

Unit 1 Analysing and displaying data

1.1 Averages and range

- 1 a 101, 101, 102, 105, 107, 118, 119
 b i 105 ii 119 iii 101 iv 118
- 2 a Phone b 4 c 0.3
- 3 Set b 7 Set c 0.4
- 4 a Any set of data with 2 modes.
 b Any set of data with no mode.
- 5 a 7 b 12
- 6 a 4 b 9.5
- 7 2.5
- 8 a 2 b 6 c 17
- 9 a 6.9 b 7 c 7
- 10 a Player A: Mean = 1.2, Median = 1, Mode = 1
 Player B: Mean = 1.3, Median = 0, Mode = 0
 b Player A: range = 3; Player B: range = 5
 c Player A is more consistent even though their mean is slightly lower.
- 11 England = 0.3 cm, St Lucia = 0.8 cm
 Discussion: No, because it rains nearly every day in England, but on only one day in St Lucia.
- 12 6
- 13 a 3, 3, 3 b $x, 3, y$ where $x + y = 12$ and $x < 3$.
 c 7, 7 and any other value. d 4, 4, 7

1.2 More averages and range

1

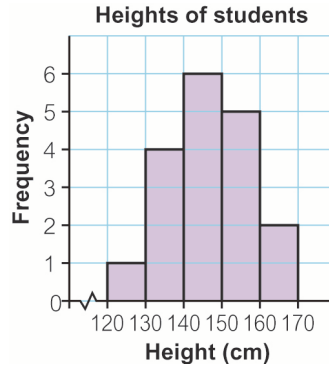
Class	Tally	Frequency
1–5		5
6–10		2
11–15		6
16–20		2
21–25		1

- 2 a 8 b 10 c 80–89
- 3 a continuous b discrete c continuous
 d discrete e discrete
- 4 a

Wingspan, w (cm)	Frequency
$0 \leq w < 10$	2
$10 \leq w < 20$	4
$20 \leq w < 30$	6

b $20 \leq w < 30$

5 a



b $140 \leq h < 150$ c 7

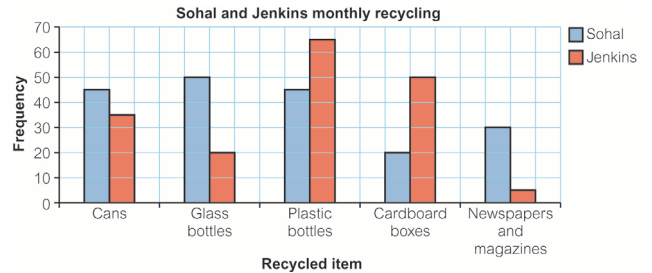
1.3 Two-way tables and bar charts

1 a 5 b juice c 4 d 30

2 a–e

	Saturday	Sunday	Total
Alan	20	22	42
Yolanda	20	15	35
Total	40	37	77

3 a



b 35 c Glass bottles d 180

e Sohal family

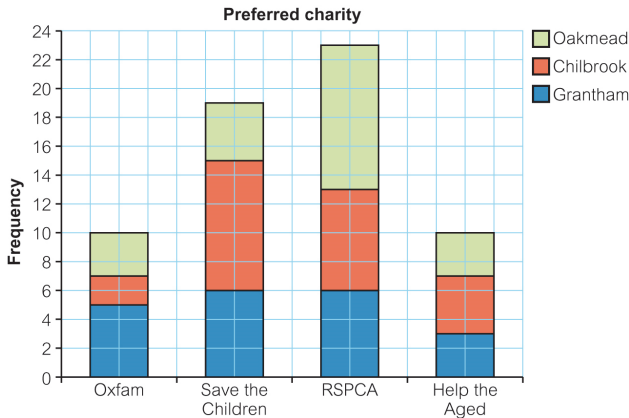
4 a i 50 ii 20

b

	Facebook	Flickr	Instagram	Tumblr
Photos of Giselle	50	30	20	20
Photos of places	20	30	10	40

c There are 120 photos of herself in total, and only 100 photos of places, so she has taken more photos of herself.

5 a



b 22 c Oakmead d RSPCA

6 a 21

b blue

c Not able to say for certain. There were more bees overall so a smaller proportion liked white, but the sample size is small.

d i Butterflies appear to prefer red much more than bees, and bees appear to prefer blue much more than butterflies.

ii About one third of bees and one third of butterflies are attracted to yellow.

1.4 More graphs and tables 1

1 a i 15 litres ii 13 litres b 40 minutes
c 3 litres

d Between 20 and 30 minutes. The graph is steeper so the diver used up air more quickly, so was probably more active.

2 a Correct points plotted on given axes.

b Students' own answers. For example: 'The wind speed is likely to vary according to the seasons, and may be quite different after a few months.'

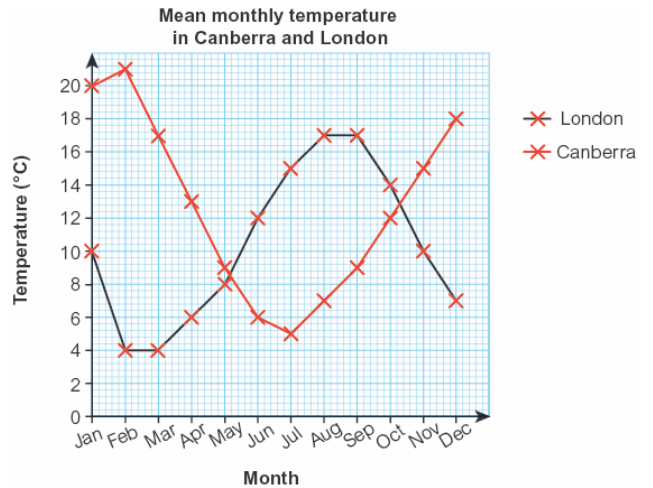
3 a i 10am ii 4.5 m iii 1.5 m

b 6pm

c i The predicted times for low tide are the same, but the predicted and reported times for high tide differ by 1 hour.

ii The recorded tide height at a particular time was always higher than the predicted height.

4 a



b i June, July and August

ii February, March and April

c Students' own observations. For example:

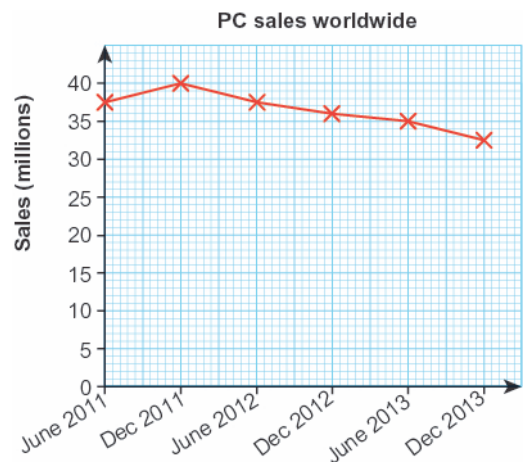
'The minimum temperature in Canberra is higher than the minimum temperature in London.'

'The maximum temperature in Canberra is also higher than the maximum temperature in London.'

'The minimum temperatures in Canberra occur when the maximum temperatures in London occur.'

5 a The scales on the sales axes are different. The scale for tablet sales starts at 0 and goes up in intervals of 1 million. The scale for PC sales has a discontinuity between 0 and 30 and goes up in intervals of 2 million.

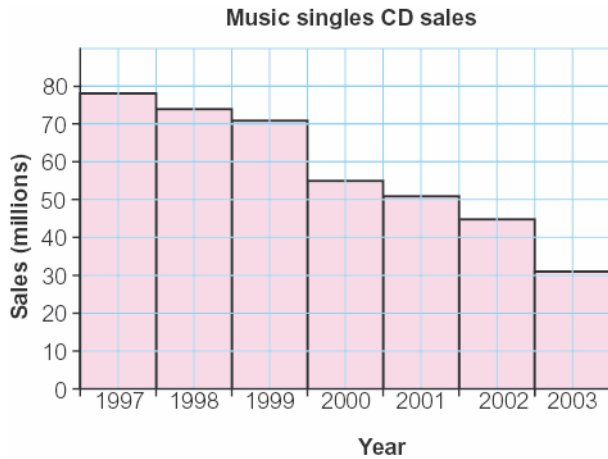
b



c Students' own answers. For example: 'Tablet sales increase by more than 4 times in 2 years'.

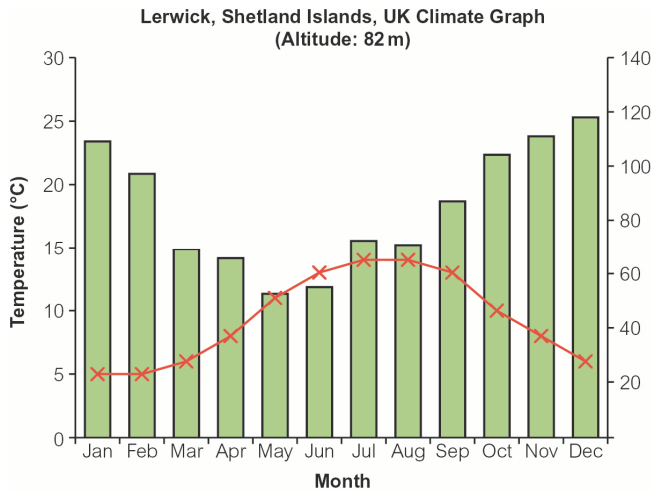
6 a The scale on the vertical axis has unequal intervals. Bars for 2002 and 2003 are wider.

b



7 a Bar chart for rainfall.

b Line graph for maximum temperature (°C).



c The maximum temperature increased steadily between March and July, then began to decrease between September and December. The rainfall decreased between January and May, then began to increase again between June and December.

1.5 More graphs and tables 2

1 a 25

b cell A1

2, 3 On spreadsheet.

4 a, b On spreadsheet.

c 10

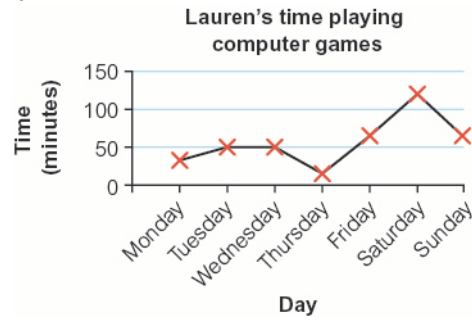
d 11.5

e 11.9

f 6

5 a On spreadsheet.

b



c 45

d i 55

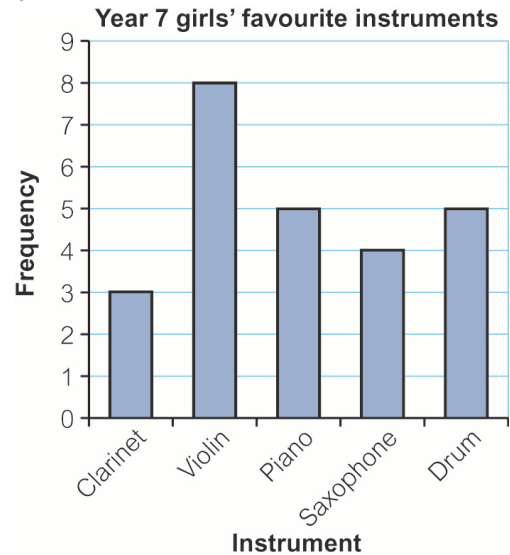
ii 45

iii 45

iv 105

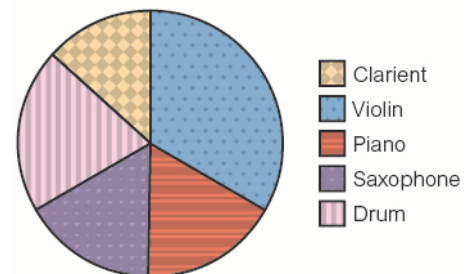
6 a On spreadsheet

b



7 a

Girls' favourite musical instrument

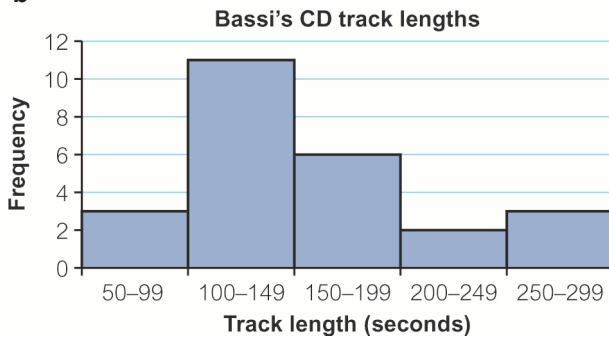


b Violin c No

d Students' own answers, for example, both compound and dual bar charts are better because they show actual figures whereas the pie chart only shows proportions.

8 a On spreadsheet.

b



c On spreadsheet.

- 9 a i Car ii Bicycle b Group A c 32
 d Students' own answers, for example, the bar chart is better because it shows actual figures whereas the pie chart only shows proportions.

1 Check up
 Averages and range

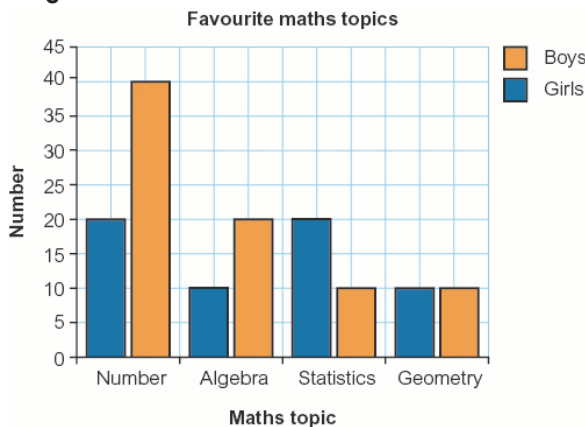
- 1 a i 1.5 km ii 2 km iii 6.5 km
 b Yes. The mean is affected by the extreme value of 7 km, and there is more than one mode, so the median is best.
 c Students live closer to School A, on average.

Charts and tables

- 2 a i 12 ii 20 iii 54 b 100
 3 a Number
 b

	Number	Algebra	Statistics	Geometry
Boys	40	20	10	10
Girls	20	10	20	10

c



- 4 a $125 \leq h < 130$ b 64 c 134
 d There is a break in the scale on the y-axis, so it looks as if there are more than double, but that is because we can't see the bottom of the scale.
 5 a Kazakhstan b 3 c Jamaica
 d Gold and bronze both 19.

Line graphs and spreadsheets

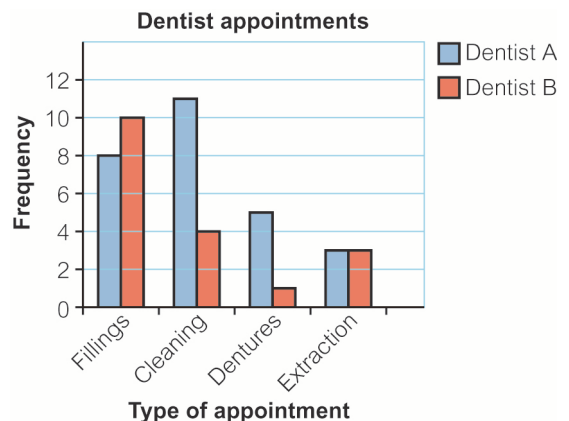
- 6 a 200 cm b Winter Park
 c November and April.
 d Avoriaz. The depth starts to decrease in February, compared with March in Winter Park.
 e 70 cm
 7 a False; the value in cell B2 is 12.
 b False; the median age is 11. c True
 d True (if rounding to nearest whole number).
 e False; the range is 2.

1 Strengthen
 Averages and range

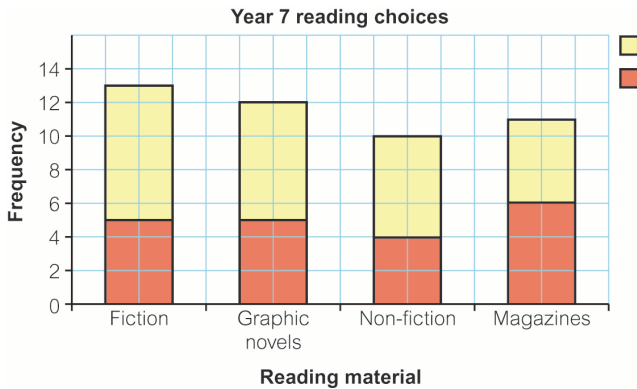
- 1 a Jo
 b Jo's range: 2 Karl's range: 11
 c The **smaller** the range, the more consistent the results.
 d Student's own choice with reasons. For example: 'Jo, her scores were consistently OK' or 'Karl, although he had one very bad score, he had one very good score and one medium score.'
 2 a i 2.6 ii 7
 b Mean: 1.8 Range: 2
 c On average, Fiona used her smartphone **more** on Sunday. The data for Sunday is **less** consistent than the data for Monday.
 3 a 0, 0, 7, 8, 9, 10, 11, 12, 12.5, 13
 b Ring drawn around 9 and 10.
 c 9.5 hours
 d 8.25 hours
 e 0
 f Median or mean, since mode is not representative of the data.

Charts and tables

- 1 a 10
 b



- 2 a 5 girls b 8 boys
c

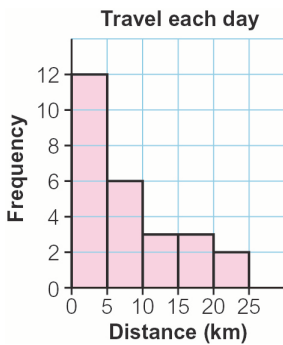


- 3 a i 19 minutes ii 18.5 minutes
iii Travelling by car is quicker than by bus on average, because the median time by bus is more than by car.
b i 7 minutes ii 22 minutes
iii Car travel times vary more than by bus, because the range of the car times is greater than the range of bus times.
4 a In the $1 \leq h < 2$ group. b 30
c $0 \leq h < 1$

5 a

Distance, d (km)	Tally	Frequency
$0 \leq d < 5$		12
$5 \leq d < 10$		6
$10 \leq d < 15$		3
$15 \leq d < 20$		3
$20 \leq d < 25$		2

- b $0 \leq d < 5$
c



Line graphs and spreadsheets

- 1 a Oxfam: £30, MSF: £10 b June
c April d £10
e i Decreased ii Increased
2 a i B3 ii B5
b Sum B2 to B5. c Spanish

- 3 The left-hand chart. The scales on the axes are different. The scale for the left-hand chart goes up in intervals of 2 m whereas the right-hand chart has intervals of 10 m. The left-hand chart also has a discontinuity between 0 and 50.

Enrichment

- 1 a 21 minutes b 46 minutes

1 Extend

1

	IT	Computing
Music	5	28
Drama	15	12

- 2 a Student's own grouped frequency table. For example:

Minutes late, m	Frequency
$0 \leq m < 5$	8
$5 \leq m < 10$	1
$10 \leq m < 15$	4
$15 \leq m < 20$	2
$20 \leq m < 25$	1
$m \geq 25$	2

- b Students' own answers. For example:
'The modal class is $0 \leq m < 5$, but this doesn't mean most trains were less than 5 minutes late.'
'Very few trains were more than 20 minutes late.'

- 3 a 27 million
b 110 million
c The scales for full time and part time workers are different, so they aren't comparable.
4 a i 91.4 kg
ii 19 kg
iii 88.45 kg
b The Cambridge rowers have more consistent weights, with a smaller range. The Oxford rowers are light on average (median and mean).
c i The range, because the cox's mass is less than any other member of the team.
ii The median, as the mean is brought down much further by the extreme value.

- 5 a 1
b 5
c

Number of generators hired	Frequency
0	4
1	6
2	5
3	3
4	1
5	1

d 1.7

6 a

Time, t minutes	Frequency
$0 \leq t < 4$	1
$4 \leq t < 8$	8
$8 \leq t < 12$	4
$12 \leq t < 16$	2
$16 \leq t < 20$	2

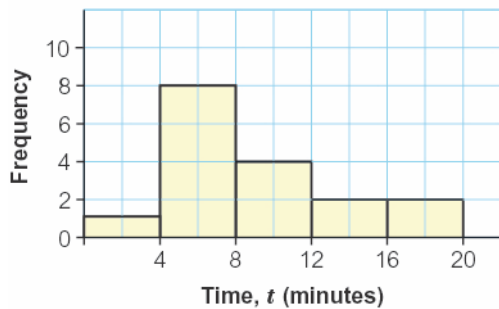
b $4 \leq t < 8$

c i 9

ii 8

d

Ambulance response times



- e i There are no times greater than 10 minutes. This may have been because there were fewer calls.
ii There is no mode.
Median: 7.55
Mean: 7.175
iii The median. It lies exactly in the middle and is not affected by extreme values. The mean is also reasonable because it takes all values into account.

7 a World Eco

b i 28 500 GWh

ii 21 000 GWh

c Answers will vary but may include: Eco-Electric does not generate as much energy using renewable sources; Eco-Electric generates a larger % of its energy using oil; Eco-Electric does not generate any energy using hydro-electric. World-Eco is the more environmentally sound company, because it generates more energy using renewable sources and a much smaller % of energy is generated using oil.

8 a i

Distance (d miles)	Tally	Frequency
$0 \leq d < 5$		8
$5 \leq d < 10$		14
$10 \leq d < 15$		6
$15 \leq d < 20$		2

ii $5 \leq d < 10$

iii 8 days

b i

Distance (d miles)	Tally	Frequency
$0 \leq d < 4$		7
$4 \leq d < 8$		7
$8 \leq d < 12$		10
$12 \leq d < 16$		4
$16 \leq d < 20$		2

ii $8 \leq d < 12$

iii There would be fewer and fewer values per class, some empty. Eventually there would be more classes than values, defeating the purpose of classifying data to make it more manageable.

c i 8 am

ii 700 m

iii 1300 m

iv faster descent than ascent

v about 900 m

vi It gives a rough idea of how a lion might cross the canyon, but other lions might cross at a different place, they may have different abilities, the weather may be different, etc.

9 a

	$135 \leq h < 140$	$140 \leq h < 145$	$145 \leq h < 150$	$150 \leq h < 155$	$155 \leq h < 160$	Total
Boys	3	7	3	4	0	17
Girls	2	2	6	4	1	15
Total	5	9	9	8	1	32

b 10

c 18

d The mode height for girls is $145 \leq h < 150$, whereas the mode height for boys is shorter, at $140 \leq h < 145$.

We can only estimate the mean because the data is grouped.

10 £3.26

1 Unit test

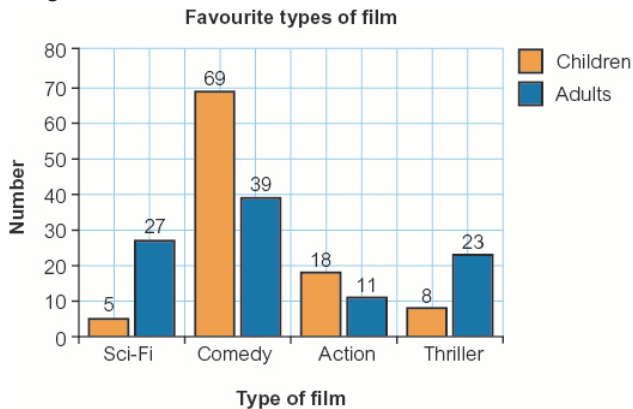
1 a 30 b 25 c 75
 d i 15 ii 20 iii 55

2 127.9 m

3 a 30

b 100 children and 100 adults, giving 200 in total.

c



4 Students' own answers. For example:

a 'The students' mean scores were very similar.'
 'Oscar's score was much more varied than Venus's.'

b 'Venus. Her score is more reliable.'

5 a 55°C b 20°C

c The pan without the lid reached room temperature after 40 minutes. The pan with the lid took 20 minutes longer, and reached room temperature after 60 minutes.

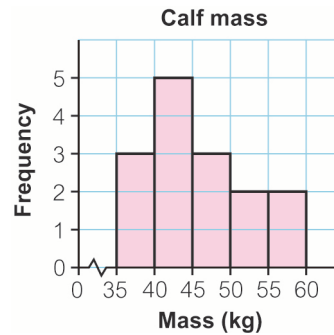
d 15°C

6 a

Mass, m (kg)	Tally	Frequency
$35 \leq m < 40$		3
$40 \leq m < 45$		5
$45 \leq m < 50$		3
$50 \leq m < 55$		2
$55 \leq m < 60$		2

b $40 \leq m < 45$

c



Unit 2 Rules of divisibility

2.1 Rules of divisibility

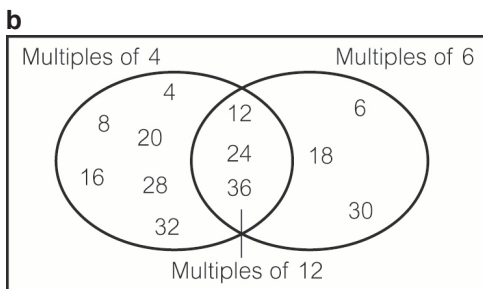
- 1 a 12, 14, 16 b 18, 21, 24 c 24, 28, 32
 d 30, 35, 40 e 54, 63, 72 f 60, 70, 80
- 2 a Yes b Yes c Yes
 d No e Yes f No
- 3 b Yes b No c Yes d Yes
- 4 a 124, 84, 120, 300, 252, 100, 56
 b It ends in a 0. c It ends in a 5 or 0.
 d i 120, 300, 100
 ii 35, 120, 300, 45, 100
- 5 a It is.
 b i Yes ii No iii No iv Yes
- 6 a Yes b No
 c i 2, 4, 6, 8, 10, 12, 14, 16, 18, 20
 ii 4, 8, 12, 16 and 20 circled
 iii They are all even.
 d A number is divisible by 4 if, when you halve it, the answer is even.

7 No

- 8 a i Yes ii Yes iii No
 iv Yes v No vi Yes
 b 18

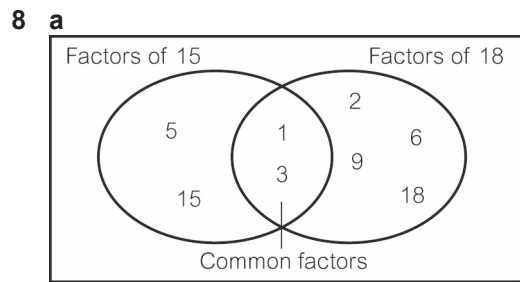
2.2 Factors, multiples and primes

- 1 a 3, 12, 15, 18, 24, 30 b 5, 15, 20, 30
 c 2, 4, 5, 8, 20
- 2 a i 4, 8, 12, 16, 20, 24, 28, 32, 36
 ii 6, 12, 18, 24, 30, 36 iii 12, 24, 36

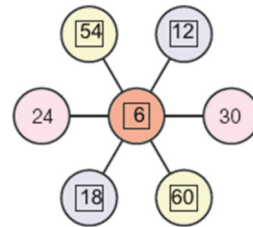


- 3 2, 3, 11, 17
- 4 a 1, 2, 4, 7, 14, 28 b 2, 7
- 5 a 1, 2, 3, 4, 6, 8, 12, 16, 24, 48
 b 1, 2, 4, 7, 8, 14, 28, 56
 c 1, 2, 4, 8, 13, 26, 52, 104
 d 1, 2, 4, 5, 10, 20, 25, 50, 100
 e 1, 2, 3, 4, 6, 9, 12, 18, 36
- 6 6, 18, 26, 52, 117

- 7 a 1, 2, 4, 8 b 1, 2, 3, 4, 6, 12
 c 1, 2, 4 d 4



- b 3
- 9 a 3 b 4 c 6
- 10



Pairs were chosen where the lower number did not divide into the higher.

