

Unit 1 Significant figures, powers and standard form

1.1 STEM: Powers of 10

1 $10^2 = 100$, $10^3 = 1000$, $10^4 = 10\ 000$,
 $10^5 = 100\ 000$

2 a 45 b 2360 c 84.3
d 14 500 e 27 f 4.685
g 0.35 h 0.045

3

100 000	10 000	1000	100	10	1		$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$	$\frac{1}{10000}$	$\frac{1}{100000}$
10^5	10^4	10^3	10^2	10	10^0	.	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}

4 a

10^5	10^4	10^3	10^2	10	10^0	.	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}
		kilo					deci	centi	milli		

b 1000 c 1 000 000
d 1 000 000 000

5 a 4000 b 2 400 000
c 12 500 000 000

6 a 1 000 000 b 1000 c 1000
d 1000

7 a

Name of planet	Diameter of planet (km)	Average distance from Sun (km)
Mercury	4 900	57 900 000
Earth	12 800	150 000 000
Saturn	120 000	1 427 000 000

b Saturn c Mercury

8 110 tonnes

9 a

Name of organism	Length (m)	Width (m)
dust mite	0.00 042	0.00 025
bacteria	0.000 002	0.0 000 005
virus	0.0 000 003	0.000 000 015

b dust mite c virus

10 0.0 000 001 mm

1.2 Calculating and estimating

1 a 5^6 b 8^2 c 7^3

2 a 16 b 49 c 9 d 100

3 Students' own estimations to:

a $97 \div 4$, e.g. $100 \div 4 = 25$
b 12.3×10.2 , e.g. $12 \times 10 = 120$
c $18.6 \div 5$, e.g. $20 \div 5 = 4$

4 18

5 a 40 b 36 c 1250 d 360

6 112

7 Rashid is correct. Sarka has squared -5 to get -25 instead of $+25$.

8 $14 + 4^2$ and $14 + (-4)^2$
 $14 - 4^2$ and $14 - (-4)^2$
 $25 - 2^2 - 6^2$ and $25 - 2^2 - (-6)^2$
 $25 - (-2)^2 + 6^2$ and $25 - 2^2 + (-6)^2$

9 a 12 b 48 c 10 d 48

10 a 47.37 b 0.007 c 580 000

11 a $40 \times 500 = 20\ 000$ b $6000 \times 30 = 180\ 000$
c $900 \div 30 = 30$ d $50\ 000 \div 200 = 250$

12 a 3 b 160 c $\frac{1}{2}$ d 1800

13 43.8 m^3

14 a Students' own answers: any two numbers such that $665 \leq \text{number} < 675$
b 674 c 665

15 a

Planet	Mercury	Venus	Earth	Mars	Uranus
Diameter (km)	5000	10 000	10 000	7000	50 000

b 45 000 km

16 $40\ 000 \times \pounds 30 = \pounds 1\ 200\ 000$

1.3 Indices

1 a 3^9 b 7^4 c 4^3 d 2^{12}
 e 11^{21} f 5^{25} g 2^9 h 3^9
 i 5^7

2 a $3^{-2} = \frac{1}{9}$ b $\frac{1}{3} = 3^{-1}$
 c $6^{-2} = \frac{1}{36}$ d $13^{-2} = \frac{1}{169}$
 e $4^{-3} = \frac{1}{64}$ f $\frac{1}{81} = 3^{-4} = 9^{-2}$
 g $\frac{1}{64} = 8^{-2} = 4^{-3} = 2^{-6}$

h $5^{-1} = \frac{1}{5}$

3 a 10^3 b 4^2 c 11^{-7} d 7^7
 e 6^{-6} f 8^{-4} g 9^{-10} h 12^8

4 a i 3^{-3} ii $\frac{1}{27}$
 b i 4^3 ii 64
 c i 5^{-2} ii $\frac{1}{25}$
 d i 2^{-4} ii $\frac{1}{16}$

5 a $\frac{1}{9}$ b $\frac{9}{16}$ c $\frac{27}{125}$ d $\frac{16}{81}$

6 a $\left(\frac{4}{10}\right)^2 = \left(\frac{2}{5}\right)^2$ b $\left(\frac{3}{7}\right)^2$
 c $\left(\frac{5}{8}\right)^2$ d $\left(\frac{2}{4}\right)^3 = \left(\frac{1}{2}\right)^3$
 e $\left(\frac{2}{5}\right)^4$ f $\left(\frac{1}{3}\right)^3$

7 a $\frac{1}{8}$ b $\left(\frac{1}{2}\right)^3$

1.4 Standard form

1 a 250 b 0.073 c 0.406
 d 0.00955

2 a 23400 b 2 c 3 d 6.7

3 a, b, e and f

4 a 700 b 0.000025
 c 5400 000 d 0.00304

5 a 2.35×10^4 b 3.15×10^2
 c 1.2×10^7 d 4×10^{-2}
 e 3.5×10^{-4} f 9.01×10^{-8}

6 a

Object	Distance from Earth (Light years)
Centre of our galaxy	2.6×10^4
Andromeda (a neighbouring galaxy)	2.5×10^6
Betelgeuse (a star of Orion)	6×10^2

b No, it is further away.

7 a 3.59×10^2 , 9.87×10^2 , 1.9×10^3 ,
 1.95×10^4 , 8.65×10^4

b 8.05×10^{-6} , 3.99×10^{-5} , 5.3×10^{-3} ,
 8.76×10^{-3} , 4.8×10^{-2}

c 3.2×10^{-3} , 3.22×10^{-3} , 3.22×10^{-2} ,
 3.02×10^2 , 3.22×10^2

8 a

Planet	Mass (kg)
Earth	5.97×10^{24} kg
Jupiter	1.899×10^{27} kg
Mars	6.42×10^{23} kg
Mercury	3.3×10^{23} kg
Neptune	1.02×10^{26} kg
Saturn	5.685×10^{26} kg
Uranus	8.68×10^{25} kg
Venus	4.87×10^{24} kg

b Approximately 10 times heavier

c Saturn

9 Gold, aluminium, helium

10 a i 0.0000625 m ii 0.0625 mm
 b i 0.00000018 m ii 0.00018 mm

1.5 Calculating with standard form

1 a 5.9×10^4 b 6.01×10^{-2}
 c 7.2×10^{-8} d 5.323×10^3

2 a 10^{-1} b 10^{-5} c 10^4 d 10^{-3}

3 a 3.6×10^5 b 7.5×10^8
 c 2.5×10^6 d 1.44×10^6

4 a 2×10^6 b 4×10^2
 c 4×10^4 d 1.6×10

5 a 6.1536×10^{11} b 2.2×10^5

6 a i 300 000 km/s ii 3×10^5 km/s
 b 8 minutes

7 $8.82 \times 10^5 : 1$

8 a No b Yes c Yes

9 a

Object	Approximate diameter (m)
Extinct elephant bird	16.67
Ostrich	10.00
Hummingbird	0.67
Sea star	0.06
Human	0.008

b Students' own answers. A typical student answer could refer to the fact that all models are visible, though the elephant bird egg might be too big to display. However, the ostrich and elephant bird eggs would be difficult to hold.

10 0.2 mm (= 0.00 02 m)

11 3.3×10^{-7} mm

12 a 680 000 b 82 000 (= 81 967.213 11)

c 3×10^{10} red light rays

13 5×10^{-4}

14 4×10^{-7} m (= 0.000 000 4 m)

15 2 mm (= 2.4192 mm)

16 a 6.55×10^8 b 1.685×10^6

c 1.1×10^{-3} d 4.32×10^7

e 2.63×10^{-3}

17 a 3.3×10^{-7} b 5.1×10^3

c 5.05×10^6 d 6.41×10^{-3}

18 3.7×10^{-7} m

1 Check up Powers of 10

1 a

Prefix	Power of 10	Number
giga	10^9	1 000 000 000
mega	10^6	1 000 000
kilo	10^3	1000
deci	10^{-1}	0.1
centi	10^{-2}	0.01
milli	10^{-3}	0.001
micro	10^{-6}	0.000 001

b 0.005 kilograms and 5 grams
5000 kilograms and 5 megagrams
50 000 milligrams and 500 decigrams

2 $2.4 \div 10^7$, $8.9 \div 10^5$, 4.6×10^4 , 2.1×10^5

Calculating and estimating

3 a 169 b 5

4 a 67.5 b 6

5 17.9 cm^2

Indices

6 a $\frac{1}{125}$ b $\frac{1}{6}$ c $\frac{1}{16}$

7 a 10^{-1} b 3^{-3} c 3^{-6} d 7^{-3}

Standard form

8 a 3.45×10^2 b 3.45×10^4

c 5×10^3

9 7.231×10^{-3}

10 3.2×10^{-5} , 3.2×10^{-3} , 3.1×10^{-2} , 3.22×10^3
 3.022×10^4

Calculating with standard form

11 a 8.2×10^{-3} b 4×10^1

12 a i 6.3×10^{-2} ii 0.063

b i 4.4667×10^6 ii 4 466 700

13 35%

14 Students' own answers

1 Strengthen Powers of 10

1 a kilo (k) = 10^3 = 1000

b mega (M) = 10^6 = 1 000 000

c giga (G) = 10^9 = 1 000 000 000

2 a 6 500 000 000 km b 14 000 000 nm

c 0.05 mm d 2.2 Mm

e 600 000 mm

3 a 5 000 J b 21 000 W

c 270 000 000 m/ d 0.72 mg

4 a 6100 kHz b 0.69 μm

Calculating and estimating

1 a 32.45 with the 3 circled

b 0.64 with the 6 circled

c 25 800 with the 2 circled

d 0.0782 with the 7 circled.

2 a 30 b 0.6 c 30 000 d 0.08

3 a 54 000 b 0.74 c 56.6

d 0.002 41

4 a 12 000 b 35 000 c 20 d 400

Indices

- 1 a i 3^{-3} ii $\frac{1}{3^3}$ iii $3^{-3} = \frac{1}{3^3}$
 b i $7^{-2} = \frac{1}{7^2}$ ii $4^{-5} = \frac{1}{4^5}$
 iii $\frac{1}{9^3} = 9^{-3}$ iv $\frac{1}{5^7} = 5^{-7}$
 2 a 7^{-2} b 3^4 c 5^{-3} d 8^{-4}
 e 4^2 f 10^{-4} g 5^{-6} h 6^{-20}
 3 a, c, d, f, g, h

Standard form

- 1 a 3700 b 25 000 c 810
 d 54 000 000
 2 a 0.0093 b 0.073 c 0.000 15
 d 0.000 0049
 3 a 3.1×10^3 b 2.9×10^4
 c 7.15×10^6 d 6.9×10^{10}
 4 a 6.4×10^{-3} b 7.2×10^{-2}
 c 4×10^{-6} d 2.1×10^{-8}
 5 a 6.9×10^{-7} , 3.7×10^{-2} , 9.4×10^2 , 1.8×10^5
 b 4.2×10^{-2} , 2.44×10^{-1} , 4×10^{-1} , 2.4×10^2 ,
 4.22×10^2

Calculating with standard form

- 1 a 7.8×10^9 b 3.4×10^8
 c 1.25×10^{11} d 3×10^3
 e 2.6×10^{-4} f 2.5×10^3
 2 a 1.1538×10^{13} b 3.441×10^8
 c 9×10^7 d 6×10^{-6}
 3 500 s
 4 Students' own answers, for example:
 a There are 256 pages in the book, which is 128 sheets of paper.
 b The thickness of 256 pages is 11 mm.
 (Don't measure the front and back covers.)
 c One sheet of paper is $\frac{11}{128} = 8.59 \times 10^{-2}$ mm
 (to 3 s.f.).
 d 8.6×10^4 nm (to 1 d.p.)
 5 St Lucia, Iceland, New Zealand, UK, Japan, Brazil
 6 a 326 300 b 3.99×10^8 (3 s.f.)
 c 356 (3 s.f.)
 7 a 1.098×10^{30} b 1837

Enrichment

- 8 1.33×10^{19} m³

1 Extend

- 1 a centi 10^{-2} , micro 10^{-6} , giga 10^9 , pico 10^{-12} , kilo 10^3
 b 10^{-3} milli and 10^{-1} deci
 2 a 1000 g b 1 000 000 J
 c 1 000 000 000 t d 1 000 000 000 000 W
 e 0.1 l
 3 95.7 cm²
 4 a 11^6 b 3^{-6} c 7^0 d 5^{-13}
 5 a $\frac{3}{8}$ b 18 c 1.5 d 1
 6 a km h⁻¹ b m s⁻²
 c kg m⁻³ d miles h⁻¹
 7 1×10^{13}
 8 0.12×10^{-2} , 1205×10^{-6} , 0.00 124, $\frac{1}{8 \times 10^2}$,
 1.26×10^{-3}
 9 a 4 b 10 c 2
 10 E 1.62×10^{-4} , C $1.656\ 25 \times 10^{-4}$, B 1.69×10^{-4} ,
 D 1.691×10^{-4} , A 1.702×10^{-4}
 11 a 5×10^{-10} b 1.25×10^{-8}
 c 2.5×10^4 d 6.25×10^3
 12 a 1×10^9
 b An increase of 7.499×10^{10} , or 7500 times as many (roughly 10 000 as many)
 13 $10^6 \times (200 \times 10^{-9}) = 2 \times 10^{-1}$ m so it would be visible to the human eye if the particles were end to end.
 Even if a million particles were arranged in a circle, one particle deep, they would still have a diameter of 1.13×10^3 particles and their group would be $1.13 \times 10^3 \times (200 \times 10^{-9}) = 2.26 \times 10^{-4}$ m wide, so would also be visible.
 14 a 4.3×10^{14} m b 6.5×10^{14} m
 15 a All equal $0.125 \left(= \frac{1}{8} \right)$, except $8^{-2} = \frac{1}{64}$
 and $\left(\frac{1}{4} \right)^2 = \frac{1}{16}$
 b Students' own answers, for example:
 $\left(\frac{1}{3} \right)^2$, 9^{-1} , 3^{-2} , $\left(\frac{1}{81} \right)^{\frac{1}{2}}$, $81^{-\frac{1}{2}}$, $729^{-\frac{1}{3}}$

- 16 a** Bangladesh, Pakistan, India, China
b 1.19×10^8
c Roughly 7 times (6.63 times, to 3 s.f.)
d 2.9566×10^9
e 36% (to 2 s.f.)

1 Unit test

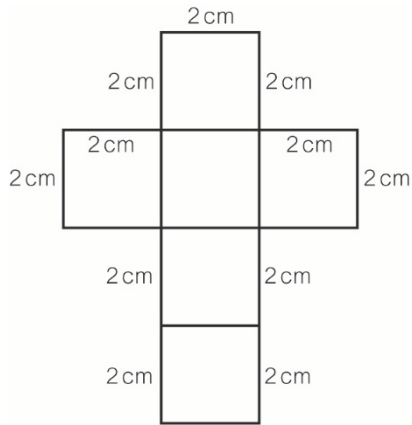
- 1** \$12 million
- 2 a** 3.6 **b** 435
- 3 a** 10 000 **b** 90
- 4 a** 8.2×10^2 **b** 9.15×10^{-5}
- 5** 1.21×10^{-4} , 1.24×10^{-2} , 1.24×10 , 1.2×10^2 ,
 1.23×10^3
- 6 a** 4×10^5 **b** 1.25×10^{-2}
- 7 a** 1.24915×10^{-4} **b** 9.6×10^{10}
- 8 a** 6^{-1} **b** 3^{-2} **c** 7^{-6}
d 1
- 9 a** {1 000 000 000, 10^9 , giga, G}
 {1 000 000, 10^6 , mega, M}
 {1 000, 10^3 , kilo, K}
 {0.001, 10^{-3} , milli, m}
 {0.000001, 10^{-6} , micro, μ }
 {0.000 000 001, 10^{-9} , nano, n}
b i 9 000 000 000 J
ii 13 000 W
iii 8 500 000 s
- 10 a** 1000 **b** 5.97×10^{21}
c 9.95×10^{20}
d 9.95×10^{20} , 3.17×10^{23} , 1.07×10^{20} ,
 5.5×10^{19} , 1.7×10^{22} , 9.48×10^{22} ,
 1.45×10^{22} , 8.12×10^{20}

Unit 2 2D shapes and 3D solids

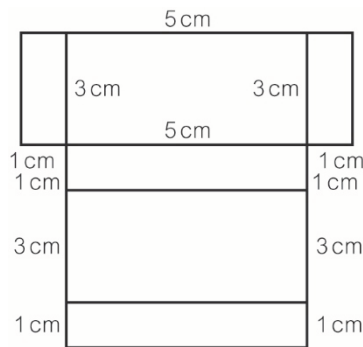
2.1 Surface area of prisms

- 1 a 14 cm^2 b 16 cm^2 or 1600 mm^2
c 17.5 cm^2 d 34 cm^2

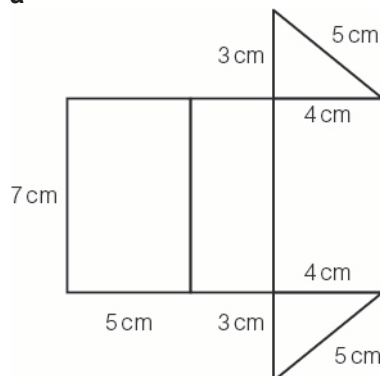
- 2 a i ii 24 cm^2



- b i ii 46 cm^2



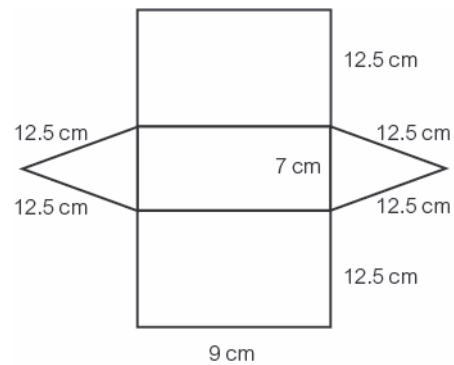
- 3 a



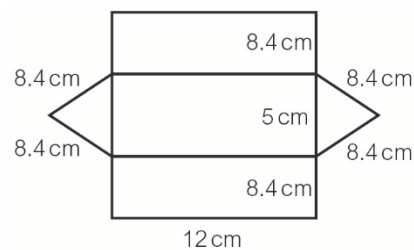
- b 6 cm^2 , 28 cm^2 , 6 cm^2 , 21 cm^2 , 35 cm^2
c 96 cm^2

- 4 a A, C, E
b A triangle, C pentagon, E trapezium

- 5 a i ii 372 cm^2



- b i ii 301.6 cm^2



- 6 7.56 m^2

- 7 324 cm^2

- 8 9.5 cm

2.2 Volume of prisms

- 1 a 7.5 cm^3 b 43.75 cm^3
c 880 mm^3 d 24 cm^3 e 3150 mm^3

- 2 a 280 cm^3 b 140 cm^3 c 20 cm^3

- 3 a i 7 cm^2 ii 35 cm^3

- b i 10.8 cm^2 ii 162 cm^3

- 4 a 432 cm^3 b 196 cm^3

- 5 8 cm

- 6 a 33.75 cm^2 b 201.75 cm^2

- 7 Any 3D shape with a volume of 36 cm^3

- 8 a 95.25 m^2 b 1428.75 m^3
c $1\,428\,750 \text{ l}$

2.3 Circumference of a circle

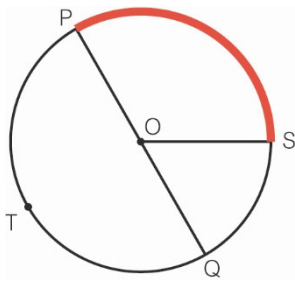
- 1 a i 4.3 ii 4.33

- b 937 cm

- c 75 mm

- 2 a 18 cm b 4.5 cm c 11 cm d 2.5 cm

3 a, b, d, e



c OP or OQ

f No, the line does not go through the centre.

4 a 6 cm b 8.4 cm

5 a 12π cm b 4π cm c 14π cm d 10π cm

6 a 11.8 mm b 96.4 m c 1087.0 km

7 a i 25.1 cm ii $\frac{1}{2}$ iii 12.6 cm

b i 44.0 cm ii $\frac{1}{4}$ iii 11.0 cm

8 a i π cm ii $(4 + \pi)$ cm

b i 4π cm ii $4(2 + \pi)$ cm

9 200.11 m

10 Yes, 62.8 cm and 31.4 cm

11 628 lights

12 76 mm

13 2 cm

2.4 Area of a circle

1 a 16 b 100 c 5

d $\frac{3}{2}$ or 1.5

2 a $x = 12.6$ b $A = 254.3$

c $p = 4.5$

3 a 16π cm² b 4π cm²

c 49π cm² d 9π cm²

4 a 254.5 cm² b 834.7 cm²

c 1134.1 mm² d 16.3 m²

5 a 49π cm² b 24.5π cm²

c 12.25π cm²

6 a 190.1 cm² b 17.3 cm²

c 27.7 cm²

7 a 850.1 cm² b 113.1 cm²

c 26.1 cm² d 127.3 cm²

8 201.1 cm², 50.3 cm². No, the area is 4 times as large.

9

Pizza diameter	Pizza area	Cost	Area per £1
8 inch	50.3 in²	£5.99	8.4 in²
10 inch	78.5 in²	£7.99	9.8 in²
12 inch	113.1 in²	£9.99	11.3 in²

The 12 inch pizza is the best value as it provides the most pizza per £1.

10 a 5.1 cm b 4.7 cm

11 a Area of whole circle = 32 m², radius = 3.2 m

b Area of whole circle = 28 cm², radius = 3.0 cm

12 a 2.5 m b 7 m c 49 m²

13 10591 m²

14 a 13.7 cm² b 122.5 cm²

15 $(4437 - 337.5\pi)$ mm²

2.5 Cylinders

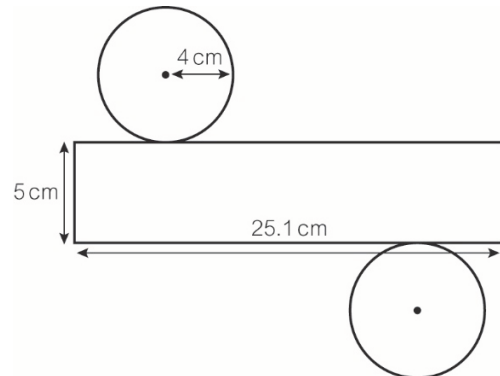
1 a i 31.4 cm ii 78.5 cm²

b i 22.0 cm ii 38.5 cm²

2 a 96 b 3 c 4

3 96 cm³

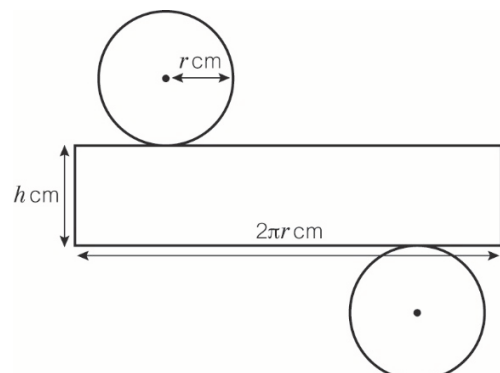
4 a



b 125.7 cm², 50.3 cm², 50.3 cm²

c 226.2 cm²

5 a



b πr^2 , πr^2 , $2\pi r h$

c Total surface area of cylinder = $2\pi r^2 + 2\pi r h$

- 6 a 207.3 cm² b 483.8 cm²
 7 a i 78.5 cm² ii 706.9 cm³
 b i 201.1 cm² ii 603.2 cm³
 c i 7.1 cm² ii 63.6 cm³
 8 a Students' own answer, for example: 'The tall, thin one because the area of each one is small.' OR 'The shortest one because the area around the middle is small.'
 b A 125.7 cm², B 75.4 cm², C 106.8 cm²
 9 Capacity of the saucepan is 4084.1 cm³, which is more than 4 litres, so the claim is correct.

2.6 Pythagoras' theorem

- 1 a 73 b 90.1 c 11.4 d 2.8
 2 a Students copy diagram on centimetre squared paper
 b $a = 20$ mm, $b = 40$ mm, $c = 45$ mm
 c 45 mm
 3 a AB b DF c HI d KJ
 4 a 8.1 cm b 6.7 cm c 8.2 cm
 5 12.04 m
 6 b, c
 7 a 4.4 cm b 11.3 cm c 4.6 cm
 8 $h = 7.4$ cm Area = 11.1 cm²
 9 $h = 11.6$ cm Area = 34.9 cm²
 10 6.2 m
 11 a 64 cm² b 11.3 cm
 c 128 cm², double the area
 d 450 cm²
 12 a 7.2 cm
 b i 5.8 cm ii 10.8 cm iii 6.1 cm

2 Check up

Surface area and volume of prisms

- 1 $A = 510$ cm² $V = 450$ cm³
 2 15 cm
 3 a 144 cm³ b 132 cm²

Circumference and area of a circle

- 4 a i 37.7 cm ii 113.1 cm²
 b i 34.6 cm ii 95.03 cm²
 5 a 33.24 cm² b 23.65 cm
 6 20π cm
 7 25π cm²
 8 300π cm²

Cylinders

- 9 a Volume = 115.45 cm³
 b Surface area = 142.94 cm²

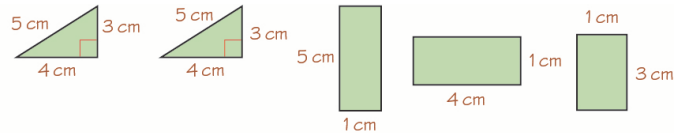
Pythagoras' theorem

- 10 a 25 cm b 8.5 cm

2 Strengthen

Surface area and volume of prisms

1 a



b 24 cm²

2 216 cm²

3 168 cm³

Circumference and area of a circle

1 a $r = 5$ cm, $d = 10$ cm

b $r = 8$ cm, $d = 16$ cm

2 a 7 cm

b $C = \pi \times 7$

c 22.0 cm

3 a i 2

ii 2

iii 2

b i 13π cm

ii 17π cm

4 a 2.5 cm

b 2.5

c 6.25π cm²

5 a 36.3 cm²

b 66.5 cm²

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

b 78.5 cm²

c 39.3 cm²

d 31.4 cm

e 15.7 cm

f 25.7 cm

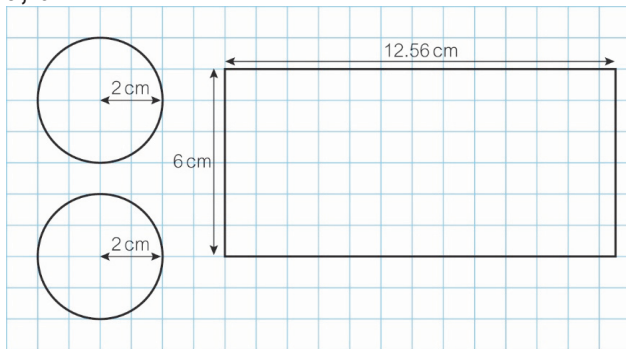
7 a 30.2 cm²

b 22.1 cm

8 217.1 cm²

Cylinders

1 a, b

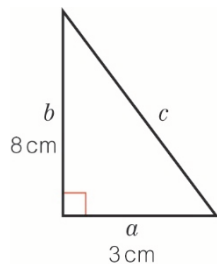


- c circular faces = 12.6 cm^2 each,
rectangle = 75.4 cm^2
d 100.5 cm^2
e 75.4 cm^3

Pythagoras' theorem

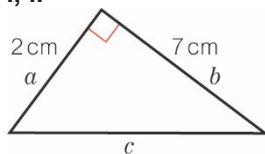
1 a 6.1 cm b 91 mm c 5.7 cm

2 a i, ii



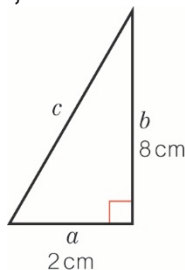
iii 8.5 cm

b i, ii



iii 7.3 cm

c i, ii



iii 8.2 cm

3 a 7.5 cm b 85.6 mm c 10.8 cm

4 a 11.5 cm^2 b 60 cm^2 c 27.7 cm^2

Enrichment

1 $48\pi \text{ cm}^2$

2 a Method A

1 7 cm 2 49 cm^2

3 6 cm^2 4 25 cm^2

Method B

1 5 cm 2 25 cm^2

- b Students' own answer, for example: 'Method B because once I worked out x , the rest of the question was straightforward.' OR 'Method A because I just had to work out the different areas.'

2 Extend

1 a 75.4 cm b 37.7 cm

2 a 113.1 cm^2 b 144 cm^2

c 78.5 % d 50.3 cm^2 , 64, 78.5%

3 a She left π in the answer.

b $C = 11\pi \text{ cm}$, $A = 30.25\pi \text{ cm}^2$

4 a Students' own answers

b $C \approx 7.9 \text{ cm}$ c $d \approx 2.5 \text{ cm}$

d, e Students' own answers

5 a i 4.6 m ii 21.7 rotations

b i 92.6 cm ii 14.7 cm

6 a 3 cm b 7.6 cm

c 22.8 cm^2 d 36 cm^2

e 127.2 cm^2 f 84 cm^3

7 a 149 cm b 74.6 km

8 a $6x = 360^\circ$, so $x = 60^\circ$

b $x + 2y = 180^\circ$, so $y = 60^\circ$

c Equilateral d 4.3 cm

e 10.8 cm^2 f 64.9 cm^2

9 a 9.1 cm b 18.2 cm^2

10 a i 40.8 cm ii 183.8 cm^2

b i 5.2 cm ii 15.7 cm^2

11 a Shape a

i Surface area = 270 cm^2

ii Volume = 210 cm^3

Shape b

i Surface area = 301.2 cm^2

ii Volume = 233.8 cm^3

b Shape b

12 a i AB = 7.1 cm ii BC = 10 cm

iii AC = 7.1 cm

b Isosceles

13 a 4.5 cm b 0.086 cm

14 a 9.95 cm b 10.30 cm

2 Unit test

- 1 a i 12.57 cm ii 12.57 cm²
 b i 267.04 mm ii 5674.50 mm²
- 2 a 8π cm² b $4\pi + 8$ cm
- 3 a i $V = 36$ cm³ ii $A = 84$ cm²
 b i $V = 80$ cm³ ii $A = 140$ cm²
- 4 a 10.8 cm b 7.42 cm
- 5 22.2 cm²
- 6 7.62 cm
- 7 15 cm²
- 8 a 70.7 cm³ b 103.7 cm²
- 9 a **A**
 i 12 cm
 ii 6 cm
 iii 70.69 cm²
 iv 113.10 cm²
B
 i 6 cm
 ii 3 cm
 iii 28.27 cm²
 iv 113.10 cm²
C
 i 3 cm
 ii 1.5 cm
 iii 7.06 cm²
 iv 113.10 cm²
- b Shaded area is the same for all three.

