiday?

4. Jane Bond is a secret agent who finds herself in a room from which she needs to escape.
There are four doors (**A**, **B**, **C** and **D**) from the room. Behind each door is a tunnel (**T**), a rope to climb (**R**) and a pole (**P**) to slide down.
Only one of the paths leading from the room is the escape route.

- (a) Using the abbreviations (**A**, **B**, **C**, **D**, **T**, **R**, **P**), list all the possible escape routes. (**AT**, **AR**, etc)
- (b) What is the probability that Jane escapes?
- (c) What is the probability that Jane does not escape?

5. Secret Agent Jane Bond is in another life and death situation! A bomb is about to explode and Jane needs to disarm it. There are three control panels on the bomb and she needs to press the correct button on each panel to stop the bomb from exploding.

The first panel has three buttons - a red, a yellow and a green (**R**, **Y**, **G**).
The second panel has four buttons numbered from **1** to **4** (**1**, **2**, **3**, **4**).
The third panel has two buttons - a black and a white (**B**, **W**).

- (a) Using the abbreviations, list all the possible combinations of pressing the buttons. (**R1B**, **R1W**, **R2B**, etc)
- (b) What is the probability that Jane selects the correct combination?
- (c) What is the probability that the bomb explodes?
- (d) If Jane gets the first and second buttons correct, what is the probability that she disarms the bomb?



Combined Probability

Example

Saffy wants to go sailing at the weekend. The probability that the weather will be safe enough to sail on a particular day is 0.6.

1. What is the probability she can sail on both days?
2. What is the probability she can sail on one day only?
3. What is the probability she can sail on at least one day?
4. What is the probability she *cannot* sail on either day of the weekend?

Solution

Step 1 List all the possible outcomes.

In this example use **S** to represent safe enough to sail and **N** to represent not safe enough to sail.

<i>Possible outcomes</i>	
<i>Saturday</i>	<i>Sunday</i>
S	S
S	N
N	S
N	N

Step 2 List the probabilities for all the possible outcomes.
(Remember the two probabilities add to 1)

Probability of **S** = 0.6
Probability of **N** = 0.4

SS = 0.6 and 0.6

SN = 0.6 and 0.4

NS = 0.4 and 0.6

NN = 0.4 and 0.4

Continued on next page

In the mathematics of probability it is important to know the following.

$$\begin{aligned} \text{'and'} &= \times \\ \text{'or'} &= + \end{aligned}$$

Step 3 Calculate the probabilities.

1. What is the probability she can sail on both days (**SS**)?

$$\begin{aligned} \text{SS} &= 0.6 \text{ and } 0.6 \\ \text{Probability of SS} &= 0.6 \times 0.6 \\ &= \mathbf{0.36} \end{aligned}$$

$$\text{'and'} = \times$$

2. What is the probability she can sail on one day only?

This can happen two ways: **SN** or **NS**

$$\begin{aligned} \text{SN} &= 0.6 \text{ and } 0.4 \\ \text{NS} &= 0.4 \text{ and } 0.6 \\ \text{Probability of SN} &= 0.6 \times 0.4 \\ &= \mathbf{0.24} \\ \text{Probability of NS} &= 0.4 \times 0.6 \\ &= \mathbf{0.24} \end{aligned}$$

$$\text{'and'} = \times$$

$$\begin{aligned} \text{Probability of SN or NS} &= 0.24 + 0.24 \\ &= \mathbf{0.48} \end{aligned}$$

$$\text{'or'} = +$$

3. What is the probability she can sail on at least one day?

This means one day or both days: **SN** or **NS** or **SS**

$$\begin{aligned} \text{Probability of SN} &= \mathbf{0.24} \\ \text{Probability of NS} &= \mathbf{0.24} \\ \text{Probability of SS} &= \mathbf{0.36} \end{aligned}$$

$$\begin{aligned} \text{Probability of SN or NS or SS} &= 0.24 + 0.24 + 0.36 \\ &= \mathbf{0.84} \end{aligned}$$

$$\text{'or'} = +$$

Continued on next page

4. What is the probability she *cannot* sail on either day of the weekend (**NN**)?

$$\begin{aligned}\text{NN} &= 0.4 \text{ and } 0.4 \\ \text{Probability of NN} &= 0.4 \times 0.4 \quad \text{'and' = } \times \\ &= \mathbf{0.16}\end{aligned}$$

It can be seen that the sum of the probabilities of all of the possible outcomes should equal 1.

This can be used as a check of the answers.

$$\begin{aligned}\text{Probability of SS} &= 0.36 \\ \text{Probability of SN} &= 0.24 \\ \text{Probability of NS} &= 0.24 \\ \text{Probability of NN} &= 0.16 \\ 0.36 + 0.24 + 0.24 + 0.16 &= 1\end{aligned}$$

EXERCISE 18G

1. The probability that Bree scores from a free throw in basketball is 0.7. Bree has two free throws.
 - (a) What is the probability she scores just one free throw?
 - (b) What is the probability she scores both free throws?
 - (c) What is the probability she scores at least one free throw?
 - (d) What is the probability she scores no free throws?
2. Harley caught a tram into the city on Monday and Tuesday to study. He calculated that the probability of getting a seat on a tram was 0.9.
 - (a) What is the probability he would get a seat on just one day?
 - (b) What is the probability he would get a seat on both days?
 - (c) What is the probability he would get a seat on at least one day?
 - (d) What is the probability he would not get a seat on either day?

3. Holly has five different coloured pairs of socks - *red*, *green*, *blue*, *yellow* and *pink*. She also has five different coloured shorts - *red*, *green*, *blue*, *yellow* and *pink*. One day she randomly chooses a pair of socks and shorts.
- What is the probability the socks will be *pink*?
Give answer as a decimal.
 - What is the probability the shorts will be *pink*?
Give answer as a decimal.
 - What is the probability they will both be *pink*?
 - What is the probability that neither will be *pink*?
 - What is the probability they will both be *red*?

4. Bindi is a wildlife guide and conducts night walks in a park to spot animals. She says the probability of seeing a sugar glider on any night is 0.3. Zana and Kiama go out with Bindi on two nights to hopefully see a sugar glider.



- What is the probability they will see a sugar glider on at least one of the nights?
 - What is the probability they will see a sugar glider on both nights?
 - What is the probability they will not see a sugar glider on either night?
5. Hervey bought two clownfish for his aquarium - one male and one female. He was told that clownfish had a 10% chance of changing sex when placed in a new environment. Give the following answers as decimals and percentages.

- What is the probability that Hervey will end up with two males?
- What is the probability that Hervey will end up with two females?
- What is the probability that Hervey will end up with one male and one female?



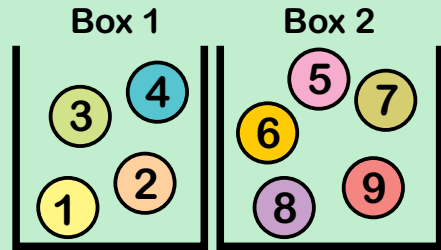
Two-way Tables

Two-way tables can be used when there is a large number of possible outcomes.

Example 1

A ball is chosen at random from each of these boxes and the numbers *added*.

1. What is the probability that the sum of the numbers is greater than 10?
2. What is the probability that the sum of the numbers is equal to 10?



Step 1 Construct a two-way table as shown here.

		Box 1			
		1	2	3	4
Box 2	5	6	7	8	9
	6	7	8	9	10
	7	8	9	10	11
	8	9	10	11	12
	9	10	11	12	13

Total number of outcomes = 20

Step 2 Use this to find the probabilities.

		Box 1			
		1	2	3	4
Box 2	5	6	7	8	9
	6	7	8	9	10
	7	8	9	10	11
	8	9	10	11	12
	9	10	11	12	13

6 of the 20 outcomes are greater than 10

1. The probability that the sum of the numbers is greater than 10 $= \frac{6}{20} = \frac{3}{10}$ (Simplest form)

		Box 1			
		1	2	3	4
Box 2	5	6	7	8	9
	6	7	8	9	10
	7	8	9	10	11
	8	9	10	11	12
	9	10	11	12	13

4 of the 20 outcomes are equal to 10

2. The probability that the sum of the numbers is equal to 10 $= \frac{4}{20} = \frac{1}{5}$ (Simplest form)

Example 2

The names of the players in two mixed basketball teams are shown below.

The Beebees: Adam, Jenny, Ben, Damien and Kate

The Hotshots: Andrew, William, Emma, Brooke, James and Mike

After these teams play each other, one player is chosen from each team to score the next game in the competition. If one player is chosen at random from each team, what is the probability they will both be boys?

Solution

Using the letters **B** (boys) and **G** (girls) construct a two-way table.

		Beebees				
		B	G	B	B	G
Hotshots	B	BB	BG	BB	BB	BG
	B	BB	BG	BB	BB	BG
	G	GB	GG	GB	GB	GG
	G	GB	GG	GB	GB	GG
	B	BB	BG	BB	BB	BG
	B	BB	BG	BB	BB	BG

12 of the 30 possible outcomes are both boys

The probability that they are both boys $= \frac{12}{30} = \frac{2}{5}$ (Simplest form)

EXERCISE 18H

Write the answers to the following questions as fractions in their simplest form.

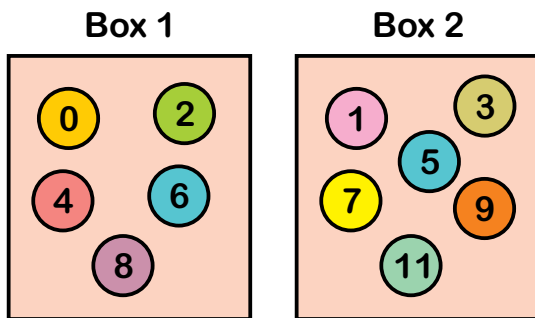
1. A ball is taken at random from each of these boxes and the numbers are **added**.

(a) Construct a two-way table to show all the possible outcomes.

(b) What is the probability that the sum of the two numbers is less than 12?

(c) What is the probability the sum of the two numbers is equal to 9?

(d) What is the probability the sum of the two numbers is greater than 5?



2. A ball is taken at random from each of the boxes in question 1 and the numbers are **multiplied**.

(a) Construct a two-way table to show all the possible outcomes.

(b) What is the probability that the product of the two numbers is less than 50?

(c) What is the probability the product of the two numbers is equal to 50?

(d) What is the probability the product of the two numbers is greater than 70?

3. Tammy has five skirts in one drawer - **blue**, **green**, **pink**, **red** and **orange**. She has five shirts in another drawer that are the same colours as the skirts - **blue**, **green**, **pink**, **red** and **orange**.

One morning, in the dark, she randomly chooses a skirt and shirt.

(a) Construct a two-way table to show all the possible outcomes for the combinations of skirt and shirt.

(b) What is the probability that she chose the **green** skirt and the **red** shirt?

(c) What is the probability that she chose two colours that were the same?

(d) What is the probability that she chose a **blue** and **orange** combination?

(e) What is the probability that she chose two colours that were different?

(f) What is the probability that **at least** one item of clothing was **pink**?



4. Two dice are rolled and the numbers are ***added***.

- (a) Construct a two-way table to show all the possible outcomes.
- (b) What is the probability that the sum of the two numbers is 5?
- (c) What is the probability that the sum of the two numbers is less than 5?
- (d) What is the probability that the sum of the two numbers is greater than 8?
- (e) What is the probability that the sum of the two numbers is an even number?
- (f) What is the probability that the sum of the two numbers is an odd number?
- (g) What sum/s of the numbers has the highest probability of occurring?
- (h) What sum/s of the numbers has the lowest probability of occurring?



5. Two dice are rolled and the numbers are ***multiplied***.

- (a) Construct a two-way table to show all the possible outcomes.
- (b) What is the probability that the product of the two numbers is 12?
- (c) What is the probability that the product of the two numbers is less than 20?
- (d) What is the probability that the product of the two numbers is greater than 20?
- (e) What is the probability that the product of the two numbers is between 10 and 20?
- (f) What is the probability that the product of the two numbers is a single digit number?
- (g) What is the probability that the product of the two numbers is an even number?
- (h) What is the probability that the product of the two numbers is an odd number?
- (i) What product/s of the numbers has the highest probability of occurring?
- (j) What product/s of the numbers has the lowest probability of occurring?

Another type of two-way table can be used when data from surveys, for example, is being displayed.

Example

A number of boys and girls at a school were asked if they would prefer indoor or outdoor activities at lunch.

45 boys were asked and 10 of these preferred indoor activities.

55 girls were asked and 30 of these preferred indoor activities.

This information can be displayed on the two-way table shown below.

	<i>Boys</i>	<i>Girls</i>	<i>Total</i>
<i>Indoor</i>	10	25	
<i>Outdoor</i>			
<i>Total</i>	45	55	

The table can be completed by calculating the other numbers.

The number of boys who prefer outdoor activities = $45 - 10 = 35$

The number of girls who prefer outdoor activities = $55 - 25 = 30$

The total number of students who prefer indoor activities = $10 + 25 = 35$

The total number of students who prefer outdoor activities = $35 + 30 = 65$

The total number of students surveyed = $45 + 55 = 35 + 65 = 100$

	<i>Boys</i>	<i>Girls</i>	<i>Total</i>
<i>Indoor</i>	10	25	35
<i>Outdoor</i>	35	30	65
<i>Total</i>	45	55	100

These figures can then be used to find probabilities. *See next page*

	<i>Boys</i>	<i>Girls</i>	<i>Total</i>
<i>Indoor</i>	10	25	35
<i>Outdoor</i>	35	30	65
<i>Total</i>	45	55	100

Use this information to find the following probabilities.

Give answers as fractions in their simplest form.

1. What is the probability that a boy prefers an outdoor activity?
2. What is the probability that someone who prefers an indoor activity is a girl?
3. What is the probability that a student prefers an outdoor activity?

Solutions

$$\begin{aligned}
 \text{1. The probability that a boy} &= \frac{35}{45} \quad \begin{array}{l} \swarrow \text{number of boys who prefer} \\ \text{an outdoor activity} \end{array} \\
 \text{prefers an outdoor activity} &\quad \searrow \text{total number of boys} \\
 &= \frac{7}{9}
 \end{aligned}$$

$$\begin{aligned}
 \text{2. The probability that someone who} &= \frac{25}{35} \quad \begin{array}{l} \swarrow \text{number of girls who prefer} \\ \text{an indoor activity} \end{array} \\
 \text{prefers an indoor activity is a girl} &\quad \searrow \text{total number of students who} \\
 &\quad \quad \quad \text{prefer an indoor activity} \\
 &= \frac{5}{7}
 \end{aligned}$$

$$\begin{aligned}
 \text{3. The probability that a student} &= \frac{65}{100} \quad \begin{array}{l} \swarrow \text{number of students who} \\ \text{prefer an outdoor activity} \end{array} \\
 \text{prefers an outdoor activity} &\quad \searrow \text{total number of students} \\
 &= \frac{13}{50}
 \end{aligned}$$

EXERCISE 18I

Give all probabilities as fractions in their simplest form.

1. 80 students were asked if they wanted to visit a zoo or a museum.
50 of the students asked were boys and 30 of these wanted to visit a museum.

20 of the girls asked wanted to visit a zoo.

(a) Copy and complete the table below displaying this information.

	<i>Boys</i>	<i>Girls</i>	<i>Total</i>
<i>Zoo</i>			
<i>Museum</i>			
<i>Total</i>			

(b) What was the probability that a student wanted to visit a zoo?

(c) What was the probability that a girl wanted to visit a museum?

(d) What was the probability that a student who wanted to visit a zoo was a boy?

2. A number of students and parents were asked if a school lunch shop should add more healthy meals to the menu.

Of the 40 students asked 15 agreed that there should be more healthy meals.

Of the 60 parents asked 50 agreed that there should be more healthy meals.

(a) Copy and complete the table below displaying this information.

	<i>Students</i>	<i>Parents</i>	<i>Total</i>
<i>Agreed</i>			
<i>Did not agree</i>			
<i>Total</i>			

(b) What was the probability that a student agreed that there should be more healthy meals?

(c) What was the probability that a parent did not think there needed to be more healthy meals?

(d) What was the probability that one of the people asked agreed that there should be more healthy meals?

3. 100 bowlers from different cricket clubs were surveyed.

24 of the 100 were left-handed.

62 of the 100 were fast bowlers.

10 of the left-handed bowlers were slow bowlers.

- (a) Copy and complete the table below displaying this information.

	<i>Left-handed</i>	<i>Right-handed</i>	<i>Total</i>
<i>Fast</i>			
<i>Slow</i>			
<i>Total</i>			

Based on these figures:

(b) what is the probability that a left-handed bowler is a slow bowler?

(c) what is the probability that a bowler is a fast bowler?

(d) what is the probability that a fast bowler is right-handed?

(e) what is the probability that a bowler is left-handed?

4. 200 shoppers in a supermarket were surveyed.

160 of the 200 were females.

30 males spent less than \$100.

120 of the shoppers spent more than \$100.

- (a) Copy and complete the table below displaying this information.

	<i>Female</i>	<i>Male</i>	<i>Total</i>
<i>Spent less than \$100</i>			
<i>Spent more than \$100</i>			
<i>Total</i>			

Based on these figures:

(b) what is the probability that a female shopper spent less than \$100?

(c) what is the probability that a male shopper spent more than \$100?

(d) what is the probability that a shopper was male?

(e) what is the probability that a shopper spent more than \$100?

Venn Diagrams

Venn diagrams are another way of representing data and providing a way to help calculate probabilities.

Example 1

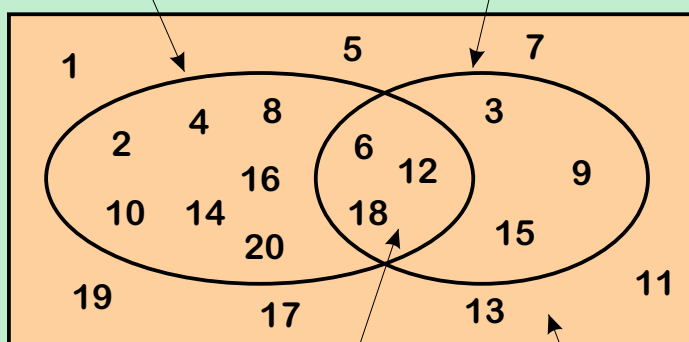
From the numbers 1-20 a number is chosen at random.

- What is the probability that it is a multiple of 2?
- What is the probability that it is a multiple of 3?
- What is the probability that it is a multiple of 2 **and** 3?
- What is the probability that it is **not** a multiple of 2 **or** 3?
- What is the probability that it is a multiple of 2 but **not** 3?
- What is the probability that it is a multiple of 3 but **not** 2?
- Given that the number is **greater** than 12, what is the probability that it is a multiple of 3?
- Given that the number is **less** than 10, what is the probability that it is a multiple of 2 and 3?

The Venn diagram for this problem is shown below.

Numbers in this ellipse are multiples of 2.

Numbers in this ellipse are multiples of 3.



Numbers in the section where the two ellipses overlap are multiples of 2 and 3.

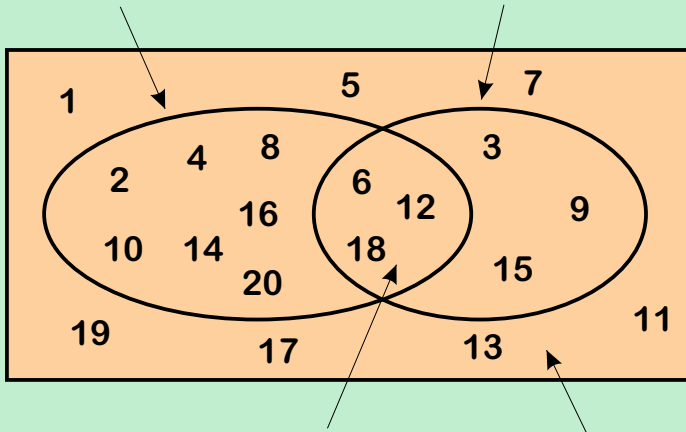
Numbers outside the ellipses are **not** multiples of 2 or 3.

Continued on next page

To calculate the probabilities, the number of numbers in each section need to be stated.

10 numbers in this ellipse
(multiples of 2)

6 numbers in this ellipse
(multiples of 3)



3 numbers in the section where
the two ellipses overlap
(multiples of 2 and 3)

7 numbers outside the ellipses
(not multiples of 2 or 3)

(a) Probability that it is a multiple of 2 $= \frac{10}{20} = \frac{1}{2}$ (Simplest form)

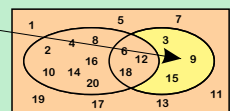
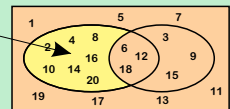
(b) Probability that it is a multiple of 3 $= \frac{6}{20} = \frac{3}{10}$ (Simplest form)

(c) Probability that it is a multiple of 2 **and** 3 $= \frac{3}{20}$

(d) Probability that it is **not** a multiple of 2 **or** 3? $= \frac{7}{20}$

(e) Probability that it is a multiple of 2 but **not** 3? $= \frac{7}{20}$

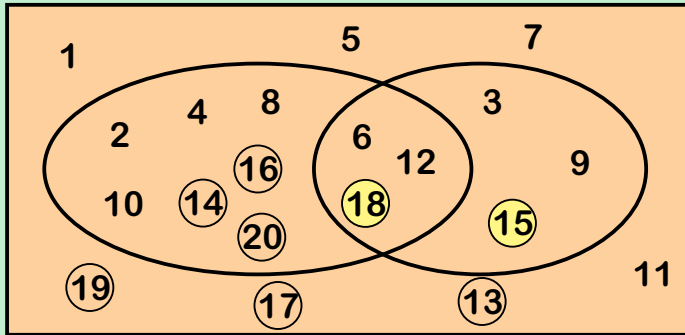
(f) Probability that it is a multiple of 3 but **not** 2? $= \frac{3}{20}$



- (g) Given that the number is **greater** than 12, what is the probability that it is a multiple of 3?

This means that the number chosen is greater than 12. There are eight numbers greater than 12 and these are circled below.

The numbers from these that are multiples of 3 are coloured. There are two of these.

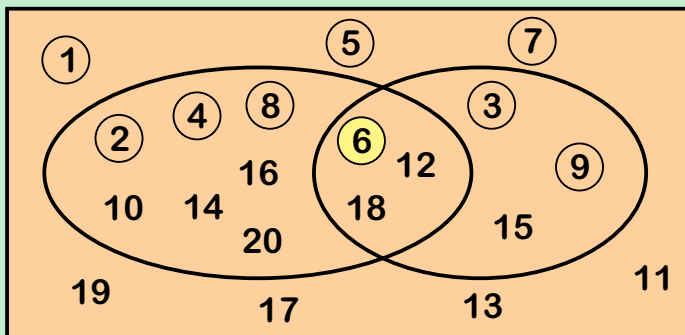


Given that the number is **greater** than 12, the probability that it is a multiple of 3 $= \frac{2}{8} = \frac{1}{4}$ (Simplest form)

- (h) Given that the number is **less** than 10, what is the probability that it is a multiple of 2 and 3?

This means that the number chosen is less than 10. There are nine numbers less than 10 and these are circled below.

The numbers from these that are multiples of 2 and 3 are coloured. There is one of these.



Given that the number is **less** than 10, the probability that it is a multiple of 2 and 3 $= \frac{1}{9}$

EXERCISE 18J

1. (a) Draw a Venn diagram with two ellipses. Write all the numbers from 1 to 20 such that:

- * One ellipse shows the numbers that are multiples of 3.
- * The other ellipse shows the numbers that are multiples of 4.
- * Note there will be some numbers in the section where the two ellipses overlap.

From the numbers 1-20, a number is chosen at random.

- (b) What is the probability that it is a multiple of 3?
 (c) What is the probability that it is a multiple of 4?
 (d) What is the probability that it is a multiple of 3 **and** 4?
 (e) What is the probability that it is **not** a multiple of 3 **or** 4?
 (f) What is the probability that it is a multiple of 3 but **not** 4?
 (g) Given that the number is **greater** than 10, what is the probability that it is a multiple of 3?
 (h) Given that the number is **greater** than 10, what is the probability that it is a multiple of 4?
 (i) Given that the number is **greater** than 10, what is the probability that it is a multiple of 3 and 4?
 (j) Given that the number is **greater** than 10, what is the probability that it is a multiple of 3 or 4?
 (k) Given that the number is **less** than 10, what is the probability that it is a multiple of 3?
 (l) Given that the number is **less** than 10, what is the probability that it is a multiple of 3 and 4?

2. (a) Draw a Venn diagram with two ellipses that shows the following.

- * All the numbers from 1 to 30.
- * One ellipse shows all the numbers that are multiples of 4.
- * The other ellipse shows all the numbers that are multiples of 5.

From the numbers 1-30 a number is chosen at random.

- (b) What is the probability that it is a multiple of 4?
 (c) What is the probability that it is a multiple of 4 **and** 5?
 (d) What is the probability that it is a multiple of 4 **or** 5?
 (e) What is the probability that it is **not** a multiple of 4?
 (f) What is the probability that it is a multiple of 4 but **not** 5?
 (g) Given that the number is **greater** than 10, what is the probability that it is a multiple of 4?
 (h) Given that the number is **less** than 16, what is the probability that it is a multiple of 5?

Example 2

15 people attended a music camp.

Jimi, Eric, Carlos, Suzi and Angus played guitar.

Elton, Joni and Chris played piano.

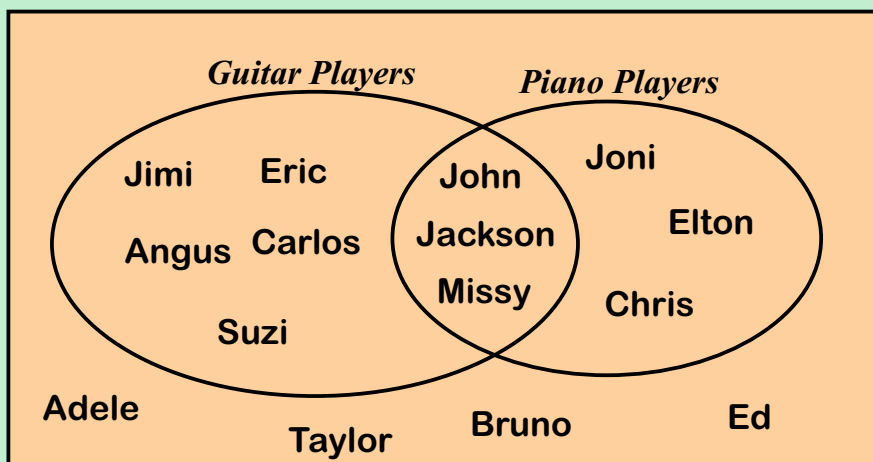
John, Jackson and Missy played guitar and piano.

Adele, Taylor, Bruno and Ed did not play guitar or piano.

1. Draw a Venn diagram to display this information.
2. A person is chosen at random from the group. Find the probability of the following.
 - (a) The person plays guitar.
 - (b) The person does not play guitar.
 - (c) The person plays guitar or piano.
 - (d) The person only plays piano.
 - (e) The person plays guitar and piano.
 - (f) Given that the person chosen plays an instrument, find the probability that they only play guitar.
 - (g) Given that the person chosen plays an instrument, find the probability that they play guitar and piano.

Answers

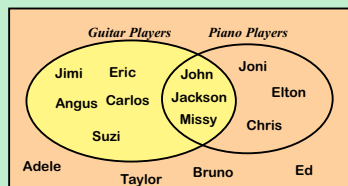
1.



2. (a) The probability that the person plays guitar.

There are 8 out of the 15 people that play guitar.

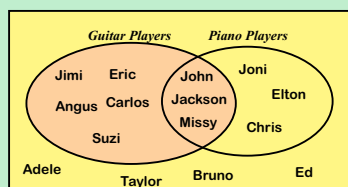
$$\text{Probability that a person chosen at random plays guitar} = \frac{8}{15}$$



- (b) The probability that the person does not play guitar.

There are 7 out of the 15 people that do not play guitar.

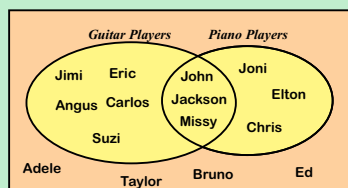
$$\text{Probability that a person chosen at random does not play guitar} = \frac{7}{15}$$



- (c) The probability that the person plays guitar or piano.

There are 11 out of the 15 people that play guitar or piano.

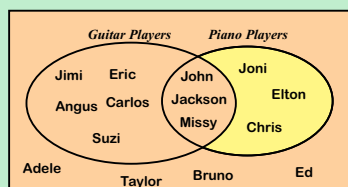
$$\text{Probability that a person chosen at random plays guitar or piano} = \frac{11}{15}$$



- (d) The probability that the person only plays piano.

There are 3 out of the 15 people that only play piano.

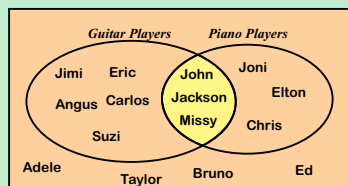
$$\begin{aligned} \text{Probability that a person chosen at random only plays piano} &= \frac{3}{15} \\ &= \frac{1}{5} \quad (\text{Simplest form}) \end{aligned}$$



- (e) The probability that the person plays guitar and piano.

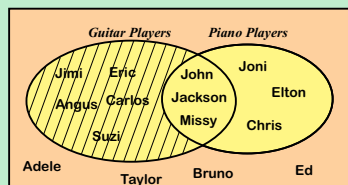
There are 3 out of the 15 people that play guitar and piano.

$$\begin{aligned} \text{Probability that a person} &= \frac{3}{15} \\ \text{chosen at random plays} & \\ \text{guitar and piano} & \\ &= \frac{1}{5} \quad (\text{Simplest form}) \end{aligned}$$



- (f) Given that the person chosen plays an instrument, find the probability that they only play guitar.

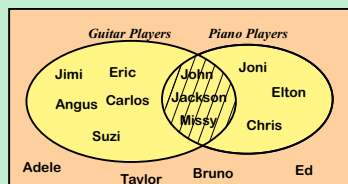
There are 11 people that play an instrument. **Given that the person chosen plays an instrument** means one of these 11 people is chosen at random. Of these 5 play guitar only.



Given that the person chosen plays an instrument the probability that they only play guitar. $= \frac{5}{11}$

- (g) Given that the person chosen plays an instrument, find the probability that they play guitar and piano.

There are 11 people that play an instrument. **Given that the person chosen plays an instrument** means one of these 11 people is chosen at random. Of these 3 play guitar and piano.

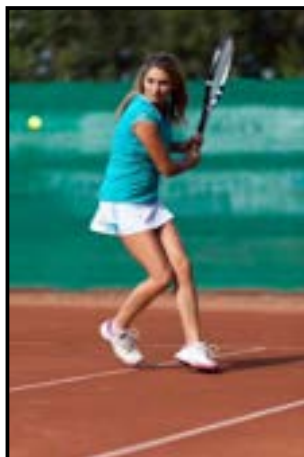


Given that the person chosen plays an instrument the probability that they play guitar and piano. $= \frac{3}{11}$

EXERCISE 18K

Write the answers to the following probabilities as fractions in their simplest form.

1. 20 students were asked if they played basketball and/or tennis.
Amelia, Ben, Carrie, Delta, Eve and Faran played basketball but not tennis.
Garth, Harry, Indie, Jaan and Kiera played tennis but not basketball.
Liam, Mia, Nellie and Ollie played both basketball and tennis.
Pat, Quinn, Rose, Sian and Tilly did not play either sport.
- (a) Draw a Venn diagram to display this information.
A student is chosen at random from the group. Find the probability of the following.
- (b) The student plays basketball but not tennis.
(c) The student plays tennis.
(d) The student plays tennis and basketball.
(e) The student does not play either sport.
(f) The student does not play basketball.
(g) The student does not play both sports.
(h) Given that the student chosen plays basketball and/or tennis, find the probability that they play both sports.
(i) Given that the student chosen plays basketball and/or tennis, find the probability that they play only basketball.
(j) Given that the student chosen does not play basketball, find the probability that they play tennis.
(k) Given that the student chosen does not play tennis, find the probability that they do not play one of the sports.



2. Students in a visual art class were asked if they wanted to study painting, photography or another type of visual arts.

Nell, Lonie, Keiren, Xavier, Tye, Peta, Georgia and Marvin wanted to study painting but not photography.

Kyle, Oscar, Hilda, Josh, Wanda and Fleur wanted to study photography but not painting.

Rohan, Darian, Jueban and Bessy wanted to study both painting and photography.

Zena, Will, Tasha, Crosby, Vera and Clara wanted to study other types of visual arts.

(a) Draw a Venn diagram to display this information.

A student is chosen at random from the group. Find the probability of the following.

- (b) The student wants to study only painting.
 (c) The student does not want to study painting.
 (d) The student does not want to study painting or photography.
 (e) The student wants to study painting and photography.
 (f) Given that the student chosen wants to study painting and/or photography, what is the probability that they want to study both?
 (g) Given that the student chosen wants to study painting and/or photography, what is the probability that they want to study painting?
 (h) Given that the student chosen does not want to study painting, what is the probability that they want to study photography?
 (i) Given that the student chosen does not want to study photography, what is the probability that they don't want to study painting?



Example 3

There are 25 students in a class.

14 of them play a musical instrument.

18 of them play sport.

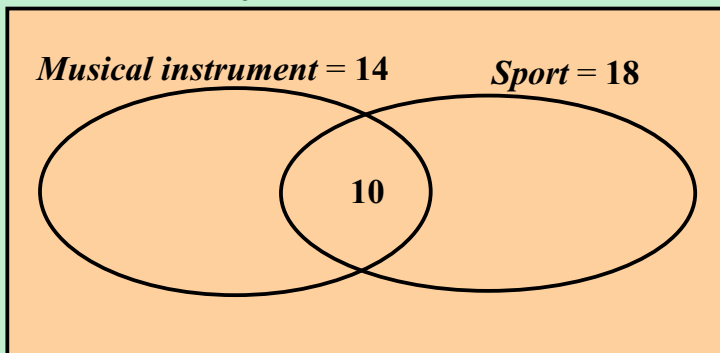
10 play a musical instrument and play sport.

1. Draw a Venn diagram to display this information.
2. Complete all sections of the Venn diagram.
3. Find the following:
 - (a) How many students play a musical instrument but don't play sport?
 - (b) How many students play sport but not a musical instrument?
 - (c) How many students don't play a musical instrument and don't play sport?
4. A student is chosen at random.
 - (a) What is the probability that they sport?
 - (b) What is the probability that they play a musical instrument but don't play sport?
 - (c) Given that the student chosen plays sport, what is the probability that they also play a musical instrument?

