Unit 1 Significant figures, powers and standard form

1.1 Powers of 10

1

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

2 a

Prefix	Letter	Power	Number
tera	T	10^{12}	1 000 000 000 000
giga	G	10^9	1 000 000 000
mega	M	10^6	1 000 000
kilo	K	10^3	1000
deci	d	10^{-1}	0.1

Prefix	Letter	Power	Number
centi	c	10^{-2}	0.01
milli	m	10^{-3}	0.001
micro	μ	10^{-6}	0.000 001
nano	n	10^{-9}	0.000 000 001
pico	p	10^{-12}	0.000 000 000 001

b i 1000 times
ii 1 000 000 times
iii 10 000 times
iv 10 000 000 times

3 a

Name of planet	Diameter of planet (km)	Average distance from Sun (km)
Earth	12 800	150 000 000
Mars	6 800	228 000 000
Jupiter	143 000	779 000 000

b Jupiter **c** Earth

4 330 tonnes

5 0.0015 mm

1.2 Calculating and estimating

1 a 50 **b** 32 **c** 45

2 10

3 $19 + 3^2$ and $19 + (-3)^2$
$19 - 3^2$ and $19 - (-3)^2$
$34 - 5^2 - 4^2$ and $34 - (-5)^2 - 4^2$
$34 - (-5)^2 + 4^2$ and $34 - 5^2 + (-4)^2$

4 a 52.54 **b** 0.004 72 **c** 86 000

5 a About 15 000 **b** About 160 000
c About 25

6 a About 10 **b** About 2 **c** About 1

7 The largest is 434 and the smallest is 425.

8 a 80 000, 50 000, 5 000, 60 000, 30 000
b About 75 000

1.3 Indices

1 b 2^{-1} **c** 7^{-2} **d** 11^{-2}
e $\frac{1}{27}$ **f** $\frac{1}{32}$ **g** $\frac{1}{8}$
h $4^{-2} = 2^{-4}$ **i** $25^{-2} = 5^{-4}$

2 b 6^{-2} **c** 3^{-6} **d** 5^{-5}
e 9^{-5} **f** 11^{-12} **g** 4^{-12}

3 a i 6^{-2} **ii** $\frac{1}{36}$
b i 3^3 **ii** 27
c i 5^{-3} **ii** $\frac{1}{125}$

4 a $\frac{1}{25}$ **b** $\frac{25}{64}$ **c** $\frac{27}{1000}$

5 a $\left(\frac{5}{7}\right)^2$ **b** $\left(\frac{8}{12}\right)^2$ **c** $\left(\frac{9}{10}\right)^2$
d $\left(\frac{3}{11}\right)^2$ **e** $\left(\frac{2}{3}\right)^3$ **f** $\left(\frac{1}{5}\right)^3$

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

1.4 Standard form

1 3.5×10^8, 2×10^7, 9.9×10 and 4.306×10^{-9}

2 a 5000 **b** 0.000 37
c 49 000 000 **d** 0.000 002 09

3 b 4.98×10^2 **c** 7.1×10^6
e 6.35×10^{-6} **f** 4×10^{-8}

4 a Mars 2.25×10^8, Our Moon 3.844×10^5, Saturn 1.3×10^9
b Yes

5 a 7.8×10^2, 8.52×10^2, 6.4×10^3, 2.1×10^4, 3.51×10^4
b 9.27×10^{-6}, 5.31×10^{-5}, 1.4×10^{-4}, 6.8×10^{-4}, 2.67×10^{-3}

6 neutron, proton, electron

7 a i 0.0001 m **ii** 0.1 mm
b i 0.000 005 1 m
ii 0.0051 mm

1.5 STEM: Calculating with standard form

1 **b** 1.14×10^8 **c** 2.52×10^{11} **d** 2.25×10^8

2 **a** 2×10^4 **b** 3×10^3 **c** 3×10^3

3 **a** 2.5955×10^8 **b** 4.7×10^4

4 10 mm

5 **a** 5.67×10^5 **b** 4.77×10^4
c 4.4×10^{-6} **d** 2.835×10^{-5}

6 9.983×10^{-7} m

1 Strengthen

Powers of 10

1 **a** 4 700 000 km
b 530 000 nm
c 0.000 829 km
d 43 000 μm

Calculating and estimating

2 **a** 50 **b** 0.7
c 60 000 **d** 0.02

3 **a** 20 000 **b** 300

Indices

4 **a** **i** 4^{-5} **ii** $\frac{1}{4^5}$ **iii** $\frac{1}{4^5}$

b **i** $\frac{1}{5^2}$ **ii** $\frac{1}{3^4}$

iii $\frac{1}{8^7}$ **iv** $\frac{1}{7^3}$

5 **a** 5^{-4} **b** 4^3 **c** 7^{-5}
d 3^{-5} **e** 9^7 **f** 6^{-21}

Standard form

6 **a** 5200 **b** 38 000
c 910 **d** 4 700 000

7 **a** 0.0065 **b** 0.000 27
c 0.083 **d** 0.000 009 4

8 **a** 4.9×10^3 **b** 7.3×10^5 **c** 5.1×10^{10}

9 **a** 8.3×10^{-4} **b** 9.7×10^{-6}
c 5×10^{-3} **d** 4.6×10^{-9}

10 She is incorrect. They are the same number.

Calculating with standard form

11 **a** 7.2×10^7 **b** 7.2×10^7 **c** 1.55×10^{10}
d 4×10^5 **e** 1.2×10^{-3} **f** 8×10^3

1 Extend

1 **a** 0.0103 m **b** 3350 mg
c 0.0726 litres

2 7340, $734\,000 \div 10^2$, 0.0734×10^5, $7\,340\,000 \div 10^3$

3 **a** 3 **b** 12 000 000 **c** 9

4 **a** 59 **b** 8773 **c** 58

5 3^4 cm

6 **a** $(0.2)^3$ and $\left(\frac{1}{5}\right)^3$

b e.g. $(0.1)^2$, 10^{-2}, $\left(\frac{1}{10}\right)^2$, $1000^{-\frac{2}{3}}$

7 3106×10^{-7}, $\frac{6.2 \times 10^{-9}}{2 \times 10^{-5}}$, 0.31×10^{-3}, 0.000 315, 3.17×10^{-4}

8 **a** 5×10^{-8} **b** 2×10^{-7}
c 1.25×10^3 **d** 4×10^5

9 **a** Switzerland, Austria, Italy, UK, France
b 1.95×10^6 **c** About 7.5 times
d 2.076×10^8 **e** About 17.6%

10 **a** $3^8 \times 5^9$, $3^3 \times 5^6$, $3^5 \times 5^3$
b $2^{12} \times 7^6$, $2^9 \times 7^4$

11 **a** $a^{p+r} \times b^{q+s}$
b $a^{p-r} \times b^{q-s}$

1 Unit test

1

Prefix	Letter	Power	Number
tera	T	10^{12}	1 000 000 000 000
giga	G	10^9	1 000 000 000
deci	d	10^{-1}	0.1
milli	m	10^{-3}	0.001
micro	μ	10^{-6}	0.000 001
nano	n	10^{-9}	0.000 000 001

2 **a** About 32 000
b About 80

3 **a** 5^{-7} **b** 8^{-7} **c** 3^{-8} **d** 6^1

4 **a** 7.9×10^3
b 8.13×10^{-6}

5 38 400 000 m

6 **a** 3×10^4
b 1.2×10^{-5}

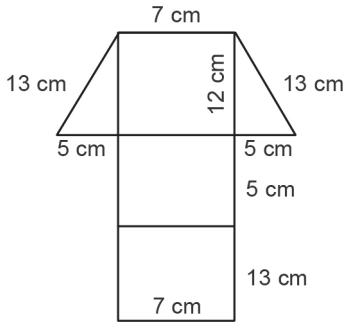
7 0.12 g

8 160 200

Unit 2 2D Shapes and 3D solids

2.1 Surface area of prisms

1 a



b Area of triangle = 30 cm^2

Areas of the rectangles are 84 cm^2, 35 cm^2, 91 cm^2

c 270 cm^2

2 a i Sketch of any working net of the triangular prism

ii 304 cm^2 (3 s.f.)

b i Sketch of any working net of the triangular prism

ii 314.4 cm^2 (3 s.f.)

3 x = 8.3 cm (1 d.p.)