Unit 3 Quadratics

3.1 Arithmetic and quadratic sequences

- 1 a 6, 12, 18, 24, ... 60 b -6, -5, -4, -3, ... 3
c 5, 8, 11, 14, ... 32 d -1, 1, 3, 5, ... 17
- 2 a $5n$ b $n + 4$ c $3n - 1$ d $4n - 7$
- 3 a Arithmetic b Not arithmetic
c Arithmetic d Arithmetic
e Not arithmetic
- 4 a 1, 4, 9, 16, ... 100 b 3, 12, 27, 48, ... 300
c -2, -8, -18, -32, ... -200
d 5, 20, 45, 80, ... 500
- 5 a 6, 12, 22, 36, ... 204 b 0, 9, 24, 45, ... 297
c 4, -5, -20, -41, ... -293
d -1, 11, 31, 59, ... 395
- 6 a i 11, 16, 21, 26, ... 56 ii Arithmetic
b i -4, 2, 12, 26, ... 194 ii Quadratic
c i -4, -2, 0, 2, ... 14 ii Arithmetic
d i 98, 92, 82, 68, ... -100 ii Quadratic
- 7 $T(5) = 55$; $T(10) = 205$. $T(10)$ is not double $T(5)$ because it is a quadratic sequence and because there is a constant term added (+5).
- 8 a 8, 10, 12 b +2 c $2n + 2$
d The common difference is the coefficient of n .
- 9 a 24 b 36 c $6n + 6$

3.2 Geometric sequences

- 1 a $\frac{1}{4}$ b $\frac{1}{8}$ c $\frac{1}{16}$ d $\frac{3}{8}$
- 2 a 0.3 b 0.03 c 0.09 d 0.003
- 3 a 100, 1000, 10 000 b 9, 27, 81
c 1, 0.1, 0.01 d 100, 50, 25
e It is between 0 and 1.
- 4 3 terms
- 5 a Arithmetic b Geometric
c Quadratic d Arithmetic
e Neither f Quadratic
g Arithmetic
- 6 $2^9 = 512$
- 7 a Each term is multiplied by 3 to find the next term.
b 3^{19}

- 8 a -4, 4, -4, 4, -4
b 0.5, 0.05, 0.005, 0.0005, 0.000 05
c $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{16}, \frac{1}{32}$
d $\frac{1}{4}, \frac{3}{16}, \frac{9}{64}, \frac{27}{256}, \frac{81}{1024}$

3.3 Expanding

- 1 a $7x + 10$ b $6a - 24$ c $5z - 9$ d $-7t + 7$
- 2 a $2x^3 + 7x$ b $12y - 2y^2$ c $b^3 + 3b^2 + 2b + 3$
d $3w^4 - 2w^3 - 2w^2 - 6w$
- 3 a $x^2 + 5x + 6$ b $y^2 + 5y + 6$
c $d^2 + 7d + 10$ d $m^2 + 7m + 12$
e $v^2 + 9v + 18$ f $h^2 + 13h + 42$
- 4 a $p^2 + p - 6$ b $w^2 - w - 6$
c $x^2 + 2x - 8$ d $e^2 + 3e - 18$
e $s^2 - 10s + 16$ f $j^2 - 9j + 20$
- 5 Kari is right. Adam makes mistakes adding and multiplying negative terms.
- 6 a $x^2 + 10x + 25$ b $x^2 + 12x + 36$
c $x^2 + 14x + 49$ d $x^2 - 2x + 1$
e $x^2 - 8x + 16$ f $x^2 - 14x + 49$
- 7 a $5x^2 + 4x - 16$ b $n^2 - 18n - 28$
- 8 Both expand and simplify to $n^2 + 6n - 10$.
- 9 a a^2 b $a^2 - b^2$ c It is b^2 less.
- 10 a $2x^2 - 3x - 35$ b $2x^2 - 10x + 12$
c $2x^2 + 12x - 14$ d $6x^2 - 24$
e $8x^2 - 2x - 15$ f $9x^2 - 45x + 56$
- 11 a $9x^2 + 42x + 49$ b $4x^2 - 16x + 16$
c $25x^2 + 60x + 36$ d $16x^2 + 72x + 81$
e $49x^2 - 42x + 9$ f $64x^2 - 144x + 81$
- 12 a $4x^2 - 1$ b $9x^2 - 16$ c $4x^2 - 25$ d $c^2 - d^2$

3.4 Factorising

- 1 a $x^2 + 8x + 16$ b $x^2 - 6x + 9$
c $x^2 + 2xy + y^2$ d $4x^2 + 16x + 16$
e $9x^2 - 24x + 16$ f $4x^2 + 4xy + y^2$
- 2 a $x^2 - 25$ b $a^2 - 49$ c $y^2 - 4$ d $x^2 - y^2$
- 3 a $4x(x + 3)$ b $5x(5x^2 - 3)$
c $y^2(1 - 9y)$ d $3x^2(x^2 + 5)$
- 4 a $(x + 4)(x + 3)$ b $(x + 3)(x + 6)$
c $(x + 2)(x + 7)$ d $(x + 9)(x + 3)$
e $(x - 2)(x - 1)$ f $(x - 4)(x - 3)$

- 5 a $(x+6)(x-3)$ b $(x+6)(x-2)$
 c $(x+11)(x-3)$ d $(x-11)(x+4)$
 e $(x-12)(x+3)$ f $(x-14)(x+2)$
- 6 A = vi B = iv C = i D = viii
 E = ii F = vii G = v H = iii
- 7 a $(x+3)^2$ b $(x+7)^2$ c $(x-4)^2$ d $(x-6)^2$
- 8 a $(x+5)(x-5)$ b $(x+8)(x-8)$
 c $(x+9)(x-9)$ d $(x+11)(x-11)$
 e $(p+q)(p-q)$
- 9 $x+8$ and $x+3$
- 10 a He added 7 to one side and subtracted 7 from the other.
 b Square

3.5 Solving quadratic equations

- 1 $x = \pm 6$
- 2 a $(x-1)(x-2)$ b $(x+9)(x-9)$
 c $(x-7)(x+5)$ d $(x+5)^2$
- 3 a $x = 4, x = -4$ b $x = 7, x = -7$
 c $x = 10, x = -10$ d $x = 8, x = -8$
 e $x = 5, x = -5$ f $x = 13, x = -13$
- 4 a $x = -2, x = 1$ b $x = -9, x = -6$
 c $x = 4, x = -5$ d $x = 3, x = -7$
 e $x = 11, x = -2$ f $x = 17, x = -3$
- 5 a $x = -2$ b $x = -7$ c $x = 3$ d $x = 5$
- 6 a 12 m b 8 m
- 7 Bonita is 21, Kalila is 19
- 8 Bahir is 19, Jamal is 23
- 9 4 and 6
- 10 a $x = 6$ or -6 b $x = 5$ or -5
 c $x = 7$ or -7
- 11 a $x^2 + 9 = 25$ b $x = 4$ or -4
 c Two solutions satisfy the equation.

3 Check up

- 1 a Geometric b Arithmetic
 c Neither d Geometric
- 2 a 24, 35, 48 b 23, 34, 47
 c 23, 33, 45 d 48, 96, 192
 e $1, \frac{1}{3}, \frac{1}{9}$
- 3 a 4, 16, 36, 64, ... 400
 b $-7, -28, -63, -112, \dots -700$

- 4 a 2, 14, 34, 62, ... 398
 b 2, $-4, -14, -28, \dots -196$
 c $-8, -17, -32, -53, \dots -305$
 d $-2, -3, -6, -11, \dots -83$

5 3 terms

- 6 a $-3, 3, -3, 3, -3$
 b 6, 1.2, 0.24, 0.048, 0.0096

Expanding

- 7 a $x^2 + 9x + 14$ b $x^2 + 3x - 40$
 c $x^2 + 2x - 24$ d $x^2 - 16x + 63$
- 8 No, because there would be a term of $-12x$.
- 9 a $x^2 - 4$ b $x^2 - 49$ c $x^2 + 10x + 25$
- 10 a $2x^2 - 9x - 18$ b $6x^2 + x - 40$
 c $12x^2 - 41x + 24$ d $4x^2 - 49$
- 11 $6x^2 - x - 2$

Factorising

- 12 a $(x+3)(x+2)$ b $(x+9)(x-2)$
 c $(x-4)(x-1)$ d $(x-9)(x+5)$
- 13 a $(x+3)^2$ b $(x-5)^2$ c $(x+7)(x-7)$
- 14 Length = $x+3$, width = $x-7$

Solving quadratic equations

- 15 a $x = -5, x = -3$ b $x = -8, x = -3$
 c $x = 6, x = -5$ d $x = -7, x = 1$
- 16 Milo is 23, Vlad is 18.

3 Strengthen

Arithmetic, quadratic and geometric sequences

- 1 a, b, e
- 2 a 24, 27, 30 b 120, 122, 124
 c 160, 150, 140 d $-11, -16, -21$
- 3 a, b, e
- 4 a 125, 625 b 2, 0.2
 c 16, 8 d 0.9, 0.09
- 5 a 1, 4, 9, 16 b 100
- 6 a 5, 8, 13, 20, ... 104
 b $-2, 1, 6, 13, \dots 97$
 c 4, 16, 36, 64, ... 400
 d 10, 19, 34, 55, ... 307
 e 3, $-3, -13, -27, \dots -195$

Expanding

- 1 a $a^2 + 9a + 20$ b $n^2 + 5n + 6$
 c $x^2 + 11x + 28$ d $p^2 + 5p + 6$
 e $y^2 + 8y + 7$
- 2 a $b^2 - 3b - 18$ b $y^2 + y - 12$
 c $x^2 - 6x - 16$ d $a^2 - a - 12$
 e $b^2 - 11b + 30$ f $x^2 - 8x + 15$
 g $g^2 - 10g + 21$ h $n^2 - 12n + 27$
- 3 a $c^2 + 14c + 49$ b $y^2 - 10y + 25$
 c $n^2 + 16n + 64$ d $n^2 - 2n + 1$
 e $p^2 - 12p + 36$
- 4 a $x^2 - 9$ b $x^2 - 4$ c $x^2 - 81$ d $x^2 - y^2$
- 5 a $2x^2 - 2x - 12$ b $2x^2 - 9x + 10$
 c $2x^2 + 5x - 12$ d $4x^2 + 6x - 28$
 e $3x^2 + x - 10$ f $6x^2 + 23x - 18$

Factorising

- 1 a i 3 and 5 ii 4 and 7
 b i $(x + 2)(x + 3)$ ii $(x + 7)(x + 5)$
 iii $(x + 8)(x + 1)$ iv $(x + 6)(x + 4)$
 v $(x + 8)(x + 3)$ vi $(x + 2)(x + 9)$
- 2 a i -2 and -3 ii -3 and -7
 b i $(x - 4)(x - 3)$ ii $(x - 2)(x - 4)$
 iii $(x - 5)(x - 4)$ iv $(x - 1)(x - 7)$
 v $(x - 11)(x - 4)$ vi $(x - 7)(x - 6)$
- 3 a $(x + 2)(x - 4)$ b $(x + 2)(x - 5)$
 c $(x + 3)(x - 6)$ d $(x + 4)(x - 12)$
 e $(x + 3)(x - 9)$ f $(x + 3)(x - 4)$
- 4 a $(x - 2)(x + 9)$ b $(x - 4)(x + 6)$
 c $(x - 7)(x + 8)$ d $(x - 6)(x + 9)$
 e $(x - 3)(x + 7)$ f $(x - 3)(x + 8)$
- 5 a $(x + 2)^2$ b $(x - 3)^2$ c $(x + 6)^2$ d $(x - 2)^2$
- 6 a $(x + 2)(x - 2)$ b $(x + 4)(x - 4)$
 c $(x + 12)(x - 12)$

Solving quadratic equations

- 1 a $x = 0, x = -6$ b $x = 0, x = 4$
 c $x = 0, x = 8$ d $x = 0, x = 7$
 e $x = 0, x = -5$
- 2 a $x = -2, x = -1$ b $x = -1, x = -4$
 c $x = 2, x = -5$ d $x = 4, x = -3$
 e $x = -4, x = -5$ f $x = 9, x = -2$
 g $x = -6$ h $x = 8, x = -2$
- 3 13 and 10
- 4 a 16 b 11

Enrichment

- 1 a There are 10 different potential answers.
 b Similarities: they all have a positive x^2 term and a number.
 Differences: some of them have x terms, some do not; some of the x terms are negative, some are positive; some of the numbers are positive, some are negative.

3 Extend

- 1 a 47, 62, 79 b 60, 85, 114
 c 114, 174, 246 d -85, -127, -177
- 2 a 5, 14, 25, 38; 518; 10 598
 b 4, 13, 26, 43; 859; 20 299
 c 7, 17, 35, 61; 1565; 39 805
 d 0, -8, -20, -36; -836; -20 196
 e -5, -15, -33, -59; -1563; -39 803
 f -6, 20, 62, 120; 3224; 80 184
- 3 a 5 b 16
- 4 a 32 b $-3n + 35$ c 5
- 5 870
- 6 a 15, 21, 28 b Neither
- 7 a $2x - 1$ b $x - 13$
- 8 a $x^3 + 9x^2 + 26x + 24$
 b $x^3 + 13x^2 + 20x - 100$
 c $x^3 - 13x^2 + 24x + 108$
- 9 a $-6x^2 - 24x - 24$ b $-18x^2 - 39x - 20$
 c $-15x^2 - 47x - 28$ d $9x^2 + 9x - 54$
 e $8x^2 + 20x + 8$ f $12x^2 + 36x + 24$
- 10 a $4x^2 + 16x + 16$ b $9x^2 - 12x + 4$
 c $16x^2 + 24x + 9$ d $25x^2 - 60x + 36$
 e $16x^2 - 1$ f $4x^2 - 9$
 g $16x^2 - 49$ h $(ax)^2 - b^2$
- 11 a $6x^2 - 6$ or $6(x^2 - 1)$ b 714 cm^2
- 12 a $16xy - 4x - 4y + 1$ b Scale factor is 4.
- 13 a $(2x + 1)(x - 4)$ b $(3x + 2)(x - 2)$
 c $(5x + 12)(x - 3)$ d $(-5x - 4)(x + 2)$
 e $(-3x - 24)(x - 2)$ f $(2x - 3)(x - 4)$
- 14 a $(2x - 1)(2x + 3)$ b $(6x + 4)(x - 2)$
 c $(2x + 1)(2x - 1)$ d $(4x + 1)(3x - 3)$
 e $(4x - 3)(3x + 2)$ f $(9x - 1)(x + 3)$
- 15 $3x + 5$ and $2x - 3$
- 16 $2(x + 1)$ and $2x + 7$
- 17 a $x = -8$ and $x = -2$ b $x = -18$ and $x = -2$
 c $x = -5$ and $x = -1$ d $x = -14$ and $x = -2$
 e $x = -10$ and $x = -4$
- 18 $n = -3$ or $n = 5$

19 21 and 26

20 17 and 18

21 8 seconds

22 8.5 seconds

23 a $x = -\frac{3}{2}$ and $-\frac{2}{3}$ b $x = -\frac{1}{3}$ and $\frac{2}{3}$
 c $x = -\frac{5}{2}$ and $\frac{3}{4}$ d $x = -11$ and $-\frac{2}{5}$
 e $x = -\frac{8}{3}$ and $\frac{8}{3}$ f $x = -2$ and $\frac{5}{8}$

3 Unit test

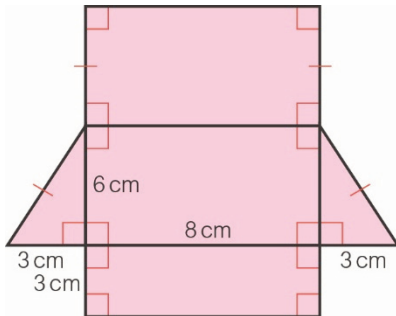
- 1 a 27, 32, 37 b 5, 2.5, 1.25
 c -81, -243, -729
- 2 a $x^2 - 25$ b $x^2 - 100$ c $a^2 - b^2$
- 3 a $x^2 + 4x + 3$ b $x^2 + 18x + 77$
 c $x^2 + 16x + 39$ d $x^2 + ax + bx + ab$
- 4 a $x^2 + 6x - 16$ b $x^2 - 16x + 60$
 c $x^2 - 6x - 27$ d $x^2 + ax - bx - ab$
- 5 a $x^2 + 10x + 25$ b $x^2 - 8x + 16$
 c $x^2 + 2ax + a^2$ d $x^2 - 2ax + a^2$
- 6 2, 4
- 7 a -3 and -300 b -1 and 197
- 8 a $2x^2 + 3x - 14$ b $4x^2 - 17x + 15$
 c $4x^2 - 4x - 15$ d $6x^2 - x - 12$
- 9 $8x^2 + 26x - 7$
- 10 a 19 b $2n - 1$
- 11 a $x(x + 6)$ b $(x + 3)(x + 9)$
 c $(x + 4)(x + 5)$
- 12 a $(x + 6)(x - 5)$ b $(x - 4)(x + 3)$
 c $(x - 8)(x - 3)$ d $(x + 9)(x - 6)$
- 13 a $(x + 12)(x - 12)$ b $(p + q)(p - q)$
 c $(2x - 6)(2x + 6)$ d $(x + 4)^2$
- 14 a $x = -4$ and $x = 3$ b $x = 2$ and $x = 5$
 c $x = -5$ and $x = 1$

- 15 No. $T(n) = 2n^2 + 4$ reduces to $n = \sqrt{178}$,
 which does not have an integer solution.

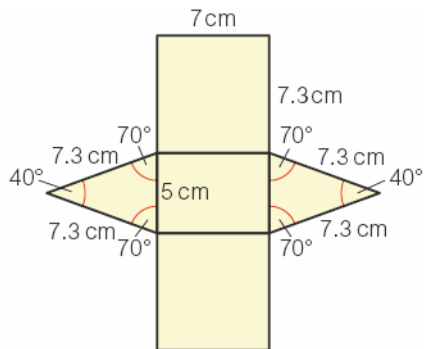
Unit 4 Constructions

4.1 Constructing shapes

- 1 a Cube
b Square-based pyramid
c Triangular prism d Cuboid
- 2 a Not drawn to scale.

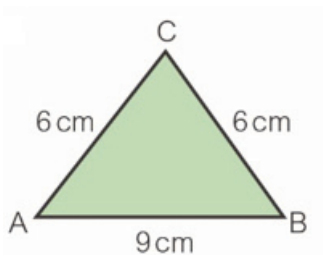


- b Not drawn to scale.

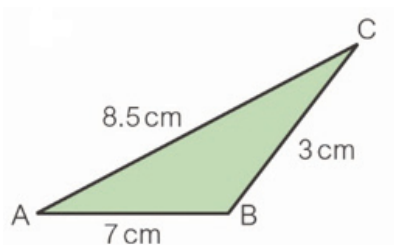


- 3 Not drawn to scale.

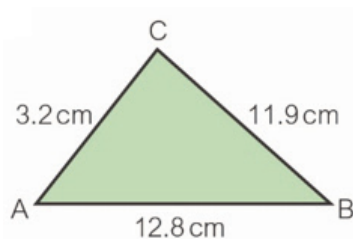
a



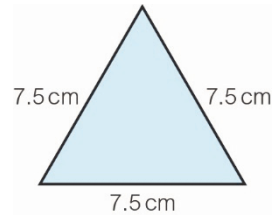
b



c

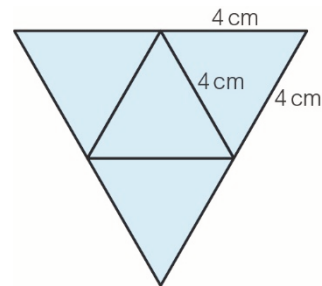


- 4 Not drawn to scale.

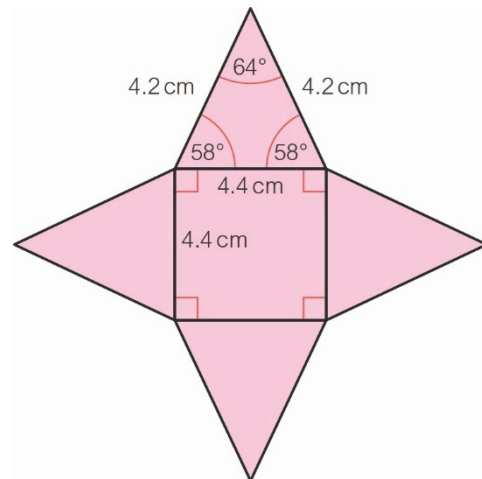


- 5 a Students' own accurate drawings
b Yes, the ladder makes an angle of 68° to the ground.

- 6 Not drawn to scale.

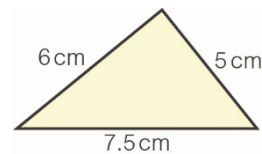


7

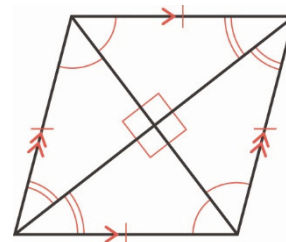


4.2 Constructions 1

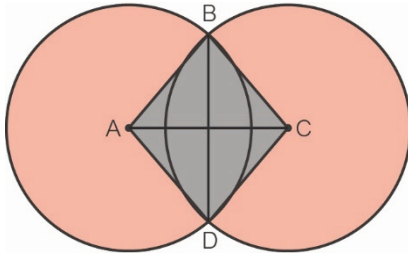
1



- 2 a Rhombus b 2
c, d



3 a, b, d



c Rhombus

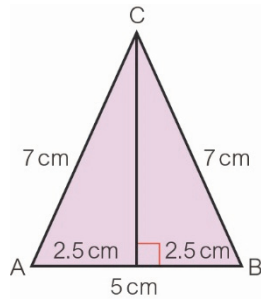
e Midpoint of AC and BD. Cross at right-angles.

4 a Students' accurate construction of perpendicular bisector.

b Students check their answers.

c P is equidistant from A and B.

5 a Not drawn to scale.



b Isosceles

c Students' accurate construction of perpendicular bisector

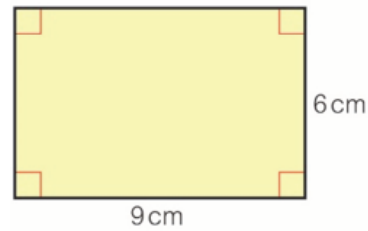
d Two congruent right-angled triangles

6 a, b Students' accurate construction

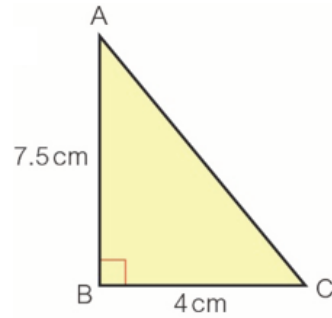
7 a, b Students' accurate constructions

8 Not drawn to scale.

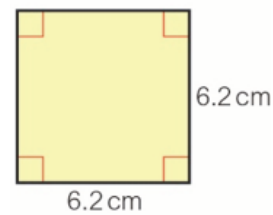
a



b

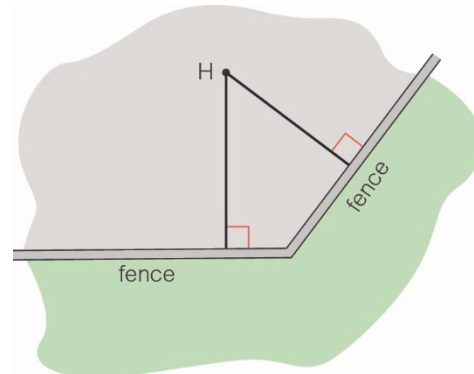


c



9 a, b Perpendicular bisector passes through P.

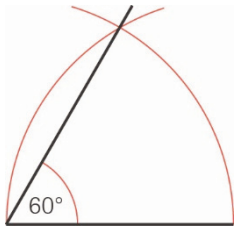
10 a, b Not drawn to scale.



c 4 m

4.3 Constructions 2

1



2 a, b Students' accurate constructions

3 a 12 m b 2.5 cm

4 Students' accurate constructions

a i 70° iii 35°

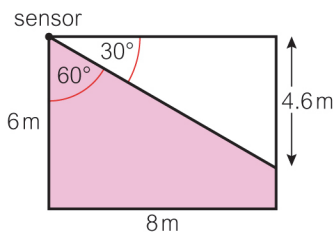
b i 130° iii 65°

5 Students' accurate constructions

a Bisect 60° to give 30°

b Bisect 90° to give 45°

6 a, b Not drawn to scale.



c 29.5 m^2 (3 s.f.)

7 a Students' accurate constructions

b 5.1 m

8 Students' accurate constructions

9 Students' own answers

4 Check up Constructing shapes

1 Students' accurate constructions

2 Students' accurate constructions

3 Students' accurate constructions

Constructions

4 a, b Students' accurate constructions

5 a, b Students' accurate constructions

6 a, b Students' accurate constructions

7 Raafid has not drawn arcs on AB and BC from point B and used these to draw a second pair of arcs.

8 Students' accurate constructions

9 15.5 m

10 a, b, c, d Students' accurate drawings

e Kite

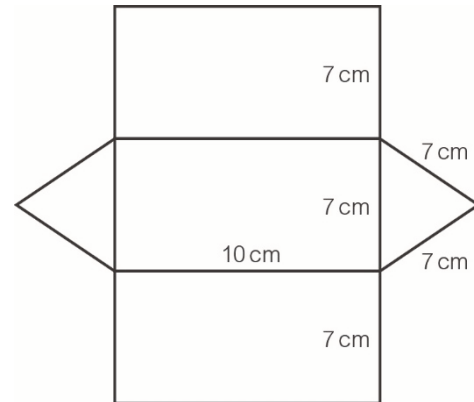
4 Strengthen Constructing shapes

1 Students' accurate constructions

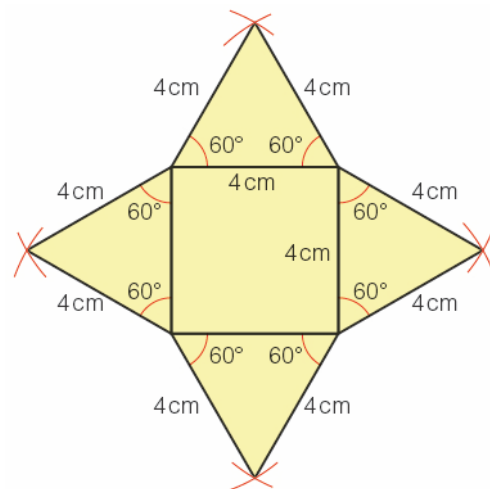
2 Students' accurate construction of triangle

3 Students' accurate construction of triangle

4 Not drawn to scale.



5



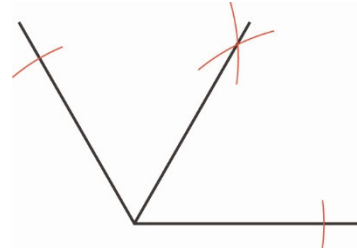
Constructions

1 Students' accurate constructions

2 Students' accurate constructions

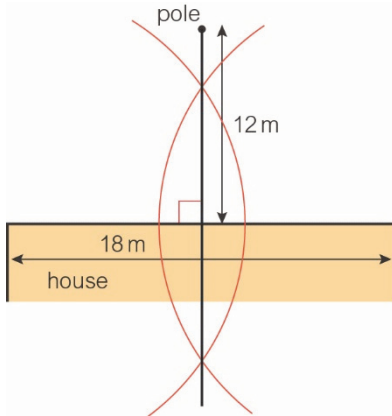
3 Students' accurate constructions

4 Not drawn to scale.



5 Students' accurate construction

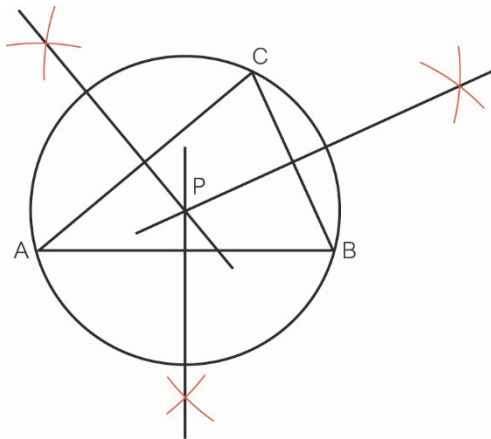
6 Not drawn to scale.



7 Students' accurate construction

4 Extend

1 a-d



c Perpendicular bisectors of sides pass through the same point P.

d The circle passes through the vertices of the triangle. It is called the circumscribing circle.

e Students' accurate construction of triangle with obtuse angle

2 a, b Students' accurate constructions

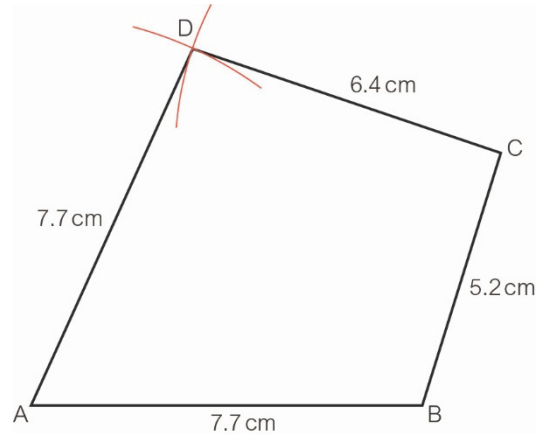
3 a Students' accurate construction

b Perpendicular is 4.1 cm.

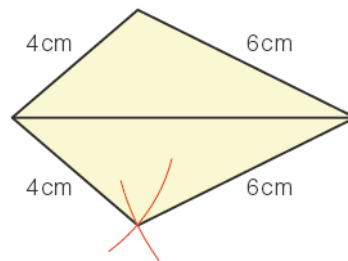
c Area = 21 cm²

4 a, b Students' accurate construction

c Students' own answer. For example:



5 a-c Not drawn to scale.

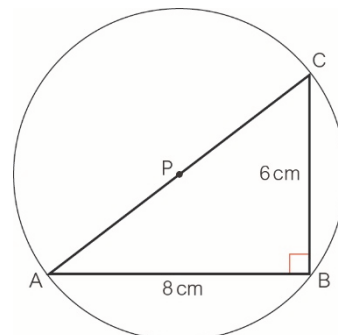


6 a Not drawn to scale.



b Yes

7 a-c Not drawn to scale.



c A, B and C are on circumference of the circle.

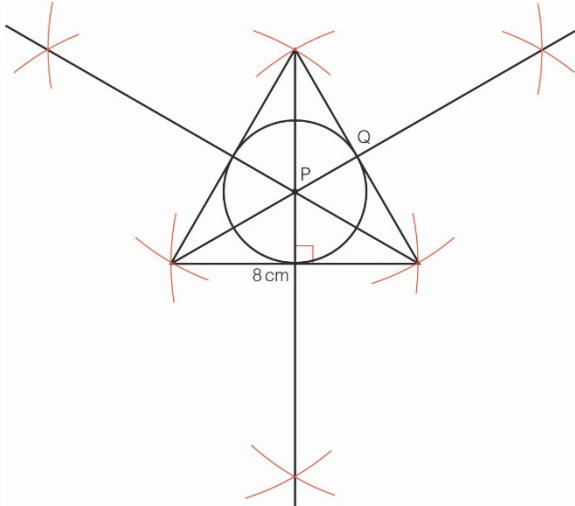
8 a, b Students' accurate drawings

c Sector of a circle

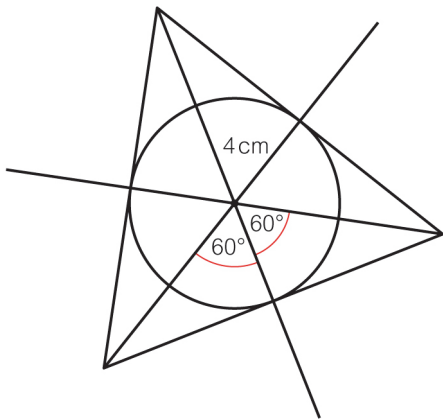
9 a 45°

b, c Students' accurate drawing of octagon

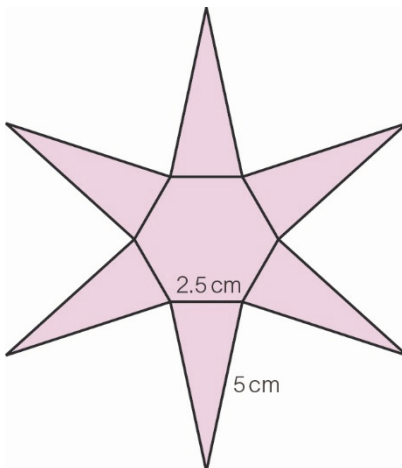
10 a, b, d, e



c Angle bisectors pass through the same point.
f



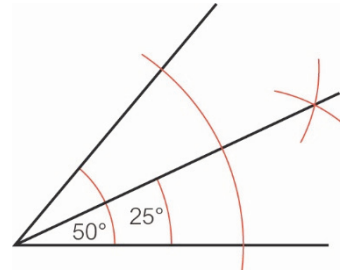
11 Not drawn to scale.