Answers

1. The Venn diagram with known information is shown below.

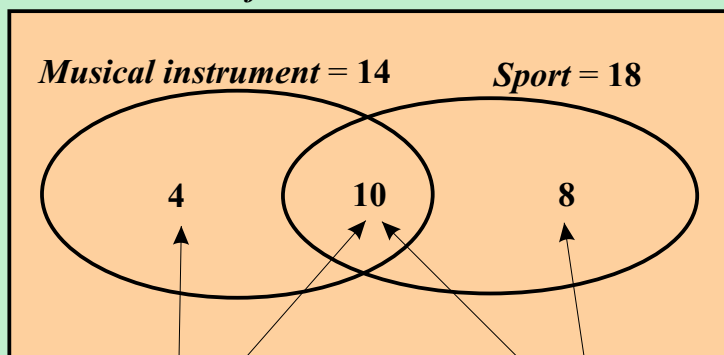
Total number of students = 25



2. Complete the other sections of the Venn diagram in two steps.

Step 1

Total number of students = 25

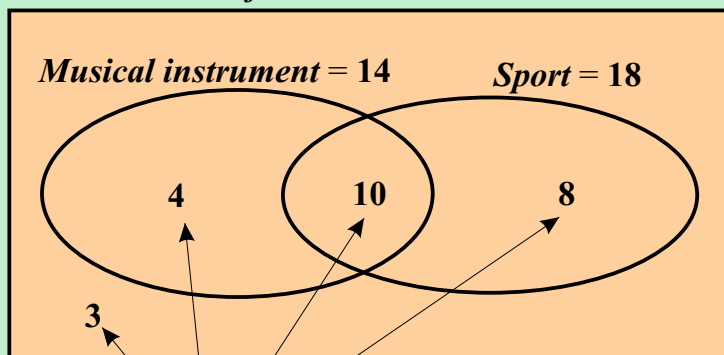


These two add to 14
(students playing a
musical instrument)

These two add to 18
(students playing sport)

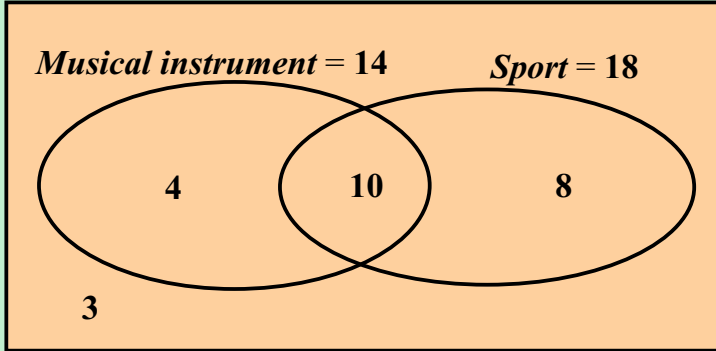
Step 2

Total number of students = 25



These four must add to 25
(the total number of students)

Total number of students = 25



Use the Venn diagram to solve the following questions.

3. (a) **4** students play a musical instrument but don't play sport.
 (b) **8** students play sport but don't play a musical instrument.
 (c) **3** students don't play a musical instrument and don't play sport.
4. (a) The probability a student chosen at random plays sport = $\frac{18}{25}$
 (b) The probability a student chosen at random plays a musical instrument but doesn't play sport = $\frac{4}{25}$
 (c) Given that the student plays sport, the probability that they also play a musical instrument = $\frac{10}{18} = \frac{5}{9}$ (Simplest form)

EXERCISE 18L

1. 50 people were asked if they had a pet dog and/or cat.
 26 had a dog, 15 had a cat and 8 of these had both.
- Draw a Venn diagram to show this information.
 - Complete all sections of the Venn diagram.
 - How many of the people only had a dog?
 - How many of the people only had a cat?
 - How many had neither a dog nor a cat?
- A person is chosen at random from the group.
- What is the probability that the person owns a dog and cat?
 - What is the probability that the person only owns a dog?
 - Given that the person chosen owns a dog, what is the probability that they also own a cat?



2. At a school there were 60 students in year 8.
 32 studied graphics, 18 studied art and 6 of these studied both.
- Draw a Venn diagram to show this information.
 - Complete all sections of the Venn diagram.
 - How many students studied graphics but not art?
 - How many students studied art but not graphics?
 - How many students did not study graphics or art?
- A student is chosen at random from the group.
- What is the probability that they studied art?
 - What is the probability that they studied art and graphics?
 - Given that they studied art, what is the probability that they also studied graphics?

3. 80 people were asked if they had been to see an AFL game or visit an art exhibition in the last year.

35 had seen an AFL game, 23 had seen an art exhibition and 12 of these had seen both.

- Draw a Venn diagram to show this information.
- Complete all sections of the Venn diagram.
- How many of the people had only seen an AFL game?
- How many of the people had only seen an art exhibition?
- How many had seen neither?

One of these people was chosen at random.

- What is the probability that they had been to an AFL game and an art exhibition?
- What is the probability that they had seen an art exhibition but not been to an AFL game?
- Given that the person had been to an AFL game, what is the probability that they had not seen an art exhibition?



4. 65 students were asked if they had cereal and/or fruit juice for breakfast.

42 had cereal, 27 had both cereal and fruit juice and 9 had neither cereal nor fruit juice for breakfast.

- Draw a Venn diagram to show this information.
- Complete all sections of the Venn diagram.
- How many had cereal but not fruit juice for breakfast?
- How many had fruit juice but not cereal?
- How many had fruit juice for breakfast?
- If one of the students was chosen at random, what is the probability that they had both cereal and fruit juice for breakfast?

5. 100 people were asked if they had travelled overseas and/or to another state in Australia.
37 had not travelled overseas or to another state.
6 had travelled overseas but not interstate.
16 had travelled overseas and interstate.
(a) Draw a Venn diagram to show this information.
(b) Complete all sections of the Venn diagram.
(c) How many of the people had travelled overseas?
(d) How many of the people had travelled interstate but not overseas?
(e) How many of the people had travelled interstate?
(f) If one of these people was chosen at random, what is the probability that they had travelled to another state in Australia?



6. 120 companies were surveyed to see if they used the internet for advertising or newspapers.
48 used only the internet.
16 used only newspapers.
13 didn't use either.
(a) Draw a Venn diagram to show this information.
(b) Complete all sections of the Venn diagram.
(c) If one of the companies was chosen at random, what is the probability that they had advertised in a newspaper and the internet?
7. An ice-cream seller recorded how many people had chocolate and/or crushed nuts on their ice-creams. Out of 110 ice-creams sold, 75 had chocolate, 36 had crushed nuts and 21 had neither chocolate nor crushed nuts.
(a) Draw a Venn diagram to show this information.
(b) Complete all sections of the Venn diagram.
(c) If one of these people was chosen at random, what is the probability that they had both chocolate and crushed nuts?

PROBLEM SOLVING

1. A college wanted to install combination locks on all the students' lockers. The locks would consist of two digits that the students would need to press in the correct order to open their locker.
 - (a) How many different combinations could be made using two digits? (i.e. 00, 01, 02, 03 98, 99)
 - (b) If a student forgets their digits, what is the probability that they could guess the correct combination?
2. The college realised there weren't enough combinations for the number of school lockers. Find the number of combinations if they used the following code systems.
 - (a) A number followed by a letter. (i.e. 0A, 0B, 0C 9X, 9Y, 9Z)
 - (b) Two letters. (i.e. AA, AB, AC, AD ZX, ZY, ZZ)

PUZZLES

1. Unscramble the letters from the following phrases to find words from this chapter. Each phrase forms one word.
 - (a) *semi lip sob* (b) *nice art* (c) *cot mouse* (d) *I'm into bacon*
 - (e) *Bali boy trip* (f) *mad Ron* (g) *fetid fern* (h) *ill key*
2. Find words from this chapter hidden in these sentences.

Example A keyboard is used for typing.

- (a) Magdalena loved ice-cream and peaches for dessert.
- (b) The church bell I could hear rang especially for the wedding.
- (c) The chemistry student studied the adsorption rate of chemicals.
- (d) Duncan put the taco in the oven to heat it up.
- (e) The salad I eat regularly for lunch has a special dressing.
- (f) The dancer tainted her performance by falling off the stage!
- (g) Qatar and Oman are small countries near Saudi Arabia.

CHAPTER REVIEW

1. Match the terms below with the probabilities.

- (a) certain to occur
- (b) unlikely to occur
- (c) could go either way equally
- (d) impossible
- (e) likely to occur

A 50% B 0.3 C 1 D $\frac{7}{10}$ E 0

2. Find the following probabilities. Give answers as fractions in their simplest form.

- (a) Rolling a 3 on a die.
- (b) Rolling a 7 on a die.
- (c) Rolling a number greater than 2 on a die.
- (d) Rolling an even number on a die.
- (e) Randomly choosing a black ball from a box with eight black balls and six white balls.
- (f) Randomly choosing a boy from a class of 24 students that has 10 girls.

3. (a) The probability of winning a prize in a game is 0.2. What is the probability of **not** winning a prize?

- (b) The probability of rain on a particular day was predicted to be 60%. What is the probability of rain **not** falling?

4. (a) List all the combinations of the numbers 6, 8 and 1.

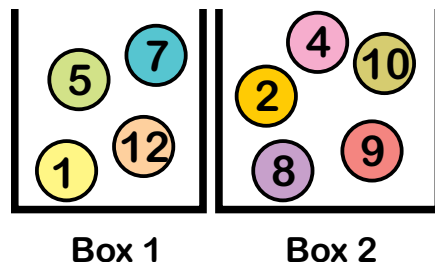
- (b) If these three numbers are randomly arranged, what is the probability that the resultant number is larger than 700?
Give answer as a fraction in its simplest form.

5. The probability of catching a fish on a fishing trip was 0.8. Harley goes on the fishing trip on Saturday and Sunday.

- (a) What is the probability of catching fish on both days?
- (b) What is the probability of not catching a fish on either day?
- (c) What is the probability of catching a fish on at least one day?

6. A ball is taken from each of the two boxes shown and the numbers ***multiplied***.

- (a) Construct a two-way table to show all possible outcomes.
 (b) What is the probability that the product of the numbers is:
 (i) greater than 100?
 (ii) less than 50?
 (iii) between 30 and 100?



7. 200 students were surveyed and asked if they thought a famous musician or a famous astronaut should be invited to speak at the school.

120 of the students asked were girls.

50 of the boys wanted an astronaut to visit.

110 of the students wanted a musician to visit.

- (a) Copy and complete the two-way table shown below.
 (b) What is the probability that a girl wanted a musician to visit?
 (c) What is the probability that a boy wanted an astronaut to visit?
 (d) What is the probability that a student wanted a musician to visit?

	<i>Boys</i>	<i>Girls</i>	<i>Total</i>
<i>Musician</i>			
<i>Astronaut</i>			
<i>Total</i>			

8. 50 people who lived in a large city were surveyed to see if they owned a car and/or a bicycle.

32 owned a car, 18 owned a bicycle and 10 owned both.

- (a) Draw a Venn diagram to show this information.
 (b) Complete all sections of the Venn diagram.
 (c) How many of the people owned a car but not a bicycle?
 (d) How many of the people did not own either a car or bicycle?
 (e) If a person was chosen at random, what is the probability that they owned a bicycle but not a car?
 (f) If a person is chosen at random and given they owned a car and/or a bicycle, what is the probability that they owned a car?

Data

Data

Data is collected for many reasons. For example:

- A clothes shop may want to find the types of clothes their customers would like stocked.
- A local government may want to find if a pedestrian crossing is needed in a certain street.
- A farmer may need to find whether to water more regularly.
- A company producing string may need to find the strength of their product.

Many organisations or groups collect data. For example:

- All levels of government
- Retailers
- Companies
- Scientific and research organisations
- Educational organisations
- Community groups
- Sporting and recreational organisations
- Workplaces

When collecting data the following steps need to be followed:

- What data is needed?
- What is the best way to collect the data?
- What is the best way to present the data?
- How is the data to be interpreted?

The Australian census is conducted every five years and is completed by every Australian. People answer questions about age, where they live, religion, etc. This information is available from the Australian Bureau of Statistics and is used to record changes in Australia's population and is used for many reasons such as planning for the future.

Collecting Data

There are several ways that data can be collected.

- From the many ***data collecting organisations*** (for example: the Australian Bureau of Statistics).
- ***Observation*** (for example: standing near a road and counting the number of cars)
- ***Questionnaire*** (for example: asking a number of people to answer a set of questions) - this can be achieved face-to-face, mail, email, telephone, etc.
- ***Experiment*** (for example: testing a number of car windows to see if they break under certain conditions)

Collecting data can be a time consuming and expensive process so it is important that sufficient planning be put into preparing for the collection of data.

If a ***questionnaire*** is being designed it is important that the questions are simple, clear and relevant. It is also important that the information can be easily collated such as ***tick the box*** or a ***rating scale***.

Examples

Do you think the main street needs more rubbish bins? ***Yes*** ***No***
☐ ☐

How is the quality of your local street? ***poor*** ***good*** ***excellent***
☐ ☐ ☐

How well is the local radio station meeting the needs of the community? Use the rating scale of 0 - 10 (0 for not meeting the needs to 10 for meeting all the needs).

Where would you like to take your next holiday?

beach ***snow*** ***outback*** ***city*** ***overseas*** ***other***
☐ ☐ ☐ ☐ ☐ ☐

EXERCISE 19A

1. Choose which method (*observation* or *questionnaire*) would be best to use for the collection of the following data.
 - (a) How many students at a secondary school want to proceed to tertiary studies?
 - (b) How many students at a school eat at least two pieces of fruit each day?
 - (c) How many cars are in a supermarket car park?
 - (d) A local government wants to find out if the residents want a swimming pool?
 - (e) How many houses in a city have solar water heaters?
 - (f) How many families in a city own more than one television?
 - (g) How many supporters at a sporting event are wearing team colours?
 - (h) How many people in a city follow the local sporting team?
 - (i) How many people in a small town do their shopping in the town and how many shop in the major city nearby?
 - (j) How many families have more than one car?
 - (k) How many people have been overseas on a holiday?

2. Think of an experiment that could be used in the following situations.
 - (a) A producer of light globes wants to find the average life of their light globes.
 - (b) The manufacturer of a hay baling machine wants to find the average weight of the hay bales.
 - (c) A producer of balloons wants to find out the average diameter of the balloons before they burst.



3. For the following situations of data collection, suggest questions for a questionnaire.
 - (a) A local council is considering whether to build a swimming pool.
 - (b) A radio station wants to find the best music to play.

Samples and Population

EXERCISE 19B

When collecting data, it is often not possible to include every person or object that is affected. In these situations a smaller representative sample is used.

In statistics, the total number of people or objects affected is called the **population**. A smaller representative group is called a **sample**.

For example, a local council wants to find out if the residents want a library or a swimming pool. 500 residents are surveyed to get an idea of what they prefer.

In this example all the residents in the area would be the **population**. The 500 that were surveyed is the **sample**.

To make the results of a survey as accurate as possible:

1. The sample must be as large as possible.
2. The people or items surveyed must be a true representation of the population.

1. List the population that would be affected by the following surveys.
 - (a) A State Government wants to investigate raising the driving age to 19 to help lower the road toll.
 - (b) The Federal Government wants to find out how many people are going to vote for them in the next election.
 - (c) A park ranger wants to find the number of sugar gliders that are in a state park.
 - (d) A clothing company wants to find out which of their latest jean designs will be the most popular.
 - (e) A local radio station wants to find out how many people listen to them.
 - (f) A factory that produces blocks of chocolate that have nuts in them, wants to find out how many nuts are in each block.
 - (g) A local football team wants to find out which player is considered to be the most valuable.

2. For the surveys listed below, a list of four possible sample groups is given.

State the one that you think would give the most accurate results and give your reasons for not choosing the other three.

- (a) A secondary school wants to investigate whether the students should wear school uniform. There are 800 students at the school.

Sample Group **A** - 50 students from each year level

Sample Group **B** - 10 students from each year level and 20 teachers

Sample Group **C** - 100 randomly chosen students, 10 teachers, 100 parents and 20 people from the local community

Sample Group **D** - all the teachers and 100 parents

- (b) The state government wants to find out secondary students' attitudes towards a television advertisement aimed at stopping people drinking and driving.

Sample Group **A** - 50 year 7 students from every secondary school in the state

Sample Group **B** - 50 students randomly chosen from every secondary school in the state

Sample Group **C** - 100 students randomly chosen from every secondary school in the capital city

Sample Group **D** - every year 9 student in the state

- (c) A local council wants to investigate whether to build a skatepark in the town (population 5000).

Sample Group **A** - 10 people randomly chosen

Sample Group **B** - 1000 people between the ages of 40 and 60

Sample Group **C** - all students at the local secondary school

Sample Group **D** - 1 in 10 people chosen randomly



3. State an appropriate sample group for each of the surveys in Question 1.

Example

A sample group of 50 students from a school were asked if they wanted a music band or a sports clinic to visit the school.

There are 800 students at the school.

35 students from the sample group chose the music band.

15 students from the sample group chose the sports clinic.

1. What percentage of the sample group of 50 chose the music band and what percentage chose the sports clinic?
2. Based on this sample group, how many students in the school would have chosen the music band and how many would have chosen the sports clinic?

1. Percentage that chose music band = $\frac{35}{50} \times 100 = \mathbf{70\%}$

Percentage that chose sports clinic = $\frac{15}{50} \times 100 = \mathbf{30\%}$

2. 70% of 800 = **560 students** would want the music band
 30% of 800 = **240 students** would want the sports clinic

4. A town of 12 000 people has three television stations to watch:
 Channels 1, 2 and 3.
 200 people were asked what channel they preferred.
 90 chose Channel 1, 70 chose Channel 2 and 40 chose Channel 3.
 (a) What percentage of the sample group chose each channel?
 (b) Based on this survey, how many people in the town watch each television channel?

5. 15 000 people attended the final of a tennis tournament.
 400 of them were asked their ages and the results are shown in the table below.

- (a) What percentage of the sample group were in each age group?
 (b) Based on this sample, how many people at the final were in each age group?

<i>Age Group</i>	<i>Number</i>
- 20	48
- 30	88
- 40	112
- 50	84
over 50	68

Tally Sheets

Tally sheets are an easy way of recording data.

As each item of data is observed a stroke is recorded (|).

To make it easy to tally the items of data the record of each fifth item is noted by a diagonal stroke ().

Example $\text{||||} \text{||||} \text{||||} \text{||} = 5 + 5 + 5 + 3 = 18$ items of data

The *frequency* is the total of each item of data.

Examples

1. 50 people were asked to state their favourite pet.
The tally sheet shows the results.

<i>Pet</i>	<i>Tally</i>	<i>Frequency</i>
Dog		14
Cat		13
Bird		7
Other		5
None		11
		50

2. The heights (in cm) of 20 students are listed below and shown on this tally sheet.

150	143	140	148	153	155	158
161	149	155	159	162	171	169
175	161	159	163	174	160	

<i>Height(cm)</i>	<i>Tally</i>	<i>Frequency</i>
140 -		4
150 -		7
160 -		6
170 -		3
		20

EXERCISE 19C

- 1. Copy and complete the following tally sheets.**

- (a)
- | <i>Eye Colour</i> | <i>Tally</i> | <i>Frequency</i> |
|-------------------|--------------|------------------|
| Brown | | |
| Blue | | 17 |
| Green | | |
| Other | | 5 |
| | | 40 |

- (b)
- | Weight(kg) | Tally | Frequency |
|-------------------|--------------|------------------|
| 30 - | | |
| 40 - | | 14 |
| 50 - | | |
| 60 - | | |
| 70 - | | 17 |
| 80 - | | 8 |
| | | |

2. Construct tally sheets for the following sets of data.

- (a) 30 people were asked to state their favourite fruit. The results are shown below.

pears, apples, apples, apricots, grapes, pears, mangoes, pears, grapes, apricots, mangoes, bananas, apples, grapes, mangoes, apricots, apples, bananas, grapes, grapes, pears, apples, grapes, mangoes, apricots, apricots, bananas, apples, apples, pears

- (b) The weekly income of a number of people is listed below.
Use the following groupings in the tally sheet.

\$400 - , \$500 - , \$600 - , \$700 - , \$800 -

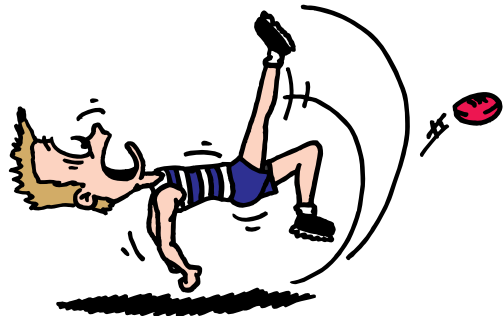
\$560, \$480, \$760, \$610, \$675, \$735, \$860, \$570, \$490, \$510,
\$700, \$850, \$745, \$670, \$635, \$520, \$485, \$580, \$525, \$675,
\$520, \$440, \$730, \$690, \$635, \$820, \$760, \$600, \$610, \$700,
\$525, \$680, \$630, \$570, \$500, \$480, \$470, \$680, \$800, \$680

- (c) The following marks were achieved by students in a year 8 maths test (the test was out of 50). Use groupings of 10 in the tally sheet.

23, 34, 27, 9, 15, 45, 33, 24, 19, 16, 27, 36,
31, 18, 9, 41, 33, 37, 21, 18, 44, 36, 29, 19, 20

- (d) A number of football players wanted to see how far they could kick a football. They all had one kick and the distances were measured. These distances (in metres) are shown below.
Use groupings of 10 metres in the tally sheet.

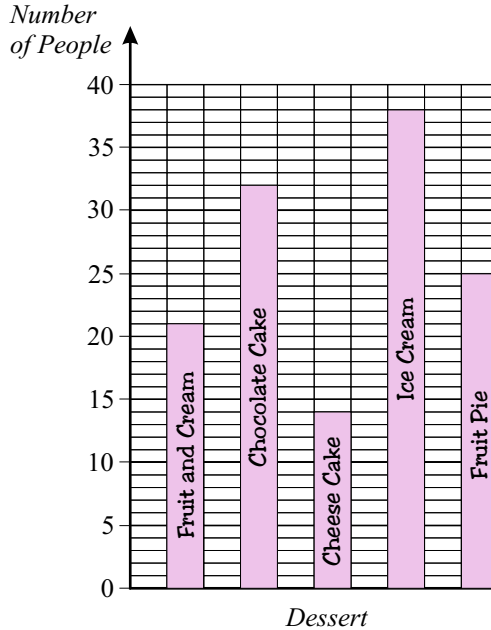
33, 41, 37, 56, 28, 35, 39, 44,
50, 42, 22, 37, 61, 55, 46, 40,
38, 24, 39, 53, 46, 41, 37, 39,
47, 42, 49, 40, 59, 47, 66, 55,
48, 40, 41, 32, 29, 36, 47, 41,
34, 27, 68, 52, 50, 46, 37, 25,
69, 50, 50, 50, 47, 24, 36, 41,
56, 20, 55, 47, 45, 61, 37, 50



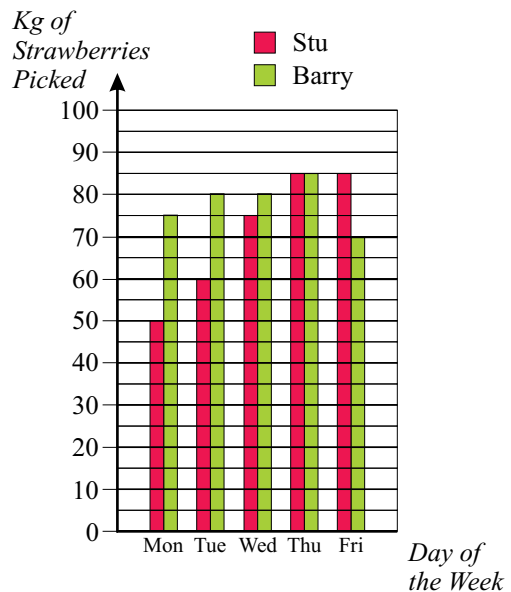
Column Graphs

EXERCISE 19D

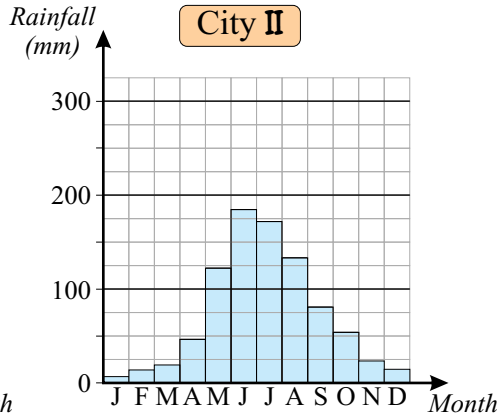
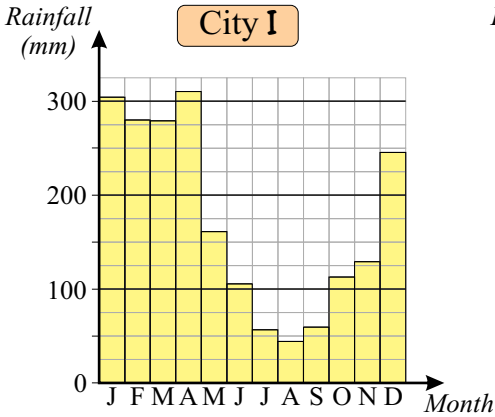
1. A number of people were asked to state their favourite dessert. The results are shown in this column graph.
- How many people chose chocolate cake?
 - What was the most popular dessert?
 - What was the least popular dessert?
 - What was the total number of people asked to state their favourite dessert?



2. Mario owns a strawberry farm. He employs Stu and Barry to pick his strawberries. The column graph shows how many kilograms of strawberries Stu and Barry picked each day in a week.
- On which day/s did Stu pick more strawberries than Barry?
 - On which day/s did Barry pick more strawberries than Stu?
 - On which day/s did they pick the same amount of strawberries?
 - Describe how the daily amount of strawberries each of them picked varied during the week.
 - How many kilograms of strawberries did they each pick during the week?
 - What was the largest daily total of strawberries picked?



3. The two graphs below show the average monthly rainfall for two cities - City I and City II.

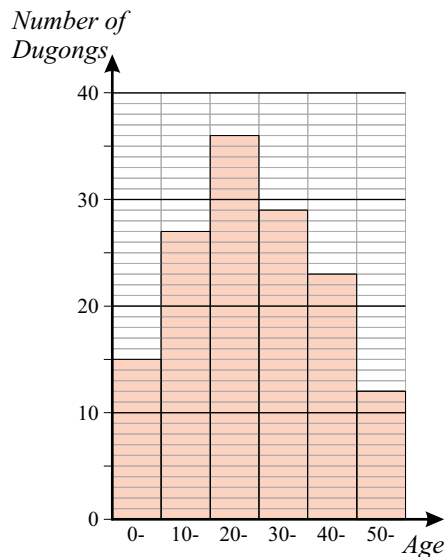


- For each city, state the month that has the highest average rainfall and state (approximately) this monthly rainfall (in mm).
- For each city, state the month that has the lowest average rainfall and state (approximately) this monthly rainfall (in mm).
- From the alternatives below, choose which one is the best estimate of the total annual rainfall for each city.
A 200 mm **B** 1000 mm **C** 2000 mm **D** 3000 mm
- For each city, find the approximate average *winter* rainfall if both cities are in the southern hemisphere.
- One of the cities is Perth and the other is Manaus (a city on the Amazon River in Brazil). Use your knowledge of rainfall in different parts of the world to state which is City I and which is City II.

4. Biologists were studying dugongs.

They would catch the dugongs, record their details, then release them. This graph shows the ages of the dugongs studied.

- How many of the dugongs were under 20 years old?
- How many of the dugongs were 40 or more years old?
- What is the total number of dugongs studied?



5. The Skata company makes skateboards. They produced models of four new skateboard designs and asked 50 skateboard experts to trial them. The new skateboards were called ***Slider***, ***Flash***, ***Cruze*** and ***Ramper***. The 50 experts were asked to state which of the models they thought was best. Their choices are listed below.

Cruze, Slider, Cruze, Ramper, Flash, Slider, Ramper, Cruze, Ramper, Cruze, Slider, Cruze, Ramper, Slider, Ramper, Flash, Ramper, Cruze, Ramper, Slider, Cruze, Slider, Cruze, Slider, Cruze, Cruze, Flash, Ramper, Cruze, Ramper, Flash, Ramper, Cruze, Cruze, Slider, Flash, Cruze, Cruze, Slider, Cruze, Cruze, Slider, Ramper, Cruze, Cruze, Slider, Ramper, Flash, Cruze, Cruze

- (a) Use this information to construct a tally sheet and column graph.
 (b) Which skateboard was chosen as the best by the experts?
6. The biologists in question 4 who studied the dugongs also recorded the weights of a number of the dugongs. These weights (in kg) are given below.

35, 45, 23, 67, 134, 170, 134, 185, 89, 111, 164, 215, 140, 112, 83, 55, 159, 83, 67, 164, 67, 217, 62, 165, 210, 63, 78, 106, 260, 188, 82, 264, 73, 173, 56, 160, 67, 135, 81, 169, 92, 84, 221, 127, 145, 101, 151, 103, 182, 109, 56, 115, 116, 119, 120, 145, 235, 190, 83, 122, 226, 123, 124, 126, 132, 137, 147, 223, 139, 130, 209, 153, 156, 162, 167, 170, 244, 184, 203, 172, 252, 174, 193, 257, 196

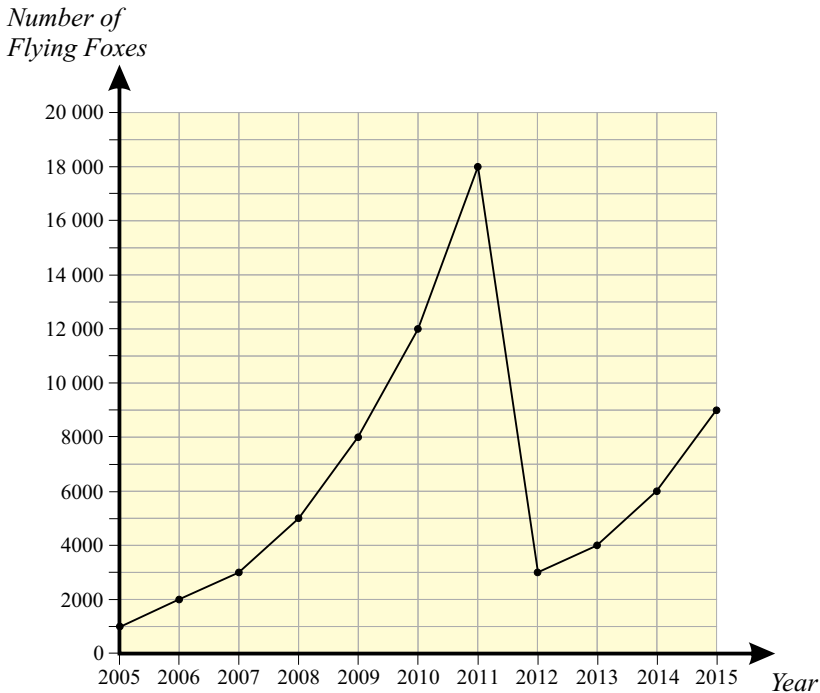
- (a) Using groupings of 50 kg (0- , 50- , etc) construct a tally sheet.
 (b) Construct a column graph.
 (c) How many dugongs weighed:
 (i) less than 100 kg?
 (ii) 200 kg or more?



Line Graphs

EXERCISE 19E

1. The line graph below shows the number of flying foxes in a state park at the *end* of each year from 2005 to 2015.



- How many flying foxes were in the park at the end of 2005?
- What was the largest number of flying foxes in the park?
- At the end of what year was the largest number of flying foxes in the park?
- What was the increase in flying fox numbers between 2005 and the year when the largest number of flying foxes existed in the park?
- In what year did the number of flying foxes increase the most?
- In what two consecutive years did the number of flying foxes increase by the same amount?
- The manager of the park decided to catch and relocate many of the flying foxes due to over population. In which year did this occur?
- How many flying foxes were relocated?
- What was the change in flying fox numbers over the ten years shown on the graph?

2. The graph below shows the average monthly maximum temperatures (in °C) for two cities - City A and City B.

- (a) In which month does the highest average monthly temperature occur for:

- (i) city A?
(ii) city B?

- (b) What is the lowest average monthly temperature for:

- (i) city A?
(ii) city B?

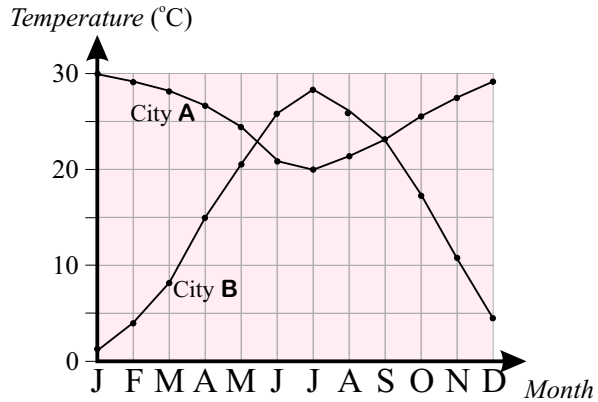
- (c) Which city has the largest range of maximum temperatures over a year?

- (d) In which month is the maximum temperature in City A the same as in City B?

- (e) What is the temperature for part (d)?

- (f) One of the cities is Chicago (USA) and the other is Brisbane. Use your knowledge of temperatures in different parts of the world to find which is City A and which is City B.

Give reasons for your answer.



3. The table below shows the value of the share price for a company at the *end* of each month for a year. The share price at the start of the year was \$0.15.

Month	Start of Year	J	F	M	A	M	J	J	A	S	O	N	D
Share Price	\$0.15	\$0.23	\$0.31	\$0.31	\$0.29	\$0.35	\$0.46	\$0.58	\$0.64	\$0.66	\$0.60	\$0.58	\$0.58

- (a) Using a scale of 1 cm = \$0.10 on the vertical axis, draw a line graph on graph paper showing this information.
- (b) In which month/s did the share price not change?
- (c) In which month/s did the share price decrease?
- (d) What was the largest monthly decrease in the share price?
- (e) In which month did the share price increase the most?
- (f) What was the largest monthly increase in the share price?
- (g) What was the change in share price for the year?