- 11 a 3, 6, 9, 12, 15, 18, 21, 24, 27, 30
 b 5, 10, 15, 20, 25, 30 c 15, 30 d 15
- 12 a 4, 5: 20 4, 6: 12 4, 10: 20
 5, 10: 10 5, 6: 30 10, 6: 30
 b 5, 10 The higher is divisible by the lower.
 c 4, 5 and 4, 10; 5, 6 and 10, 6. Each of the first pair is a factor of one of the second.

13 The larger wheel must make 2 turns, and the smaller 3. This means the teeth have connected 24 times ($24 = 12 \times 2 = 8 \times 3$). 24 is the LCM of 12 and 8.

14 The LCM of 9 and 15 is 45.

2.3 Positive and negative numbers

- 1 -5 and -2
- 2 a -2°C b -2°C
- 3 a $3 > -2$ b $-4 < -1$ c $5 > -8$ d $0 > -5$
- 4 a -3, 0, 2 b -4, -2, 1, 5
 c -3, -2, 2, 3 d -10, -7, -5, -1, 0, 8
- 5 a Winnipeg b -4.5°C c -3°C d 8°C
 e i 32°C ii 8°C iii 16°C
- 6 a -3 b -9 c -9 d 3
 e -3 f -7 g -3 h 3

- 7 a i $2 + 3 = 5$ ii $2 - 3 = -1$
 $2 + 2 = 4$ $2 - 2 = 0$
 $2 + 1 = 3$ $2 - 1 = 1$
 $2 + 0 = 2$ $2 - 0 = 2$
 $2 + -1 = 1$ $2 - -1 = 3$
 $2 + -2 = 0$ $2 - -2 = 4$
 $2 + -3 = -1$ $2 - -3 = 5$

- b i - ii +
 c replace + - with -
 replace - + with -
 replace - - with +

- 8 a 8 b 8 c 14 d 14
 e -14 f -14 g -8 h -8

- 9 a 2 b 5 c -15 d 4

- 10 a i 125°C ii 65°C
 b 123°C c 235°C

- 11 a i $9 + 3 = 12$ ii $-7 + -5 = -12$
 b i $9 - -7 = 16$ ii $-7 - 9 = -16$

- 12 a 6 b -6 c 4 d -4
 e 10 f -10 g 6 h -6
 i 48 j -48

- 13 a -12 b -14 c -40 d -27
 e -6

2.4 Squares and square roots

- 1 4, 16, 36, 49

- 2 a 64 cm^2 b 81 cm^2 c 144 cm^2

- 3 a

1^2	2^2	3^2	4^2	5^2	6^2	7^2
1	4	9	16	25	36	49

8^2	9^2	10^2	11^2	12^2	13^2	14^2	15^2
64	81	100	121	144	169	196	225

- b i 8 ii 11 iii 13 iv 15

- 4 a $\sqrt{196} = 14$ b $\sqrt{6.25} = 2.5$
 c $46^2 = 2116$ d $3.6^2 = 12.96$

- 5 a Students' own estimates

- b i 4.5 ii 2.2 iii 8.9 iv 9.5

- 6 a i 4 ii 400 iii 40 000 iv 0.04

- b i 2500 ii 810 000 iii 16 000 000

- iv 0.36

- 7 a 6 b 6 c 18 d 28

2.5 More powers and roots

- 1 a 125 b 27

- 2 a 52 b 10 c 47

- 3 a 3^4 b 2^5 c 7^3

- 4 $1^3 = 1$, $2^3 = 8$, $3^3 = 27$, $4^3 = 64$,
 $5^3 = 125$, $6^3 = 216$, $10^3 = 1000$

- 5 a 1000 b 100 000 c 10 000
 d 1 000 000

- 6 a 3 b 5 c 10
 d 1 e -2 f -4

- 7 a $2 \times 3 = 6$ b $4 \times 5 = 20$ c $3 \times 4 = 12$

- 8 a 4 b 84 c 41
 d -6 e 47 f 105

- 9 a 24 b 5000 c 2
 d 5 e 16 f 12

- 10 a 23 b 100 c 30
 d 5 e 0

- 11 a 370 b 400 c 3084
 d 40 e 0 f -1

- 12 a 4 s b 5 s c 9 s

- 13 a 1050 or 100

- b The missing number could be either the smallest number ($900 - 800$) or the largest number ($250 + 800$).

- 14 a 2 b 24 c 48

- 15 8

- 16 24

2.6 Calculations

- 1 a 7 b 3 c 9 d 6

- 2 a 30 b 40 c 80 d 60

- 3 a 29 b -4 c 18 d 31
 e 24 f 24

- 4 $\sqrt[3]{64} - 8 = -4$, $\sqrt{36} - \sqrt[3]{27} = 3$, $\sqrt{9} + 12 = 15$

- 5 a i 220 ii 700 iii 40
 iv 20 v 23 vi 5

- b i 235.2 ii 328 iii 27.276
 iv 21.65 (2 d.p.)
 v 23.27 (2 d.p.)
 vi 4.44 (2 d.p.)

- 6 No, an estimate of the total is

$$\pounds 5 + \pounds 6 + \pounds 5 + 2 \times \pounds 2 + 2 \times \pounds 3 + 3 \times \pounds 2 = \pounds 32$$

The total cost is $\pounds 29.65$

- 7 a 20 b 4 c 81 d 9
 e 4 f -8 g 8 h 3

- 8 a 7.7 m/s (1 d.p.) b 20.5 m/s (1 d.p.)
 c 26.2 m/s (1 d.p.)

- 9 a 6 b 49 c 50
 d 64 e 133 f 64

- 10 a 6 b 11 c 3
 d 3 e 2 f 10

- 11 a $\sqrt{3^3 + 3^2} = 6$, $13 - (\sqrt[3]{125 + 3}) = 5$,
 $8 \times (11 - \sqrt[3]{1000}) = 8$, $\sqrt[3]{40 + 24} = 4$
 b Students' own calculation that gives an answer of 7, for example, $\sqrt{9} + \sqrt[3]{64}$

- 12 a 675 b 135 c 2025

- 13 12, 10, 9, 7, 3

- 14 a $3(2 \times 5)^2$ b $3 \times 2 \times 5$

2 Check up
Working with numbers

- 1 a 28, 40, 198 b 123, 198 c 28, 40

- d 25, 40 e 198 f 40

- 2 a 1, 2, 3, 4, 6, 12 b 1, 2, 3, 6, 9, 18 c 2, 3
 d 6

- 3 24

- 4 a 6 b 5 c 12

- 5 a 16 b -4 c 6
 d -19 e 3 f 4

- 6 a 120 b 13

Powers and roots

- 7 a 10 000 b 8 c 49
 d 6 e 5 f 8
 g -5

- 8 9 or -9

- 9 6.2

- 10 a 270 b 32

- 11 a 60 b 6 c 16 d 36

- 12 24

- 13 15

Working with brackets

- 14 a 28 b 100 c 6
 d 22 e 25 f 37

- 15 a 18.79 (2 d.p.)
 b 0.47 (2 d.p.)

- 16 a 5 b 7 c 2 d 2

- 17 a 100 b 80 c 400

2 Strengthen
Working with numbers

- 1 a is even
 b halve it
 c ends in a 5 or 0.
 d ends in 0.

- 2 a i 6 ii Yes iii Yes
 b i $4 + 7 = 11$; 47 is not divisible by 3.
 ii $1 + 5 + 0 = 6$; 150 is divisible by 3
 iii $1 + 7 + 1 = 9$; 171 is divisible by 3

- 3 a i 18 ii Yes iii Yes
 b i No iii Yes iii Yes

- 4 The numbers that are left are 2, 3, 5, 7, 11, 13, 17, 19, 23, 29

- 5 a Factors of 16: 1, 2, 4, 8, 16
 Factors of 20: 1, 2, 4, 5, 10, 20
 Common factors: 1, 2, 4

- b 4

- 6 6

- 7 a 3, 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36, 39

- b 4, 8, 12, 16, 20, 24, 28, 32, 36

- c 12, 24, 36

- d 12

- 8 30

- 9 a-f 9

- 10 a 9 b 6 c 8 d 7

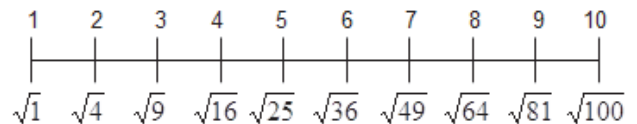
- 11 a 2 b 15 c -16 d 1
 e -15 f -14

- 12 a 8 b 7 or 8 c 12 d 12

Powers and roots

- 1 a $8^2 = 8 \times 8 = 64$
 b $3^3 = 3 \times 3 \times 3 = 27$
 c $7^2 = 7 \times 7 = 49$
 d $5^3 = 5 \times 5 \times 5 = 125$
 e $9^2 = 9 \times 9 = 81$
 f $2^3 = 2 \times 2 \times 2 = 8$

- 2 a



- b i 6.7 ii 4.2 or 4.3
 iii 9.7 or 9.8

- 3 a 40 b 54 c 8 d 2

- 4 a 40 b 14 c 18 d 20
 e 37 f -16

- 5 a 4, 5, 6, 7, 8, 9 b 27 c 42
 d 45

- 6 a 4, 5, 10 b 40 c 20 d 12

Working with brackets

- 1 a 64 b 27 c 48
 d 70 e 50 f 63
- 2 a 7 b 4
- 3 a 6 b 4 c 5
 d 5 e 2 f 1
- 4 a 3 b 2 c 6
 d 4 e 3 f 2
- 5 i C ii E iii F
 iv A v D vi B

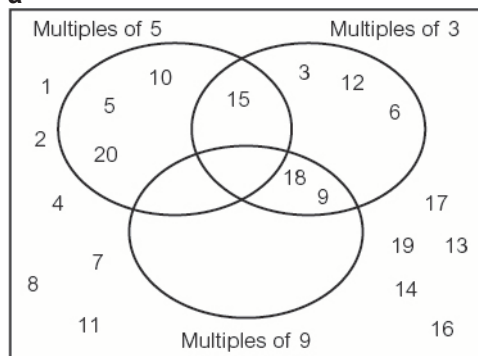
Enrichment

- 1 a 9 and -2 b 11 and -4
 c 9 and -4 d 11 and -2

2 Extend

- 1 45 or 90
- 2 $2^3, 4^2, 5^2, 3^3, 4^3$
- 3 $15^2 = 225, 2^{15} = 32\,768$, so 2^{15} is larger

4 a



- b Yes; there are no multiples of 9 that are not also multiples of 3.
- 5 Yes. $8 + 5 + 6 = 19$ which is not a multiple of 9. Therefore \$856 will not divide exactly by 9.
- 6 24
- 7 a i 1, 2, 4, 8, 16
 ii 1, 2, 4, 5, 8, 10, 20, 40
 iii 1, 2, 4, 7, 8, 14, 28, 56
 b 8
- 8 a i 3, 6, 9, 12, 15, 18, 21, 24, 27, 30
 ii 4, 8, 12, 16, 20, 24, 28, 32, 36, 40
 iii 6, 12, 18, 24, 30, 36, 42, 48, 54, 60
 b 12

9 240 seconds

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

- 11 a i 7 and -5 ii 8 and -6
 b i -6 and -5 ii 7 and 8
 c i 8, -6 and 7 or 7, -6 and 8
 ii -6, 8, -5 or -5, 8, -6

12 $5^2 = 25$ so the side length must be greater than 5 cm

13 Side length estimate is 8.4, so perimeter is about 33.6 cm

14 a Square B b Square C

15 a i 5 s ii 10 s iii 6 s
 b i 6.3 s ii 7.7 s

16 a 5 or -5 b 7 or -7 c 4 or -4
 d 3 or -3

17 a -5 b -4 c -4
 d 3 e -4 f -2

18 a $2 + 2 + 2 = 3 \times 2 = 6$
 $1 + 1 + 1 = 3 \times 1 = 3$
 $0 + 0 + 0 = 3 \times 0 = 0$
 $-1 + -1 + -1 = 3 \times -1 = -3$
 $-2 + -2 + -2 = 3 \times -2 = -6$

b i -9 ii -12 iii -15 iv -18
 c 6, 4, 2, 0, -2, -4, -6

19 a -2 b -3 c -4 d -5
 e -2 f -4 g -6 h -8

20 ai 108 ii 66 iii 39 iv 80
 v 49 vi 3

b i 94.08 ii 67.77 iii 41.23 iv 93.3 (3 s.f.)
 v 45.9 (3 s.f.) vi 3.22 (3 s.f.)

21 a 27, 64, 125
 b 2, 7, 3.1, 4.5
 c 2.714417617, 3.107232506, 4.4814047466

22 -3 and 3

23 Length of side of field is approximately 12 m.
 $12 \times 4 = 48 \approx$ perimeter = approximately 50 m
 $50 \times 55 = \$2750$

24 a 15.5 b 42

25 118

26 a True b False $-1 + 6 = 5$ c True
 d False difference between -0.5 and 0.2 is 0.7.

27 a A 90 000 J, B 451 250 J, C 360 000 J
 b No, it has 4 times as much energy.

2 Unit test

1 a Any of 52, 54, 56, 58, 60, 62, 64
 b 54, 57, 60, 63 c 52, 56, 60, 64
 d 55, 60, 65 e 54, 63 f 60

2 a 1, 8 b 2, 3, 5, 13

3 4

4 60

5 37°C

6 $6^2 = 36$, $4^3 = 64$, $5^2 = 25$, $5^3 = 125$, $9^2 = 81$

7 a 4 b 20 c -3 d -7
e -30 f -17 g 0

8 2.8 or 2.9

9 a 42 b 16 c 8 d 54
e 61

10 10 or -10

11 a 108 b 64 c 250 d 4

12 A 87, B 88, C 86, D 85

13 -12, -9, -8, -2, 0

14 a -5 b 2 c -11

15 a 1000 b 66 c 52

16 24

17 Accept 14–14.5

18 6

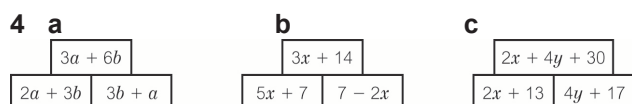
19 a 8 b 6 c 1 d 2

20 a 36 b 48 c 144 d 144

Unit 3 Equations, functions and formulae

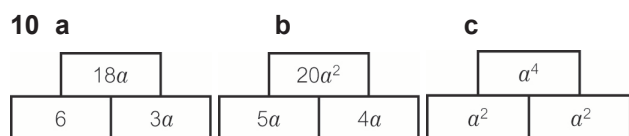
3.1 Simplifying algebraic expressions

- 1 a 3^4 b 2^3 c 5^6
 2 a $2n$ b $5y$ c $5a$ d $11b$
 e $2a$ f $5b$ g $6y$
 3 a $6x + 2$ b $2b + 3c$ c $4y - 3b + 8$
 d $7y - 2$ e $2x - 3y + 3$
 f $11a - 7b + 5$



- 5 a b^2 b t^3 c m^4
 6 a $5x^2$ b $4a + 5b^2$ c $3b^2 + 3b$
 d $2x^2 + 12x$ e $7x^4$ f $x^3 + 12x^2$
 7 a ab b bt^2 c p^3y^2 d $2m$
 e $5x$ f $7pq$
 8 a $10b^2$ b $27a^2$ c $18a^3$ d $3b$
 e $4.5a$ f $3b$
 9 $2x = x + x$ $x^2 = x \times x$
 $3x + 4x = 7x$ $2x \times 2x = 4x^2$
 $x \times 2x = 2x^2$ $4x - 3x = x$

$$\frac{9x}{3} = 3x$$



11 Pairs a and c

3.2 Writing algebraic expressions

- 1 a 0 b $5x^2 - 4x$ c $x + 9$
 2 a y^2 b b^3 c $8n$ d $8b^2$
 e $4c$
 3 a $b + 2$ b $b - 4$ c $b + 17$ d $5b$
 e $\frac{b}{2}$
 4 a $4m$ b $m + 5$ c $m - 6$ d $\frac{m}{2}$
 e $2m + 5$ f $5m - 3$
 5 a $x + y$ b xy c $x - y$ d $2y + x$
 e $3y + 4x$ f y^2 g $4x^2$ h $y^2 - 7$
 i $\frac{x}{y}$ j $\frac{20}{x} + 2$
 6 a $3t + 2$ b $2t - 5$ c $2t + 4$ d $2t$
 e $t - 5$ f t^2 g $\frac{t}{3}$ h $\frac{3}{t}$

7 a $3a - 17$ b $\frac{b}{4} + 3$ c $25c$ d $\frac{d+2}{5}$

8 a $b + 5$ b $4b + 10$ c 50 cm

3.3 STEM: Using formulae

- 1 a 140 minutes or 2 hours 20 minutes
 2 a 202 b 175 c 141
 3 a 6 b 6 c -2 d 9
 e 7
 4 a 15 b 29 c 8 d 4
 e 4
 5 a $8\frac{1}{3} \text{ m/s}$ b 12 m/s c 15.625 m/s
 6 a 54 b 160 c 175
 7 a i 50 N ii 700 N iii 300 N
 b i 8 N ii 112 N iii 48 N
 8 a 10 N/m^2 b 4 N/m^2
 9 a 40 V b 46.5 V c 144 V
 10 a 28 cm b 18 m c 33 cm
 11 a 373 K b 253 K c 273 K d 173 K
 12 a 5°C b 15°C c 25°C d -5°C

3.4 Writing formulae

- 1 a $x + 2$ b $y - 5$ c $20x$
 2 a 14 b 8 c 4 d 25
 3 a $r =$ number of films rented
 b $d =$ number of films downloaded c £35
 4 a £45 b £108 c $9x$ d $E = 9x$
 5 a $15x$ b $C = 15x$
 6 $L = b + 10$
 7 $L = 6B$
 8 a $\frac{x+y+z}{3}$ b Mean = $\frac{x+y+z}{3}$ c 13
 9 a i £52.50 ii £12.50
 b $C = 12.5 + 4n$
 10 a i 28 ii -7 iii -32 iv $5x + 3$
 b $y = 5x + 3$
 11 a 155 minutes b $C = 45k + 20$

3.5 Brackets and formulae

- 1 a $3y$ b $6a$ c $-3p$ d $14s$
 e $45z$
 2 a b^2 b $2m^2$ c a^3 d $6b^2$
 e $18n^2$
 3 a i 21 ii 21 They are equal.
 b i 20 ii 20 They are equal.

- 4 a $3x + 12$ b $2n + 24$ c $3p - 21$ d $4y - 20$
 e $4 + 2r$ f $40 - 5b$ g $16 - 8q$
 h $100 - 10a$

5 $2(x + 3)$

- 6 a $x - 5$ b $x(x - 5) = x^2 - 5x$
 c $A = x^2 - 5x$
 d i 50 cm^2 ii 84 cm^2

- 7 a x^2 b $x^2 + 5$ c $2x^2 + x + 5$ d 60

- 8 a $b^2 + 4b$ b $y^2 - 2y$
 c $10t + t^2$ d $2r - r^2$
 e $3w^2 + 2w$ f $10p + 4p^2$
 g $15q - 2q^2$ h $6r^2 + 2r$
 i $16m^2 - 24m$ j $40b - 8b^2$

3 Check up

Simplifying expressions

- 1 a $4x^2$ b $x^2 + 2x$ c $3x^2 - 3$
 2 a $3x + 12$ b $2a - 2w$ c $55 - 5x$
 3 a $2x$ b $11x$ c $5c$ d $3t$
 e $2x + 2b$
 4 a y^3 b x^2 c $3t^2$ d $10r^3$
 e $5r^2$ f $14t^2$ g $\frac{y}{7}$ h $2y$
 5 a $x^2 + 3x$ b $b^2 - 2b$ c $10a - a^2$ d $6x^2 + 2x$
 e $40t - 8t^2$

Substitution

- 6 84 cm^2
 7 $T = 60$
 8 5 kg/m^3
 9 10 cm
 10 a $b = 25$ b $b = 3$ c $b = 42$ d $b = 34$
 11 28
 12 49

Writing expressions and formulae

- 13 a $x - 7$ b $12x$ c $\frac{x}{2}$
 14 $T = 5x$
 15 a $b + a$ b $b(a + 3)$ c a^2 d $\frac{b}{5}$
 16 $S = \frac{P}{30}$
 17 $A = a^2$

3 Strengthen

Simplifying expressions

- 1 a $3p$ b $4m$ c $2d$ d $5t$

- 2 a $5t$ b $12g$ c $7y$
 d $4p$ e $13y + 2b$ f $11m + n$
 g $3a + 3b$ h $3q - b$ i $2t + 7$
 j $7y + 6$

3 18

- 4 a $2(x + 3) = 2x + 6$
 b $3(x + 4) = (x + 4) + (x + 4) + (x + 4) = 3x + 12$
 c $4(b + 2) = 4b + 8$
 d $5(t + 3) = 5 \times t + 5 \times 3 = 5t + 15$
 e $3(6 + a) = 18 + 3a$
 f $2(r - 3) = 2 \times r + 2 \times -3 = 2r - 6$
 g $6(10 - b) = 60 - 6b$

- 5 a 6^3 b 5^4 c 11^2

- 6 a iv b iii c v d i
 e ii

- 7 a $6w^2$ b $8a^2$ c $15b^2$ d $24m^2$
 e $99n^2$

- 8 a n^2 b $2n$ c $2n$ d $2n$

Expression a is the odd one out.

- 9 a $m(m + 1) = m \times m + m \times 1 = m^2 + m$
 b $b(b + 2) = b \times b + b \times 2 = b^2 + 2b$
 c $d(3 + d) = d \times 3 + d \times d = 3d + d^2$
 d $r(r - 1) = r \times r - r \times 1 = r^2 - r$
 e $m(m - 3) = m \times m - m \times 3 = m^2 - 3m$
 f $t(10 - t) = t \times 10 - t \times t = 10t - t^2$

10 a $t^4 + t^4 = 2t^4$

- b i $2p^2$ ii $2x^3$ iii $3m^2$ iv $5x^2$

- 11 a $2t^2 + 3t$ b $p^3 + 2p$ c $x^2 + 5x$

Substitution

- 1 £72
 2 100 km
 3 a 5 b 1 c 8 d 8
 e 18 f 3 g 12 h 14
 i 3
 4 a 15 b 63 c 16 d 20
 5 a 120 b 70 c 150
 6 a $P = 8$ b $P = 5$ c $P = 0$
 7 a 25 b 1 c 49
 8 a $m^4 = 2 \times 2 \times 2 \times 2 = 16$
 b $m^2 + 1 = 2 \times 2 + 1 = 5$
 c $m^2 - 2 = 2 \times 2 - 2 = 2$
 d $3m^2 = 3 \times 2 \times 2 = 12$

Writing expressions and formulae

- 1 a iii b i c v
 d iv e ii

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

3 b $\frac{m}{2}$ c $5n$

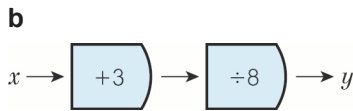
4 $p = 100m$

- 5 a y more than x b x multiplied by y
 c y less than x d x divided by y
 e x more than y f x less than y
 g y divided by x h y multiplied by x

6 $M = \frac{5K}{8}$

7 a $\frac{a+b}{2}$ b $M = \frac{a+b}{2}$

8 a 3



c $y = \frac{x+3}{8}$

Enrichment

- 1 a i 1 ii 1 iii 1 iv 1
 b 1

2 Subtracting x from both sides of the inequality leaves $2 < 3$, which is always true, so Victoria is correct.

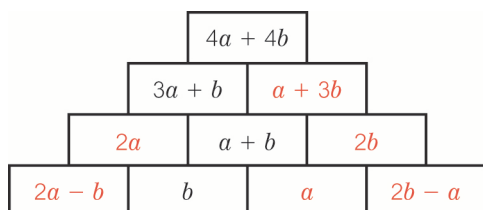
3 Extend

- 1 a $4x$ b x^2
 2 a 100 cm^2 b 600 cm^2 c x^2 d $6x^2$
 3 a Customer A: £20.50 Customer B: £15.40
 Customer C: £50
 b Customer A: £11 Customer B: £30.20
 Customer C: £100
 c Customer A should use company 2.
 Customers B and C should use company 1.

4 Students' own pairs of coordinates, e.g. (0, 3), (1, 4), (2, 5), (3, 6), (4, 7), etc.
 The line crosses the y -axis at $y = 3$.