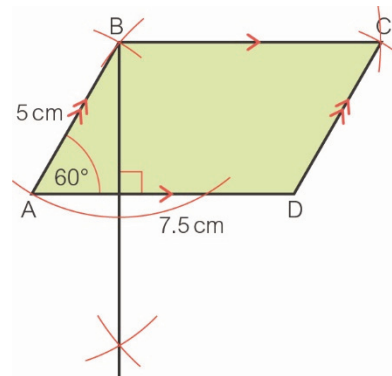
12 a Students' accurate construction of triangle
b, c 12.8 cm

4 Unit test

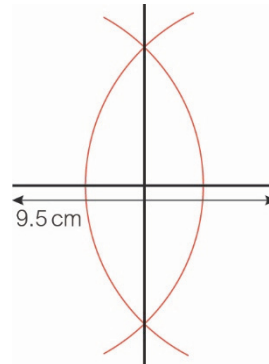
- 1 Students' accurate constructions
- 2 a Students' accurate constructions
b A kite
- 3 a, b



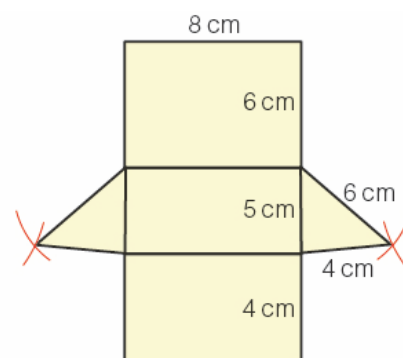
4 a, b Not drawn to scale.



5 Not drawn to scale.



- 6 Students' accurate constructions
- 7 a, b Students' accurate constructions
- 8 Students' accurate construction
- 9



Unit 5 Inequalities, equations and formulae

5.1 Substitution

1 A4, B5, C6, D1, E3, F2

2 a \$152

b $C = 72 + 40h$

3 a \$230

b $T = 65A + 50C$

4 a \$175.50

b $hr + t$

c $P = hr + t$

d \$137.50

5 a \$1720

b $C = 65lw + 8(2l + 2w)$

or $C = 65lw + 16(l + w)$

or $C = 65lw + 16l + 16w$

c \$1273.50

6 a 17

b 36

c 24

d 151

e 62

f 45

g -7

h 100

i 64

j 50

k 70

l -2

7 a 108

b 10

c 48

d 5.5

8 a 0 m

b 6.4 m

9 a $u = 19$

b $t = 6$

c $a = 2$

10 a $m = 5$

b $c = 4.1$

11 a 198

b -12

c 236

d 130

e 146

f -62

g 4

h 27

i 6

5.2 Inequalities

1 a 5

b -7

c -5

d -10

e -2

f 32

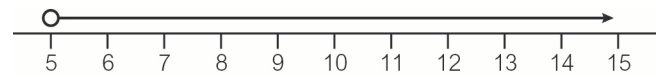
2 a $x = 7$

b $x = 9$

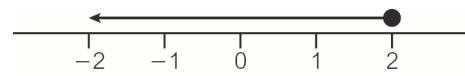
c $x = 7$

d $x = 27$

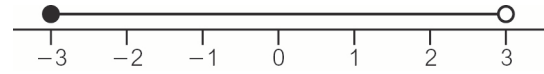
3 a



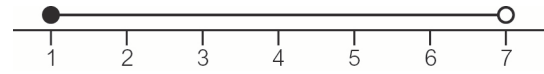
b



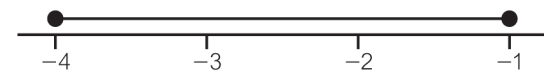
c



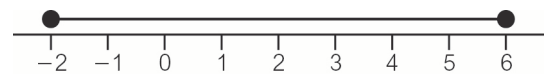
d



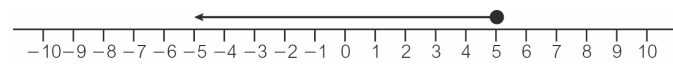
e



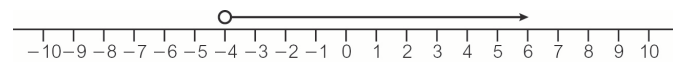
f



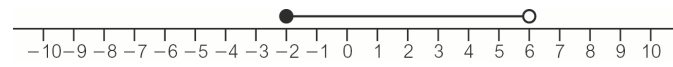
4 a $x \leq 5$



b $x > -4$



c $-2 \leq x < 6$



d $-8 \leq x \leq -1$



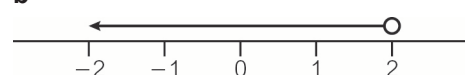
5 a $x > 3$

b $x \leq 2$

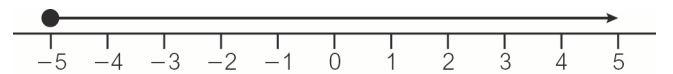
c $6 \leq x < 10$

6 a $x \geq 3$

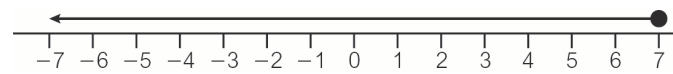
b



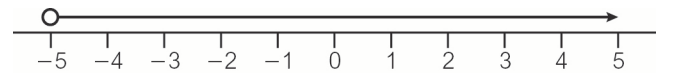
c



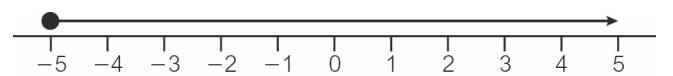
d



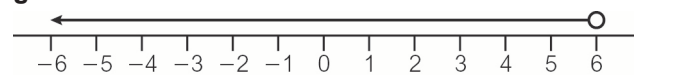
e



f

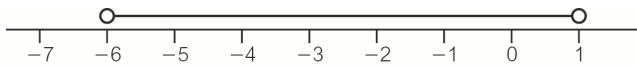


g

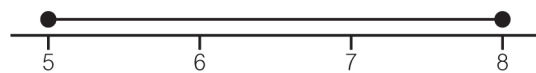


7 a $x \leq 50$ b Yes

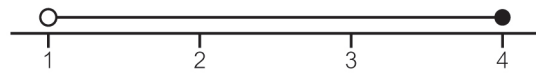
8 a $-6 < x < 1$



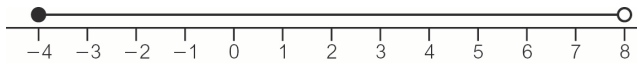
b $5 \leq y \leq 8$



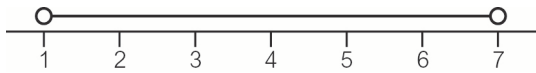
c $1 < y \leq 4$



d $-4 \leq x < 8$

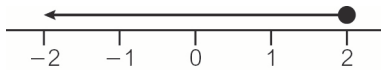


9 a $2 < 2x < 14$ b $1 < x < 7$

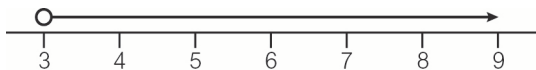


c 2, 3, 4, 5 or 6

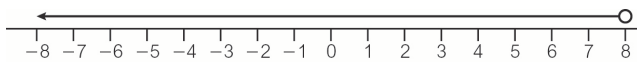
10 a $n \leq 2$



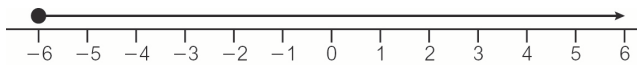
b $n > 3$



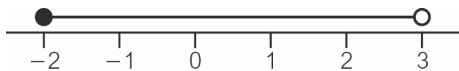
c $x < 8$



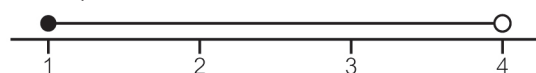
d $x \geq -6$



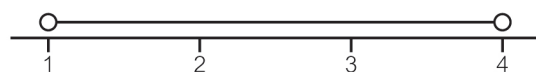
11 a $-2 \leq y < 3$



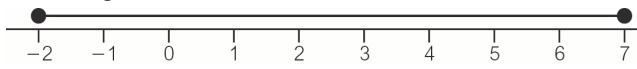
b $1 \leq x < 4$



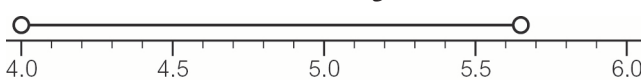
c $1 < n < 4$



d $-2 \leq p \leq 7$



12 a $7 < 3x - 5 < 12$ b $4 < x < \frac{17}{3}$



c 5

13 a $x > -8$ b $x < -5$ c $x \geq 9$
d $x > 5$ e $-5 < x < -3$ f $3 \geq x \geq -5$

5.3 Using index laws

1 a -3 b 3 c 4

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

3 a 5^6 b 3^7 c 4^6
d 7^9 e 10^2 f 10^5

4 a 1 b 1 c 1
d 1 e 1 f 1
g 2 h 5

5 a F b T c T
d T e F f T
g T h F

6 a 3 b 32 c 9
d 4 e -2 f -16

7 a $x^{-3} = \frac{1}{x^3}$ b $y^{-6} = \frac{1}{y^6}$ c $p^{-1} = \frac{1}{p}$

d $z^{-8} = \frac{1}{z^8}$

8 a $3x^{-2} = \frac{3}{x^2}$ b $6y^{-4} = \frac{6}{y^4}$

c $8y^{-7} = \frac{8}{y^7}$ d $\frac{p^{-4}}{3} = \frac{1}{3p^4}$

e $\frac{r^{-7}}{9} = \frac{1}{9r^7}$ f $\frac{q^{-10}}{5} = \frac{1}{5q^{10}}$

9 a 3 b 5 c 4

d $\frac{1}{3}$

5.4 Expressions, equations, identities and formulae

1 a $6xy$ b $4x^3$ c $10x^2y^2$
d $15x^4y^3$

2 a $7x + 11$ b $5p - 62$ c $12m^2 - 2m$
d $2y^2 - 10y + 30$

3 a Expression b Formula c Formula
d Expression e Expression f Formula

4 a Equation b Identity c Identity
d Equation e Identity f Equation

5 a Equation b Formula c Identity
d Formula e Equation f Identity

- 6 a $y^3 + 5y^2$ b $x^4 + 3x^2 + 7x$
 c $a^3 - 8a^2 + a$ d $b^4 + 5b^3 - 6b$
 e $8p + 10p^2 + 2p^3$ f $24y^2 - 6y^4$
 g $6z^4 - 24z^3 + 54z$
 h $2a^4 + 3a^3 - 4a^2$ i $3k^4 - 18k^2 - 21k$
- 7 a $3x^3 + 11x^2$ b $3b^3 + 19b^2$ c $3d^4 - 6d$
 d $3y^3 + 4y^2 - 2y$ e $5z^4 - 4z^3 - 7z$
 f $p^3 + 3p^2 + 50p$ g $46q + 34q^2 - 45q^3$
 h $16a^2 + 6a^3 - 2a$

8 $3x^3 + x(4x^2 + 9x) = 3x^3 + 4x^3 + 9x^2 = 7x^3 + 9x^2$
 $7x^2(x + 3) - 12x^2 = 7x^3 + 21x^2 - 12x^2 = 7x^3 + 9x^2$
 $\therefore 3x^3 + x(4x^2 + 9x) = 7x^2(x + 3) - 12x^2$

- 9 a $2^2 + 2^2 = 4 + 4 = 8$
 $2^3 = 8$; so $2^2 + 2^2 \equiv 2^3$
 b No, it is only true when $x = 2$

10 $x \times x \times (x + 7) = x^2(x + 7) = x^3 + 7x^2$

- 11 a $4(x + 2)$ b $4x(x + 2)$
 c $4x^2(x + 2)$ d $2x(3 - x^2)$
 e $y^2(1 + 5y)$ f $3y^3(3y^2 - 1)$
 g $5y^2(2y^2 - 1)$ h $3y^5(4y^2 + 3)$
- 12 a $3(x + 2y + 3z)$ b $y(x + 5 + z)$
 c $x(x + 6y + 9z)$ d $5x(x + 2y + 3z)$
 e $x^2(x + 2y + 5z)$ f $4y(3x - x^2y + 2z)$

- 13 a Possible answer:
 $3x^2y + 12xy^2 + 9xy = 3xy(x + 4y + 3)$
 b No, there could be a lot of different answers to the question.
 These two parts could have different values:
 $3x^2y + 12xy^2 + 9\Box = 3xy(x + 4y + \Box)$
 for example,
 $3x^2y + 12xy^2 + 9xyz = 3xy(x + 4y + 3z)$
 or $3x^2y + 12xy^2 + 9x^2y = 3xy(x + 4y + 3x)$

5.5 Solving equations

- 1 a $y = -2$ b $p = 11$ c $y = 11$
 2 a $x = 7$ b $x = 9$ c $x = 4$
 d $x = 7$
 3 6
 4 $x = -5$, perimeter = 36
 5 a $x = 7$ b $x = \frac{12}{13}$ c $x = 11$
 d $x = -7$
 6 a $\frac{11x - 10}{10} = \frac{7x + 46}{8}$ b $x = 30$
 c 32° d 116°
 7 16

- 8 a Students' own answers. $lh = 2ab$,
 so $l = 2a$ and $h = b$, or $l = a$ and $h = 2b$
 b No, the sides do not need to be whole number multiples of a and b .

5.6 Changing the subject

- 1 a $x = 4$ b $x = 24$ c $x = 4$
 d $x = 2$
- 2 a $7(x + 2)$ b $3(3y - 2)$ c $4a(b + 2c)$
 d $3x(x - 3y)$
- 3 a $x = y - 5$ b $x = z + 12$ c $x = \frac{h}{5}$
 d $x = 4k$
- 4 a i $a = \frac{F}{m}$ ii 8
 b i $m = \frac{F}{a}$ ii 3.5
- 5 a $x = \frac{y - 3}{2}$ b $x = \frac{t + 9}{5}$
 c $x = \frac{v - 8m}{3}$
- 6 a $y = 5x + 12$ b $y = -4x + 11$ c $y = 3x + 9$
- 7 a $r = \frac{C}{2\pi}$ b $r = \sqrt{\frac{A}{\pi}}$ c $r = \sqrt{\frac{A}{4\pi}}$
 d $r = \sqrt{\frac{V}{\pi h}}$
- 8 a $A = \frac{1}{2}(a + b)h$ b $a = \frac{2A}{h} - b$ c 9
- 9 5 cm
- 10 a She has cancelled $2\pi r$ but she can't do that because there is no $2\pi r$ term with A .
 b 6.20 cm
- 11 a $x = \frac{p}{5 - k}$ b $x = \frac{10 - t}{m - 1}$ c $x = \frac{17}{y - 4}$
 d $x = \frac{mr}{r^2 - m^2}$
- 12 a $u = \frac{2v + ev}{6e - 1}$ b 5
- 13 a $y = (a - 2b)^2$ b $y = (T - 2x)^2$
 c $y = \frac{(kL - 2kx)^2}{5}$

14 a $k = mw^2$ b $e = \sqrt{1 - \frac{b^2}{a^2}}$

15 a $a = \frac{2d}{t^2}$ b 3.125 ms^{-2} c 2 s

5 Check up Substitution and formulae

1 a 5 b 180 c 83
d -12

2 a \$160 b $dx + f$ c $T = dx + f$
d \$245

3 8

4 a $t = 20$ b $v = 1.6$

5 a $x = u - v$ b $x = \frac{y+9}{4}$ c $x = \sqrt{\frac{A}{7}}$

6 a $x = \frac{a+b}{y-1}$ b $x = \frac{pq}{p^2 - q^2}$ c $x = 2T^2$

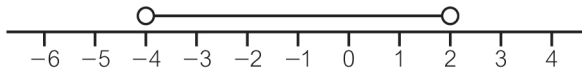
Inequalities

7 a $x < 3$ b $3 \leq x < 7$

8 a



b



9 a $x < 3$ b $y < -3$
c $-2 < y < 4$ d $6 > x > -3$

10 a $n < 2$ b $x > 4$
c $-1 < y < 4$ d $-2 < n < 4$

11 a $x < -2$ b $x > 6$
c No solutions d $-7 < x < 4$

Expanding, factorising and indices

12 4

13 x^{-2}

14 a $y^4 + 7y^2$ b $2x^4 + 5x^3 - 7x^2$

15 $4x^3 + 32x^2$

16 a $3x(3 - x^2)$ b $5y^4(4y^2 + 3)$
c $3(3x + 4y + 6z)$ d $x(x + 8y + 2z)$

17 a She hasn't factorised fully as the highest common factor is $4xy^2$.
b $4xy^2(2x - z)$

Equations and identities

18 a $x = 5$ b $x = -3$

19 a 2 b 12

20 $x = 22$

21 a Identity b Equation

5 Strengthen Substitution and formulae

1 a 22 b 45 c 150
d 83 e 20 f 14
g 24 h 28

2 a Carrie
b Dai has written $(-2)^2 = -4$ and it should be 4. He has also written $-4 \times -3 = -12$ and it should be 12.

c 36

3 a 50 b 82.4 c 23
d -4

4 a 14 b 69 c 95
d 282 e 12 f 1

5 a i \$54
ii \$120

b cd c $T = cd$ d \$95

6 a 5 b 15

7 a $p = 12$ b $p = 11$ c $m = 3$
d $m = 4$ e $u = 2$ f $u = 9$

8 b $x = \frac{y}{3}$ c $x = \frac{y - c}{m}$ d $x = \frac{h + 2}{g}$

e $x = \sqrt{\frac{T}{2}}$ f $x = \sqrt{\frac{h}{p}}$

9 a $x = \frac{c}{5 - b}$ b $\frac{n - m}{p - 1}$ c $\frac{8}{7 + y}$

d $\frac{cd}{a^2 - b^2}$ e $x = 4R^2$ f $\frac{9M^2}{2}$

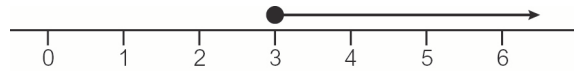
Inequalities

1 a ii b iv c iii d i

2 a C b B

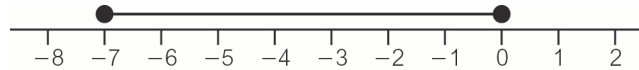
3 a $x \leq -1$

b $x \geq 3$

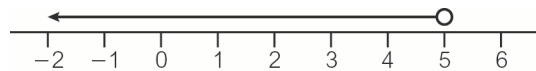


c $-3 \leq x < 4$

d $-7 \leq x \leq 0$



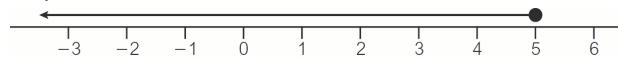
4 a $x < 5$



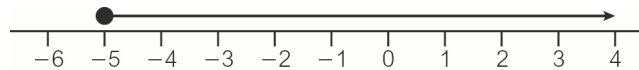
b $n > 13$



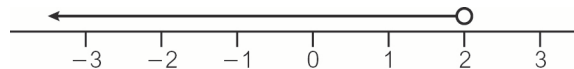
c $y \leq 5$



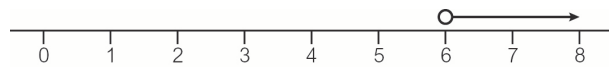
d $z \geq -5$



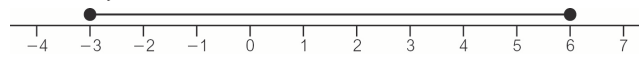
e $n < 2$



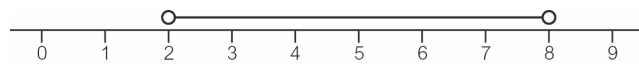
f $z > 6$



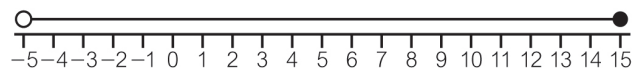
5 a $-3 \leq y \leq 6$



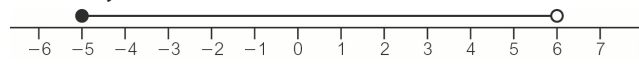
b $2 < x < 8$



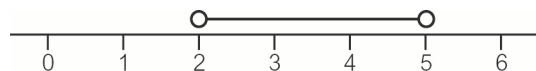
c $15 \geq x > -5$



d $-5 \leq y < 6$



e $5 > n > 2$



6 a $x > 5$

b $y < -6$

c $x \leq 3$

d $y \geq -8$

e $-2 > x > -9$

f $-5 \leq x \leq 3$

Expanding, factorising and indices

1 a $d^3 + 8d^2 + 6d$ b $a^4 + 9a^3 - 2a^2$

c $6b^3 + 8b^2 + 16b$ d $3c^4 - 2c^3 - c^2$

2 a $3a^3 + 16a^2$

b $2y^3 + 5y^2 + 13y$

c $5a^3 + 5a^2 - 12a$

d $2b^3 + 14b^2 + 27b$

3 a $125a^3$

b $9b^2$

c $16x^4$

d $\frac{x^2}{49}$

e $\frac{y^2}{81}$

f $\frac{b^3}{8}$

4 a $\frac{1}{2^2}$

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

c $\frac{1}{x^2}$

d $\frac{1}{y^3}$

5 a x^{-1} or $\frac{1}{x^1}$ or $\frac{1}{x}$ b y^{-2} or $\frac{1}{y^2}$

c z^{-5} or $\frac{1}{z^5}$

d w^{-6} or $\frac{1}{w^6}$

6 a 3

b $4x$

c $5x^2$

7 a $5(2x + 1)$

b $3x(4 - 3x)$

c $5y^2(5y^3 + 2)$

d $2a(7a^2 - 5)$

e $b^2(1 + 3b^2)$

f $6c^2(2 + 3c)$

8 a $2(2x + 7y + 4z)$

b $x(x + 3y + 5z)$

c $3a(a + 3b - 2c)$

d $5m(n + 3m + 2m^2)$

e $4wx(2x + w + 3)$

f $6b(1 + 4ab^2 - 2c)$

Equations

1 a $x = 4$

b $x = 3$

2 a $4(-8 - 5x) = -3x + 2$

b $x = -2$

c 8

3 a 6

b $2(2x + 3)$

c $5x + 2$

d $x = 4$

4 a $x = -1.5$

b $x = 3$

c $x = 4$

Enrichment

1 $x = 2$

2 a $\frac{(x+2)}{5} = \frac{(x-4)}{3}$

b $x = 13$

5 Extend

1 a A5

B2

C3

D1

E6

F4

b Card 7 with value 12 has not been used.
Expressions with value 12 include:

$$\sqrt{d} + i + g, 2h^2 - cg, (bc)^2 - ae - (i + 1)$$

2 a $x = 5$

b Yellow rectangle = 16 cm^2 ,
Grey rectangle = 32 cm^2

3 a $\frac{9}{2x^3}$

b $\frac{11}{3x^3}$

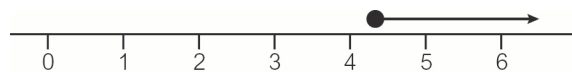
c $\frac{4}{7m^4}$

d $\frac{1}{y^5}$

e $\frac{1}{x^4}$

f $\frac{4}{3xp}$

4 a $x \geq 4\frac{1}{3}$



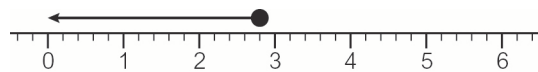
b $x < 5\frac{7}{8}$



c $x > 4\frac{1}{3}$



d $x \leq 2\frac{4}{5}$

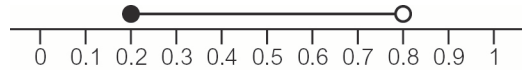


5 a $w \geq 2\frac{1}{2}$

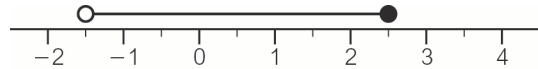
b i 3 ii $3\frac{1}{4}$ litres

c i 4 ii $3\frac{3}{4}$ litres

6 a $0.2 \leq x < 0.8$

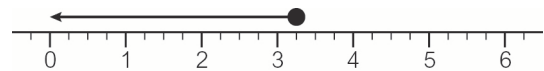


b $-1.5 < x \leq 2.5$



7 $10 < 8x \leq 30$

8 a $n \leq 3\frac{1}{4}$



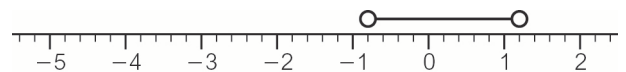
b $x < 1\frac{7}{8}$



c $2\frac{1}{3} \leq x < 3\frac{2}{3}$



d $1\frac{1}{5} > n > -\frac{4}{5}$



9 a 4

b 12.5

c 14

10 Carlos is correct. If you multiply three negative numbers together, you always get a negative number, so $3x^2y$ and z^3 will both be negative for all values of x , y and z .

11 a 80

b 8

c 15.99

d -80

e 100

f $\frac{1}{8}$

g $\frac{16}{5}$

h $-\frac{5}{6}$

12 a i 12

ii 20

b i 15

ii 48

c 9

13 a $m = \frac{x}{2h}$

b $m = \frac{P}{gh}$

c $m = 2lr$

d $m = \frac{4xy}{3}$

e $m = \pm\sqrt{y}$

f $m = \pm\sqrt{x - 2n}$

14 a $x = \frac{1}{y - 8}$

b $\frac{1}{x} = \frac{y + z}{yz}$

$yz = x(y + z)$

$x = \frac{yz}{y + z}$

c $x = \frac{qp}{3p + 2q}$

d $x = \frac{5km}{m - 3k}$

15 a i $a = \frac{2s}{t^2}$

ii $t = \pm\sqrt{\frac{2s}{a}}$

b $s = 45$

16 a i $\frac{3x-4}{5}$ ii $\frac{4x+8}{8}$

b $\frac{3x-4}{5} = \frac{4x+8}{8}$ c $x = 18$

d i Pentagon side = 10, octagon side = 10.

ii Pentagon perimeter = 50

Octagon perimeter = 80

17 $x = 3\frac{1}{2}$

18 a $P = r(\pi + 2)$ b 6.4 cm

19 a $y = \frac{48}{9-a}$ b $y = 6$, Kyle 22, Gina 66.

c $y = 6\frac{6}{7}$, Kyle $24\frac{4}{7}$, Gina $73\frac{5}{7}$.

d When $a = 6$, $y = 16$. Gina would be 156, which is impossible.

20 $A = \pi R^2 - \pi(R-x)^2$
 $= \pi R^2 - \pi R^2 + 2\pi xR - \pi x^2$
 $= 2\pi xR - \pi x^2$
 $= \pi x(2R - x)$

5 Unit test

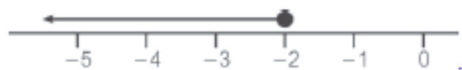
1 a 14 b 5 c 44
d 6

2 a \$2700 b $px + hy$ c $T = px + hy$
d \$3740

3 $x = 7$

4 a $x = -3$ b 24 kg

5 a



b



6 a $-3 < x < 3$ b $-3 < x \leq 3$ c $x \leq -3$
d $x \geq -3$

7 35

8 q^{-7}

9 a T b F c F
d T

10 a 68 b 31

11 a $8(3x + 1)$ b $3x^3(4 - 3x^2)$
c $y(y + 15x + 10z)$ d $2x(2x - 7y - yz)$

12 $m = 4$

13 a $x < 4$ b $y \leq -1$ c $10 > x > 6$
d $-4 \leq x < 2$ e $x < 6$ f $x > 5$

14 $x = 5$

15 a $x = m - t$ b $x = \frac{F}{a}$ c $x = \frac{g+5}{3}$

d $x = \sqrt{\frac{T}{r}}$

16 $t = \sqrt{\frac{w-r}{2}}$

17 a $x = \frac{p}{12-y}$ b $x = \frac{13}{m-n}$ c $x = \frac{5d}{a^2-b}$

d $x = \frac{(Pr)^3}{3}$

Unit 6 Collecting and analysing data

6.1 Planning a survey

- 1 a kilometres (km)
b centimetres (cm) or millimetres (mm)
c metres
- 2 100 times; Because experimental probability approaches theoretical probability as the number of trials increases, a greater number of trials is more likely to reveal a structural bias.
- 3 a metres b cm c metres
- 4 a B (nearest second) b A (nearest gram)
c B (nearest 1 mph)
- 5 a Nearest millisecond or second
b Nearest litre
c Nearest milligram (mg)
- 6 a i Secondary
ii Download data from Australian website
b i Primary
ii Survey – ask people outright
c i Secondary
ii Download data from Indian website
d i Secondary
ii Download data from New Zealand website
e i Primary
ii Survey – give questionnaire to random sample of population
f i Primary
ii Survey – observation of random sample
- 7 a i 5000
b iii 1 000 000
c ii 6000
- 8 The sample is likely to be biased because the fraction of the sample consisting of children is likely to be greater than in the general population; children like pet shops.
- 9 This may be a time when the library is unusually busy, with students going to the library at that time every week, straight after school.
- 10 a 150
b i Biased – Y10 students alone do not represent whole population; every member of the population is not equally likely to be in the sample.
ii Not biased
iii Biased – only students who like what is currently on offer will be included in sample.
iv Biased – only students who do not like what is currently on offer will be included in sample.
c Primary
- 11 a Restrictive, because not all possible options are included; expand the options to include bicycle, motorbike, boat, aeroplane, helicopter.
b Leading, because it suggests using car less because of cost; replace with 'During next year do you expect to use your car: less frequently, more frequently, with about the same frequency?'
c Vague; replace with question about specific activities, for example, 'At weekends, which of these activities do you usually engage in: shopping, sport, reading, walking, watching TV, using a computer, cooking, other housework, other hobby?'
d Leading, because it suggests the answer 'Yes'; replace with unbiased question such as 'Does the bus service need to be improved?'
e Restrictive, because not all possible options are included; expand the options and make response appear obviously subjective. For example, 'Do you believe that the main cause of bad behaviour in lessons is: some students have general problems, the lesson is too long, the lesson is not interesting, the lesson is too hard, the lesson is too easy, the teacher is not strict, the class is too big, the classroom is not comfortable, an unknown factor?'
f Leading, because it suggests the answer 'Yes'; replace with unbiased question such as 'Should more people become vegetarians?'
g Vague; replace with question about specific kinds of food, for example, 'Which of these kinds of food forms the greatest part of your diet: fruit, vegetables, bread or cake or biscuit products, meat, fish, dairy products, pasta or rice?'