Mean, Median and Range

Mean = $\frac{\text{the sum of all numerical data}}{\text{the number of items of data}}$

Median = the middle value when the data is arranged in numerical order from smallest to largest

Range = the difference between the largest and smallest values

The *mean* is also called the *average*

Examples

For the following sets of data find the:

(a) mean (b) median (c) range

1. 16, 11, 18, 10, 9, 4, 9

$$\begin{aligned} \text{(a) mean} &= \frac{16+11+18+10+9+4+9}{7} \\ &= \frac{77}{7} \end{aligned}$$

mean = 11

(b) median = middle number when the numbers are arranged in numerical order from smallest to largest

4 9 9 (10) 11 16 18

median = 10

(c) range = the difference between the highest and lowest numbers
= 18 - 4

range = 14

2. 15, 5, 21, 8, 14, 2, 23, 0, 7, 17, 20

$$\begin{aligned} \text{(a) mean} &= \frac{15+5+21+8+14+2+23+0+7+17+20}{11} \\ &= \frac{132}{11} \end{aligned}$$

$$\text{mean} = 12$$

- (b) the numbers need to be arranged in numerical order from smallest to largest

0 2 5 7 8 (14) 15 17 20 21 23

$$\text{median} = 14$$

- (c) range = the difference between highest and lowest numbers
= 23 - 0

$$\text{range} = 23$$

3. 13, 16, 10, 11, 8, 12, 11, 13, 14, 13

$$\begin{aligned} \text{(a) mean} &= \frac{13+16+10+11+8+12+11+13+14+13}{10} \\ &= \frac{121}{10} \end{aligned}$$

$$\text{mean} = 12.1$$

- (b) the numbers need to be arranged in numerical order from smallest to largest

8 10 11 11 12 13 13 13 14 16

When there is an even number of data items, the median is mid way between the centre two numbers

$$\text{median} = 12.5$$

- (c) range = the difference between the highest and lowest numbers
= 16 - 8

$$\text{range} = 8$$

Use a calculator if necessary.

4. 8.9, 7.4, 10.9, 4.6, 8.0, 11.5, 13.7, 5.8

$$\begin{aligned} \text{(a) mean} &= \frac{8.9 + 7.4 + 10.9 + 4.6 + 8.0 + 11.5 + 13.7 + 5.8}{8} \\ &= \frac{70.8}{8} \end{aligned}$$

$$\text{mean} = 8.85$$

- (b) the numbers need to be arranged in numerical order from smallest to largest

4.6 5.8 7.4 8.0 8.9 10.9 11.5 13.7



When there is an even number of data items, the median is mid way between the centre two numbers

$$\text{median} = \frac{8.0 + 8.9}{2}$$

$$\text{median} = 8.45$$

- (c) range = the difference between highest and lowest numbers
= 13.7 - 4.6

$$\text{range} = 9.1$$

EXERCISE 19F

1. For each of the following sets of numbers find the:

(i) mean (ii) median (iii) range

(a) 4, 4, 5, 7, 10

(b) 9, 11, 15, 12, 18, 15, 7, 8, 12, 15, 21

(c) 12, 5, 13, 13, 17, 15, 14, 7, 12, 8, 12, 14, 14

(d) 4, 6, 10, 12, 14, 14

(e) 50, 61, 63, 75, 43, 39, 50, 62, 47, 60

(f) 5, 0, 7, 8, 9, 2, 7, 8, 9, 13, 10, 0

(g) 7, 8, 9, 0, 9, 6, 2, 6, 7, 9, 11, 11, 10, 9, 3, 8, 8, 6, 1, 10

(h) 3.6, 8.2, 4.0, 9.6, 11.9, 5.8, 6.7, 4.4, 5.2

(i) 28.7, 32.6, 25.2, 30.4, 21.6, 28.9, 22.3

(j) 17.3, 6.2, 32.7, 8.9, 28.1, 19.5, 16.3, 28.6

(k) 46.7, 53.1, 72.9, 80.3, 52.0, 66.6, 59.2, 37.7, 50.9, 46.8

2. Eleven people went on a hike to Mt Beauty. Their ages were:

28, 36, 40, 19, 21, 23, 38, 57, 18, 41, 31

(a) What is the mean age of the hikers?

(b) What is the median age of the hikers?

(c) What was the range of hikers' ages?

3. A 400 metre runner had the following times (in seconds) in nine races.

48.7, 49.6, 47.3, 50.2, 53.1, 52.2, 49.8, 50.2, 51.6

(a) What is the mean time for the races?

(b) What is the median time for the races?

(c) What was the range of times run by the runner?

4. Zoologists were studying lions and recorded the amount of food (in kg) that eight lions ate in one meal. These figures are shown below.

35, 25, 40, 45, 50, 30, 40, 45

Based on these figures:

(a) what is the mean amount of food eaten by a lion at one meal?

(b) what is the median amount of food eaten by a lion at one meal?

(c) what is the range of the amount of food eaten by a lion at one meal?

5. Scientists were studying crocodiles in a river in the Northern Territory and the weight (in kg) of ten crocodiles is shown below.

420, 385, 450, 500, 390, 435, 475, 365, 390, 430

Based on these figures:

- what is the mean weight of the crocodiles?
- what is the median weight of the crocodiles?
- what is the range of weights of the crocodiles?



6. A local government wanted to find out the number of people in each car on a major road during peak hour traffic. The number of people in 50 cars was counted and these figures are shown below.

1, 2, 1, 3, 4, 2, 1, 3, 2, 1, 2, 1, 3, 2, 1, 4, 5, 2, 1, 3, 2, 1, 2, 3, 3, 2, 2, 1, 1, 3, 1, 1, 1, 2, 1, 3, 2, 3, 5, 2, 1, 3, 2, 1, 1, 2, 3, 1, 2, 4

Based on these figures:

- what is the mean number of people in each car?
 - what is the median number of people in each car?
7. Lizzy is the goal shooter in a netball team. In nine games she has scored the following number of goals:

23, 17, 24, 15, 16, 20, 21, 21, 14

- What is the mean number of goals she has scored each game?
- Lizzy wants to have an average (mean) of 20 goals per game after 10 games. How many goals does she need to score in the tenth game to achieve this?

8. Abby plays guitar and often busks at local markets. At six markets she earned the following amounts:

\$54, \$61, \$70, \$59, \$2, \$42

- (a) What was the average (mean) amount she earned at the markets?
 (b) What was the median amount she earned at the markets?

It can be seen that at one market she earned only \$2. This is because it rained all day and very few people attended.

If this amount is taken out of these figures, find the following.

- (c) The average (mean) amount she earned at the other five markets.
 (d) The median amount she earned at the other five markets.
 (e) Which figure, the mean or median, was affected most by removing this low amount?

In data analysis very high or very low values can distort the mean of a set of data. These very high or very low values are called **outliers**. Sometimes they can be removed so the mean better reflects the data. Sometimes the median is used to summarise numerical data as it is affected much less by outliers.

9. The scores of two batsmen in a cricket team in 8 innings are shown below.

Driver Dan 0, 3, 7, 8, 329, 8, 4, 1
Peter Puller 42, 43, 53, 38, 44, 46, 41, 45

- (a) Find the mean of both batsman's scores.
 (b) Find the median of both batsman's scores.
 (c) Find the range of scores for each batsman.
 (d) Comment on which batsman you think played better in the 8 innings. Give reasons for your answer.
 (e) What would be the mean of Driver Dan's scores if the outlier was removed?

10. The manager of a store earns \$3700 per week. There are five employees at the store who each earn \$700 per week.

- (a) Find the mean weekly wage.
 (b) Find the median weekly wage.
 (c) Which is the better indicator of the amount earned by the people at the store?

11. The heights (in cm) of the six players in two volleyball teams are shown below.

<i>The Scene Setters</i>	170, 179, 187, 193, 220, 191
<i>The Specky Spikers</i>	190, 194, 188, 187, 195, 186

- (a) Calculate the mean height for each team.
 (b) Calculate the median height for each team.
 (c) Calculate the range of heights for each team.
12. Amelia and Betsy both buy five items of clothing.
 The median amount that Amelia spent on her five items of clothing was \$40 which was \$15 more than her cheapest item.
 The median amount that Betsy spent on her five items of clothing was \$105 which was \$35 more than her cheapest item.
 The range of prices of Amelia's items of clothing was \$330.
 The range of prices of Betsy's items of clothing was \$45.
 They both had three items that cost the same amount.
 (a) Find the price of each of the girl's items of clothing.
 (b) Find the average (mean) amount they each spent on each item of clothing.
13. The organisers of a music festival wanted to find out the mean, median and range of ages of the people at the festival. They recorded the ages of 50 people who attended the festival.

18, 20, 19, 23, 25, 37, 45, 19, 60, 48,
 36, 26, 36, 49, 52, 18, 25, 30, 44, 51,
 62, 56, 21, 29, 43, 47, 29, 50, 44, 50,
 50, 66, 54, 27, 33, 51, 18, 17, 16, 42,
 50, 67, 36, 41, 17, 27, 34, 25, 43, 29

- (a) Find the mean, median and range of the following three groups of ages.
 (i) The first five ages listed in this data.
 (ii) Every fifth age listed (the fifth, the tenth, the fifteenth, etc).
 (iii) Every age listed.
 (b) Which of these three would be most accurate? Why?

PROBLEM SOLVING

1. Ninetta, Lily and Lena are sisters. Ninetta is 3 years older than Lily and 5 years older than Lena. The median of their ages is 15. What is the age of each of the sisters?
2. James, Michael and William are brothers. James is 4 years older than Michael and 5 years older than William. The mean of their ages is 14. Find the age of each of the brothers.
3. (a) In the first nine matches of the cricket season David scored the following runs:

24, 56, 47, 38, 67, 33, 20, 49, 90

What score does he need to make in the next match to have an average of 50 runs?

- (b) Abdul also wants to have an average of 50 runs after the tenth match. He has averaged 46 runs per innings for the first nine matches. What score does Abdul need to make in the tenth match to have an average of 50 runs?

PUZZLES

1. Unscramble the letters from the following phrases to find words from this chapter. Each phrase forms one word.
 (a) *me and I* (b) *senior antique* (c) *age rave* (d) *naïve robots*
2. Find words from this chapter hidden in these sentences.

Example A keyboard is used for typing.

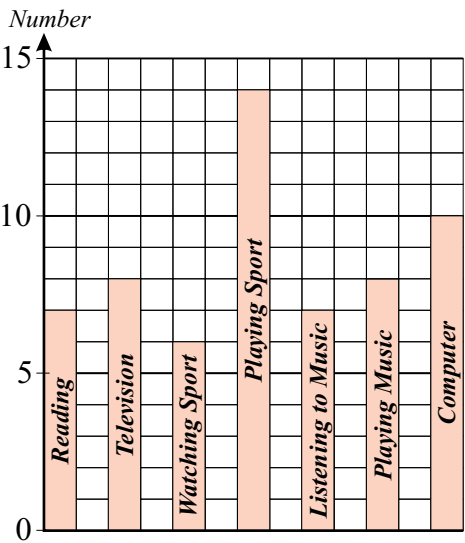
- (a) The tall yellow sunflower swayed gently in the breeze.
- (b) The 100 metre sprinter ran generally faster in the outside lane.
- (c) The rare rainforest bird had a tail that was bright orange.
- (d) The team coach decided to name a novice as the new captain.

CHAPTER REVIEW

- 1. List two important considerations when choosing a sample of a population to be surveyed.
- 2. Copy and complete this tally sheet.

Weight(kg)	Tally	Frequency
30 -		
40 -		12
50 -		
60 -		
70 -		17
80 -		9

- 3. 60 students from a college were asked to state their favourite leisure activity. The results are shown in this graph. There are 600 students at the college. Based on the results from this survey, how many students from the college would choose each of the leisure activities?



- 4. The heights (in metres) of 20 trees in a national park are shown below.

4, 15, 22, 9, 11, 17, 12, 9, 13, 24, 19, 8, 12, 3, 7, 14, 19, 12, 6, 4

- (a) Using groupings of 5 m (0- , 5- , 10- ,etc) construct a tally sheet.
- (b) Construct a column graph.
- (c) How many trees are less than 10 m high?
- (d) What is the mean height of the trees?
- (e) What is the median height of the trees?
- (f) What is the range of tree heights?

Answers

Chapter 1

Exercise 1A

- (a) 87 (b) 530 (c) 701 (d) 3018
(e) 9264 (f) 7207 (g) 10 001
(h) 25 033 (i) 109 746
(j) 302 057 009
- (a) nine hundred and five
(b) three thousand, four hundred and ninety-one
(c) eight thousand and fifty-six
(d) two hundred and seven thousand and ninety
(e) eight hundred and thirty-one thousand, four hundred and seventy-one
(f) one million, ten thousand, one hundred and one
(g) four million, five thousand and seven hundred
(h) twenty million, twenty thousand and twenty
- 72 795, 72 975, 72 978, 72 985, 72 987, 73 589, 73 856, 73 859, 73 862, 73 867
- (a) 178, 187, 718, 781, 817, 871
(b)(i) 178, 718
(ii) 187, 781, 817, 871
(iii) 718, 781, 817, 871
(iv) 178, 187, 718, 781
(v) 718, 781
- (a) $399 < 405$ (b) $87 > 59$
(c) $1027 > 985$ (d) $1257 < 1260$
(e) $3745 < 3766$ (f) $1976 > 1967$
(g) $2098 < 2103$ (h) $5431 < 5433$
- (a) 9 (b) 35 (c) 70 (d) 160
(e) 22 (f) 300 (g) 275 (h) 2250
- (a) 10 (b) 50 (c) 90 (d) 200
(e) 750 (f) 1720 (g) 2500
(h) 18 000

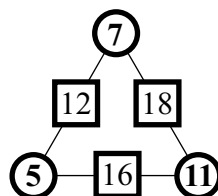
- (a) 0 (b) 100 (c) 100 (d) 200 (e) 700
(f) 1700 (g) 2500 (h) 18 000

Exercise 1B

- (a) 8 (b) 3 (c) 15 (d) 8 (e) 66
(f) 23 (g) 63 (h) 17 (i) 114
(j) 23 (k) 190 (l) 91 (m) 396
(n) 317 (o) 1021 (p) 695
- (a) 13 842 (b) 12 941 (c) 14 554
(d) 1392 (e) 4757 (f) 29 909
- (a) 977 987, 998 1008, 1098 1108, 1108 1118, 1119 1129
(b) 877 977, 987 1087, 998 1098, 1008 1108, 1019 1119, 1119 1219
- (a)
$$\begin{array}{r} + 99 \\ + 22 \\ \hline 121 \end{array}$$
 (b)
$$\begin{array}{r} + 3578 \\ + 5345 \\ \hline 8923 \end{array}$$

(c)
$$\begin{array}{r} - 279 \\ - 127 \\ \hline 152 \end{array}$$
 (d)
$$\begin{array}{r} - 6250 \\ - 5625 \\ \hline 625 \end{array}$$

5.



- (a) 1, 1, 1, 1, 1
(b) 1, 1, 1, 4, 8
(c) 4, 4, 4, 4, 4
(d) 8, 8, 4, 4, 1
(e) 4, 4, 4, 8, 15
(f) 8, 8, 8, 8, 8
(g) 1, 4, 15, 15, 15
(h) 15, 15, 15, 15, 15
- $44 + 44 + 4 + 4 + 4$
- 37
- 37, 38, 39
- 15

11. 72

12. 71 960

13. (a) 0, 1, 3, 6, 10, 15, **21, 28, 36**(b) 140, 135, 125, 110, 90, **65, 35, 0**(c) 1, 1, 2, 3, 5, 8, 13, **21, 34, 55**(d) 1000, 980, 940, 880, 800, **700, 580, 440**

14. (a) 31, 32, 37

(b) 17, 18, 32, 33

(c) 14, 29, 32

Exercise 1C

1. (a) 18 (b) 40 (c) 18 (d) 16 (e) 70

(f) 24 (g) 88 (h) 24 (i) 35 (j) 54

(k) 48 (l) 90 (m) 49 (n) 48 (o) 121

(p) 72 (q) 36 (r) 56 (s) 108 (t) 36

2. (a) 5 (b) 6 (c) 10 (d) 5 (e) 6

(f) 12 (g) 4 (h) 6 (i) 6 (j) 3

(k) 9 (l) 10 (m) 8 (n) 7 (o) 9

(p) 9 (q) 12 (r) 9 (s) 5 (t) 8

3. (a) 3 (b) 9 (c) 5 (d) 6 (e) 16

(f) 11 (g) 90 (h) 11 (i) 7 (j) 9

(k) 21 (l) 8

4. (a) 348 (b) 1640 (c) 4529

(d) 24 232 (e) 1335 (f) 5808

(g) 13 671 (h) 119 280

5. (a) 64 (b) 59 (c) 546 (d) 3579

6. 54 litres

7. 5 spiders and 10 beetles

8. Ann - 36, Daniel - 8

9. 23, 24

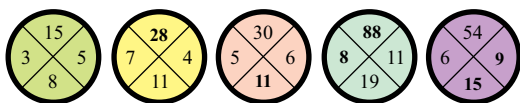
10. 3, 24

11. (a) 1 736 640 km (b) 1206 km

12. Peter - 14, Tess - 4

13. (a) 652×35 (b) $77\,320 \div 8$

14.

**Exercise 1D**

1. (a) 21 (b) 13 (c) 11 (d) 32 (e) 9

(f) 17 (g) 13 (h) 10 (i) 48 (j) 16

(k) 6 (l) 0 (m) 16 (n) 3 (o) 4 (p) 14

2. There may be more than one answer for these questions.

(a) $8 + 4 \div 4 = 9$ (b) $20 \div 5 \div 4 = 1$ (c) $10 + 10 \div 5 = 12$ (d) $8 - 4 \times 2 = 0$ (e) $8 \div 2 + 5 = 9$ (f) $8 + 2 \times 5 = 18$ (g) $8 + 6 \div 3 = 10$ (h) $8 \times 6 \div 3 = 16$ (i) $6 + 8 - 2 \times 5 = 4$ (j) $2 + 3 \times 4 - 5 = 9$ (k) $3 + 5 \times 2 - 8 = 5$ (l) $8 \div 4 + 3 \times 1 = 5$

3. There may be more than one answer for these questions.

 $1 + 4 - 2 - 3 = 0$ $(2 + 3) \div (1 + 4) = 1$ $4 + 2 - 1 - 3 = 2$ $3 \times 2 - 4 + 1 = 3$ $4 + 3 - 2 - 1 = 4$ $4 \times 3 \div 2 - 1 = 5$ $4 \times 3 \div 2 \div 1 = 6$ $4 \times 3 \div 2 + 1 = 7$ $4 \times (3 - 2 + 1) = 8$ $4 \times 3 - 2 - 1 = 9$ $1 \times 2 \times 3 + 4 = 10$ $4 \times 2 + 3 \times 1 = 11$ $4 \times 2 + 3 + 1 = 12$ $4 \times 3 + 2 - 1 = 13$ $4 \times 3 + 2 \times 1 = 14$ $4 \times 3 + 2 + 1 = 15$ $4 \times 2 \times (3 - 1) = 16$ $(4 + 1) \times 3 + 2 = 17$ $4 \times (3 + 1) + 2 = 18$ $4 \times (3 + 2) - 1 = 19$ $4 \times (3 + 2) \times 1 = 20$

Exercise 1E

- (a) 5000 (b) 2000 (c) 30 000
(d) 80 000 (e) 1 400 000
(f) 250 000 (g) 300 (h) 4 (i) 80
(j) 30 (k) 100 (l) 30
- (a) $60 \times 20 = 1200$
(b) $90 \times 50 = 4500$
(c) $80 \times 20 = 1600$
(d) $90 \times 80 = 7200$
(e) $50 \times 120 = 6000$
(f) $260 \times 100 = 26\ 000$
- (a) $700 \times 100 = 70\ 000$
(b) $900 \times 500 = 450\ 000$
(c) $800 \times 300 = 240\ 000$
(d) $800 \times 800 = 640\ 000$
(e) $1600 \times 100 = 160\ 000$
(f) $2700 \times 1000 = 2\ 700\ 000$
- (a) B (b) B

Exercise 1F

- (a) 1, 2, 3, 4, 6, 12
(b) 1, 2, 3, 4, 6, 9, 12, 18, 36
(c) 1, 3, 9, 27
(d) 1, 2, 4, 5, 8, 10, 16, 20, 40, 80
(e) 1, 2, 4, 7, 8, 14, 16, 28, 56, 112
(f) 1, 2, 4, 7, 8, 14, 28, 56
(g) 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 25, 30, 50, 60, 75, 100, 150, 300
(h) 1, 23
(i) 1, 2, 3, 4, 6, 8, 12, 18, 24, 36, 48, 72, 144
(j) 1, 3, 9, 19, 57, 171
- (a) 1, 2, 4 (b) 1, 3 (c) 1, 2, 4
(d) 1, 2, 3, 4, 6, 12 (e) 1, 2, 4
- (a) 4 (b) 3 (c) 4 (d) 12 (e) 4
- (a) 8 m (b) 34
- (a) \$9
(b) Hayley - 8 hours
Nathan - 7 hours
Jacqui - 5 hours

Exercise 1G

- (a) 1, 7 (b) 1, 17 (c) 1, 29
(d) 1, 61 (e) 1, 163
- Prime numbers have only two factors - themselves and one.
- 5, 59, 137
- There are different factor trees for each number but the prime factors will be the same.
 - (a)

```

      24
     / \
    2  12
       / \
      2  6
         / \
        2  3
          
```

(b)

```

      18
     / \
    2  9
       / \
      3  3
          
```
 - (c)

```

      56
     / \
    7  8
       / \
      2  4
         / \
        2  2
          
```

(d)

```

      64
     / \
    2  32
       / \
      2  16
         / \
        2  8
           / \
          2  4
             / \
            2  2
          
```

(e)

```

      224
     / \
    2  112
       / \
      2  56
         / \
        7  8
           / \
          2  4
             / \
            2  2
          
```
 - (ii)(a) $2 \times 2 \times 2 \times 3$ (b) $2 \times 3 \times 3$
(c) $7 \times 2 \times 2 \times 2$
(d) $2 \times 2 \times 2 \times 2 \times 2 \times 2$
(e) $2 \times 2 \times 7 \times 2 \times 2 \times 2$
- (a) $2^3 \times 3$ (b) 2×3^2 (c) $2^3 \times 7$
(d) 2^6 (e) $2^5 \times 7$
- (a) 72 (b) 48 (c) 45 (d) 175
(e) 250 (f) 225 (g) 5929 (h) 900

Exercise 1H

- (a) 3 6 9 12 15 18 21 24
8 16 24 32 40 48 56 64

(b) 6 12 18 24 30 36 42 48
10 20 30 40 50 60 70 80

(c) 4 8 12 16 20 24 28 32
6 12 18 24 30 36 42 48

(d) 8 16 24 32 40 48 56 64
12 24 36 48 60 72 84 96

(e) 6 12 18 24 30 36 42 48
3 6 9 12 15 18 21 24

(f) 10 20 30 40 50 60 70 80
12 24 36 48 60 72 84 96

1. (g) 5 10 15 20 25 30 35 40
7 14 21 28 35 42 49 56
(h) 12 24 36 48 60 72 84 96
20 40 60 80 100 120 140 160
2. (a) 56 (b) 40 (c) 12 (d) 120
3. (a) 2054 (b) 2070 (c) 2110
(d) 2062 (e) 2110

Exercise 1I

1. (a) 1 (b) 4 (c) 9 (d) 16 (e) 25
2. 36, 49, 64, 81, 100
3. (a) 169 (b) 625 (c) 2209
(d) 7396 (e) 15 129
4. (a) 14 (b) 18 (c) 27 (d) 99
(e) 210
5. (a) 4 (b) 5 (c) 7 (d) 10 (e) 12
6. (a) 10^3 (b) 10^7 (c) 10^9
7. (a) 5×10^3 (b) 7×10^5 (c) 6×10^{12}
(d) 2×10^7 (e) 3×10^8 (f) 2×10^{27}
(g) 3×10^7 (h) 5×10^{25} (i) 4×10^{13}

Exercise 1J

1. (a) $2 \times 2 \times 2 \times 2$
(b) $6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6$
(c) 10×10
(d) $9 \times 9 \times 9 \times 9 \times 9 \times 9 \times 9 \times 9$
(e) $8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8$
(f) 3×3
(g) $13 \times 13 \times 13 \times 13 \times 13$
(h) $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$
(i) $4 \times 4 \times 4 \times 4 \times 4 \times 4$
(j) $1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1$
2. (a) 6^4 (b) 9^6 (c) 2^5 (d) 12^5 (e) 15^2
(f) 3^{10} (g) 5^7 (h) 1^{10}
3. (a) $3 \times 3 \times 3 \times 3 \times 3 \times 3 = 3^6$
(b) $2 \times 2 \times 2 \times 2 \times 2 = 2^5$
(c) $7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 = 7^8$
(d) $6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 = 6^8$
(e) $5 \times 5 \times 5 \times 5 \times 5 \times 5 = 5^6$

3. (f) $10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 10^8$
(g) $9 \times 9 \times 9 \times 9 \times 9 \times 9 \times 9 = 9^7$
(h) $8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8 = 8^{11}$
(i) $6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 = 6^8$
(j) $1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 = 1^{10}$
(k) $5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 = 5^9$
(l) $7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 = 7^7$
4. Add the indices to find the index of the answer.
5. (a) 6^{10} (b) 5^{12} (c) 4^{11} (d) 8^7 (e) 2^{15}
(f) 13^{14} (g) 3^9 (h) 15^{11} (i) 9^{27}
(j) 17^{22} (k) 11^{13} (l) 26^{16}

Exercise 1K

1. (a) $\frac{4 \times 4 \times 4 \times 4 \times 4}{4 \times 4} = 4^3$
(b) $\frac{2 \times 2 \times 2 \times 2 \times 2 \times 2}{2 \times 2 \times 2 \times 2} = 2^2$
(c) $\frac{7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7}{7 \times 7 \times 7} = 7^4$
(d) $\frac{9 \times 9 \times 9 \times 9 \times 9 \times 9}{9 \times 9} = 9^4$
(e) $\frac{5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5}{5 \times 5 \times 5 \times 5 \times 5} = 5^3$
(f) $\frac{10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10}{10} = 10^6$
(g) $\frac{3 \times 3 \times 3 \times 3 \times 3 \times 3}{3 \times 3 \times 3} = 3^3$
(h) $\frac{6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6}{6 \times 6} = 6^7$
(i) $\frac{8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8 \times 8}{8 \times 8 \times 8 \times 8 \times 8 \times 8} = 8^2$
(j) $\frac{11 \times 11 \times 11 \times 11 \times 11 \times 11 \times 11 \times 11 \times 11}{11 \times 11 \times 11 \times 11 \times 11} = 11^4$
(k) $\frac{2 \times 2 \times 2 \times 2 \times 2}{2} = 2^4$
(l) $\frac{13 \times 13 \times 13 \times 13}{13 \times 13 \times 13} = 13^1 = 13$
(m) $\frac{3 \times 3 \times 3 \times 3 \times 3}{3 \times 3 \times 3 \times 3} = 3^1 = 3$

$$1. (n) \frac{15 \times 15 \times 15 \times 15 \times 15 \times 15 \times 15}{15 \times 15 \times 15 \times 15 \times 15} = 15^2$$

$$(o) \frac{20 \times 20 \times 20 \times 20}{20} = 20^3$$

$$(p) \frac{7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7}{7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7} = 7^2$$

2. Subtract the index on the denominator (bottom line) from the index on the numerator (top line) to find the index of the answer.

3. (a) 5^5 (b) 3^4 (c) 4^5 (d) 7^2 (e) 6^8
 (f) 12^6 (g) 2^7 (h) 8 (i) 9 (j) 15^8
 (k) 9^4 (l) 17^6

4. (a) 9^3 (b) 12^6 (c) 7^3 (d) 8^2 (e) 10
 (f) 6^7 (g) 5^6 (h) 2^8 (i) 3^8 (j) 20
 (k) 4 (l) 17^{11}

Exercise 1L

1. (a) $\frac{5 \times 5 \times 5 \times 5}{5 \times 5 \times 5 \times 5} = \frac{1}{1} = 1$

(b) $\frac{3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3}{3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3} = \frac{1}{1} = 1$

(c) $\frac{4 \times 4 \times 4}{4 \times 4 \times 4} = \frac{1}{1} = 1$

(d) $\frac{7 \times 7 \times 7 \times 7 \times 7}{7 \times 7 \times 7 \times 7 \times 7} = \frac{1}{1} = 1$

2. (a) $5^0 = 1$ (b) $3^0 = 1$ (c) $4^0 = 1$
 (d) $7^0 = 1$

3. (a) 5^0 (b) 3^0 (c) 4^0 (d) 7^0

4. (a) 6 (b) 13 (c) 13 (d) 1 (e) 25
 (f) 5 (g) 1 (h) 1 (i) 27 (j) 5
 (k) 3 (l) 3

Exercise 1M

1. (a) $4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 4 = 4^8$

(b) $8 \times 8 \times 8 \times 8 \times 8 \times 8 = 8^6$

(c) $6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6 \times 6$
 $6 \times 6 = 6^{10}$

(d) $3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3$
 $3 \times 3 = 6^{10}$

(e) $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$
 $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^{16}$

(f) $9 \times 9 \times 9 \times 9 = 9^4$

1. (g) $5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5$
 $5 \times 5 \times 5 \times 5 \times 5 = 5^{12}$

(h) $10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$
 $10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 10^{15}$

(i) $12 \times 12 \times 12 \times 12 \times 12 \times 12 \times 12 \times 12 \times 12$
 $12 \times 12 \times 12 \times 12 \times 12 = 12^{12}$

(j) $7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7$
 $7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 \times 7 = 7^{14}$

(k) $3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3$
 $3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 \times 3 = 7^{14}$

(l) $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$
 $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^{18}$
 $2 \times 2 \times 2 \times 2 = 2^{18}$

2. Multiply the indices.

3. (a) 5^{24} (b) 6^{25} (c) 2^{28} (d) 9^{56} (e) 7^{40}
 (f) 8^{36} (g) 10^{50} (h) 11^{54} (i) 13^{42} (j) 9^{72}
 (k) 3^{63} (l) 8^{160}

Exercise 1N

1. 4^{13}

2. 7^{21}

3. 8^8

4. 1

5. 5^{56}

6. 8^{21}

7. 9^{19}

8. 6^7

Exercise 1O

1. (a) 4 (b) 8 (c) 16 (d) 32 (e) 64

(f) 128 (g) 256 (h) 512 (i) 1024

(j) 2048 (k) 9 (l) 27 (m) 81 (n) 25

(o) 125 (p) 100 (q) 1000 (r) 10 000

(s) 100 000 (t) 1 000 000

2. (a) 100 000 (b) 512 (c) 243 (d) 729
 (e) 49 (f) 36

3. (a) 5 (b) 112 (c) 2000 (d) 1 (e) 2
 (f) 111

Exercise 1P

1. 50 625
2. 176 812
3. 2613
4. 1 108 809
5. 262 144
6. 324
7. 3010
8. 4096
9. 5
10. 370 942
11. 117 649
12. 2 131 936

Chapter Review

1. (a) six thousand and forty-eight
(b) one hundred and five thousand, seven hundred and nine
(c) six hundred and thirty-four thousand, two hundred and fifty
(d) ten million, five thousand and fifty-nine
2. (a) $31 < 57$ (b) $92 > 78$
(c) $959 < 1003$ (d) $10\ 005 > 9762$
3. (a) 90 (b) 1600
4. (a) 20 (b) 60 (c) 460 (d) 3300
5. (a) 0 (b) 100 (c) 500 (d) 3300
6. (a) 23 (b) 32 (c) 271 (d) 9
(e) 54 (f) 40 (g) 84 (h) 115
(i) 12 (j) 3 (k) 6 (l) 21
7. (a) 8991 (b) 12 050 (c) 18 055
(d) 5678
8. (a) 19 968 (b) 64 025
9. 6920 kg
10. (a) 17 (b) 2 (c) 7 (d) 14
11. (a) 40 000 (b) 70 (c) 20
12. (a) 6 (b) 30 (c) 8
13. (a) 2^5 (b) $2^2 \times 3^2$ (c) $2 \times 3 \times 5^2$
14. (a) 40 (b) 18 (c) 12
15. (a) 25 (b) 64 (c) 9 (d) 10
16. (a) 841 (b) 18 769 (c) 35
(d) 257
17. (a) 8×10^3 (b) 9×10^5 (c) 10^9
18. (a) 3^7 (b) 6^9

19. (a) 5^{10} (b) 9^{12} (c) 7^5 (d) 3^9 (e) 8^{18}
(f) 14^{36} (g) 4^7 (h) 6^{17}
20. (a) 1 (b) 17 (c) 75 (d) 114

Chapter 2**Exercise 2A**

1. (a) D (b) C (c) B (d) A
2. (a) -4 (b) -3 (c) 0 (d) 2 (e) 5
(f) -8 (g) -4 (h) 4 (i) 10 (j) -11
(k) -8 (l) -2 (m) 3 (n) 9 (o) -18
(p) -12 (q) -6 (r) 8 (s) 22
3. (a) -9, -8, -7, -6, -5, **-4, -3, -2, -1, 0**
(b) -12, -10, -8, -6, -4, **-2, 0, 2, 4, 6**
(c) -35, -30, -25, -20, -15, **-10, -5, 0, 5, 10**
(d) 6, 5, 4, 3, 2, **1, 0, -1, -2, -3**
(e) 60, 50, 40, 30, 20, **10, 0, -10, -20, -30**
(f) -37, -32, -27, -22, -17, **-12, -7, -2, 3, 8**
(g) 34, 28, 22, 16, 10, **4, -2, -8, -14, -20**
(h) 20, 19, 17, 14, 10, **5, -1, -8, -16, -25**
(i) 100, 95, 85, 70, 50, **25, -5, -40, -80, -125**
(j) -50, -48, -44, -38, -30, **-20, -8, 6, 22, 40**
(k) -50, -47, -41, -32, -20, **-5, 13, 34, 58, 85**

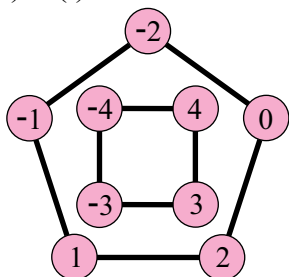
Exercise 2B

1. (a) -8, -5, -4, 3, 4, 6, 9
(b) -23, -14, -11, -5, 0, 9, 17, 21
(c) -12, -10, -8, -4, -3, 0
(d) -6, -4, -2, -1, 0, 1, 3, 5, 7, 8
2. (a) 33 (b) 0
3. (a) -13 (b) -3
4. (a) $-5 < 1$ (b) $-4 > -7$ (c) $9 > 4$
(d) $4 > -9$ (e) $0 < 7$ (f) $7 < 12$
(g) $-8 < -5$ (h) $0 > -7$ (i) $6 > -1$
(j) $-12 < -1$
5. (a) 5 (b) 3 (c) 7 (d) 3 (e) 4
(f) 9 (g) 9 (h) 5 (i) 6 (j) 1

6. (a) 11 (b) 14 (c) 18 (d) 31 (e) 11
(f) 40 (g) 42 (h) 26 (i) 56 (j) 68
(k) 18 (l) 39 (m) 46 (n) 39 (o) 55
7. (a) 17°C (b) 10°C (c) 9°C (d) 26°C
8. 14 kilometres
9. (a) 26°C (b) -4°C
10. 1943 years

Exercise 2C

1. (a) 1 (b) -1 (c) -2 (d) -4 (e) -3
(f) -1 (g) 2 (h) 6 (i) -2 (j) 0 (k) 1
(l) -4 (m) -6 (n) -6 (o) -1 (p) 3
2. (a) 2 (b) -9 (c) -5 (d) -12 (e) -20
(f) -13 (g) 6 (h) -14 (i) -18 (j) -6
(k) -34 (l) -1 (m) 7 (n) -20 (o) 4
(p) -13
3. (a) 2 (b) 6 (c) 5 (d) 5 (e) 3 (f) 7
(g) 12 (h) 9 (i) 8 (j) -3 (k) -3
(l) 3 (m) -6 (n) -6 (o) -5
4. (a) 7 (b) 3 (c) 2 (d) 4 (e) 2 (f) -3
(g) -9 (h) 10 (i) 4 (j) -11 (k) 0
(l) -12 (m) 12 (n) -6 (o) 2 (p) 2
5. (a) 8 (b) -10 (c) 34 (d) -50 (e) -50
(f) -10 (g) 5 (h) -14 (i) 15 (j) 3
(k) -16 (l) -22
6. (a) -2 (b) 4 (c) -2 (d) -3 (e) -6
(f) 6 (g) -4 (h) -7 (i) -6 (j) -6
(k) -6 (l) -5
7. (a) + (b) + (c) - (d) - (e) - (f) +
(g) - (h) - (i) -
8.