2.2 Volume of prisms

1 a i 28.5 cm^2 **ii** 285 cm^3

b i 2.7 cm^2 **ii** 18.9 cm^3

2 a 240 cm^3 **b** 450 cm^3

3 x = 9 cm

4 a 20 cm^2 **b** 597.5 cm^2

5 a 8.48 m^2 **b** 42.4 m^3

2.3 Circumference of a circle

1 a 28.3 cm **b** 21.0 mm

2 a 63.8 mm **b** 377.0 m **c** 314.2 km

3 a i 6π cm **ii** $\frac{1}{2}$ **iii** 3π cm

b i 16π cm **ii** $\frac{1}{4}$ **iii** 4π cm

4 a i 3.6 cm **ii** 8.2 cm

b i 14.1 cm **ii** 23.1 cm

5 11.1 cm

2.4 Area of a circle

1 a 63.6 cm^2 **b** 35.3 mm^2

2 a 12.5π cm^2 **b** 3.8025π cm^2

c 20.48π cm^2

3 a 69.6 cm^2 **b** 122.3 cm^2 **c** 104.0 cm^2

4 4.8 cm

5 (200 − 50π) cm^2

2.5 Cylinders

1 a 377.0 cm^2 **b** 653.5 cm^2

2 a i 28.3 cm^2 **ii** 311.0 cm^3

b i 153.9 cm^2 **ii** 307.9 cm^3

c i 3.1 cm^2 **ii** 31.4 cm^3

3 a 26 477.3 cm^3

b No, because 26 477.3 cm^3 is 26.4773 litres, which is less than 27 litres.

4 6.3 glasses (or 7 glasses, rounding up)

2.6 Pythagoras' theorem

1 a 8.9 cm **b** 10.3 cm

c 13.9 cm **d** 14.3 cm

2 Triangle **b** is a right-angled triangle.

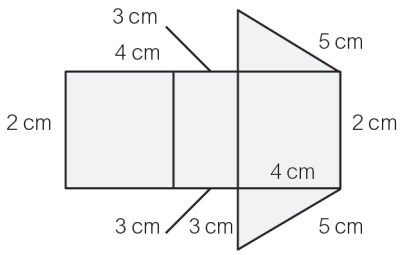
3 a 5.7 cm **b** 8.3 cm **c** 3.6 cm

4 18.7 cm^2

2 Strengthen

Surface area and volume of prisms

1



2 36 cm^2

3 12 cm^3

Circumference and area of a circle

4 a r = 6 cm; d = 12 cm

b r = 5.5 cm; d = 11 cm

5 a 47.1 cm **b** 19.5 cm

6 a 3.8 cm **b** $A = \pi \times 3.8^2$ **c** 45.4 cm^2

7 **a** $\frac{1}{2}$ **b** 16π cm^2 **c** 8π cm^2

d 8π cm **e** 4π cm

f $4(2 + \pi)$ cm

Cylinders

8 **a** A sketch of two circles both with radius 3 cm and a rectangle with the width labelled 7 cm

b 18.8 cm

c Area of each circle = 28.3 cm^2

Area of the rectangle = 131.9 cm^2

d 188.5 cm^2

e 197.9 cm^3

Pythagoras' theorem

9 **a** 9.8 cm **b** 11.7 cm **c** 9.2 cm

10 **a** 9.7 cm **b** 90.9 mm **c** 7.5 cm

11 **a** 15.6 cm^2 **b** 198.4 cm^2 **c** 43.3 cm^2

2 Extend

1 **a** 72.0 cm **b** 35.4 cm

2 **a** $C = 2 \times \pi \times r = 2\pi \times 6 = 12\pi$

$A = \pi \times r^2 = \pi \times 6^2 = 36\pi$

b $C = 15\pi$ cm

$A = 56.25\pi$ cm^2

3 **a** **i** 2.20 m **ii** 181.89 revolutions

b **i** 1.57 m **ii** 25.1 cm

4 **a** 4.8 cm **b** 3.8 cm

5 **a** 4 cm **b** 8.1 cm **c** 32.2 cm^2

d 64 cm^2 **e** 193.0 cm^2 **f** 149.3 cm^3

6 **a** 7.3 units **b** 6.4 units **c** 4.2 units

7 The volume of the cake tin needed for the recipe is 942.5 cm^3.

My cake tin has a volume of only 678.6 cm^3, so no, it is not big enough.

8 **a** $x = 4.77$ cm

b $y = 12.62$ cm

2 Unit test

1 **a** **i** 8π cm **ii** 16π cm^2

b **i** 65π mm **ii** 1056.25π cm^2

2 **a** 15.8 cm **b** 12.7 cm

3 **a** **i** 42 cm^3 **ii** 96 cm^2

b **i** 162 cm^3 **ii** 203.4 cm^2

4 60 cm^2

5 **a** 510.5 cm^3 **b** 361.3 cm^2

Unit 3 Quadratics

3.1 Arithmetic and quadratic sequences

1 **a** arithmetic **b** quadratic **c** arithmetic

2 **a** 1, 4, 9, 16; 100
b 2, 8, 18, 32; 200
c −3, −12, −27, −48; −300
d 5, 20, 45, 80; 500

3 5th term = $2 \times 5^2 + 3 = 53$
10th term = $2 \times 10^2 + 3 = 203$
$2 \times (2 \times 5^2 + 3) \neq 2 \times 10^2 + 3$

4 **a** 6, 9, 14, 21,…105
b 7, 13, 23, 37, … 205
c 8, 17, 32, 53, … 305

5 **a** 13, 18, 23, …
b 5 **c** $5n - 2$
d The common difference is the coefficient of n.

3.2 Geometric sequences

1 **a** 16, 64, 256 **b** 32, 128, 512
c 25, 5, 1 **d** 50, 5, 0.5

2 If the common ratio of a geometric sequence is greater than 1, the sequence is ascending.
If the common ratio of a geometric sequence is between 0 and 1, the sequence is descending.

3 **a** 10 **b** 5

4 **a** 2, 10, 50, 250, 1250
b 100, 50, 25, 12.5, 6.25
c 1, −2, 4, −8, 16
d 200, 40, 8, 1.6, 0.32

3.3 Expanding

1 **b** $y^2 + 9y + 14$ **c** $a^2 + 8a + 15$
d $p^2 + 10p + 24$ **e** $n^2 + 15n + 56$

2 **a** $d^2 - d - 20$ **b** $z^2 - z - 30$
c $q^2 + 3q - 10$ **d** $b^2 - 10b + 21$
e $f^2 - 12f + 32$ **f** $b^2 - 14b + 45$

3 Dan is correct; Emily's mistakes were $-5 \times -6 \neq -30$ and $-6x - 5x \neq x$.

4 **a** $4x^2 - 3x - 35$
b $x^2 - 13x - 14$

5 LHS = $x^2 - 10x + 9x + 9 = x^2 - x + 9$
RHS = $x^2 - 7x + 12 + 6x - 3 = x^2 - x + 9$
LHS = RHS

6 **a** $2x^2 - x - 15$
b $6x^2 - 23x + 20$
c $10x^2 - 13x - 3$

7 **a** $4x^2 + 4x + 1$
b $9x^2 + 12x + 4$
c $25x^2 - 30x + 9$
d $36x^2 - 84x + 49$

8 **a** $4x^2 - 9$ **b** $9x^2 - 1$
c $25x^2 - 4$ **d** $x^2 - y^2$

3.4 Factorising

1 **b** $(x + 5)(x + 3)$ **c** $(x + 11)(x + 2)$
d $(x - 7)(x - 1)$ **e** $(x - 4)(x - 6)$

2 **a** $(x + 5)(x - 2)$ **b** $(x + 4)(x - 3)$
c $(x + 9)(x - 2)$ **d** $(x + 3)(x - 8)$
e $(x + 2)(x - 10)$ **f** $(x + 7)(x - 4)$

3 **a** $(x + 5)^2$ **b** $(x + 4)^2$
c $(x - 9)^2$ **d** $(x - 7)^2$

4 **a** $(x + 3)(x - 3)$
b $(x + 2)(x - 2)$
c $(x + 6)(x - 6)$

5 Lengths of $x + 7$ and $x + 8$, where $x > -7$

6 **a** Yuto has increased the length by the same amount as he has decreased the width by; the length is $x + 5$ and the width is $x - 5$.
b The original shape was a rectangle with length $x + a$ and width $x - a$ where $a = 0$ or -10.