5 $n + 2n - 5 + 4n - 10 = 7n - 15$

6



7 The algebraic expression is $2(x + 3) - 2x$ which expands to $2x + 6 - 2x$, giving 6.

8 a

8	1	6
3	5	7
4	9	2

b

$c + a$	$c - a - b$	$c + b$
$c - a + b$	c	$c + a - b$
$c - b$	$c + a + b$	$c - a$

9 They all have value 6 except $a - b$ which has the value -6

10 a 200

b $= B^3 \cdot C^3 = B^4 \cdot C^4$

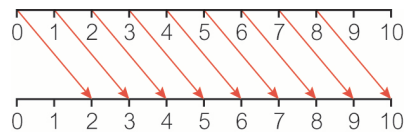
c 285

d 19

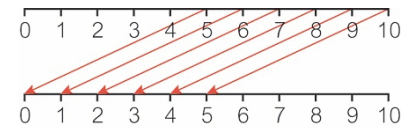
e The mean pay per hour

11 a $3L^2$ b $8L$

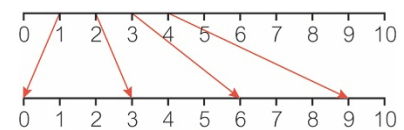
12



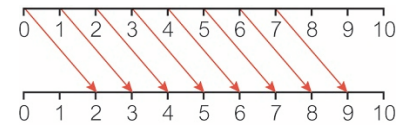
13 a



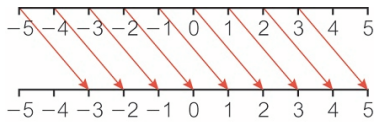
b



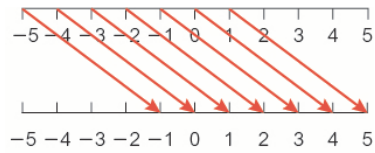
c



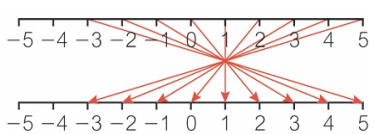
14 a



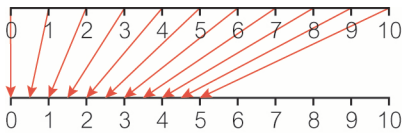
b



c



15 a



b 20

16 a $x + 1, x + 2$

b $x + x + 1 + x + 2 = 3x + 3$

17 a $2x - 4$

b i 6 ii -2 iii -4

c 4

18 Students' answers, for example,



$\times 3 + (-6)$

$\times 4 + (-9)$

$\times 5 + (-12)$

19 a 2U Taxis: \$20 A2B Taxis: \$22

b 2U Taxis: $T = 2d$ A2B Taxis: $T = d + 4p$

c A2B Taxis

d 20 miles

e 32 miles

3 Unit test

1 a $3x$ b $3x + 2y$ c $17 - 2y$

2 420 minutes

3 $P = 31$

4 $m = 3.25$

5 a $3x + 12$ b $5x - 35$ c $70 - 7x$

6 a $y - 2$ b $5m$ c $\frac{y}{10}$ d $y + x$

7 $A = I + 10$

8 a b^2 b $2b$ c $\frac{a}{b}$

9 a 12 b 60

10 a 38 b 5 c 73

11 $D = 2$

12 a $z = 1$ b $z = 9$

13 a r^5 b $14y^3$ c $3y^2$ d $15m^2$
e $6x$

14 a $13r^3$ b $7x + 3x^2$

15 a $x^2 + 7x$ b $r^2 - 5r$ c $2b^2 + 10b$
d $6b^2 - 12b$

16 a 8 b -5 c 10 d 77
e 21

Unit 4 Fractions

4.1 Working with fractions

1 a 4 b 3 c 7 d 8

2 a $\frac{1}{2}$ b $\frac{1}{3}$ c $\frac{3}{8}$ d $\frac{5}{9}$

3 $\frac{1}{4} = \frac{2}{8}$ $\frac{4}{5} = \frac{8}{10}$ $\frac{1}{2} = \frac{3}{6}$ $\frac{15}{20} = \frac{3}{4}$

4 a $\frac{2}{7} < \frac{3}{8}$ b $\frac{5}{6} > \frac{3}{4}$ c $\frac{1}{3} < \frac{3}{7}$ d $\frac{3}{5} > \frac{1}{2}$

5 $\frac{2}{5}, \frac{1}{2}, \frac{4}{7}, \frac{5}{8}$

6 $\frac{3}{4}$

7 $\frac{4}{5}$

8 a $\frac{3}{5}$ b $\frac{3}{4}$ c $\frac{2}{3}$ d $\frac{1}{2}$

e $\frac{1}{3}$ f $\frac{2}{5}$

9 $\frac{1}{2}$

10 $\frac{1}{3}$

11 a $\frac{3}{4}$ b $\frac{1}{5}$ c $\frac{1}{20}$

12 $\frac{2}{3}$

13 a £20 b 5 kg c 100 m/ d 15 cm

14 a £60 b 21 m c 100 mm d 12 kg

15 $\frac{5}{6}$ of 24 m.

16 42 cm²

4.2 Adding and subtracting fractions

1 a $\frac{1}{2}$ b $\frac{1}{3}$ c $\frac{3}{5}$ d $\frac{6}{7}$

2 a 6 b 10 c 24

3 a 2 remainder 2 b 2 remainder 2
c 4 remainder 2 d 15 remainder 1

4 a 4 b 5 c 3 d 10

5 $\frac{11}{5}$

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

7 a $\frac{2}{3}$ b $\frac{6}{7}$ c $\frac{5}{11}$ d $\frac{2}{5}$

8 a $\frac{1}{3}$ b $\frac{1}{6}$

9 Students' own answers, for example, $\frac{1}{10} + \frac{3}{10}$, $\frac{2}{15} + \frac{4}{15}$, $\frac{5}{20} + \frac{3}{20}$, etc.

10 a $\frac{7}{10}$ b $\frac{1}{6}$ c $\frac{7}{9}$ d $\frac{1}{2}$

11 $\frac{11}{16}$ inch

12 $\frac{5}{12}$

13 a $1\frac{1}{2}$ b $1\frac{1}{6}$ c $1\frac{7}{16}$ d $1\frac{2}{9}$

14 a Any one of:

$$\frac{3}{10} + \frac{22}{40} = \frac{17}{20} \quad \frac{3}{10} + \frac{13}{20} = \frac{19}{20} \quad \frac{3}{10} + \frac{2}{5} = \frac{7}{10}$$

$$\frac{22}{40} + \frac{13}{20} = 1\frac{1}{5} \quad \frac{22}{40} + \frac{2}{5} = \frac{19}{20} \quad \frac{13}{20} + \frac{2}{5} = 1\frac{1}{20}$$

b $\frac{22}{40}$ and $\frac{13}{20}$, total = $1\frac{1}{5}$

c Any one of:

$$\frac{22}{40} - \frac{3}{10} = \frac{1}{4} \quad \frac{13}{20} - \frac{3}{10} = \frac{7}{20} \quad \frac{2}{5} - \frac{3}{10} = \frac{1}{10}$$

$$\frac{13}{20} - \frac{22}{40} = \frac{1}{10} \quad \frac{22}{40} - \frac{2}{5} = \frac{3}{20} \quad \frac{13}{20} - \frac{2}{5} = \frac{1}{4}$$

d $\frac{3}{10} + \frac{13}{20} = \frac{7}{20}$

15 a $\frac{1}{2} + \frac{2}{12} + \frac{1}{4} = \frac{11}{12}$ b $\frac{3}{5} + \frac{3}{20} + \frac{1}{2} = 1\frac{1}{4}$

c $\frac{5}{8} + \frac{7}{16} - \frac{1}{4} = \frac{13}{16}$ d $\frac{26}{30} - \frac{2}{5} - \frac{4}{15} = \frac{1}{5}$

16 a $1\frac{1}{4}$ hrs b $\frac{11}{12}$ of an hour.

4.3 Fractions, decimals and percentages

1 a $\frac{2}{10}$ b $\frac{4}{10}$ c $\frac{6}{10}$

2 a 0.875 b 0.45

3 $\frac{5}{12}$

4

Fraction	$\frac{1}{10}$	$\frac{1}{5}$	$\frac{1}{4}$	$\frac{3}{10}$	$\frac{2}{5}$	$\frac{1}{2}$	$\frac{3}{5}$	$\frac{7}{10}$	$\frac{3}{4}$	$\frac{4}{5}$	$\frac{9}{10}$
Decimal	0.1	0.2	0.25	0.3	0.4	0.5	0.6	0.7	0.75	0.8	0.9
Percentage	10%	20%	25%	30%	40%	50%	60%	70%	75%	80%	90%

5

Fraction	$1\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{3}{10}$	$1\frac{1}{5}$	$1\frac{7}{10}$	$1\frac{2}{5}$
Decimal	1.75	1.5	1.3	1.2	1.7	1.4
Percentage	175%	150%	130%	120%	170%	140%

6 a 2.5 b £455 000

7 a 0.8 b 0.15 c 0.75 d 1.875
e 0.4

8 a $\frac{13}{20}$ b 0.65 c 65%

9 a A $\frac{132}{150} = \frac{22}{25}$, B $\frac{182}{200} = \frac{91}{100}$, C $\frac{68}{80} = \frac{17}{20}$, D $\frac{320}{350} = \frac{32}{35}$, E $\frac{382}{420} = \frac{191}{210}$

b Yes, because the success rates are all close to 0.9.
A 0.88, B 0.91, C 0.85, D 0.91 (2 d.p.), E 0.91 (2 d.p.)

10 Yes. Fraction carrot cake = $\frac{17}{37} = 0.459... = 45.9...%$ which is approximately 45%.

11 a 0.125 b 0.0625 c 0.03125

12 a 0.005 b 0.0025 c 0.02 d 0.04

4.4 Multiplying by a fraction

1 a £30 b 9 m c 12 cm d 20 kg

2 $\frac{4}{6} = \frac{2}{3}$, $\frac{12}{15} = \frac{4}{5}$, $\frac{16}{28} = \frac{4}{7}$, $\frac{35}{50} = \frac{7}{10}$

3 a 24 b 60 c 12 d 3
e 4 f 5 g 14 h 8

4 a $\frac{10}{3}$ m² b $\frac{2}{3}$ cm² c 5 cm²

5 a $\frac{1}{6}$ b $\frac{1}{6}$ c $\frac{1}{5}$ d $\frac{4}{9}$

6 a Area = $\frac{1}{4}$ m², Perimeter = 2 m.

b Area = $\frac{9}{16}$ cm², Perimeter = 3 cm.

c Area = $\frac{1}{16}$ m², Perimeter = 1 m.

7 $\frac{1}{60}$

4.5 Working with mixed numbers

1 a $\frac{11}{15}$ b $\frac{1}{24}$ c $\frac{2}{5}$

2 a $1\frac{2}{3}$ b $3\frac{1}{2}$ c $1\frac{4}{5}$ d $2\frac{2}{7}$

3 a 3.25 b 2.2 c 3.6

4 a $3\frac{7}{8}$ b $20\frac{11}{15}$ c $6\frac{3}{10}$ d $5\frac{1}{2}$

e $6\frac{1}{6}$ f $12\frac{3}{16}$

5 a $2\frac{1}{2}$ b $2\frac{1}{10}$ c $3\frac{5}{24}$ d $1\frac{5}{6}$

e $1\frac{5}{8}$ f $2\frac{11}{15}$ g $2\frac{15}{28}$

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

7 a $17\frac{1}{2}$ b $27\frac{1}{3}$ c $1\frac{1}{2}$ d $1\frac{3}{5}$

8 $2\frac{5}{6}$ m²

4 Check up Equivalence

1 $\frac{7}{10}$

2 a $\frac{1}{2}$ b $\frac{2}{3}$

3 $\frac{1}{3}$

4 a $\frac{5}{6}$ b $\frac{5}{9}$ c $\frac{1}{2}$ d $\frac{1}{15}$

5

Fraction	$\frac{1}{4}$	$\frac{2}{5}$	$\frac{1}{2}$	$\frac{7}{10}$	$1\frac{1}{2}$	$2\frac{3}{4}$	$3\frac{1}{5}$
Decimal	0.25	0.4	0.5	0.7	1.5	2.75	3.2
Percentage	25%	40%	50%	70%	150%	275%	320%

6 $\frac{2}{5}$

7 a 0.875 b 4.4

Multiplying fractions

8 a £5 b 10 kg

9 18

10 16 tonnes

11 $\frac{16}{25}$ cm²

12 $\frac{1}{10}$

13 $\frac{3}{5}$

14 6 litres

Working with mixed numbers

15 a $9\frac{5}{6}$ b $1\frac{1}{2}$

16 $28\frac{4}{5}$

17 a $12\frac{2}{3}$ cm b $3\frac{7}{9}$ cm²

4 Strengthen Equivalence

1 a $\frac{1}{2}$ b $\frac{3}{4}$ c $\frac{5}{6}$ d $\frac{3}{8}$ e $\frac{8}{11}$

2 $\frac{3}{8}$

3 a $\frac{1}{3}$ b $\frac{2}{3}$

4 a 64 b i $\frac{1}{8}$ ii $\frac{3}{8}$

- 5 a $\frac{3}{4} = 0.75 = 75\%$
 b $\frac{2}{5} = 0.4 = 40\%$, $\frac{3}{5} = 0.6 = 60\%$, $\frac{4}{5} = 0.8 = 80\%$
 c $\frac{2}{10} = 0.2 = 20\%$, $\frac{3}{10} = 0.3 = 30\%$, $\frac{4}{10} = 0.4 = 40\%$, $\frac{5}{10} = 0.5 = 50\%$, $\frac{6}{10} = 0.6 = 60\%$, $\frac{7}{10} = 0.7 = 70\%$,
 $\frac{8}{10} = 0.8 = 80\%$, $\frac{9}{10} = 0.9 = 90\%$


6

Fraction	$1\frac{1}{2}$	$2\frac{2}{5}$	$2\frac{1}{2}$	$2\frac{3}{5}$	$3\frac{1}{10}$
Decimal	1.5	2.4	2.5	2.6	3.1
Percentage	150%	240%	250%	260%	310%

- 7 a 0.125 b 1.375 c 2.25 d 0.35

Multiplying fractions

- 1 a 5 b 10
 2 a 4 b 8 c 12 d 16
 3 a £12 b 21 kg c 15 km
 4 a 26 b 12 c 20
 5 a $\frac{1}{6}$ b $\frac{1}{6}$

- 6 a-c 
 d $\frac{1}{8}$

- 7 a $\frac{1}{3}$ b $\frac{1}{8}$ c $\frac{2}{15}$ d $\frac{3}{20}$
 8 a $\frac{1}{14}$ b $\frac{6}{35}$ c $\frac{3}{10}$ d $\frac{1}{3}$

Working with mixed numbers

- 1 a $\frac{9}{4}$ b $\frac{7}{2}$ c $\frac{17}{3}$ d $\frac{23}{10}$
 e $\frac{17}{6}$ f $\frac{53}{5}$
 2 a 5 b 3 c $3\frac{1}{4}$ d $3\frac{1}{3}$
 e $3\frac{1}{3}$ f $2\frac{2}{7}$
 3 a $9\frac{1}{6}$ b $9\frac{1}{10}$ c $9\frac{8}{9}$ d $3\frac{7}{12}$
 4 a $\frac{1}{3} - \frac{11}{9} = \frac{42}{90} - \frac{11}{9} = \frac{31}{9} = 3\frac{4}{9}$
 b $\frac{1}{2}$ c $\frac{1}{2}$ d $1\frac{2}{3}$
 5 a 6 b $\frac{2}{4} = \frac{1}{2}$ c $6\frac{1}{2}$

6 a $17\frac{3}{5}$ b $26\frac{2}{3}$

Enrichment

1 a $\frac{9}{10} + \frac{3}{5}$
 b $\frac{7}{10} + \frac{9}{10} = 1\frac{3}{5}$
 c $\frac{9}{10} - \frac{3}{20} = \frac{3}{4}$

4 Extend

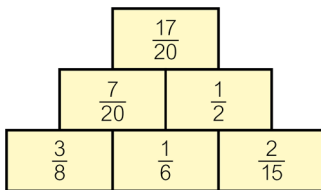
1 $\frac{28}{49}$ is the odd one out because in all the other fractions, once they are simplified, the denominator is 1 more than the numerator.

$$\frac{15}{20} = \frac{3}{4}, \frac{30}{36} = \frac{5}{6}, \frac{19}{38} = \frac{1}{2}, \frac{28}{49} = \frac{4}{7}, \frac{34}{51} = \frac{2}{3}, \frac{36}{45} = \frac{4}{5}$$

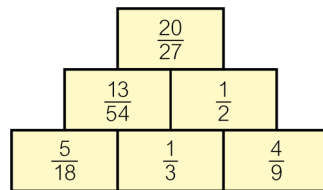
2 a 400 g b $\frac{1}{4}$

3 $\frac{1}{3}$

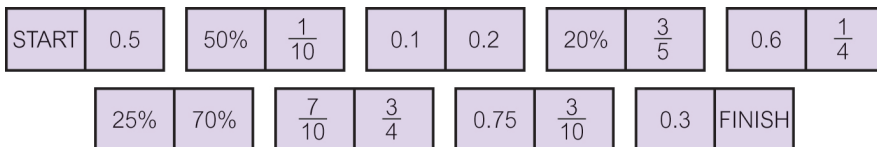
4 a



b



5



6 Nitrogen 6 tonnes, phosphorus 12 tonnes.

7 a Any one of:

$\frac{5}{8} \times 315 = 196\frac{7}{8}$	$\frac{5}{8} \times 320 = 200$	$\frac{5}{8} \times 280 = 175$	$\frac{5}{8} \times 360 = 225$
$\frac{3}{5} \times 315 = 189$	$\frac{3}{5} \times 320 = 192$	$\frac{3}{5} \times 280 = 168$	$\frac{3}{5} \times 360 = 216$
$\frac{7}{9} \times 315 = 245$	$\frac{7}{9} \times 320 = 248\frac{8}{9}$	$\frac{7}{9} \times 280 = 217\frac{7}{9}$	$\frac{7}{9} \times 360 = 280$
$\frac{4}{7} \times 315 = 180$	$\frac{4}{7} \times 320 = 182\frac{6}{7}$	$\frac{4}{7} \times 280 = 160$	$\frac{4}{7} \times 360 = 205\frac{5}{7}$

b i $\frac{7}{9} \times 360 = 280$ ii $\frac{4}{7} \times 280 = 160$

8 a Yes. As long as both numbers are positive, whether you're adding two integers, fractions or decimals, the answer will always be bigger than the individual numbers you are adding.

b No. The answer will be smaller than the first fraction, but may not be smaller than the second.

For example, $\frac{7}{9} - \frac{2}{9} = \frac{5}{9}$

$\frac{5}{9}$ is smaller than $\frac{7}{9}$, but is not smaller than $\frac{2}{9}$.

9 a She divided 16 by 15 rather than 15 by 16. b 0.9375

10 a 8 b $8\frac{1}{18}$

11 a $12\frac{2}{3}$ m b $11\frac{11}{20}$ m

12 a $\frac{1}{14}$ b $\frac{5}{7}$

13 a $\frac{39}{50}$ b $\frac{21}{100}$ c $\frac{1}{100}$

14 a $\frac{1}{2}$ b $\frac{1}{4}$ c $\frac{3}{4}$ d $\frac{1}{6}$ e $\frac{1}{12}$ f $\frac{1}{60}$

15 $23\frac{1}{4}$ hours

16 a 90 miles b $137\frac{1}{2}$ miles c 200 miles d $210\frac{4}{5}$ miles

17 a i £5 ii £5 iii They are the same. $\frac{1}{6}$. Multiply them.

b i £24 ii £24 iii $\frac{3}{10}$. Multiply them. c Yes

18

$$9\frac{13}{30} - 6\frac{9}{10}$$

$$8\frac{2}{3} - 6\frac{2}{15}$$

$$4\frac{2}{5} - 2\frac{1}{4}$$

$$5\frac{17}{20} - 3\frac{7}{10}$$

$$7\frac{2}{3} - 5\frac{11}{12}$$

$$5\frac{19}{36} - 3\frac{7}{9}$$

19 Students' own answers, for example, $10\frac{3}{4} - 6\frac{11}{20} = 4\frac{1}{5}$

20 Yes. When you multiply a number by 1 you get the same number.
When you multiply a number by a fraction less than 1 you will get a fraction of the number you started with, so the answer must be less than the number you started with.

21 $\frac{3}{10}$

22 a i Copy and complete:

$$100 \div 4 = 25$$

$$100 \div 2 = 50$$

$$100 \div 1 = 100$$

$$100 \div \frac{1}{2} = 200$$

$$100 \div \frac{1}{4} = 400$$

$$100 \div \frac{1}{8} = 800$$

ii 100 is multiplied by the denominator.

b i $1 \div \frac{1}{2} = 2$

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

$$3 \div \frac{1}{2} = 6$$

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

$$5 \div \frac{1}{2} = 10$$

ii Dividing by $\frac{1}{2}$ is the same as multiplying by 2.

4 Unit test

1 $\frac{2}{3}, \frac{1}{2}, \frac{3}{4}, \frac{5}{6}, \frac{3}{5}$

2 $\frac{3}{8}$

3 $\frac{6}{7}$ of 21, $\frac{1}{5}$ of 100, $\frac{2}{3}$ of 36.

4 450 ml

5 a $\frac{7}{8}$ b $\frac{3}{4}$ c $\frac{16}{25}$ d $\frac{1}{2}$

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

7 $\frac{67}{10}$

8 a 12 b 15

9

Fraction	$\frac{1}{2}$	$\frac{4}{5}$	$\frac{3}{4}$	$\frac{3}{10}$	$1\frac{1}{4}$	$4\frac{7}{10}$	$6\frac{2}{5}$
Decimal	0.5	0.8	0.75	0.3	1.25	4.7	6.4
Percentage	50%	80%	75%	30%	125%	470%	640%

10 3.4

11 a $8\frac{3}{8}$ b $2\frac{4}{5}$ c $4\frac{5}{9}$ d $\frac{1}{7}$

12 $\frac{5}{13}$

13 50 mm = 5 cm

14 $\frac{3}{103}$

15 $\frac{4}{15}$

16 $7\frac{2}{3}$

17 a $\frac{5}{14}$ **b** $\frac{3}{20}$

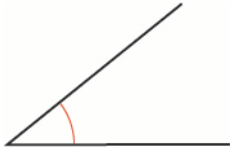
18 $13\frac{1}{3}$

Unit 5 Angles and shape

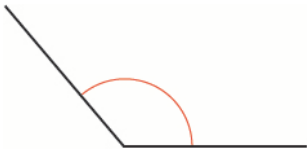
5.1 Working with angles

1 a 90° b 180°

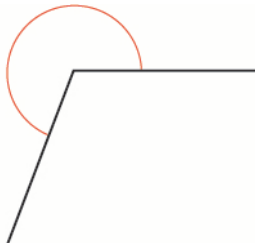
2 a Students' own drawings of an acute angle, e.g.



b Students' own drawings of an obtuse angle, e.g.



c Students' own drawings of a reflex angle, e.g.



3 a 70° b 40°

4 a i Acute, obtuse ii Students' estimates iii 65, 140

5 a Smaller angle = 120° , so marked angle = $360^\circ - 120^\circ = 240^\circ$

b Smaller angle = 50° , so marked angle = 310°

6 a Draws 60° angle. b Draws 75° angle.

c Draws 100° angle. d Draws 145° angle.

7 a $360^\circ - 220^\circ = 140^\circ$

b Draws 220° angle.

8 a Students' own drawings.

b 90° angle, as it's a more upright position.

9 Students' own drawings.

10 a–e Vertically opposite angles are equal.

11 $a = 25^\circ$, $b = 155^\circ$, $c = 155^\circ$

Vertically opposite angles are equal.

12 a $a = 140^\circ$ (angles on a straight line)

$b = 40^\circ$ (vertically opposite angles or angles on a straight line)

$c = 120^\circ$ (angles on a straight line)

b $d = 70^\circ$ (vertically opposite angles)

$e = 60^\circ$ (angles on a straight line)

$f = 50^\circ$ (vertically opposite angles or angles on a straight line)

$g = 60^\circ$ (vertically opposite angles or angles on a straight line)

c $h = 75^\circ$ (angles on a straight line)

$i = 75^\circ$ (vertically opposite angles or angles on a straight line)

$j = 105^\circ$ (angles on a straight line or vertically opposite angles)

5.2 Triangles

- 1 a A: equilateral, B, D: isosceles, C, E: scalene
 b A: $a = b = c$, B: $e = f$, D: $k = l$, C, E: no equal angles

2

Triangle	Equilateral	Isosceles	Scalene
number of lines of symmetry	3	1	0
order of rotational symmetry	3	1	1

- 3 a $a = 180^\circ - 55^\circ - 45^\circ = 80^\circ$
 b $b = 180^\circ - 150^\circ - 12^\circ = 18^\circ$
 c $c = 180^\circ - 90^\circ - 25^\circ = 65^\circ$
- 4 a $180^\circ - 50^\circ = 130^\circ$
 $a = 130^\circ \div 2 = 65^\circ$ (isosceles triangle)
 b $180^\circ - 120^\circ = 60^\circ$
 $b = 60^\circ \div 2 = 30^\circ$ (isosceles triangle)
 c $180^\circ - 90^\circ = 90^\circ$
 $c = 90^\circ \div 2 = 45^\circ$ (isosceles triangle)
 d $d = 180^\circ - 40^\circ - 40^\circ = 100^\circ$ (isosceles triangle)
- 5 Two angles must be equal; the equal angles cannot each be 100° because of the angle sum of a triangle.
 $180^\circ - 100^\circ = 80^\circ$
 $80^\circ \div 2 = 40^\circ$
 Both angles are 40° .
- 6 a $a = 60^\circ$ (angles on a straight line) $b = 70^\circ$ (angle sum of a triangle)
 b $c = 55^\circ$ (angle sum of a triangle) $d = 125^\circ$ (angles on a straight line)
 c $e = 100^\circ$ (angles on a straight line) $f = 60^\circ$ (angle sum of a triangle)

7 a

	a	b	c
exterior angle	120°	125°	80°
sum of opposite interior angles	$50^\circ + 70^\circ = 120^\circ$	$90^\circ + 35^\circ = 125^\circ$	$20^\circ + 60^\circ = 80^\circ$

- b The exterior angle of a triangle is the sum of the opposite interior angles.
- 8 $e + a = 180^\circ$ because they lie on a **straight line**.
 $b + c + a = 180^\circ$ because the angles in a triangle sum to 180°
 This proves that $e = b + c$
- 9 a Interior angles are equal, so interior angle = $180^\circ \div 3 = 60^\circ$
 b Exterior angle = sum of the two opposite interior angles = $60^\circ + 60^\circ = 120^\circ$
- 10 a $180 - 84^\circ = 96^\circ$
 $p = 96^\circ \div 2 = 48^\circ$ (isosceles triangle)
 $q = 180^\circ - 48^\circ = 132^\circ$ (angles on a straight line)
 b $r = 180^\circ - 124^\circ = 56^\circ$ (angles on a straight line)
 $s = 180^\circ - 56^\circ - 56^\circ = 68^\circ$ (isosceles triangle)
 c $t = 180^\circ - 76^\circ - 76^\circ = 28^\circ$ (isosceles triangle)
 $u = 180^\circ - 76^\circ = 104^\circ$ (angles on a straight line)

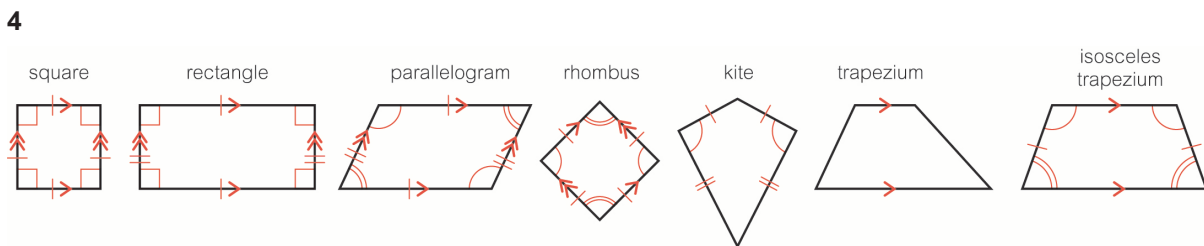
- 11 a $180^\circ - 110^\circ = 70^\circ$ (angles on a straight line)
 $x = 180^\circ - 70^\circ - 70^\circ = 40^\circ$ (isosceles triangle)
 b $180^\circ - 100^\circ = 80^\circ$
 $y = 80^\circ \div 2 = 40^\circ$ (isosceles triangle)
 c $180^\circ - 110^\circ - 40^\circ = 30^\circ$ (angle sum of a triangle)
 or $100^\circ - 40^\circ = 60^\circ$
 $60^\circ \div 2 = 30^\circ$

5.3 Quadrilaterals

- 1 a 2 b 1 c 4 d 0
 2 a Yes b No c No d Yes

3

Quadrilateral	Square	Rectangle	Parallelogram	Rhombus	Kite	Arrowhead	Trapezium	Isosceles trapezium
Number of lines of symmetry	4	2	0	2	1	1	0	1
Order of rotational symmetry	4	2	2	2	1	1	1	1



- 5 a $a = 110^\circ, b = 4 \text{ cm}$ b $m = 90^\circ, n = 12 \text{ cm}$
 c $p = 60^\circ, q = 120^\circ, r = 4 \text{ cm}$ d $x = 40^\circ, y = 140^\circ, z = 6 \text{ m}$
 6 a $e = 90^\circ, f = 45^\circ$ b $p = 6 \text{ cm}, q = 8 \text{ cm}$
 c $x = 40^\circ, y = 90^\circ$

- 7 a A rectangle is a special type of **parallelogram**.
 b Students' own answers. For example, 'A rhombus is a special type of parallelogram.'