- 12 1 a Population: every patient visiting A & E of a UK hospital during unspecified time interval (possibly previous year).
b Sample is not random because Saturday nights may be quite unlike other times of the day and other days of the week.
- 2 a Population: every person currently living in Denmark.
b Sample is not random because not every person living in Denmark has an equal chance of being in the sample.
- 3 a Population: every teacher in a UK secondary school.
b Sample is not random because not every teacher in a UK secondary school has an equal chance of being in the sample.
- 4 a Population: every teacher in a UK secondary school.
b Sample is not random because not every teacher in a UK secondary school has an equal chance of being in the sample.

6.2 Collecting data

1 a

Age	Tally	Frequency
0–10		3
11–20		8
21–30		14
31–40		10
40+		15

b 30%

2 a $0.5 \leq l < 1$ b $0 < l \leq 0.5$

3 a 42% b $\frac{15}{26}$ c 21 : 29

4 a Students' frequency table with 4–5 equal width classes, e.g.

Mass, m (kg)	Frequency
$50 \leq m < 65$	
$65 \leq m < 80$	
$80 \leq m < 95$	
$95 \leq m < 110$	

b i

		Age (years)		
		10–29	30–49	50+
Mass, m (kg)	$50 \leq m < 70$	2	2	2
	$70 \leq m < 90$	0	5	5
	90+	0	3	1

ii 2

iii $\frac{1}{10}$ or 10% iv $\frac{1}{2}$ or 50%

5 Students' own two-way tables, e.g.

		Language		
		French	Spanish	Mandarin
Year	Year 8			
	Year 9			

6 a Discrete

b Students' frequency tables with 4–5 equal width classes, e.g.

Number of customers	Frequency
50–99	1
100–149	5
150–199	17
200–249	7

c Answers will depend on table drawn in part b. For table above, answer is 150–199.

7 a Students' frequency table with 4–5 equal width classes, e.g.

Mass of parcel	Frequency
$0 \leq m < 2$	2
$2 \leq m < 4$	3
$4 \leq m < 6$	4
$6 \leq m < 8$	4
$8 \leq m < 10$	2

b Answers will depend on table drawn in part a. For table above, answer is $4 \leq m < 6$ and $6 \leq m < 8$.

8 a Most people will agree.

b Students' own answers

- 9 a i e.g. There are gaps between the groups and no option for more than 8 portions.
Change groups to
☐ 0–2 ☐ 3–5 ☐ 6–8 ☐ 9+
- ii e.g. Most people will answer 'Yes'. You need to define a healthy diet as this is subjective.
Change to: What have you eaten today?
- iii e.g. Most people will agree.
Change to: Are fruit and vegetables good for you? ☐ Yes ☐ No
- b Students' own answers. Answers could include questions like:
How many pieces of fruit do you eat a day? ☐ 0–2 ☐ 3–5 ☐ 6–8 ☐ 9+
How many portions of vegetables do you eat a day?
☐ 0–2 ☐ 3–5 ☐ 6–8 ☐ 9+
What do you consider a healthy diet?
What have you eaten today?

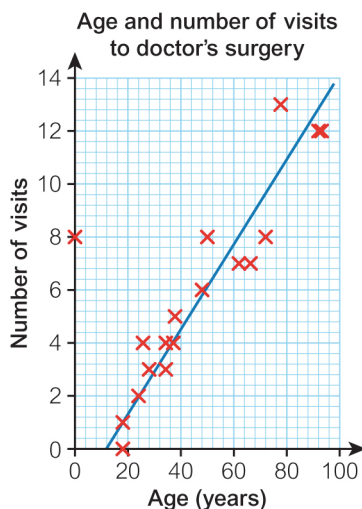
10 Students' own answers

6.3 Calculating averages and range

- 1 a Mean = $43 \div 30 = 1.43$
b 7
- 2 a 2400 miles b 653 miles (3 s.f.)
- 3 a 30 000 km
b $1\,235\,000 \div 100 = 12\,350$ km
- 4 a 54 b 27th c $400 < L \leq 800$
d $0 < L \leq 400$
e i Mean = $41\,600 \div 54 = 770$ miles (3 s.f.)
ii Range = 3200 miles

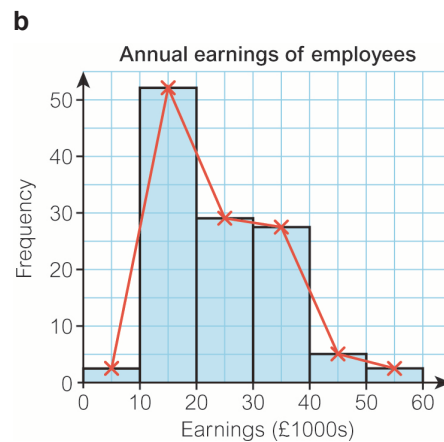
6.4 Displaying and analysing data

1 a, c

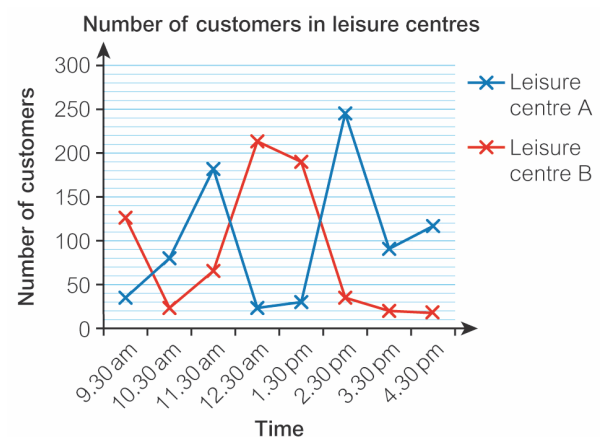


b Positive

- 2 a 4 or 5 times, depending on line of best fit
b 75 to 85 years old, depending on line of best fit
c The data does seem to support the hypothesis.
d Students' own answers, e.g.
You would need to check the records of patients at the surgery generally, not just those who have attended the surgery recently (otherwise the sample is biased). The best source of information would be secondary data (the patients' records) because patients themselves may not remember or be reluctant to share the information with you directly.
- 3 (1, 8); Students' own explanations, e.g. The outlier might have been caused by a very unwell child but the very young might attend the doctors more often and this should be looked into.
- 4 a 10.45–11.30 am, 12–2 pm and 4.15–5.30 pm
b These might be times when people are not at work.
c e.g. She should carry out the same survey on other days of the week.
- 5 a She has not used the points in the middle of the group.



6 a, b

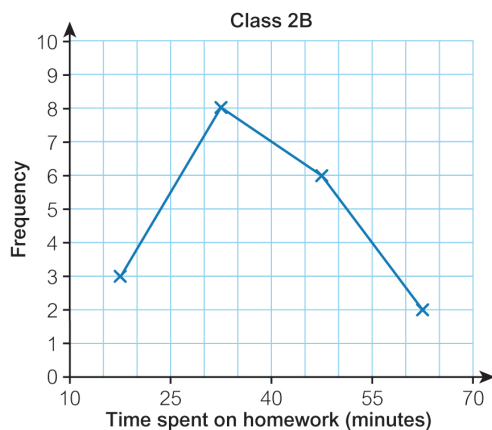


- c e.g. Leisure centre B is busier over lunchtime, but leisure centre A is busier mid-morning and mid-afternoon.

- 7 a 3 minutes
b Students' frequency table with 4–5 equal width classes, e.g.

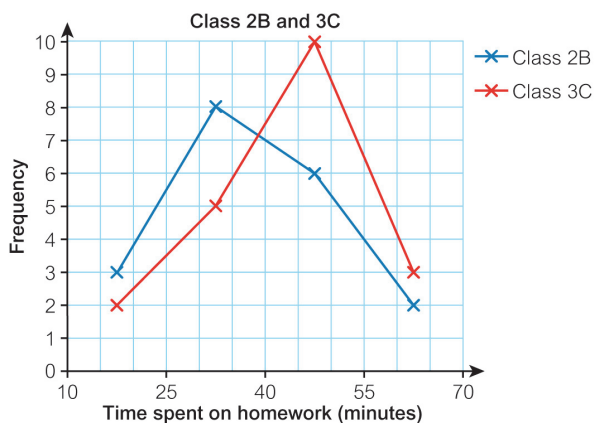
Time spent on homework, t (minutes)	Frequency
$10 < t \leq 25$	3
$25 < t \leq 40$	8
$40 < t \leq 55$	6
$55 < t \leq 70$	2

- c Frequency polygon using answer to part b, e.g.



- d Class with highest frequency from table in part b, e.g. $25 < t \leq 40$
e Accurate values: range = 43 minutes; mean = 38 minutes
Estimated values from frequency table in part b: range = 60 minutes; mean = 38 minutes

f



- g Class with highest value from frequency polygon in part f, e.g. $40 < t \leq 55$
h Accurate values: range = 42 minutes; mean = 43.35 minutes
Estimated values from frequency polygon in part g: range = 60 minutes; mean = 43 minutes
i e.g. Using the accurate range and mean: Class 3C spent longer on their homework than 2B. The range of times was higher for class 2B.

6 Check up Planning a survey

- 1 a A – primary data; B – secondary data
b 200 students

Collecting data

- 2 C 200
3 400
4 a A – primary data; B – secondary data
b Sample will be biased because Fiona has given the questionnaire only to Year 10 students.
c She could reduce bias by giving questionnaires to 10% of students in each year group.
5 a Overlapping groups
b Leading question, as people are likely to agree.
6 The phrase 'too much' is not precise enough. Students' answer should have a question like 'For how many hours do you watch TV each day?' along with a tick box answer section that starts at zero hours and has no overlaps or gaps.

- 7 Students' frequency table with 4–5 equal width classes, e.g.

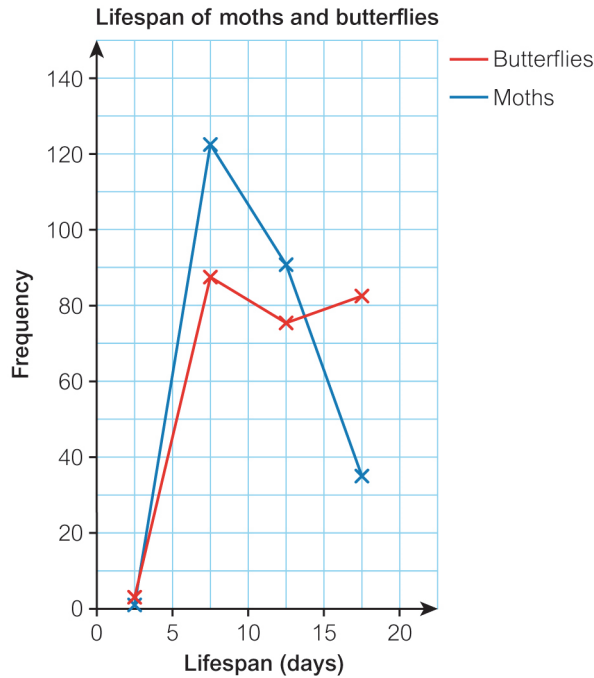
Mass, g (grams)	Frequency
$60 \leq g < 70$	3
$70 \leq g < 80$	10
$80 \leq g < 90$	5
$90 \leq g < 100$	2

Calculating averages and range

- 8 a $615 \div 50 = 12.3$ kg b 6 kg
9 Girls: $4265 \div 50 = 85.3$ cm
Boys: $4400 \div 50 = 88$ cm

Displaying and analysing data

10 a



- b On average, butterflies have a longer lifespan than moths (with an estimated mean of 12.3 days versus 10.7 days).

11 a (5, 1)

- b e.g. Student might have driven off road or had a parent teach them.
c 2

6 Strengthen Planning a survey

- 1 a Primary b Secondary
2 500
3 a 100 b B the nearest 10 minutes
c No. Year 11 students probably spend more time on homework than students in other years. He needs to ask students from all the years in the school.

Collecting data

- 1 c 500
2 a 100 b 2000 c 20 000 d 100 000
3 a Secondary data b Primary data c Primary data
4 i a too unclear/too many possible answers b leading question c not all options included d leading question e too unclear/too many possible answers
ii Students' own answers

- 5 a Not everyone visits a health club. Therefore, not every member of the population has an equal chance of being in the sample.
b Not everyone goes into a health food shop. Therefore, not every member of the population has an equal chance of being in the sample.
c Most people are not in an old people's home. Therefore, not every member of the population has an equal chance of being in the sample.
6 a Both 0–10 and 10–20
b The groups overlap.
c 0–9 cm, 10–19 cm, 20–29 cm

7

Time, t (minutes)	Tally	Frequency
$20 < t \leq 30$		1
$30 < t \leq 40$		3
$40 < t \leq 50$		2
$50 < t \leq 60$		2
$60 < t \leq 70$		2

- 8 Students' frequency table with 4–5 equal width classes

Calculating averages and range

- 1 a 1000 m b 650 m c 350 m d 36
e, f

Height, H (metres)	Frequency	Midpoint of class	Frequency $\times$ midpoint
$650 < H \leq 700$	7	675	$7 \times 675 = 4725$
$700 < H \leq 750$	11	725	$11 \times 725 = 7975$
$750 < H \leq 800$	6	775	$6 \times 775 = 4650$
$800 < H \leq 850$	4	825	$4 \times 825 = 3300$
$850 < H \leq 900$	4	875	$4 \times 875 = 3500$
$900 < H \leq 950$	3	925	$3 \times 925 = 2775$
$950 < H \leq$	1	975	$1 \times 975 = 975$
	36		27 900

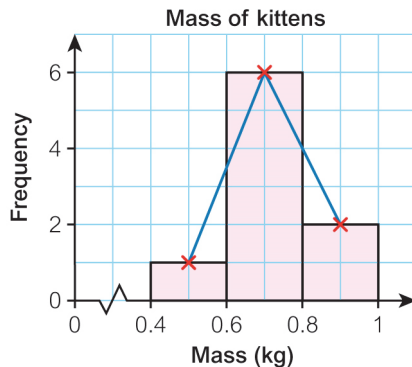
- g Estimate of the mean
 $= 27\,900 \text{ m} \div 36$
 $= 775 \text{ m}$

- 2 a 50 minutes b 21 minutes

Displaying and analysing data

- 1 Put a cross on the midpoint of the top of each bar, and then join them with straight lines.

2 a, b



3 a Positive correlation

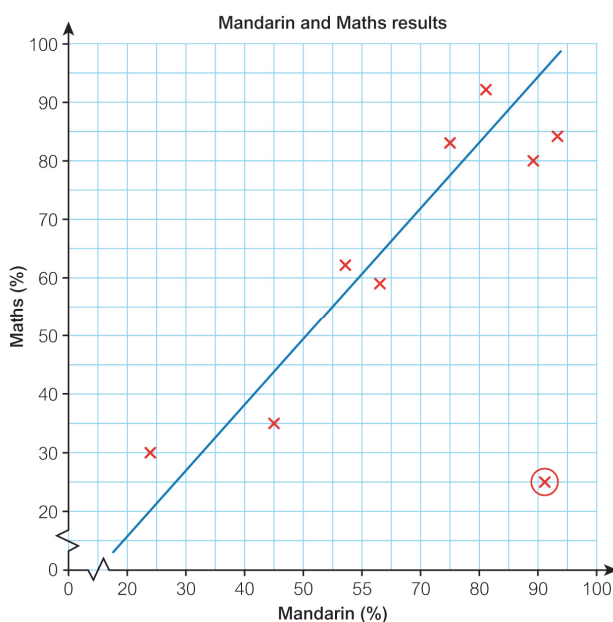
b i 27.5 seconds

ii 29 seconds

iii 28 seconds

c Yes; the point (20, 25)

4 a, b, e



c i Approximately 27%

ii Approximately 50%

iii Approximately 95%

d i Approximately 60%

ii Approximately 40%

iii Approximately 70%

e Outlier 91% Mandarin, 25% maths

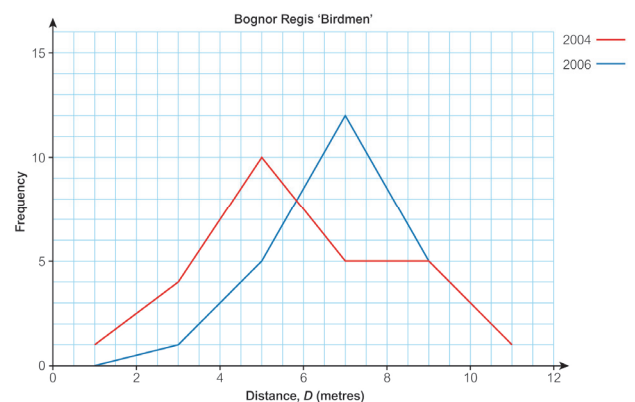
Enrichment

1 a Table B b Table C

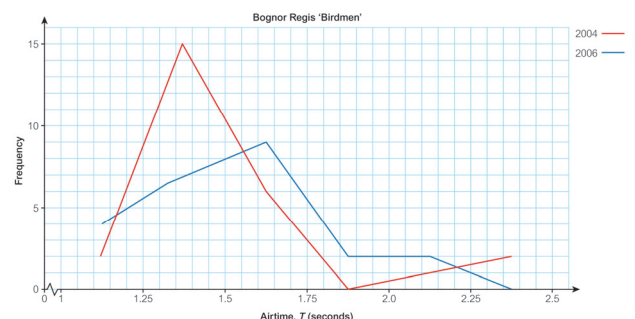
6 Extend

- 1 a Should collect B, C, D and E
 B This might show any trends in the data, so it should be recorded. (It would be best to use groups, since some people might be embarrassed about giving their age.)
 C Level of satisfaction with the company (with options)
 D Number of years with company (with groups as people might not remember)
 E How their working conditions should be improved (with space for a written answer and some suggestions)
 Should not collect A. It is better for a survey to be anonymous so that people will be honest.

2 a



b



- c In 2006 the modal distance travelled was 2 metres greater than in 2004, and more people achieved it even though there were 2 fewer contestants. The greatest and second greatest distance classes contain the same number of contestants in both years.
 In 2006 the modal airtime was also greater than in 2004. In 2006, in general, more people achieved the longer airtimes, but this was not true for the longest distance.
- d For most contestants, greater distance travelled corresponded to longer airtime.

3 a The question suggests an answer.

b e.g.

Which facilities do you use? Tick the most appropriate box.

- ☐ Play parks ☐ Library
☐ Sports centre ☐ Park
☐ Playing fields

Do any of these facilities need improvement?
 Tick the most appropriate box.

- ☐ Play parks ☐ Library
☐ Sports centre ☐ Park
☐ Playing fields

Are there any further facilities you would like to see in this town?

4 a Question A: too vague, needs specific time options.

Question B: too vague.

Question C: leading question that encourages the answer 'yes'.

b Replace Question A with Question U.

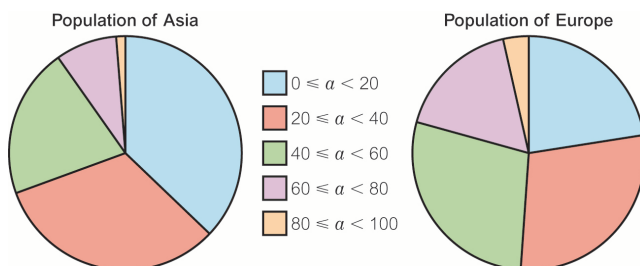
Replace Question B with Question Q.

Replace Question C with Question W.

5 a $3395 \div 110 = 30.9$ to 1 d.p.

b 30–39

6 a



b Asia: $0 \leq a < 20$; Europe: $20 \leq a < 40$

c Asia: 30.9 years; Europe: 40.1 years

d Students' own answers, e.g.

A higher proportion of the population is less than 20 in Asia than in Europe.

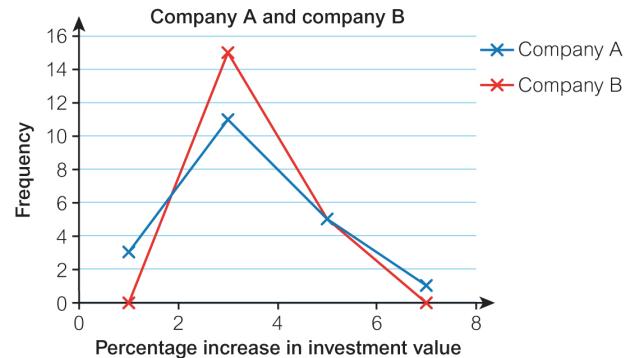
The mean age is lower in Asia than in Europe.

A greater proportion of the population are over 80 in Europe than in Asia.

7 a No b No

c Company A: mean = 3.4%;

Company B: mean = 3.5%



Students could choose either company A or company B.

Arguments for company A: steadier rate of interest, never drops to zero, money safer, good short-term investment

Arguments for company B: slightly higher rate of interest on average, more risky but higher income over the long term, good long-term investment

8 a Table 1: $20 \leq b < 40$ Table 2: $30 \leq b < 45$

b Table 1: 80 Table 2: 75

c Table 1: 35.6 Table 2: 37.8

9 a The vertical axis of Graph A is not a frequency scale because the total number of UK voters is different and unknown for each election year. The percentages represented by the dots on the diagram are not percentages of the same number. Therefore, this polygon does not compare frequencies; it was not made by joining the midpoints of a frequency diagram. Therefore, Graph A is not a frequency polygon.

b $3355 \div 50 = 67.1\%$

6 Unit test

1 a A: groups overlap; B: leading question

b A: Change categories to

☐ 0–2 ☐ 3–5 ☐ 6–8 ☐ 9+ (or similar)

B: Who has most accidents, men or women?

2 a B (nearest 1 mph)

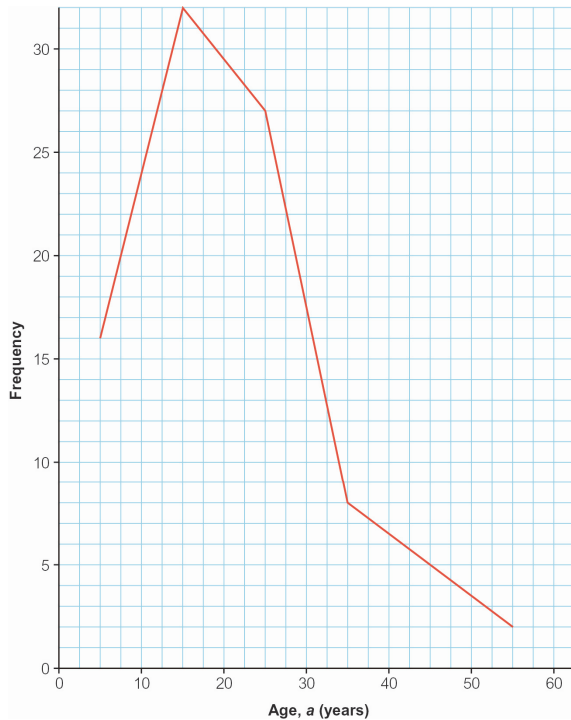
b Students' frequency table with 4–5 equal width classes, e.g.

Speed, s (mph)	Frequency
$0 < s \leq 10$	
$10 < s \leq 20$	
$20 < s \leq 30$	
$30 < s \leq 40$	
$40 < s \leq 50$	
$50 < s \leq 60$	

3

	Tennis	Badminton	Squash
Swimming			
Athletics			
Gymnastics			

4

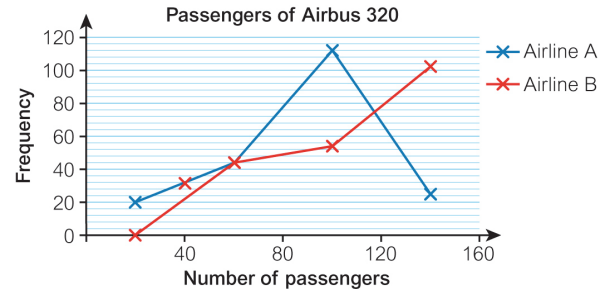


- 5 a Abingley: $3090 \div 87 = 35.52$ to 2 d.p.
Brownston: $3000 \div 54 = 56.56$ to 2 d.p.
- b The average number of employees per company is greater in Brownston than it is in Abingley.
- 6 a Estimated range = 2000 metres
b Estimated mean = $4\,127\,000 \div 11\,130 = 371$ metres (3 s.f.)
- 7 a Positive b 26°C c Graph A
- d i Answers between 25.5°C and 26.5°C
ii Answers between 27 and 28

- 8 a i $80 \leq p < 120$
ii $120 \leq p < 160$

- b Airline A: mean = 88.4; Airline B: mean = 111.6
c Airline A: range = 160; Airline B: range = 120

d



- e Students' own answers, e.g.
Airline B has more passengers on average.
Airline A has a larger range.

Unit 7 Multiplicative reasoning

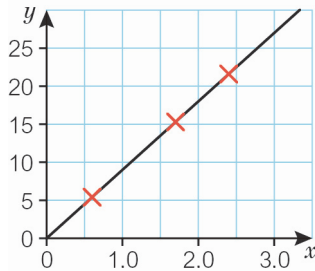
7.1 Direct proportion

1 a Yes b No c No d Yes

2 a \$3.96 b \$4.95

3 Majed
Arhan 3.5p / text
Majed 3.4p / text

4 a

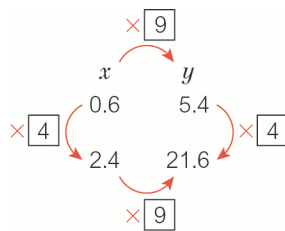


b Yes.

c $\frac{y}{x} = 9$. All values are the same.

$\frac{x}{y} = \frac{1}{9}$. All values are the same.

d



e $y = 9x$

5 a 13.5 for each pair b Yes

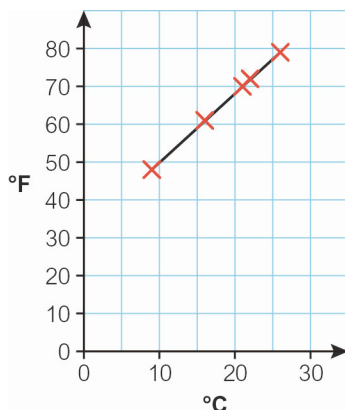
c Graph of the data with days on the horizontal axis and cost on the vertical axis. Points plotted. Line through the points.

d Cost = $13.5 \times$ Number of days

e £202.50

6 a No. The value of $F \div C$ is different each time.

b



7 a = 37.5 b = 16 c = 20 d = 62.5

8 $x = 148$ m $y = 212$ yards $z = 335$ yards

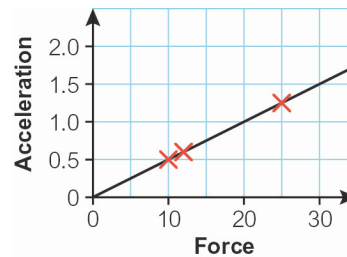
9 a $48 : 162 = 8 : 27$ b 118.1 cm
c 54.8 cm

7.2 Solving problems using direct proportion

1 A : $y = \frac{5}{2}x$ B : $y = 5x + 4$

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

3 a



b Yes.

The graph is a straight line through (0, 0).

c $F = 20a$

4 a $C = 5t$ b $C = 4x$ c $E = 52x$

d $m = 2.5x$ e $C = 0.35n$

5 a Yes b No c Yes d No

6 a $P = 2.42m$ b \$10.16

7 a $R = 17.8P$

b 4450 South African rand

c £36.52

8 a £75 b £6000

9 a $y = 6x$ b $t = 2.4$

10 a 176.4N b 9.8 m/s^2

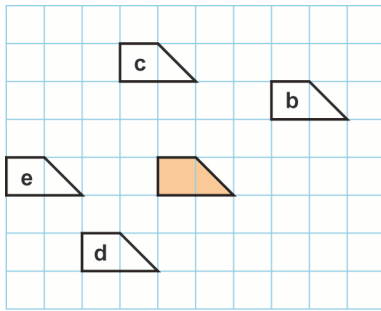
c i $W = 1.6m$ ii 22.4N

11 a i 1120 miles ii 600 miles

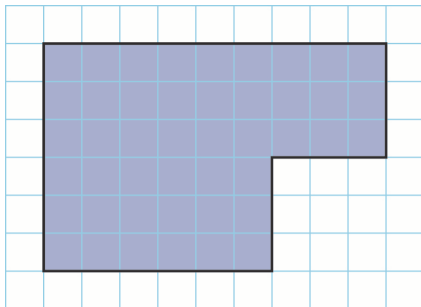
b 480 mph c 7 hours 11 minutes

7.3 Translations and enlargements

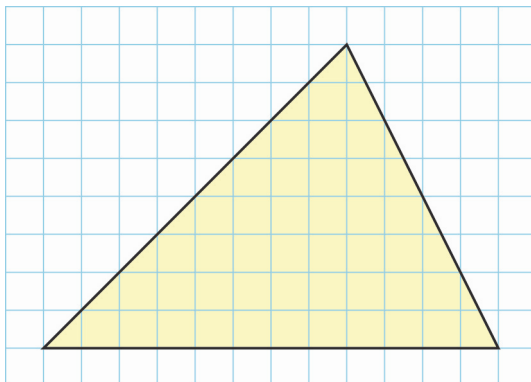
1



2 a



b



3 Scale factor 2

4 Yes, 4 squares left and 3 squares right is the same as 1 square left, 2 squares down and 4 squares up is the same as 2 squares up.