3.5 Solving quadratic equations

1 **b** $x = -2$ or $x = 12$
c $x = 4$ or $x = 9$
d $x = -6$ or $x = 7$

2 **a** $x = -6$ **b** $x = -9$ **c** $x = 4$

3 Jehaan is 13 and Chavdar is 18.

4 3 or 12

5 **a** $x = -4$ or $x = 4$
b $x = -8$ or $x = 8$
c $x = -10$ or $x = 10$

3 Strengthen
Arithmetic, quadratic and geometric sequences

1 **a** No
b Yes – the common difference is 5
c No

2 **a** Yes **b** Yes **c** No

3 **a** 1, 4, 9, 16 and 100
b 2, 5, 10, 17 and 101
c 3, 5, 11, 18 and 102
d 2, 8, 18, 32 and 200
e 3, 12, 27, 48 and 300

Expanding

4 **a** $x^2 + 10x + 24$ **b** $x^2 + 10x + 21$
c $x^2 + 6x + 5$ **d** $x^2 + 5x - 24$
e $x^2 - 14x + 45$ **f** $x^2 - 8x + 12$

5 **a** $x^2 + 12x + 36$ **b** $x^2 - 16x + 64$
c $x^2 + 2x + 1$

6 **a** $x^2 - 36$ **b** $x^2 - 64$ **c** $x^2 - y^2$

7 **a** $2x^2 - 5x - 12$ **b** $12x^2 + 17x - 5$
c $2x^2 - 15x + 7$

Factorising

8 **a** **i** 5 and 7 **ii** 2 and 6
b **i** $(x + 5)(x + 7)$
ii $(x + 2)(x + 6)$
iii $(x + 4)(x + 5)$
iv $(x + 3)(x + 10)$
v $(x + 1)(x + 9)$

9 **a** −2 and −5
b **i** $(x - 2)(x - 5)$
ii $(x - 2)(x - 8)$
iii $(x - 5)(x - 6)$

10 **a** $(x - 10)(x + 2)$ **b** $(x - 7)(x + 4)$
c $(x - 11)(x + 3)$ **d** $(x - 3)(x + 6)$
e $(x - 4)(x + 6)$ **f** $(x - 6)(x + 7)$
g $(x - 3)(x + 24)$

Solving quadratic equations

11 **b** $x = -8$ or $x = -3$
c $x = -6$ or $x = 2$
d $x = -2$ or $x = 14$
e $x = -9$ or $x = -5$
f $x = -2$ or $x = 5$
g $x = -5$
h $x = -6$ or $x = 8$

12 Length = 12 cm, width = 7 cm

13 **a** Alfie is 16 **b** Ben is 13

3 Extend

1 **a** 3, 10, 19, 30; 2698; 10 398
b 0, 9, 22, 39; 5145; 20 295
c −1, −8, −23, −46; −9752; −39 502

2 **a** $1\frac{1}{4}$ **b** 4

3 3075

4 **b** 6 **c** $3(2x - 1)$

5 **b** $x^3 + 5x^2 - 2x - 24$
c $x^3 - 7x^2 + 2x + 40$

6 **a** $(2x - 1)(x - 3)$ **b** $(3x - 2)(x + 2)$
c $(3x + 5)(x - 1)$ **d** $(-2x + 3)(x + 4)$
e $(-5x + 2)(x - 3)$ **f** $(5x + 1)(-x + 5)$

7 **a** $(x - 1)(4x + 3)$ **b** $(2x + 1)(2x - 3)$
c $(3x - 2)(3x + 2)$ **d** $(3x + 5)(3x - 1)$
e $(6x + 1)(2x - 3)$ **f** $(4x + 3)(3x - 2)$

8 Length = $3x + 2$, width = $2x - 5$, where $x > 2\frac{1}{2}$

9 **a** $x = -2\frac{1}{2}$ or $x = 1\frac{1}{2}$
b $x = -2\frac{1}{2}$ or $x = -\frac{2}{3}$
c $x = -1\frac{1}{2}$ or $x = \frac{2}{5}$

10 6 or −4

11 **a** $x = -1$ or $x = -7$
b $x = -1$ or $x = -11$
c $x = -1$ or $x = -21$

3 Unit test

1 **a** 14, 16, 18 **b** $2n + 8$

2 **a** $x^2 + 6x + 5$ **b** $x^2 + 2xy + y^2$
c $x^2 + 2x - 24$ **d** $x^2 - y^2$

3 **a** $x^2 + 14x + 49$ **b** $x^2 + 2xy + y^2$
c $x^2 - 6x + 9$ **d** $x^2 - 2xy + y^2$

4 **a** 25 **b** $\frac{1}{5}$

5 **a** $2x^2 + 7x - 30$ **b** $3x^2 - 13x + 14$
c $12x^2 + x - 6$

6 **a** $(x - 5)(x + 8)$ **b** $(x - 3)(x + 4)$
c $(x - 7)(x + 3)$

7 **a** $(x - 8)(x + 8)$
b $(x - y)(x + y)$
c $(5x - 11)(5x + 11)$
d $(x + 3)^2$

8 **a** $x = -7$ or $x = 9$
b $x = -6$ or $x = -3$
c $x = -10$ or $x = 1$

Unit 4 Constructions

4.1 Constructing shapes

1 **a** Triangle PQR constructed accurately.
b Triangle PQR constructed accurately.
c Triangle PQR constructed accurately.

2 Net of tetrahedron (four equilateral triangles) constructed accurately.

4.2 Constructions 1

1 Perpendicular bisector constructed accurately (diagram must show construction marks).

2 Line perpendicular to AB through the point P constructed accurately (diagram must show construction marks).

4.3 Constructions 2

1 Angle bisector constructed accurately (diagram must show construction marks).

2 **a** Angle bisector constructed accurately (diagram must show construction marks).
b Angle bisector constructed accurately (diagram must show construction marks).

3 Parallelogram constructed accurately (diagram must show construction marks).

4 Strengthen

Constructing shapes

1 Triangle constructed accurately (diagram must show construction marks).

2 Triangle constructed accurately (diagram must show construction marks).

3 Triangle constructed accurately (diagram must show construction marks).

4 Net constructed accurately.

5 Net of square-based pyramid constructed accurately (diagram must show construction marks).

Constructions

6 Perpendicular bisector constructed accurately (diagram must show construction marks).

7 Angle bisector constructed accurately (diagram must show construction marks).

8 **a** Angle bisector constructed accurately (diagram must show construction marks).
b Angle bisector constructed accurately (diagram must show construction marks).

9 **a** Perpendicular bisector constructed accurately (diagram must show construction marks).
b **ii** Students' own pairs of measurements (should be the same)
iii e.g. Every point on the perpendicular bisector is the same distance from A as it is from B.

10 **a** Angle bisector constructed accurately (diagram must show construction marks).
b **ii** Students' own pairs of measurements (should be the same)
iii e.g. Every point on the angle bisector is the same distance from A as it is from B.

4 Extend

1 **a** Triangle ABC drawn accurately (diagram must show construction marks).
b Perpendicular bisectors of AB and BC constructed accurately (diagram must show construction marks).
c Perpendicular bisector of AC constructed accurately (diagram must show construction marks).
All the perpendicular bisectors intersect at the point P.
d The points A, B and C are all on the circumference of the circle.

2 Net of hexagonal pyramid drawn accurately (diagram must show construction marks).

3 **a** Triangle constructed accurately.
b 13 cm
c $5^2 + 12^2 = 169 = 13^2$

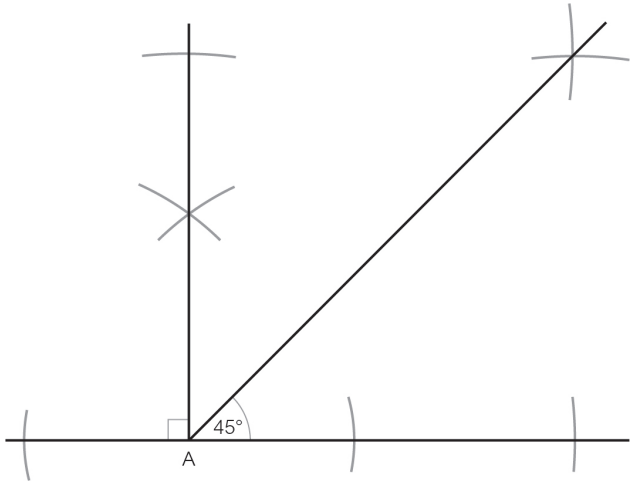
4 **a** Triangle constructed accurately.
b 6.1 cm

5 75° angle constructed accurately (45° + 30°).

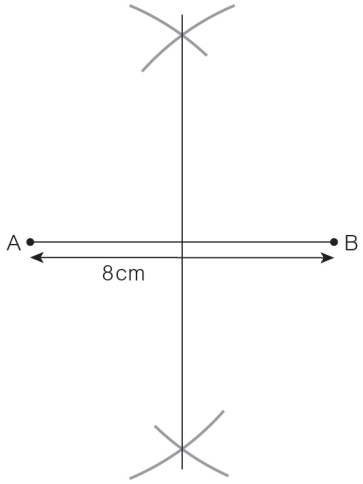
4 Unit test

1 **a** 70° angle drawn accurately.
b Angle bisector constructed accurately (diagram must show construction marks).