- 8 a i parallelogram ii kite
 iii rhombus iv kite
 b Students' own answers.

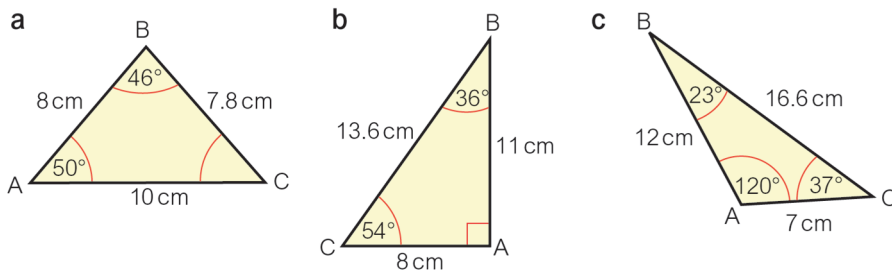
- 9 $p + r + c = 180^\circ$ because the angles in a triangle sum to 180°
 $q + s + d = 180^\circ$ because the angles in a triangle sum to 180°
 $p + q + r + s + c + d = 180^\circ + 180^\circ = 360^\circ$
 $a + b + c + d = 360^\circ$ because $a = p + q$ and $b = r + s$
 This proves that the angles in a quadrilateral add up to 360°

- 10 a 133° b 220°

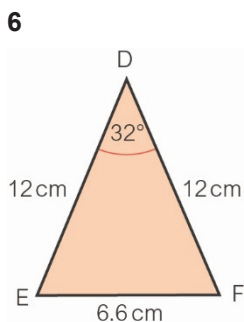
- 11 a i trapezium ii $b = 50^\circ$ (angle sum of a quadrilateral)
 b i arrowhead
 ii $f = 25^\circ$ (line of symmetry or pair of equal angles), $g = 210^\circ$ (angle sum of a quadrilateral)
 c i rectangle
 ii $k = 80^\circ$ (vertically opposite angles), $l = 100^\circ$ (angles on a straight line)
 $m = 40^\circ$ (isosceles triangle), $n = 50^\circ$ (isosceles triangle or right-angled triangle)
 d i rhombus
 ii $p = 20^\circ$ (isosceles triangle), $r = 140^\circ$ (line symmetry or opposite angles of a rhombus are equal)
 $q = 20^\circ$ (isosceles triangle or alternate angles)
- 12 a 110° b 38° c 51°

5.4 Construction

- 1 a Students' own drawings of line 7 cm.
 b Students' own drawings of line 8.2 cm.
 c Students' own drawings of line 46 mm.
- 2 Students' own drawings of line 4 cm.
- 3 a, b Students' own drawings of angles of 27° and 138°
- 4 Not drawn to scale



- 5 a Sketch of this triangle.
-
- b Students' accurate drawings of the triangle.

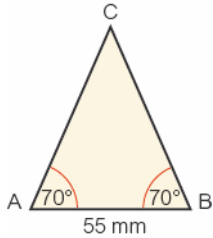


- 7 a Students' accurate drawings of this triangle
-

- b Approximately 20°
 c i Approximately 7.4 cm ii Approximately 7.4 m

- 8 a, b, ci Accurate drawings of these triangles
 a ii, iii **AB = 8 cm, AC = 5.4 cm, 80°**
 b ii, iii **AC = 21.3 cm, BC = 19.3 cm, 25°**
 c ii, iii **AC = 53.2 cm, BC = 101.0 cm, 35°**

- 9 a Sketch of this triangle



- b Students' accurate drawings of the triangle.
 c Isosceles triangle.
- 10 a Students' own accurate drawings of the truss.
 b No; this truss's height is less than 3 m.
- 11 Students' accurate drawings.
- 12 27 m

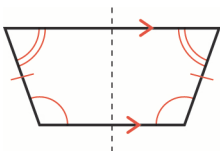
5 Check up
Working with angles

- 1 a obtuse b 150°
- 2 No; Kevin has measured the smaller angle, but the marked angle is $360 - 120 = 240^\circ$.
- 3 Students' own drawings
- 4 a $a = 50^\circ$ (vertically opposite angles)
 b $b = 30^\circ$ (vertically opposite angles)
 c $c = 40^\circ$ (angles on a straight line), $d = 140^\circ$ (angles on a straight line)

Triangles and quadrilaterals

- 5 a $a = 28^\circ$ (angle sum of a triangle) b $b = 60^\circ$ (equilateral triangle)
- 6 a $a = 50^\circ$ (isosceles triangle) b $b = 124^\circ$ (isosceles triangle)
- 7 $x = 100^\circ - 65^\circ = 35^\circ$ (exterior angle of a triangle)
 or $180^\circ - 100^\circ = 80^\circ$, $x = 180^\circ - 65^\circ - 80^\circ = 35^\circ$ (angle sum of a triangle)

- 8 a, b



- c 1
- 9 Square, rhombus, kite.
- 10 a $w = 95^\circ$ (angle sum of a quadrilateral)
 b $x = 55^\circ$ (diagonal bisector of a rhombus), $y = 70^\circ$ (isosceles triangle)
 $z = 70^\circ$ (opposite angles of a rhombus)

Accurate drawings

- 11 a Students' own accurate drawings. b Angle ACB = 60° c equilateral
- 12 a Students' own accurate drawings. b 12.1 cm c 121 cm

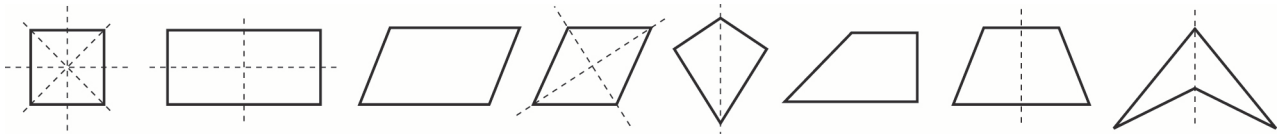
5 Strengthen
Working with angles

- 1 a 70° b 40°
- 2 He is not correct; angle ABC is an obtuse angle so it must be bigger than 90° .
- 3 a 120° b 120°
- 4 a 30° b 10°
- 5 a $50^\circ, 110^\circ$: Angles on a straight line add up to 180° .
 b 30° : Vertically opposite angles are equal.
 c 110° : Angles at a point add up to 360° .
 d $30^\circ, 150^\circ$: Angles on a straight line add up to 180° .

Triangles and quadrilaterals

- 1 a $a = 55^\circ$ (angle sum of a triangle)
 b $b = 90^\circ$ (angle sum of a triangle)
 c $c = 60^\circ$ (angle sum of a triangle)
- 2 a $x = 95^\circ$ b $x = 120^\circ$ c $x = 65^\circ$
- 3 a $m = 40^\circ$ (isosceles triangle), $n = 100^\circ$ (angle sum of a triangle)
 b $p = 70^\circ$ (isosceles triangle), $q = 40^\circ$ (angle sum of a triangle)
 c $180^\circ - 30^\circ = 150^\circ$ (angle sum of a triangle), $s = 150^\circ \div 2 = 75^\circ$ (isosceles triangle)
 d $w = 180^\circ - 35^\circ - 35^\circ = 110^\circ$ (angle sum of a triangle and isosceles triangle)
 e $180^\circ - 90^\circ = 90^\circ$ (angle sum of a triangle), $x = 90^\circ \div 2 = 45^\circ$ (isosceles triangle)
- 4 a y
 b $x = 60^\circ$ (angle sum of a triangle)
 c $y = 120^\circ$ (angles on a straight line or exterior angle of a triangle)
- 5 a $a = 130^\circ$ b $b = 85^\circ$ c $c = 20^\circ$

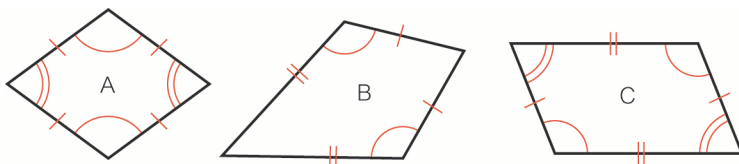
6 a



- i B, C, D
- ii E, F, G, H

- 7 a $x = 100^\circ$ b $x = 25^\circ$ c $x = 95^\circ, y = 85^\circ$
- 8 a $x = 120^\circ, y = 60^\circ$ b Opposite angles of a parallelogram are **equal**.

- 9 a A rhombus, B kite, C parallelogram
- b



- 10 $a = 130^\circ, b = 50^\circ, c = 30^\circ$

Accurate drawings

- 1 a, b Students' accurate drawings.
- 2 Students' own accurate drawings.
- 3 a, b, c Students' accurate drawings.

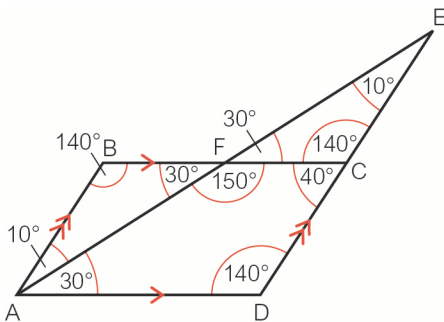
- 4 Students' accurate constructions.
- 5 a,b i Students' drawings of a line 12 cm long.
 ii Students' drawings of a 30° angle at the left-hand end of the line.
 iii Students' drawings of a 45° angle at the right-hand end of the line.
 iv Completed triangle.

Enrichment

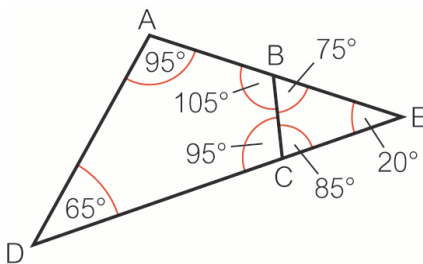
- 1 a Angles a, c, g, h, j, m, p all 107°
 Angles b, d, e, f, i, k, l, n all 73°
 b Colour added to the diagram to indicate the angles that are the same.
 c Possible answers: same coloured pattern around each vertex of the parallelogram; opposite angles are the same colour; describes any of corresponding or alternate angles without using those words.

5 Extend

- 1 a $x = 85^\circ$
 b $360^\circ - 3 \times 85^\circ = 105^\circ$
 $y = 105^\circ \div 3 = 35^\circ$
- 2 a Isosceles: ABD, DCB, EFC, EGC, ADC, ABC, Scalene: BEF, DEG, Right-angled: AEB, BEC, AED, DEC
 b i kite ii rhombus
- 3 a



b



- 4 a $a + b + c + d = 360^\circ$
 b Angles at a point add up to 360° .
- 5 a rhombus
 b i Rhombus, parallelogram or kite.
 ii Isosceles triangle, parallelogram, kite or rectangle/square, depending on the two sides joined and angles.
- 6 a $BAC = 130^\circ - 60^\circ = 70^\circ$ (equilateral triangle)
 $v = 180^\circ - 70^\circ - 70^\circ = 40^\circ$ (isosceles triangle and angle sum of a triangle)
 b $PSR = 60^\circ$ (equilateral triangle)
 $PSQ = 120^\circ$ (angles on a straight line)
 $180^\circ - 120^\circ = 60^\circ$
 $z = 60^\circ \div 2 = 30^\circ$ (isosceles triangle and angle sum of a triangle)

- 7 $\angle BCA = 50^\circ$ (exterior angle of a triangle)
 $\angle DCE = 40^\circ$ (angles on a straight line)
 $\angle FEG = 60^\circ$ (exterior angle of a triangle)
 $\angle DEC = 30^\circ$ (angles on a straight line)
 $x = 110^\circ$ (angle sum of a triangle)

- 8 a $150^\circ/210^\circ$
 b $150^\circ/210^\circ$
 c $75^\circ/285^\circ$
 d $45^\circ/315^\circ$

- 9 $a = 180^\circ - 90^\circ - 45^\circ = 45^\circ$ (angles in a triangle)
 $b = 180^\circ - 45^\circ = 135^\circ$ (angles on a straight line)
 $c = 180^\circ - 135^\circ - 35^\circ = 10^\circ$ (angles in a triangle)

- 10 a 50° b 150° c 30° d 140° e 210°

- 11 $x = 70^\circ, y = 35^\circ, z = 105^\circ$

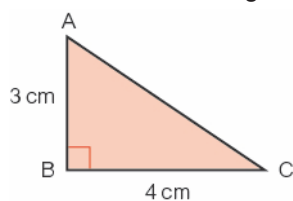
12

	Always true	Sometimes true	Never true
A rhombus is a parallelogram	x		
A parallelogram is a square		x	
A kite is a rectangle			x
A rectangle is a rhombus			x
A square is a rectangle	x		

- 13 a Students' accurate scale drawings.

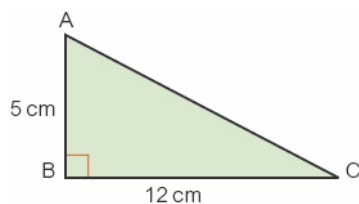
b 16.2 m

- 14 a i Students' drawings of this triangle.



- ii 5 cm
 iii 25 and 25
 iv They are the same.

- b i Students' accurate drawings of this triangle.



- ii 13 cm
 iii 169 and 169
 iv They are the same.

- 15 a Students' own drawings.

b 39.2 km, 27.8 km

c 1 hr 34 min, 1 hr 7 min

5 Unit test

- 1 Student draws an angle of 310° .
- 2 $a = 40^\circ$ (vertically opposite angles)
 $b = 90^\circ$ (vertically opposite angles)
 $c = 50^\circ$ (angles on a straight line)
- 3 $x = 35^\circ$
- 4 **a** $x = 130^\circ$
b $x = 140^\circ$
- 5 35°
- 6 Student's own accurate drawings.
- 7

Property	Square	Rectangle	Rhombus	Parallelogram	Kite
Two pairs of parallel sides	x	x	x	x	
All four sides are equal	x		x		
Diagonals cross at a right angle	x		x		x

- 8 $a = 60^\circ$ $b = 120^\circ$ $c = 20^\circ$
- 9 **a** Students' own drawings.
b 5°
- 10 **a** 65° **b** 25°

Unit 6 Decimals and percentages

6.1 Place value and rounding

1 12, 23, 31, 123, 231, 321

2 a 12 b 9 c 9 d 122 e 20

3 a 3 b 30 c 300

4

	Hundreds	Tens	Units	Hundreds	Tens	Units			
Billions	Millions			Thousands			Hundreds	Tens	Units
		5	3	4	0	0	0	0	0
	1	2	3	0	0	0	0	0	0
					9	9	1	5	4
4	0	0	0	0	0	0	0	0	0

b 99 154, 53 400 000, 123 000 000, 4000 000 000

c The further left a digit is in the place value table the larger the number.

5 a 50 010 b 3 001 000
 c 28 000 000 d 9 300 000 000
 e 8 296 000 000

6 a 999 000 001 b 999 999 999

7 a 15.6 b 9.2 c 18.9 d 110.7

8 5.3499

9 329.4 million

10 a 7.1 b 1.4 c 5.9 d 80.8

11 4.15kg

6.2 Ordering decimals

1 a -3, -2, 0, 5, 7 b -5, -3, -2, 0, 2 c -8, -7, -5, -3

2 a < b > c >

3 0.006, 0.06, 0.6

4 Students' own answers. For example: 'No, because 4 is less than 5 so 10.42 is less than 10.5.'

5 a 0.703, 0.7124, 0.724, 0.7241, 0.73
 b 12.8475, 12.874, 12.9, 12.92
 c -0.291, -0.29, -0.24, -0.203, -0.2
 d -0.491, -0.49, -0.45, -0.43, -0.405

6 a 0.376, 0.37, 0.3516, 0.315, 0.3105
 b 18.9142, 18.49, 18.429, 18.4
 c -0.107, -0.13, -0.17, -0.7, -0.73
 d -0.502, -0.514, -0.52, -0.55, -0.56

7 a Gold – Barbara Špotáková Silver – Christina Obergföll Bronze – Linda Stahl
 b descending order
 c Gold – Sanya Richards-Ross Silver – Christina Ohuruogu Bronze – DeeDee Trotter
 d ascending order

- 8 1 – Lewis Hamilton
 2 – Nico Rosberg
 3 – Sebastian Vettel
 4 – Mark Webber
 5 – Daniel Ricciardo

9 0.098 cm, 0.1 cm, 0.0955 cm

10 a < b > c > d > e <

6.3 Adding and subtracting decimals

1 a 231 b 352

2 a 117 b 633

3 a 0.6 b 0.7 c 0.58 d 0.33

4 a 2.8 b 6.6 c 3.66 d 91.41

5 a 5.96 b 12.44 c 23.23 d 9.92
 e 13.277 f 3.342 g 12.061

6 Students' own answers. For example: 'She forgot to line up the decimal points.'

7 a 2.83 b 0.72 c 6.85 d 2.151
 e 5.208

8 3.59 GB

9 a 12.27 b 9.19 c 8.85 d 15.313
 e 0.973

10 8.08 m

11 0.312 m

12 a 0.12 b 0.12 c 0.04

6.4 Multiplying decimals

1 a 332 b 1261 c 11 658

2 a $4 \times 56 = 4 \times 50 + 4 \times 6 = 224$
 b $9 \times 27 = 9 \times 20 + 9 \times 7 = 243$
 c $83 \times 7 = 7 \times 80 + 7 \times 3 = 581$

3 a 400 b 1200 c 6000

4

$7 \times 100 = 700$ $7 \times 10 = 70$ $7 \times 1 = 7$ $7 \times 0.1 = 0.7$ $7 \times 0.01 = 0.07$	$7 \times 200 = 1400$ $7 \times 20 = 140$ $7 \times 2 = 14$ $7 \times 0.2 = 1.4$ $7 \times 0.02 = 0.14$	$7 \times 300 = 2100$ $7 \times 30 = 210$ $7 \times 3 = 21$ $7 \times 0.3 = 2.1$ $7 \times 0.03 = 0.21$
--	---	---

5 a 42 b 4.2 c 4.2 d 0.42

6 a 1.8 b 3.2 c 1.8

7 a i 4.2 ii 4.2
 b i 37 ii 37

8 a i 8 ii 0.8 iii 0.08 b Dividing by 100.

9 a 36.8 b 51.38 c 148.56 d 16.12
 e 52.08

10 \$42

11 84.6 cm

12 a 3.368 b 336.8 c 3368

13 a 30 b 30 c 30
 d i 140 ii 1200

14 About 2.4 m.

6.5 Dividing decimals

1 a 5 b 50

2 a 129 b 56.5 c 29

3 a 14.6 b 6.92 c 24.83

4 0.55 m

5 a 0.5775 b Because it does not divide in exactly.

6 a 0.684 b 1.535 c 2.405 d 36.275

7 a 0.574 b 57.4 c 0.82 d 7

8 Any facts for example: $0.0341 \times 9 = 0.3069$, $3.41 \times 9 = 30.69$,
 $3.069 \div 9 = 0.341$, $3.069 \div 0.341 = 9$

9 a 0.3 b 0.7 c 0.3 d 0.8
 e 0.2 f 0.4 g 0.8 h 0.1
 i 0.4 j 0.9

10 0.6 kg

11 8.4

12 $30 \div 6 = 5$

6.6 Decimals, fractions and percentages

1 a 3 tenths b 6 hundredths

2 a 0.8 b 0.875 c 0.08

3

Fraction	$\frac{1}{10}$	$\frac{1}{4}$	$\frac{3}{10}$	$\frac{2}{5}$	$\frac{1}{2}$	$\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{3}{5}$
Decimal	0.1	0.25	0.3	0.4	0.5	0.75	1.5	1.6
Percentage	10%	25%	30%	40%	50%	75%	150%	160%

4 To convert a decimal to a percentage, $\times 100$
 To convert a percentage to a decimal, $\div 100$

5 a 72% b 23% c 9% d 108%

6 a She did not multiply by 100, she only multiplied by 10.
 b 58%

7 a 0.42 b 1.91 c 0.06 d 0.013
 e 0.294

8 a 6%, 0.6, 0.606, 63%, 0.66 b 8%, 8.8%, 80%, 0.85, 0.88

9 a $\frac{17}{20}$ b 85%

10 a $\frac{1}{2}$ b $\frac{1}{4}$ c $\frac{3}{4}$
 d $\frac{1}{6}$ e $\frac{1}{3}$ f $\frac{1}{12}$

11 a 1.5 hours b 5.25 hours c 3.75 hours
 d 2.2 hours e Students' own answers.

12 a $\frac{3}{10}$ b $\frac{8}{10} = \frac{4}{5}$ c $\frac{39}{100}$ d $1\frac{85}{100} = 1\frac{17}{20}$
 e $5\frac{48}{100} = 5\frac{12}{25}$ f $2\frac{529}{1000}$

13 a $\frac{6}{10} = \frac{3}{5}$
 b Students' own answer, for example, $\frac{9}{15}, \frac{12}{20}, \frac{30}{50}, \frac{60}{100}$

14 a i 0.33 ii 0.67 b 33.3% and 66.6%

15 a 25%, $\frac{1}{3}$, 35%, 0.38, 0.39, $\frac{2}{5}$
 b $\frac{7}{10}$, 73%, 0.74, 79%, $\frac{17}{20}$, 0.86
 c 0.08, 0.56, $\frac{4}{5}$, $\frac{5}{6}$, 84%, 86%

16

Fraction	Decimal	Percentage
$\frac{27}{50}$	0.54	54%
$\frac{5}{8}$	0.625	62.5%
$\frac{19}{25}$	0.76	76%

17 a $\frac{23}{100}$ b $\frac{9}{100}$ c $\frac{1}{100}$ d $\frac{4}{25}$
 e $\frac{3}{25}$ f $\frac{9}{20}$

18 $\frac{2}{5}$ off

6.7 Calculating percentages

1 a 100 cm b 6 m c 21 kg d 163 g
 2 a 6 g b 9.9 km c 18.2 m d 420 g
 3 a 150 b 60 c 45 d 1.5

4 a $50\% = \frac{1}{2}$. To find 50% divide by 2.
 b $25\% = \frac{1}{4}$. To find 25% divide by 4.
 c $10\% = \frac{10}{100}$. To find 10% divide by 10.
 d $1\% = \frac{1}{100}$. To find 1% divide by 100.

5 a 30 b 12 c 1.2 d 8.6 e 21.5 f 0.86

6 a He has not converted 20% to a fraction first. b 5

7 8 750 000 000

8 a 36° b 18° c 108° d 126°
 e 90° f 270° g 324°

9 a 171 b 360 c 256 d 243

10 12 kg

11 91 cm

12 $\frac{1}{5}$ of £80

13 $\frac{2}{3}$ of 63 m

14 a i 5.4

ii 54

b i 10.8

ii 162

iii 172.8

iv 367.2

6 Check up

Place value, ordering numbers and rounding

1 4730

2 52.13

3 6.015, 6.05, 6.53, 6.535, 6.6

4 0.3

5 5 010 000

Add and subtract decimals

6 a 13.3 b 11.89 c 6.9 d 1.87

e 60.8 f 5.209 g 4.971

7 71.5 km

8 0.85 m

Multiply and divide decimals

9 $1.4 \text{ kg} \times 7 \approx 2 \times 0.7 \times 7 \approx 2 \times 4.9 \approx 10 \text{ kg}$

10 a 37.1 b 17.3 c 73.04

11 a 9.2 b 0.81 c 0.028 d 0.0018

12 0.15 kg

Fractions, decimals and percentages

13

Fraction	$\frac{1}{4}$	$\frac{3}{4}$	$\frac{7}{10}$	$1\frac{4}{5}$
Decimal	0.25	0.75	0.7	1.8
Percentage	25%	75%	70%	180%

14 a $\frac{7}{25}$ b 28%

15 a 2700 b 11 700

16 0.04, 25%, $\frac{3}{8}$, 38%, $\frac{2}{5}$, 44%

17

Fraction	Decimal	Percentage
$\frac{13}{40}$	0.325	32.5%
$\frac{49}{200}$	0.245	24.5%
$\frac{7}{40}$	0.175	17.5%

18 a 75 b 63 b 45

19 $\frac{1}{3}$ of 90 kg.