5 a Translation with vector $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$

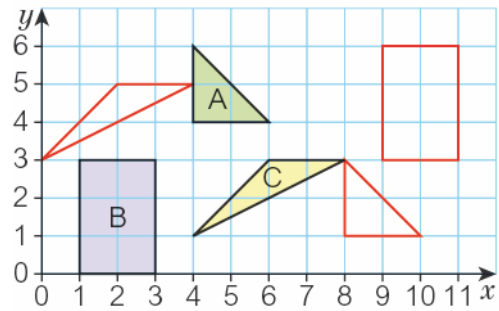
b Translation with vector $\begin{pmatrix} 1 \\ -5 \end{pmatrix}$

c Translation with vector $\begin{pmatrix} -5 \\ 6 \end{pmatrix}$

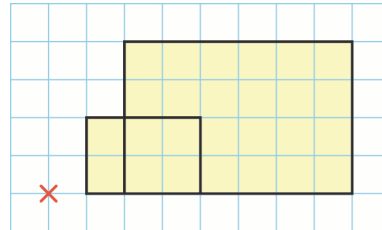
d Column vector to move from $\begin{pmatrix} x_1 \\ y_1 \end{pmatrix}$ to $\begin{pmatrix} x_2 \\ y_2 \end{pmatrix}$

is $\begin{pmatrix} x_2 - x_1 \\ y_2 - y_1 \end{pmatrix}$

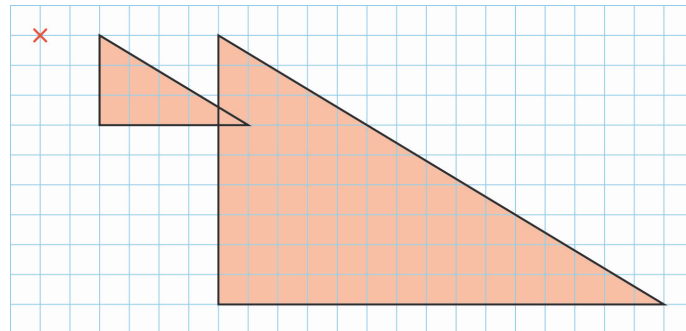
6



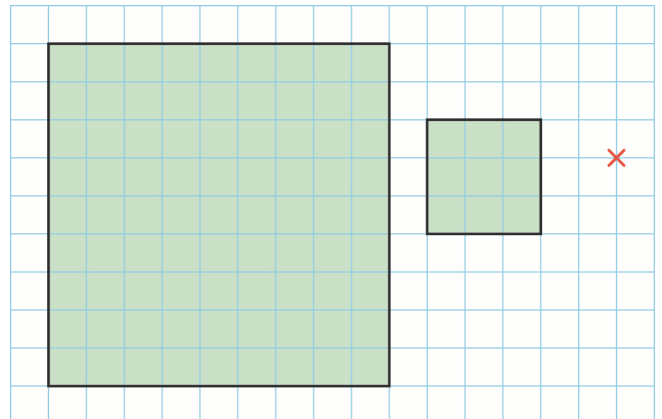
7 a



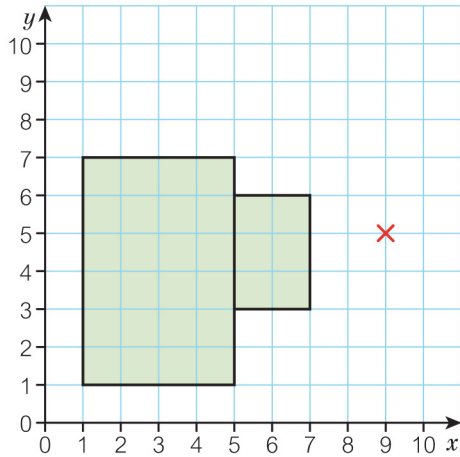
b



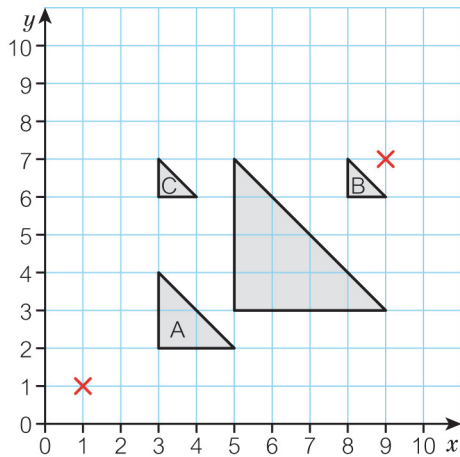
c



8



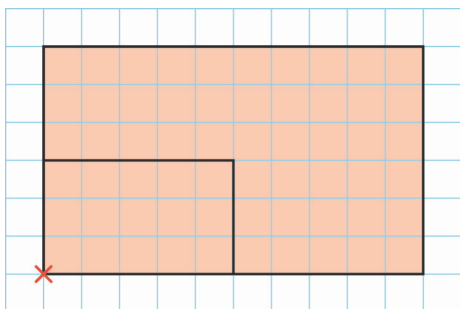
9 a, b, d



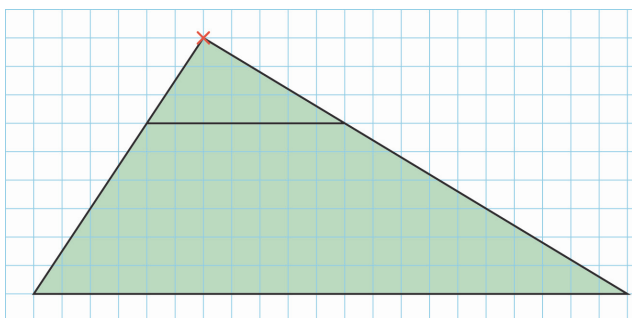
c Same triangle

e No; a scale factor of 3 will not give the same side lengths as the other triangle.

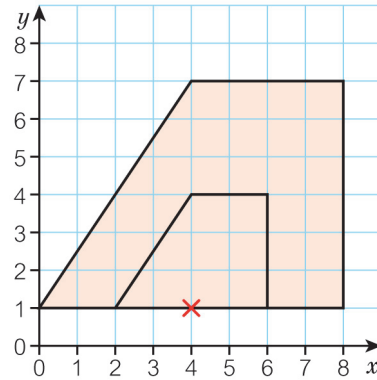
10 a



b



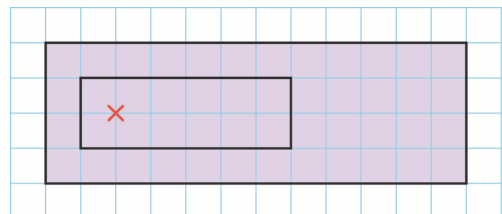
11 a



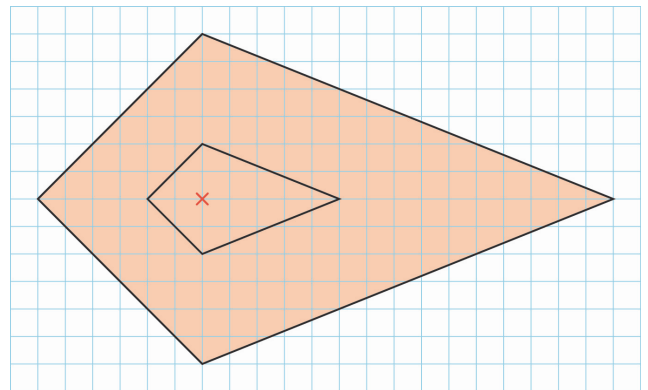
b Same angles

c The lengths are all 2 times bigger in the enlarged shape.

12 a



b

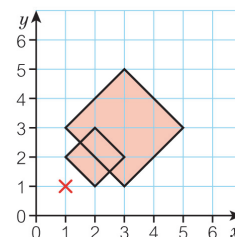


7.4 Negative and fractional scale factors

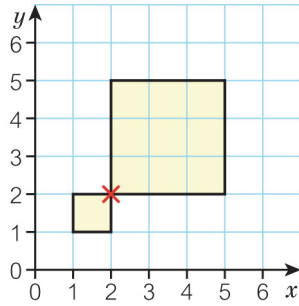
1 a



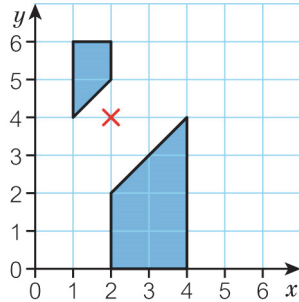
b



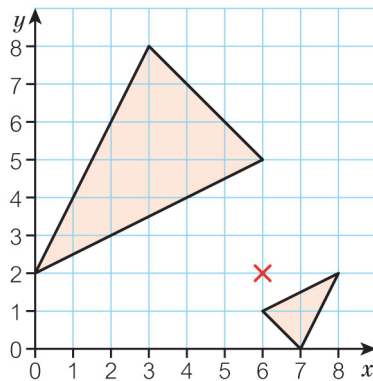
2 a



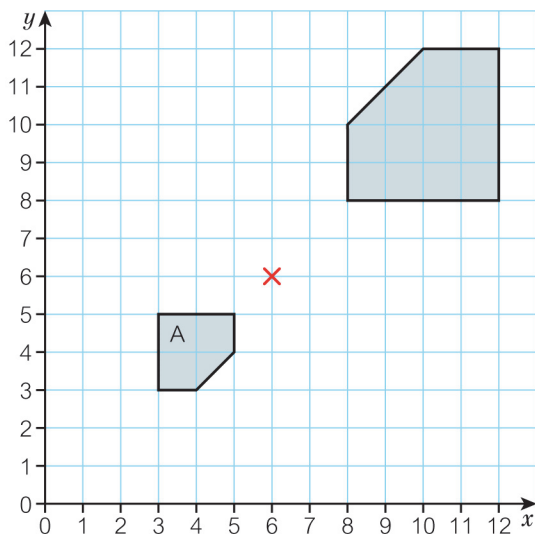
b



c

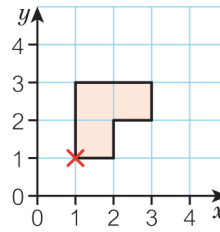


3 a, b

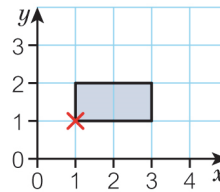


c They are the same. This means that enlarging by a negative scale factor is the same as enlarging by the same positive scale factor and then rotating 180° about the centre of enlargement.

4 a



b



5 a i scale factor $\frac{1}{3}$ ii scale factor $\frac{1}{2}$

b i scale factor 3 ii scale factor 2

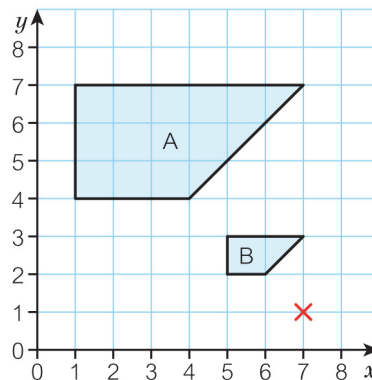
6 a scale factor 2

b i 1 : 2 ii 1 : 2

c The scale factor (2) is the second number in the ratio (1 : 2).

7 17.0 m

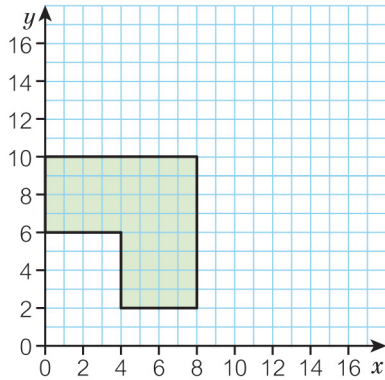
8 a



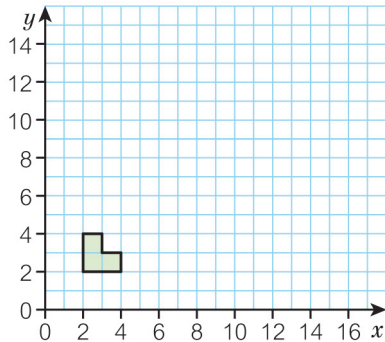
b 3 : 1

c enlargement scale factor 3, centre (7, 1)

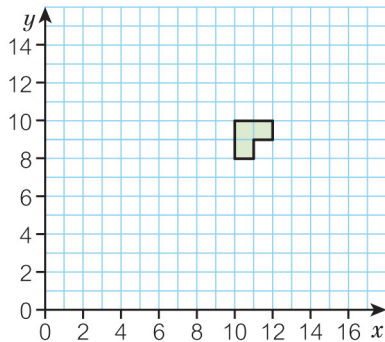
9 a i



ii



iii



- b Any combined transformation, e.g. rotate 90° clockwise about (4, 2) then translate 6 squares right and 6 squares up.

7.5 Percentage change

1 a 54% b 63.95%

2 a \$28.75 b \$374.40

3 \$47.50

4

	Original price
Item 1	\$70
Item 2	\$82
Item 3	\$285

5 a \$560

- b Sachita saved the most money.
Juanita saved $\$560 - \$420 = \$140$
Sachita saved $\$690 - \$483 = \$207$

6 \$120 000

7 \$498

8 actual change = \$192

$$\text{percentage change} = \frac{192}{2400} \times 100\% = 8\%$$

9 2%

10

Item	Actual profit	Percentage profit
Hoody	\$9	75%
T-shirt	\$3	60%
Fleece	\$15	50%
Polo shirt	\$10	125%

11 12%

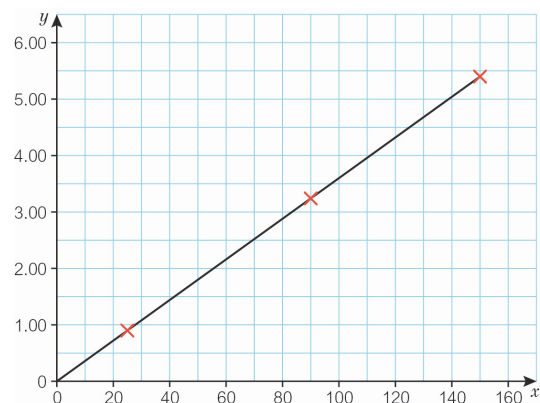
12 30%

13 a 10.0% b decrease c 5.6% increase

7 Check up Direct proportion

1 a \$20.25 b \$16.20

2 a



b Yes c Cost = $0.036 \times \text{volume}$

3 No. Cost $\div$ (toilet rolls) is not the same for 6 and 9.

4 $w = 30$ $x = 18$ $z = 0.75$

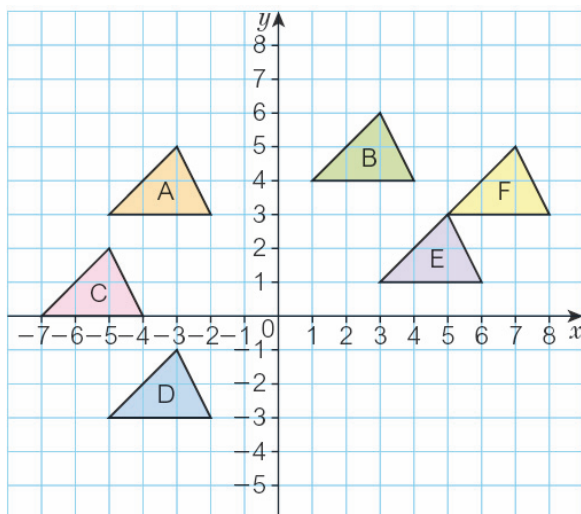
Proportion and problems

5 a $y = 0.1875x$ or $y = \frac{3}{16}x$

b $y = 8.625$

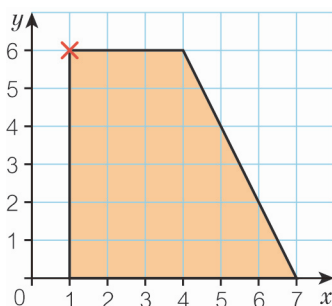
Translation

6

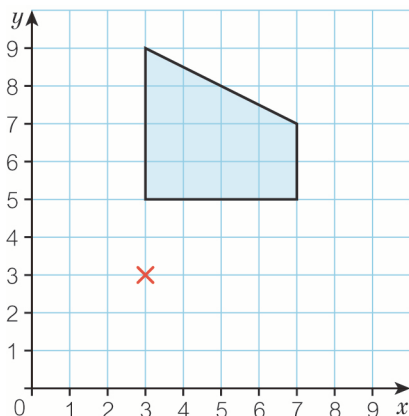


Enlargement

7 a

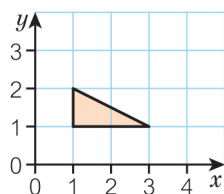


b



8 Enlargement scale factor 2, centre (0, 5)

9



10 390 mm

Percentage change

11 £40

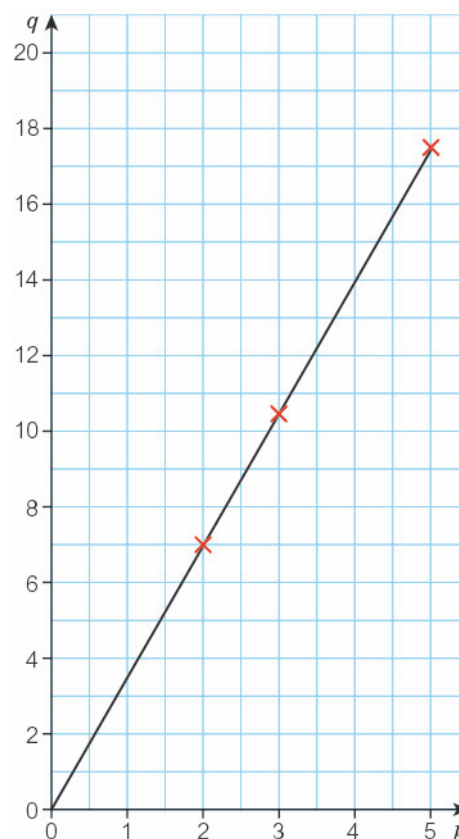
12 a £384 b 12%

7 Strengthen

Direct proportion

1 C

2 a



b Yes. It is a straight-line graph through (0,0).

c $q = 3.5p$

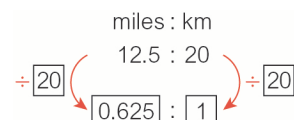
3 a $c = 3x$ b $M = 2.3x$ c $d = 1.4n$

4 a 64 cm b 5 minutes

5 $a = 36$ b = 35

6 Yes, he charges £18 an hour.

7 a



b $M = 0.625K$

c Yes, $24 = 0.625 \times 38.4$

8 a 3200 tughrik

b $T = 3200P$

c 256 000 tughrik

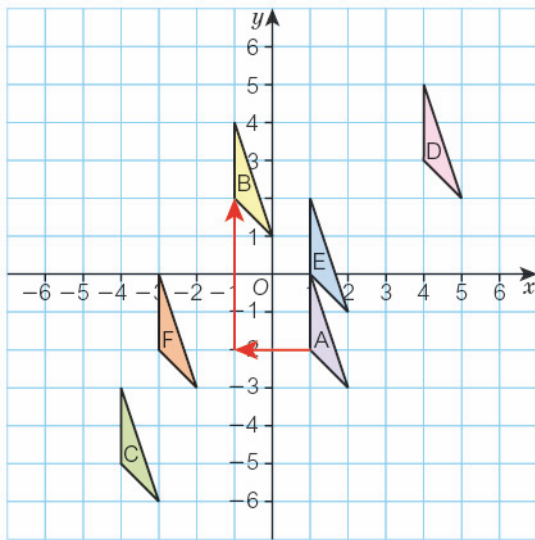
Proportion and problems

- 1 a $y = kx$ b $c = kr$ c $m = kt$
 d $p = kq^2$ e $n = kx^2$
- 2 a $y = kx$ b $11.25 = k \times 4.5$ c $k = 2.5$
 d $y = 2.5x$ e $y = 25$
- 3 a $r = 1.2t$ b $r = 8.4$
- 4 a $p \propto q^2$ $p = kq^2$ b $30 = k \times 4^2$
 c $k = 1.875$ d $p = 1.875q^2$
 e $p = 67.5$

Translation

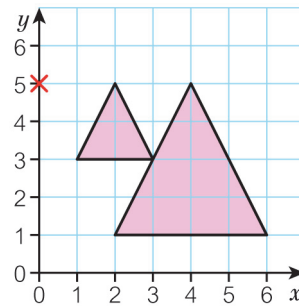
- 1 a $\begin{pmatrix} 5 \\ -3 \end{pmatrix}$ b $\begin{pmatrix} -5 \\ 3 \end{pmatrix}$

2

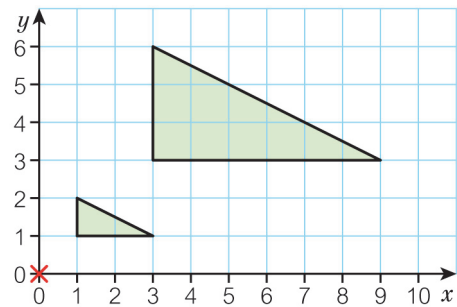


Enlargement

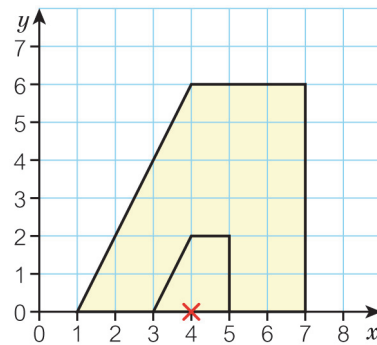
1 a



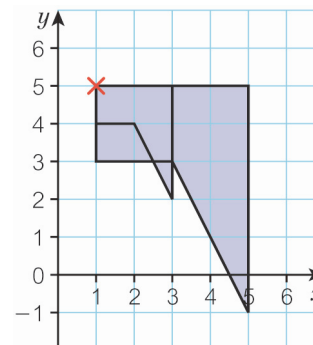
b



c

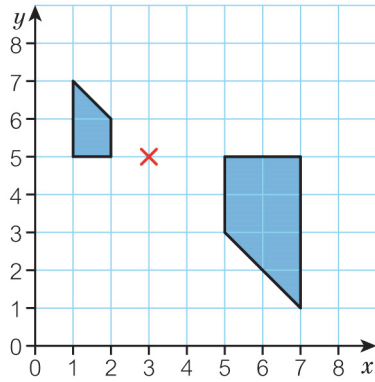


d

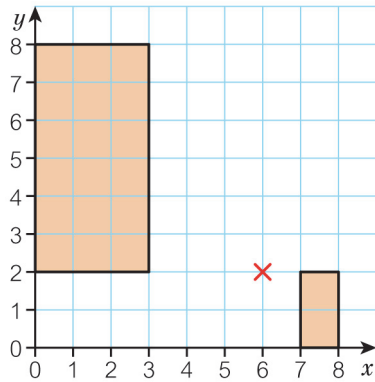


- 2 a scale factor 2, centre (7, 1)
 b scale factor 3, centre (3, 4)

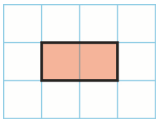
3 a



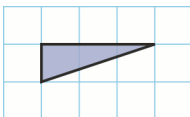
b



4 a



b



5 a 6460 mm b 6.46 m

Percentage change

- 1 \$40
 2 a \$60 b \$120 c \$80
 3 16
 4 a 60 members b 150 members
 c 120 members
 5 a 4% b yes
 6 a 25% b 30% c 85%
 7 a 25% b 15% c 37%

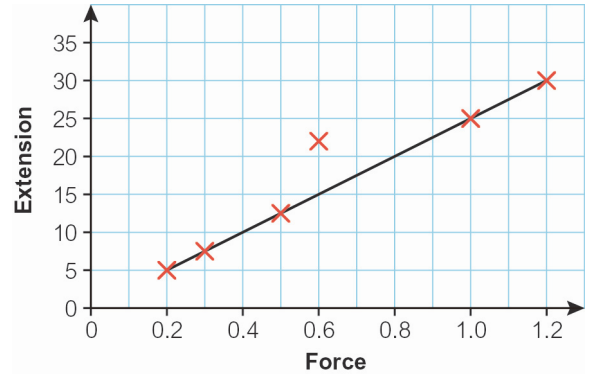
Enrichment

- 1 a 70 cm^2
 b Students' own answers, e.g. length 10 cm and width 7 cm

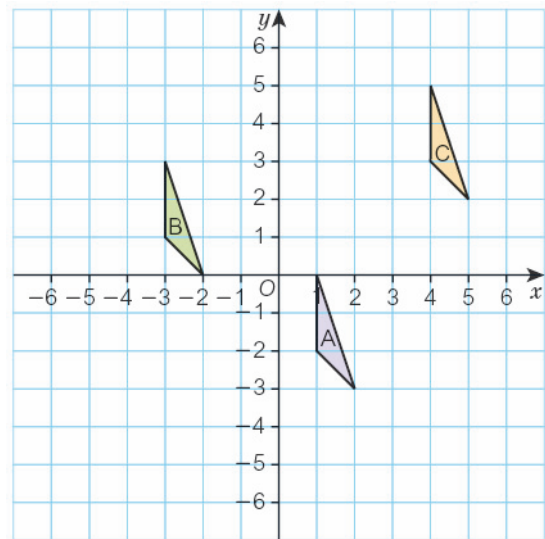
7 Extend

- 1 a i 132 500 cm ii 1.325 km
 b 39.2 cm
 2 a 334.4 km b 7.65 km
 3 a $P = 4s$ b $C = 2\pi r$ c $A = s^2$
 d $P = 2l + 2w$ or $2(l + w)$

4 a

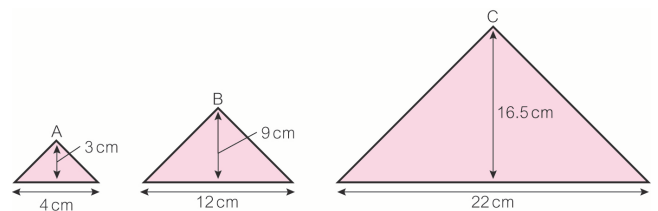


- b (0.6, 22)
 c Yes. It is a straight-line graph through (0, 0).
 5 a Yes b $h = 250T$ c 10.3°C
 6 a, b



$$\text{c } \begin{pmatrix} 3 \\ 5 \end{pmatrix} \quad \text{d } \begin{pmatrix} -4 \\ 3 \end{pmatrix} + \begin{pmatrix} 7 \\ 2 \end{pmatrix} = \begin{pmatrix} -4+7 \\ 3+2 \end{pmatrix} = \begin{pmatrix} 3 \\ 5 \end{pmatrix}$$

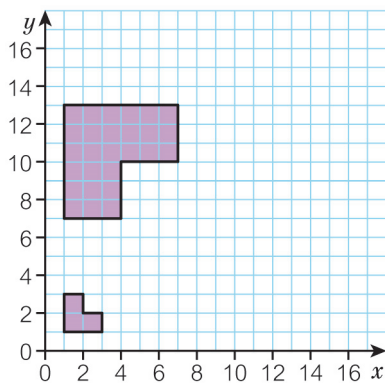
7



$$\text{8 a } \begin{pmatrix} -x \\ -y \end{pmatrix} \quad \text{b } \begin{pmatrix} a+c \\ b+d \end{pmatrix}$$

9 a 24 units

b



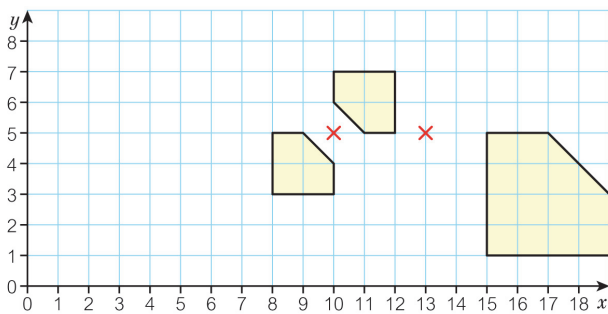
c 8 units

10 a 29.2 million b 53.2 million

c 82.2% d 58.9%

e No; 13% of 146 million is different from 13% of 140 million.

11 a



b Enlargement by scale factor 2 about the centre (1, 5)

12 a 31.25 b 12.4

13 a 16 b 31.87

14 a 0.06

b i \$1260 ii \$90

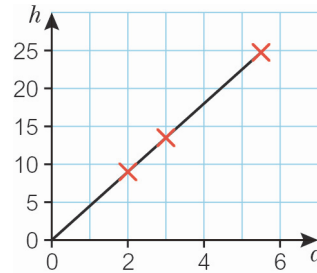
7 Unit test

1 440 km

2 a i Yes ii $C = 59x$

b i No ii $C = 12x + 14$

3 a

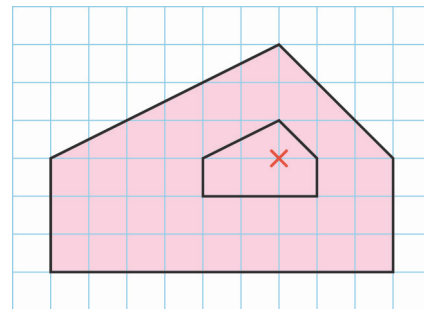


b Yes

4 $a = 12.5$ $b = 138$

5 a Yes b $m = 25e$

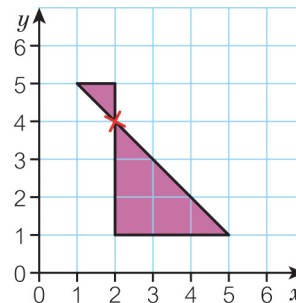
6



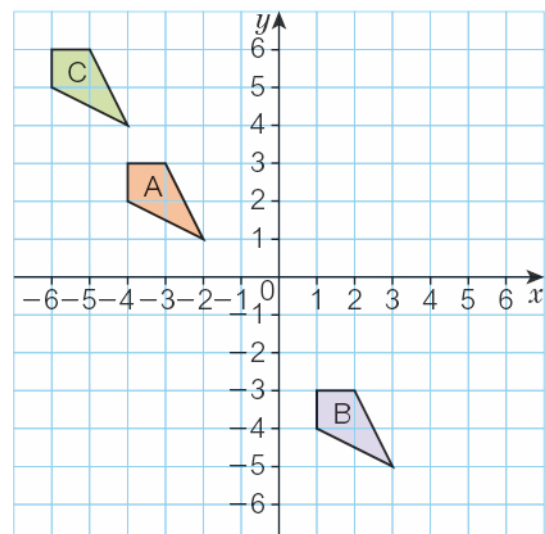
7 a scale factor 2 centre (4, 4)

b scale factor 3 centre (1, 6)

8



9 a, b



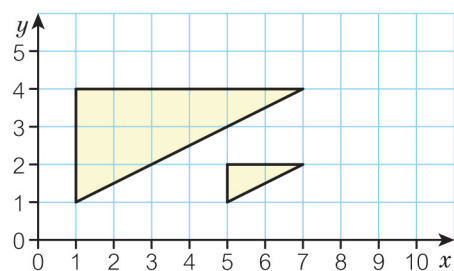
c $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$

10 a $y = 0.57x$ **b** $y = 7.41$ **c** $x = 29$

11 a \$13 000 **b** \$437 500

12 a \$168 **b** 6%

13



14 a 16 **b** 1 : 16

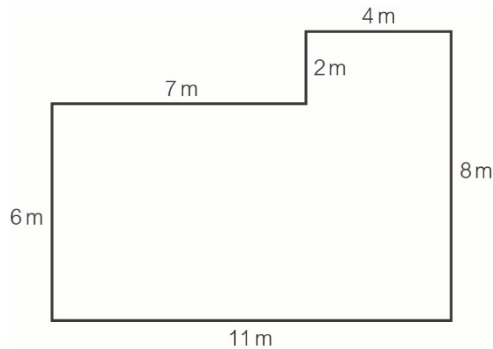
15 40%

Unit 8 Scale drawings and measures

8.1 Maps and scales

- 1 a 200 cm b 6.2 m c 1.35 km
2 a 25 cm b 30 cm c 75 cm d 22.5 cm
e 7 cm

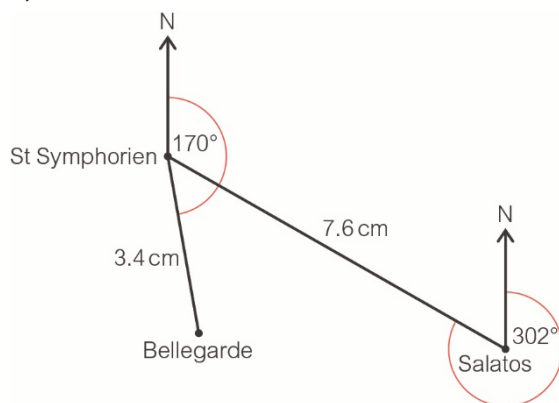
3



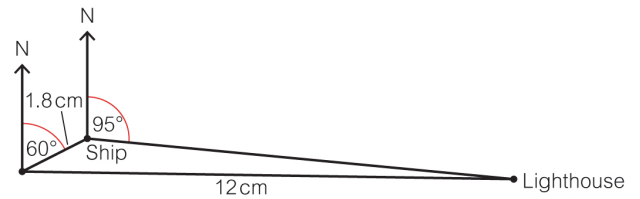
- 4 a 1800 m b 1440 m c 5400 m d 720 m
5 a 20 cm b 300 cm c 45 cm d 50 cm
e 250 cm f 450 cm
6 a i 250 m ii 150 m iii 100 m
b 6 minutes
7 a 1 cm on the map is 200 km in real life.
b i 300 km ii 540 km iii 900 km
8 Angle is 78°

8.2 Bearings

- 1 Angles accurately drawn.
2 a $a = 323^\circ$ b $b = 98^\circ$ c $c, d = 70^\circ$
3 a 120 km b 6 cm
4 a 090° b 180° c 270° d 135°
e 225° f 315°
5 a 115° b 295°
6 a, b

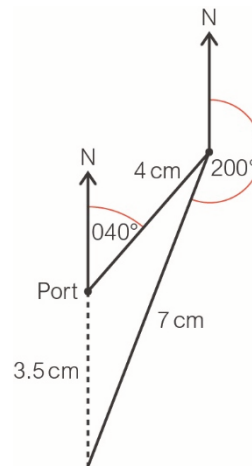


7 a



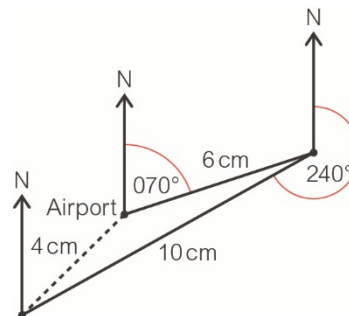
- b Bearing 095° , distance 104 km.