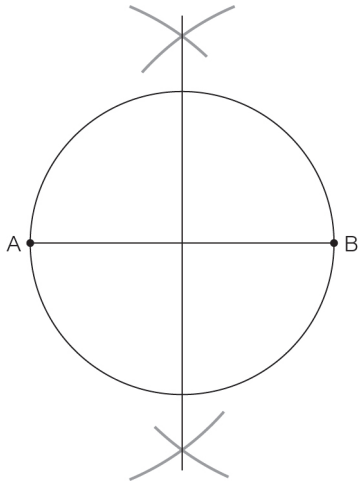
2 Students' accurate constructions



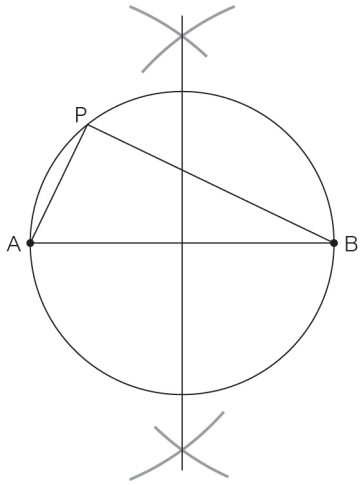
3 **a** Students' accurate constructions



b Students' accurate constructions



c Students' accurate constructions



d 90°

4 Net of triangular prism constructed accurately (diagram must show construction marks).

Unit 5 Inequalities, equations and formulae

5.1 Substitution

1 **a** 25 **b** 127 **c** 90

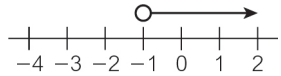
2 **a** \$22.60 **b** $C = 4.2n + 10$

c 7

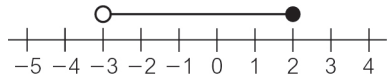
3 **a** 1.4 g/cm^3 **b** 32 g **c** $\frac{5}{6}$ cm^3

5.2 Inequalities

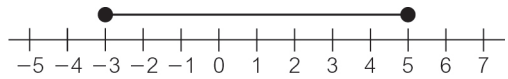
1 **a** **ii**



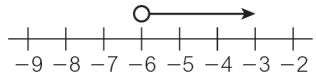
iii



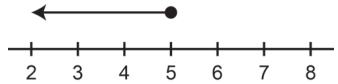
iv



b **ii** $x > -6$



iii $x \leqslant 5$



2 **a** $x \leqslant 4$ **b** Yes

3 **a** $-4 \leqslant x < 3$ **b** $-3 < y \leqslant 4$ **c** $-6 < z \leqslant 4$

4 **a** $x < -4$ **b** $x \geqslant 7$

c $6 > x > -14$

5.3 Using index laws

1 **a** 1 **b** 1 **c** 1

d 1 **e** 2

2 **a** 12 **b** 36 **c** 6

d 7

3 **a** $x^{-5} = \frac{1}{x^5}$ **b** $p^{-4} = \frac{1}{p^4}$

c $n^{-7} = \frac{1}{n^7}$ **d** $h^{-6} = \frac{1}{h^6}$

4 **b** **i** $7m^{-5}$ **ii** $\frac{7}{m^5}$

c **i** $5t^{-8}$ **ii** $\frac{5}{t^8}$

d **i** $\frac{1}{4}e^{-5}$ **ii** $\frac{1}{4e^5}$

e **i** $\frac{1}{7}v^{-11}$ **ii** $\frac{1}{7v^{11}}$

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

5.4 Expressions, equations, identities and formulae

1 **a** identity **b** equation **c** expression

d equation **e** equation **f** formula

2 **a** $x^3 + 2x^2 + 5x$ **b** $x^4 + 2x^3 + 5x^2$

c $2x^4 + 4x^3 + 10x^2$ **d** $2x^4 - 4x^3$

3 **a** $y(3y + 10)$ **b** $2y(y^2 + 4)$

c $3y^2(3y^2 - 2)$

4 **a** $3y(x + 3 + 4z)$ **b** $5x(x + 2y + 5z)$

5 Students' own answers

5.5 Solving equations

1 **a** $x = 4$ **b** $x = 6$

2 9

3 **b** $x = -1$ **c** $x = -7$

4 $P = 6$ units

5.6 Changing the subject

1 **a** $x = p - 7$ **b** $x = m + 10$

c $x = \frac{y}{2}$ **d** $x = 3h$

2 **a** $x = \frac{y-5}{3}$ **b** $x = \frac{z+9}{8}$

c $x = \frac{p-3q}{4}$

3 **a** $r = \frac{A}{\pi l}$ **b** $r = \sqrt{\frac{A}{\pi}}$

c $r = \sqrt{\frac{2A}{\pi}}$ **d** $r = \sqrt{\frac{3V}{\pi h}}$

4 **a** $A = \frac{1}{2}(a + b)h$

b $b = \frac{2A}{h} - a$ **c** $b = 38$

5 **b** $x = \frac{8-m}{4}$ **c** $x = \frac{24}{z-2}$ **d** $x = \frac{pq}{p^2 - q^2}$

6 **a** $y = (C - 3W)^2$ **b** $y = \left(\frac{P-K}{2}\right)^2$

c $y = \frac{z^2(A-5x)^2}{3}$

5 Strengthen

Substitution

1 **a** 10 **b** 7 **c** 100

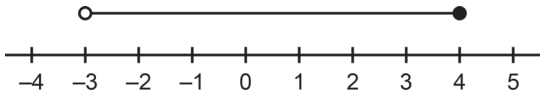
d 49 **e** 52

Inequalities

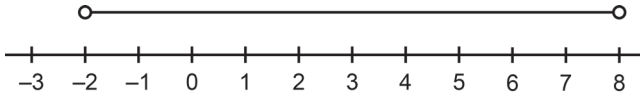
2 **a** diagram **iv** **b** diagram **iii**

c diagram **ii** **d** diagram **i**

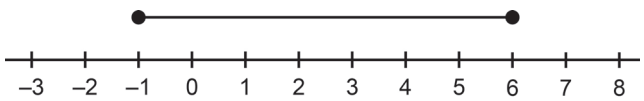
3 **b** $-3 < x \leqslant 4$



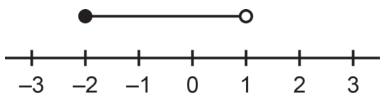
c $8 > x > -2$ or $-2 < x < 8$



d $-1 \leqslant x \leqslant 6$



e $-2 \leqslant x < 1$



4 **a** $x \geqslant 5$ **b** $a \leqslant 5$ **c** $-2 < m < 5$

Using index laws

5 5

6 **a** **i** $\frac{1}{x^5}$ **ii** x^{-5}

b **i** $\frac{1}{p^7}$ **ii** p^{-7}

c **i** $\frac{1}{q^4}$ **ii** q^{-4}

Expanding and factorising

7 **a** $a^3 + 7a^2$ **b** $b^4 + 3b^3 - b^2$

c $2c^3 - 6c^2 + 8c$

8 **a** $y(2y^2 + 1)$ **b** $y^2(3y + 2)$ **c** $5y(y + 3)$

d $3y(2y^3 + 3)$ **e** $5y(2y - 3)$

Solving equations

9 **a** $11 - x = 4(11 - 3x)$

b $x = 3$ **c** 8 units

Changing the subject

10 **b** $x = \frac{y}{8}$ **c** $x = \frac{y+t}{7}$

d $x = \sqrt{\frac{A}{5}}$ **e** $x = \sqrt{\frac{m}{n}}$

11 **a** $x = \frac{n}{4-m}$ **b** $x = \frac{c-b}{a-1}$ **c** $x = \frac{5}{p+q}$

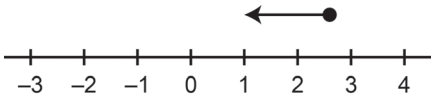
d $x = 9A^2$ **e** $x = \frac{25E^2}{6}$

5 Extend

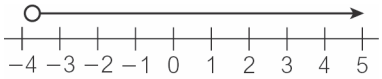
1 **a** $\frac{7}{2x^4}$ **b** $\frac{5}{2x^7}$ **c** a^{-3}

d t^{-1} **e** $\frac{5}{3b^2}$

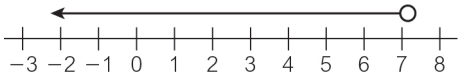
2 **a** $x \leqslant 2\frac{3}{5}$



b $x > -3\frac{5}{6}$



c $x < 7\frac{1}{3}$



3 $n = -1$

4 $x = 1\frac{1}{6}$

5 **a** $y = -4x + \frac{5}{2}$ **b** $y = 2x + \frac{7}{6}$

c $y = \frac{3}{8}x + \frac{5}{8}$

6 **a** $s = \frac{v^2 - u^2}{2a}$ **b** $s = 40$

7 **a** $x = \frac{-a-18}{3}$ **b** $x = \frac{8-4p}{3p+7}$

c $x = \frac{-3(12q+5)}{5-24q}$ or $\frac{3(12q+5)}{24q-5}$

8 **a** 20 m **b** 4 s

9 **a** $x = \frac{1}{y+5}$ **b** $x = \frac{1}{c-3}$ **c** $x = \frac{4}{y+1}$

10 **a** $x = \frac{tu}{u+t}$ **b** $x = \frac{ab}{5a+3b}$ **c** $x = \frac{7vy}{3y+2v}$

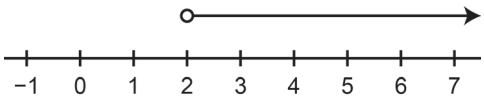
5 Unit test

1 16

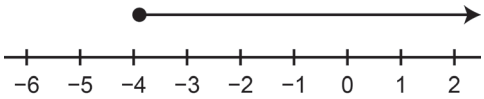
2 54

3 x^{-5}

4 **a** $x > 2$

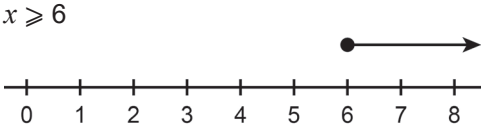


b $x \geqslant -4$



c $-3 \leqslant x < 5$

d $x \geqslant 6$



5 $x = 7$

6 **a** $20y^2 - 2y^4$ **b** $x^3 + 3x^2 + 4x$

7 **a** $7x^2(2x + 3)$ **b** $2x(y + 3y^2 + 4)$

8 **a** $x = \frac{y-2}{7}$ **b** $x = \sqrt{\frac{A}{t}}$ **c** $x = \frac{7}{a-b}$

d $x = \frac{(st)^2}{5}$ **e** $x = \frac{1}{y+z}$

Unit 6 Collecting and analysing data

6.1 Planning a survey

1 a i Secondary data

b i Primary data **ii** Questionnaire

c i Primary data **ii** Survey

2 a 80 000 **b** 2000

3 a Not all options are given – what about students who walk?

e.g. What methods of transport have you used to travel to school this month?