Exercise 2D

1. (a) 14 (b) -9 (c) -40 (d) 6 (e) 55
(f) -10 (g) -20 (h) 30 (i) 25
(j) -66 (k) -40 (l) -2 (m) 0 (n) 8

1. (o) 1 (p) -4 (q) -56 (r) 54 (s) -132
(t) 35
2. (a) -6 (b) 10 (c) 2 (d) -8 (e) -5
(f) 6 (g) -5 (h) 5 (i) -1 (j) -6
(k) 3 (l) 7 (m) -7 (n) -12 (o) 1
(p) 0 (q) -12 (r) 8 (s) -9 (t) -9
3. (a) 24 (b) 2 (c) -15 (d) 4 (e) 24
(f) -1 (g) 64 (h) -27 (i) -1 (j) 10 000
(k) 48 (l) 3 (m) -5 (n) 28 (o) 40
(p) -6
4. (a) 48 (b) 24 (c) -72 (d) 36 (e) -4
(f) 4 (g) -3 (h) 12 (i) 3 (j) 18

Exercise 2E

1. (a) 10 (b) -3 (c) -2 (d) 8 (e) -1
(f) 12 (g) -10 (h) 9 (i) 3 (j) 1
2. (a) 3 (b) -2 (c) -7 (d) 15 (e) 25
(f) -4 (g) 15 (h) 1 (i) 12 (j) 30
(k) 11 (l) 2

Exercise 2F

1. 9
2. 17
3. 4
4. 68
5. -53
6. -1
7. -175

Chapter Review

1. (a) -11 (b) -7 (c) -3 (d) 4 (e) 8
2. (a) -34, -28, -22, -16, **-10, -4, 2**
(b) 15, 14, 12, 9, **5, 0, -6**
3. -26, -21, -19, -15, -6, 5, 9, 13
4. (a) $-1 < 7$ (b) $-9 > -15$
(c) $0 > -5$ (d) $-6 < -1$
5. (a) 10 (b) 8 (c) 34 (d) 27
6. 23°C
7. (a) -6 (b) 4 (c) -15 (d) 13 (e) -16
(f) 8 (g) -11 (h) 22 (i) -24 (j) -24
(k) 30 (l) -210 (m) -4 (n) 4 (o) -6
(p) -2

8. (a) -16 (b) 6 (c) 12 (d) -19
(e) 24 (f) 15
9. (a) -3 (b) -5 (c) 7 (d) -2 (e) 9
(f) -19 (g) -10 (h) -12

Chapter 3

Exercise 3A

1. (a) $\frac{3}{8}$ (b) $\frac{9}{28}$ (c) $\frac{11}{18}$
2. (a) $\frac{5}{8}$ (b) $\frac{19}{28}$ (c) $\frac{7}{18}$
3. (a) $\frac{2}{5}$ (b) $\frac{6}{11}$
4. (a) 7 (b) 5
5. $\frac{10}{13}$
6. (a) $\frac{13}{29}$ (b) $\frac{16}{29}$
7. (a) $\frac{18}{31}$ (b) $\frac{13}{31}$

Exercise 3B

1. (a) $\frac{3}{6}$ (b) $\frac{6}{8}$ (c) $\frac{15}{18}$ (d) $\frac{22}{55}$ (e) $\frac{4}{18}$
(f) $\frac{3}{5}$ (g) $\frac{5}{8}$ (h) $\frac{8}{10}$ (i) $\frac{4}{6}$ (j) $\frac{72}{81}$
(k) $\frac{12}{16}$ (l) $\frac{14}{20}$
2. (a) $\frac{2}{5} = \frac{4}{10} = \frac{8}{20} = \frac{18}{45} = \frac{40}{100} = \frac{60}{150}$
(b) $\frac{12}{16} = \frac{24}{32} = \frac{6}{8} = \frac{3}{4} = \frac{36}{48} = \frac{144}{192}$
3. (a) $\frac{2}{3}$ (b) $\frac{4}{5}$ (c) $\frac{3}{4}$ (d) $\frac{1}{3}$ (e) $\frac{5}{6}$
(f) $\frac{31}{35}$
4. (a) $\frac{12}{36} = \frac{1}{3}$ (b) $\frac{24}{36} = \frac{2}{3}$
5. (a)(i) $\frac{15}{80} = \frac{3}{16}$ (ii) $\frac{13}{16}$ (iii) $\frac{32}{80} = \frac{2}{5}$
(iv) $\frac{3}{5}$
(b)(i) $\frac{52}{88} = \frac{13}{22}$ (ii) $\frac{9}{22}$
(c)(i) $\frac{100}{250} = \frac{2}{5}$ (ii) $\frac{3}{5}$
(d)(i) $\frac{2}{8} = \frac{1}{4}$ (ii) $\frac{3}{4}$
(e) Machine Heads $\frac{15}{60} = \frac{1}{4}$
Stray Cats $\frac{13}{60}$
Armpits $\frac{20}{60} = \frac{1}{3}$
Tempest $\frac{12}{60} = \frac{1}{5}$
(f)(i) Woneta - 30 litres
Meg - 40 litres
Swampy - 30 litres
Meryl - 20 litres
(ii) Woneta - $\frac{1}{4}$ Meg - $\frac{1}{3}$
Swampy - $\frac{1}{4}$ Meryl - $\frac{1}{6}$
6. (a) $\frac{2}{3} = \frac{10}{15}$, $\frac{3}{5} = \frac{9}{15}$
(b) $\frac{5}{8}$, $\frac{3}{4} = \frac{6}{8}$
(c) $\frac{2}{5} = \frac{12}{30}$, $\frac{1}{6} = \frac{5}{30}$
(d) $\frac{7}{8} = \frac{21}{24}$, $\frac{5}{6} = \frac{20}{24}$

6. (e) $\frac{1}{2} = \frac{9}{18}$, $\frac{5}{9} = \frac{10}{18}$
(f) $\frac{2}{3} = \frac{14}{21}$, $\frac{5}{7} = \frac{15}{21}$
(g) $\frac{8}{9} = \frac{88}{99}$, $\frac{9}{11} = \frac{81}{99}$
(h) $\frac{7}{8} = \frac{63}{72}$, $\frac{7}{9} = \frac{56}{72}$
(i) $\frac{5}{6} = \frac{15}{18}$, $\frac{7}{9} = \frac{14}{18}$
(j) $\frac{11}{12}$, $\frac{5}{6} = \frac{10}{12}$
7. (a) $\frac{2}{3} > \frac{3}{5}$ (b) $\frac{5}{8} < \frac{3}{4}$ (c) $\frac{2}{5} > \frac{1}{6}$
(d) $\frac{7}{8} > \frac{5}{6}$ (e) $\frac{1}{2} < \frac{5}{9}$ (f) $\frac{2}{3} < \frac{5}{7}$
(g) $\frac{8}{9} > \frac{9}{11}$ (h) $\frac{7}{8} > \frac{7}{9}$ (i) $\frac{5}{6} > \frac{7}{9}$
(j) $\frac{11}{12} > \frac{5}{6}$
8. $\frac{11}{15}$
9. (a) A - $\frac{3}{5}$, B - $\frac{8}{16} = \frac{1}{2}$, C - $\frac{2}{3}$, D - $\frac{8}{15}$
(b) B - $\frac{15}{30}$, D - $\frac{16}{30}$, A - $\frac{18}{30}$, C - $\frac{20}{30}$
10. Health $\frac{3}{4} = \frac{18}{24}$
Maths $\frac{17}{24}$
Science $\frac{2}{3} = \frac{16}{24}$
Italian $\frac{5}{8} = \frac{15}{24}$

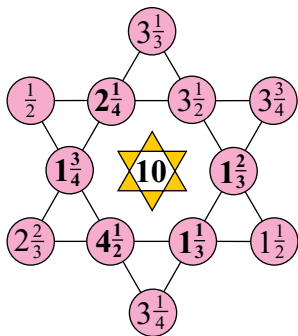
Exercise 3C

1. (a) $\frac{3}{7}$, $\frac{5}{6}$, $\frac{15}{23}$
(b) $\frac{25}{9}$, $\frac{37}{12}$, $\frac{23}{22}$
(c) $8\frac{1}{3}$, $2\frac{3}{7}$, $11\frac{7}{9}$
2. (a)(i) $2\frac{3}{4}$ (ii) $\frac{11}{4}$
(b)(i) $5\frac{5}{8}$ (ii) $\frac{45}{8}$
3. (a) 20 (b) 12 (c) 10
4. (a) 20 (b) 33 (c) 31
5. (a) $\frac{11}{3}$ (b) $\frac{23}{4}$ (c) $\frac{49}{6}$ (d) $\frac{39}{5}$ (e) $\frac{63}{10}$
(f) $\frac{188}{9}$
6. $\frac{1}{10}$ $\frac{3}{4}$ $1\frac{1}{3}$ $1\frac{5}{6}$ $2\frac{1}{5}$ $2\frac{1}{2}$ $2\frac{11}{12}$ $3\frac{1}{9}$ $3\frac{3}{5}$ $4\frac{1}{6}$
 $4\frac{7}{8}$ $6\frac{2}{7}$ $6\frac{5}{8}$ $8\frac{1}{7}$ $8\frac{3}{5}$ $10\frac{1}{3}$ $10\frac{3}{4}$

Exercise 3D

1. (a) $\frac{3}{5}$ (b) $\frac{5}{7}$ (c) 1 (d) $\frac{10}{13}$ (e) $\frac{1}{9}$
(f) $\frac{2}{5}$ (g) $\frac{7}{23}$ (h) 0 (i) $\frac{2}{3}$ (j) $\frac{3}{5}$
(k) $\frac{4}{7}$ (l) $\frac{8}{25}$ (m) $3\frac{4}{5}$ (n) $11\frac{7}{9}$
(o) $1\frac{3}{7}$ (p) $9\frac{2}{7}$
2. 4 tonnes
3. 0
4. (a) $\frac{5}{8}$ (b) $\frac{1}{4}$ (c) $\frac{7}{10}$ (d) $\frac{7}{8}$ (e) $\frac{1}{6}$
(f) $\frac{2}{9}$ (g) $\frac{5}{12}$ (h) $\frac{17}{20}$ (i) $\frac{13}{15}$ (j) $\frac{17}{24}$
(k) $\frac{17}{20}$ (l) $\frac{13}{36}$ (m) $\frac{5}{12}$ (n) $\frac{17}{20}$ (o) $\frac{7}{30}$
(p) 1

5.



6. 10 days

7. $2\frac{1}{12}$ kg

8. (a) $4\frac{1}{4}$ (b) $1\frac{1}{2}$ (c) $6\frac{1}{8}$ (d) $1\frac{1}{2}$ (e) $1\frac{3}{4}$
 (f) $6\frac{1}{6}$ (g) $8\frac{1}{2}$ (h) $5\frac{3}{8}$ (i) 9 (j) $4\frac{2}{5}$
 (k) $8\frac{1}{6}$ (l) $3\frac{14}{15}$ (m) $3\frac{11}{20}$ (n) $3\frac{11}{15}$ (o) $4\frac{1}{14}$
 (p) $2\frac{1}{10}$

9. (a) $\frac{1}{2}$, 2, $3\frac{1}{2}$, 5, $6\frac{1}{2}$, 8, $9\frac{1}{2}$
 (b) $\frac{1}{4}$, $1\frac{7}{12}$, $2\frac{11}{12}$, $4\frac{1}{4}$, $5\frac{7}{12}$, $6\frac{11}{12}$, $8\frac{1}{4}$

10. 9 metres

11. $2\frac{1}{4}$, $3\frac{1}{4}$ **Exercise 3E**

1. (a) $\frac{1}{6}$ (b) $\frac{6}{35}$ (c) $\frac{25}{42}$ (d) $\frac{10}{27}$ (e) $\frac{9}{100}$
 (f) $\frac{11}{24}$ (g) $\frac{1}{24}$ (h) $\frac{15}{56}$
2. (a) $\frac{1}{2}$ (b) $\frac{2}{3}$ (c) $\frac{3}{4}$ (d) $\frac{1}{5}$ (e) $\frac{9}{28}$
 (f) $\frac{4}{7}$ (g) $\frac{8}{25}$ (h) $\frac{4}{15}$
3. (a) $1\frac{1}{2}$ (b) $4\frac{1}{2}$ (c) 6 (d) $5\frac{1}{4}$ (e) $8\frac{3}{4}$
 (f) $9\frac{3}{5}$ (g) 63 (h) 15
4. (a) 10 (b) 8 (c) 4 (d) 12 (e) 12
 (f) 6 (g) 12 (h) 12 (i) 30 (j) 44
 (k) 22 (l) 15 (m) $\frac{1}{6}$ (n) $\frac{2}{5}$ (o) $\frac{2}{3}$
 (p) $\frac{10}{13}$ (q) $2\frac{1}{3}$ (r) $6\frac{1}{3}$ (s) 5 (t) $6\frac{1}{2}$
5. (a) 4 m (b) 15 kg (c) \$50
 (d) 200 mm (e) 18 cm (f) \$75
 (g) 150 m (h) 800 kg (i) 7 g
 (j) $1\frac{1}{2}$ m (k) $1\frac{1}{2}$ m (l) 6 kg
6. (a) $\frac{1}{10}$ (b) \$10 (c) 1 (d) $\frac{9}{16}$ (e) $\frac{8}{27}$
 (f) $\frac{1}{32}$ (g) $2\frac{1}{4}$ (h) $7\frac{9}{16}$
7. (a) 60 litres (b) 20 litres
8. (a) \$40 (b) \$30 (c) \$50
9. (a) \$1800 (b) \$10
10. (a) 720 hectares (b) 300 hectares
 (c) 180 hectares (d) 240 hectares
 (e) $\frac{1}{5}$
11. (a) 9 (b) 3

Exercise 3F

1. (a) $\frac{8}{9}$ (b) $\frac{24}{35}$ (c) $\frac{2}{3}$ (d) $\frac{21}{50}$ (e) $\frac{9}{10}$
 (f) $\frac{1}{2}$ (g) $\frac{8}{11}$ (h) $\frac{7}{9}$ (i) $1\frac{1}{2}$ (j) $1\frac{1}{5}$
 (k) $1\frac{1}{2}$ (l) $1\frac{1}{12}$
2. (a) $1\frac{3}{7}$ (b) $\frac{3}{4}$ (c) $\frac{1}{3}$ (d) 4 (e) $1\frac{1}{3}$
 (f) 6 (g) $\frac{2}{9}$ (h) $\frac{17}{79}$
3. (a) $\frac{31}{3} = 10\frac{1}{3}$ (b) $\frac{52}{5} = 10\frac{2}{5}$
 (c) $\frac{3}{8}$ (d) $\frac{7}{10}$
4. (a) $\frac{3}{5}$ (b) $\frac{17}{22}$ (c) $\frac{8}{9}$ (d) $\frac{1}{6}$ (e) $1\frac{3}{4}$
 (f) $6\frac{3}{4}$
5. (a) 3 (b) 10 (c) 16 (d) 30 (e) 7
 (f) 11 (g) 73 (h) 13
6. (a) 4 (b) 28 (c) 9 (d) $\frac{5}{14}$ (e) $\frac{3}{4}$
 (f) $3\frac{1}{2}$ (g) 3 (h) $\frac{47}{72}$
7. (a) 20 (b) $\frac{20}{12}$ (c) $13\frac{1}{2}$ (d) $\frac{2}{27}$ (e) 10
 (f) $18\frac{2}{3}$ (g) $\frac{2}{5}$ (h) $3\frac{3}{4}$
8. 96 tiles
9. 12
10. 300 paces
11. 10 discs
12. 18
13. (a) $\frac{1}{5}$ kg (b) 25 avocados
14. (a) 20 doses (b) Middy Saturday

Exercise 3G

1. $\frac{3}{4}$ 2. $\frac{1}{2}$ 3. 3 4. $\frac{5}{6}$ 5. $1\frac{1}{3}$ 6. $\frac{1}{5}$
 7. $\frac{46}{63}$ 8. 0

Exercise 3H

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Chapter Review

1. (a) $\frac{3}{10}$ (b) $\frac{5}{9}$
2. (a) $\frac{3}{5} = \frac{6}{10} = \frac{12}{20} = \frac{27}{45} = \frac{60}{100} = \frac{90}{150}$
 (b) $\frac{10}{16} = \frac{20}{32} = \frac{5}{8} = \frac{30}{48} = \frac{50}{80} = \frac{150}{240}$
3. (a) $\frac{1}{2}$ (b) $\frac{2}{3}$ (c) $\frac{2}{3}$ (d) $\frac{3}{11}$ (e) $\frac{11}{12}$
 (f) $\frac{3}{4}$
4. (a) $\frac{2}{3} = \frac{10}{15}$, $\frac{4}{5} = \frac{12}{15}$ (b) $\frac{5}{8}$, $\frac{1}{4} = \frac{2}{8}$
 (c) $\frac{2}{5} = \frac{12}{30}$, $\frac{5}{6} = \frac{25}{30}$ (d) $\frac{5}{8} = \frac{15}{24}$, $\frac{5}{6} = \frac{20}{24}$
 (e) $\frac{1}{2} = \frac{9}{18}$, $\frac{7}{9} = \frac{14}{18}$
5. (a) $\frac{14}{3}$ (b) $\frac{21}{4}$ (c) $\frac{47}{6}$ (d) $\frac{44}{5}$ (e) $\frac{69}{10}$
 (f) $\frac{145}{7}$
6. (a) $3\frac{1}{3}$ (b) $8\frac{3}{4}$ (c) $5\frac{5}{6}$ (d) $9\frac{3}{5}$
 (e) $9\frac{9}{10}$ (f) $18\frac{1}{7}$

7. (a) $\frac{4}{5}$ (b) $\frac{3}{7}$ (c) $5\frac{7}{11}$ (d) $3\frac{3}{7}$ (e) $\frac{5}{8}$
 (f) $\frac{3}{4}$ (g) $\frac{5}{8}$ (h) $1\frac{4}{15}$ (i) $\frac{1}{12}$ (j) $\frac{45}{56}$
 (k) $\frac{19}{30}$ (l) $\frac{13}{14}$
8. (a) $3\frac{17}{20}$ (b) $1\frac{11}{12}$ (c) $1\frac{5}{7}$ (d) $10\frac{1}{28}$
9. (a) $\frac{1}{12}$ (b) $\frac{3}{10}$ (c) $\frac{2}{9}$ (d) $\frac{7}{15}$
10. (a) 4 (b) 10 (c) $12\frac{2}{3}$ (d) $13\frac{1}{2}$
11. (a) \$20 (b) 10 kg (c) \$180
 (d) 84 m
12. (a) 320 (b) $\frac{3}{5}$
13. $\frac{1}{60}$
14. (a) $\frac{3}{4}$ (b) $\frac{4}{7}$ (c) $\frac{5}{21}$ (d) $\frac{12}{25}$
15. (a) 4 (b) $\frac{1}{4}$ (c) $1\frac{1}{2}$ (d) $1\frac{13}{35}$
16. (a) $\frac{3}{4}$ kg
 (b) 21 kg of clay, $11\frac{1}{2}$ kg of sand,
 $3\frac{1}{2}$ kg of cement

Chapter 4

Exercise 4A

1.

10 000	1000	100	10	1	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$	$\frac{1}{10\,000}$
Ten Thousands	Thousands	Hundreds	Tens	Units	Tenths	Hundredths	Thousandths	Ten Thousandths

2. (a)(i) eight thousandths (ii) $\frac{8}{1000}$
 (b)(i) five tenths (ii) $\frac{5}{10}$
 (c)(i) six hundredths (ii) $\frac{6}{100}$
 (d)(i) nine hundred-thousandths
 (ii) $\frac{9}{100\,000}$
 (e)(i) one ten-thousandth (ii) $\frac{1}{10\,000}$
3. (a) 53.36 (b) 382.5 (c) 4.17
 (d) 5.902 (e) 0.56 (f) 25.041
4. (a) 31.6 (b) 6.3 (c) 2.12
 (d) 6.234
5. (a) 0.07 (b) 0.002 (c) 0.9
 (d) 0.0004 (e) 0.005 (f) 0.00008
 (g) 0.06 (h) 0.18 (i) 0.087
 (j) 0.206 (k) 0.0039 (l) 0.4
 (m) 2.7 (n) 15.18 (o) 6.279
 (p) 123.082 (q) 7.2 (r) 8.7
 (s) 1.63 (t) 20.5 (u) 7.099
 (v) 8050.1
6. 0.008 0.08 0.085 0.8 0.8005
 0.803 0.805 0.808 0.855 0.87
 0.888 8 8.05 85

7. Willy Weels, Harry Handels,
 Freddie Fraim, Henry Helmut,
 Peter Peddals
8. (a) $0.2 > 0.1$ (b) $1.58 < 1.85$
 (c) $6.09 < 6.1$ (d) $0.058 > 0.0567$
 (e) $2.0045 < 2.0201$
 (f) $56.09 > 56.0895$
9. (a) 2.59 (b) 0.5743 (c) 6.219
 (d) 5.304 (e) 13.001
10. (a) 2.582 (b) 0.5663 (c) 6.211
 (d) 5.300 (e) 13.001
11. (a) 4.5 (b) 5.65 (c) 0.295
 (d) 0.2455 (e) 13.5 (f) 6.875
12. (a) 0.4 (b) 1.4 (c) 0.035
 (d) 0.7 (e) 1.25 (f) 0.175

Exercise 4B

1. (a) \$8.50 (b) \$10.80 (c) \$15.35
 (d) \$68.15 (e) \$22.20 (f) \$22.00
 (g) \$6.05 (h) \$1.00 (i) \$0.65
 (j) \$0.35
2. (a) \$8.50 (b) \$10.80 (c) \$15.30
 (d) \$68.20 (e) \$22.20 (f) \$22.00
 (g) \$6.10 (h) \$1.00 (i) \$0.70
 (j) \$0.30
3. (a) \$9.00 (b) \$11.00 (c) \$15.00
 (d) \$68.00 (e) \$22.00 (f) \$22.00
 (g) \$6.00 (h) \$1.00 (i) \$1.00
 (j) \$0
4. (a) 1 (b) 3 (c) 4 (d) 3 (e) 5
 (f) 4 (g) 5 (h) 3 (i) 0 (j) 6
5. (a) 9.75 (b) 17.16 (c) 10.56
 (d) 0.78 (e) 120.52 (f) 10.40
 (g) 18.92 (h) 9.01 (i) 14.20
 (j) 60.00
6. (a) 9.7 (b) 17.2 (c) 10.6 (d) 0.8
 (e) 120.5 (f) 10.4 (g) 18.9 (h) 9.0
 (i) 14.2 (j) 60.0
7. (a) 18.768 (b) 0.058 (c) 145.973
 (d) 63.500 (e) 7.820 (f) 20.000
 (g) 127.279 (h) 0.008 (i) 6.091
 (j) 900.916 (k) 0.183 (l) 937.174

8. (a) 18.7682 (b) 0.0580 (c) 145.9735
 (d) 63.4996 (e) 7.8202 (f) 19.9997
 (g) 127.2793 (h) 0.0079 (i) 6.0908
 (j) 900.9163 (k) 0.1825 (l) 937.1739
9. (a) Andre \$21, Mandy \$22
 (b) \$20.97
 (c) \$20.95, Change \$29.05

Exercise 4C

1. (a) 0.1 (b) 0.03 (c) 0.27 (d) 0.009
 (e) 0.081 (f) 0.451
2. (a) 0.5 (b) 0.75 (c) 0.2 (d) 0.125
 (e) 0.45 (f) 2.75
3. (a) 0.4 (b) 0.6 (c) 0.8
4. (a) 3.5 (b) 8.25 (c) 10.2 (d) 6.75
 (e) 25.6 (f) 17.8

Exercise 4D

1. (a) $0.\dot{7}$ (b) $0.\overline{25}$ (c) $0.6\dot{1}$
 (d) 0.971245
2. (a) $0.\dot{3}$ (b) $0.8\dot{3}$ (c) $0.\dot{7}$ (d) $0.41\dot{6}$
 (e) 0.428571 (f) 5.91 $\dot{6}$
3. (a) $\frac{2}{3}$ (b) $\frac{1}{9}$ (c) $\frac{8}{9}$ (d) $\frac{1}{6}$ (e) $\frac{1}{7}$

Exercise 4E

1. $\frac{13}{16}$ (0.8125) $\frac{29}{35}$ (0.8285) $\frac{5}{6}$ (0.8333)
 $\frac{31}{36}$ (0.8611) $\frac{239}{276}$ (0.8659) $\frac{7}{8}$ (0.875)
 $\frac{61}{69}$ (0.8840) $\frac{8}{9}$ (0.8888)
2. 0.8125 = 0.8, 0.8285 = 0.8,
 0.8333 = 0.8, 0.8611 = 0.9,
 0.8659 = 0.9, 0.875 = 0.9,
 0.8840 = 0.9, 0.8888 = 0.9
3. 1, 1, 1, 1, 1, 1, 1, 1

Exercise 4F

1. 9.9 2. 19.5 3. 29.88 4. 14.77
 5. 38.07 6. 0.899 7. 394.2 8. 13.17
 9. 24.692 10. 16.36 11. 12.68
 12. 99.698 13. 13.353 14. 5.576
 15. 46.818

Exercise 4G

1. 1.3 2. 13.3 3. 25.43 4. 1.9
 5. 18.6 6. 0.667 7. 259 8. 3.5
 9. 3.37 10. 8.76 11. 23.52
 12. 474.482 13. 7.907 14. 4.904
 15. 7605.8555

Exercise 4H

1. (a) 58.9 kg (b) 62.7 kg
2. (a) $5.2 + 3.8 = 9$ or $5.8 + 3.2 = 9$
 (b) $5.7 - 1 = 4.7$ or
 $5.7 - 1.7 = 4$ or
 $5.7 - 4 = 1.7$
3. (a) There are two decimal places
 in the answer but three decimal
 places in the problem.
 (b) 0 (c) 11.5 (d) 14.5 (e) 1.1
 (f) 2.09
4. (5.4, 7.8, 6.6), (7.3, 3.8, 8.7)
5. (a) 0.28, 0.30, 0.34, 0.40, **0.48,**
0.58, 0.70, 0.84, 1.00, 1.18, 1.38,
1.60, 1.84, 2.10, 2.38, 2.68, 3.00,
3.34 m
 (b) 3.06 m (c) 3.00 pm

6. Sharon - 1.67 m
 Yvonne - 1.63 m
 Christa - 1.61 m
 Charley - 1.57 m

Exercise 4I

1. (a) 1 (b) 2 (c) 1 (d) 3 (e) 3 (f) 3
 (g) 0 (h) 4
2. (a) 588.0 (b) 54.45 (c) 80.58
 (d) 12.481 (e) 43.2 (f) 145.88
 (g) 1132.080 (h) 715.815
 (i) 2770.74
3. (a) \$10.95 (b) \$36.50 (c) \$131.40
4. (a) 49 seconds (b) 1190 seconds
 (c) 280 030.5 seconds
 (7 hours 46 minutes 43.5 seconds)

Exercise 4J

- (a) 28.35 (b) 60.45 (c) 83.08
(d) 2.584 (e) 0.432 (f) 0.416
(g) 1.132 (h) 1.5015 (i) 0.4003
(j) 0.01005 (k) 0.14122
(l) 24.582 (m) 0.00002 (n) 0.01
(o) 0.000064
- (a)(i) $6 \times 10 = 60$ (ii) 63.426
(b)(i) $40 \times 10 = 400$ (ii) 388.266
(c)(i) $12 \times 6 = 72$ (ii) 75.888
(d)(i) $80 \times 20 = 1600$ (ii) 1621.95
(e)(i) $3 \times 60 = 180$ (ii) 169.94
(f)(i) $4 \times 8 = 32$ (ii) 32.1883
(g)(i) $30 \times 30 = 900$ (ii) 878.149
(h)(i) $1 \times 70 = 70$ (ii) 70.04998
(i)(i) $8 \times 100 = 800$ (ii) 790.91274
(j)(i) $200 \times 2 = 400$ (ii) 414.865
(k)(i) $30 \times 40 = 1200$
(ii) 1267.09002
(l)(i) $12 \times 12 = 144$ (ii) 143.154

Exercise 4K

- (a) 1.3 (b) 3.2 (c) 12.3 (d) 48.9
(e) 12.9 (f) 24.75 (g) 48.36
(h) 25.46 (i) 5.247 (j) 1.254
(k) 0.026 (l) 0.0048
- (a) 1.5 (b) 4.5 (c) 3.4 (d) 0.15
(e) 15.5 (f) 3.75 (g) 0.0125
(h) 0.688 (i) 3.8875 (j) 9.062
(k) 5.9325 (l) 25.0025
- (a) $0.666 = 0.67$ (b) $2.571 = 2.57$
(c) $2.833 = 2.83$ (d) $0.133 = 0.13$
(e) $41.333 = 41.33$ (f) $1.337 = 1.34$
(g) $0.018 = 0.02$ (h) $7.813 = 7.81$
(i) $6.387 = 6.39$ (j) $6.472 = 6.47$
(k) $4.296 = 4.30$ (l) $16.995 = 17.00$

Exercise 4L

1. 4 2. 9 3. 0.3 4. 90 5. 410 6. 0.42
7. 2 8. 10.1 9. 40 10. 40 11. 12.3
12. 80 13. 3450 14. 10 15. 500

Exercise 4M

1. 0.09 kg 2. 50 laps 3. 300 sheets
4. (a) 12 000 skips (b) no
5. (a) 150 (b) 9000 6. 464

Exercise 4N

- (a) 78.3 (b) 6208 (c) 21.4
(d) 31 000 (e) 0.08 (f) 5500
(g) 27.8 (h) 8 270 000 (i) 5000
- (a) 3.52 (b) 0.6573 (c) 0.06
(d) 50 (e) 0.07935 (f) 89.13
(g) 2.2 (h) 0.000038 (i) 0.0059
- (a) 98.3 (b) 1.628 (c) 80.4
(d) 0.457 (e) 5 (f) 8.439
(g) 44.8 (h) 8.2702 (i) 0.0005
(j) 16 (k) 950.75 (l) 0.2967

Exercise 4O

- (a) 7×10^3 (b) 8×10^4 (c) 5×10^8
(d) 4.57×10^5 (e) 2.3×10^5
(f) 9.11×10^7 (g) 1.6508×10^8
(h) 2.3×10^{11} (i) 5.0001×10^4
(j) 6.587×10^3 (k) 2.5434×10^2
(l) 1.5378×10^3
- (a) 1.27×10^8 (b) 7.682×10^6
(c) 6.671×10^3 (The Nile)
(d) 1.5×10^8 (e) 9.389×10^8
(f) 1.06×10^5 (g) 1.35×10^{18}

Exercise 4P

- (a) 3000 (b) 5640 (c) 2 (d) 25.4
(e) 2 000 000 (f) 56 000 (g) 21 500
(h) 785 (i) 5 (j) 78.6
- (a) 7500 (b) 2.5 (c) 0.35 (d) 3650
(e) 0.035 (f) 678 500 (g) 0.25
(h) 0.008 (i) 0.00625
- 895 000 000 4. 0.0000586

Exercise 4Q

1. 1.91 m 2. 20.605 3. 9.2 mm

Exercise 4R

- (a) 9.76 , 0.5 , $\sqrt{25}$, $0.\dot{6}$, $\frac{7}{17}$, $0.75\overline{32}$, -3.7311 , $\sqrt{529}$
(b) $\frac{\pi}{2}$, $\sqrt{11}$
- (a) $6.28318\dots$ (b) $4.35889\dots$
(c) $1.04719\dots$ (d) $3.42782\dots$
(e) $15.42477\dots$ (f) $7.11043\dots$
(g) $24.13411\dots$ (h) $105.74389\dots$
- (a) 6.283 (b) 4.359 (c) 1.047
(d) 3.428 (e) 15.425 (f) 7.110
(g) 24.134 (h) 105.744
- (a) 47.12 cm (b) 78.54 cm
(c) 30.47 cm

Chapter Review

- (a) 0.33 (b) 0.052 (c) 6.73
(d) 3.56 (e) 875.3
- $\frac{64}{1000}$ 0.6 $\frac{627}{1000}$ $\frac{65}{100}$ $\frac{7}{10}$ 3. 3.465
- (a) 6.8 (b) 17.1 (c) 9.0 (d) 0.8
(e) 80.0
- (a) 0.75 (b) 0.4 (c) 8.5 (d) 3.375
(e) 7.428571
- (a) 9.7 (b) 24.22 (c) 19.11 (d) 2.2
(e) 12.93 (f) 87.36 (g) 52
(h) 155.97 (i) 14.26 (j) 4.064
(k) 21.15 (l) 1.4625 (m) 1.5
(n) 340 (o) 150 (p) 2370 (q) 3.78
(r) 0.0162
- (a) 2×10^4 (b) 7.83×10^4
(c) 1.2105×10^7
- (a) 2000 g (b) $5\,720\,000$ (c) 56 m
- 7.5 10. 25 jelly beans
- 32.06 km
- 3π , $\sqrt{13}$

Chapter 5**Exercise 5A**

- (a)(i) 1% (ii) 99%
(b)(i) 40% (ii) 60%
(c)(i) 55% (ii) 45%
- 15% 3. 56%
- (a) 36% (b) Niki
- 26.7%

- (a)(i) B (ii) E (iii) D (iv) C
(v) F (vi) A
(b) 17%
- (a) B (b) E (c) G
- (a) 93% (b) 2%
- Mulberries - 20%
Blackberries - 20%
Strawberries - 10%
Sugar - 50%

Exercise 5B

- (a) 10% (b) 30% (c) 90%
(d) 50% (e) 20% (f) 75%
(g) 35% (h) 26% (i) 48%
(j) 60% (k) 50% (l) 80%
(m) 25% (n) 48% (o) 60%
- (a) 75% (b) 25%
- (a) 120 students
(b) Mystery - 10%
Romance - 15%
Action - 25%
Comedy - 30%
Horror - 20%
- Science - 80%
Maths - 85%
German - 75%
English - 72%
- (a) 40% (b) 25% (c) 9% (d) 5%
(e) 20% (f) 5% (g) 60% (h) 10%
(i) 25% (j) 8% (k) 19% (l) 27%

Exercise 5C

- (a) $\frac{1}{100}$ (b) $\frac{11}{100}$ (c) $\frac{19}{100}$ (d) $\frac{73}{100}$ (e) $\frac{99}{100}$
- (a) $\frac{1}{20}$ (b) $\frac{3}{25}$ (c) $\frac{9}{50}$ (d) $\frac{1}{4}$ (e) $\frac{7}{20}$
(f) $\frac{1}{2}$ (g) $\frac{3}{5}$ (h) $\frac{19}{25}$ (i) $\frac{19}{20}$ (j) 1
(k) $1\frac{1}{2}$ (l) 6

Exercise 5D

- 33% 2. 19% 3. 87% 4. 6%
- 40% 6. 29.5% 7. 5.6% 8. 0.8%
- 200% 10. 10.57%

Exercise 5E

1. 0.59 2. 0.24 3. 0.76 4. 0.3 5. 0.08
 6. 0.1 7. 1 8. 0.654 9. 0.058
 10. 0.0025

Exercise 5F

Percentage	Fraction	Decimal
50%	$\frac{1}{2}$	0.5
10%	$\frac{1}{10}$	0.1
25%	$\frac{1}{4}$	0.25
20%	$\frac{1}{5}$	0.2
90%	$\frac{9}{10}$	0.9
66%	$\frac{33}{50}$	0.66
18%	$\frac{9}{50}$	0.18
32%	$\frac{8}{25}$	0.32
85%	$\frac{17}{20}$	0.85
9%	$\frac{9}{100}$	0.09
3%	$\frac{3}{100}$	0.03
4%	$\frac{1}{25}$	0.04

Exercise 5G

1.