8 a



- b 7 km

9 a



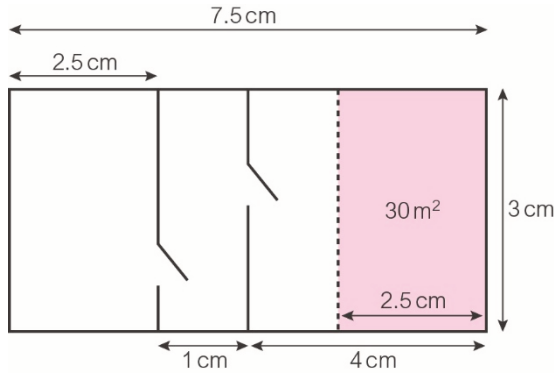
- b 40 miles c 050°

- 10 a 300° b 060° c 140°

8.3 Scales and ratios

- 1 a 250 m b 400 m c 1 km d 1.5 km
2 a 1 : 5 b 1 : 3 c 1 : 15 d 1 : 10
3 a 300 b 150 c 1000 d 1500
4 a 800 m b 1200 m c 900 m d 100 m
5 A iv B i C iii D ii
6 a i 1.7 cm ii 8.5 km
b i 12.5 km ii 5 km iii 15.5 km

7 a, b



c 18 m^2

8 a 1: 100 b 1: 500 000

c 1: 20 000 d 1: 75 000

9 a i 400 m ii 2 km iii 10 km

b i 100 cm ii 20 cm iii 4 cm

8.4 Congruent and similar shapes

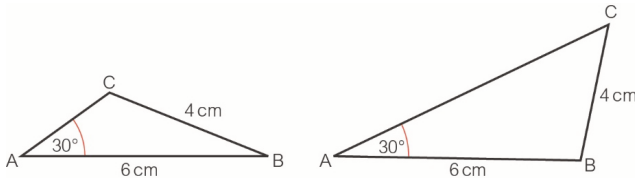
1 a 2 b $\frac{1}{2}$

2 a $a = c$ and $b = d$ (vertically opposite)

b $a = c$ and $b = d$ (alternate angles)

3 A and C, B and E are congruent.

4



5 a SAS b SSS c ASA

6 DEF congruent – SSS

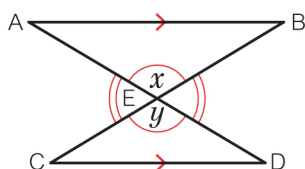
HGI congruent – SAS

JKL not congruent because the 93° angle is adjacent to the 4.2 cm dimension, not opposite to it.

7 Yes – because SAS

8 a $x = y$ (vertically opposite angles)

b



c Angle AEB = Angle CED (vertically opposite)

Angle BAE = Angle EDC (alternate angles)

Angle ABE = Angle ECD (alternate angles)

$AB = CD$

As all angles are the same and one side is equal, the two triangles are congruent.

9 Angle BAC = 85° which is equal to angle EDF.
Angle EFD = 30° which is equal to angle BCA.
As all angles are the same the triangles are similar.

10 12 cm

11 a $a = 4.5$, $b = 2$

b $c = 2.5$ cm, $d = 2.4$ cm

12 A and C are similar.

8.5 Solving geometrical problems

1 No, they are not similar. The base and height are not enlarged by the same scale factor.

2 $x = 5$ cm

3 a Vertically opposite

b d is equal to b – alternate angles

c c is equal to f – alternate angles

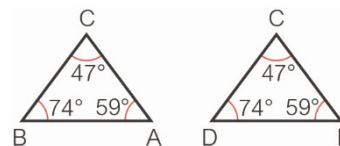
4 a Angle DCE = 47° – vertically opposite

Angle CDE = 74° – alternate angles

Angle CED = 59° – alternate angles

b As all angles are the same the triangles ABC and CDE are similar.

c



5 a Angle MPN = Angle QPR – vertically opposite
Angle NMP = Angle PRQ – alternate angles
Angle MNP = Angle PQR – alternate angles
As all angles are the same the two triangles are similar.

b 6 cm

6 a Angle AEC = Angle BDC

Angle CAE = Angle CBD = 90°

Angle DCB = Angle ECA

As the triangles have the same angles they are similar.

b 6 cm c 4 cm

7 a Angle ACB = Angle AED

Angle ABC = Angle ADC

Angle BAC = Angle DAE = 36°

As the triangles have the same angles they are similar.

b 14 cm c 7 cm d 3 cm

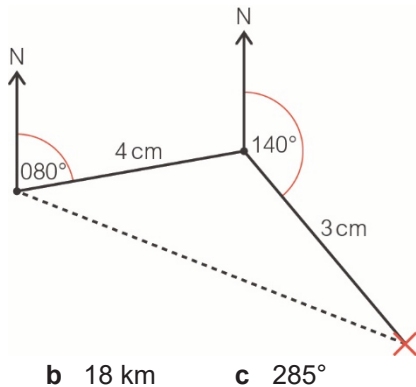
8 320 m

8 Check up Maps and scales

- 1 48 cm
2 0.5 cm
3 a 250 m b 8 cm
4 1000 m

Bearings

- 5 020°
6 a

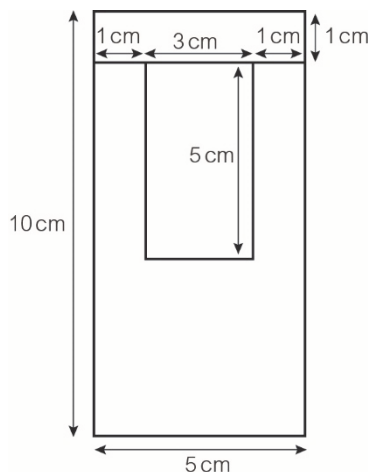


Congruence and similarity

- 7 A and C as they are SAS.
8 b $x = 8$ cm c $y = 6$ cm
9 Angle AED = Angle ACB = 90°
Angle ABC = Angle ADE
Angle A is the same in both
AAA so are similar
10 a Angle DAE = Angle BAC, vertically opposite
Angle DEA = Angle ACB, alternate angles
Angle EDA = Angle ABC, alternate angles
AAA, so are similar
b $a = 10$ b = 3

8 Strengthen Maps and scales

1

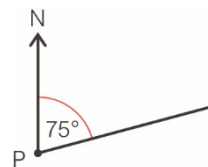


- 2 a 2 cm b 6 cm c 20 cm d 40 cm
e 20 cm
3 a 20 m b 4 m c 4 m by 8 m
4 a 100 cm b 200 cm c 460 cm d 840 cm
5 a 1.4 km b 1.5 km c 2.15 km
6 a 1 : 100 b 1 : 20 c 1 : 100 d 1 : 300
e 1 : 100 000

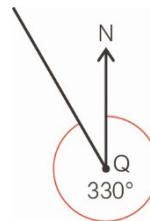
Bearings

- 1 a 048° b 075° c 170° d 240°

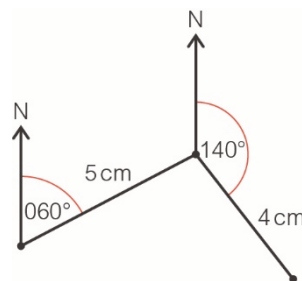
2 a, b



3 a, b



- 4 a 285° b 000° c 075° d 105°
5 a, b



- c i 14 km ii 275°

Congruence and similarity

- 1 B
2 b i congruent ASA ii similar AAA
iii congruent SAS

3 a

P	Q
5	10
12	x
13	y

- b 2 c $x = 24, y = 26$

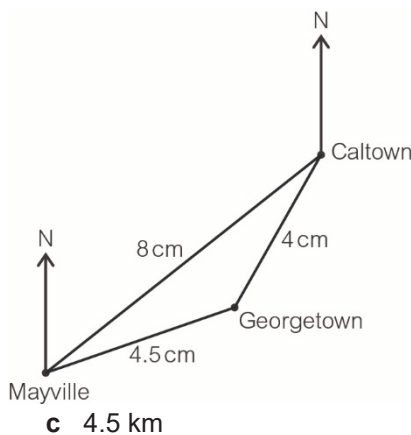
4 6

- 5 a = 16 cm b = 3 cm c = 9 cm d = 6 cm
6 C and E

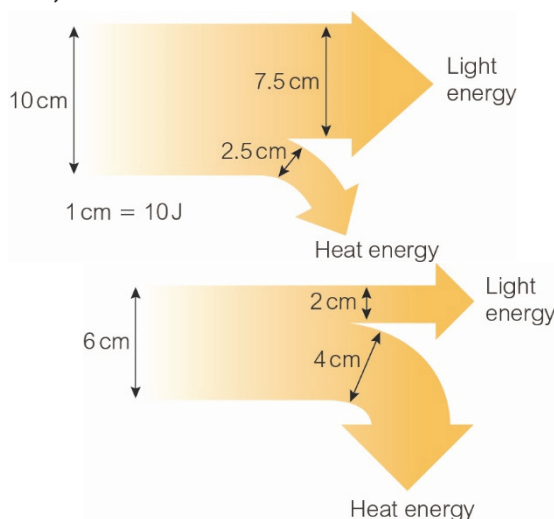
- 7 a i Alternate angles ii Alternate angles
iii Vertically opposite angles
b They are similar
c $x = 4$ cm, $y = 10$ cm
- 8 a BC and DE are parallel because both are at right angles to AE.
b Angle ABC = angle ADE because triangles ABC and ADE are similar (AAA).
c 2
d 20 cm
- 9 Students' own answers

8 Extend

- 1 a, b

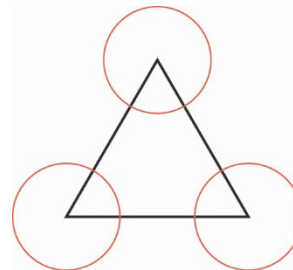


- 2 a 1 : 50 000 b 1 : 500 000
c 3 : 200 000
- 3 a i 135 km ii 75 km iii 145 km
b 3 hours 40 minutes
c Roads aren't straight, so the actual distance travelled will be greater.
- 4 a i 40 J ii 30 J iii 10 J
b i, ii

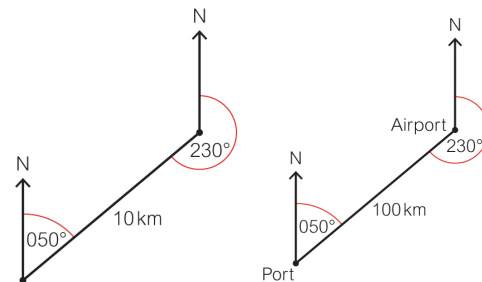


- 5 a 1 cm to 20 m b 8000 m² c 600 m²
d £40 500

- 6 a Students' own accurate scale drawing made using an appropriate scale
b 40 m² c 160 d £800
- 7 a 105° b 105° c 35°
d All angles are the same and all sides are the same.
- 8 a 8 cm b 4.5 cm c 85° d 5 cm
e 45° f 85°
- 9 a 5 cm b 15 cm
- 10 Memmingen
- 11 a



- b No
- 12 a Bearing back to port is 230°
b Bearing back to airport is 050°

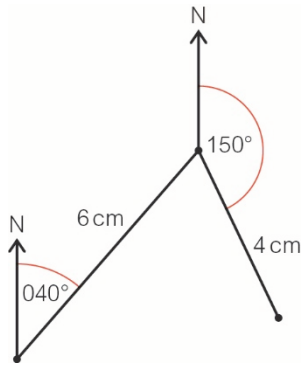


- 13 $x = 6$ cm, $y = 12.5$ cm
- 14 Angle B = Angle D
Angle BAC = Angle ACD – alternate angles
Angle DAC = Angle BCA – alternate angles
Side AD = Side BC
AAA and a side the same – must be congruent
- 15 OC is a side of both triangles.
Side OB = OA as both radii so triangle ABO is an isosceles triangle.
Angle OBC = Angle OAC
Angle BOC = Angle AOC
As all angles are the same and two pairs of sides are the same, must be congruent.

8 Unit test

- 1 a 095° b 150° c Kalimnos
- 2 a 100 m b 250 m c 12.5 m
- 3 a 3 cm b 8 cm c 20 cm d 0.2 cm
- 4 a 1000 m b 325 m

5 a



b 30 km c 260°

6 a $a = 80^\circ$, $b = 6$ cm, $c = 8$ cm, $d = 80^\circ$,
 $e = 6$ cm, $f = 35^\circ$, $g = 80^\circ$

b 6 cm side is between angles of 35° and 80° in A, B and C.

7 a $a = 5$ cm b $b = 12.8$ cm
c $c = 12.5$ cm

8 a $a = 7$ cm
b $b = 9$ cm, $c = 12$ cm
c $d = 15$ cm, $e = 24$ cm, $f = 21$ cm

9 a Angle ACE is the same in both triangles.
Angle BDC = Angle AEC – corresponding angles
Angle DBC = Angle EAC – corresponding angles
As the angles are the same the triangles are similar.

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

10 Triangle SXT and triangle VXU are congruent.
Angle SXT = Angle VXU – vertically opposite
Angle TSU = Angle SUV alternate angles
Angle STV = Angle TVU alternate angles
Side ST = VU
AAA and side equal, so must be congruent.
Triangle SXV and triangle TXU are congruent.
Angle SXV = Angle TXU – vertically opposite
Angle VSU = Angle SUT – alternate angles
Angle VTU = Angle SVT – alternate angles
Side SV = side TU
AAA and side equal so must be congruent.

Unit 9 Accuracy and measures

9.1 Rates of change

- 1 a 2 mph b 0 mph c 2.5 mph
- 2 a 2 hours and 15 minutes
b 45 minutes
c 1 hour and 30 minutes
d 3 hours and 12 minutes
- 3 a 40 km/h b 6.25 m/s c 550 mph
d 1.25 m/s
- 4 0.25 s
- 5 a 0.075 hours
b 4 minutes and 30 seconds
- 6 40 minutes
- 7 The latest time Johanna should leave is approximately 11.20 am.
(Allow 11.20–11.22 am.)
- 8 19 minutes (nearest minute)
- 9 12.5 m/s
- 10 324 km/h
- 11 No. For example: average speed of athlete = 10.2 m/s (1 d.p.) = 36.7 km/h (1 d.p.). This is faster than Amir's remote-controlled car.
- 12 a C b A c 8.3 mph (1 d.p.)

9.2 Density and pressure

- 1 648 cm³
- 2 a 400 mm² b 0.06 m² c 300 000 cm³
d 750 cm³
- 3 a $x = \frac{y}{10}$ b $x = 2 - 3y$
c $x = \frac{5}{y}$ d $x = 2y - 1$
- 4 Titanium: 4.5 g/cm³ Zinc: 7.1 g/cm³
Silver: 10.5 g/cm³ Tin: 7.3 g/cm³
- 5 a 0.0060 m³ (3 d.p.) b 10 166 kg
c 0.042 kg (3 d.p.) d 8.9 cm³ (1 d.p.)
- 6 0.92 g/cm³
- 7 486 kg
- 8 10.4 g/cm³
- 9 13.5 g/cm³
- 10 5.4 N/cm² (1 d.p.)
- 11 3136 N
- 12 13 N
- 13 1.76 m²

- 14 a A and C will float in water.
b A, C and D will float in mercury.

9.3 Upper and lower bounds

- 1 a 300 b 250 c 253.1 d 253.10
- 2 4.17 m, 4.22 m, 4.209 m
- 3 a 10.5 km, 11.5 km b 26.5 days, 27.5 days
c 56.65 g, 56.75 g d 295 m, 305 m
- 4 65 499, 64 500,
- 5 a 0.646 p/ml (3 d.p.) b 0.634 p/ml (3 d.p.)
- 6 $0.255 \leq t < 0.265$
- 7 1 decimal place (or nearest tenth of a second).

8

Measurement	Degree of accuracy	Actual value
6.3 seconds	1 decimal place	6.3 ± 0.05 seconds
5800 m	nearest 100 m	5800 ± 50 m
0.09 km	2 decimal places	0.09 ± 0.005 km
8.0 kg	1 decimal place	8.0 ± 0.05 kg

- 9 120 ± 5
- 10 1.25 g
- 11 a 175 cm, 185 cm b 1400 cm, 1480 cm
c 40 cm

9 Check up Rates of change

- 1 a 20 km/h b 0 c 40 km/h
- 2 37.5 mph
- 3 6 hours
- 4 10 m/s
- 5 43.2 km/h
- 6 $12 \text{ km} = 12 \div 8 \times 5 = 7.5$ miles. At a speed of 50 mph this would take $7.5 \div 50 = 0.15$ hours = 9 minutes. So yes, Duhr does stay within the speed limit.

Density and pressure

- 7 a 72 cm³ b 1.39 kg (2 d.p.)
- 8 3.8 g/cm³
- 9 1500 N/m²
- 10 14.9 g/cm³

Upper and lower bounds

- 11 59.5 g, 60.5 g
 12 $19.5 \text{ m} \leq \text{height} < 20.5 \text{ m}$
 13 $11.9 \pm 0.05 \text{ cm}$
 14 Lower bound 3.145 mm, upper bound 3.155 mm
 15 a $105 \text{ cm} \leq \text{length} < 115 \text{ cm}$
 b $525 \text{ cm} \leq \text{height} < 575 \text{ cm}$ c 25 cm

**9 Strengthen
Rates of change**

- 1 a 3 mph b 72 mph c 3 mph
 2 8 minutes and 20 seconds
 3 2 hours and 30 minutes
 4 80 km/h
 5 28 800 km/h

Density and pressure

- 1 a 6980 kg/m^3 b 21.4 g/cm^3
 2 10 800 kg
 3 $11\,300 \text{ kg/m}^3$
 4 5.2 N/cm^2
 5 8 cm^2
 6 0.00679 m^3

Upper and lower bounds

- 1 86 499 and 85 500
 2 a True. The upper bound is 3.5 litres
 b False. The upper bound is 3.5 litres
 c True
 3 a 134.5 m, 135.5 m
 b 4.535 billion years, 4.545 billion years
 c 65 mph, 75 mph d 3.75 days, 3.85 days
 4 64.05 million, 64.15 million
 5 Actual capacity = $250 \pm 5 \text{ ml}$

Enrichment

- 1 a Tin b Aluminium
 c Magnesium
 2 a 196 N b 74 N

9 Extend

- 1 $115 \pm 15 \text{ yards}$, $75 \text{ yards} \pm 25 \text{ yards}$
 2 Nearest 100 kg
 3 No. For example, the oven temperature could be 177.495°C .
 4 58.2 seconds (1 d.p.)

- 5 Approximately 17 minutes
 6 1.4 g/cm^3
 7 3.6 km/h
 8 223 seconds, or 3 minutes and 43 seconds (nearest second)
 9 Iron bar has a volume of $4200 \div 7.9 = 532 \text{ cm}^3 = 532 \text{ ml}$. Remaining capacity in measuring flask is 550 ml. The flask will not overflow.

- 10 a 49.5 b 50.5
 11 a 612 000 kg b 5 997 600 N
 c $666\,400 \text{ N/m}^2$ d $249\,900 \text{ N/m}^2$

- 12 No. $1500 \times 10.5 = 15750 < 15800$

- 13 He is incorrect. The pressure would double.

- 14 Students' own answers. For example, if the mass of each box is out by 0.5 kg then the total mass of many boxes could be out by a lot more.

- 15 a $500 \pm 5 \text{ g}$
 b $4000 \pm 40 \text{ g}$ (or just 40 g)
 c $62.5 \pm 0.625 \text{ g}$ (or just 0.625 g)

- 16 a 0.00504 m^3 b 5950 kg/m^3

- 17 1176 N/m^2

- 18 0.25 m

9 Unit test

- 1 a 52.5 g b 51.5 g
 2 $395 \text{ g} \leq \text{weight} < 405 \text{ g}$
 3 51 ± 5
 4 7.5 mph
 5 2 hours and 30 minutes
 6 18 km/h
 7 6.4 g/cm^3
 8 $19\,000 \text{ N/cm}^2$
 9 210 cm
 10 1 ml

Unit 10 Graphical solutions

10.1 Drawing straight-line graphs

- 1 **A** a 1 b (0, -4) c $y = x - 4$
B a -2 b (0, 3) c $y = -2x + 3$
C a 3 b (0, 0) c $y = 3x$
- 2 a 0 b 0
 c i The y -intercept of a graph has x -coordinate of 0.
 ii The x -intercept of a graph has y -coordinate of 0.
- 3 Students' graphs of:
 a $y = 2x + 3$ (goes through (0, 3) and (2, 7))
 b $y = 2x - 2$ (goes through (0, -2) and (2, 2))
 c $y = 3x$ (goes through (0, 0) and (3, 9))
 d $y = \frac{1}{2}x + 1$ (goes through (0, 1) and (6, 4))
 e $y = -2x + 1$ (goes through (0, 1) and (2, -3))
 f $y = -3x + 4$ (goes through (0, 4) and (2, -2))
- 4 A, E
- 5 a Any equation of the form $y = 3x + \underline{\hspace{1cm}}$
 b Any equation of the form $y = -2x + \underline{\hspace{1cm}}$
 c $y = 3x + 4$
 d $y = -2x - 5$
- 6 a A and D B and F C and E
 b A, B and E at (0, 3); C and F at (0, -3)
- 7 a
- | | | |
|-----|---------------|---|
| x | 0 | 2 |
| y | $\frac{3}{2}$ | 0 |
- b Students' graphs of $3x + 4y = 6$
- 8 a Students' graphs of $2x - y = -4$
 b Students' graphs of $3x - y = 4$
 c Students' graphs of $y + 3x = 1$
 d Students' graphs of $2y - x = 2$
 e Students' graphs of $x - y = 3$
 f Students' graphs of $x + y = 5$

10.2 Graphs of quadratic functions

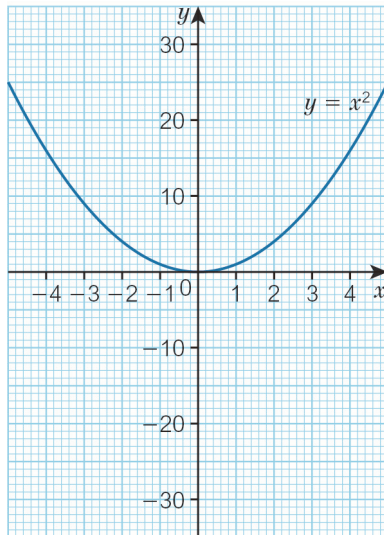
1

x	-4	-3	-2	-1	0	1	2	3	4
y	16	9	4	1	0	1	4	9	16

2 a 32 b 18 c 2

3 a 11 b -1 c -5

4 a

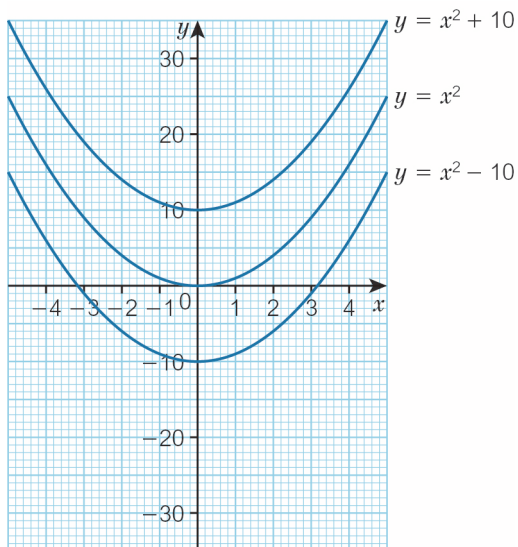


b The y -axis is a line of symmetry.

5 a

x	-4	-3	-2	-1	0	1	2	3	4
y	26	19	14	11	10	11	14	19	26

b, e

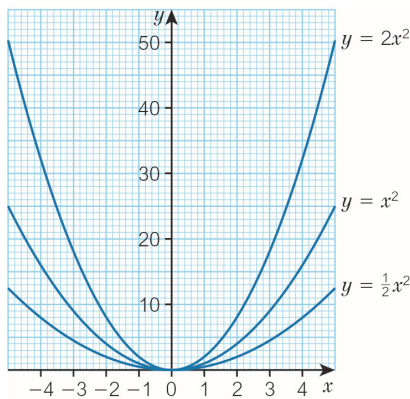


c Similarities: line of symmetry, shape

d Differences: cross y -axis at different points

e Crosses y -axis at $y = -10$

6 a, c



b

x	-4	-3	-2	-1	0	1	2	3	4
y	32	18	8	2	0	2	8	18	32

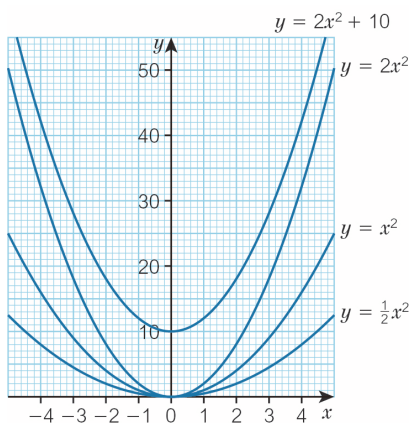
d Similarities: all graphs pass through $(0, 0)$; line of symmetry is y -axis

e Differences: $y = x^2$ is stretched vertically to give $y = 2x^2$ and flattened vertically to give $y = \frac{1}{2}x^2$

7 a

x	-4	-3	-2	-1	0	1	2	3	4
$2x^2$	32	18	8	2	0	2	8	18	32
+ 10	+ 10	+ 10	+ 10	+ 10	+ 10	+ 10	+ 10	+ 10	+ 10
y	42	28	18	12	10	12	18	28	42

b



c Moves / translates +10 vertically.

d Stretches $y = x^2$ vertically and shifts +10 vertically.

- 8 $y = x^2$ minimum at $(0, 0)$
 $y = x^2 + 10$ minimum at $(0, 10)$
 $y = x^2 - 10$ minimum at $(0, -10)$
 $y = 2x^2$ minimum at $(0, 0)$
 $y = 2x^2 + 10$ minimum at $(0, 10)$
 $y = 3x^2$ minimum at $(0, 0)$
 $y = \frac{1}{2}x^2$ minimum at $(0, 0)$
 $y = -x^2$ maximum at $(0, 0)$
 $y = -2x^2$ maximum at $(0, 0)$
 $y = -3x^2$ maximum at $(0, 0)$

- 9 A: ii $y = -x^2 + 10$ B: iv $y = 2x^2 - 10$
 C: i $y = x^2$ D: vi $y = -2x^2$
 E: v $y = -x^2$ F: iii $y = 2x^2$

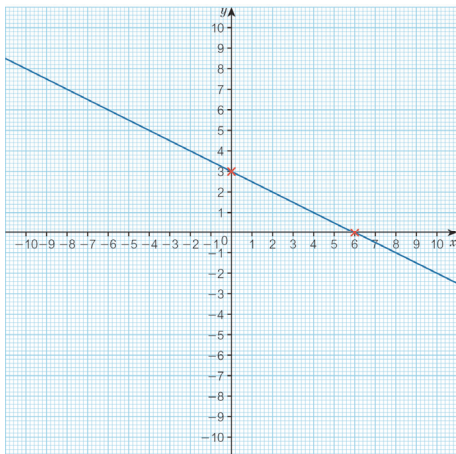
- 10 a Maximum height of ball launched at 45° is
 20 ft (from graph; actual coordinates are
 (39, 19.5))
 b 7 ft or 40.5 ft
 c 9 ft
 d 35.5 ft (from the 19° launch graph)

10.3 Simultaneous equations

- 1 a $3x + y = 75$ b $2x + 2y = 44$ c $3x + 2y = 10.49$
 2 a $x = 15$ b $x = 22.5$ c $y = -3$ d $y = -\frac{1}{5}$
 3 a $x = 3, y = 6$ b $x = 7.5, y = 22.5$ c $x = 4.25, y = 8.5$ d $x = 8.8, y = 4.4$
 e $x = \frac{16}{3}, y = \frac{64}{3}$
 4 a \$0.70 b \$3.50
 5 a 36 b 18
 6 a \$3.50 b \$7
 7 43 programmes 86 ice creams
 8 a $x = 4, y = 1$ b $x = 4, y = 8$ c $x = 8, y = 13$
 d $x = 1.5, y = 3.5$ e $x = 8, y = 1.5$ f $x = 5, y = 2$
 9 a 5 mph b 1.5 mph
 10 a $a + b = 19, a - b = 7$ b $a = 13, b = 6$
 11 a $x = 6, y = 3$ b $x = 7, y = 3$ c $x = 4, y = 6$ d $x = 5, y = 1$
 12 a \$1.50 b \$12 c \$15
 13 1 child = \$3 1 adult = \$7.50

10.4 Using $y = mx + c$

- 1 $x + 2y = 6$

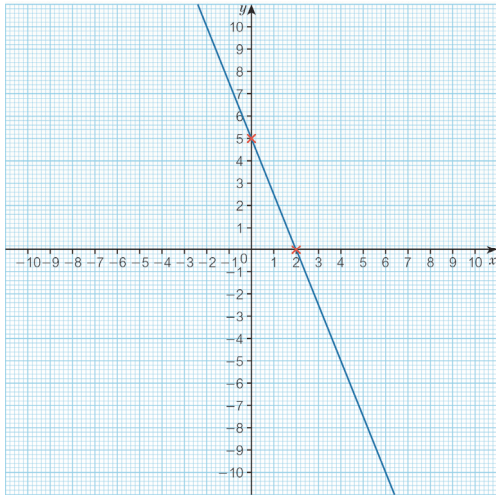


- 2 a A and F, B and D, C and E
 b C and D, B and F

3 a $x = y + 9$ b $x = \frac{y}{5}$ c $x = 3y$ d $x = -\frac{4y}{3}$

e $x = \frac{5(8-y)}{2}$ f $x = \frac{y+6}{2}$

4 a $5x + 2y = 10$



b Gradient = $-\frac{5}{2}$, y-intercept = (0, 5) c $y = -\frac{5}{2}x + 5$

d $y = -\frac{5}{2}x + 5$. It's the same as part c.

5 B and E, A and C

6 a i $y = 4x + 9$ ii $y = \frac{7}{2}x + \frac{3}{2}$ iii $y = -\frac{11}{3}x + 3$ iv $y = -8x + 10$

b The line in part iv has the steepest gradient.