☐ Car ☐ Bus ☐ Train ☐ Cycle ☐ Walk ☐ Other

b The question is too vague – there are no tick box options so students may just say 'go home'.

e.g. How do you fill your time between finishing school and going to bed?

☐ Do homework ☐ Play sport ☐ Watch TV ☐ Play games ☐ Other

4 a Everyone living in London

b No; e.g. Not everyone in London has a chance of being chosen if the sample is just staff from a food chain.

6.2 Collecting data

1 c Students' own questions, e.g.

Flying to a holiday destination instead of holidaying in this country is not a good idea.

Do you agree? Yes ☐ No ☐ Don't know ☐

2 a e.g.

Age, a (years)	Tally	Frequency
$20 \leqslant a < 30$		
$30 \leqslant a < 40$		
$40 \leqslant a < 50$		
$50 \leqslant a < 60$		
$60 \leqslant a < 70$		

b i

		Number of fillings		
		1–5	6–10	11+
Age, a (years)	$20 \leqslant a \leqslant 39$	1	3	1
	$40 \leqslant a \leqslant 59$	3	2	2
	60+		2	

ii 4 patients

iii $\frac{1}{2}$

3 Students' own questionnaires, e.g.

Are you in Year 9? Yes ☐ No ☐

Approximately what time did you go to sleep last night? .....

Approximately what time did you wake up this morning? .....

6.3 Calculating averages and range

1 a 40 cm **b** 161.88 cm

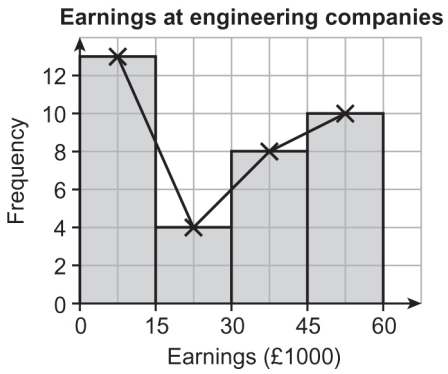
2 a 3 hours **b** 3 hours and 22 minutes

c 100 people **d** 50th item

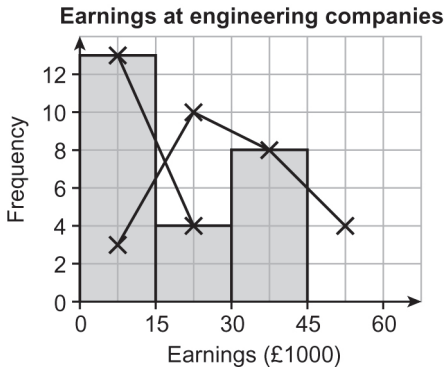
e 3 to 3.5 hours **f** 3 to 3.5 hours

6.4 Displaying and analysing data

1 a



b

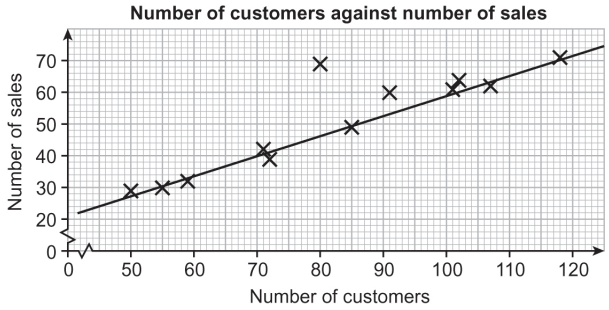


c e.g. In the first firm, most employees earn less than £15 000 or more than £45 000. The second firm has fewer employees, and most of them earn between £15 000 and £45 000.

d e.g. Make the class intervals for wages smaller, to be more accurate. Ask the employees their ages, to investigate whether that makes a difference to earnings. Look to see whether product prices and sales volumes are different between the two companies.

2 **a** Positive correlation

b



c Data point at (80, 70) circled

d 36 to 38 sales

e 86 to 88 customers

f e.g. 'Yes, it's 'about' half' or 'No, it's slightly more than half'

g e.g. Collect more data, by collecting similar data for a longer time.

6 Strengthen

Planning a survey

1 **a** Primary **b** Secondary

Collecting data

2 **a** A or B

b Either of the groups 10–20 cm or 20–30 cm

c The groups overlap

d 0–9 cm, 10–19 cm, 20–29 cm

3 **a** 810 **b** 17 140 **c** 255 340

4 **a** primary data

b secondary data

c primary data

5 **a** e.g. People leaving a swimming pool are likely to be people who take more exercise than the general population.

b e.g. People on a football team are likely to be people who take more exercise than the general population.

c e.g. Students at a school are younger than the average age.

Calculating averages and range

6 **a** 9000 m

b 4000 m

c 5000 m

d 19 mountains

e 4500, 5500, 6500, 7500, 8500

f 36 000, 22 000, 19 500, 15 000, 17 000

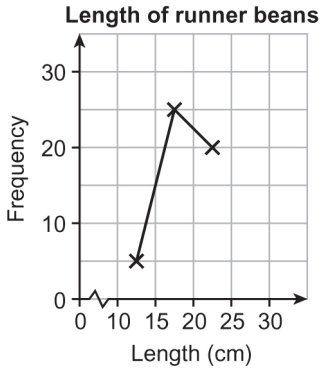
g 5763 m (to the nearest m)

Displaying and analysing data

7 **a**

Length, l (cm)	Midpoint	Frequency
$10 \leqslant l < 15$	12.5	5
$15 \leqslant l < 20$	17.5	25
$20 \leqslant l < 25$	22.5	20

b



8 **a** Positive correlation

b Data point at (22, 0.5) circled

c e.g. 'It's too low' or 'It should have half of the points above the line; this shows almost all of the points above the line.'

d Line of best fit drawn

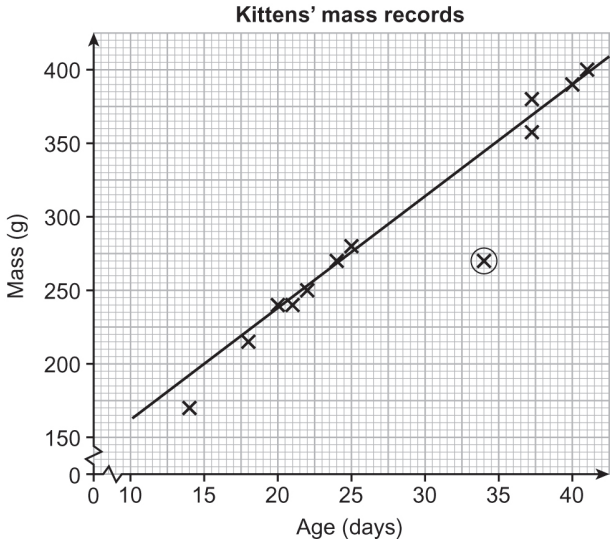
e Between 1600 and 1900 visitors

f 22.5 °C to 23 °C

6 Extend

1 **a** 102.4 (to 1 d.p.) **b** 100–119

2 **a**



b Data point at (34, 270) circled; e.g. this kitten was not healthy.

c Line of best fit drawn

i 310–320 g **ii** about 10 days

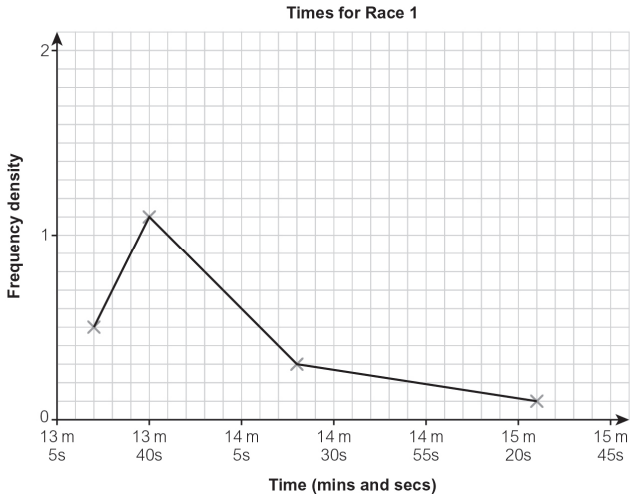
d e.g. Not very accurate, there is no data for very young kittens.