Percentage	25%	50%	75%	$33\frac{1}{3}\%$	$66\frac{2}{3}\%$	10%	20%
Fraction	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{1}{3}$	$\frac{2}{3}$	$\frac{1}{10}$	$\frac{1}{5}$
Decimal	0.25	0.5	0.75	0.3	0.6	0.1	0.2

2. (a) 4 m (b) \$10 (c) \$5 (d) 3 kg
 (e) 6 kg (f) 9 m (g) \$60 (h) \$100
 (i) 10 km (j) 25 kg (k) \$4000
 (l) 100 kg (m) \$2.50 (n) 30 cents
 (o) \$2.60
3. (a) 120 kg (b) 90 m (c) \$96
 (d) \$210 (e) 1350 m (f) 44 m
 (g) \$51 (h) \$21 (i) 28 km
 (j) 40 kg (k) \$31.50 (l) 134.4 kg
 (m) 10 cents (n) \$2.28 (o) \$42.96
4. (a) 279 kg (b) 161.5 m (c) \$593.40
 (d) \$1128 (e) 3013.5 m (f) 0.385 m
 (g) \$48.75 (h) \$3570 (i) \$10 799.25
5. 8 mangoes 6. 80 students
7. (a) 28 boys (b) 4 girls
8. (a) 30 (b) 14 (c) 50 (d) 17
9. (a) Fiona - 308 goals
 Louise - 318 goals
 (b) Fiona - she scores a higher percentage of her goal attempts

10. 104 beats per minute

11. 4725 litres

12. (a) 420 (b) 93% (c) 5580
 (d) 120

13. (a) 1260 (b) 1323

14. (a) 5 years (b) 4000 hectares

15. (a) \$300 (b) \$315

16. (a) 10 ML (b) 25 weeks (c) 48%
 (d) 120 ML**Exercise 5H**

1. (a)(i) \$12 (ii) \$28
 (b)(i) \$15 (ii) \$45
 (c)(i) \$12 (ii) \$18
 (d)(i) \$9 (ii) \$51
 (e)(i) \$42.50 (ii) \$42.50
2. (a) \$64 (b) \$27 (c) \$450 (d) \$23 750
 (e) \$245 (f) \$390 (g) \$2992 (h) \$460

Exercise 5I

1. \$350 2. \$360 3. \$45 4. \$3.40

5. \$5 6. \$20 700

7. Mandolin - \$650, guitar - \$1235

8. \$25.20

9. Pappa bear - \$51.20

Mamma bear - \$40

Baby bear - \$25.60

10. \$504

Exercise 5J

1. (a) profit (b) \$80 (c) 40%

2. (a) profit (b) \$1000 (c) 20%

3. (a) loss (b) \$4000 (c) 25%

4. (a) profit (b) \$180 (c) 37.5%

5. (a) profit (b) \$6000 (c) 60%

6. (a) profit (b) \$30 000 (c) 15.8%

7. Cat Woman, Spider Man, Superman,
 Wonder Woman, Batman, Hulk

Exercise 5K

- (a)(i) \$45 (ii) \$495
(b)(i) \$1850 (ii) \$20 350
(c)(i) \$3.60 (ii) \$39.60
(d)(i) \$10.50 (ii) \$115.50
(e)(i) \$2.50 (ii) \$27.50
(f)(i) \$6.80 (ii) \$74.80
- (a) \$6 (b)(i) \$18 (ii) \$42 (iii) \$78
- (a) \$60 (b) \$2300 (c) \$5.60
(d) \$320 (e) \$37.50 (f) \$0.65

Chapter Review

- (a) 68% (b) 80%
- (a) 5% (b) $\frac{5}{100} = \frac{1}{20}$
- (a) 70%
(b) red - 2 litres
yellow - 4 litres
white - 14 litres

4.

Percentage	10%	25%	50%	20%	1%	$33\frac{1}{3}\%$	70%
Fraction	$\frac{1}{10}$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{5}$	$\frac{1}{100}$	$\frac{1}{3}$	$\frac{7}{10}$
Decimal	0.1	0.25	0.5	0.2	0.01	0.3	0.7

- (a) \$8 (b) 50 m (c) 30 kg
(d) \$90 (e) 2 m (f) 12 kg
- (a) \$60 (b) 406 m (c) 255 kg
(d) 56 cents (e) 69 m (f) \$41.25
- 4500
- (a) \$120 (b) \$72
- (a) \$56 (b) \$91 (c) \$117.60
- (a) loss (b) \$70 (c) 35%
- (a) profit (b) \$4500 (c) 30%
- (a)(i) \$40 (ii) \$440
(b)(i) \$12 (ii) \$132
(c)(i) \$7.60 (ii) \$83.60
- (a) \$35 (b) \$13.50 (c) \$540

Chapter 6**Exercise 6A**

- (a) \$10 (b) 6 kg (c) 12 m (d) \$4
(e) \$100 (f) 8 litres
- (a)(i) 3 (ii) \$12
(iii) Marcus \$12, Nicholas \$24

- (b) (i) Marcus \$24, Nicholas \$12
(ii) Marcus \$9, Nicholas \$27
(iii) Marcus \$27, Nicholas \$9
(iv) Marcus \$6, Nicholas \$30
(v) Marcus \$32, Nicholas \$4
(vi) Marcus \$28, Nicholas \$8
(vii) Marcus \$20, Nicholas \$16

3.

Amount to be Divided	Ratio	Total Number of Parts	Size of each Part	Size of First Amount	Size of Second Amount
\$24	3:1	4	\$6	\$18	\$6
\$30	1:4	5	\$6	\$6	\$24
28 m	4:3	7	4 m	16 m	12 m
35 kg	2:3	5	7 kg	14 kg	21 kg
100 m	7:3	10	10 m	70 m	30 m
80 km	3:5	8	10 km	30 km	50 km

- Tim - \$40, Jay - \$50
- 10 bags of oats, 25 bags of lucerne
- Petria - 8 cubic metres
Rhiannon - 12 cubic metres
- Sebastian - 25 hectares
Christian - 15 hectares
- Dry food - 840 grams
Fresh meat - 560 grams
- (a) Sharks - $\frac{1}{4}$, Dolphins - $\frac{3}{4}$
(b) Sharks - 25%, Dolphins - 75%
(c) Sharks - 3000, Dolphins - 9000
- (a) Cement - 2 kg, sand - 12 kg
(b) 18 kg
- (a) 4 litres (b) 5 litres
- Females
- (a) Chris - \$480, Terry - \$720
(b) \$150
(c) Chris - \$600, Terry - \$400
- (a) 3:1 (b) $\frac{3}{4}$ (c) 25% (d) 10
(e) 17
- (a) Sand - 6 kg, stones - 12 kg
(b) Cement - 4 kg
Sand - 12 kg
Stones - 24 kg
- 24 games
- 20 games
- (a) 3:2:4 (b) \$90 000
- 164 students

Exercise 6B

- (a) 2:1 (b) 1:4 (c) 5:4 (d) 2:3
(e) 9:7 (f) 3:4
- (a) 4:1 (b) 1:6 (c) 3:2 (d) 7:9
(e) 2:7 (f) 9:7 (g) 2:3 (h) 4:3 (i) 8:9
- 17:5
- 9:2

Exercise 6C

- (a) 3:5 (b) 25 kg
(c) 15 kg of meat,
25 kg of vegetables
- (a) 1:24 (b) 600 mL (c) 50 mL
(d) 80 mL of oil, 1920 mL of petrol
- (a) 1:4 (b) 16 (c) 3
(d) 5 of cement, 20 of sand
- (a) 1:20 (b) 1500 mL (c) 100 mL
(d) 500 mL of fertilizer, 10 000 mL
of water
- (a) 8:5 (b) 125 cm (c) 240 cm
- (a) 3:4
(b) 15 000 tulips, 20 000 daffodils
(c) 12 000 tulips

Exercise 6D

- 1:2
- (a) $\frac{3}{8}$ (b) 3:5 (c) 400 g
- (a)(i) $\frac{7}{12}$ (ii) $\frac{5}{8}$ (iii) $\frac{2}{3}$ (iv) $\frac{3}{4}$ (v) $\frac{1}{2}$
(b)(i) $\frac{5}{12}$ (ii) $\frac{3}{8}$ (iii) $\frac{1}{3}$ (iv) $\frac{1}{4}$ (v) $\frac{1}{2}$
(c)(i) 7:5 (ii) 5:3 (iii) 2:1 (iv) 3:1
(v) 1:1
(d)(i) 5:7 (ii) 3:5 (iii) 1:2 (iv) 1:3
(v) 1:1
(e)(i) 7:8 (ii) 7:6

Exercise 6E

- (a) 80% (b) 20%
- 70%
- 1:9
- 17:3

Exercise 6F

- (a) 160 (b) $\frac{1}{5}$ (c) 4:1 (d) 7:3 (e) 70%
- (a) 20% (b) $\frac{4}{5}$ (c) 1:4 (d) 1:2
- (a) 96 (b) 43
- 160 mm, 128 mm, 102 mm, 82 mm

Chapter Review

- (a) \$16, \$56 (b) 35 kg, 21 kg
(c) 40 m, 30 m (d) 600 L, 3600 L
- Garth 22 kg, Mona 33 kg
- (a) 2:3 (b) 3:1 (c) 13:5 (d) 7:6
- (a) 4:3 (b) 15 kg (c) 80 kg of
sunflower seeds, 60 kg of grain
- (a) $\frac{9}{20}$ (b) 9:11
- 4:1
- 2:3
- (a) 10% (b) 270 mL
- 40 mL

Chapter 7**Exercise 7A**

- (a) \$5 (b) \$10 (c) \$30 (d) \$100
- (a) \$2 (b) \$12 (c) \$18 (d) \$100
- (a) \$2.50 (b) \$7.50 (c) \$12.50
(d) \$30
- (a) \$7 (b) \$14 (c) \$63 (d) \$140
- (a) 5 kg (b) 3 kg (c) 9 kg (d) 15 kg
- (a) 12 kg (b) 4 kg (c) 10 kg (d) 5 kg
- C
- B
- 600 g
- (a) \$28 (b) \$42 (c) \$91 (d) \$105
- 450 kg
- (a) \$1.80 (b) \$3 (c) \$5.40
(d) \$14.40
- (a)(i) 60 m (ii) 150 m (iii) 300 m
(b)(i) 3 sec (ii) 4 sec (iii) 20 sec
- Cheetah
- (a)(i) 160 m (ii) 400 m
(iii) 960 m
(b) $\frac{1}{2}$ sec
- (a)(i) 36 km (ii) 180 km
(iii) 720 km
(b)(i) 2 litres (ii) 5 litres (iii) 30 litres

17. 15 km
 18. Car A - 10 km/L
 Car B - 12 km/L
 19. Car C - 13.3 km/L
 Car D - 15 km/L
 20. (a) \$9.00 (b) \$1.80 (c) 18 cents
 21. 2 tablets
 22. (a) 8 mL (b) 12 mL (c) 18 mL
 23. (a)(i) 20 L (ii) 30 L (iii) 900 L
 (b) 10 minutes
 24. (a)(i) 12 nautical miles
 (ii) 30 nautical miles
 (iii) 3 nautical miles
 (b) 40 hours
 25. (a) 18.52 km (b) 277.8 km
 (c) 1111.2 km (d) 4630 km
 26. (a) 18.52 km/h (b) 370.4 km
 (c) 63 hours
 27. (a) 5 metres
 (b)(i) 150 m (ii) 600 m (iii) 18 000 m
 28. (a) Callum - 4 m/s
 Annabelle - 3 m/s
 Mitchell - 6 m/s
 Clara - 5 m/s
 (b) Annabelle, Callum, Clara, Mitchell
 (c) Callum - 2400 m
 Annabelle - 1800 m
 Mitchell - 3600 m
 Clara - 3000 m
 29. (a) Elephant - 11 m/s
 Bluefin Tuna - 20 m/s
 Dolphin - 10 m/s
 Kangaroo - 19 m/s
 (b) Dolphin, Elephant, Kangaroo,
 Bluefin Tuna
 (c) Elephant - 660 m
 Bluefin Tuna - 1200m
 Dolphin - 600 m
 Kangaroo - 1140 m
 30. (a) A - 10 L/s, B - 12 L/s, C - 8 L/s
 (b)(i) A - 6000 L, B - 7200 L,
 C - 4800 L
 (ii) A - 36 000 L, B - 43 200 L,
 C - 28 800 L
 30. (c) A - 1 hour 20 minutes
 B - 1 hour 6 minutes 40 seconds
 C - 1 hour 40 minutes
 31. 2700
 32. 40 000
 33. (a) 5500 kg (b) 6050 kg
 34. 882
 35. 9604
 36. (a) China - 7 000 000
 Switzerland - 88 000
 India - 15 600 000
 Kenya - 1 269 000
 Oman - 322 000
 (b) China - 1 407 000 000
 Switzerland - 8 088 000
 India - 1 315 600 000
 Kenya - 48 269 000
 Oman - 3 822 000
 37. (a) The population is decreasing
 (b) 83 000 (c) 82 917 000
 38. (a) Japan - 127 000
 Russia - 429 000
 Serbia - 38 000
 Lithuania - 9000
 Ukraine - 315 000
 (b) Japan - 126 873 000
 Russia - 142 571 000
 Serbia - 9 462 000
 Lithuania - 2 991 000
 Ukraine - 44 685 000

Exercise 7B

1. (a) increase (b) 2%
 2. (a) increase (b) 15.5%
 3. (a) decrease (b) 5.2%
 4. (b) Liam - 6.7%, Sean - 5.6%
 5. (b) Australia - 1.3%
 Philippines - 1.7%
 Indonesia - 1.2%

Chapter Review

1. (a) \$20 (b) \$25 (c) \$12.50 (d) \$32.50
 2. (a) 660 kg (b) 400 bricks
 3. A

4. (a)(i) 25 m (ii) 300 m
 (b)(i) 6 seconds (ii) 15 seconds
 5. (a) 100 litres (b) 600 km
 6. 480 seconds (8 minutes)
 7. B
 8. 2875 hectares
 9. 1 900 000 litres
 10. (a) 6.5% (b) 9532

Chapter 8

Exercise 8A

1. (a) 16 (b) 48 (c) 8 (d) 3 (e) 28
 (f) 12 (g) 2 (h) 18 (i) 16 (j) 22
 (k) 7 (l) 12 (m) 25 (n) 8 (o) 3
 (p) 24 (q) 27 (r) 4
 2. (a) **G** (b) **Q** (c) **L** (d) **D** (e) **J**
 (f) **C** (g) **I** (h) **E** (i) **B** (j) **R**
 (k) **A** (l) **K** (m) **O** (n) **H** (o) **M**
 (p) **N** (q) **F** (r) **P**
 3. (a) **F** (b) **J** (c) **I** (d) **C** (e) **L**
 (f) **A** (g) **G** (h) **M** (i) **B** (j) **E**
 (k) **N** (l) **D** (m) **H** (n) **K**

Exercise 8B

1. (a) **E** (b) **G** (c) **B** (d) **H** (e) **F**
 (f) **C** (g) **A** (h) **I** (i) **D**
 2. (a) $y = x + w$ (b) $K = LM$
 (c) $p = q + 4$ (d) $D = J - F$
 (e) $B = A^2Z$ (f) $Y = (T + U)^2$
 (g) $e = d - 7$ (h) $L = PQ + 5$
 (i) $h = j/k$
 3. (a) $v = at$ (b) $W = mg$
 (c) $P = 2w + 2l$ (d) $E = c^2m$
 (e) $V = lwh$ (f) $D = C/\pi$
 (g) $m = y/x$ (h) $h = \sqrt{b^2 + a^2}$
 4. (a) $2b + 6a$ (b) $5a + 8p$
 (c) $7p + 10b$ (d) $a + p$
 (e) $b + 2a + 3p$ (f) $6p + 9a + 15b$
 5. (a) $6c + 7b$ (b) $4b + 6c$
 (c) $b + 2c$ (d) $20 - 2c$
 (e) $40 - 3b$ (f) $50 - (4b + 2c)$
 (g) $100 - (4c + 5b)$
 (h) $2b + 5c + 40$ (i) $4b + 6c + 15$

6. (a) C
 (b)(i) \$50 (ii) \$130 (iii) \$410

7. (a) B
 (b)(i) 110 (ii) 125 (iii) 200
 (c) 100 years

8. (a) D
 (b)(i) 190 (ii) 160 (iii) 100
 (c) 100 minutes

9. (a) $C = 30n + 10$
 (b)(i) \$70 (ii) \$160 (iii) \$310
 (c) 7 tickets

10. (a) $A = 50w + 500$
 (b)(i) \$600 (ii) \$750 (iii) \$1100
 (c) 10 weeks

11. (a) $N = 300 - 5d$
 (b)(i) 275 (ii) 250 (iii) 225 (iv) 200
 (c)

Number of days burning (d)	5	10	15	20	25	30	35	40
Number of logs remaining (N)	275	250	225	200	175	150	125	100

- (d) 60 days

12. (a) $d = 2t$
 (b)(i) 20 metres (ii) 60 metres
 (iii) 120 metres
 (iv) 7200 metres

- (c)

Number of seconds (t)	10	20	30	40	50	60	70	80
Distance (metres) run (d)	20	40	60	80	100	120	140	160

13. (a)(i) 3 (ii) 4 (iii) 11 (iv) 13
 (v) 23

- (b)

B	0	1	2	3	4	5	6	7	8	9	10
A	3	4	5	6	7	8	9	10	11	12	13

14. (a)

B	0	1	2	3	4	5	6	7	8	9	10
A	0	4	8	12	16	20	24	28	32	36	40

- (b)

B	0	1	2	3	4	5	6	7	8	9	10
A	1	3	5	7	9	11	13	15	17	19	21

- (c)

B	0	1	2	3	4	5	6	7	8	9	10
A	4	7	10	13	16	19	22	25	28	31	34

15. (a)

<i>N</i>	2	4	6	8	10	12	14	16	18	20	22
<i>M</i>	0	2	4	6	8	10	12	14	16	18	20

(b)

<i>N</i>	2	4	6	8	10	12	14	16	18	20	22
<i>M</i>	1	5	9	13	17	21	25	29	33	37	41

(c)

<i>N</i>	2	4	6	8	10	12	14	16	18	20	22
<i>M</i>	0	8	16	24	32	40	48	56	64	72	80

16. (a)

<i>x</i>	1	4	7	12	15	30	5	11	17	23	29
<i>y</i>	5	11	17	27	33	63	13	25	37	49	61

(b)

<i>x</i>	1	4	7	12	15	30	6	10	14	18	22
<i>y</i>	-2	7	16	31	40	85	13	25	37	49	61

(c)

<i>x</i>	1	4	7	12	15	30	2	5	8	11	14
<i>y</i>	9	21	33	53	65	125	13	25	37	49	61

Exercise 8C

- (a) $5c$ (b) $2x$ (c) $2y + 4z$ (d) $5m + n$
(e) $3p + 3q$ (f) $6f + g$ (g) $3A + 3B$
(h) $3a + 3b + 3c$
- (a) $5x$ (b) $9c$ (c) $6p$ (d) $9q$
(e) $9v$ (f) $6w$ (g) $2a$ (h) g
(i) $5j$ (j) $5p$ (k) $6s$ (l) 0 (m) $12y$
(n) $2d$ (o) 0
- (a) $-3x$ (b) $-4c$ (c) $-2p$ (d) $-5q$
(e) $3v$ (f) $-2w$ (g) $-6a$ (h) $-10g$
(i) $-3j$ (j) $-5p$ (k) $-3s$ (l) $-12r$
- $[2m, -4m]$ $[4n^2, \frac{1}{4}n^2]$ $[6mn, \frac{1}{4}mn]$
 $[n, 4n]$ $[6m^2, 3m^2]$ $[4m^2n, -3m^2n]$
- (a) $7a + 7b$ (b) $3m + 3n$ (c) p
(d) $7t + u$ (e) $9 + 8a$ (f) $7c + 6d$
(g) $6m$ (h) $5v + 6y$ (i) $5n^2 + n$
(j) 0
- (a) $2x - 3y$ (b) $-2a + 2b$ (c) $2p - 5q$
(d) $-2d + 2f$ (e) $-4m - 2$ (f) $-2a - 2b$
(g) $-8p + 10$ (h) $-4q$ (i) $-10y$
(j) $4k - 6m$

- (a) $4x$ (b) $8w$ (c) $4a + 6b$
(d) $2c + 2d$ (e) $5p$ (f) $10t$
(g) $14y$

- (a)(i) $4b$ (ii) $8b$ (iii) $12b$
(b) $24b$

- (a) $6x$ (b) $14x$ (c) $9x$

- (a)(i) $2x$ (ii) $x + 2$ (iii) $x - 1$
(b) $5x + 1$ (c) 3 kg

- (a)(i) $t + 10$ (ii) $2t$ (iii) $2t - 10$
(b) $6t$ (c) 20 minutes

Exercise 8D

- (a) $12a$ (b) mn (c) $20vw$ (d) $21gh$
(e) $48cd$ (f) $30mnp$ (g) $18ab$
(h) $22xy$ (i) $24abc$
- (a) $2p$ (b) $8s$ (c) $5t$ (d) $8ab$
(e) $4m$ (f) $3n$ (g) $3p$ (h) $4xyz$
- (a) $12x$ (b) $2x$
- (a) $6t$ (b) $42t$
- (a) $20x$ (b) $\$80x$

Exercise 8E

- (a) b^3 (b) $2t^8$ (c) $12p^2$ (d) $16q^5$
(e) $32w^5$ (f) $30c^6$ (g) $12a^3b^2$
(h) $48d^5e^3$
- (a) m^8 (b) q^{10} (c) b^9 (d) $6g^{11}$
(e) h^5 (f) $12k^9$ (g) $12n^8$ (h) $3c^8$
(i) $6p^{12}$ (j) $8w^{10}$ (k) $5y^{12}$ (l) $a^{(x+y)}$
- (a) g^8 (b) m^9 (c) v^{14} (d) p^{15}
(e) q^{18} (f) a^8b^{12} (g) f^5g^{20} (h) $c^{12}e^{24}$
(i) a^{22} (j) $a^4b^8c^{12}$ (k) n^{100} (l) $9a^8$
- (a) 1 (b) 1 (c) 1 (d) 2 (e) 1
(f) 5 (g) 3 (h) 3 (i) 6 (j) 1
(k) 0 (l) $5x^3$
- (a) x^2 (b) $3y^2$ (c) $3a^2$ (d) $5p^2$
- (a) $6x^3$ (b) $2b^3$ (c) d^3 (d) $18m^3$

Exercise 8F

- $8y + 24$, $8(y + 3)$
- $5b + 20$, $5(b + 4)$
- $6r + 120$, $6(r + 20)$
- $3e - 12$, $3(e - 4)$
- $7p - 35$, $7(p - 5)$
- $12g - 60$, $12(g - 5)$

Exercise 8G

- (a)(i) $6a$, 24 (ii) $6(a + 4)$
 (b)(i) 63, $7b$ (ii) $7(9 + b)$
 (c)(i) mp , $5m$ (ii) $m(p + 5)$
 (d)(i) $12d$, 84 (ii) $12(d + 7)$
 (e)(i) x , xy (ii) $x(1 + y)$
 (f)(i) uv , ut (ii) $v(t + u)$
- (a) $5(a + 4)$, $5a + 20$
 (b) $7(3 + b)$, $21 + 3b$
 (c) $6(2 + c)$, $12 + 6c$
 (d) $8(d + 12)$, $8d + 96$
 (e) $9(5 + e)$, $45 + 9e$
 (f) $7(f + 6)$, $7f + 42$
 (g) $g(5 + g)$, $5g + g^2$
 (h) $m(n + p)$, $mn + mp$

Exercise 8H

- (a) $4a + 8$ (b) $3x - 12$
 (c) $2m + 2p$ (d) $18c + 6$
 (e) $2e + 4f$ (f) $15 - 5g$
 (g) $12 - 6t$ (h) $12a - 8b$
 (i) $xy + 2x$ (j) $a^2 + 2a$
 (k) $2m^2 + 2m$ (l) $6v^2 - 9vw$
 (m) $20t^2 + 25tu$ (n) $3p^2 + 12pq$
 (o) $6a^2 + 12ab$ (p) $3ab - 3ac$
 (q) $30xy - 18xz$ (r) $42km - 35kn$
 (s) $14a^2 + 21ab$ (t) $20t^2 - 35tu$
 (u) $8p^2 - 10pq$ (v) $24xy + 16y^2$
 (w) $10g^2 - 30gh$ (x) $18x^2y - 27xyz$
- (a) $-4a - 8$ (b) $-3x - 21$
 (c) $-6y - 27$ (d) $-3m + 3n$
 (e) $-3r + 24$ (f) $-km + kn$
 (g) $-14a - 6b$ (h) $-28t + 35u$
 (i) $-10p^2 + 4pq$ (j) $-24xy - 32y^2$
 (k) $-20g^2 + 30gh$ (l) $-18x^2y + 36xz$
- (a) $12x + 11$ (b) $16m + 6$
 (c) $16t + 2$ (d) $12g - 1$
 (e) $19t - 17$ (f) $30z - 16$
 (g) $w - 2$ (h) $2p + 6$
 (i) $8h - 6$ (j) $3q + 30$

Exercise 8I

- (a) 1, 2, 3, 4, 6, 12
 (b) 1, 2, 3, 4, 6, 9, 12, 18, 36
 (c) 1, 3, 9, 27
 (d) 1, 2, 4, 5, 8, 10, 16, 20, 40, 80
 (e) 1, 2, 4, 8, 14, 28, 56, 112
 (f) 1, 2, 4, 7, 8, 14, 28, 56
 (g) 1, 2, 3, 4, 5, 6, 10, 15, 20, 30, 50, 60, 100, 150, 300
 (h) 1, 23
 (i) 1, 2, 3, 4, 6, 8, 9, 12, 16, 18, 24, 36, 48, 72, 144
 (j) 1, 3, 9, 19, 57, 171
- (a) 1, 2, 4 (b) 1, 3 (c) 1, 2, 4
 (d) 1, 2, 3, 4, 6, 12 (e) 1, 2, 4
- (a) 4 (b) 3 (c) 4 (d) 12 (e) 4
- (a) 4 (b) 6 (c) 4 (d) 9 (e) 7 (f) 8
 (g) 5 (h) 12 (i) 36 (j) 7
- (a) m (b) b (c) p (d) u (e) a (f) y
 (g) m (h) e (i) a (j) m (k) p (l) y
 (m) h (n) a (o) n (p) y
- (a) $4x$ (b) $5a$ (c) $6q$ (d) $7d$ (e) $4z$
 (f) $5b$ (g) $9m$ (h) $8x$ (i) $6c$ (j) $18y$
 (k) $12m$ (l) $7h$ (m) $2g$ (n) $18t$ (o) $8l$
- (a) 2 (b) 12 (c) p (d) $3d$ (e) $4z$
 (f) b (g) $4m$ (h) 18 (i) $2c$ (j) $3y$
 (k) 18 (l) h (m) $4g$ (n) 9 (o) $5l$
- (a) $2(3m + 4p)$ (b) $x(5 - 2y)$
 (c) $9(1 - 2a)$ (d) $a(3b + 1)$
 (e) $5(2d - 3e)$ (f) $6a(b + 2)$
 (g) $x(x + 7)$ (h) $4u(2 - 5u)$
 (i) $7(2bc - 3de)$ (j) $8b(4a + 3)$
 (k) $m(1 - 8n)$ (l) $3c(3c - 2d)$
 (m) $12q(2p + 3r)$ (n) $6r(2r - 1)$
 (o) $7l(3k + 7r)$ (p) $6y(6x - 5z)$
 (q) $g(20h + 9i)$ (r) $9b(5a - 8d)$
- (a) $3xy(x - 2 + 4y)$
 (b) $4m(4 - 3p + 6m)$
 (c) $3bc(5a + 8b - 3d)$
 (d) $2hi(4g + 3j + 6f)$
 (e) $6r(6pqr - 4qs + 5pt)$
 (f) $9mnp(8m - 5 + 7n)$
 (g) $7yz(6xz + 5z - 2x^2)$
 (h) $8cde(4d + 3c - e)$

9. (i) $9abc(2b - 1 + 5c)$
 (j) $2xyz(5xyz + 6y - 2xz)$

Chapter Review

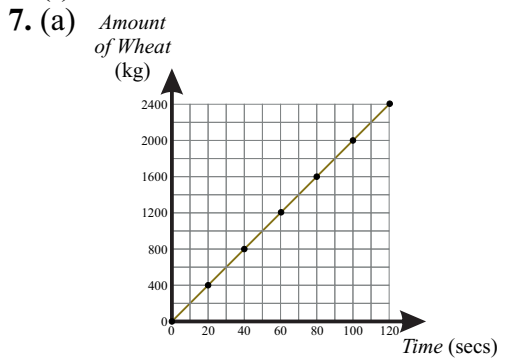
1. (a) $4x$ (b) $15p$ (c) 0 (d) $5a$
 (e) $m + 4n$ (f) $-5a + 2b$
 2. (a) $8d$ (b) $32d$
 3. (a) Sam = y , Dion = $y + 3$,
 Anthea = $y - 2$, Nea = $3y$,
 Ernie = $3y - 1$
 (b) $9y$
 4. (a) $6a$ (b) $12mn$ (c) n^5 (d) $144x^3y$
 (e) m^9 (f) $15j^5$ (g) e^8 (h) $u^{10}v^{15}$
 (i) c^{14} (j) 1 (k) 1 (l) 8
 5. (a) $5x + 15$ (b) $4n - 8$ (c) $6a + 15b$
 (d) $8m^2 + 12mn$ (e) $-6 - 15v$
 (f) $-6x^2 + 15xy$
 6. $14x + 5$
 7. (a) $4(2m + p)$ (b) $a(7 - 3b)$
 (c) $12(1 - 2x)$ (d) $y(5x + 1)$
 (e) $6(2e - 3f)$ (f) $8a(b + 3)$
 (g) $x(2 + x)$ (h) $3u(3 - 5u)$
 (i) $6m(3n - 4p)$ (j) $12b(3a + 2)$
 (k) $m(1 - 7n)$ (l) $2c(5c - 4d)$
 (m) $24q(p + 2r)$ (n) $2r(9r - 4)$
 (o) $27l(k + 2r)$