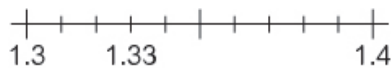
20 6365 km

6 Strengthen

Place value, ordering numbers and rounding

1 30 33 303 330 333 3000

2 a



b 1.4 c 1.39

3 a 6.3, 6.5, 7.2, 7.4

b 4.06, 4.4, 4.44, 4.5, 4.6

c 0.004, 0.033, 0.04, 0.33, 0.404

4 3.5

5 a 3.3 b 3.4 c 3.3

d 3.4 e 3.3

6 a 1.25 b 1.3

Add and subtract decimals

1 a 13.7 b 93.6 c 97.9

2 a 10.3 b 7.2 c 14.03

d 11.02 e 12.5 f 1.23

3 a 1.17 b 7.58 c 1.418

4 0.85 m

Multiply and divide decimals

1 a 8.6 b 98.4 c 32.76

2 a $4 \times 0.03 = 0.12$

b $7 \times 6 = 42$, $7 \times 0.6 = 4.2$, $7 \times 0.06 = 0.42$

3 a 1.4 b 8 c 0.45

d 1.8

4 a 0.36 b 0.048 c 0.002

5 a F $0.5 \times 2 = 1$

b T

c F $9 \times 0.6 = 5.4$

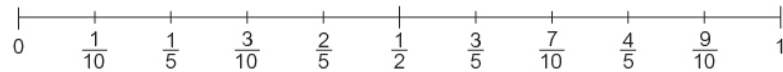
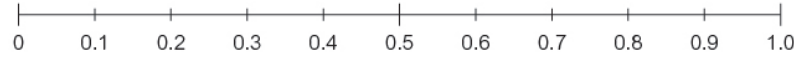
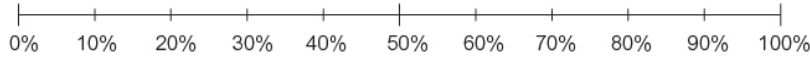
d F $3 \times 0.3 = 0.9$

6 a 0.06 b 1.23

- 7 a 8.3 b 7.3 c 5.27
 8 a 41.3 b 413 c 4130 d 41 300

Fractions, decimals and percentages

1



2 $\frac{15}{10} = 1.5 = 150\%$, $\frac{1}{4} = 0.25 = 25\%$, $\frac{1}{3} = 0.\dot{3} = 33.3\dots\%$, $\frac{13}{10} = 1.3 = 130\%$,
 $\frac{3}{4} = 0.75 = 75\%$, $\frac{5}{4} = 1.25 = 125\%$, $\frac{14}{10} = 1.4 = 140\%$

3 a 24% b 198% c 134.5%

4 a 0.27 b 0.855 c 1.32

5 a $\frac{6}{25}$ b $1\frac{49}{50}$ c $1\frac{69}{200}$

6 a $\frac{27}{100}$ b $\frac{171}{200}$ c $1\frac{8}{25}$

7 a i 23%, $\frac{3}{10}$, 40%, 0.45, 0.79, $\frac{4}{5}$ ii 27%, $\frac{7}{20}$, $\frac{2}{5}$, 0.6, 0.72, 75%

b 90%, $\frac{4}{5}$, $\frac{3}{10}$, $\frac{3}{25}$, 9%, 0.08

8 a 37.5% b 17.5% c 32%

9 a 0.3 b 1.5 c 0.75

10 a 30 b 7 c 4.5 d 0.62

11 a 20 b 10 c 30

12 a 3.6 b 36 c 39.6

13 a 4 b 2 c 14

Enrichment

1 a

Year	Value at start of year	Percentage change	Value at end of year
1	\$50	30% increase	$\$50 \times 1.3 = \65
2	\$65	20% decrease	\$52
3	\$52	20% decrease	\$41.60
4	\$41.60	10% increase	\$45.76
5	\$45.76	5% increase	\$48.05

b It decreased by \$1.95

6 Extend

- 1 a Decimal = percentage \div 100.
 b Percentage = decimal \times 100.
- 2 a 150 b 43.3...% c 46.6...%
 d 43.3% and 46.7%

3 a

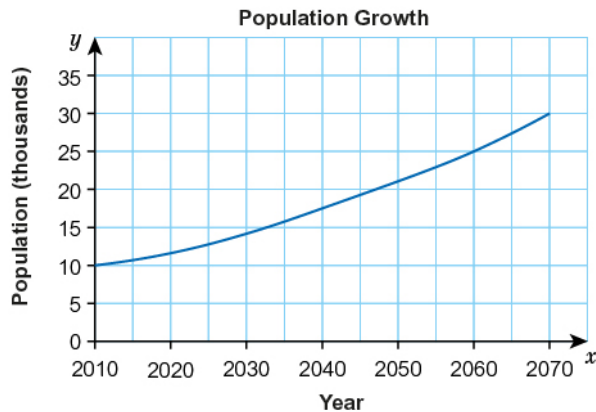
	Full calculator display	Rounded to 1 decimal place
$\sqrt{2}$	1.414 213 562	1.4
$\sqrt{3}$	1.732 050 808	1.7
$\sqrt{5}$	2.236 067 977	2.2
$\sqrt{6}$	2.449 489 743	2.4

b $\sqrt{4} = 2$, so it is an exact value.

4 a

Year	2010	2020	2030	2040	2050	2060	2070
Population (thousands)	10	12	14	17	21	25	30

b



- c Answers from 17 000 or 19 000.
 d Students' own answers. For example, 'The population is expected to roughly treble.'

5 a

Original number	Rounded to 1 d.p.	Rounded to nearest whole number
6.45 – 6.49	6.5	6
6.5 – 6.549	6.5	7

b Students can have different answers and both be correct.

- 6 1991 Tokyo: 9.720 seconds
- 7 76° – 89° inclusive
- 8 Yes. After expansion, the door dimensions are 1.957 m by 0.824 m.
- 9 21 minutes
- 10 a 640, 6400, 64 000 b 6.4
- 11 a 27.72 b 2.772 c 2.772
 d 4.4 e 44 f 4.4
- 12 2.875 m

- 13 a 6.1666666666666666 b 6.2
 14 a 0.59 b 3.5 c 4.8 d 33.2
 15 a 4.5 b 3.8 c 81.5 d 9.2
 16 \$15
 17 a 132cm b 145.2cm

18

Year	Total at beginning of year	5% of total	Total at end of year
1	\$10000	5% of \$10000 = \$500	\$10000 + \$500 = \$10500
2	\$10500	5% of \$10500 = \$525.00	\$11025.00
3	\$11025.00	\$551.25	11576.25

- 19 0.3%, $\frac{9}{200}$, 4.51%, 7.7%, $\frac{7}{90}$, 0.79
 20 a 7 000 000 b 25 400 000 c 5 588 000
 d 1 412 000 e 20%
 21 a 64 b 320 c 640
 22 $9.65 \leq y < 9.75$
 23 16.5

6 Unit test

- 1 a 8.4 b 0.84 c 24.36
 2 1.56 m

3

Fraction	$\frac{3}{10}$	$\frac{2}{5}$	$\frac{1}{4}$	$1\frac{1}{3}$	$1\frac{1}{5}$	$1\frac{3}{4}$
Decimal	0.3	0.4	0.25	$1.\dot{3}$	1.2	1.75
Percentage	30%	40%	25%	133. $\dot{3}$ %	120%	175%

- 4 219.11
 5 a $\frac{17}{20}$ b 85%
 6 a 216 b 2.16 c 21.6
 7 5.078, 5.08, 5.287, 5.78, 5.8
 8 4.4
 9 200 100
 10 12.15 seconds
 11 a 5.6 b 0.1 c 0.64 d 4.5
 12 \$72
 13 16
 14 $\frac{1}{3}$ of 60 km
 15 17.92 kg
 16 a $22\% > \frac{1}{5}$ b $\frac{3}{4} < 81\%$

Unit 7 Ratio and proportion

7.1 Writing ratios

- 1 a 5 b 8 c 9
- 2 There are 3 red cubes for every 2 blue cubes.
- 3 a 3 : 2 b 2 : 3 c 3 : 4
- 4 a Yes b No
c No (usually the other way around)
- 5 a 2 : 5 b 4 : 10
- 6 6 cans.
- 7 2 : 4, 6 : 12, 5 : 10
- 8 a 10 : 5 b 10 g c 50 g
- 9 a 1 : 4 b 1 : 3 c 1 : 5
d 5 : 1 e 4 : 5 f 2 : 1
- 10 Ratio of adults to students is 8 : 120 which can be simplified to 1 : 15. Therefore the ratio of adults to students is correct.
- 11 a 1 : 5 : 9 b 1 : 4 : 2 c 5 : 4 : 9
d 3 : 1 : 4 e 5 : 8 : 3 f 9 : 7 : 3
- 12 14 : 1 : 5
- 13 5 : 4 : 5
- 14 a 4 : 1 b 1 : 4 c 1 : 6
d 1 : 1
- 15 9 : 7
- 16 a 2 : 5 b 4 : 13 c 4 : 7
d 50 : 11
- 17 15 cm

7.2 Sharing in a given ratio

- 1 a 2 : 5 = 6 : 15 b 4 : 7 = 16 : 28
c 3 : 10 = 15 : 50 d 6 : 4 = 48 : 32
- 2 3 : 2
- 3 Students' own answers. For example: 'Sarah has paid more for the lottery ticket than Paul. The ratio of the amounts paid by Pavel and Sarah is 20 : 80 or 1 : 4.

It would be fairer if Pavel received $\frac{1}{4}$ of the winnings and Sarah received $\frac{3}{4}$ of the winnings. This would mean Paul received £200 and Sarah received £800.'
- 4 a £8 : £12 b £40 : £20 c £15 : £20
d £35 : £42 e £40 : £32 f £50 : £70
- 5 Enzo £36, Catlina £24
- 6 15
- 7 a 6 b 12

- 8 a 88 b 198
- 9 12 million
- 10 \$500
- 11 a i £180 ii £280
b i £270 ii £350
c Wilson

7.3 Proportion

- 1 a 30% b 8% c 15%
d 28% e 80%
- 2 a $\frac{2}{5}$ b $\frac{3}{4}$ c $\frac{4}{5}$
d $\frac{16}{27}$
- 3 a 2 : 1 b $\frac{2}{3}$
- 4 a 12 : 8 or 3 : 2 b $\frac{8}{20}$ or $\frac{2}{5}$, 40%
- 5 a 12 : 8 : 5
b James $\frac{12}{25}$ or 48%, Robert $\frac{8}{25}$ or 32%,
Fernando $\frac{1}{5}$ or 20%
- 6 a Footballer A: $\frac{7}{10}$ or 70%
Footballer B: $\frac{13}{20}$ or 65%
b Footballer A as they scored goals in a higher proportion of matches played.

- 7 First sample: proportion of lemon = $\frac{3}{20}$ = 15%,
Second sample: proportion of lemon = $\frac{4}{25}$ = 16%,
The second drink had a higher proportion of lemon so had a stronger flavour.

- 8 a $\frac{6}{20} = \frac{3}{10}$ = 30%
b $\frac{8}{20} = \frac{2}{5}$ = 40%

- 9 7 : 8 : 5
- 10 3 : 2
- 11 7 : 13

7.4 Proportional reasoning

- 1 a \$6 b \$20 c 8
- 2 a £5.00 b £7.50 c £1.25
d £8.75
- 3 a £22.50 b £67.50

- 4 To make the recipe for 14 people, Sophie needs 700 g of flour, 1225 ml of milk and 7 eggs. She does not have enough milk.
- 5 Cost per plant: Fazia £0.60, Kunal £0.67. Fazia got the better deal.
- 6 a 6 hours b 9 hours c 1.5 hours
- 7 a 4 days b 16 days
- 8 \$333.33
- 9 a 60 mins b 240 mins c 80 mins

7.5 Using the unitary method

- 1 a 25 cm b 40 g c £0.50 d 60 m
e £4.50 f £7.70
- 2 a 10 : 1 b 1 : 3 c 1 : 50
- 3 a \$0.90 b \$6.30 c 8
- 4 \$50
- 5 \$208.25
- 6 a £280 b £350
- 7 \$4.40 for 8 pack
- 8 Jin travels 9 miles on 1 litre, Selma only travels 8 miles on 1 litre. Jin's car is more economical.
- 9 £1.35
- 10 a i 30p ii 29.8p iii 27.5p
b Large, as it is the cheapest per packet of crisps.
- 11 a i 24p ii 19p iii 21p
b Honey B, as it is the cheapest per gram of honey.

7 Check up Ratio

- 1 12 : 7
- 2 b 6 : 8
- 3 a 2 : 5 b 7 : 8
- 4 2 : 4 : 5
- 5 French 90, Spanish 120
- 6 12
- 7 140
- 8 a 1 : 2 b 5 : 4
- 9 a 10 : 12 = 5 : 6 b 1.2

Direct and inverse proportion

- 10 a $\frac{3}{5}$ b $\frac{2}{5}$ c 3 : 2
- 11 $\frac{3}{10}$, 30%

- 12 a 40% b 60%
- 13 a 100 minutes b 25 minutes c 75 minutes
- 14 \$26.00
- 15 6 cartons of milk for \$4.80 is cheaper.
- 16 Saturday
- 17 a 8 days b 2 days c 24 days
- 18 a 20 minutes b 160 minutes

7 Strengthen Ratio

- 1 a 1 : 2 b 2 : 4 = 1 : 2
c 4 : 8 = 1 : 2
d The same fraction of each bar is coloured red and blue.
- 2 a 1 : 4 b 1 : 4
- 3 3 : 6 = 1 : 2
4 : 12 = 1 : 3
5 : 20 = 1 : 4
24 : 6 = 4 : 1
6 : 9 = 2 : 3
8 : 28 = 2 : 7
4 : 10 = 2 : 5
- 4 a 1 : 5 b 1 : 4 c 1 : 2
- 5 a 1 : 2 b 4 : 1 c 2 : 3
- 6 12
- 7 a 4 b 12 c Yes
- 8 a 8 b 12
- 9 9
- 10 Allie 30, Billy 33
- 11 a \$4 : \$16 b \$8 : \$24 c \$25 : \$5

Direct and inverse proportion

- 1 a $\frac{3}{10}$ or 30% b $\frac{3}{5}$, 60%
- 2 a $\frac{1}{4}$ b $\frac{1}{3}$ c June
- 3 a 25 b 10 out of 25 or 40% c $\frac{10}{25}$
d $\frac{2}{5}$
- 4 a 70% b 30%
- 5 a 20% b 80%
- 6 a 70% b 20% c Anna
- 7 a \$8.00 b \$12.00 c \$2.00

- 8 a £6 b £36.00 c £84.00
 9 a 12 cents b 11 cents c Shop B
 10 Price per bottle: Shop A £1.90, Shop B £1.80
 Shop B is better value for money.
 11 a 1 minute b 3 minutes
 c 4 minutes
 12 More time.
 13 Less time.
 14 Half the time.
 15 a 4 days b 2 days
 16 2 days
 17 a 5 days b 20 days c 40 days

Enrichment

- 1 a 5938 km b 21 021 km
 c \$2362.31
 2 Students' own question. For example: 'How long would it take 2 people to clean a car? Answer: 15 minutes'

7 Extend

- 1 4 : 5 : 6
 2 a 16 km b 1.6 km c 12.8 km d 128 km
 3 a GB top speed is 86.75 mph, US top speed is 86.8 mph.
 US top speed is faster than GB top speed.
 b GB range is 0.07 s, US range is 0.58 s. GB is more consistent.
 c GB team mass is 888.6 lbs, US team mass 900 lbs.
 d Total GB mass is 1001 lbs, total US mass 950 lbs.
 e 5% f 11%
 4 $\frac{32}{50} = \frac{16}{25}$, 64%
 5 a Team A 50%, Team B 53% b Team B
 6 18
 7 a 2 : 3 b 24 c 60
 8 a 3 : 7 b 18 c 60
 9 3 : 6 : 8
 10 a Offer C b Students' own answers
 11 a Price per bottle: 6-bottle deal 58 cents, 8-bottle deal 63 cents
 b The 6-bottle deal is better value for money.
 12 Potatoes bought for \$1: 1st farmer 1.1 kg, 2nd farmer 1.6 kg. The 2nd farmer's potatoes are better value.

- 13 a British Museum 29 : 28, Tate Modern 489 : 530, National Gallery 265 : 271
 b In 2011 36% of the total visitors to the top three attractions went to the British Museum. In 2012, the proportion had reduced to 34%.

- 14 1 : 4
 15 16 people

7 Unit test

- 1 10 : 3
 2 a 2 : 3 b 5 : 2
 3 £45 : £27
 4 a 16 b 28
 5 6000 kg
 6 a $\frac{1}{10}$ b 10%
 7 Murray won 70% and Djokovic won 58%. Murray won the greater proportion.
 8 2 : 3
 9 \$225
 10 Offer C
 11 a 3 : 4 b 2 : 9 c 15 : 2
 12 1 : 3
 13 a 40% b 3 : 2 c 100
 14 a 10 hours
 b 2.5 hours c 20

Unit 8 Measures and shapes

8.1 STEM: Metric measures

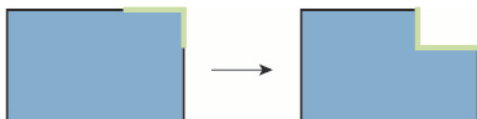
- 1 a metres b kilograms c litres
- 2 a mm, cm, m, km b mg, g, kg, t c ml, l
- 3 a 60 b 800 c 9000
 d 4 e 8 f 25
- 4 a 250 b 12 500
 c 8.8 d 1.6
- 5 a 5000 b 7000
 c 15 d 6
- 6 a 4200 b 750
 c 4.25 d 0.875
- 7 a 400 cm b 15 cm c 6 km
- 8 a i 1.5 m ii 150 cm
 b i 1.53 m ii 153 cm
- 9 a 3 : 100 b 10 : 1
 c 1 : 40 d 4 : 5
- 10 a 80 000 g b 80 kg
- 11 a 1.175 t b 6 cars
- 12 30 m/

- 13 a Fill up Jug 3 from Jug 1.
 b Fill up Jug 2 and Jug 3 from Jug 1.

8.2 Perimeter

- 1 a Equilateral triangle b Square
 c (Regular) pentagon
 d (Regular) hexagon
 e (Regular) octagon
- 2 a (left to right) 7 cm and 2 cm.
 b (left to right) 3 cm and 9 cm.
- 3 a 6 cm b 30 cm
 c 30 cm d 32 cm
- 4 a 24 cm b 60 mm c 8.4 m
- 5 a 50 mm b 144 mm c 106 mm
- 6 a 2 cm b 2 cm c 24 cm
- 7 a 18 cm b 20 m c 280 mm
- 8 a 24 m b 6x
- 9 a $80 \times 172 = \$13\,760$
 b original field = $2 \times (32 + 54) = 172$ m
 remaining part = $32 + 54 + 27 + 5 + 7 + 47 = 172$ m

c The edges just move, so same perimeter.

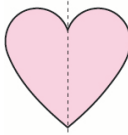
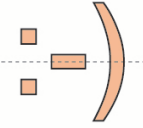
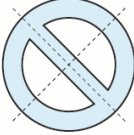


10 80 cm

8.3 Area

- 1 a 28 cm b 48 mm
- 2 a A: 5 cm \times 3 cm, B: 6 cm \times 2 cm
 b A: 18 m \times 14 m, B: 32 m \times 21 m
- 3 a 8 cm² b 6 cm²
- 4 a 16.81 cm² b 27.2 cm²
 c 63 cm² d 16 cm²
- 5 71 cm²
- 6 a 27 cm² b 924 m²
- 7 36 m²
- 8 36 cm
- 9 4 rectangles (8 if you count length and width as distinct).
- 10 a 100 m² b €2000
- 11 a 60 m b 7.5 m

8.4 3D solids

- 1 a Cube, cuboid, triangular prism, triangular-based pyramid, square-based pyramid, cylinder
 b Square, rectangle, triangle, circle
- 2 b  c  d 
- 3 a 6 faces, 12 edges, 8 vertices
 b 6 faces, 12 edges, 8 vertices
 c 4 faces, 6 edges, 4 vertices
- 4 5 faces, 8 edges, 5 vertices
- 5 Triangular prism
- 6 Students' drawings with suitable planes of symmetry.
 a 3 b 9 c 4
 d 2 (if the base is a square, it will have 4 planes of symmetry)
- 7 a 8 faces, 18 edges, 12 vertices
 b 4
- 8 a Infinite b Infinite c Sphere, cone

8 Check up Metric measures

- 1 a 80 b 2000 c 6
- 2 a 320 b 8700 c 2.4
- 3 a 7 cm, 100 mm, 0.1 m, 15 cm, 0.2 km, 3 km
 b 100 mm or 0.1 m

Perimeter and area

- 4 24 cm
- 5 a 24.8 cm b 24 mm
- 6 a 38.44 cm² b 32 mm²
- 7 12 m
- 8 44 m
- 9 33 m²
- 10 4 m
- 11 3

3D solids

- 12 10 vertices, 15 edges, 7 faces
- 13 5

**8 Strengthen
Metric measures**

- 1 a 60 b 300 c 4
d 1000, 5 e 1000, 8
- 2 a 460 b 6500 c 5250
d 48 e 350 f 580
- 3 a 2.4 b 3.25 c 9.2
d 4.28 e 5.6 f 0.54
- 4 a 300 g, 100 g, 250 g, 150 g, 200 g
b 200 g c 200 g

Perimeter and area

- 1 a 35 cm b 72 cm c 42 cm
- 2 a 6 b 4 c 20
d 24
- 3

Shape	Perimeter	Units	Area	Units
A	12	m	9	m ²
B	8	cm	4	cm ²
C	24	cm	27	cm ²
D	24	mm	35	mm ²

- 4 a 9 cm b 81 cm²
- 5 30
- 6 a Perimeter: 24 cm Area: 20 cm²
b Perimeter: 30 cm Area: 29 cm²
- 7 a Perimeter: 32 cm Area: 49 cm²
b Perimeter: 30 cm Area: 19 cm²
- 8 3.4 cm

3D solids

- 1 a 6 b 8 c 12
- 2 D
- 3 C
- 4 2

Enrichment

- 1 a A, B, C, E, I b G c H

8 Extend

- 1 a A 6.41 and B 9.43
b Yes, he is correct because 9.43 is about 3 m more than 6.41.
c i 6.95 (remove the faulty rocket's data, that is, 0.5 and then recalculate the mean for 11 data)
ii The new mean is 6.9 m so Sarah's rockets travel about 2 m further than Claire's.
d Yes, on average they do, as most measures for type B are larger than type A.

2 3.5 cm

3 88 m

4 a 162 m² b 420 m

5 53084 m²

6 200 cm

- 7 a The length and width can be 2.5 cm and 2 cm, to give perimeter 9 cm.
b If the length is 2 cm and the width is 1 cm, then the area is 2 cm². If doubled, the length is 4 cm, the width is 2 cm and the area is 8 cm², so the area is more than doubled.
c A square with side 1 cm has an area of 1 cm² but a perimeter of 4 cm.

8 a 16 600 m² b £498 000

- 9 a i Hexagon and rectangle
ii Heptagon and rectangle
iii Decagon and rectangle

b

Solid	Faces	Edges	Vertices	Check $F + V = E + 2$
pentagonal prism	7	15	10	17 = 17
hexagonal prism	8	18	12	20 = 20
heptagonal prism	9	21	14	23 = 23
decagonal prism	12	30	20	32 = 32

c Octagonal prism

10 a 52 cm² b 52 cm²

11 32 cm

12 a 2 b 4

13 a 42 cm b 66 cm²

14 a 1800 cm² b 1260 mm²

c 15.91 m² d 4.8 m²

15 a 6 cm b 3 cm

- 16 a** 7.44 m^2
b 130, assuming no tiles that are cut can be reused.

- 17 a i** $8y + 1 \text{ m}$
ii $2y \text{ m}^2$
b i $18 + 2x \text{ m}$
ii $14 + 3x \text{ m}^2$

8 Unit test

- 1 a** 1 km **b** 20 000 ml
c 9 kg **d** 0.2 m
- 2 a** 3 m, 3500 mm, 400 cm, 0.04 km, 50 m
b 400 cm
- 3 a** 12 cm **b** 120 mm
- 4 a i** 22 m **ii** 24 m^2
b i 200 cm **ii** 2500 cm^2
- 5 a** 26 cm **b** 22 cm^2
- 6** A cube. A square has more lines of symmetry than a rectangle.
- 7 a** 9 edges, 5 faces, 6 vertices
b 8 edges, 5 faces, 5 vertices
- 8** 25 cm^2
- 9 a** 240 cm **b** 2.4 m **c** 0.75 m
- 10** 13

Unit 9 Sequences and graphs

9.1 Sequences

- 1 **a** 20, 24, 28 **b** 3, 3.5, 4 **c** 3.9, 4.1, 4.3 **d** 0.6, 0.3, 0
- 2 **a** 18 and 27 **b** 8 and 64 **c** 3 and 9 **d** 25 and 20
- 3 Sequences a, b and c.
- 4 **a** infinite **b** finite **c** infinite **d** finite **e** infinite
- 5 **a** 1st term = 5, term-to-term rule = +2
b 1st term = 100, term-to-term rule = -10
c 1st term = 15, term-to-term rule = +6
d 1st term = 20, term-to-term rule = -5
- 6 a, c and d
- 7 **a** 9, 14, 19, 24, 29 **b** 15, 12, 9, 6, 3
c -50, -55, -60, -65, -70 **d** 0, 4, 8, 12, 16
e 9.5, 9.7, 9.9, 10.1, 10.3 **f** -12, -11.7, -11.4, -11.1, -10.8
- 8 **a** 1st term = 9, common difference = 9
b 1st term = 20, common difference = 10
c 1st term = 3, common difference = 2
d 1st term = 30, common difference = -5
e 1st term = 9, common difference = 2
f 1st term = 100, common difference = -11
- 9 **a** £1, £3, £5, £7, £9, £11, £13, £15, £17, £19, £21
b 21 days
- 10 **a** 30 **b** 150 **c** 300
- 11 **a** 67 000 000
b It is better than not predicting at all. Students' own explanation.
For example: 'When there are more people there will be more births.'
c Yes. The new data shows it is not necessarily an arithmetic sequence.