3 a i $40 \leqslant a < 60$ **ii** $20 \leqslant a < 40$

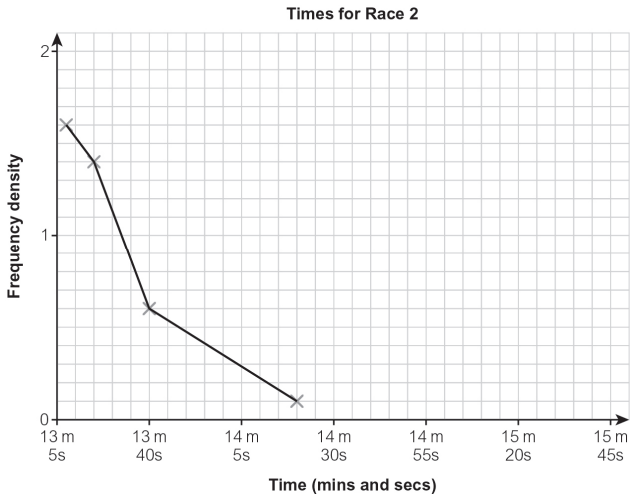
b i 40.6 years **ii** 43.3 years

c e.g. The projection estimates that there will be 10.8 million more people in the UK in 2035 than in 2010. The number of people over 80 years of age is predicted to go up by 2.9 million. The percentage of people over 80 years of age is predicted to rise from 4.65% in 2010 to 7.93% in 2035.

4 a



b



c The times for the 5000 m heats were faster in 2012 than in 1992.

6 Unit test

1 250

2 100 times

3 a The answer boxes overlap.

b e.g. ☐ 0 ☐ 1–3 ☐ 4–6 ☐ 7–9 ☐ 10+

4 a Primary data – individual times that male and female students can stand on one leg

b At least 10%, i.e. 80 students

c No, because she collected the data herself.

d e.g.

Males

Time (s)	Frequency
0–9	
10–19	
20–29	
30–39	
40+	

Females

Time (s)	Frequency
0–9	
10–19	
20–29	
30–39	
40+	

5 a Positive correlation

b Data point at (1.68, 82) circled

c Line of best fit drawn

d Between 70 kg and 73 kg

6 a i $0 \leqslant n < 100$ **ii** $100 \leqslant n < 200$

b i 108 cars **ii** 168 cars

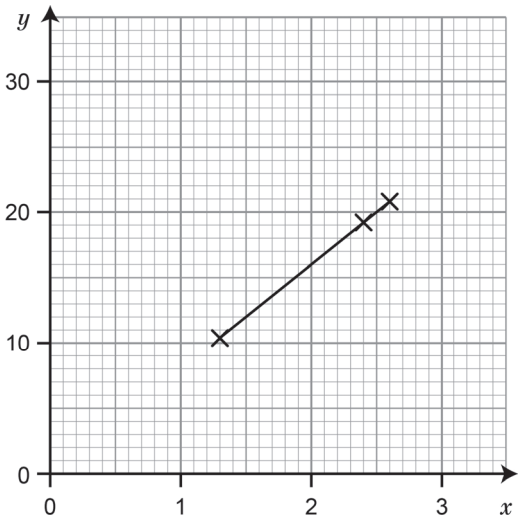
c e.g. Maier only did the survey for 22 hours while Samir did the survey over 24 hours. Samir recorded more hours with fewer cars passing. Samir and Maier recorded the same number of hours with $100 \leqslant n < 200$ cars passing.

Unit 7 Multiplicative reasoning

7.1 Direct proportion

1 Hana (Hana is charged \$11 per photograph while Freya is charged \$12 per photograph)

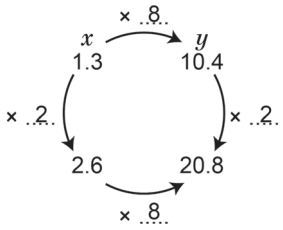
2 a



b Yes

c The answer is 8 for all three pairs of values.

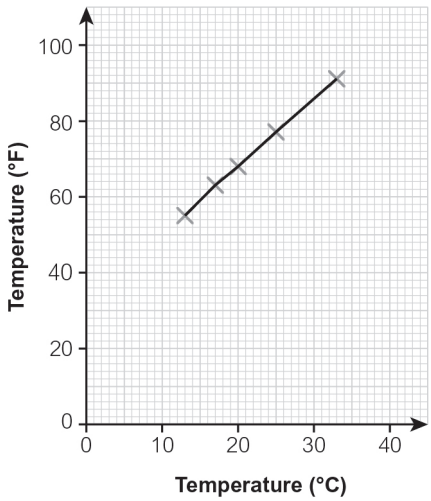
d



e $y = 8x$

3 a No, because the answer to $F \div C$ is not the same for each city.

b



4 a = 325.6 inches, b = 831 cm, c = 253.2 inches

7.2 Solving problems using direct proportion

1 a $C = 20p$ **b** $C = 3b$

c $S = 12t$ **d** $m = 4.5h$

2 a $P = 1.22a$ **b** \$48.80

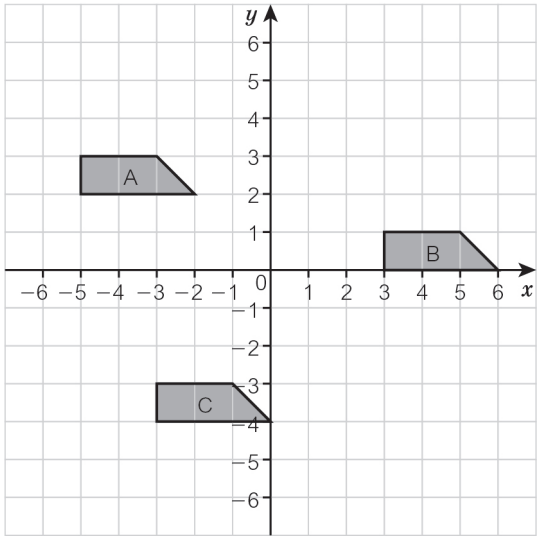
3 a $A = 1.8P$

b 270 Australian dollars

c £277.78

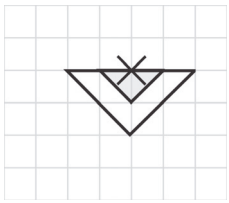
7.3 Translations and enlargements

1 a

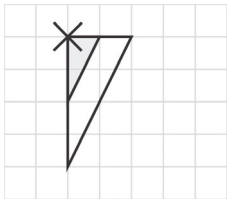


b $\begin{pmatrix} -2 \\ 6 \end{pmatrix}$

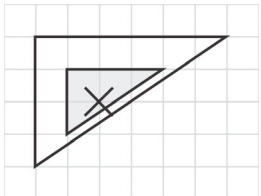
2 a



b



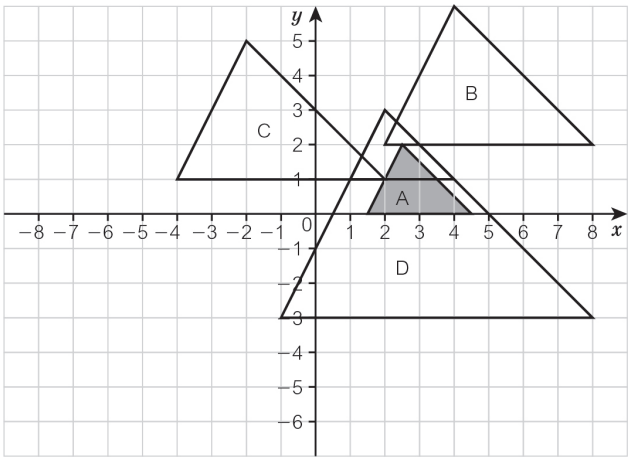
c



3 **a** Scale factor 2, centre of enlargement at (7, 1)

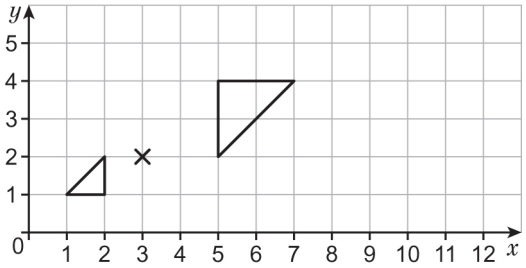
b Scale factor 3, centre of enlargement at (4, 3)