Chapter 9

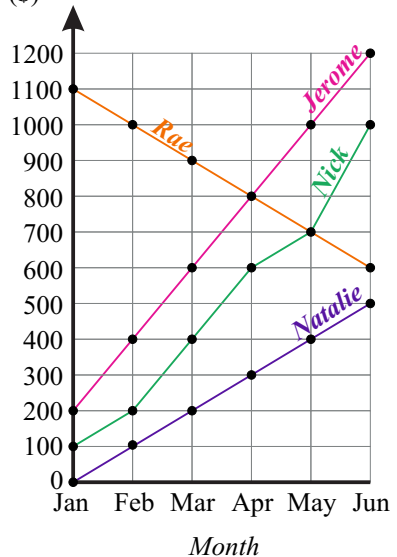
Exercise 9A

1. (a)(i) \$18 (ii) \$30 (iii) \$27 (iv) \$48
 (b)(i) 2 kg (ii) 6 kg (iii) 2.5 kg
 (iv) 20 kg
 2. (a)(i) \$8 (ii) \$16 (iii) \$40
 (b) \$72 (c) \$56
 (d)(i) 45 minutes (ii) 75 minutes
 (iii) 3 hours 45 minutes
 (e) 2 pm
 3. (a) \$5 (b) \$6.50 (c) 2 (d) 5 (e) \$6.50
 4. (a) 6000 litres (b) 1000 litres
 (c) 5000 litres (d) 1500 litres
 (e) 200 km

5. (a) Balloon **A**
 (b) Balloon **A** - 60 minutes
 Balloon **B** - 80 minutes
 (c) Balloon **A** - 400 m
 Balloon **B** - 300 m
 (d) Balloon **A** - 1200 m
 Balloon **B** - 900 m
 6. (a) 30 seconds (b) 2 laps
 (c) 300 seconds (5 minutes)
 (d) 20 laps (e) 50 metres
 (f) 20 minutes

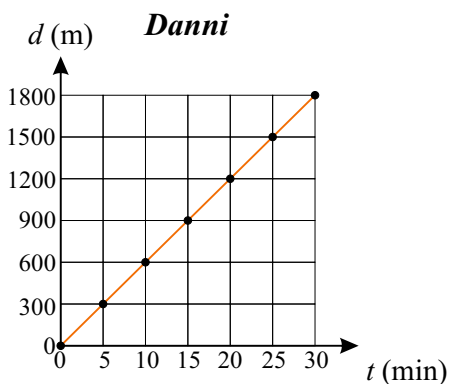
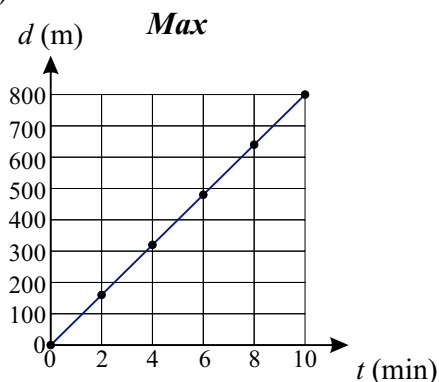


- (b) Yes (c) 1800 kg (c) 50 seconds
 8. (a) *Amount in bank account (\$)*



- (b) Jerome, Natalie and Rae

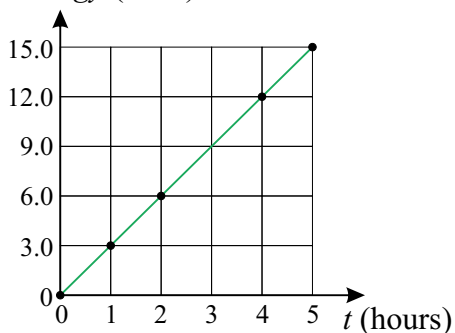
9. (a)



- (b) 80 m (c) 60 m (d) 5 minutes
 (e) 12 minutes (f) 1200 m
 (g) 3600 m (h) Max

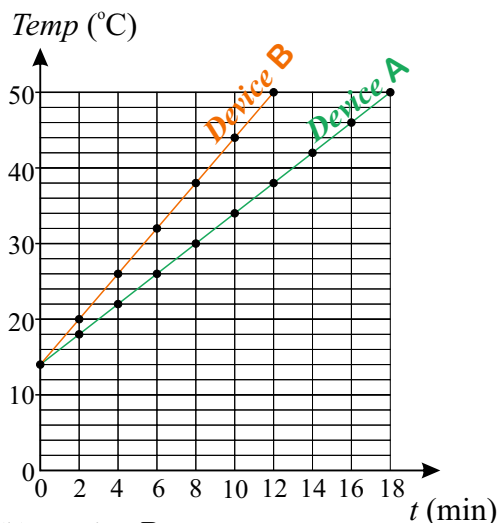
10. (a)

Energy (kWh)



- (b) Yes (c) 7.5 kWh

11. (a)



(b) Device B

(c)(i) 24°C (ii) 29°C

(d)(i) 70°C (ii) 80°C

Exercise 9B

- (a) 200 m (b) 2 minutes (c) $d = 50t$
 (d)(i) 500 m (ii) 1250 m (iii) 3000 m
 (e)(i) 16 minutes (ii) 20 minutes
- (a)(i) 4 m (ii) 10 m
 (b) 4 min (c) $L = 2t$
 (d)(i) 20 m (ii) 120 m (iii) 960 m
 (e) 100 min (1 hour 40 minutes)
- (a)(i) 50 tonnes (ii) 80 tonnes
 (b) 6 hours (c) $F = 10t$
 (d)(i) 100 tonnes (ii) 240 tonnes
 (e)(i) 7 hours (ii) 15 hours
 (iii) 28 hours
- (a)(i) 20 volts (ii) 50 volts
 (iii) 35 volts (iv) 5 volts
 (b)(i) 6 amps (ii) 8 amps (iii) 9 amps
 (iv) 5 amps
 (c) $V = 5I$
 (d)(i) 100 volts (ii) 75 volts
 (iii) 60 volts (iv) 210 volts
 (v) 285 volts
 (e)(i) 11 amps (ii) 18 amps
 (iii) 40 amps (iv) 48 amps
 (v) 61 amps

5. (a)(i) 100 mm (ii) 250 mm
 (b) 15 kg (c) $x = 10M$
 (d)(i) 20 mm (ii) 120 mm
 (iii) 240 mm (iv) 300 mm
 (iv) 450 mm
 (e)(i) 4 kg (ii) 7 kg (iii) 18 kg
 (iv) 34 kg (v) 42 kg

Exercise 9C

1. (a) $F = 40n$
 (b)(i) 240 g (ii) 280 g (iii) 400 g
 (iv) 1680 g
 (c)(i) 5 days (ii) 25 days
 (iii) 300 days
2. (a) $D = 120t$
 (b)(i) 1200 m (ii) 3000 m
 (iii) 7200 m
 (c)(i) 6 minutes (ii) 20 minutes
 (iii) 50 minutes (iv) 200 minutes
3. (a) $A = 5t$
 (b)(i) 10 mL (ii) 75 mL (iii) 300 mL
 (iv) 18 000 mL
 (c)(i) 12 sec (ii) 34 sec (iii) 200 sec
 (iv) 4000 sec
4. (a) $A = 2t$
 (b)(i) 4 L (ii) 60 L (iii) 90 L
 (c) 100 seconds

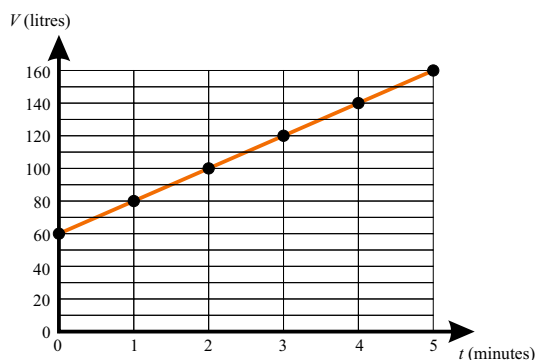
Exercise 9D

1. (a)(i) 40°C (ii) 70°C
 (b)(i) 1 minute (ii) 3 minutes
 (c) 20°C (d) C (e) 100°C
2. (a) 30 litres
 (b)(i) 40 litres (ii) 70 litres
 (c) 3 minutes (d) B
 (e)(i) 90 litres (ii) 130 litres
 (iii) 630 litres
 (f)(i) 8 minutes (ii) 17 minutes
 (iii) 30 minutes

3. (a)

t (minutes)	0	1	2	3	4	5
V (litres)	60	80	100	120	140	160

(b)



4. (a)

t (minutes)	0	1	2	3	4	5
V (litres)	60	70	80	90	100	110

(b)

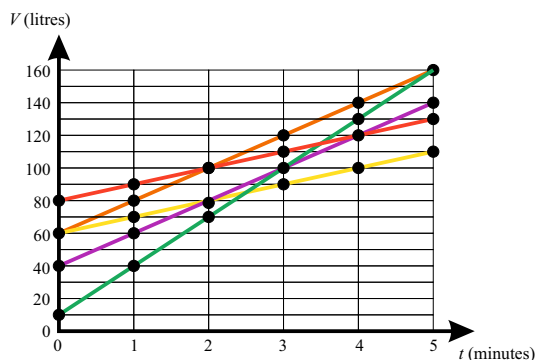
t (minutes)	0	1	2	3	4	5
V (litres)	40	60	80	100	120	140

(c)

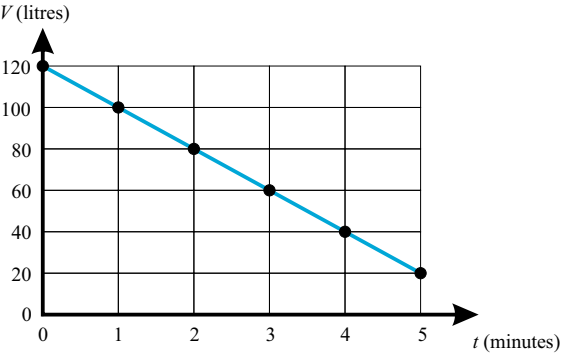
t (minutes)	0	1	2	3	4	5
V (litres)	10	40	70	100	130	160

(d)

t (minutes)	0	1	2	3	4	5
V (litres)	80	90	100	110	120	130

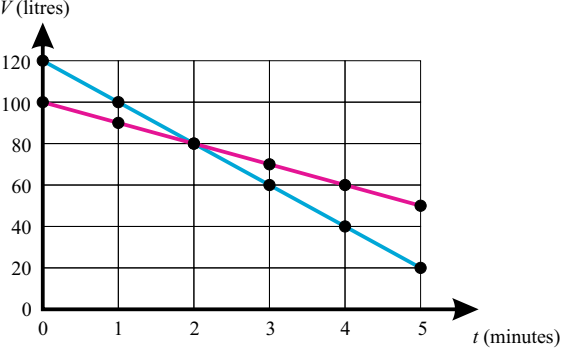


5. (a)



(b) C

6. (a)

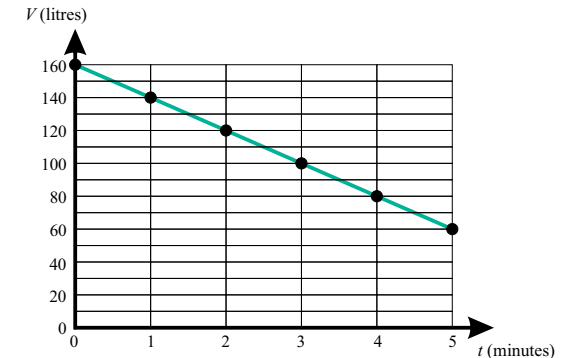


(b) B

7. (a)

t (minutes)	0	1	2	3	4	5
V (litres)	160	140	120	100	80	60

(b)



8. (a)

t (minutes)	0	1	2	3	4	5
V (litres)	160	150	140	130	120	110

(b)

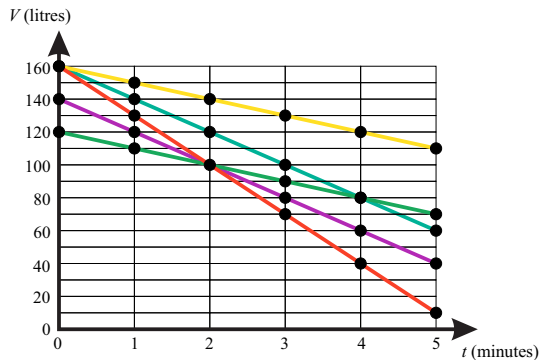
t (minutes)	0	1	2	3	4	5
V (litres)	140	120	100	80	60	40

(c)

t (minutes)	0	1	2	3	4	5
V (litres)	120	110	100	90	80	70

(d)

t (minutes)	0	1	2	3	4	5
V (litres)	160	130	100	70	40	10

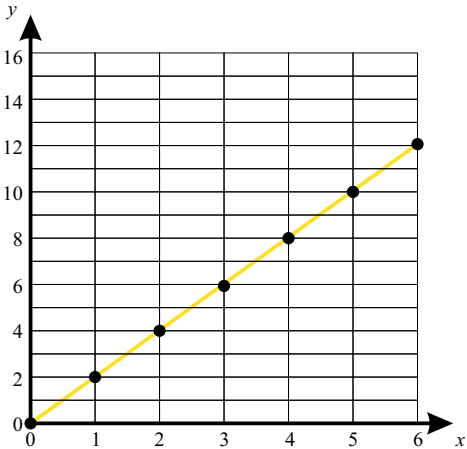


Exercise 9E

1. (a)

x	0	1	2	3	4	5	6
y	0	2	4	6	8	10	12

(b)



2. (a)

x	0	1	2	3	4	5	6
y	3	5	7	9	11	13	15

(b)

x	0	1	2	3	4	5	6
y	10	9	8	7	6	5	4

(c)

x	0	1	2	3	4	5	6
y	1	3	5	7	9	11	13

(d)

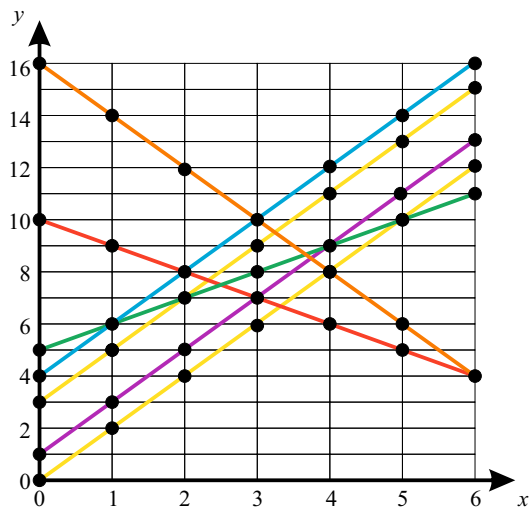
x	0	1	2	3	4	5	6
y	5	6	7	8	9	10	11

(e)

x	0	1	2	3	4	5	6
y	4	6	8	10	12	14	16

(f)

x	0	1	2	3	4	5	6
y	16	14	12	10	8	6	4



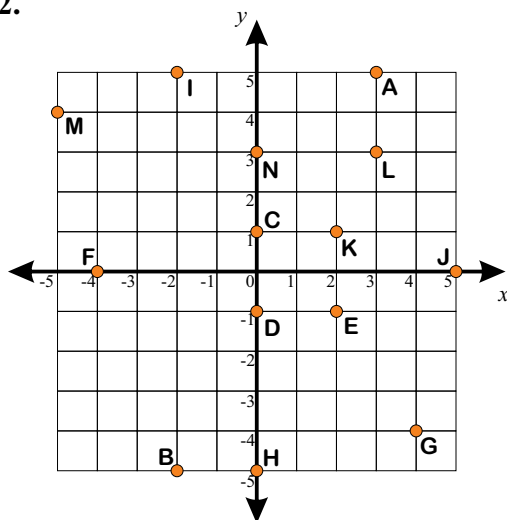
3. (a) **A** (b) **F** (c) **E** (d) **B** (e) **C** (f) **D**

4. (a) **D** (b) **B** (c) **F** (d) **E** (e) **A** (f) **C**

Exercise 9F

1. **A** = (5,4) **B** = (-4,2) **C** = (0,1)
D = (-4,-3) **E** = (1,-1) **F** = (-4,1)
G = (5,-3) **H** = (0,-4) **I** = (-2,4)
J = (-2,-2) **K** = (3,0) **L** = (2,3)

2.



Exercise 9G

1. (a)

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
y	-10	-7	-4	-1	2	5	8	11	14	17	20

(b)

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
y	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1

(c)

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
y	-13	-11	-9	-7	-5	-3	-1	1	3	5	7

(d)

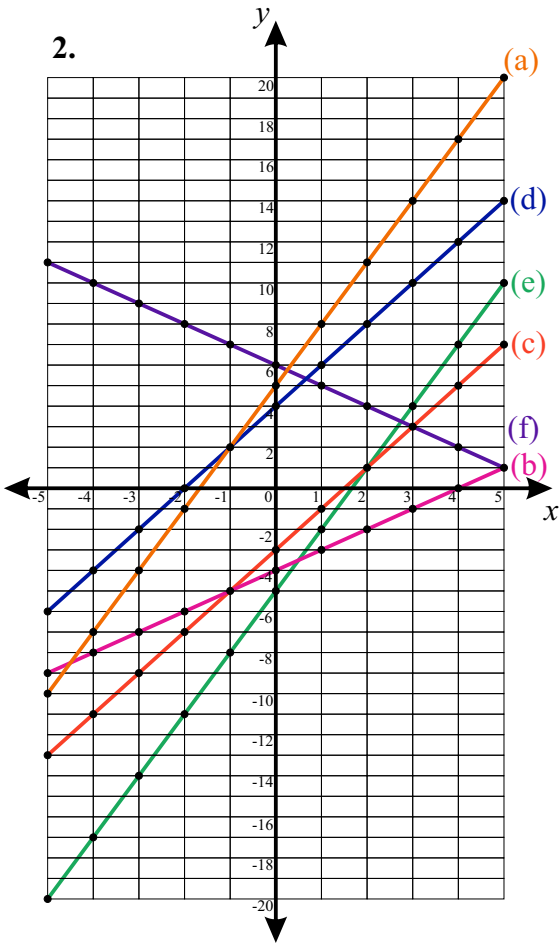
x	-5	-4	-3	-2	-1	0	1	2	3	4	5
y	-6	-4	-2	0	2	4	6	8	10	12	14

(e)

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
y	-20	-17	-14	-11	-8	-5	-2	1	4	7	10

(f)

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
y	11	10	9	8	7	6	5	4	3	2	1

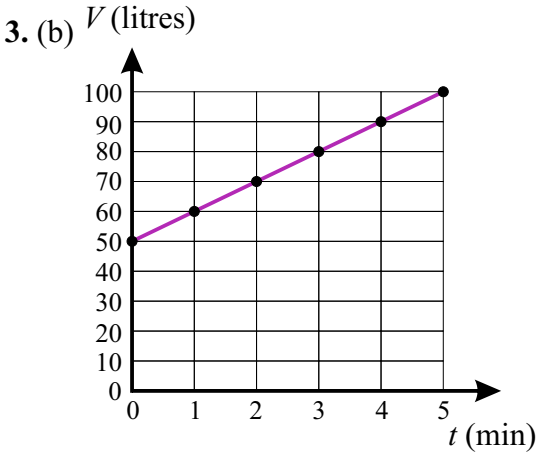


3. **A** : $y = 2x + 5$ **B** : $y = 2x - 1$
C : $y = x + 2$ **D** : $y = 2x - 5$
E : $y = x - 5$ **F** : $y = x - 8$

Chapter Review

1. (a)(i) 20 m (ii) 50 m
(b) **D**
(c)(i) 80 m (ii) 120 m (iii) 7200 m
2. (a) $A = 3t$
(b)(i) 15 L (ii) 210 L (iii) 360 L
(c) 400 seconds
3. (a)

t (minutes)	0	1	2	3	4	5
V (litres)	50	60	70	80	90	100



4. (a) **C** (b) **D** (c) **B** (d) **A**

5. (a)

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
y	-10	-8	-6	-4	-2	0	2	4	6	8	10

- (b)

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
y	-4	-3	-2	-1	0	1	2	3	4	5	6

- (c)

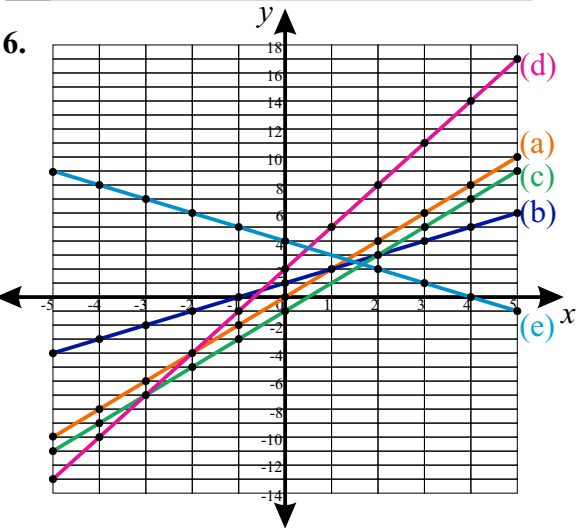
x	-5	-4	-3	-2	-1	0	1	2	3	4	5
y	-11	-9	-7	-5	-3	-1	1	3	5	7	9

- (d)

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
y	-13	-10	-7	-4	-1	2	5	8	11	14	17

- (e)

x	-5	-4	-3	-2	-1	0	1	2	3	4	5
y	9	8	7	6	5	4	3	2	1	0	-1



Chapter 10

Exercise 10A

- (a) 5 (b) 4 (c) 13 (d) 18 (e) 9
(f) 9 (g) 28 (h) 4 (i) 10 (j) 3
(k) 14 (l) 7
- (a) 15 years old (b) 3 and 5
(c) 3 kg and 6 kg (d) 5 kg
(e) 13 years old
- (a)(i) $n - 8 = 5$ (ii) $n = 13$
(b)(i) $\frac{m}{3} = 4$ (ii) $m = 12$
(c)(i) $3x = 18$ (ii) $x = 6$
(d)(i) $4a + 6 = 26$ (ii) $a = 5$
(e)(i) $3y - 7 = 17$ (ii) $y = 8$
(f)(i) $\frac{24}{8} = s$ (ii) $s = 3$ kg
(g)(i) $2t + 10 = 40$ (ii) $t = 15$ kg
(h)(i) $c + 49 = 58$ (ii) $c = 9$ kg

Exercise 10B

- (a) $a = 4$ (b) $b = 6$ (c) $c = 5$
(d) $d = 12$ (e) $e = 9$ (f) $f = 16$
(g) $g = 18$ (h) $h = 22$ (i) $i = 22$
(j) $j = 18$ (k) $k = 28$ (l) $l = 27$
- (a) $a = 3$ (b) $b = 5$ (c) $c = 7$
(d) $x = 1$ (e) $y = 11$ (f) $m = 4$
(g) $n = 6$ (h) $k = 26$ (i) $e = 18$
(j) $a = 18$ (k) $c = 33$ (l) $d = 9$
- (a) $n = 8$ (b) $x = 11$ (c) $m = 14$
(d) $n = 8$ (e) $a = 16$ (f) $u = 8$
(g) $m = 10$ (h) $n = 2$ (i) $d = 1$
(j) $n = 10$ (k) $l = 6$ (l) $e = 11$

Exercise 10C

- (a) $x = 5$ (b) $n = 5$ (c) $m = 13$
(d) $k = 18$ (e) $d = 4$ (f) $r = 7$
(g) $p = 6$ (h) $c = 32$ (i) $y = 3$
- (a) $x = 12$ (b) $c = 44$ (c) $m = 11$
(d) $m = 9$ (e) $n = 8$ (f) $d = 3$

Exercise 10D

- (a) $x = 2$ (b) $x = 14$ (c) $x = 7$
(d) $x = 23$ (e) $x = 4$ (f) $x = 7$
(g) $x = 16$ (h) $x = 63$ (i) $x = 2$
(j) $x = 6$ (k) $x = 2$ (l) $x = 6$
(m) $x = 16$ (n) $x = 15$ (o) $x = 5$
(p) $x = 10$ (q) $x = 7$ (r) $x = 3$
- (a) $x = 10$ (b) $x = 11$

Exercise 10E

- (a) $n = 3$ (b) $n = 5$ (c) $n = 7$ (d) $n = 6$
(e) $n = 4$ (f) $n = 6$
- (a) $x = 6$ (b) $x = 3$ (c) $x = 4$ (d) $x = 4$
(e) $x = 9$ (f) $x = 4$ (g) $x = 4$ (h) $x = 2$
(i) $x = 2$ (j) $x = 7$ (k) $x = 9$ (l) $x = 5$
(m) $x = 13$ (n) $x = 2$ (o) $x = 4$
(p) $x = 0$
- (a) $8b$ (b) $5b + 30$ (c) $8b = 5b + 30$
(d) $b = 10$ kg
- (a) $8c + 18$ (b) $5c + 30$
(c) $8c + 18 = 5c + 30$ (d) $c = \$4$
(e) $\$50$

Exercise 10F

- (a) $x = 3$ (b) $x = 16$ (c) $x = 7$
(d) $x = 20$ (e) $x = 3$ (f) $x = 2$
(g) $x = 5$ (h) $x = 3$ (i) $x = 7$
(j) $x = 8$ (k) $x = 25$ (l) $x = 12$
(m) $x = 6$ (n) $x = 11$ (o) $x = 19$
(p) $x = 8$ (q) $x = 10$ (r) $x = 6$
(s) $x = 4$ (t) $x = 6$ (u) $x = 4$
- (a) $x = 9$ (b) $a = 8$ (c) $m = 11$
(d) $n = 10$ (e) $e = 7$ (f) $b = 8$
(g) $e = 4$ (h) $x = 6$ (i) $k = 6$
(j) $n = 5$ (k) $e = 7$ (l) $w = 2$
(m) $x = 4$ (n) $h = 9$ (o) $x = 9$
(p) $g = 1$ (q) $u = 2$ (r) $p = 12$
- (a) $x = -3$ (b) $a = -5$ (c) $b = -5$
(d) $d = -7$ (e) $f = -2$ (f) $g = -1$
(g) $h = 1$ (h) $y = -5$ (i) $p = -4$
(j) $d = -1$ (k) $k = -1$ (l) $m = -10$
(m) $x = -6$ (n) $a = -8$ (o) $c = 8$
(p) $e = -5$ (q) $x = -1$ (r) $m = -3$

4. (a) $x = 0.25$ (b) $m = 0.4$
 (c) $k = 1.5$ (d) $k = 0.3$
 (e) $g = 5.4$ (f) $u = 6.5$
 (g) $y = 5.6$ (h) $j = 6.2$
 (i) $d = 5.25$ (j) $t = 12.5$
 (k) $m = 25.5$ (l) $z = 19.5$
 (m) $x = 11.2$ (n) $u = 8.6$
 (o) $m = 5.8$
5. (a) $x + 8 = 17$ $x = 9$
 (b) $p - 5 = 13$ $p = 18$
 (c) $2b + 3 = 11$ $b = 4$
 (d) $3m - 5 = 13$ $m = 6$
 (e) $\frac{d}{5} + 1 = 4$ $d = 15$
 (f) $\frac{y}{4} - 6 = 0$ $y = 24$
 (g) $\frac{n+5}{6} = 3$ $n = 13$
6. (a) $y + 2$ (b) $2y + 2 = 10$
 (c) Josephine's scarf = 4 metres
 Joseph's scarf = 6 metres
7. (a)(i) Jackson: $x + 5$
 (ii) Cecilia: $2x$
 (iii) Georgia: $2x + 5$
 (b) $6x + 10$
 (c) $6x + 10 = 130$
 (d)(i) \$20 (ii) \$25 (iii) \$40
 (iv) \$45
8. (a) $7x + 1 = 57$ (b) $x = 8$
9. (a) $4p + 2 = 50$ (b) \$12
10. (a) $8x + 4 = 20$ (b) 2 metres
11. (a) $\frac{x}{3}$ (b) $\frac{x}{3} - 2$
 (c) $\frac{x}{3} - 2 = 10$ (d) 36 kg
12. (a) $x - 20$
 (b) $\frac{x - 20}{4}$ (c) $\frac{x - 20}{4} = 30$
 (d) $x = 140$

Exercise 10G

1. (a) $b = a + 6$ (b) $k = 8m$
 (c) $H = G - 7$ (d) $q = \frac{p}{3}$
 (e) $x = y - z$ (f) $p = \frac{m}{n}$
 (g) $k = h + j$ (h) $v = wy$
 (i) $x = \frac{y - 5}{2}$ (j) $N = \frac{M + 4}{3}$
 (k) $b = \frac{a - c}{4}$ (l) $v = \frac{w - 5z}{3}$
 (m) $x = \frac{y}{2z}$ (n) $n = \frac{m + q}{5p}$
 (o) $n = 3(m - p)$ (p) $d = \frac{a - 2bc}{3}$
 (q) $x = \sqrt{y}$ (r) $B = A^2$
 (s) $m = 3k - 4$ (t) $x = \frac{3y - z}{2}$

2. (a) $m = \frac{F}{10}$ (b) 20

3. (a) $P = \frac{W}{t}$ (b) 40
 (c) $W = Pt$ (d) 300

Exercise 10H

1. (a) $y = 4$ (b) $y = 16$ (c) $y = 31$
 (d) $y = 37$ (e) $y = 301$
2. (a) $b = 6$ (b) $b = 26$ (c) $b = 51$
 (d) $b = 96$ (e) $b = 496$
3. (a) $y = 10$ (b) $y = 25$ (c) $y = 25$
 (d) $y = 4$ (e) $y = 21$ (f) $y = 3$
 (g) $y = 40$ (h) $y = 7$
4. (a) $y = 32$ (b) $a = 74$ (c) $m = 6$
 (d) $F = 70$ (e) $v = 42$ (f) $k = 8$
 (g) $V = 62$
5. (a) $y = 44$ (b) $a = -30.8$ (c) $m = -3.9$
 (d) $F = -1.85$ (e) $v = 778.4$
 (f) $k = -0.4025$ (g) $V = 3.6777$
6. $A = 55 \text{ cm}^2$
7. $V = 288.7 \text{ cm}^3$
8. (a) $V = IR$ (b) 84
9. 15

Chapter Review

- (a) $m + 6 = 9$ $m = 3$
(b) $2n - 5 = 7$ $n = 6$
- (a) $x = 9$ (b) $x = 4$ (c) $m = -1$
(d) $x = 3$ (e) $a = 8$ (f) $c = -2$
- 17 years old
- (a) $x = 6$ (b) $x = 4$
- (a) $n = \frac{m}{3}$ (b) $q = 4(p + 4r)$
- (a) $y = 21$ (b) $m = 22$
- (a) $v = at$ (b) $v = 40$

Chapter 11

Exercise 11A

- (a) B (b) C (c) D (d) D (e) C
(f) A (g) A(B) (h) C (i) A (j) B
(k) D (l) C (m) B (n) D
- (a) 30 cm (b) 20 m (c) 400 km
(d) 2500 km (e) 350 m (f) 5 mm
(g) 50 mm (h) 8 m (i) 1 mm
(j) 12 cm (k) 10 km (l) 2200 m
(m) 160 cm (n) 1000 km
- (a) 20 mm (b) 14 cm (c) 1680 km
(d) 1640 km (e) 76.80 m (f) 5.63 m
(g) 300 m (h) 20 m
- (a) 6 (b) 14 (c) 28 (d) 15 (e) 45
(f) 90 (g) 60 (h) 220 (i) 380
(j) 800 (k) 2300 (l) 3600 (m) 300
(n) 1200 (o) 1650 (p) 75 (q) 150
(r) 325
- (a) 1 cm (b) 4 cm (c) 2.5 cm
(d) 2 cm (e) 3 cm (f) 4.5 cm
(g) 10 cm (h) 9.5 cm
- (a) $AB = 32$ mm, $AC = 32$ mm
(b) $ED = 46$ mm, $DF = 48$ mm
- 42 mm, 44 mm, 46 mm, 49 mm,
52 mm, 55 mm, 58 mm, 59 mm

Exercise 11B

- (a) 60 mm (b) 800 cm (c) 20 000 m
(d) 23 000 mm (e) 400 mm
(f) 59 000 m (g) 89 mm (h) 375 cm
(i) 2300 m (j) 100 mm (k) 70 m
(l) 276 mm (m) 0.3 cm
(n) 23.57 mm (o) 578 m
(p) 30 000 cm (q) 430 000 mm
(r) 1.7 m
- (a) 5 cm (b) 2 m (c) 7 km
(d) 9 m (e) 80 cm (f) 930 km
(g) 0.6 cm (h) 0.33 m
(i) 0.058 km (j) 0.003 m
(k) 5.8 cm (l) 3.8 m
(m) 0.3502 m (n) 7.851 m
(o) 0.0037 m (p) 0.005 km
(q) 0.03 km (r) 872.1 m
- (a) 1 cm (b) 320 cm (c) 820 mm
(d) 0.35 m (e) 90 mm (f) 47.5 m
(g) 0.04 cm (h) 0.0235 m
(i) 0.123456 km (j) 22 mm
(k) 1.25 cm (l) 0.8 cm
(m) 0.00003 m (n) 0.0005 m
(o) 0.00235 m
- (a) 2.11 m (b) 3.2 cm (c) 6.06 m
(d) 20.2 m (e) 5.02 km
(f) 18.05 m (g) 5.08 m
(h) 6.238 m (i) 4.007 m
(j) 20.4 cm (k) 3.882 m
(l) 10.057 m
- (a) 3 m (b) 66 m (c) 14 m
(d) 30 m (e) 16 m (f) 20 m
(g) 3 m (h) 3 m (i) 16 m
(j) 4 m (k) 8 m (l) 10 m
(m) 11 m (n) 6 m (o) 48 m
- (a) 3 cm (b) 3 cm (c) 16 cm
(d) 1 cm (e) 14 cm (f) 26 cm
(g) 1 cm (h) 7 cm (i) 20 cm
- Mustafa, Dale, Klete
- Height of cupboard on
luggage-rack = 2.2 m.
Will **not** pass under the branch.
- 95 cm

10. Hair needs to grow 1080 mm.

This will take 72 months.

She will be 21 years old!