7 a Yes b No c Yes d Yes

8 a Parallel b Not parallel c Not parallel d Parallel e Not parallel

9 B, E

10 a $y = 3x - 2$ b $y = -4x + 3$ c $y = 2x$

11 $y = 2x - 4$

12 $y = x - 5$

13 a 4 b (4, 9)

14 a (2, 60) and (5, 99) b $P = 13h + 34$ c Cost per hour d Initial call out fee

15 a $V = -1300a + 20\,500$ b \$20 500

10.5 More simultaneous equations

1 a $x = 3, y = 3$ b $x = 2, y = 8$

2 a $4x + 6y = 12$ b $6x + 9y = 18$ c $-4x - 6y = -12$

3 a 2 b 7 c $x = 6, y = 11$

4 a $x = 7, y = 4$ b $x = 3, y = 9$ c $x = 2, y = 5$ d $x = 8, y = 1$

5 a $5x + y = 117$ b $x + 3y = 43$ c i \$22 ii \$7

6 a \$3 b \$1.50

7 a 6 hours b 8 hours

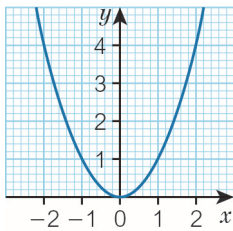
- 8 a $x = 2, y = 5$ b $x = 8, y = 6$ c $x = 3, y = 7$ d $x = 1, y = 11$
 9 Manager = \$35 000 Staff = \$21 500
 10 a 9 calories b 6 calories
 11 Company A = \$2.43 Company B = \$5.61

10.6 Graphs and simultaneous equations

1 a

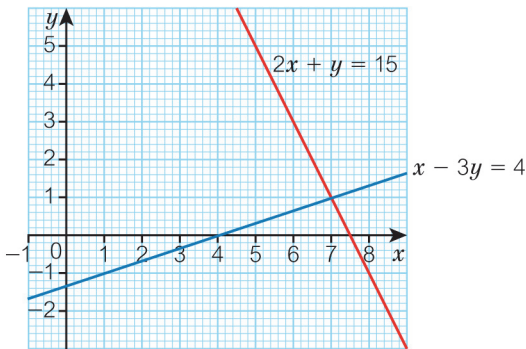
x	-2	-1	0	1	2
y	4	1	0	1	4

b



- 2 a $x = -4, x = -2$ b $x = 6, x = -3$

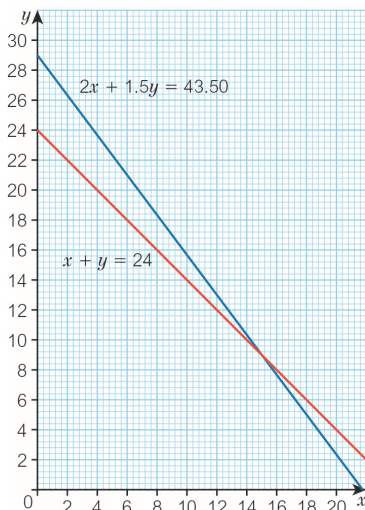
3 a



b (7, 1)

- 4 a $x = 4, y = 4$ b $x = 5, y = 4$
 5 a $x + y = 24$ b $2x + 1.5y = 43.50$

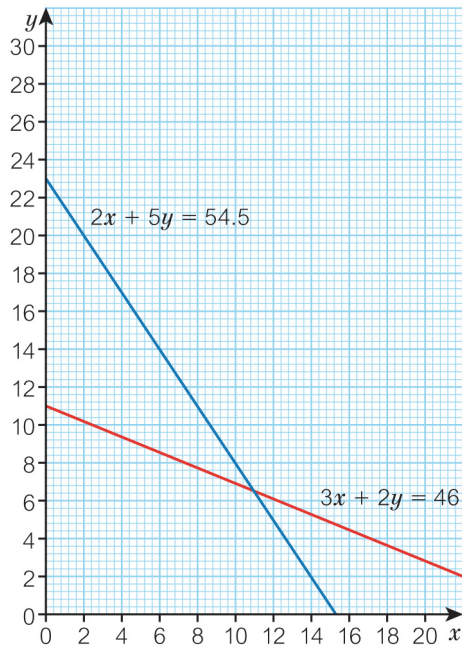
c



d 15 hardbacks, 9 paperbacks

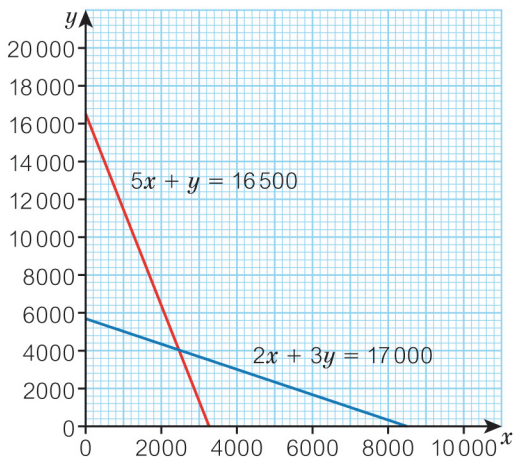
6 a $3x + 2y = 46$ and $2x + 5y = 54.50$

b



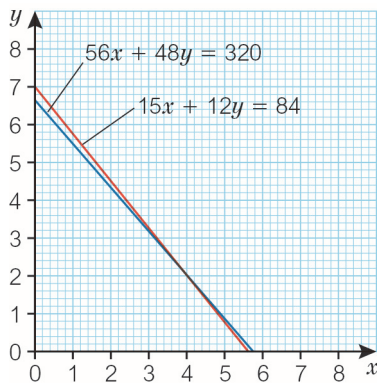
c Adults cost \$11, children cost \$6.50.

7 a



b 20-second = \$2500, 30-second = \$4000

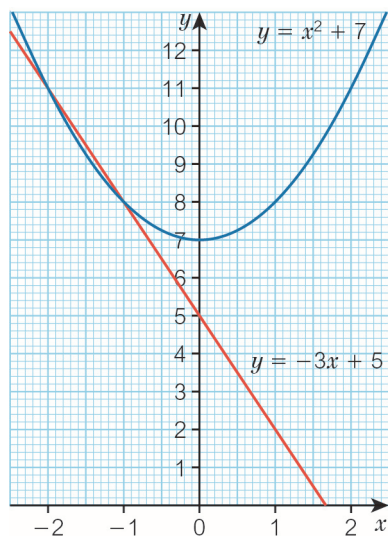
8 a



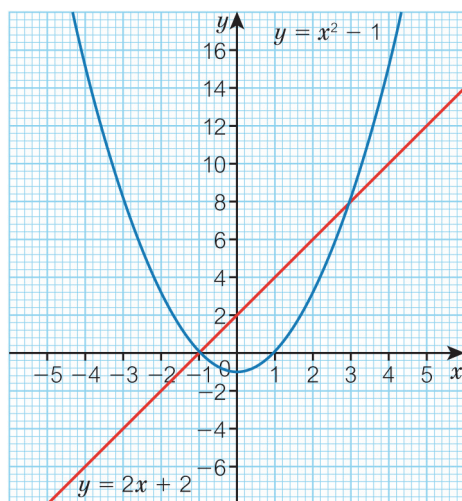
b A burger costs \$4, a drink costs \$2

9 $x = 0, y = 1$ and $x = -2, y = 5$

10 a i



ii



b i $x = -2, y = 11$ and $x = -1, y = 8$

ii $x = -1, y = 0$ and $x = 3, y = 8$

11 a $x = 6, y = 30$ and $x = -1, y = -5$

b $x = 1, y = -4$ and $x = -5, y = 20$

c $x = -2, y = 4$ and $x = 4, y = 16$

d $x = 4, y = 8$ and $x = -2, y = -4$

12 Students' own answers. There will be no points of intersection on the graphs.

13 a Any equation $y = a$ where a is less than 2
(or various other more complicated options)

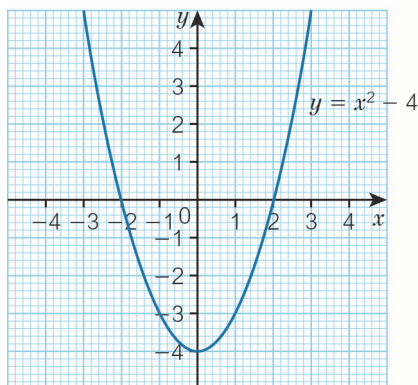
b Student solutions solving $y = x^2 + 2$ and equation used in part a student answer, as simultaneous equations.

10 Check up
Quadratic graphs

1 a

x	-3	-2	-1	0	1	2	3
y	5	0	-3	-4	-3	0	5

b



2 a y-axis is the line of symmetry

b (0, -5), minimum

Simultaneous equations

3 $x = 9, y = 27$

4 a $5x + y = 31.50, y = 2x$

b Child price = \$4.50, adult price = \$9.00

5 a $x + y = 21 \quad x - y = 7$

b $x = 14, y = 7$

6 $x = 3, y = 1$

7 $x = 5, y = 2$

Straight-line graphs

8 a i $y = 3x - 7$ ii $y = -\frac{3}{2}x + 3$ iii $y = -\frac{1}{6}x + \frac{5}{3}$

b i Gradient = 3 y-intercept = (0, -7)

ii Gradient = $-\frac{3}{2}$ y-intercept = (0, 3)

iii Gradient = $-\frac{1}{6}$ y-intercept = $(\frac{10}{3}, \frac{5}{3})$

9 a Parallel b Not parallel c Not parallel

10 $x = 2, y = 0$

11 $y = -2x + 13$

12 i B ii C iii D iv A

13 $y = -2x + 3$

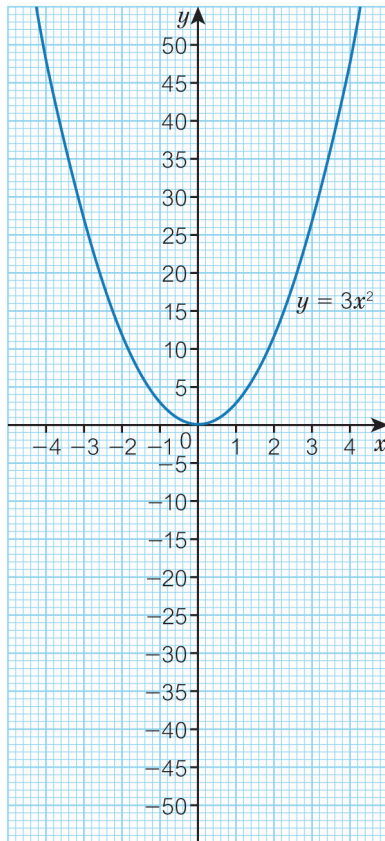
10 Strengthen
Quadratic graphs

1 a

x	-4	-3	-2	-1	0	1	2	3	4
x^2	16	9	4	1	0	1	4	9	16
$y = 3x^2$	48	27	12	3	0	3	12	27	48

b $(-4, 48), (-3, 27), (-2, 12), (-1, 3), (0, 0), (1, 3), (2, 12), (3, 27), (4, 48)$

c



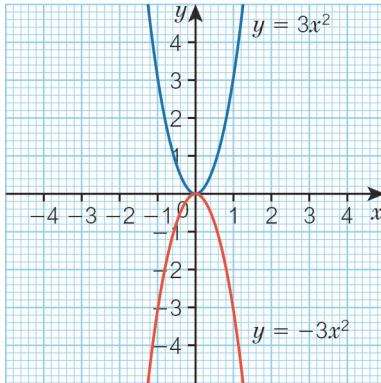
d $(0, 0)$

e Minimum

2 a

x	-4	-3	-2	-1	0	1	2	3	4
$3x^2$	48	27	12	3	0	3	12	27	48
$y = -3x^2$	-48	-27	-12	-3	0	-3	-12	-27	-48

b



c (0, 0) d Reflection in the x -axis

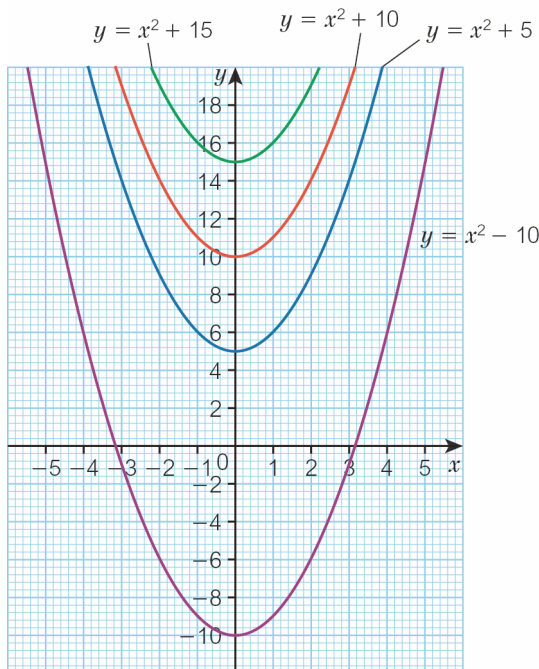
3 a i $y = 1$ ii $y = 2$ iii $y = 4$

b A: ii $y = 2x^2$ B: i $y = x^2$ C: iii $y = 4x^2$

4 a

x	-4	-3	-2	-1	0	1	2	3	4
x^2	16	9	4	1	0	1	4	9	16
$y = x^2 + 5$	21	14	9	6	5	6	9	14	21

b, e



c i (0, 5) ii When $x = 0$, $y = 5$

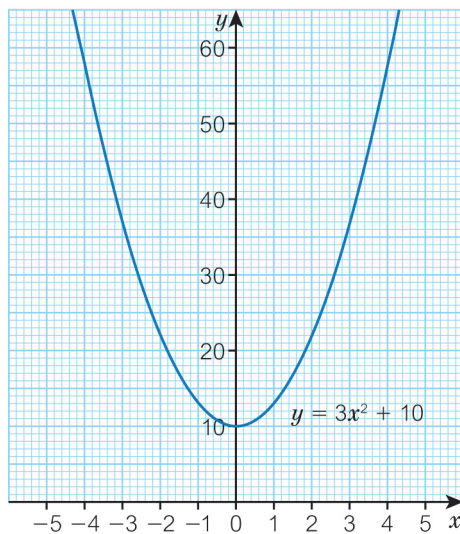
d i (0, 10) ii (0, 15) iii (0, -10)

f Translate $y = x^2 + 10$ up 5 units

g i Translate $y = x^2 + 5$ up 10 units

ii Translate $y = x^2 + 5$ down 15 units

5 a



- b i (0, 10) ii When $x = 0$, $y = 10$
 c i (0, 15) ii (0, -10)

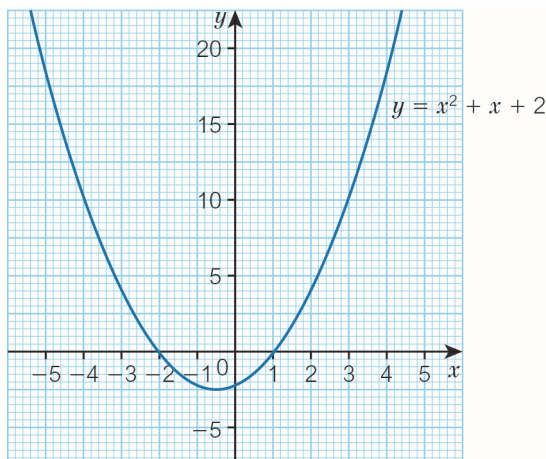
- 6 A: iii $y = -3x^2$
 B: i $y = x^2$
 C: iv $y = x^2 + 5$
 D: ii $y = 3x^2 + 10$

- 7 a i (4, 80) ii The arrow is at its highest point.
 b 8 seconds
 c i $t = 2$
 ii LHS = 60
 RHS = $40 \times 2 - 5 \times 2^2 = 80 - 20 = 60$
 d $t = 6$

8 a

x	-4	-3	-2	-1	0	1	2	3	4
x^2	16	9	4	1	0	1	4	9	16
$y = x^2 + x - 2$	10	4	0	-2	-2	0	4	10	18

b



- c The graph crosses the x -axis at $x = -2$ and $x = 1$
 d $(x + 2)(x - 1)$
 e Expressions in brackets give x -axis intercepts.

Simultaneous equations

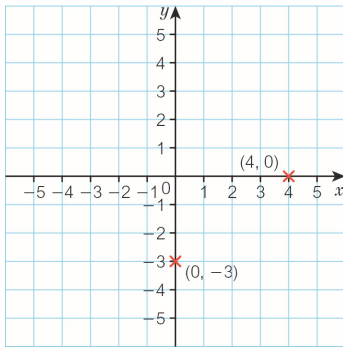
- 1 a $x = 4, y = 8$ b $x = 5, y = 20$
 c $x = 24, y = 6$ d $x = 9, y = 1.25$
- 2 a $x + 5y = 28$ b $x = 3y$
 c Adults = \$10.50, children = \$3.50
- 3 Adult = \$18, child = \$9
- 4 a $11x = 55$ b It is eliminated.
 c $x = 5$ d $y = 9$
- 5 a $x = 5, y = 4$ b $x = 7, y = 9$
- 6 a $x + y = 46, x - y = 20$
 b $x = 33, y = 13$
- 7 a $2x = 16$ b It is eliminated.
 c $x = 8$ d $y = 9$
- 8 a $x = 2, y = 1$ b $x = 2, y = 2$
- 9 a $x = 5, y = 8$ b $x = -2, y = 6$
 c $x = 5, y = 1$
- 10 Flat fee = \$55 Hourly rate = \$23/hr
- 11 a $x = 4, y = 1$ b $x = 4, y = 1$
- 12 a $x = 3, y = 10$ b $x = 1, y = 1$
 c $x = 3, y = 6$
- 13 Crate = 4.5 kg Box = 2.3 kg

Straight-line graphs

- 1 a $y = 4x + 5$ b $y = 3x + 7$
 c $y = 2x + 9$
- 2 a i $y = 3x + 4$
 b i Gradient = 3, y -intercept = (0, 4)
- a ii $y = -\frac{7}{2}x + \frac{5}{2}$
- b ii Gradient = $-\frac{7}{2}$, y -intercept = (0, $\frac{5}{2}$)
- a iii $y = -\frac{2}{7}x + \frac{5}{7}$
- b iii Gradient = $-\frac{2}{7}$, y -intercept = (0, $\frac{5}{7}$)
- a iv $y = \frac{5}{3}x + \frac{7}{3}$
- b iv Gradient = $\frac{5}{3}$, y -intercept = (0, $\frac{7}{3}$)
- a v $y = 4x + 6$
- b v Gradient = 4, y -intercept = (0, 6)

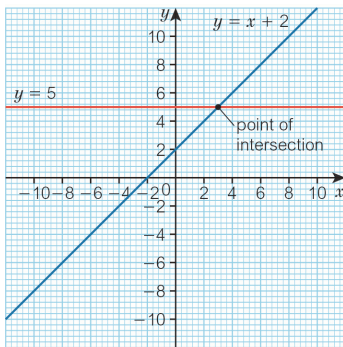
- 3 a $x = 4$ b $(4, 0)$ c $y = -3$ d $(0, -3)$

e



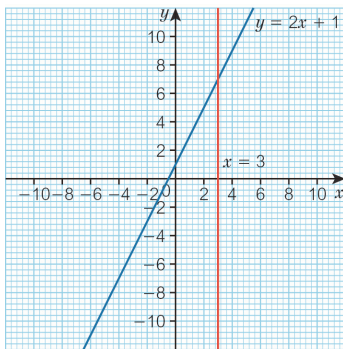
f A straight line passing through the points marked in part e.

- 4 a, b, c

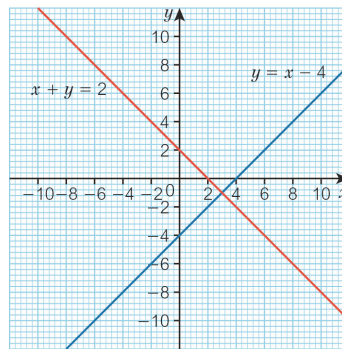


d $(3, 5)$

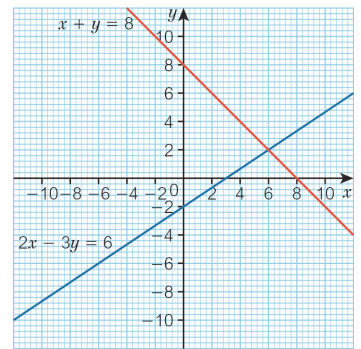
- 5 a



- b



- c



- 6 B and D

- 7 a, b

With y -intercept $(0, 1)$

$y = \frac{1}{2}x + 1$ gradient $\frac{1}{2}$ ✓

$y = 2x + 1$ gradient 2 ✓

With y -intercept $(0, -1)$

$y = -x - 1$ gradient -1 ✓

$y = 2x - 1$ gradient 2 ✓

- c i C ii B iii A iv D

- 8 Entrance fee = \$7 Fee per ride = \$0.45

- 9 a $x = 1, y = 3$ $3 = m + c$ (1)

b $15 = 7m + c$ (2)

c $m = 2, c = 1$

d $y = 2x + 1$

10 a $y = 4x - 7$

b $y = -3x + 19$

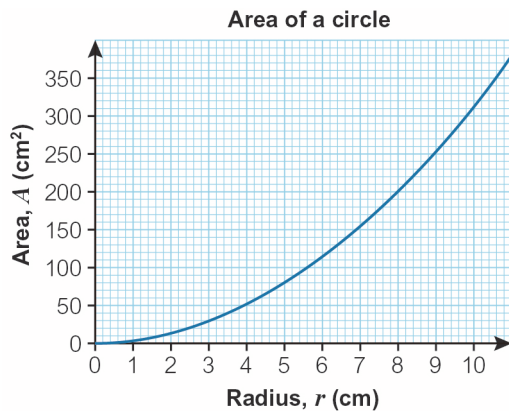
11 $C = 0.18u + 5$

10 Extend

1 a

Radius, r cm	0	2	4	6	8	10
Area, A cm ²	0	12.56	50.24	113.04	200.96	314

b



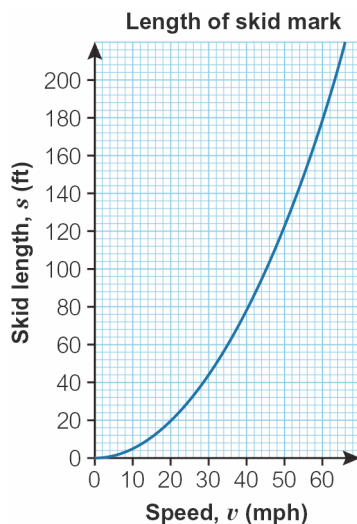
c i Area ≈ 150 cm²

ii Radius ≈ 5.6 cm

2 a

Speed, v (mph)	0	10	20	30	40	50	60
Skid, s (ft)	0	5	20	45	80	125	180

b



c i 45 mph

d i 90 ft ii 185 ft

3 a $x = -4, y = 8$

b $x = -4, y = 4$

4 $y = \frac{-7}{2}x - \frac{57}{2}$

5 a $2x + 2y = 20$ so $x + y = 10$ Divide all parts by 2.

b $3x + 3y = 30$

c $2x = 14$

d $x = 7, y = 3$

e $x = 11, y = 1$

6 a $x + 9y = 343$

b $x + 6y = 235$

c \$36

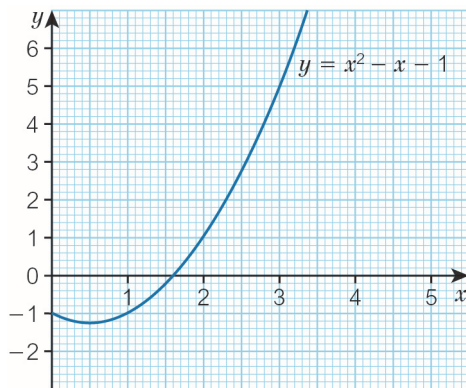
d \$19

- 7 a Translation 10 units up.
 b Reflection in the x -axis.
 c i Translation 5 units down.
 ii Reflection in the x -axis.

8 a

x	0	0.5	1	1.5	2	2.5	3
y	-1	-1.25	-1	-0.25	1	2.75	5

b

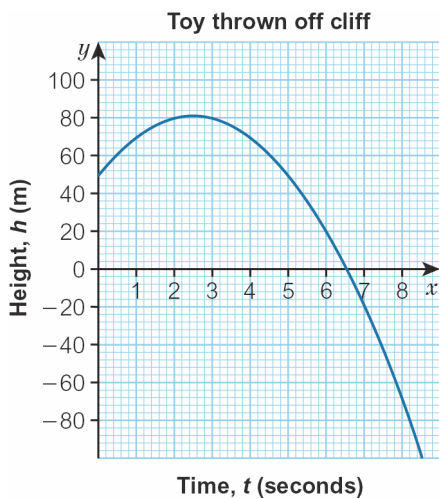


c 1.25 m

9 a

Time, t (seconds)	0	1	2	3	4	5	6	7	8
Height, h (m)	50	70	80	80	70	50	20	-20	-70

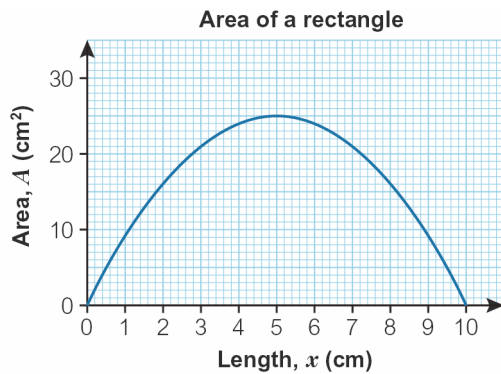
b



- c i Maximum height ≈ 81 m
 ii Time to reach ground ≈ 6.5 seconds

10 a $A = x(10 - x)$ or $A = 10x - x^2$

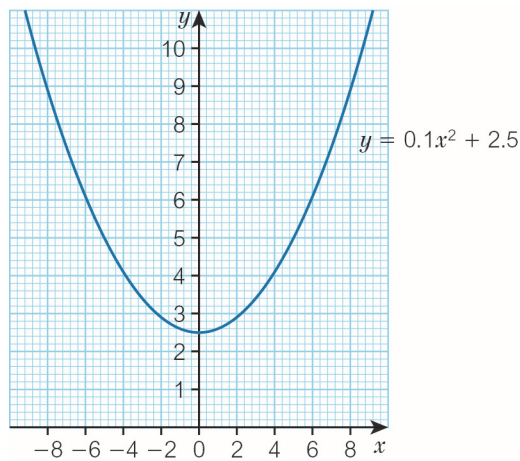
b



c i Maximum possible area = 25 cm^2

ii Dimensions $\approx 8.2 \text{ cm}$ by 1.8 cm

11 a



b 6.4 cm ($9 - 2.6$)

c i-iii Students' own answers.

iv 2.5 cm

d 8.9 cm ($2.5 + 6.4$)

12 a $x = 4, y = 3$

b $x = 2, y = 2$

13 $x = 15, y = 4$

14 a $x = 6, y = 2$

b $x = 5, y = 9$

c $x = 3, y = 7$

d $x = 0, y = -4$

15 a $3x + 2y = 70, 5x + 3y = 113.50$

b Adults = \$17, children = \$9.50

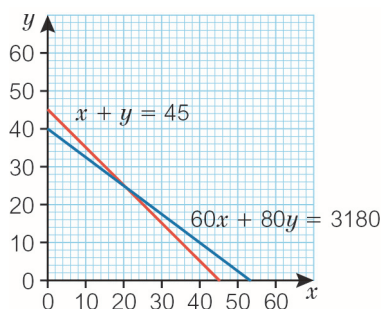
c \$81.50

16 Texts = 7 cents, calls = 11 cents

17 a $x + y = 45$

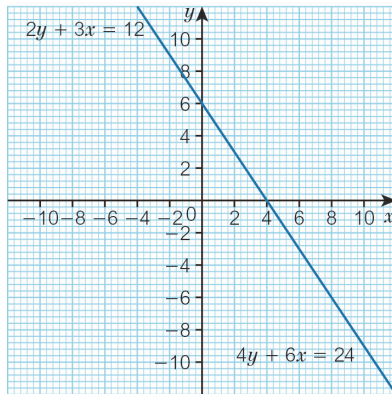
b $60x + 80y = 3180$

c

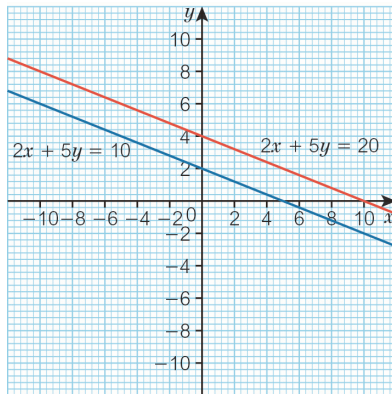


d 21 water, 24 fizzy drinks

18 a



b



19 a $x = -4, y = -7$ b $x = 2, y = 3$ c Infinitely many solutions d No solutions e $x = 0, y = -3$

20 a $x = 4, y = 6$ b $x = 16.8, y = 9.8$

21 a i $x + y = 65, x = 4y$ ii $x + y = 8, x - y = 20$ iii $x + y = 51, x = y + 19$

b i $x = 52, y = 13$ ii $x = 14, y = -6$ iii $x = 35, y = 16$

22 A = \$65, B = \$38

23 a $x = 3, y = 5$ b $x = 5.6, y = 7.6$ c $x = 14, y = 7$

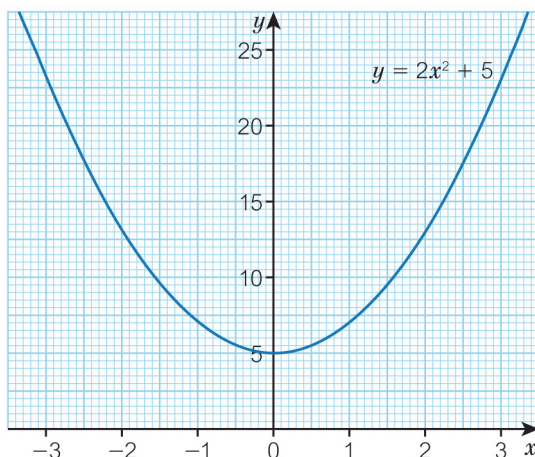
24 a $(x - 1)(x - 7)$ b (1, 0) and (7, 0)

10 Unit test

1 a

x	-3	-2	-1	0	1	2	3
y	23	13	7	5	7	13	23

b



2 a $y = 2x + 11$ b $y = -\frac{1}{2}x + 7$

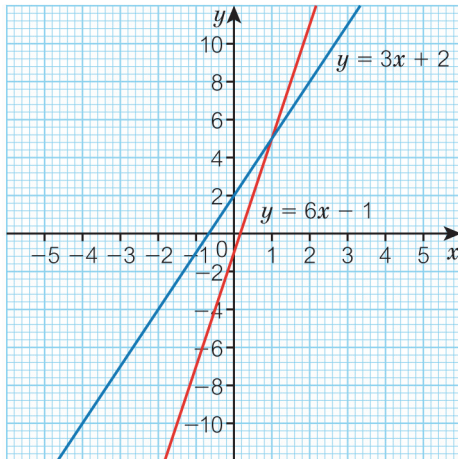
3 a i 3 ii $\frac{1}{4}$

b i (0, 7) ii (0, -1)

4 a $x = 4, y = 12$ b $x = 10, y = 5$

5 $x = 7.5, y = 1.5$

6



Point of intersection is (1, 5).