4 **a–c**

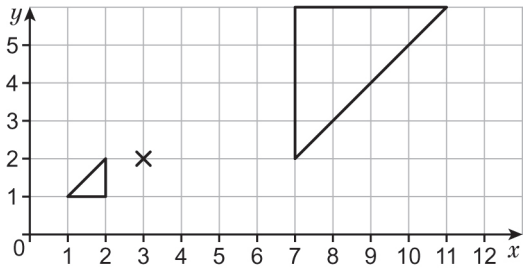


7.4 Negative and fractional scale factors

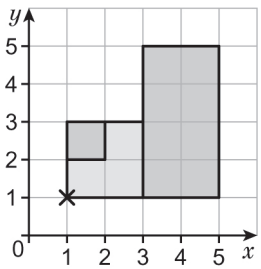
1 **a**



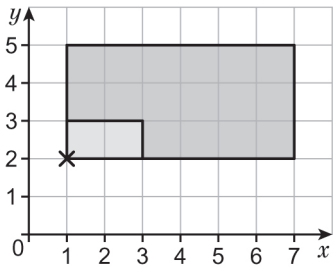
b



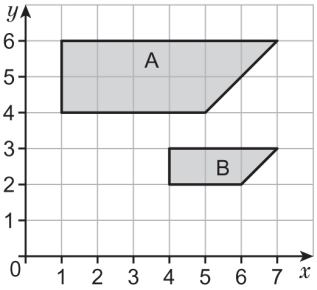
2 **a**



b



3 **a**



b 2 : 1

c Scale factor 2, centre of enlargement (7, 0)

7.5 Percentage change

1 $6500

2 **a** $65

b Dai saved more money (£13 > £12).

3 6%

4 22%

5 4%

7 Strengthen
Direct proportion

1 $a = 27$, $b = 32$

2 Yes, he charges $26 for each hour

3 **a** 97 Indian rupees

b $R = 97P$

c 12 610 rupees

Solving problems using direct proportion

4 **a** $P \propto Q$, $P = kQ$

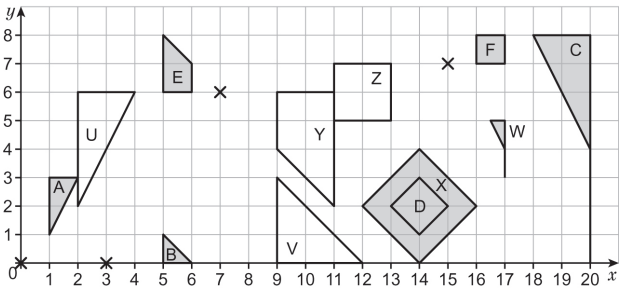
b $23.4 = 6.5k$ **c** $k = 3.6$

d $P = 3.6Q$ **e** 54

5 **a** $a = 0.36b^2$ **b** 43.56

Translations and enlargements

6 **a, b**



c Scale factor $\frac{1}{4}$, centre of enlargement (16, 4)

d Scale factor 2, centre of enlargement (14, 2)

e Shape Y drawn correctly.

f Shape Z drawn correctly.

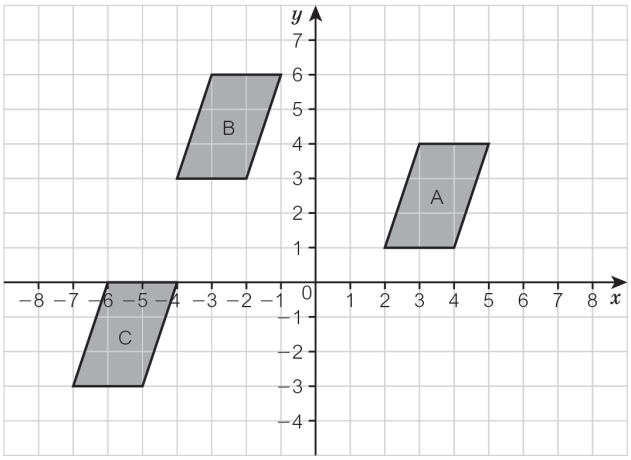
Percentage change

7 **a** 35 members
b 120 members
c 80 members

8 **a** 3% **b** Yes

7 Extend

1 **a**



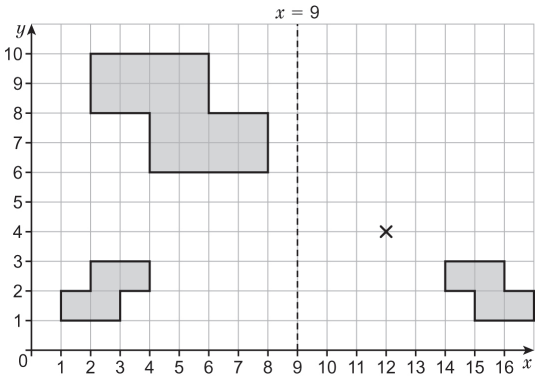
b $\begin{pmatrix} 3 \\ 6 \end{pmatrix}$

2 **a** Scale factor −3, centre of enlargement (2, 3)
b Scale factor −2, centre of enlargement (3, 4)

3 10.5 m

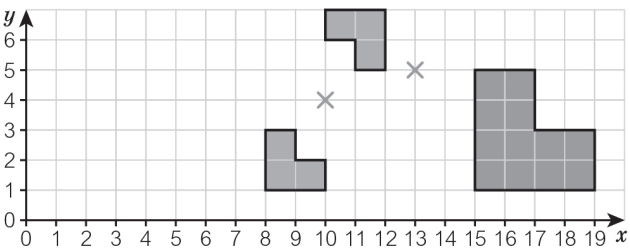
4 $22 600

5 **a** 20 units
b



c 10

6 **a**



b Enlargement with scale factor $\frac{1}{2}$, centre of enlargement (1, 1)

7 **a** 20.48 **b** ±30.6

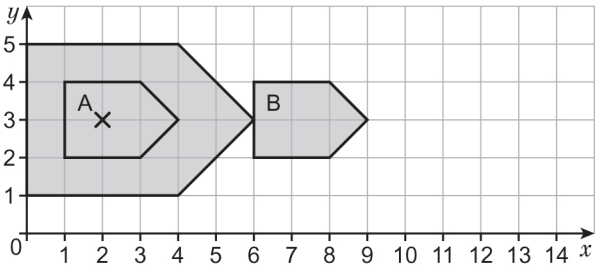
8 **a** 0.03125 **b** $1125 **c** $62.50

7 Unit test

1 **a** **i** Yes **ii** $C = 62b$
b **i** No **ii** $P = 0.05m + 12.95$

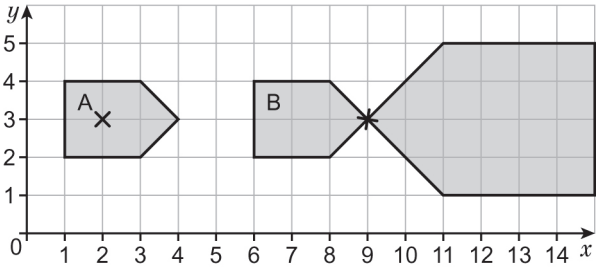
2 $x = 19$, $y = 135$

3 **a**

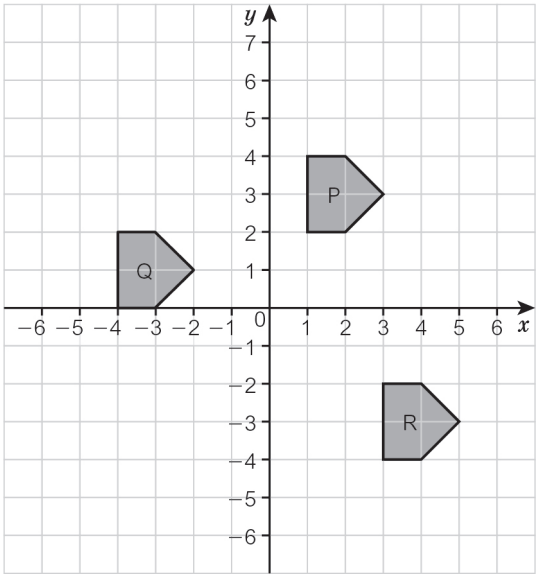


b scale factor 2, centre of enlargement (12, 3)

c



4 **a, b**



c $\begin{pmatrix} 2 \\ -6 \end{pmatrix}$

5 **a** $c = 1.375d$ **b** 82.5 **c** 24

6 20 members

7 60%

Unit 8 Scale drawings and measures

8.1 Maps and scales

1 Plan correctly labelled with 22 m, 16 m, 14 m, 3 m, 2 m, 19 m

2 **a** 600 m **b** 1800 m **c** 3750 m

3 **a** 20 mm **b** 80 mm **c** 280 mm

4 **a** 1 cm on the map is 100 km in real life.

b **i** about 80 km **ii** about 140 km **iii** about 45 km

8.2 Bearings

1 **a** 134° **b** 314°

2 **a** Accurate drawing of 4.4 cm line at angle of 138° to north line

b Accurate drawing of 2.7(2) cm line at angle of 326° to north line

3 **a** 280° **b** 040° **c** 150°

8.3 Scales and ratios

1 **a** 250 000 cm = 2500 m

b 3500 m

c 750 m

2 A iv B i C ii D iii

3 **a** 1 : 100 000 **b** 1 : 500 000

c 1 : 25 000 **d** 1 : 800 000

4 **a** Accurate scale drawing with a width of 2.5 cm and lengths of 3.5 cm for root vegetables, 1.5 cm for salad vegetables and 1 cm for onions.

b 2.5 cm by 1 cm rectangle drawn within the root vegetables patch and labelled ‘peas’.

c 25 m^2

5 **a** **i** 0.5 km **ii** 2.5 km **iii** 12.5 km

b **i** 2 m **ii** 40 cm **iii** 8 cm

8.4 Congruent and similar shapes

1 **b** The two sides of triangle P and the included angle, 90°, are the same as for triangle Q (SAS).