11. (a) 120 mm (b) 25 (c) \$2.50
(d) \$30 000 (e) \$8

Exercise 11C

1. (a) 26 m (b) 21.6 mm
(c) 370 mm (d) 2840 mm
2. (a) 1600 m
(b) 320 sec (5 min 20 sec)
3. 284 cm
4. (a) 300 m (b) 24 km/hour
5. Length - 80 m, width - 40 m
6. 144 paving blocks

Exercise 11D

1. (a) 37.7 mm (b) 268.0 cm
(c) 39.0 m
2. (a) 25.1 mm (b) 37.1 m
(c) 17.6 km (d) 628.3 cm
(e) 1.8 m (f) 5.0 km (g) 37.6 mm
(h) 207.0 m
3. (a) 94.2 mm (b) 162.1 m
(c) 47.8 km (d) 3141.6 cm
(e) 16.3 m (f) 3.7 km (g) 68.9 mm
(h) 1042.3 m
4. (a) 51.4 m (b) 88.0 cm (c) 17.9 m
(d) 82.3 cm (e) 185.7 m
5. (a) 188.5 cm (b) 754 m
6. (a) 408.4 mm (b) 816.8 mm
(c) 4084.1 mm (d) 8.2 m/min
7. (a) 157.1 cm (b) 2.6 cm
8. 180 cm
9. B

Chapter Review

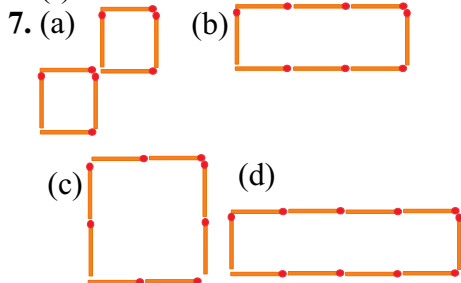
1. (a) B (b) B (c) D
2. (a) 8 (b) 13 (c) 29 (d) 20 (e) 160
(f) 440
3. (a) 5 cm (b) 7.5 cm

4. (a) 70 mm (b) 1000 m (c) 2000 cm
(d) 60 m (e) 85 cm (f) 0.6 cm
(g) 9.7 m (h) 3 cm (i) 0.05 cm
(j) 0.04 m (k) 710.5 m (l) 0.21 m
5. (a) 3.67 m (b) 8.9 cm (c) 10.07 m
(d) 5.3 km (e) 1.05 km (f) 7.06 m
(g) 1.1 cm (h) 8.342 m
6. (a) 6 m (b) 38 m (c) 100 m
(d) 1 m (e) 15 m (f) 5 m
7. (a) 6 cm (b) 11 cm (c) 9 cm
(d) 2 cm (e) 3 cm (f) 36 cm
8. 200 strides
9. 10 cm
10. 400 m
11. (a) 15.7 cm (b) 19.8 mm
(c) 58.1 m
12. (a) 75.4 cm (b) 98.0 mm
(c) 754.0 m
13. (a) 44 cm (b) 60 cm
(c) 615 mm (d) 36.6 m

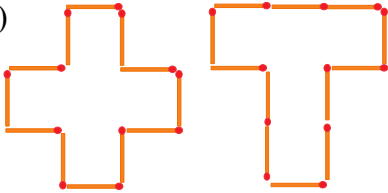
Chapter 12

Exercise 12A

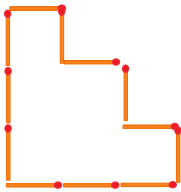
1. (a) 25 (b) 20 (c) 24 (d) 15
(e) 24 (f) 28
2. (a) 9 (b) 10 (c) 14
3. 100
4. (a) C (b) C (c) A (d) C (e) B
5. (a) Square (b) Pentagon (c) A
(d) D
6. (a) G (b) F (c) C (d) E (e) B
(f) D



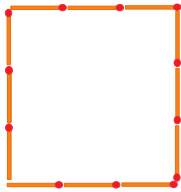
7. (e)



(f)



(g)

**Exercise 12B**

- (a) $5\,000\,000\text{ m}^2$ (b) $90\,000\text{ cm}^2$
(c) 200 mm^2 (d) $2\,700\,000\text{ m}^2$
(e) $53\,910\text{ cm}^2$ (f) 5.8 mm^2
(g) 9200 mm^2 (h) 410 m^2
(i) 2380 mm^2 (j) 5790 mm^2
- (a) 60 cm^2 (b) 9.5 m^2 (c) 0.78 m^2
(d) 10.78 m^2 (e) 4100 cm^2
(f) 35.28 km^2
- (a) 4300 mm^2 (b) 0.0075 km^2
(c) 0.083 cm^2 (d) 0.000232 m^2
(e) 760 cm^2 (f) 5.38 km^2
(g) 720 mm^2 (h) 0.0000083 km^2
- (a) 9 m^2 (b) m^2 - easier to measure
- (a) 600 cm^2
(b) cm^2 - easier to measure
- (a) B (b) B (c) A (d) C (e) D (f) B

Exercise 12C

- (a) 6 cm^2 (b) 12 cm^2 (c) 8 cm^2
(d) 11 cm^2 (e) 9 cm^2 (f) 16 cm^2
(g) 17 cm^2 (h) 17 cm^2
- (a) $12\text{--}13\text{ cm}^2$ (b) 23 cm^2
(c) 36 cm^2

Exercise 12D

- (a) 16 cm^2 (b) 10 cm^2 (c) 12 cm^2
(d) 12 cm^2
- (a) 36 cm^2 (b) 40 m^2 (c) 27 mm^2
(d) 80 m^2 (e) 180 mm^2
(f) 1008 cm^2 (g) 106.25 mm^2
(h) $70\,000\text{ m}^2$
- (a) 81 m^2 (b) 108 cm^2
- (a) 1200 m^2 (b) 12 kg (c) 3000 m
- (a) 5400 m^2
- (a) $7\text{ m} \times 1\text{ m}$, $6\text{ m} \times 2\text{ m}$,
 $5\text{ m} \times 3\text{ m}$, $4\text{ m} \times 4\text{ m}$
(b) 7 m^2 , 12 m^2 , 15 m^2 , 16 m^2
(c) $4\text{ m} \times 4\text{ m}$
(d) Square
(e) 100 m^2
- (a) $60\,000\text{ m}^2$ (b) $87\,500\text{ m}^2$
(c) $27\,500\text{ m}^2$ (d) $97\,500\text{ m}^2$

Exercise 12E

- 12 m^2 2. 72 m^2 3. 189 m^2
- 139 m^2 5. 16 m^2 6. 45 m^2
- 490 m^2

Exercise 12F

- (a) 21 hectares (b) 600 hectares
(c) 4.5 hectares
- (a) $60\,000\text{ m}^2$ (b) $150\,000\text{ m}^2$
(c) $57\,500\text{ m}^2$ (d) 3000 m^2
- 400 metres
- 2000 hectares
- 4200 metres

Exercise 12G

- (a)(i) 16 cm^2 (ii) 8 cm^2
(b)(i) 12 cm^2 (ii) 6 cm^2
(c)(i) 18 cm^2 (ii) 9 cm^2
(d)(i) 24 cm^2 (ii) 12 cm^2
(e)(i) 16 cm^2 (ii) 8 cm^2
(f)(i) 24 cm^2 (ii) 12 cm^2
- The area of the rectangle is twice the area of the triangle.

3. (a) 24 cm^2 (b) 9 m^2 (c) 100 mm^2
 (d) 17.5 mm^2 (e) 112 m^2
 (f) 88 cm^2 (g) 7.5 m^2 (h) 9000 m^2

Exercise 12H

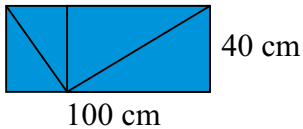
1. 150 m^2 2. 320 cm^2 3. 25.5 m^2
 4. 1.2 km^2 5. 0.3 m^2

Exercise 12I

1. 56 cm^2 2. 60 mm^2 3. 450 m^2
 4. 62 m^2 5. 25.5 mm^2

Exercise 12J

1. (a) 120 cm^2 (b) 840 cm^2
 (c) 193.44 cm^2
 2. (a) 5000 cm^2 (b) 3990 cm^2
 3. (a)(i) 90 cm (ii) 2700 cm^2
 (b)(i) 80 cm (ii) 4800 cm^2
 4.



Exercise 12K

1. 600 cm^2 2. 320 cm^2 3. 2.52 cm^2
 4. 18.9 cm^2

Exercise 12L

1. 153.9 m^2 2. 452.4 cm^2 3. 13.9 m^2
 4. 201.1 mm^2 5. 6221.1 m^2
 6. 157.1 cm^2

Exercise 12M

1. (a) 360 cm^2 (b) 149.9 m^2
 2. 400 cm^2
 3. 40 cm
 4. 60 cm and 40 cm
 5. (a) equilateral triangles (b) 800 cm^2
 6. (a) 25 (b) 50 (c) 1875 (d) 400
 (e) 1257 (f) 16 250
 7. 70.9 cm
 8. (a) 800 metres square
 (b) 8 minutes (c) 40 times
 (d) 320 minutes

9. (a) 128 cm^2 (b) 384 cm^2 (c) 4
 10. (a) 4314 m^2 (b) 431.4 litres
 11. 3, 1, 10, 5, 2, 13, 4, 9, 6, 8, 12, 11, 7

Chapter Review

1. (a) 200 m^2 (b) 40 cm^2 (c) 3500 cm^2
 (d) 49 cm^2 (e) 254.5 mm^2
 (f) 615.8 cm^2 (g) 480 cm^2
 (h) 35.84 cm^2 (i) 1.32 m^2
 2. (a) 142.9 cm^2 (b) 1511 cm^2
 (c) 697.1 cm^2 (d) 264 cm^2
 3. (a) 0.1 m^2 (b) 1000 cm^2
 (c) $100\,000 \text{ mm}^2$
 4. 750 hectares

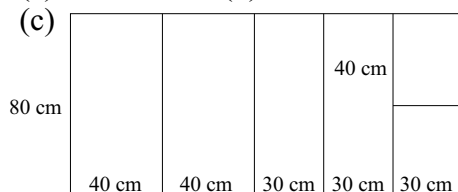
Chapter 13

Exercise 13A

1. (a)(i) 0 (ii) 8 (iii) 12 (iv) 6 (v) 1
 (b)(i) 3 (ii) 8 (iii) 5 (iv) 4 (v) 0
 (c)(i) 4 (ii) 6 (iii) 6 (iv) 2 (v) 0
 (d)(i) 4 (ii) 8 (iii) 3 (iv) 0 (v) 0
 (e)(i) 3 (ii) 11 (iii) 3 (iv) 3 (v) 0
 2. (a) 54 cm^2 (b) 50 cm^2 (c) 48 cm^2
 (d) 46 cm^2 (e) 54 cm^2 (f) 46 cm^2

Exercise 13B

1. (a) 108 m^2 (b) 680 cm^2
 (c) 1600 cm^2 (d) 551.5 m^2
 2. 150 cm^2
 3. (a) 22 m^2 (b) \$440
 4. (a) $13\,600 \text{ cm}^2$ (b) D



- (d) 1.36 m^2 (e) \$136

Exercise 13C

1. 1407.4 cm^2
2. 88.0 m^2
3. 215.1 m^2
4. 100.5 m^2

Exercise 13D

1. (a) 480 cm^2 (b) 84 m^2
(c) 246 cm^2 (d) 408 cm^2
2. (a) 201.1 cm^2 (b) 50.3 cm^2
(c) 172.0 cm^2

Chapter Review

1. 310 m^2
2. 104.32 m^2
3. 1363.45 cm^2
4. 1536 cm^2
5. 1017.9 cm^2
6. 1448 cm^2

Chapter 14**Exercise 14A**

1. (a) D (b) C (c) C (d) C (e) C
2. (a) A (b) D (c) C (d) C (e) B
(f) B (g) D (h) C (i) A (j) D (k) D

Exercise 14B

1. (a) 8 L (b) 12 L (c) 200 L
(d) 0.5 L (e) 9.6 L (f) 35.7 L
(g) 0.41 L (h) 0.02 L (i) 0.085 L
(j) 3.9765 L (k) 0.0134 L
(l) 0.2587 L (m) 0.001 L
(n) 0.0085 L (o) 0.0007 L
2. (a) 2000 cm^3 (b) 7000 cm^3
(c) $13\,000 \text{ cm}^3$ (d) $80\,000 \text{ cm}^3$
(e) 4100 cm^3 (f) 7150 cm^3
(g) $12\,685 \text{ cm}^3$ (h) $10\,080 \text{ cm}^3$
(i) 5555.5 cm^3 (j) 900 cm^3
(k) 675.2 cm^3 (l) 5000.8 cm^3
(m) 5.2 cm^3 (n) 10 cm^3
(o) 0.07 cm^3

3. (a) 5000 L (b) 19 000 L (c) 200 000 L
(d) 400 L (e) 12 600 L (f) 4512 L
(g) 20 L (h) 523 600 L (i) 5.69 L
(j) 3 976 500 L (k) 13 400 L
(l) 258 700 L
4. (a) 2 m^3 (b) 15 m^3 (c) 5.879 m^3
(d) 0.688 m^3 (e) 42.1 m^3
(f) 0.5 m^3 (g) 0.061 m^3
(h) 0.6505 m^3 (i) 0.03 m^3
(j) 0.0008 m^3 (k) 0.01056 m^3
(l) 0.8256 m^3
5. (a) 0.0067 m^3 (b) 49 mm^3 (c) 0.0328 L
(d) $75\,000 \text{ mm}^3$ (e) 9100 mL
(f) 28 000 mL (g) 73.9 L
(h) $105\,825\,000 \text{ mm}^3$ (i) 0.089 L
(j) 8100 mm^3

Exercise 14C

1. (a) 18 cm^3 (b) 12 cm^3 (c) 27 cm^3
(d) 24 cm^3 (e) 8 cm^3 (f) 16 cm^3
(g) 36 cm^3 (h) 40 cm^3 (i) 15 cm^3
2. The volume is equal to all the numbers of blocks on the edges multiplied.
3. (a) 90 cm^3 (b) 300 cm^3 (c) 64 cm^3
(d) 60 cm^3 (e) 480 cm^3
4. (a) $30\,000 \text{ cm}^3$ (b) 400 cm^3
(c) 120 cm^3 (d) $15\,200 \text{ cm}^3$
(e) $13\,572 \text{ cm}^3$
5. (a) 36 m^3 (b) 18 scoops
6. (a) $1\,000\,000 \text{ cm}^3$ (b) 5000 cm^3
(c) 200 boxes
7. (a) 220 cm^3 (b) 880 cm^3

Exercise 14D

1. $42\,000 \text{ cm}^3$
2. $694\,790 \text{ cm}^3$

Exercise 14E

1. (a)(i) 66 m^3 (ii) 66 000 L
(b) (i) 320 m^3 (ii) 320 000 L
2. (a) 500 000 litres
(b) 10 hours
3. 42 m^3

4. 40 doses
5. 10 days
6. 4 glasses
7. 30 mL
8. 80 litres
9. 250 litres

Chapter Review

1. (a) 125 cm^3 (b) 48 cm^3
(c) 4950 cm^3 (d) 72 cm^3
2. (a) 4000 litres (b) 21 000 litres
(c) 24 litres (d) 540 litres
3. 47.25 litres
4. (a) 0.0255 m^3 (b) $25\,500 \text{ cm}^3$
5. 2 cm
6. 18 litres
7. 10 glasses

Chapter 15

Exercise 15A

1. millisecond, second, minute, hour, day, week, month, year, decade, century, millennium
2. (a) millisecond (b) minute
(c) century (d) millennium
3. (a) .. course condition ..
(b) .. watch our ..
(c) .. foam on the ..
(d) .. very early ..
(e) .. made cadets ..
(f) Frieda yelled ..
(g) .. loan in utensils ..
4. Second, minute, hour, day, week, fortnight, month, year, decade, century, millennium.
Pendulum

5. (a) 7 = days in a week
(b) 60 = minutes in an hour
(c) 10 = years in a decade
(d) 30 = days in April
(e) 60 = seconds in a minute
(f) 14 = days in a fortnight
(g) 168 = hours in a week
(h) 3 = months in summer
(i) 1000 = years in a millennium
(j) 24 = hours in a day
(k) 31 = days in January
(l) 10 = decades in a century
(m) 366 = days in a leap year
(n) 1440 = minutes in a day
(o) 1800 = seconds in half an hour
(p) 15 = minutes in quarter of an hour
(q) 1000 = milliseconds in a second

Exercise 15B

1. (a) 120 minutes (b) 600 minutes
(c) 2880 minutes (d) 330 minutes
2. (a) 300 seconds (b) 7200 seconds
(c) 86 400 seconds (d) 510 seconds
3. (a) 14 days (b) 31 days
(c) 92 days (d) 365 days
4. (a) 336 hours (b) 84 hours
(c) 16 hours
5. (a) 60 years (b) 50 years
(c) 300 years (d) 250 years
6. (a) 2000 milliseconds
(b) 30 000 milliseconds
(c) 500 milliseconds
(d) 25 750 milliseconds
7. (a)(i) 80 metres (ii) 3600 metres
(iii) 5400 metres
(iv) 43 200 metres
(b)(i) 1 minute (ii) 20 minutes
8. (a) 10 (b) 600 (c) 36 000

Exercise 15C

- (a) 08:00 (b) 17:00 (c) 13:30
(d) 09:15 (e) 15:45 (f) 00:40
(g) 12:55 (h) 19:28 (i) 04:52
(j) 23:02 (k) 10:21 (l) 22:11
- (a) 2:00 am (b) 10:35 am
(c) 2:20 pm (d) 10:38 pm
(e) 11:09 am (f) 9:42 pm
(g) 9:05 am (h) 12:10 am
(i) 12:12 pm (j) 10:01 am
(k) 3:30 am (l) 3:48 pm
- (a)(i) six-fifty (ii) ten to seven
(iii) 6:50
(b)(i) three-ten (ii) ten past three
(iii) 3:10
(c)(i) six-thirty-five
(ii) twenty-five to seven
(iii) 6:35
(d)(i) nine-fifteen
(ii) quarter past nine
(iii) 9:15
(e)(i) eleven-0-five
(ii) five past eleven
(iii) 11:05
(f)(i) one-forty
(ii) twenty to two
(iii) 1:40
(g)(i) ten-thirty (ii) half past ten
(iii) 10:30
(h)(i) five-forty-five
(ii) quarter to six
(iii) 5:45
- (a) 20 (b) 43 (c) 41 (d) 15 (e) 18
(f) 37 (g) 30 (h) 40 (i) 55 (j) 55
(k) 75 (l) 75 (m) 75 (n) 100
(o) 65 (p) 39 (q) 76 (r) 85
(s) 102 (t) 136
- (a) 77 (b) 39 (c) 125 (d) 202
(e) 168 (f) 125 (g) 305 (h) 105
(i) 204 (j) 445
- 8:31 pm
- 15:38
- 1 hour and 52 minutes
- 10 800 litres
- 12:02 pm

Exercise 15D

- 1600, 1664, 1992, 2004, 2016,
2080, 2800
- (a) 366 (b) 366 (c) 365 (d) 365
- Thursday 10th April
- 24th April

Exercise 15E

- 8
- (a) 57 minutes (b) 56 minutes
(c) 1 hour and 5 minutes
- 13:04
- 2
- (a) 13:35 (b) 20 minutes

Exercise 15F

- (a) Fiji is two hours **ahead of** Melbourne.
(b) Dublin is two hours **behind** Athens.
(c) Perth is eight hours ahead of **Dublin**.
(d) Los Angeles is eight hours **behind** Dublin.
(e) Melbourne is **10 hours** ahead of Dublin.
(f) Fiji is **10 hours** ahead of Athens.

2.

Los Angeles	Dublin	Athens	Perth	Melbourne	Fiji
Midnight	8 am Wed	10 am Wed	4 pm Wed	6 pm Wed	8 pm Wed
7 am Fri	3 pm Fri	5 pm Fri	11 pm Fri	1 am Sat	3 am Sat
1 pm Mon	9 pm Mon	11 pm Mon	5 am Tue	7 am Tue	9 am Tue

- 10 hours
- (a) Papua New Guinea
(b) China, Taiwan, Philippines,
Malaysia, Brunei, parts of Indonesia
(c) three
(d) one
(e) Laos, Thailand, Cambodia,
Vietnam, parts of Indonesia
(f)(i) 03:00 (ii) 02:00 (iii) 04:00
(g) 1:00 pm
(h) 7:00 pm

Exercise 15G

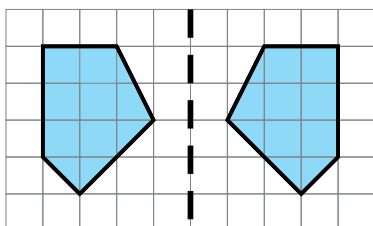
1. 09:45 (9:45 am)
2. Start - 20:30, Finish - 23:15
3. (a) 22:24
(b) Songs 2,3,5 and 6
4. (a) 6
(b) 9:30, 10:17, 11:04, 11:51, 12:38, 1:25
(c) 2:12
5. 2 hours
6. 9:10 (Ten past nine)
7. 8:35 (Twenty-five to nine)
8. Oscar by 10 minutes
9. (a) Early by 24 minutes (b) 10:48
10. 2:28
11. 2:32:19

Chapter Review

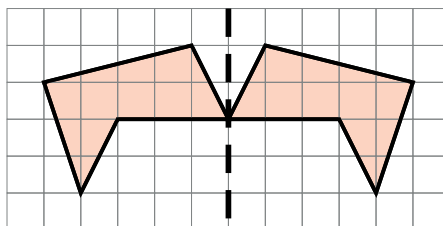
1. (a) 180 (b) 420 (c) 192 (d) 60 000
(e) 70 (f) 400
2. (a) 08:15 (b) 19:24 (c) 23:03
(d) 01:28
3. (a) 3:51 pm (b) 8:20 am
(c) 10:39 pm (d) 11:28 am
4. (a) 95 (b) 113
5. (a) 97 (b) 193
6. 3 hours and 40 minutes
7. 17:20
8. Thursday the 12th of September
9. 3:50 pm

Chapter 16**Exercise 16A**

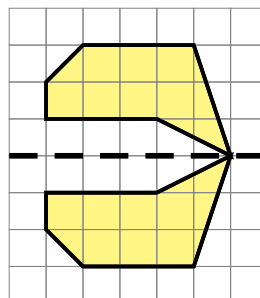
1. (a)



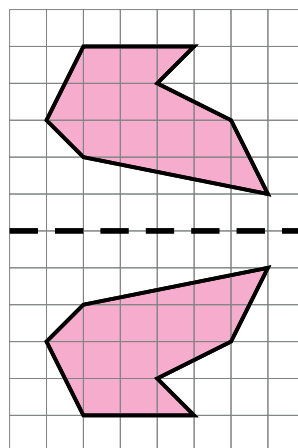
- (b)



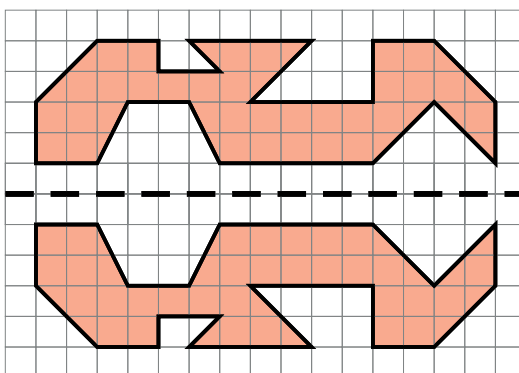
- (c)



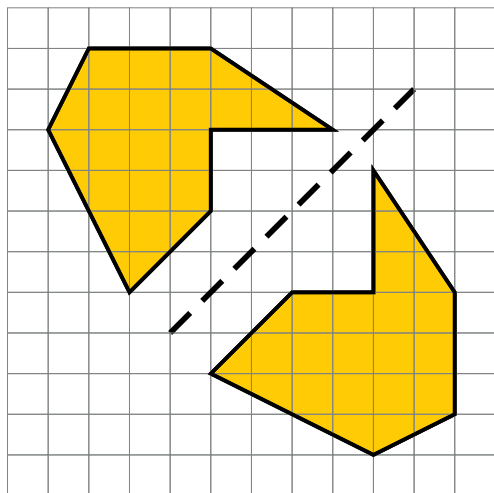
- (d)



- (e)



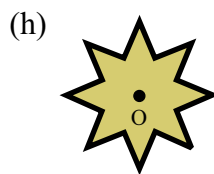
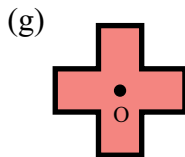
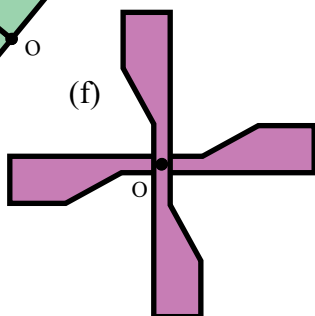
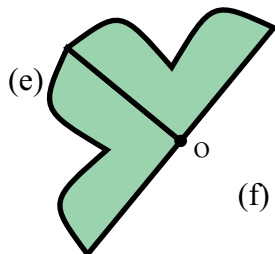
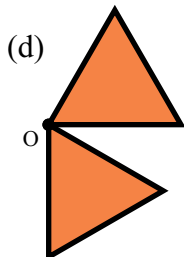
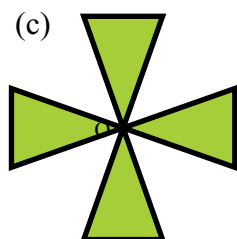
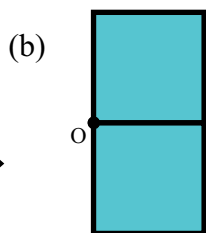
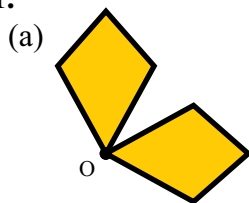
2.



3. C

Exercise 16B

1.



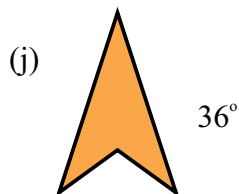
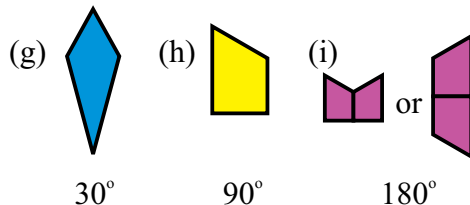
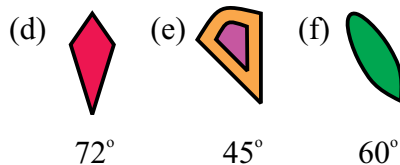
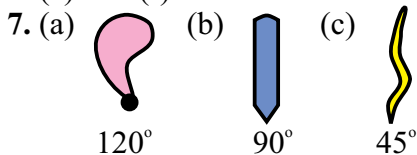
2. They look the same.

3. Square, Regular Octagon

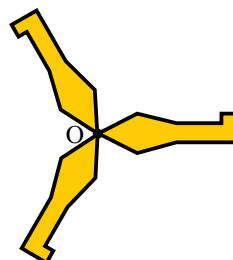
4. Square, Rectangle, Rhombus, Parallelogram, Regular Hexagon, Regular Octagon

5. (a) B (b) C (c) D

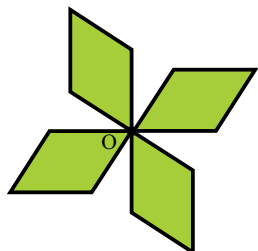
6. (a) 180° (b) 120° (c) 60° (d) 120°
(e) 72° (f) 45°



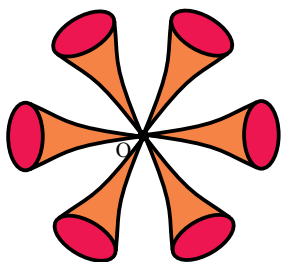
8. (a)



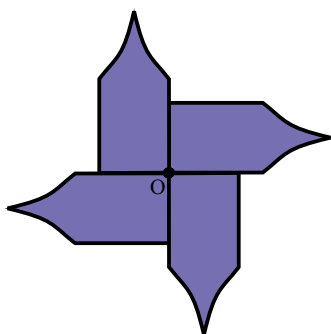
(b)



(c)



(d)



Exercise 16C

1. (a) **E**

(b) **A** - L8, U2

B - L4, U2

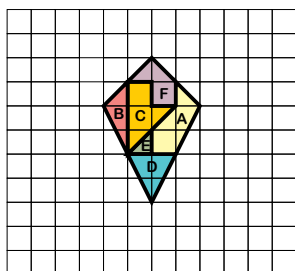
C - R5, U2

D - R7, D4

F - R2, D4

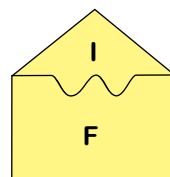
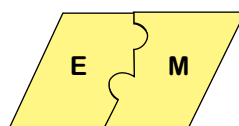
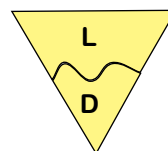
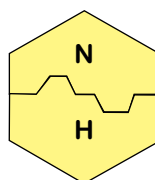
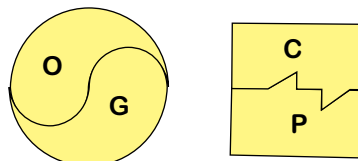
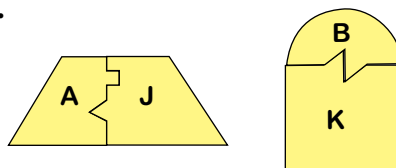
G - R5, D2

2. Kite



Exercise 16D

1.



2. Any words using the following letters: (p, q, d, b), (u, n), i, e, t

be, bet, bin, bit, bite, but, din, end,
in, it, nib, nit, pen, pet, pin, pine,
pint, pit, quit, **quiet**, **quite**, tin,
tub, tube, up

(There may be more!)

3. A, B, D, G, H

4. A - NR

B - 90° C

C - 180°

D - NR

E - 90° AC

F - 90° AC

G - 180°

H - 90° AC

I - 180°

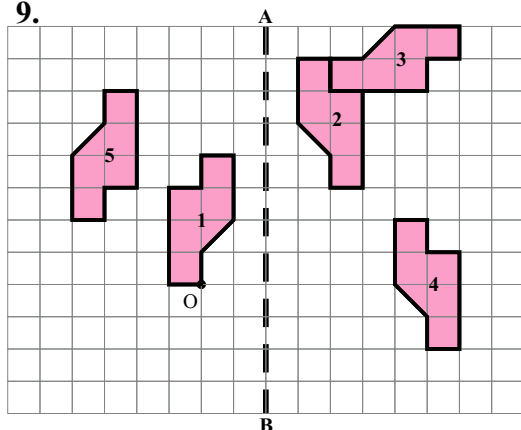
G	F	H
C	A	E
B	D	I

5. E

6. Rotation of 90° clockwise about O then translation of two units right and two units down.7. Rotation of 180° about O then translation of three units right and four units up.

8. Reflection about line AB then a translation of one unit right and three units down.

9.