9.2 The n th term

- 1 **a** +5 **b** -3
- 2 **a** 6 **b** 11 **c** 11
- 3 **a** 4, 8, 12, 16, 20 **b** 60
- 4 **a** 5, 10, 15, 20, 25
b 7, 14, 21, 28, 354
c 12, 24, 36, 48, 60
- 5 **a** 7 **b** 44 **c** 30
- 6 **a** $3n$ **b** $2n$ **c** $10n$
d $11n$
- 7 **a** **i** 11, 12, 13, 14, 15 **ii** -6, -5, -4, -3, -2
iii 13, 14, 15, 16, 17 **iv** 0, 1, 2, 3, 4
b **i** 1st term = 11, common difference = 1
ii 1st term = -6, common difference = 1
iii 1st term = 13, common difference = 1
iv 1st term = 0, common difference = 1

- 8 $n + 2$
- 9 a $n + 4$ b $n - 1$ c $n + 9$ d $n + 20$
- 10 a 7, 10, 13, 16, 19 b 7, 9, 11, 13, 15
 c 2, 6, 10, 14, 18 d 13, 14, 15, 16, 17
 e 2, 7, 12, 17, 22
- 11 a -11, -10, -9, -8, -7 b -13, -11, -9, -7, -5
 c -7, -6, -5, -4, -3 d -40, -30, -20, -10, 0
- 12 a $3n + 1$ b $2n + 5$ c $5n + 7$
 d $10n - 2$ e $12n + 12$ f $9n - 1$
 g $10n - 1$
- 13 a No. 35 is not a multiple of 10.
 b 6th term
 c 11th term
- 14 a $n = 5$, Yes. $2 \times 5 + 1 = 11$
 b 11th term
- 15 a 5 b 10
- 16 $n = 2.5$; No, the position number has to be an integer.
- 17 a -3, 3, 7, 47 b -3, 7, 32, 47
- 18 a 3000
 b Students' own answers. For example: 'No, it won't be an infinite sequence' or 'If more people read the blog they may tell more people about it, so it might not be arithmetic.'
- 19 a $5n - 17$
 b 44

9.3 Pattern sequences

1



2 a



- b 25, 36, 49
 c Square numbers.
 d The differences are not the same, but are increasing odd numbers. It is not an arithmetic sequence.

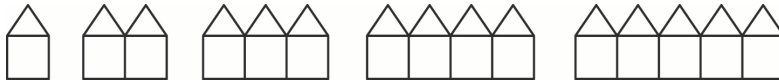
3 a



15 21

- b They are the positive integers from 2.
 c 55

4 a i

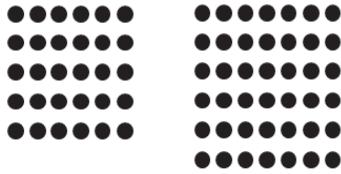


ii

Term number	1	2	3	4	5
Number of lines	6	11	16	21	26

iii 1st term = 6, term-to-term rule = +5

b i



ii

Term number	1	2	3	4	5	6
Number of dots	2	6	12	20	30	42

iii 1st term = 2, term-to-term rule = add the even numbers

5 2, 4, 8, 16, 32, 64

6 a 1st term = 1, term-to-term rule = $\times 3$

b 1st term = 10, term-to-term rule = $\times 10$

c 1st term = 1, term-to-term rule = $\times 0.5$ or $\times \frac{1}{2}$ or $\div 2$

7 a Arithmetic b Geometric c Geometric

d Geometric e Arithmetic

8 a i 1st term = 1, term-to-term rule = $\times 2$

ii 32, 64

b i 1st term = 200, term-to-term rule = $\div 2$

ii 12.5, 6.25

c i 1st term = 5, term-to-term rule = $\times 5$

ii 3125, 15 625

d i 1st term = 1, term-to-term rule = $\div 2$

ii $\frac{1}{16}, \frac{1}{32}$

9 a 3, 12, 27

b 5, 8, 13

c $\frac{1}{2}, 2, 4\frac{1}{2}$

10 a 8, 13

b The differences between terms are also the Fibonacci sequence.

9.4 Coordinates and line segments

1 a A(0, 3), B(6, 6), C(2, 0)

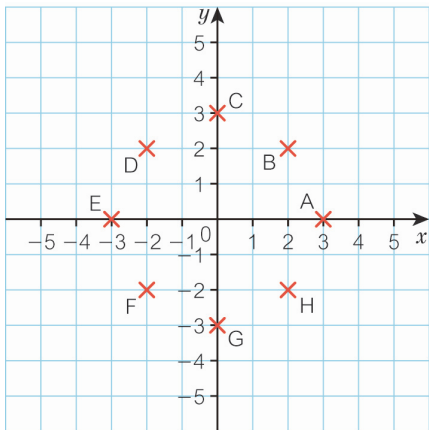
b Trapezium

2 2 units

3 a 5 units b 8 units c 2 units

4 A (1, 4), B (-4, 3), C (2, -2), D (-2, -5)

5 a



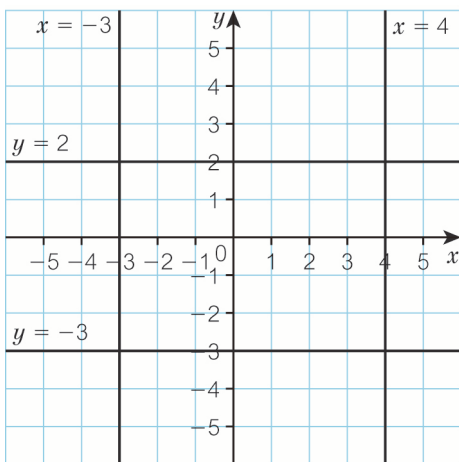
b Octagon

- 6 Midpoint of CD = (2, -3) Midpoint of EF = (-2, -2.5) Midpoint of GH = (-3.5, 4)
 Midpoint of IJ = (-1, 3) Midpoint of KL = (-4, 0)
- 7 a (3, 2) b (1, 1) c (-2, 4) d (-5, -1.5)
- 8 a (2, 8) b (8, 4) c (4, 7) d (5, 1)
 e (-3, -1) f (8.5, -4.5)

9.5 Graphs

- 1 a 17 b -8
- 2 a i $y = 21$ ii $y = -12$
 b i $y = 3$ ii $y = -7$
- 3 a (-2, -4), (-2, -3), (-2, -2), (-2, -1), (-2, 0), (-2, 1), (-2, 2), (-2, 3), (-2, 4)
 b The x-coordinate is always -2.
 c i $x = -2$ ii $x = 3$ iii $y = -1$
- 4 a Points P, R and S b Points Q and T

5



6 a

x	0	1	2	3	4
y	$2 \times 0 = 0$	2	4	6	8

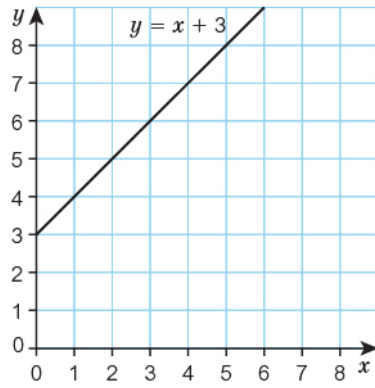
b (0, 0), (1, 2), (2, 4), (3, 6), (4, 8)

7 a

x	0	1	2	3	4
y	3	4	5	6	7

b (0, 3), (1, 4), (2, 5), (3, 6), (4, 7)

c



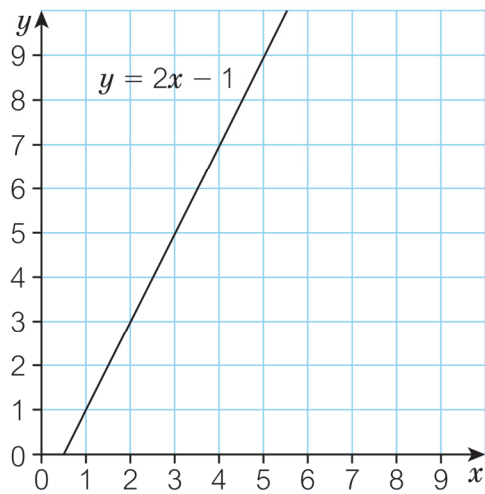
8

a

x	1	2	3	4	5
y	$2 \times 1 - 1$ $= 2 - 1$ $= 1$	3	5	7	9

b 9

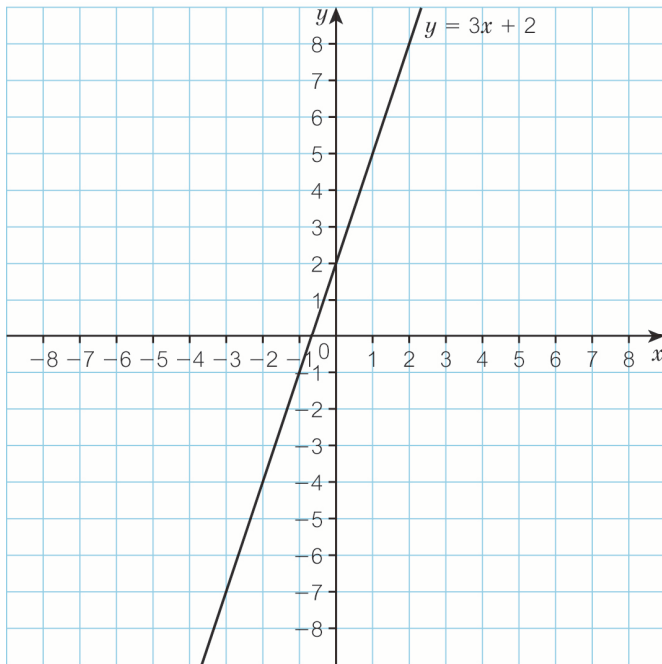
c



9 a

x	-2	-1	0	1	2
y	-4	-1	2	5	8

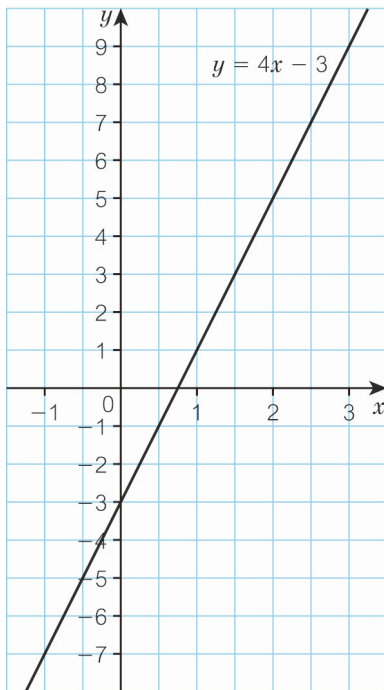
b



10 a

x	-1	0	1	2	3
y	-7	-3	1	5	9

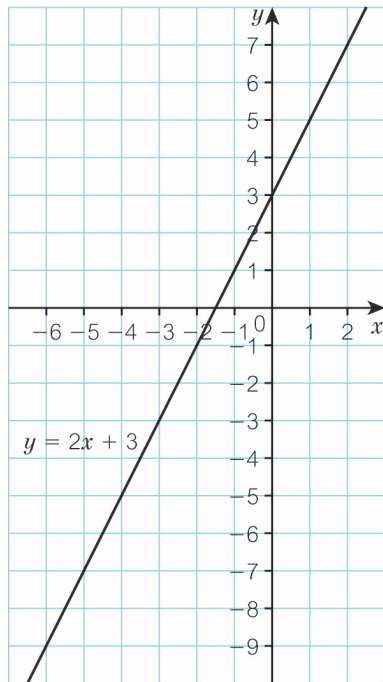
b



11 a

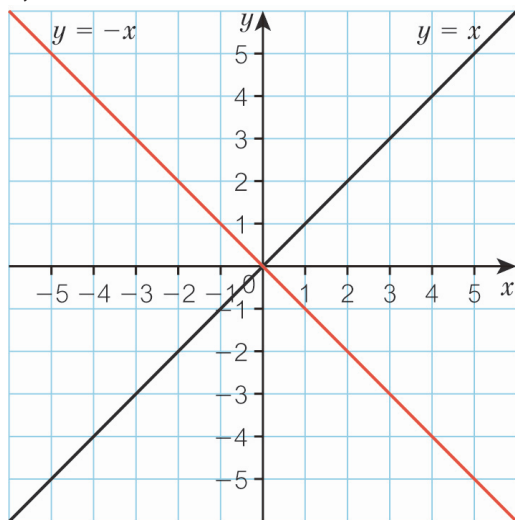
x	-6	-4	-2	0	2
y	-9	-5	-1	3	7

b



c $x = -5$

12 a, b



c 90°

- 13 A $y = x$ B $y = 4$ C $x = -2$ D $y = -x$
 E $y = -2$ F $x = 4$

9.6 Working with graphs

1 a A(2, 1), B(3, 6), C(6, 6), D(5, 1) b Parallelogram

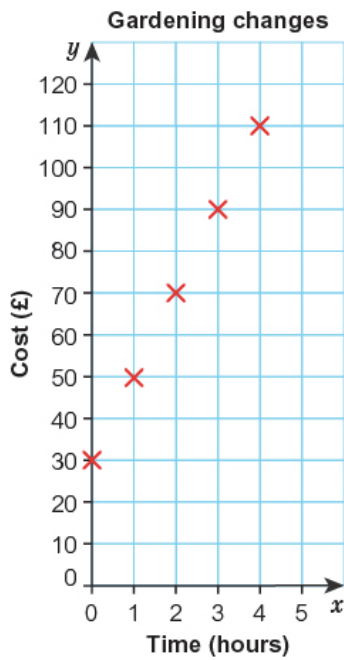
2

X	0	1	2	3	4
$y = x + 1$	1	2	3	4	5

3 a

Time (hours)	0	1	2	3	4
Cost (£)	30	50	70	90	110

b

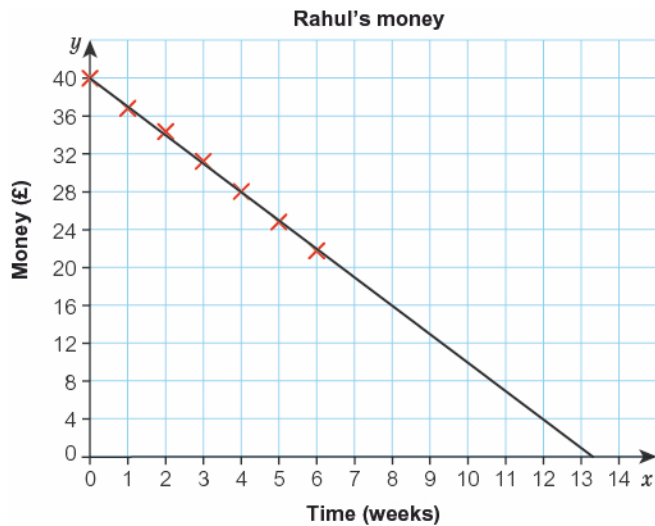


c £80

4 a

Time (weeks)	0	1	2	3	4	5	6
Money (£)	40	37	34	31	28	25	22

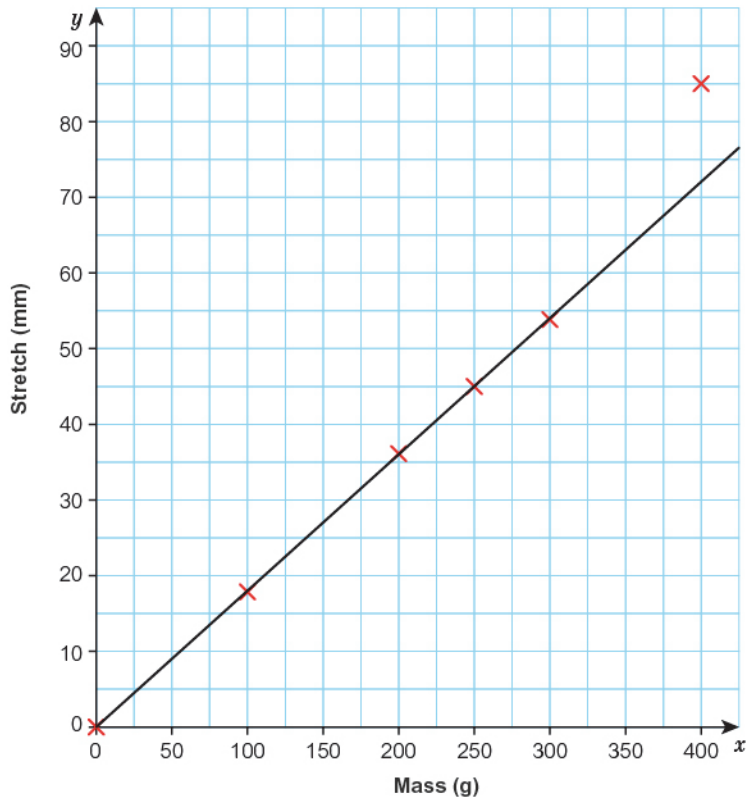
b, c



d 14 weeks. After 13 weeks there will still be some money left.

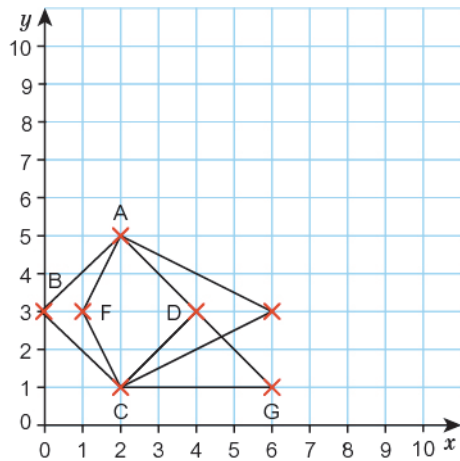
5 a, c

Stretching of a spring



- b Yes d The new point is not on the straight line.
 e Between 300 g and 400 g.

6 a

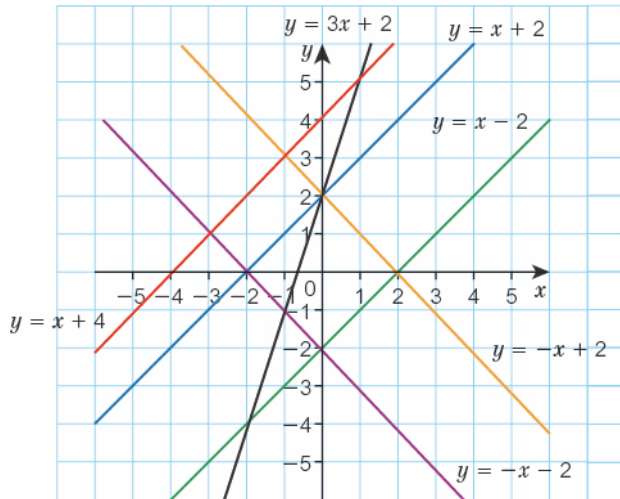


- b i (4, 3) ii For example, (6, 3)
 iii For example, (1, 3) iv For example, (6, 1)

7 a

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

b



c i Square ii Rectangle iii Trapezium

8 No. All 4 or 3 of the lines could be parallel.

9 Check up Sequences

- 1 a 1st term = 3, term-to-term rule = +2
- b 1st term = 2, term-to-term rule = $\times 10$
- c 1st term = 20, term-to-term rule = -3

2 a



b

Term number	1	2	3	4	5
Number of lines	6	11	16	21	26

c 1st term = 6, term-to-term rule = +5

3 77

- 4 a 12, 17, 22, 27, 32
- b 8, 2, -4, -10, -16

- 5 a 3, 6, 9, ..., 18
- b 8, 9, 10, ..., 13
- c 2, 7, 12, ..., 27

- 6 a $5n$
- b $n + 3$
- c $2n + 1$

- 7 a Geometric
- b Arithmetic
- c Arithmetic
- d Geometric

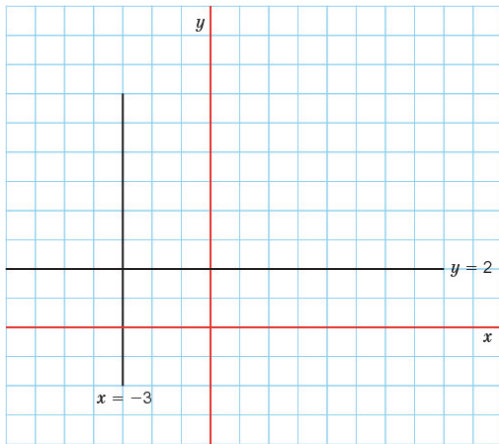
- 8 a $\times 5$
- b 125

Graphs

9 A(3, 4), B(0, 5), C(4, -6), D(-2, 5), E(-3, -7), F(-3, 0)

10 A(2, 3), B(4, -2), C(-2, -2), D(-4, 0)

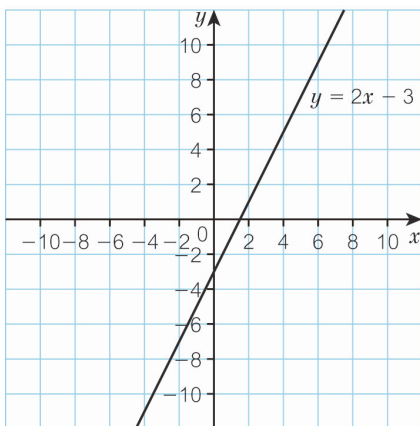
11 a, b



12 a

x	-2	0	2	4	6
y	-7	-3	1	5	9

b

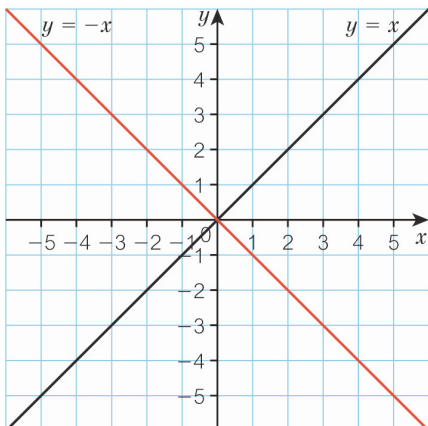


13 a (1, 7)

b (5, 3)

c (2, -1)

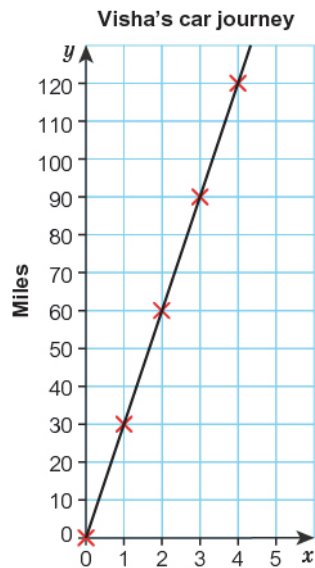
14



15 a

Time (hours)	0	1	2	3	4
Distance (miles)	0	30	60	90	120

b, c



d 45 miles

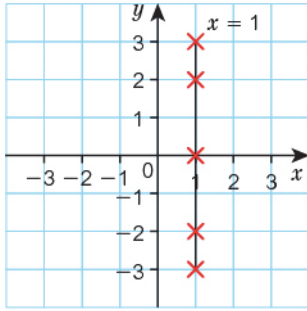
16 (5, 4)

9 Strengthen Sequences

- 1 a 2 b 12, 14
- 2 a i 26, 31, 36 ii 74, 85, 96
- b i Ascending ii Ascending
- 3 a 5, 9, 13, 17, 21 b 18, 16, 14, 12, 10
- 4 a 5 b 60 c $5n$
- 5 a i $4n$ ii 40
- b i $11n$ ii 110
- 6 a 2 b $n + 2$
- 7 a $n + 9$ b $n - 1$ c $n + 14$
- d $n - 4$
- 8 6, 7, 8, 9, 10
- 9 1, 3, 5, 7, 9
- 10 a $3n$ b 2 c $3n + 2$
- 11 a Sequence A b Sequence E
- 12 a $\times 4$ b 256, 1024

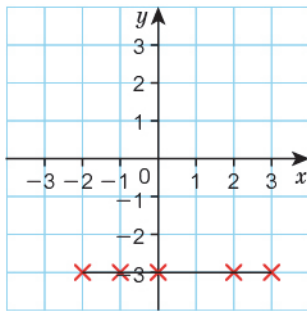
Graphs

1 a, b



- c The x -coordinate is always 1.
- d The equation of the line is $x = 1$. It is parallel to the y -axis.

2 a, b



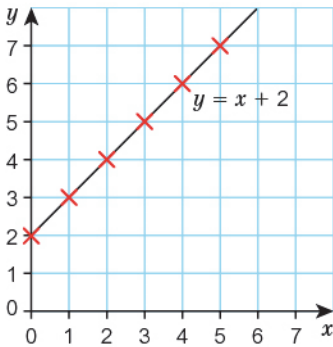
- c The y -coordinate is always -3 .
- d The equation of the line is $y = -3$. It is parallel to the x -axis.

3 a

x	0	1	2	3	4	5
y	2	3	4	5	6	7

b (0, 2), (1, 3), (2, 4), (3, 5), (4, 6), (5, 7)

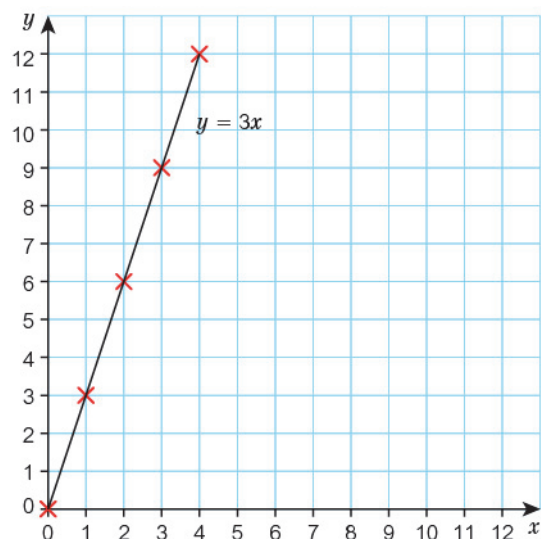
c, d



4 a

x	0	1	2	3	4
y	0	3	6	9	12

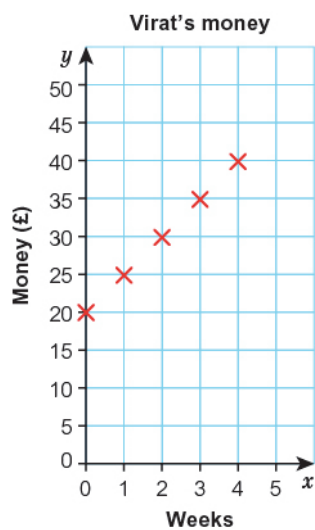
b, c



5 a

Time (weeks)	0	1	2	3	4
Money (£)	20	25	30	35	40

b



6 a (1, 1), (2, 2), (-3, -3)

b (9, -9), (4, -4), (5, -5), (-6, 6)

7 a (7, 10) b (4, 10) c (6, 7)

8 a Parallelogram b Square c Rectangle
d Trapezium

Enrichment

1 a i Students' own answers, of the form (a, a) .
ii Students' own answers, of the form $(a, -a)$.

b (0, 0)

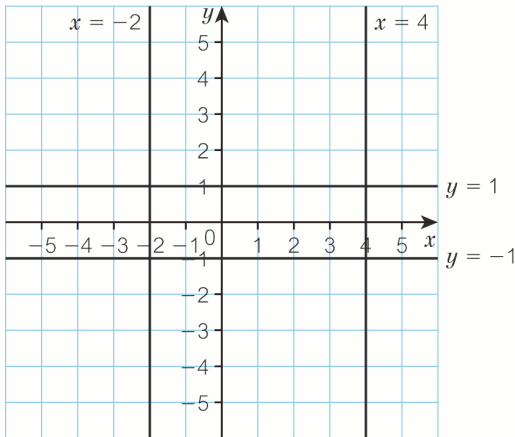
2 a 12 b 15

9 Extend

1 a £3000 b £5500 c £20 500

2 a £200 b £50

3 a



b 12 square units

4 Students' own answers, probably of the form $(-1, a)$, but other answers are also valid, for example $(-4, 7)$, $(-4, -5)$, $(2, 7)$, $(2, -5)$

5 a Adds 10 and then divides by 2.

b They get closer and closer to 10.

c The sequence still tends to 10.

d The limits increase or decrease as the denominator increases or decreases, unless the denominator is between -1 and 1 , in which case the sequence diverges.

e Students' own answers.