7 a $x = 12, y = 4$ b $x = 6, y = 7$

8 $y = 3x - 6$

9 a i $y = \frac{2}{3}x + 3$

ii $y = \frac{5}{2}x + 6$

iii $y = \frac{2}{3}x + 6$

b i and iii

c ii and iii

10 a y-axis is a line of symmetry.

b (0, 10)

c Maximum

11 a A b D c A, C

12 a $x = 3, y = 9$ b $x = 2, y = 7$

13 a $14x + y = 36$

b $5x + y = 22.50$

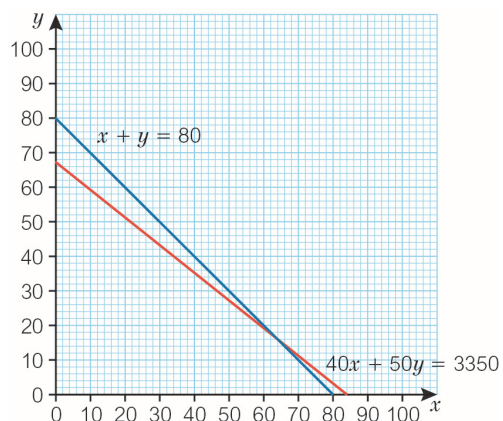
c $x = \$1.50, y = \15

14 a $x = 9, y = 5$ b $x = 3, y = 7$

15 a $x + y = 80$

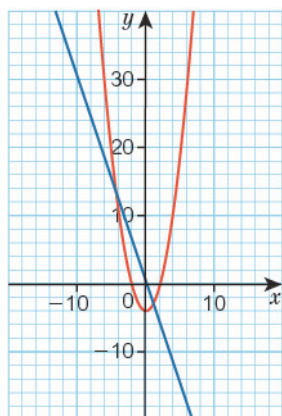
b $40x + 50y = 3350$

c



d 65 bouncy balls, 15 yo-yos

16 a



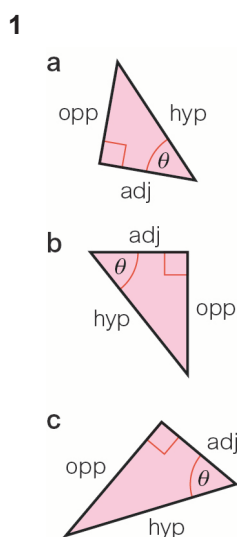
b $x = 1, y = -3$ and $x = -4, y = 12$

Unit 11 Trigonometry

11.1 The tangent ratio

- 1 a 4.6 b 7.0 c 8.5 d 0.5
- 2 a 2 b $0.\dot{1}\dot{8}$ c 1
d $0.\dot{3}0769\dot{2}$
- 3 a $P = 20$ b $P = 6$ c $P = 3T$ d $P = 2$
- 4 a i BC ii EF iii GI iv JK
v MN
b i AB ii DF iii HI iv KL
v NO
c i AC ii DE iii GH iv JL
v MO
- 5 a 0.7 b 1.4 c 3.1
- 6 a $\tan \theta = \frac{5}{8}$ b $\tan \theta = \frac{6}{5}$
c $\tan \theta = \frac{6}{4}$
- 7 a 5.3 b 10.8 c 16.7 d 5.0
- 8 a 16.0 b 3.8 c 12.8 d 15.7
- 9 705 m
- 10 5.0 m

11.2 The sine ratio



- 2 a $H = 15$ b $H = 18$ c $H = \frac{1}{2}$ d $H = 3$
- 3 a 0.7 b 1.0 c 0.3
- 4 a $\sin \theta = \frac{10}{15}$ b $\sin \theta = \frac{23}{32}$
c $\sin \theta = \frac{16}{20}$

- 5 a 7.9 b 14.9 c 14.5 d 3.5
- 6 a 32.4 b 16.1 c 18.5 d 21.5
- 7 28.7 cm
- 8 5.7 m
- 9 $15 + 12.72 + 7.95 = 35.7$ cm
- 10 a i $\tan$ ii $y = 5.5$ cm
b i $\sin$ ii $y = 15.2$ cm
c i $\tan$ ii $y = 2.3$ cm

11.3 The cosine ratio

- 1 a $\tan \theta = \frac{8}{6}$ b $\sin \theta = \frac{8}{10}$
- 2 a $T = 18$ b $T = 12$ c $T = \frac{2}{7}$ d $T = \frac{5}{2}$
- 3 a 0.6 b 0.5 c 0.7 d 0.9
- 4 a $\cos \theta = \frac{4}{7}$ b $\cos \theta = \frac{2}{5}$
- 5 a 9.7 b 21.9 c 11.7 d 2.2
- 6 a 9.4 b 15.3 c 114.5
- 7 13.9 m
- 8 a 16.1 m b 20.4 m
- 9 38.3 km
- 10 a i $\cos$ ii $p = 17.6$ cm
b i $\sin$ ii $p = 7.1$ cm
c i $\tan$ ii $p = 10.9$ cm

11.4 Using trigonometry to find angles

- 1 a $\sin \theta = \frac{8}{17}$ b $\cos \theta = \frac{15}{17}$
c $\tan \theta = \frac{8}{15}$
- 2 a $x = 11.4$ b $y = 31.8$ c $s = 13.3$
- 3 a 72.5 b 64.6 c 65.2
- 4 a 44.4 b 48.6 c 6.9
- 5 a 26.6 b 32.0 c 38.7
- 6 a i 48.6° ii 45.6°
b i 41.4° ii 48.2°
c i 59.7° ii 38.7°
- 7 a 23.6° b 53.1° c 53.1° d 48.6°
e 61.9° f 39.7°
- 8 30°
- 9 059°

- 10 $\theta = \tan^{-1} 1 = 45^\circ$ and $180 - (90 + 45) = 45^\circ$,
so the angles of the triangle are 90° , 45° and 45° .
It is an isosceles right-angled triangle.

11.5 Solving problems using trigonometry

- 1 a 5 cm b 8.5 cm c 4.9 cm d 11.2 cm
2 a 15.6 cm b 7.8 cm c 22.2 cm
3 a $\cos$; $x = 48.2$ b $\tan$; $x = 63.4$
c $\sin$; $x = 47.8$
4 a 112.8 km b 41.0 km
5 33.1 m
6 23.6 cm^2
7 21.8°
8 35.3°

11 Check up Unknown sides

- 1 a z b y c x
2 a $\frac{117}{125}$ b $\frac{44}{125}$ c $\frac{117}{44}$
3 a 10.6 cm b 11.3 cm c 7.2 cm
4 a 28.9 cm b 79.3 cm c 34.9 cm

Unknown angles

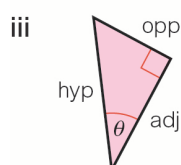
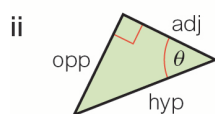
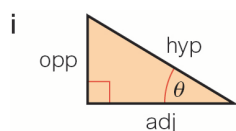
- 5 a 61.9° b 41.8° c 48.2°
6 a 32.0° b 16.6°

Solving problems

- 7 a 5.6 cm b 10.6 cm
8 30.5 cm
9 036.9°

11 Strengthen Unknown sides

- 1 a-c



- 2 a i $\frac{45}{28}$ ii $\frac{55}{48}$ iii $\frac{6}{8}$
b i $\frac{45}{53}$ ii $\frac{55}{73}$ iii $\frac{6}{10}$
c i $\frac{28}{53}$ ii $\frac{48}{73}$ iii $\frac{8}{10}$

- 3 a $\tan 18^\circ = \frac{x}{12}$ b $x = 12 \times \tan 18^\circ$
c $x = 3.9 \text{ cm}$
4 a $\sin 38^\circ = \frac{x}{24}$ b $x = 24 \times \sin 38^\circ$
c $x = 14.8 \text{ cm}$
5 a $\cos 53^\circ = \frac{x}{37}$ b $x = 37 \times \cos 53^\circ$
c $x = 22.3 \text{ cm}$

- 6 a $\sin$ b $\sin 27^\circ = \frac{x}{18}$
c $x = 18 \times \sin 27^\circ$ d $x = 8.2 \text{ cm}$
7 a 22.1 cm b 6.7 cm c 17.3 cm

Unknown angles

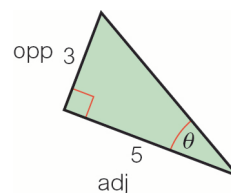
- 1 a 23.6° b 11.5°
2 a 68.0° b 25.8°
3 a 31.0° b 16.7°

- 4 a $\tan \theta = \frac{6}{7}$ b $\theta = \tan^{-1} \frac{6}{7}$
c $\theta = 40.6^\circ$

- 5 a $\sin \theta = \frac{10}{15}$ b $\theta = \sin^{-1} \frac{10}{15}$
c $\theta = 41.8^\circ$

- 6 a $\cos \theta = \frac{6}{18}$ b $\theta = \cos^{-1} \frac{6}{18}$
c $\theta = 70.5^\circ$

- 7 a



- b $\tan$ c $\tan \theta = \frac{3}{5}$
d $\theta = \tan^{-1} \frac{3}{5}$ e $\theta = 31.0^\circ$

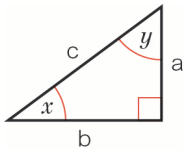
- 8 a $\theta = 53.1^\circ$ b $\theta = 60.9^\circ$
c $\theta = 25.4^\circ$

Solving problems

- 1 a $\sin$ b $h = 15.0$ m
2 033.7°
3 6.8 cm

Enrichment

- 1 a i $x = 17.5^\circ$ $y = 72.5^\circ$
ii $x = 36.9^\circ$ $y = 53.1^\circ$
iii $x = 53.1^\circ$ $y = 36.9^\circ$
iv $x = 64.2^\circ$ $y = 25.8^\circ$
b $x + y = 90^\circ$ in each triangle. This is because the two angles must sum to $180 - 90 = 90^\circ$ in the right-angled triangle. Furthermore,
 $\cos x = \frac{b}{c}$ and $\sin y = \frac{b}{c}$ so $\cos x = \sin y$ (that is, they are the same for the different non-right-angles in the right-angled triangle).



11 Extend

- 1 a 5.5 cm b 13.2 cm c 12.4 cm d 4.7 cm
e 9.4 cm f 25.6 cm
2 a $\theta = 41.4^\circ$ b $\theta = 35.8^\circ$ c $\theta = 31.2^\circ$
3 2.75 m
4 8.6°
5 a 72.5° b 66.4°
6 058.8°
7 067.1°
8 a 36.8 km b 17.2 km
9 $90^\circ, 53.1^\circ, 36.9^\circ$
10 $h = 26.6$ m
11 a 24.8° b 36.9° c 118.3°
12 39.2°
13 a 29.0 m b 6.1°
14 a 9.9 cm b 35.3° c 12.1 cm
15 a 8.5 cm b 49.7° c 6.6 cm
16 Speed = 11.2 m/s or speed = 40.4 km/h
17 216 miles

11 Unit test

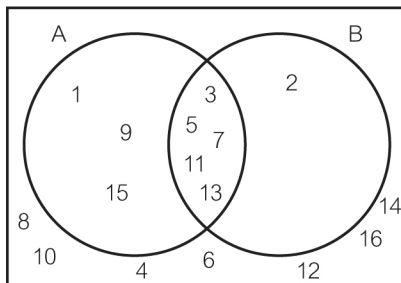
- 1 a $\frac{10}{26}$ b $\frac{24}{26}$ c $\frac{10}{24}$
2 a 23.4 cm b 13.3 cm
3 a 22.9 cm b 10.8 cm
4 54.3°
5 a 38.0° b 52.1°
6 4.1 m
7 034°
8 3.2 m
9 a 7.6 cm b 19.5 cm c 74.6 cm^2
10 23.0°
11 8.7 cm
12 a 14.1 cm b 35.3° c 17.3 cm

Unit 12 Probability

12.1 Set notation and Venn diagrams

- 1 a 2, 4, 6, 8, 10 b 2, 3, 5, 7 c 1, 8
 2 a 12, 24, 28 b 12, 18, 24 c 12, 24
 3 a $S = \{1, 4, 9, 16, 25\}$ b No
 4 c
 5 a
 6 $Z = \{2, 3, 5\}$
 7 a {4, 16}
 b {1, 2, 4, 6, 8, 9, 10, 12, 14, 16}
 c {1, 3, 5, 7, 9, 11, 13, 15}
 d {2, 3, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15}

8 a



- b i {1, 2, 3, 5, 7, 9, 11, 13, 15}
 ii {3, 5, 7, 11, 13}
 iii {2, 4, 6, 8, 10, 12, 14, 16}
 9 a True b False c False d True

12.2 Probability diagrams

- 1 a $\frac{5}{8}$ b $\frac{3}{8}$ c 1 d $\frac{3}{8}$
 e $\frac{2}{8} = \frac{1}{4}$
 2 a H, H H, T T, H T, T
 b 4
 c i $\frac{1}{4}$ or 0.25 or 25% ii $\frac{1}{2}$ or 0.5 or 50%

3 a

	H	T
1	H, 1	T, 1
2	H, 2	T, 2
3	H, 3	T, 3
4	H, 4	T, 4
5	H, 5	T, 5
6	H, 6	T, 6

12 possible outcomes

- b i $\frac{3}{12}$ or $\frac{1}{4}$ or 0.25 or 25%
 ii $\frac{2}{12}$ or $\frac{1}{6}$
 iii $\frac{2}{12}$ or $\frac{1}{6}$

4 a

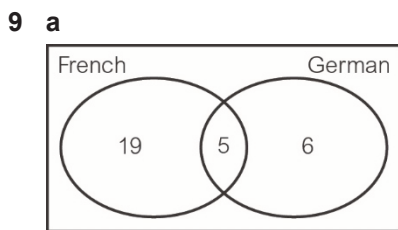
		First spin		
		1	2	3
Second spin	1	1	2	3
	2	2	3	4
	3	3	4	5

- b 9 c 4
 d i $\frac{1}{9}$ ii $\frac{3}{9}$ or $\frac{1}{3}$
 iii $\frac{5}{9}$ iv $\frac{6}{9}$ or $\frac{2}{3}$
 e 15
 5 a The Venn diagram shows two events: square numbers and multiples of 3. There is no intersection of the sets. There is no square number that is also a multiple of 3.
 b 2 and 5 are neither square numbers nor a multiple of 3.
 c $\frac{2}{6}$ or $\frac{1}{3}$ d $\frac{2}{6}$ or $\frac{1}{3}$ e $\frac{4}{6}$ or $\frac{2}{3}$
 f True because $P(\text{rolling a square number}) + P(\text{rolling a multiple of 3}) = \frac{1}{3} + \frac{1}{3} = \frac{2}{3} = P(\text{rolling a square number or a multiple of 3})$

- 6 a Because the intersection is not empty.
1 is a square number and is less than 4.
- b $\frac{2}{6}$ or $\frac{1}{3}$ c $\frac{3}{6}$ or $\frac{1}{2}$ d $\frac{4}{6}$ or
- e False because $P(\text{rolling a square number}) + P(\text{rolling a number less than 4}) = \frac{2}{6} + \frac{3}{6} = \frac{5}{6}$ whereas $P(\text{rolling a square number or a number less than 4}) = \frac{4}{6}$

- 7 a No intersection
- b $P(\text{square}) = \frac{2}{6}$ or $\frac{1}{3}$, $P(\text{prime}) = \frac{3}{6}$ or $\frac{1}{2}$,
 $P(\text{biggest}) = \frac{1}{6}$
- c $\frac{6}{6} = 1$ d 1

- 8 b and d



- b i $\frac{19}{30}$ ii $\frac{5}{30} = \frac{1}{6}$ iii $\frac{25}{30} = \frac{5}{6}$

- 10 a

		First dart			
		5	20	1	
Second dart	5	10	25	6	
	20	25	40	21	
	1	6	21	2	

- b i $\frac{1}{9}$ ii $\frac{2}{9}$ iii $\frac{4}{9}$ iv $\frac{5}{9}$

- 11 a H, H, H H, H, T H, T, H H, T, T
T, T, T T, T, H T, H, T T, H, H
- b i $\frac{1}{8}$ ii $\frac{3}{8}$ iii $\frac{7}{8}$

12.3 Tree diagrams

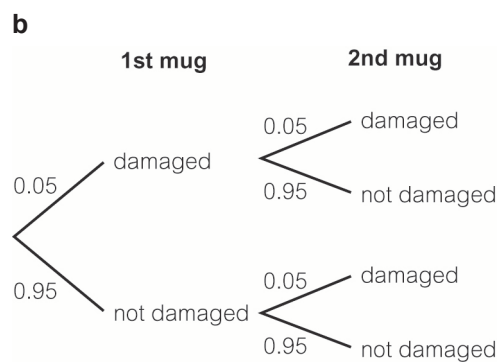
- 1 a $\frac{1}{5}$ b 58% c 0.3

- 2 a $\frac{3}{6} = \frac{1}{2}$ b $\frac{8}{12} = \frac{2}{3}$ c $\frac{3}{16}$
- d $\frac{7}{18}$

- 3 A and C

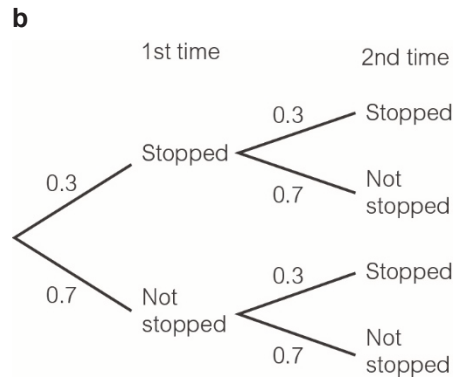
- 4 a $\frac{1}{36}$ b $\frac{1}{12}$ c $\frac{1}{12}$

- 5 a 0.95



- c 0.0025

- 6 a 0.7

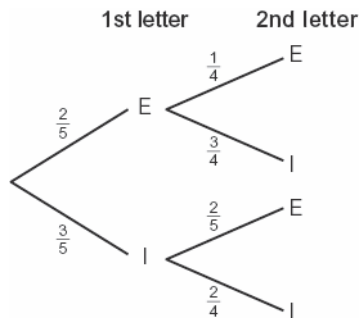


- c i 0.42 ii 0.49

- 7 0.42

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

d



e i $\frac{2}{20}$ or $\frac{1}{10}$ or 0.1 or 10%

ii $\frac{12}{20}$ or 0.6 or 60%

iii 1

9 $\frac{9}{12} \times \frac{8}{11} + \frac{3}{12} \times \frac{9}{11} = \frac{3}{4}$

12.4 Experimental and theoretical probabilities

1 a $\frac{1}{12}$ b $\frac{1}{2}$

2 a $\frac{1}{36}$ b $\frac{5}{33}$

3 A

4 a 200 b 0.265 c 0.25

d Yes. As the experimental probabilities are close to the theoretical probabilities.

5 a 6: $P(\text{total of 6}) = \frac{5}{36}$; $P(\text{total of 10}) = \frac{3}{36}$

b The same (both are $\frac{1}{36}$)

6 a

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

b 0.08 c $\frac{4}{25}$ or 0.16

7 $\frac{7}{15}$

12 Check up

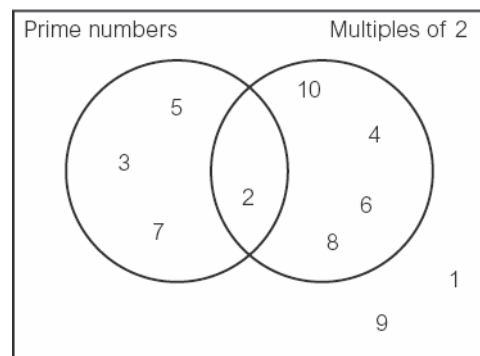
Set notation and Venn diagrams

1 a $E = \{2, 4, 6, 8, 10\}$

b Yes as 2 is the first even number

2 c

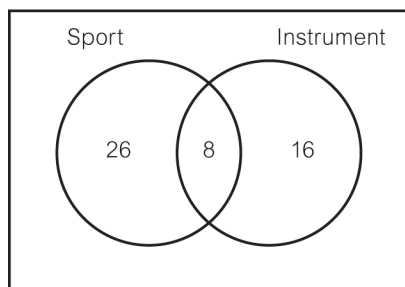
3 a



b $\frac{4}{10} = \frac{2}{5}$

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

4 a



b $\frac{16}{50} = \frac{8}{25}$

Probability diagrams

5 a

		1st spin			
		1	2	3	
2nd spin	1	2	3	4	
	2	3	4	5	
	3	4	5	6	

b i $\frac{2}{9}$ ii $\frac{5}{9}$

c Yes

6 a i $\frac{38}{80} = \frac{19}{40}$ ii $\frac{12}{80} = \frac{3}{20}$
 iii $\frac{21}{80}$ iv $\frac{13}{80}$

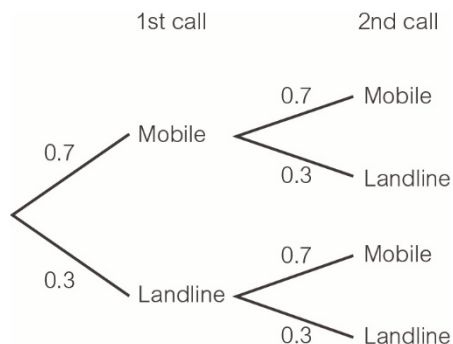
b Male aged 25 or over ($\frac{21}{80}$ vs $\frac{18}{80}$)

c $\frac{7}{38}$

Tree diagrams

7 a 0.3

b



c i 0.49 ii 0.42

Experimental and theoretical probabilities

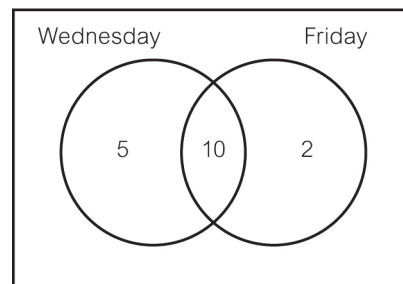
8 a The number of cards $\times 0.2$ must be a whole number, but $16 \times 0.2 = 3.2$

b $\frac{12}{19}$

12 Strengthen

Venn diagrams and mutually exclusive events

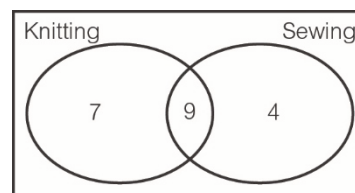
1 a i, ii, iii



b 17

c i $\frac{10}{17}$ ii $\frac{5}{17}$

2 a



b i $\frac{9}{20}$ ii $\frac{7}{20}$

3 B and D

Probability diagrams

1 a 17

b i $\frac{17}{180}$ ii $\frac{49}{180}$

c $\frac{20}{92} = \frac{5}{23}$ d $\frac{40}{88} = \frac{5}{11}$

2 a

Race 1	3rd	3, 1	3, 2	3, 3
	2nd	2, 1	2, 2	2, 3
	1st	1, 1	1, 2	1, 3
		1st	2nd	3rd
		Race 2		

b 9 c $\frac{1}{9}$

d (1, 1), (1, 2), (1, 3), (2, 1), (3, 1) e $\frac{5}{9}$

3 a

		Spinner 1					
		1	1	2	2	3	3
Spinner 2	2	1, 2	1, 2	2, 2	2, 2	3, 2	3, 2
	2	1, 2	1, 2	2, 2	2, 2	3, 2	3, 2
	4	1, 4	1, 4	2, 4	2, 4	3, 4	3, 4
	4	1, 4	1, 4	2, 4	2, 4	3, 4	3, 4
	6	1, 6	1, 6	2, 6	2, 6	3, 6	3, 6
	6	1, 6	1, 6	2, 6	2, 6	3, 6	3, 6

There are 36 outcomes.

b i $\frac{12}{36}$ or $\frac{1}{3}$ ii $\frac{12}{36}$ or $\frac{1}{3}$ iii $\frac{24}{36}$ or $\frac{2}{3}$

c Two even numbers.

d

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

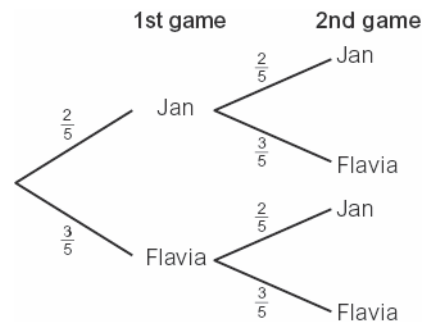
e 5 and 7 f $\frac{32}{36}$

Tree diagrams

1 a 0.04

b i 0.16 ii 0.16 iii 0.32

2 a

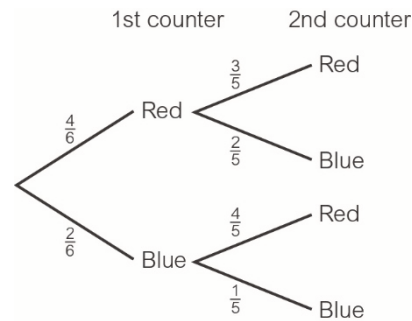


b i $\frac{4}{25}$ ii $\frac{9}{25}$ iii $\frac{12}{25}$

3 0.3324

4 a i $\frac{4}{6}$ or $\frac{2}{3}$ ii $\frac{2}{6}$ or $\frac{1}{3}$ b 5

c



d i $\frac{12}{30}$ or $\frac{2}{5}$ ii $\frac{2}{30}$ or $\frac{1}{15}$

iii $\frac{16}{30}$ or $\frac{8}{15}$

5 0.09

Experimental and theoretical probabilities

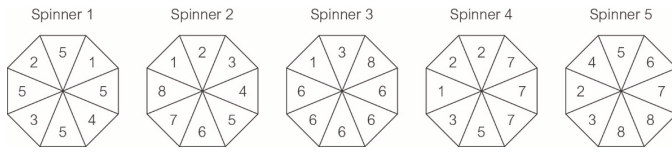
1 a 100

b No. 173 is significantly greater than 100.

2 a £525 b Every 11.4 months

Enrichment

1 a, b Students' own answer. For example:



2 Assuming that Sunni eats the chocolates,

$$P(\text{two the same}) = \frac{7}{15} = 0.46666\dots \text{so he is correct.}$$

12 Extend

1 a $A = \{1, 4, 9, 16, 25, 36, 49, 64, 81, 100\}$

b $B = \{1, 8, 27, 64, 125\}$

c $C = \{1, 64\}$

2 $P(> 5) = \frac{15}{25}$, $P(< 5) = \frac{6}{25}$
Score most likely to be > 5

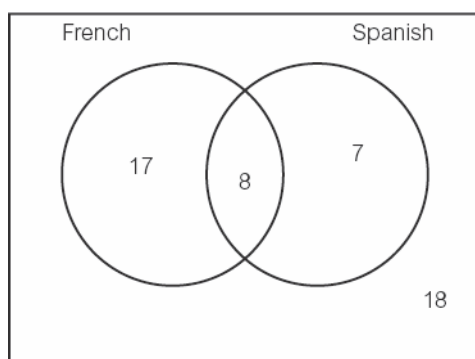
3 You are more likely get a total of 6 or more (14 possible outcomes) than a total of less than 6 (10 possible outcomes).

4 a 14% b 12.5% c 25

d The experimental probability for a head is $\frac{92}{200}$, which is close to the theoretical probability of $\frac{100}{200}$, so the coin seems to be fair.

If the spinner is fair you would expect a total of 50 for each number. The actual totals are 54, 45, 47 and 54, which are all close to 50, so the 4-sided dice also seems to be fair.

5 a



b 0.36

6 $\frac{1}{8}$

7 a i 1 ii 13

b 20 c $\frac{6}{20}$ or $\frac{3}{10}$ or 0.3 or 30%

8 a 34% or 0.34

b $0.34 \times 60 = 20.4$. Best estimate is 20.

9 Diagram of an 8-sided spinner. All sides the same length. 1 sector red, 4 sectors green, 2 sectors blue, 1 sector yellow.

For example:



10 0.16

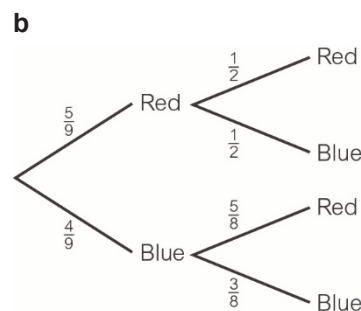
11 a 0.04 b 0.42 c 0.4

12 a $\frac{1}{8}$ b $\frac{1}{8}$ c $\frac{2}{8} = \frac{1}{4}$ d $\frac{7}{8}$

13 a $\frac{2}{30} = \frac{1}{15}$ b $\frac{4}{5}$

14 a No because $P(\text{first counter is blue}) = \frac{4}{9}$ and

$$P(\text{second counter is blue}) = \frac{1}{2}$$



15 a $(\frac{20}{38})^3 = \frac{8000}{54872} = \frac{100}{6859}$

b $P(W, W, L \text{ or } W, L, W \text{ or } L, W, W) = \frac{12000}{54872}$

$P(W, W, D \text{ or } W, D, W \text{ or } D, W, W) = \frac{9600}{54872}$

So $P(\text{winning two of next three games}) =$

$$\frac{21600}{54872} = \frac{2700}{6859}$$

12 Unit test

1 a $A = \{1, 3, 5, 7, 9\}$

b $B = \{2, 3, 5, 7, 11\}$

c $C = \{1, 9\}$

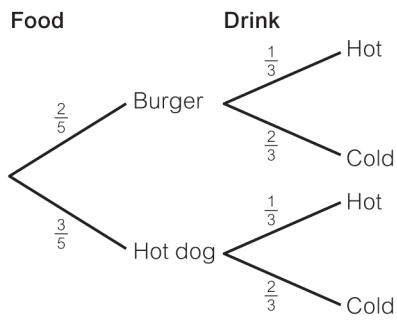
2 a (red, red), (red, red), (red, red), (red, red), (red, blue), (red, blue), (blue, red), (blue, red), (blue, blue)

b $P(A) = \frac{4}{9}$ $P(B) = \frac{5}{9}$

c No because event B includes the outcomes of event A.

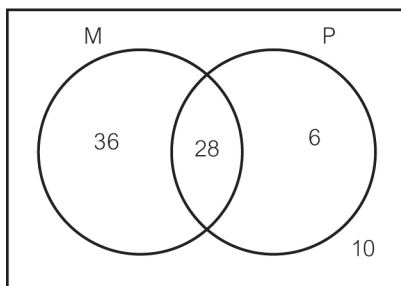
3 a 0.72 b 0.08

4 a



b i $\frac{4}{15}$ ii $\frac{6}{15} = \frac{2}{5}$

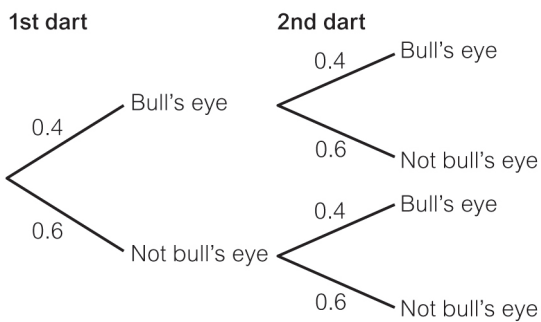
5 a



b 0.45 c 0.575

6 a $\frac{4}{9}$ b $\frac{4}{9}$

7 a



b 0.48