**Exercise 16E**1. B and R, C and M, E and N,
F and K, G and P

2. B, C and G

Exercise 16F1. (a) $A = (-2, 4)$, $B = (-1, 2)$, $C = (-5, 0)$ (b)(i) $A' = (2, 4)$, $B' = (1, 2)$,
 $C' = (5, 0)$ (ii) $A' = (-2, -4)$, $B' = (-1, -2)$,
 $C' = (-5, 0)$ (iii) $A' = (-1, -3)$, $B' = (-3, -4)$,
 $C' = (-5, 0)$ (iv) $A' = (0, 0)$, $B' = (-1, 2)$,
 $C' = (3, 4)$ (v) $A' = (4, 4)$, $B' = (5, 2)$,
 $C' = (1, 0)$ (vi) $A' = (-2, 1)$, $B' = (-1, -1)$,
 $C' = (-5, -3)$ 2. (a) $A = (1, 4)$, $B = (3, 5)$, $C = (5, 3)$,
 $D = (3, 1)$ (b)(i) $A' = (-1, 0)$, $B' = (-3, 1)$,
 $C' = (-5, -1)$, $D' = (-3, -3)$ (ii) $A' = (-2, -4)$, $B' = (0, -5)$,
 $C' = (2, -3)$, $D' = (0, -1)$ (iii) $A' = (1, -4)$, $B' = (2, -2)$,
 $C' = (0, 0)$, $D' = (-2, -2)$ (iv) $A' = (0, -3)$, $B' = (-1, -1)$,
 $C' = (1, 1)$, $D' = (3, -1)$ (v) $A' = (-4, 0)$, $B' = (-2, 1)$,
 $C' = (0, -1)$, $D' = (-2, -3)$ (vi) $A' = (-1, 1)$, $B' = (-3, 2)$,
 $C' = (-5, 0)$, $D' = (-3, -2)$ **Exercise 16G**

1. (a) Rectangles

(b) Equilateral triangles

(c) Octagons and squares

(d) Equilateral triangles and squares

(e) Hexagons and equilateral triangles

(f) Parallelograms

(g) Hexagons

(h) Hexagons, equilateral triangles and squares

(i) Kites

(j) Dodecagons and equilateral triangles

(k) Dodecagons, squares and hexagons

(l) Trapeziums

(m) Parallelograms and triangles

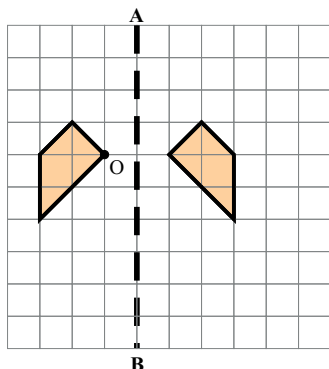
(n) Hexagons and equilateral triangles

(o) Squares and equilateral triangles

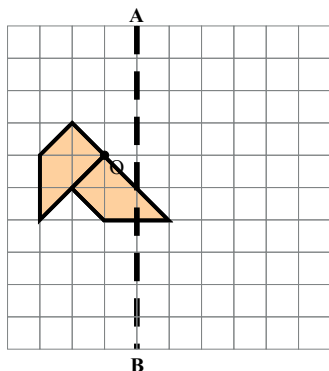
(p) Trapeziums, rhombuses, hexagons and equilateral triangles

Chapter Review

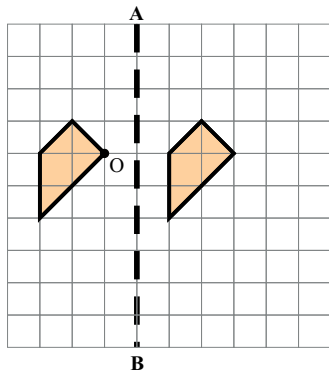
1. (a)



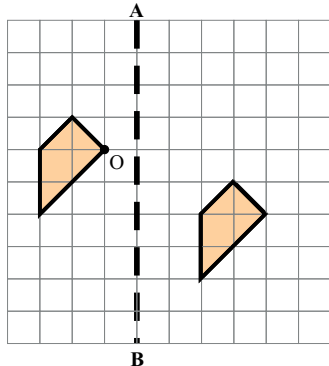
(b)



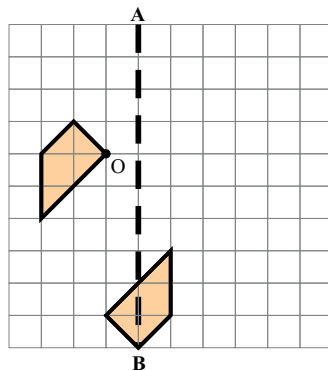
(c)



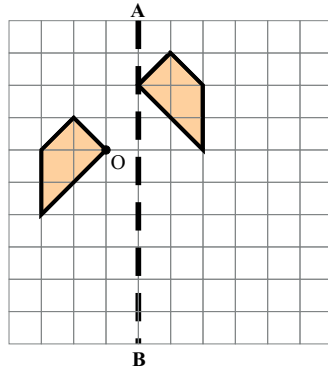
(d)



(e)



(f)

2. (a) $A = (0,3)$, $B = (2,4)$, $C = (3,1)$,
 $D = (1,1)$ (b)(i) $A' = (0,3)$, $B' = (-2,4)$,
 $C' = (-3,1)$, $D' = (-1,1)$ (ii) $A' = (0,-3)$, $B' = (2,-4)$,
 $C' = (3,-1)$, $D' = (1,-1)$ (iii) $A' = (0,3)$, $B' = (1,1)$,
 $C' = (-2,0)$, $D' = (-2,2)$ (iv) $A' = (2,-1)$, $B' = (0,-2)$,
 $C' = (-1,1)$, $D' = (1,1)$ (v) $A' = (-3,3)$, $B' = (-1,4)$,
 $C' = (0,1)$, $D' = (-2,1)$ (vi) $A' = (0,1)$, $B' = (2,2)$,
 $C' = (3,-1)$, $D' = (1,-1)$ (vii) $A' = (-3,-3)$, $B' = (-1,-4)$,
 $C' = (0,-1)$, $D' = (-2,-1)$

Chapter 17

Exercise 17A

- (a) scalene (b) isosceles
(c) right-angled (d) equilateral
- (e) 180° (f) 180°
- (d) 90°
- (a) $a = 30^\circ$ (b) $m = 25^\circ$ (c) $x = 70^\circ$
(d) $n = 60^\circ$ (e) $y = 52^\circ$ (f) $p = 133^\circ$
- (i) a,b,e,f (ii) c (iii) d (iv) a,e
- (a) $x = 65^\circ$ (b) $t = 110^\circ$ (c) $a = 20^\circ$
(d) $m = 75^\circ$ (e) $\theta = 34^\circ$ (f) $\phi = 67^\circ$
(g) $y = 36^\circ$ (h) $k = 45^\circ$

Exercise 17B

- A & D, B & G, C & I, E & L,
F & K, H & J**
- A & K, B & H, C & I, D & G,
E & J, F & L**

Exercise 17C

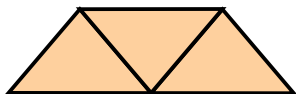
A, B, C, D, E

Exercise 17D

- (a) b (b) c & d
- 7 cm
- (a) isosceles (b) right-angled
(c) 30°
- 45°

Exercise 17E

- (a) **G** (b) **F** (c) **D** (d) **A** (e) **B**
(f) **E** (g) **C**
- (a) True (b) False (c) True
(d) True (e) False (f) True
(g) False (h) True (i) False
- 40
- 70
- A, B, C, D**
-



- (a) $a = 120^\circ$, $b = 60^\circ$, $c = 120^\circ$
(b) $d = 52^\circ$, $e = 128^\circ$, $f = 52^\circ$
- p and r
- (a) $w = 40^\circ$ (b) $m = 50^\circ$ (c) $b = 70^\circ$
(d) $p = 45^\circ$ (e) $t = 132^\circ$ (f) $x = 60^\circ$
(g) $n = 114^\circ$ (h) $m = 97^\circ$
- top angle = 100°
bottom angle = 50°
- 40° , 80° , 120° , 120°
- (a) 75° (b) 15°
- 134°
- (a) rhombus (b) parallelogram
(c) trapezium (d) rectangle
(e) perpendicular (f) quadrilateral

Exercise 17F

- 9
- 36
- 33
- 64
- 54
- 48
- 200

Chapter Review

- (a) $p = 50^\circ$ (b) $y = 37^\circ$ (c) $n = 110^\circ$
(d) $m = 68^\circ$ (e) $\theta = 40^\circ$ (f) $x = 30^\circ$
(g) $a = 125^\circ$, $b = 55^\circ$, $c = 125^\circ$
(h) $\alpha = 69^\circ$
- A & G, B & H, C & D, E & F**

Chapter 18

Exercise 18A

- (a) Depends on the weather.
(b) Very unlikely - 0-0.1
(c) Depends on where you live -
0.2-0.7
(d) 0.3-0.6
(e) Depends on where you live -
0.4-0.7
(f) Very, very unlikely - 0.00000001
(g) Depends on your teacher!
(h) Depends on your basketball skills.

1. (i) Depends on their basketball skills.
(j) Depends on your cricket skills.
(k) Try it!!! - 0.5?
(l) Unlikely!? - 0.1
(m) Most people could do this!? - 0.9
(n) 1
(o) 0
(p) Try it.

Exercise 18B

1. (a) $\frac{1}{3}$ (b) $\frac{5}{6}$ (c) 0 (d) $\frac{2}{3}$ (e) 1
(f) $\frac{1}{2}$ (g) $\frac{1}{3}$ (h) 0 (i) $\frac{5}{24}$
2. (a)(i) $\frac{5}{9}$ (ii) $\frac{4}{9}$ (b)(i) $\frac{1}{2}$ (ii) $\frac{1}{2}$
3. (a)(i) $\frac{3}{5}$ (ii) $\frac{2}{5}$ (b)(i) $\frac{2}{3}$ (ii) $\frac{1}{3}$
(c)(i) 1 (ii) 0
4. (a) Sandie $\frac{3}{4}$, Celine $\frac{3}{4}$ (b) 75
5. (a) $\frac{1}{7}$ (b) $\frac{2}{7}$ (c) $\frac{5}{7}$
(d) Leap year $\frac{31}{366}$, non-leap year $\frac{31}{365}$
6. (a) $\frac{5}{26}$ (b) $\frac{21}{26}$
7. (a)(i) $\frac{1}{500}$ (ii) $\frac{3}{500}$ (b) $\frac{1}{50}$ (c) $\frac{1}{10}$ (d) \$250
8. (a) $\frac{1}{20}$ (b) $\frac{1}{5}$ (c) $\frac{1}{4}$
9. (a) $\frac{20}{100} = \frac{1}{5}$ (b) $\frac{3}{10}$ (c) $\frac{1}{2}$ (d) $\frac{17}{20}$

Exercise 18C

1. (a) $\frac{1}{2}$ (b) 0.5 (c) 50%
2. (a) $\frac{1}{4}$ (b) 0.25 (c) 25%
3. (a) $\frac{2}{5}$ (b) 0.4 (c) 40%
4. (a) $\frac{3}{10}$ (b) 0.3 (c) 30%
5. (a) $\frac{1}{6}$ (b) 0.2 (c) 16.7%

Exercise 18D

1. (a) $\frac{1}{2}$ (b) 0.5 (c) 50%
2. (a) $\frac{3}{4}$ (b) 0.75 (c) 75%
3. (a) $\frac{3}{5}$ (b) 0.6 (c) 60%
4. (a) $\frac{7}{10}$ (b) 0.7 (c) 70%
5. (a) $\frac{5}{6}$ (b) 0.8 (c) 83.3%

Exercise 18E

1. 70%
2. 35%
3. (a) $\frac{1}{13}$ (b) $\frac{12}{13}$
4. (a) 0.1 (b) 0.9
5. (a)(i) $\frac{2}{25}$ (ii) 0.08 (iii) 8%
(a)(i) $\frac{23}{25}$ (ii) 0.92 (iii) 92%

Exercise 18F

1. (a) ART, ATR, RAT, RTA, TAR, TRA
(b) $\frac{3}{6} = \frac{1}{2}$ (ART, RAT, TAR)
2. (a) 1,1 1,5 1,7 1,10
5,1 5,5 5,7 5,10
7,1 7,5 7,7 7,10
10,1 10,5 10,7 10,10
(b) 2, 6, 8, 11, 6, 10, 12, 15, 8,
12, 14, 17, 11, 15, 17, 20
(c) $\frac{10}{16} = \frac{5}{8}$ (d) $\frac{6}{16} = \frac{3}{8}$ (e) $\frac{3}{16}$
3. (a) \$3257, \$3275, \$3527, \$3725,
\$5237, \$5273, \$5327, \$5723,
(b) $\frac{1}{8}$
4. (a) AT, AR, AP, BT, BR, BP,
CT, CR, CP, DT, DR, DP
(b) $\frac{1}{12}$ (c) $\frac{11}{12}$
5. (a) R1B, R1W, R2B, R2W,
R3B, R3W, R4B, R4W,
Y1B, Y1W, Y2B, Y2W,
Y3B, Y3W, Y4B, Y4W,
G1B, G1W, G2B, G2W,
G3B, G3W, G4B, G4W
(b) $\frac{1}{24}$ (c) $\frac{23}{24}$ (d) $\frac{1}{2}$

Exercise 18G

1. (a) 0.42 (b) 0.49 (c) 0.91 (d) 0.09
2. (a) 0.18 (b) 0.81 (c) 0.99 (d) 0.01
3. (a) 0.2 (b) 0.2 (c) 0.04 (d) 0.64
(e) 0.04
4. (a) 0.51 (b) 0.09 (c) 0.49
5. (a) 0.09 (b) 0.09 (c) 0.82

Exercise 18H

1. (a)

		Box 1				
		0	2	4	6	8
Box 2	1	1	3	5	7	9
	3	3	5	7	9	11
	5	5	7	9	11	13
	7	7	9	11	13	15
	9	9	11	13	15	17
	11	11	13	15	17	19

- (b) $\frac{2}{3}$ (c) $\frac{1}{6}$ (d) $\frac{4}{5}$

2. (a)

		Box 1				
		0	2	4	6	8
Box 2	1	0	2	4	6	8
	3	0	6	12	18	24
	5	0	10	20	30	40
	7	0	14	28	42	56
	9	0	18	36	54	72
	11	0	22	44	66	88

(b) $\frac{5}{6}$ (c) 0 (d) $\frac{1}{15}$

3. (a)

		Skirt				
		B	G	P	R	O
Shirt	B	BB	BG	BP	BR	BO
	G	GB	GG	GP	GR	GO
	P	PB	PG	PP	PR	PO
	R	RB	RG	RP	RR	RO
	O	OB	OG	OP	OR	OO

(b) $\frac{1}{25}$ (c) $\frac{1}{5}$ (d) $\frac{2}{25}$ (e) $\frac{4}{5}$ (f) $\frac{9}{25}$

4. (a)

		Die 1					
		1	2	3	4	5	6
Die 2	1	2	3	4	5	6	7
	2	3	4	5	6	7	8
	3	4	5	6	7	8	9
	4	5	6	7	8	9	10
	5	6	7	8	9	10	11
	6	7	8	9	10	11	12

(b) $\frac{1}{9}$ (c) $\frac{1}{6}$ (d) $\frac{5}{18}$ (e) $\frac{1}{2}$ (f) $\frac{1}{2}$

(g) 7 (h) 2 and 12

5. (a)

		Die 1					
		1	2	3	4	5	6
Die 2	1	1	2	3	4	5	6
	2	2	4	6	8	10	12
	3	3	6	9	12	15	18
	4	4	8	12	16	20	24
	5	5	10	15	20	25	30
	6	6	12	18	24	30	36

(b) $\frac{1}{9}$ (c) $\frac{7}{9}$ (d) $\frac{1}{6}$ (e) $\frac{1}{4}$ (f) $\frac{17}{36}$ (g) $\frac{3}{4}$ (h) $\frac{1}{4}$ (i) 6 and 12

(j) 1, 9, 16, 25 and 36

Exercise 18I

1. (a)

	Boys	Girls	Total
Zoo	20	20	40
Museum	30	10	40
Total	50	30	80

(b) $\frac{1}{2}$ (c) $\frac{1}{3}$ (d) $\frac{1}{2}$

2. (a)

	Students	Parents	Total
Agreed	15	50	65
Did not agree	25	10	35
Total	40	60	100

(b) $\frac{3}{8}$ (c) $\frac{1}{6}$ (d) $\frac{13}{20}$

3. (a)

	Left-handed	Right-handed	Total
Fast	14	48	62
Slow	10	28	38
Total	24	76	100

(b) $\frac{5}{12}$ (c) $\frac{31}{50}$ (d) $\frac{24}{31}$ (e) $\frac{6}{25}$

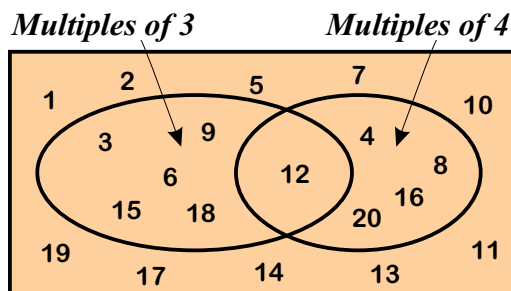
4. (a)

	Female	Male	Total
Spent less than \$100	50	30	80
Spent more than \$100	110	10	120
Total	160	40	200

(b) $\frac{5}{16}$ (c) $\frac{1}{4}$ (d) $\frac{1}{5}$ (e) $\frac{3}{5}$

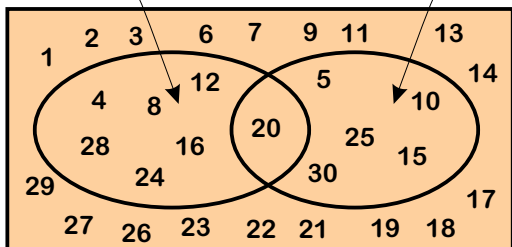
Exercise 18J

1. (a)

(b) $\frac{3}{10}$ (c) $\frac{1}{4}$ (d) $\frac{1}{20}$ (e) $\frac{1}{2}$ (f) $\frac{1}{4}$ (g) $\frac{3}{10}$ (h) $\frac{3}{10}$ (i) $\frac{1}{10}$ (j) $\frac{1}{2}$ (k) $\frac{1}{3}$

(l) 0

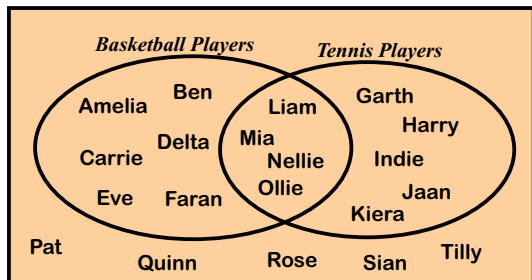
2. (a)

*Multiples of 4**Multiples of 5*

- (b) $\frac{7}{30}$ (c) $\frac{1}{30}$ (d) $\frac{2}{5}$ (e) $\frac{23}{30}$ (f) $\frac{1}{5}$
 (g) $\frac{1}{4}$ (h) $\frac{1}{5}$

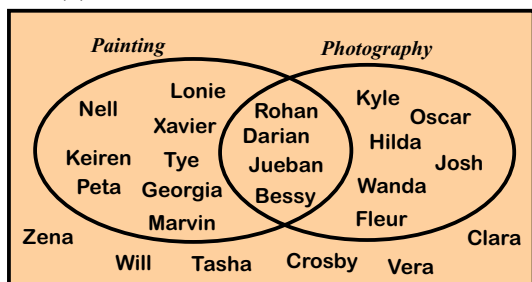
Exercise 18K

1. (a)



- (b) $\frac{3}{10}$ (c) $\frac{9}{20}$ (d) $\frac{1}{5}$ (e) $\frac{1}{4}$ (f) $\frac{1}{2}$
 (g) $\frac{4}{5}$ (h) $\frac{4}{15}$ (i) $\frac{2}{5}$ (j) $\frac{1}{2}$ (k) $\frac{5}{11}$

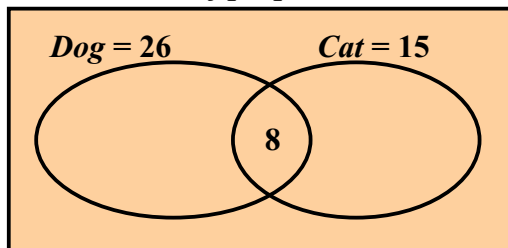
2. (a)



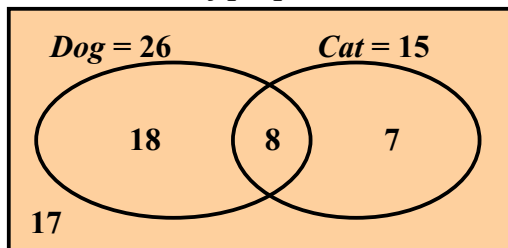
- (b) $\frac{1}{3}$ (c) $\frac{1}{2}$ (d) $\frac{1}{4}$ (e) $\frac{1}{6}$ (f) $\frac{2}{9}$
 (g) $\frac{2}{3}$ (h) $\frac{1}{2}$ (i) $\frac{3}{7}$

Exercise 18L

1. (a)

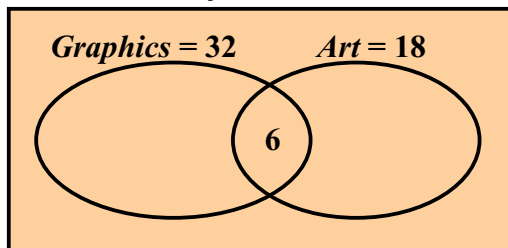
Total number of people asked = 50

(b)

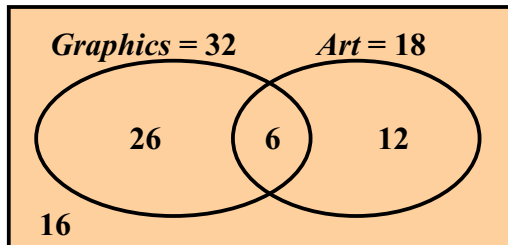
Total number of people asked = 50

- (c) 18 (d) 7 (e) 17 (f) $\frac{4}{25}$ (g) $\frac{9}{25}$ (h) $\frac{4}{13}$

2. (a)

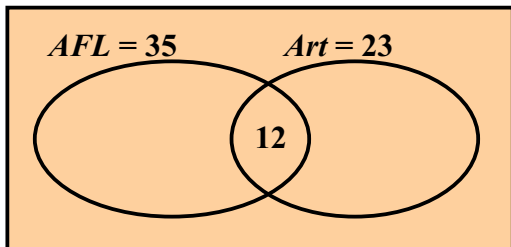
Total number of students = 60

(b)

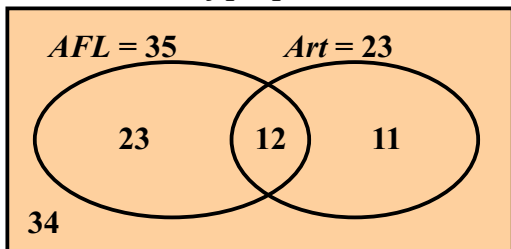
Total number of students = 60

- (c) 26 (d) 12 (e) 16 (f) $\frac{3}{10}$ (g) $\frac{1}{10}$ (h) $\frac{1}{3}$

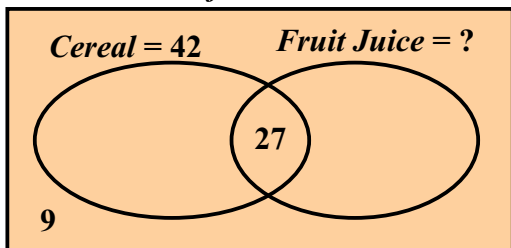
3. (a)

Total number of people asked = 80

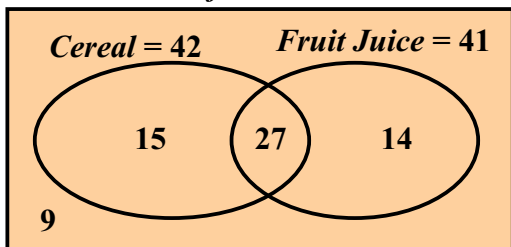
(b)

Total number of people asked = 80(c) 23 (d) 11 (e) 34 (f) $\frac{3}{20}$ (g) $\frac{11}{80}$ (h) $\frac{23}{35}$

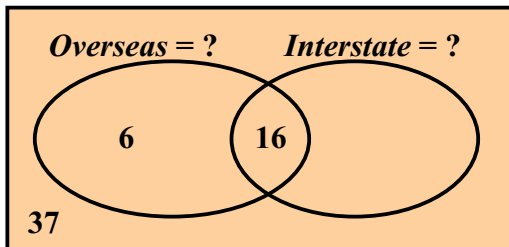
4. (a)

Total number of students = 65

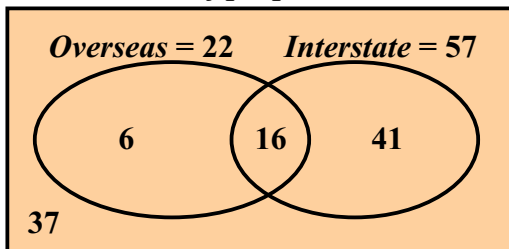
(b)

Total number of students = 65(c) 15 (d) 14 (e) 41 (f) $\frac{27}{65}$

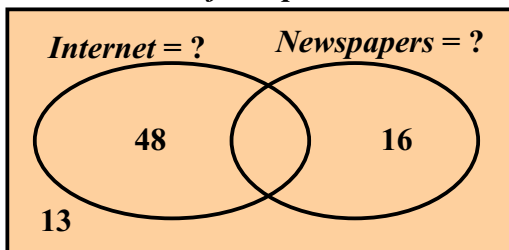
5. (a)

Total number of people asked = 100

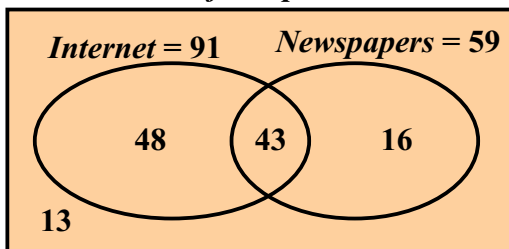
(b)

Total number of people asked = 100(c) 22 (d) 41 (e) 57 (f) $\frac{57}{100}$

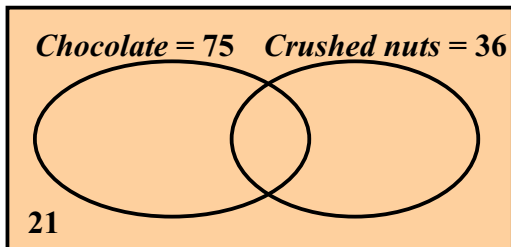
6. (a)

Total number of companies = 120

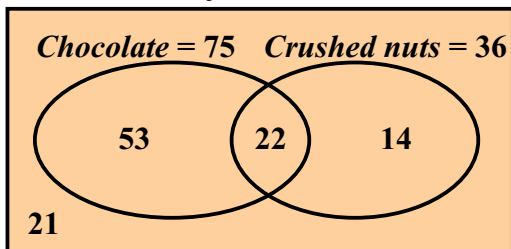
(b)

Total number of companies = 120(c) $\frac{43}{120}$

7. (a)

Total number of ice-creams = 110

(b)

Total number of ice-creams = 110(c) $\frac{1}{5}$ **Chapter Review**

1. (a) **C** (b) **B** (c) **A** (d) **E** (e) **D**
 2. (a) $\frac{1}{6}$ (b) 0 (c) $\frac{2}{3}$ (d) $\frac{1}{2}$ (e) $\frac{4}{7}$ (f) $\frac{7}{12}$
 3. (a) 0.8 (b) 40%
 4. (a) 168, 186, 618, 681, 816, 861
 (b) $\frac{1}{3}$
 5. (a) 0.64 (b) 0.04 (c) 0.96
 6. (a)

		Box 1			
		1	5	7	12
Box 2	2	2	10	14	24
	4	4	20	28	48
	8	8	40	56	96
	9	9	45	63	108
	10	10	50	70	120

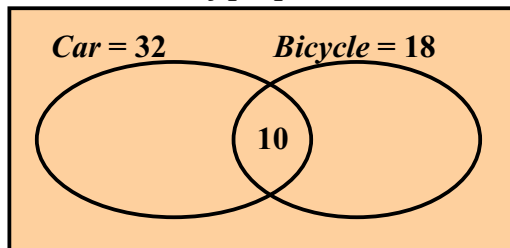
(b)(i) $\frac{1}{10}$ (ii) $\frac{13}{20}$ (iii) $\frac{2}{5}$

7. (a)

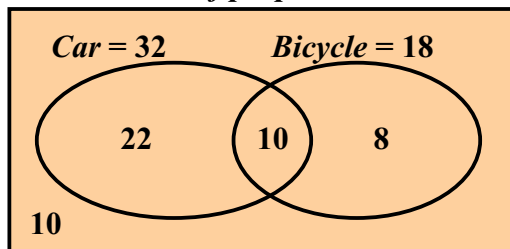
	Boys	Girls	Total
Musician	30	80	110
Astronaut	50	40	90
Total	80	120	200

(b) $\frac{8}{11}$ (c) $\frac{5}{9}$ (d) $\frac{11}{20}$

8. (a)

Total number of people asked = 50

(b)

Total number of people asked = 50(c) 22 (d) 10 (e) $\frac{4}{25}$ (f) $\frac{11}{20}$ **Chapter 19****Exercise 19A**

1. (a) questionnaire (b) questionnaire
 (c) observation (d) questionnaire
 (e) questionnaire (f) questionnaire
 (g) observation (h) questionnaire
 (i) questionnaire (j) questionnaire
 (k) questionnaire

2. (a) Leave a number of light globes switched on under different conditions and record when they fail.
 (b) Randomly select a number of bales, weigh them and find the average weight.
 (c) Inflate a number of balloons, recording their diameter until they burst.
3. (a) Questions need to be asked about how often people would use the pool.
 (b) A combination of tick the box and suggestions about the kind of music people listen to.
3. (a) As many people as possible from across the state.
 (b) As many voters as possible.
 (c) As many sugar gliders as possible.
 (d) As many people who wear jeans as possible.
 (e) As many people in the area as possible.
 (f) As many blocks of chocolate as possible.
 (g) As many people as possible that are involved with the team.
4. (a) Channel 1 - 45%
 Channel 2 - 35%
 Channel 3 - 20%
 (b) Channel 1 - 5400
 Channel 2 - 4200
 Channel 3 - 2400
5. (a) -20 = 12%, -30 = 22%,
 -40 = 28%, -50 = 21%,
 over 50 = 17%
 (b) -20 = 1800, -30 = 3300,
 -40 = 4200, -50 = 3150,
 over 50 = 2550

Exercise 19B

1. (a) Everyone in the state
 (b) All voters in the country
 (c) All the sugar gliders in the park
 (d) Everyone who wears jeans
 (e) Everyone in the area
 (f) All the blocks of chocolate
 (g) Everyone interested in the football team
2. (a) Sample Group **C** would give the best results. It covers more people and a wider range of people than the others.
 (b) Sample Group **B** would give the best results. It covers a larger range of students.
 (c) Sample Group **D** would give the best results. It covers more people and a wider range of people than the others.

Exercise 19C

1. (a)

Eye Colour	Tally	Frequency
Brown		12
Blue		17
Green		6
Other		5
		40

- (b)

Weight(kg)	Tally	Frequency
30 -		6
40 -		14
50 -		19
60 -		21
70 -		17
80 -		8
		85

2. (a)

Fruit	Tally	Frequency
Pears		5
Apples		7
Apricots		5
Grapes		6
Mangoes		4
Bananas		3
		30

(b)

Income	Tally	Frequency
\$400 -		6
\$500 -		10
\$600 -		13
\$700 -		7
\$800 -		4
		40

(c)

Mark	Tally	Frequency
0 -		2
10 -		6
20 -		7
30 -		7
40 -		3
		25

(d)

Dist (m)	Tally	Frequency
20 -		8
30 -		15
40 -		22
50 -		14
60 -		5
		64

Exercise 19D

1. (a) 32 (b) Ice Cream

(c) Cheese Cake (d) 130

2. (a) Friday

(b) Monday, Tuesday, Wednesday

(c) Thursday

(d) Stu - the amount he picked increased during the week to Thursday and Friday.

Barry - the amount he picked stayed fairly constant, but decreased on Friday

(e) Stu - 355 kg, Barry - 390 kg

(f) 170 kg (Thursday)

3. (a) City I - April, 310 mm

City II - June, 185 mm

(b) City I - August, 40 mm

City II - January, 10 mm

(c) City I - C, City II - B

(d) City I - 200 mm,

City II - 480 mm

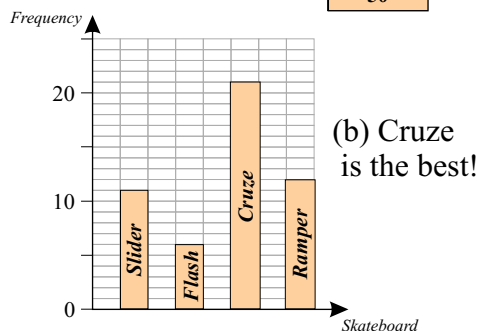
(e) City I is Manaus because it is in the tropics and has a high rainfall in the wet season - December to April.

City II is Perth because it has a low summer rainfall. Most of its rainfall is during winter.

4. (a) 42 (b) 35 (c) 142

5. (a)

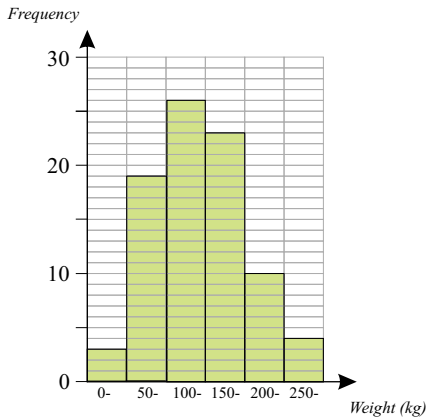
Skateboard	Tally	Frequency
Slider		11
Flash		6
Cruze		21
Ramper		12
		50



6. (a)

Weight (kg)	Tally	Frequency
0 -		3
50 -		19
100 -		26
150 -		23
200 -		10
250 -		4
		85

(b)



(c)(i) 22 (ii) 14

Exercise 19E

- (a) 1000 (b) 18 000 (c) 2011
(d) 17 000 (e) 2011
(f) 2006, 2007 (g) 2012
(h) 15 000 (i) 8000
- (a)(i) January (ii) July
(b)(i) 20°C (ii) 2°C
(c) City **B** (d) September
(e) 23°C
(f) City **A** is Brisbane, City **B** is Chicago. Brisbane is in the southern hemisphere and has its winter in June - August. Chicago is in the northern hemisphere and has its summer in June - August.

3. (a)



(b) March, December

(c) April, October, November

(d) \$0.06 (e) July (f) \$0.12

(g) \$0.43

Exercise 19F

- (a)(i) 6 (ii) 5 (iii) 6
(b)(i) 13 (ii) 12 (iii) 14
(c)(i) 12 (ii) 13 (iii) 12
(d)(i) 10 (ii) 11 (iii) 10
(e)(i) 55 (ii) 55 (iii) 36
(f)(i) 6.5 (ii) 7.5 (iii) 13
(g)(i) 7 (ii) 8 (iii) 11
(h)(i) 6.6 (ii) 5.8 (iii) 8.3
(i)(i) 27.1 (ii) 28.7 (iii) 11.0
(j)(i) 19.7 (ii) 18.4 (iii) 26.5
(k)(i) 56.62 (ii) 52.55 (iii) 42.6
- (a) 32 (b) 31 (c) 39
- (a) 50.3 sec (b) 50.2 sec (c) 5.8 sec
- (a) 38.75 kg (b) 40 kg (c) 25 kg
- (a) 424 kg (b) 425 kg (c) 135 kg
- (a) 2.1 (b) 2
- (a) 19 (b) 29
- (a) \$48 (b) \$56.50 (c) \$57.20 (d) \$59
(e) mean
- (a) Driver Dan: 45, Peter Puller: 44
(b) Driver Dan: 5.5, Peter Puller: 43.5
(c) Driver Dan: 329, Peter Puller: 15
(d) Peter Puller was more consistent.
Driver Dan had one big score
(e) 4.4
- (a) \$1200 (b) \$700 (c) median

11. (a) The Scene Setters: 190 cm
The Specky Spikers: 190 cm
(b) The Scene Setters: 189 cm
The Specky Spikers: 189 cm
(c) The Scene Setters: 50 cm
The Specky Spikers: 9 cm
12. (a) Amelia: \$25, \$40, \$40, \$40, \$355
Betsy: \$70, \$105, \$105, \$105, \$115
(b) Amelia: \$100, Betsy: \$100
13. (a)(i) mean: 21, median: 20,
range: 7
(ii) mean: 39, median: 42.5,
range: 35
(iii) mean: 37.1, median: 36,
range: 51
(b) The third set of values would be
most accurate because more
items of data have been used.

Chapter Review

1. The sample should be:
* as large as possible
* a true representation of the population
- 2.

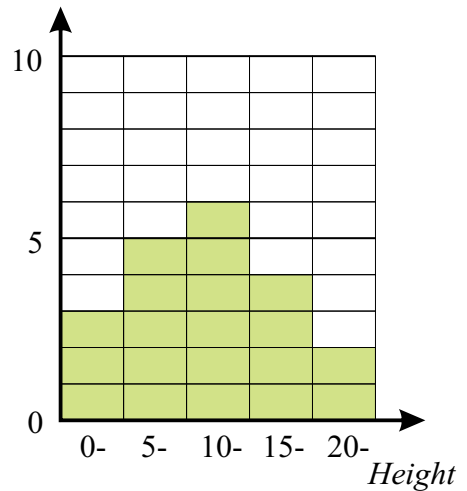
Weight(kg)	Tally	Frequency
30 -		4
40 -		12
50 -		13
60 -		20
70 -		17
80 -		9
		75

3. Reading - 70
Television - 80
Watching Sport - 60
Playing Sport - 140
Listening to Music - 70
Playing Music - 80
Computer - 100

4. (a)

Height(m)	Tally	Frequency
0 -		3
5 -		5
10 -		6
15 -		4
20 -		2
		20

(b) Frequency



(c) 8 (d) 12 m (e) 12 m (f) 21 m