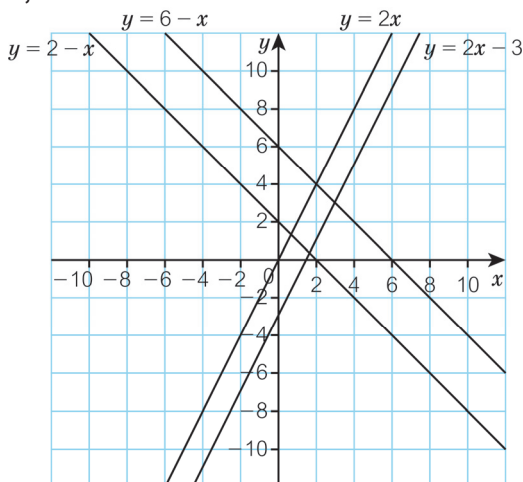
6 a

x	-2	0	2	4	6
y	-7	-3	1	5	9

c

x	-3	-1	0	5	10
y	9	7	6	1	-4

b, d



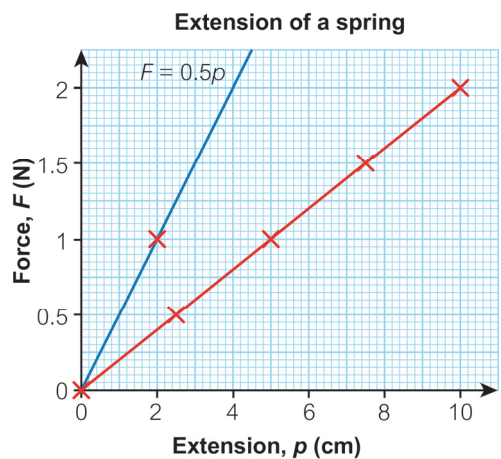
e (3, 3)

f

x	-4	-2	0	2	4
y = 2 - x	6	4	2	0	-2
y = 2x	-8	-4	0	4	8

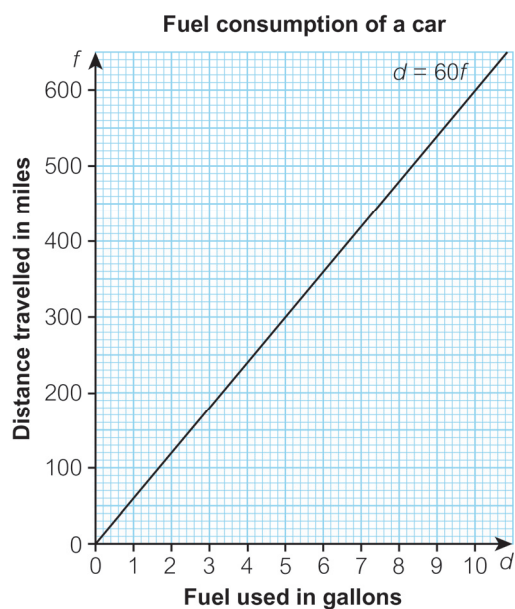
g Parallelogram

7 a, c



b $\frac{1}{5}$

8 a



- b i 2.5 gallons
- ii 210 miles

9 a 8

b

Number of tables	1	2	3	4	5
Number of seats	4	6	8	10	12

c 22

d 2

e No. 2 seats are lost each time a table is added.

f $2n + 2$

g 14

10 a $x = 2$

b $y = 3$

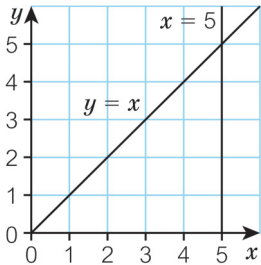
c $y = x$

11 a $(-1.5, 1.5)$

b $(9, 17)$

- 12 a** (5, 5)
b i (5, 2)
ii (7, 5)
iii (8, 3.5)
iv (4, 3.5)
v (6, 3.5)

13 a i, ii



b 12.5 square units

14 a 14 and 860. Terms in the sequence must be 5 more than a multiple of 9, and n cannot be negative.

- b** 42
c 111th

15 a infinite

b the 1st term, -17.5

16 a 42, 56

b 21, 34

c 26, 37

d $10\frac{1}{2}$, 14

17 a $-1, 1$

b $-12, 14$

c $-\frac{1}{32}, \frac{1}{64}$

18 a 1st term = 1, term-to-term rule = $\times 4$

b 1st term = 1, term-to-term rule = $\times 10$

c 1st term = 200, term-to-term rule = $\div 2$

d 1st term = 81, term-to-term rule = $\div 3$

19 a 3, 81

b 20

c 50

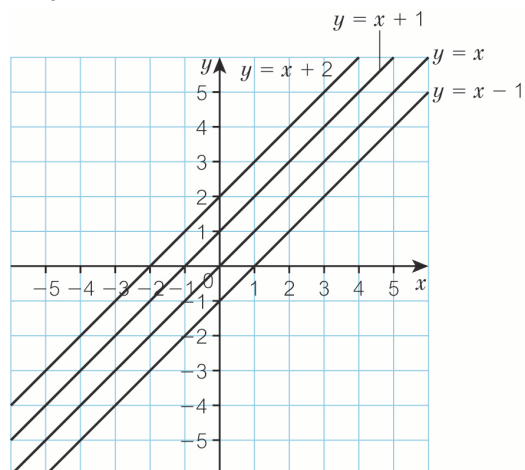
20 a i 5, 7

ii $2n - 1$

b i 9, 27

ii 1st term = 1, term-to-term rule = $\times 3$

21 a



- b i (0, 0)
- ii (0, 1)
- iii (0, 2)
- iv (0, -1)
- c i (0, -5)
- ii (0, 12)

22 a 32

b

1st term	2nd term	3rd term	4th term	5th term
2	2×2 $= 2^2$	$2 \times 2 \times 2$ $= 2^3$	$2 \times 2 \times 2 \times 2$ $= 2^4$	$2 \times 2 \times 2 \times 2 \times 2$ $= 2^5$

- c 1024
- d 2^n

9 Unit test

1 a

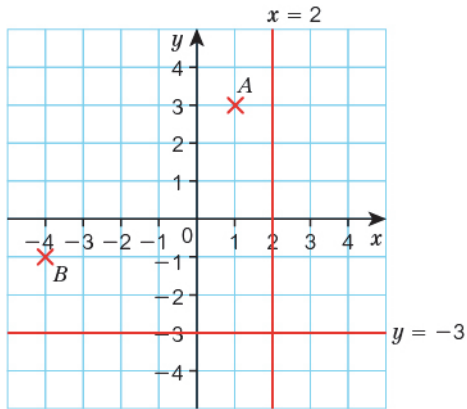


b

Term number	1	2	3	4	5	6
Number of dots	2	6	12	20	30	42

- 2 64, 32, 16, 8, 4
- 3 54
- 4 10, 4, -2, -8

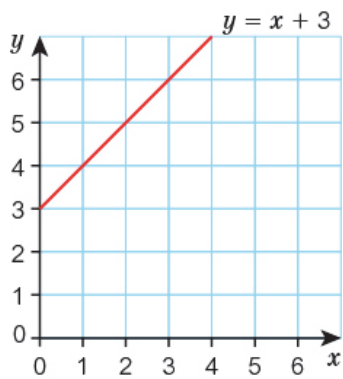
5 a, b



6 a

x	0	1	2	3
y	3	4	5	6

b



7 -5, 0, 5

8

	arithmetic	geometric
1, 2, 4, 8, 16, ...		x
1, 2, 3, 4, 5, ...	X	
9, 7, 5, 3, 1, ...	X	
2, 6, 18, 54, ...		x

9 $5n + 1$

10 (7, 7)

11 a C

b (0, 0)

12 a 81, 243

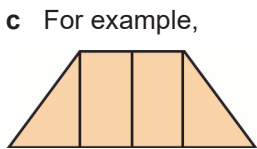
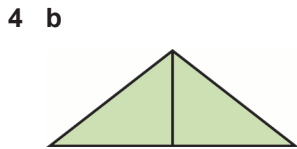
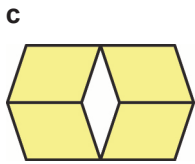
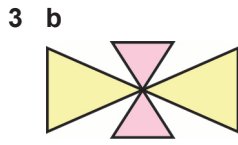
b 3^n

13 (5, 4)

Unit 10 Transformations

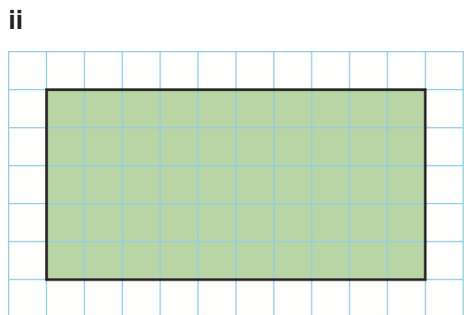
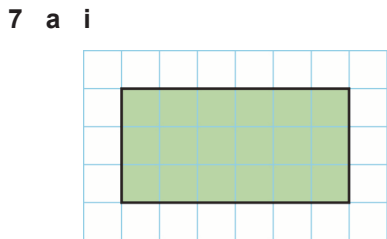
10.1 Congruency and enlargements

- 1 a C b A
 2 a $2 \times 4 = 8$ b $4 \times 3 = 12$ c $18 \div 6 = 3$
 d $15 \div 3 = 5$

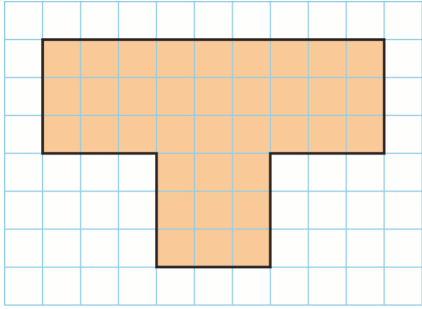


- 5 a Length x is the same as length u . b Length y is the same as length v .
 c Angle A is the same size as angle D. d Angle C is the same size as angle E.

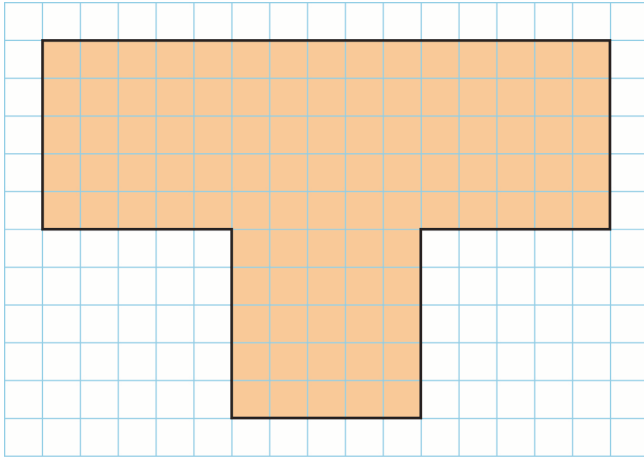
- 6 A and D, B and J, C and G, E and F, H and I



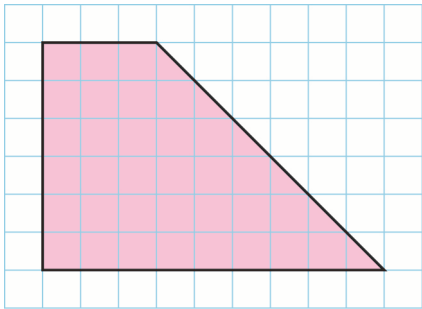
7 b i



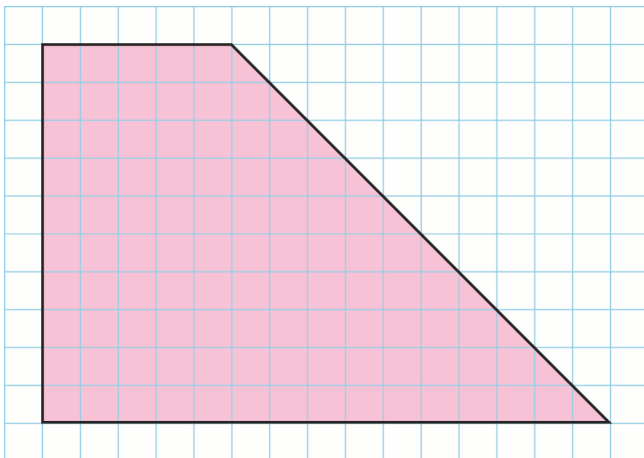
ii



c i



ii



8 a 22.5 cm b 2.1 m

9 a i 1 : 3 ii 3

b i 1 : 2 ii 2

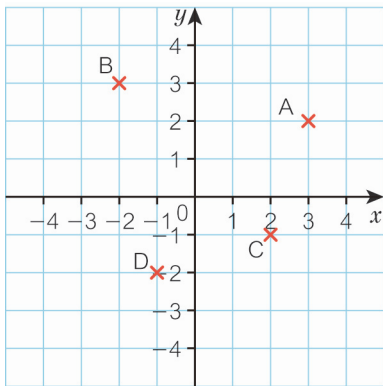
c i 1 : 4 ii 4

10 a Yes, every length will be 3 times as long as on the object.

b No, the area of the image will be 9 times the area of the object.

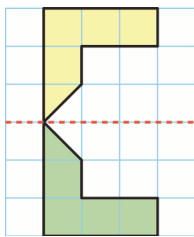
10.2 Reflection

1

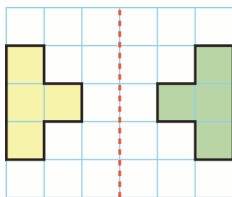


- 2 A $x = 3$ B $x = -2$ C $y = 1$
 D $y = -2$ E $y = x$

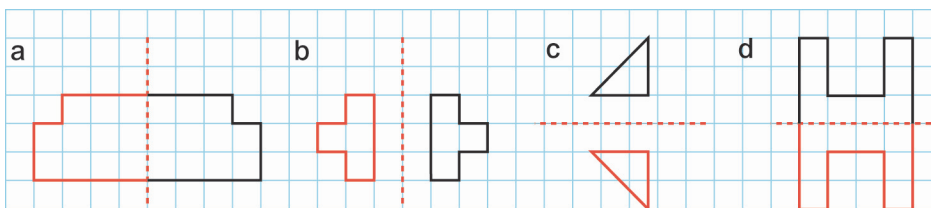
- 3 a Correct reflection.
 b No, it's a rotation. The correct reflection is:



- c No, it's a translation. The correct reflection is:

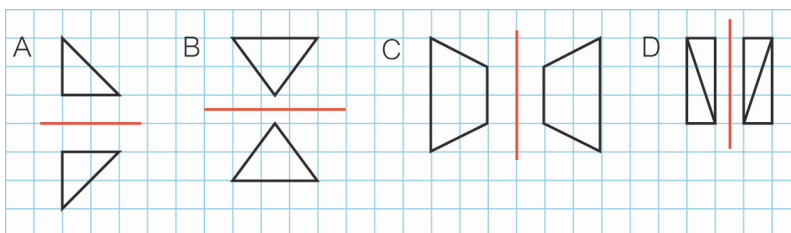


4



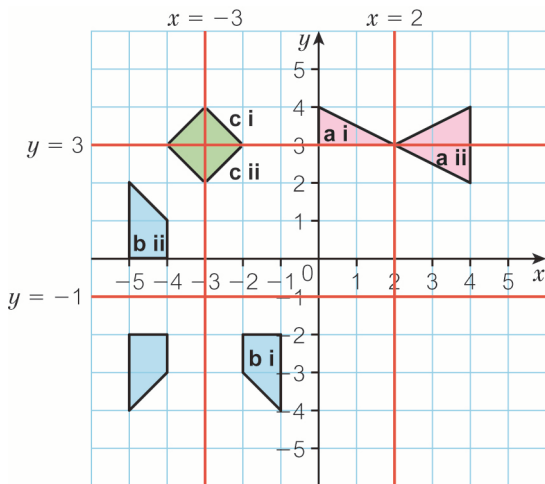
H, I, M, O, T, V, W, X
 B, C, D, E, H, I, O, X

5 a



- b Yes

6



c iii Square, 2 square units

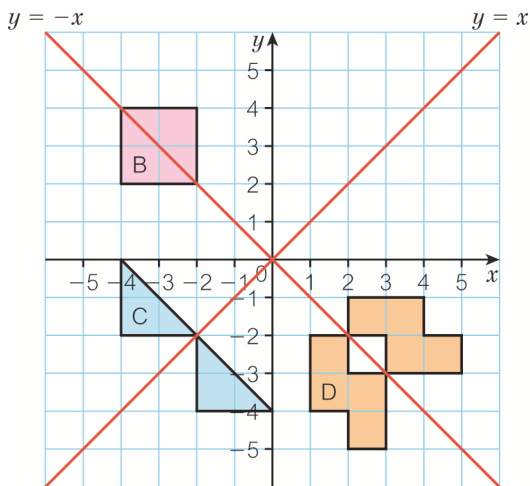
7 b $y = 1$

c $x = -2$

d $x = 2$

e $y = -1$

8 b-d



10.3 Rotation

1 a i A

ii B

iii D

iv C

b

i B

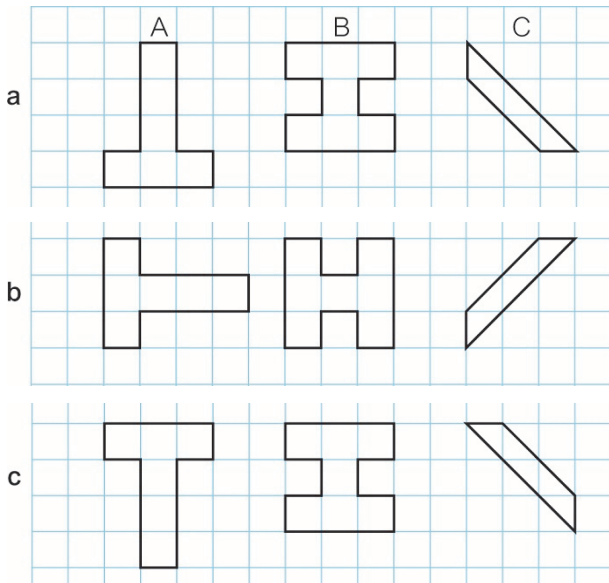
ii A

iii D

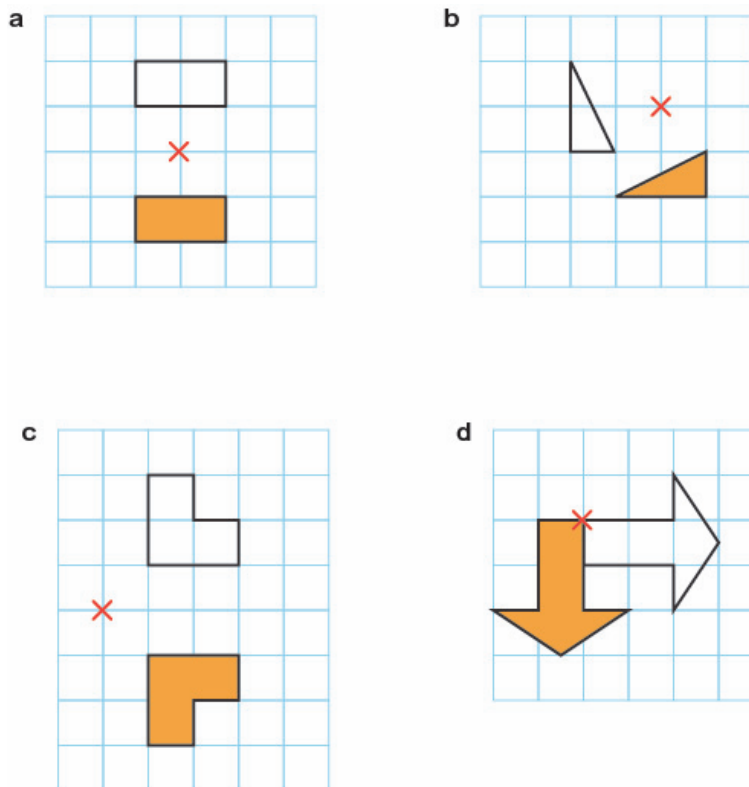
iv C

2 A anticlockwise, B clockwise.

3



4

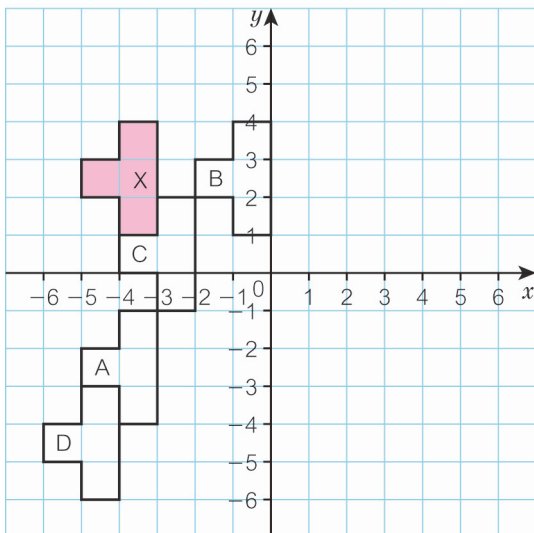


- 5 a 180° turn b 90° turn clockwise or 270° turn anticlockwise
 c 90° turn clockwise or 270° turn anticlockwise
- 6 b 90° rotation anticlockwise about (1, 0) c 180° rotation about (1, 0)
 d 90° rotation clockwise about (1, 0) e 180° rotation about (1, 0)
 f 180° rotation about (1, 0)
- 7 a (0, 1), (2, 1) and (0, 0) b (-1, 0), (-3, 0) and (-1, 1)
 c (0, -1), (0, -3) and (-1, -1)
- 8 a 90° rotation clockwise about (2, -1) b 90° rotation anticlockwise about (2, -2)
 c 180° rotation about (1, 0) d 180° rotation about (4, 1)

10.4 Translations and combined transformations

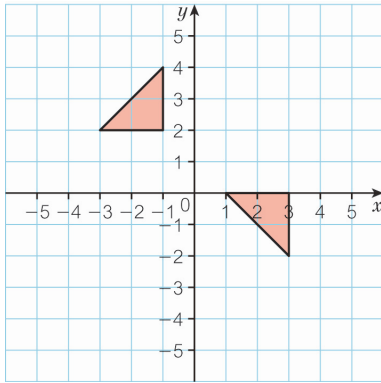
- 1 a A (2, 3), B (6, 3), C (5, 8), D (6, 1)
 b i 4 left
 ii 2 down
 iii 1 left 5 up
 iv 3 left 5 down
- 2 A 4 up, B 4 left, C 11 right, D 5 down, E 3 down
- 3 a 5 right
 b 5 up
 c 3 left, 4 up
 d 5 left 2 up
 e 3 left 2 down
 f 1 right 4 down
 g 3 right 4 up

4

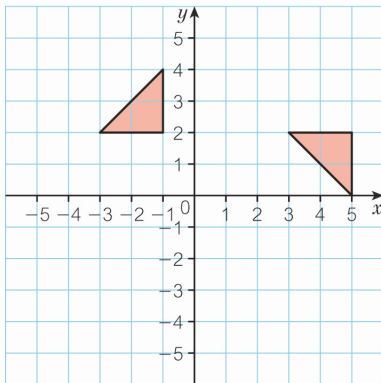


- 5 a 4 squares right, 2 squares down.
 b 1 square left, 2 squares down.
 c 2 squares right, 1 square up.
- 6 a T
 b F, different sizes
 c T
 d T
 e T
 f F, different sizes
 g F, different shapes
 h T

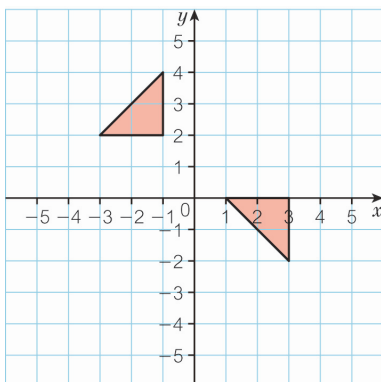
7 a



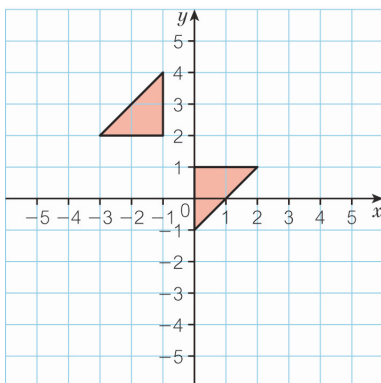
b



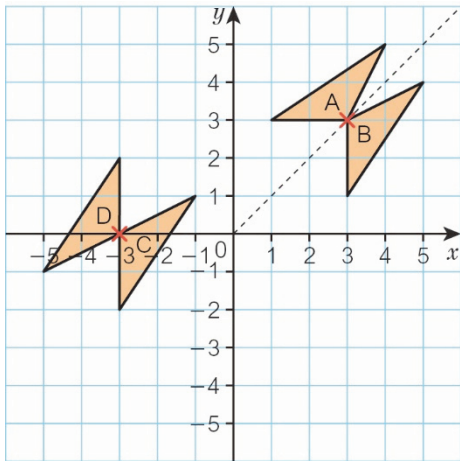
c



d



8 a-c

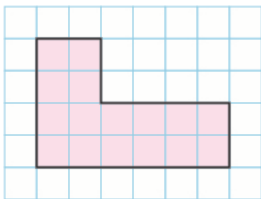


d No

10 Check up
Congruency and enlargements

1 A and D; B and F; C and E

2 a



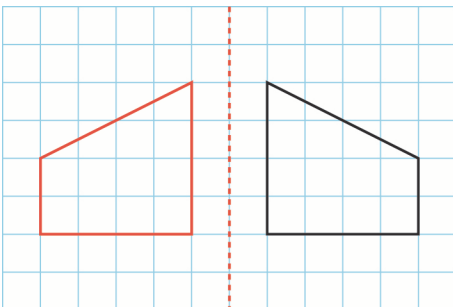
b No; they are different sizes.

3 a 1 : 3

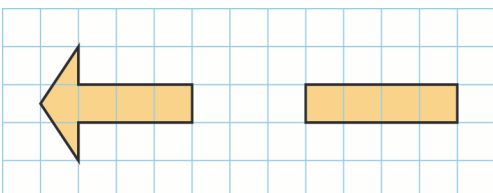
b 3

Reflections and rotations

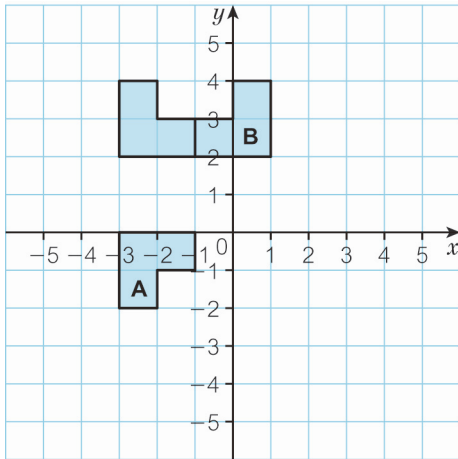
4



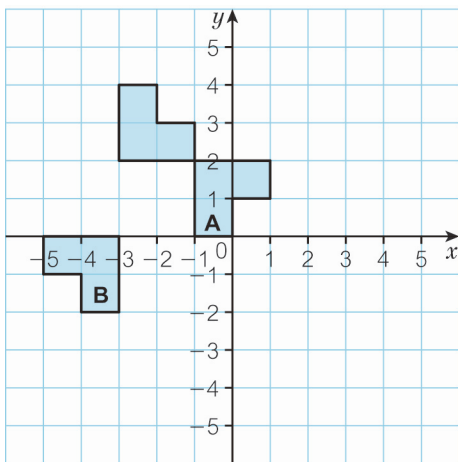
5



6 a, b

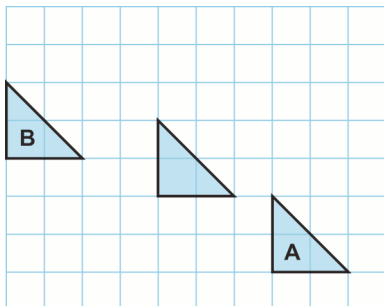


7 a, b



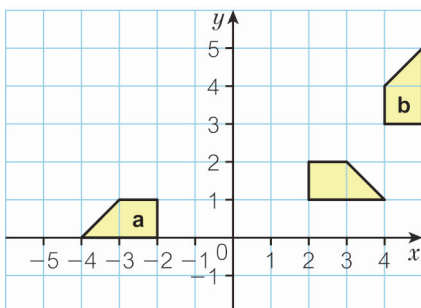
Translations and combined transformations

8



- 9 a 5 squares right, 1 square up.
- b 1 square left, 4 squares down.

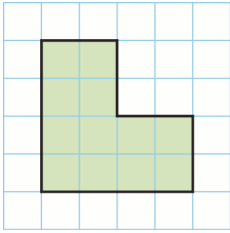
10 a, b



10 Strengthen
Congruency and enlargements

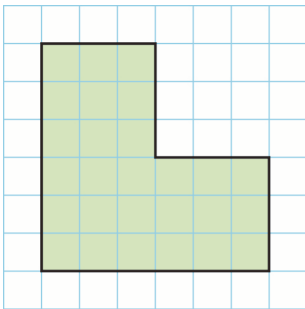
1 a Yes b No c No

2 a i



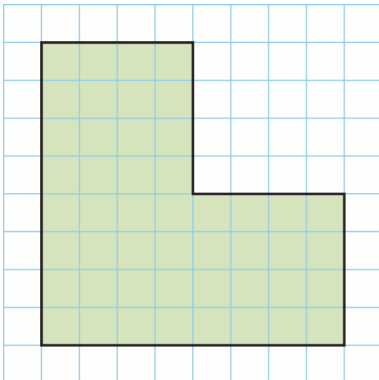
ii 1 : 2

b i



ii 1 : 3

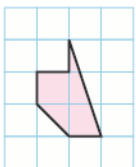
c i



ii 1 : 4

3 a 5 b 10

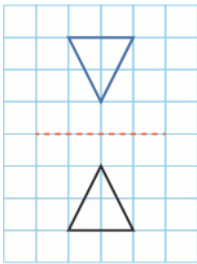
4 a For example:



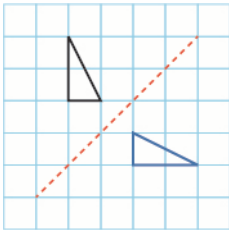
b 3

Reflections and rotations

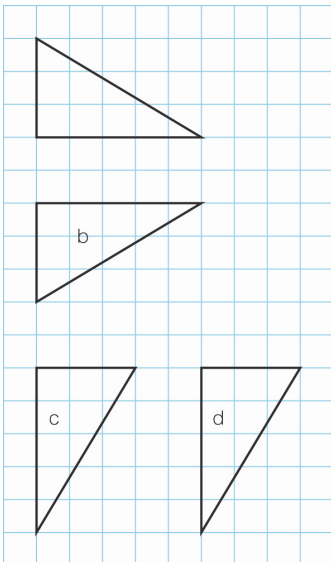
1 a



b



2



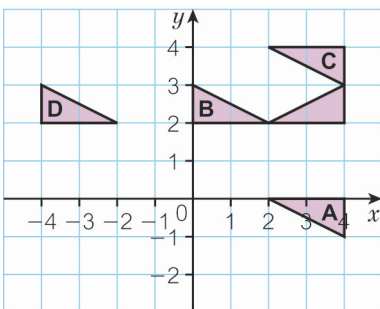
e The shape has been rotated by the same amount.

3 a 180° clockwise/anticlockwise

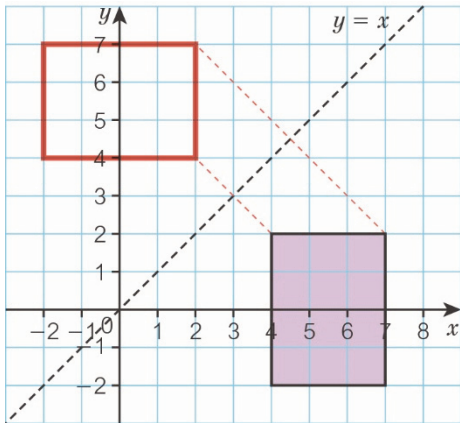
b 90° clockwise or 270° anticlockwise

c 90° clockwise or 270° anticlockwise

4

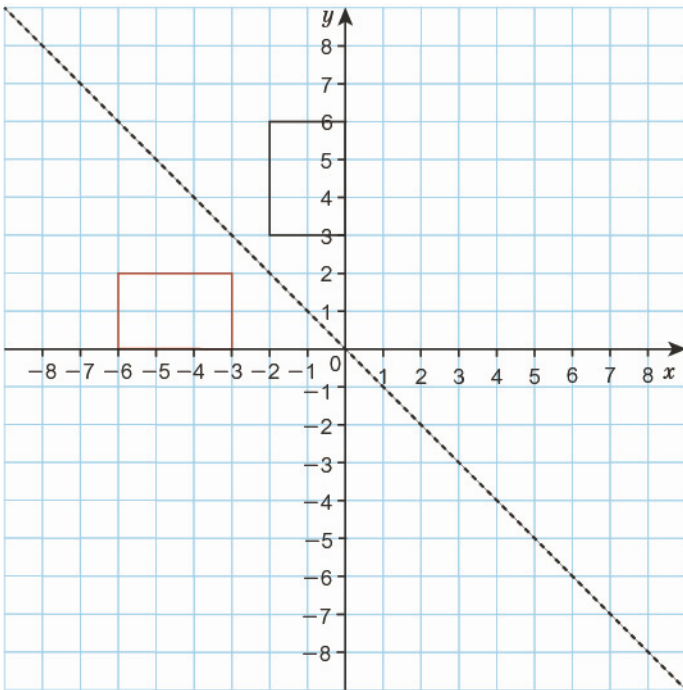


5 a, b

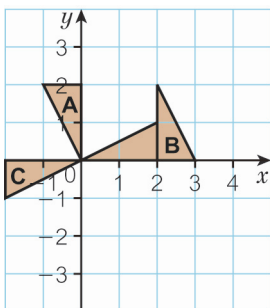


c The object and its image are on top of each other.

6



7



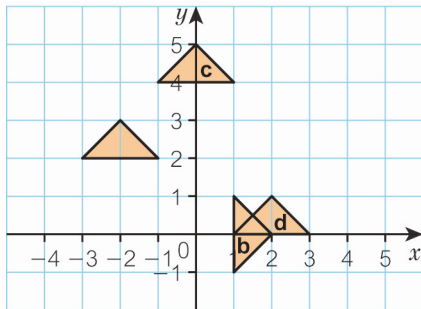
8 a Rotation 180° , centre $(0, 1)$

b Rotation 90° clockwise / 270° anticlockwise, centre $(-2, 1)$

Translations and combined transformations

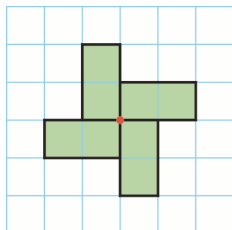
- 1 a 2 squares right, 3 squares up
 b 3 squares right
 c 2 squares left, 4 squares down
 d 2 squares right, 1 square down
 e 5 squares left, 2 squares up
 f 5 squares up
- 2 a 3 left, 2 up b 4 left, 5 down
 c 3 right, 3 up d 3 down

3 b–d



Enrichment

1 a

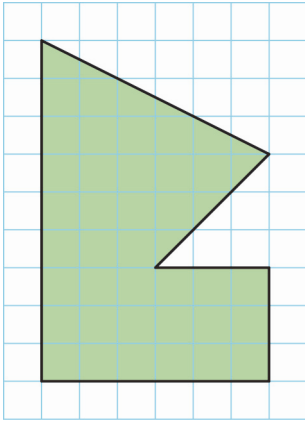


- b 4
 c No, it only has rotational symmetry.
- 2 Students' own answers.

10 Extend

- 1 a rotation 180° about (2, 2.5)
 b rotation 180° about (-0.5, 1)
 c rotation 180° about (-4, 1.5)
- 2 a rotation 90° clockwise about (-4, 2)
 b rotation 180° about (0.5, 2)
 c rotation 180° about (-2.5, 1)
- 3 a rotation 90° anticlockwise about (4, 3)
 b rotation 180° about (-2, 3)
 c rotation 90° anticlockwise about (1, 0)
 d rotation 90° anticlockwise about (-2, 0)
 e rotation 90° clockwise about (2, -4)

4



5 a 2 b 3 c 1.5

d

Rectangle	Perimeter (cm)	Area (cm ²)
A	6	2
B	12	8
C	18	18

e

Rectangles	Ratio of lengths	Ratio of perimeters	Ratio of areas
A : B	1 : 2	1 : 2	1 : 4
A : C	1 : 3	1 : 3	1 : 9

f Ratio of lengths and perimeters is the same.
Ratio of areas is the square of ratios of lengths, $2^2 = 4$ and $3^2 = 9$

6 a 40 cm b 75 cm²

7 Reflection in the line $x = -1$

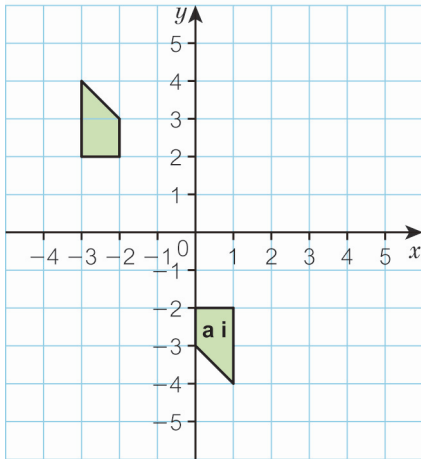
8 a $x = 3$

b

Triangle ABC	A (2, 1)	B (2, 4)	C (1, 2)
Triangle DEF	D (4, 1)	E (4, 4)	F (5, 2)
Triangle GHI	G (8, 1)	H (8, 4)	I (7, 2)

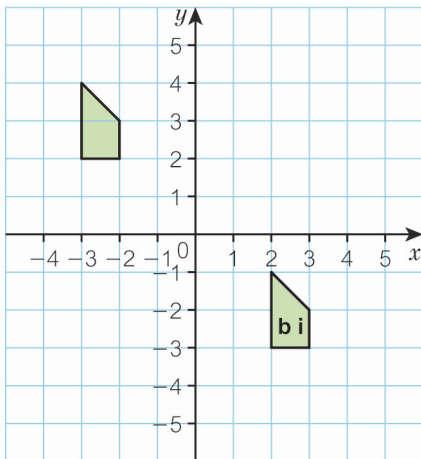
c J (10, 1), K(10, 4), L(11, 2)
To find J and K, add 2 to the x -coordinates of G and H, y -coordinates stay the same.
To find L, add 4 to the x -coordinate of I, y -coordinate stay the same.

9 a i



ii rotation 180° about $(-1, 0)$

b i



ii translation 5 squares left and 5 squares up

10 a translation 3 left and 2 up

b translation 4 left and 6 up

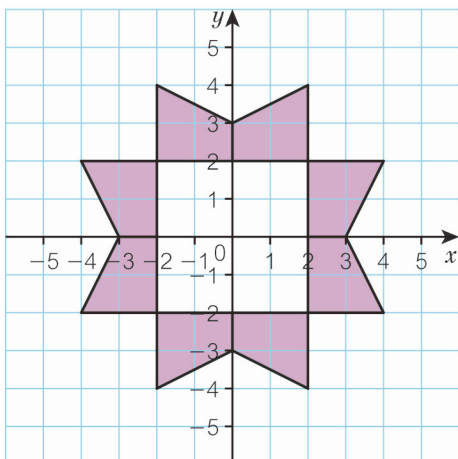
c a 5 left - 2 right = 3 left

3 up - 1 down = 2 up

b 7 left - 3 left = 4 left

2 down + 6 up = 4 up

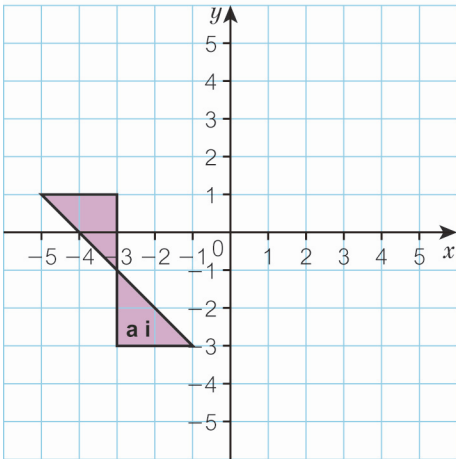
11 a, b



c 4

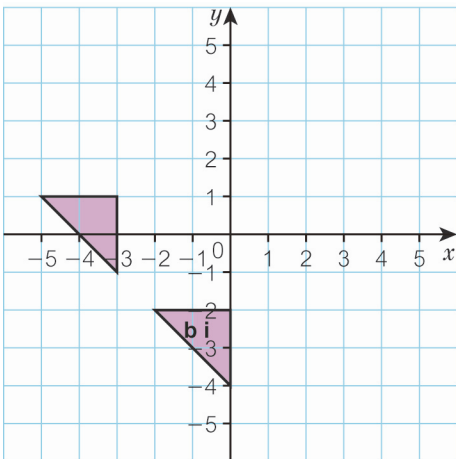
d 4

12 a i



ii rotation 180° about $(-3, -1)$

b i



ii translation 3 squares left and 3 squares up

13 a \$55.92

b 3240

c £454.35

d 36 hours

10 Unit test

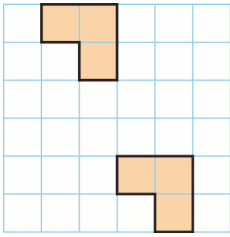
1 C

2 a C

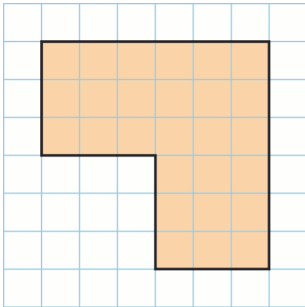
b B

c A

3 a



b i



ii 1 : 3

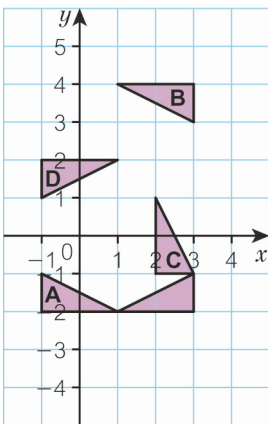
4 a A and C

b D, G, F and H

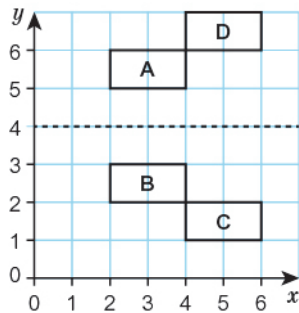
c J and L, M and N

5 She has reflected the shape in the line $x = 2$.

6



7 a-c



d Translate 2 squares left and 1 square down.

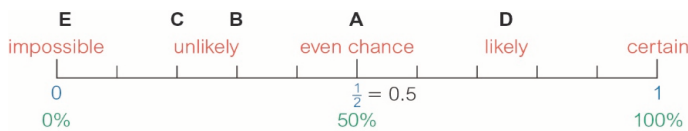
Unit 11 Probability

11.1 Comparing probabilities

1 a $\frac{7}{10}$ b $\frac{2}{3}$

2 $0.1 = 10\% = \frac{1}{10}$ $0.2 = 20\% = \frac{1}{5}$ $0.25 = 25\% = \frac{1}{4}$
 $0.4 = 40\% = \frac{4}{10}$ $0.5 = 50\% = \frac{1}{2}$

3 a, b



4 a A: 1, 2, 3, 4, 5, 6, 7, 8; B: 1, 2, 3, 4, 5; C: 1, 2, 3, 4

b A 8; B 5; C 4

5 a 2, 4, 6 b 1, 2, 3, 4

c 2, 3, 5 d 2, 3, 4, 5, 6

6 a-d

i $\frac{5}{10}$ or $\frac{1}{2}$ or 0.5 or 50%, even chance.

ii $\frac{3}{10}$ or 0.3 or 30%, unlikely.

iii 0, impossible

7 a $\frac{1}{2}$ b $\frac{3}{10}$ c $\frac{1}{5}$

8 a $\frac{7}{10}$ b $\frac{1}{5}$ c $\frac{1}{10}$

9 a A red counter b Bag B

10 a i The number 3 with dice B ($\frac{1}{5}$ vs $\frac{1}{10}$)

ii An even number with dice A ($\frac{1}{2}$ vs $\frac{2}{5}$)

b Dice B

11 Kampala

12 a $\frac{1}{10}$ or 0.1 or 10%

b i 100 ii $\frac{1}{100}$ or 0.01 or 1%

c $\frac{1}{1000}$ or 0.001 or 0.1%

13 a i A square number on dice A is less likely

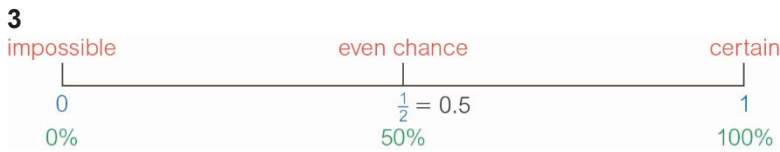
ii A prime number on dice C is less likely

b They all have the same probability = $\frac{1}{2}$

11.2 More probability calculations

1 a $\frac{2}{5}$ b $\frac{7}{10}$ c $\frac{11}{12}$

2 a 0.3 b 67%



4 a $\frac{3}{4}$ b Yes. Because $P(\text{not } Y) = 1 - P(Y) = 1 - \frac{1}{4} = \frac{3}{4}$

5 a 6

b i $\frac{1}{6}$ ii $\frac{2}{3}$ iii $\frac{5}{6}$

iv 1 v $\frac{1}{2}$ vi $\frac{1}{3}$

6 a $\frac{2}{5}$ b $\frac{3}{5}$ c 0

7 a i $\frac{7}{160}$ ii $\frac{17}{160}$

b Girl with brown eyes (32 vs 24)

8 0.35

9 a 1, 2, 3, 4, 5, 6 b $\frac{1}{6}$ c 1

d 1 e Student answers.

10 Students' pictures of a spinner with ten sections. Exactly TWO sections must be yellow and there must be exactly SIX sections made up of red and blue. A different colour is needed for the remaining sections.

11 88%

12 0.3

13 a $\frac{5}{6}$ b $\frac{3}{6}$ or $\frac{1}{2}$ c 0.9

14 95%

11 Check up
Calculating probabilities

1 R, R, B, B, W

2 a 0, 1, 2, 3, 4

b $\frac{1}{5}$ c 1

3 a $\frac{3}{10}$ b $\frac{1}{5}$ c $\frac{1}{2}$

4 a 1, 1, 1, 2, 2, 3, 4, 5

b i $\frac{3}{8}$ ii $\frac{5}{8}$ iii $\frac{7}{8}$

5 a $\frac{1}{2}$ b $\frac{1}{3}$

6 a $\frac{5}{8}$ b Chocolate c $\frac{7}{8}$

7 0.9

8 $\frac{2}{3}$

Probability problems

9 She is correct as there are 3 prime numbers and 3 odd numbers on a regular dice.

10 The probability of choosing a blue car is $\frac{6}{11}$ and the probability of choosing a red car is $\frac{3}{11}$.

Therefore Jana is correct.

11

Colour	Red	White	Blue
Probability	$\frac{2}{5}$	$\frac{1}{5}$	$\frac{2}{5}$

12 A seven-sided spinner with one side labelled 3, two sides labelled as 2 and four sides labelled as 1.

**11 Strengthen
Calculating probabilities**

1 a i $\frac{1}{3}$ ii 1

b No, because the probability of getting 2 on both spinners is $\frac{1}{3}$.

2 a B b A c A $\frac{1}{4}$, B $\frac{2}{8}$ or $\frac{1}{4}$, equally likely

3 a 10 b 4 c $\frac{4}{10}$ or $\frac{2}{5}$

d i $\frac{6}{10}$ or $\frac{3}{5}$ or 0.6 or 60% ii 0

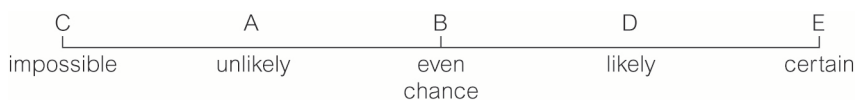
iii $\frac{5}{10}$ or $\frac{1}{2}$ or 0.5 or 50% iv $\frac{8}{10}$ or $\frac{4}{5}$ or 0.8 or 80%

4 a 6

b i $\frac{1}{6}$ ii $\frac{2}{6} = \frac{1}{3}$ iii $\frac{3}{6} = \frac{1}{2}$

iv $\frac{5}{6}$ v $\frac{5}{6}$ vi $\frac{3}{6} = \frac{1}{2}$

5



6 0.7

7 55%

8 88%

9 No. If the coin were fair then the probability of landing on heads would be 0.5.

10 $\frac{4}{8} = \frac{1}{2}$

- 11 a i $\frac{2}{10}$ or $\frac{1}{5}$ ii $\frac{5}{10}$ or $\frac{1}{2}$ iii $\frac{8}{10}$ or $\frac{4}{5}$
 iv $\frac{6}{10}$ or $\frac{3}{5}$

Probability problems

- 1 a i $\frac{1}{1\,000\,000}$ ii 0.000001 b Students' own answers

- 2 a $\frac{7}{8}$ b $\frac{5}{8}$ c $\frac{1}{8}$ d 1

- 3 No. $P(\text{green}) = \frac{3}{12} = \frac{1}{4}$, $P(\text{yellow}) = \frac{5}{12}$

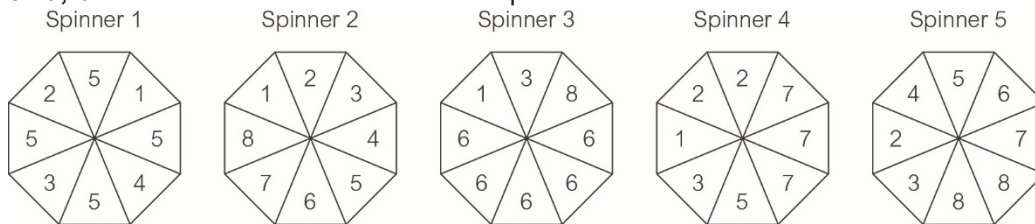
- 4 The spinner should have 3 sections: 1 blue, 1 green and 1 red.
 5 The possible outcomes are not equally likely.

Enrichment

- 1 5 sides

- 2 a For example: 1, 1, 1, 1, 1, 2 b For example: 1, 1, 1, 1, 1, 4, 4, 4, 4, 4

- 3 a, b Students' own answer. For example:



11 Extend

- 1 a The matchbox is more likely to end face up because the base has a larger surface area than the end.
 b Outcomes are not equally likely, so you cannot use the formula based on equally likely outcomes.
 2 D, A, C, B
 3 Students' own answers, e.g. 1 blue counter, 3 green, 2 red and 2 yellow.
 4 Students' own answers, for example: 6, 8, 8, 8, 10, 16, 20, 20, 20, 20.
 5 5
 6 A ii B iv C iii D i
 7 3, 7, 17
 8 a 0.4 b 0.3
 9 Students' own answer for example:
 1 green 5 blue 4 red 10 orange

11 Unit test

- 1 a $\frac{1}{6}$ b $\frac{1}{2}$ c $\frac{2}{3}$
 2 a $\frac{1}{2}$ b $\frac{5}{8}$ c Giovanni

3 a 1, 1, 2, 2, 2, 3, 3, 5, 6, 6

b i $\frac{1}{5}$ ii $\frac{1}{2}$ iii 1

4 Spinner with 2 sections coloured blue, 3 sections coloured red, 1 section coloured green, 2 sections yellow.

5 a i Spinner 2 ii Spinner 1

b No. The probability of blue on Spinner 1 is $\frac{1}{2}$ and on Spinner 2 is $\frac{1}{3}$.

6 a $\frac{2}{3}$ b $\frac{1}{2}$

7 Yes. The probability of a prime number is $\frac{3}{5}$ and the probability of a square number is $\frac{2}{5}$.

8 a $\frac{2}{5}$ b $\frac{2}{5}$

9 Net labelled such that the smallest rectangles are labelled 3 and 6, the medium rectangles are labelled 2 and 5 and the largest rectangles are labelled 1 and 4.

10

Colour	Blue	Grey	Black	White
Probability	0.1	0.4	0.2	0.3