2 Triangle DEF (SSS), triangle GHI (SAS)

3 The missing angle in triangle ABC is 29°. The missing angle in triangle PQR is 39°. The two triangles are similar because corresponding angles are equal.

4 x = 9 cm

5 p = 2.5 cm, q = 3.6 cm

8.5 Solving geometrical problems

1 **a** angle SRT = 26° (vertically opposite angle to PRQ)

angle RST = 81° (alternate angle to RQP)

angle RTS = 73° (alternate angle to QPR)

b Yes, because corresponding angles are equal.

c Sketch of the two triangles, each with the same three angles labelled

2 **b** 12.5 **c** 6.5

3 308 m

8 Strengthen

Maps and scales

1 **a** 2 cm **b** 0.5 cm **c** 2.5 cm **d** 5 cm **e** 5 cm

2 **a** 2 m **b** 2.5 m **c** 5 m **d** 8.5 m **e** 13 m

3 **b** 1 : 200 **c** 1 : 1000 **d** 1 : 200 000

Bearings

4 **a** 037° **b** 082° **c** 160° **d** 230°

5 Accurate bearing of 065° drawn.

6 Accurate bearing of 310° drawn.

7 **a** 095° **b** 062° **c** 242° **d** 306°

Congruence and similarity

8 **a**

A	B
3	9
4	x
5	y

b scale factor 3 **c** x = 12, y = 15

9 a = 12 cm, b = 19.5 cm

10 Triangles D and E

11 **a** WX is parallel to YX, because WXV and YZV (both 90°) are corresponding angles.

YZ = 2WX, because VZ is twice as long as VX.

b For example, the angle at V is the same in both triangles, the angles at X and Z are both right angles, the third angles at W and Y must be the same.

c Scale factor 2

d 18 cm

8 Extend

1 **a, b** Accurate scale drawing

c 11.6 km

2 **a** 1 : 50 **b** 1 : 25 000

c 1 : 62 500

3 **a** 105° **b** 105° **c** 30°

d For example, the corresponding sides are equal (SSS).

4 **a** a = 10 cm, b = 6.5 cm

b c = 95°

c d = 10 cm, e = 40°, f = 95°

5 **a** 13 cm **b** 32.5 cm

6 Auckland

7 **a** Accurate drawing of an equilateral triangle, side length 2 cm, with arcs drawn 1 cm from each of the three vertices

b No

8 **a** 245° **b** 070°

9 16 cm

10 The pentagon is regular, so
AB = BC = CD = DE = AE and
AX = BX = CX = DX = EX (SSS).

8 Unit test

1 **a** 100 m **b** 200 m **c** 10 m

2 **a** 2 cm **b** 14 cm **c** 20 cm

3 **a** Accurate scale drawing

b 61 km

c 275°

4 **a** a = 75°, b = 9 cm, c = 9.5 cm, d = 75°, e = 9 cm, f = 35°, g = 75°

b For example, in triangle D the 9 cm side lies between a different pair of angles from the others.

5 **a** $6\frac{6}{7}$ cm **b** 9 cm

Unit 9 Accuracy and measures

9.1 Rates of change

1 **a** 80 mph
b 24 km/h
c 6.25 m/s

2 9.54 s

3 **a** 15 m/s
b 22.5 m/s
c 37.5 m/s

4 No, the average speed of a cheetah is about 28.6 m/s. 70 mph is about 31.1 m/s

5 **a** Driver R
b Driver P
c 32 mph

9.2 Density and pressure

1 Iron 7.9 g/cm^3, copper density 8.9 g/cm^3, gold 19.2 g/cm^3,

2 **a** 1.25 m^3
b 3000 kg
c 0.026 64 kg

3 3.7 N/cm^2

4 4 704 000 000 N

5 **a** Yes, the density is 0.94 g/cm^3
b No

9.3 Upper and lower bounds

1 **b** Upper bound = 65.5 km, lower bound = 64.5 km
c Upper bound = 290.45 g, lower bound = 290.35 g

2 Upper bound = 83 499, lower bound = 82 500

3 **a** 1.3p
b 1.1p

4 43.175 s ≤ t < 43.185 s

5 $\pm 1\frac{2}{3}$ ml

6 **a** Upper bound = 195 mm, lower bound = 185 mm
b Upper bound = 2340 mm, lower bound = 2220 mm
c ±60 mm

9 Strengthen

Rates of change

1 **a** 17.5 mph **b** 50 mph

2 16 minutes and 40 seconds

3 **a** C **b** 50 km/h

Density and pressure

4 **a** 8 kg/m^3 **b** 19.32 g/cm^3

5 2.4 N/cm^2

Upper and lower bounds

6 **a** Upper bound = 308.5 m, lower bound = 307.5 m
b Upper bound = 54.65 million km, lower bound = 53.55 million km
c Upper bound = 2.455 m, lower bound = 2.445 m

7 43 499 and 42 500

8 210 ± 5 mm

9 3.95 cm and 2.45 cm

9 Extend

1 152.5 mm and 147.5 mm

2 The nearest 100 kg

3 60.5 cm^3

4 About 35 minutes and 20 seconds

5 **a** 1.376 kg
b 13.48 N
c 0.337 N/cm^2
d 0.843 N/cm^2

6 **a** 1000 g ± 5 g
b 12 000 g ± 60 g
c 125 g ± 0.625 g

7 76 km/h

8 0.01 m^2

9 Unit test

1 **a** 62.5 g **b** 61.5 g

2 495 ml ≤ C < 505 ml

3 90 mph

4 54 km/h

5 5.5 g/cm^3

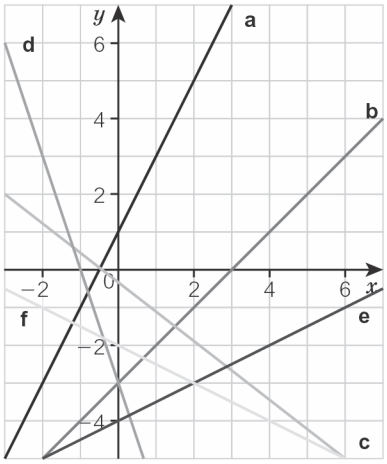
6 4030 N/m^2

7 11.75 m or 1175 cm

Unit 10 Graphical solutions

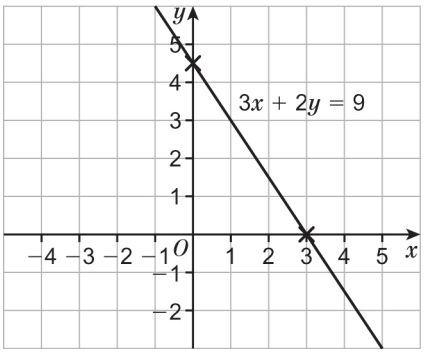
10.1 Drawing graphs

1

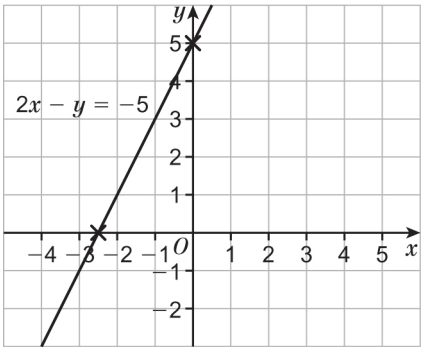


2 Equations A and E, equations B and D, equations C and F.

3



4



5 Line C; it has a gradient of 5.

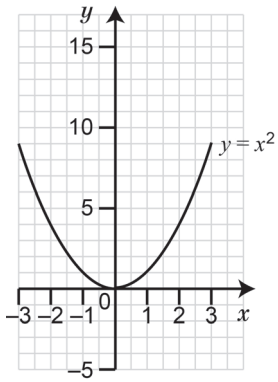
6 Lines B and C (as $5x + 2y = -8$ can be rearranged to $y = -2.5x - 4$)

10.2 Graphs of quadratic functions

1 a

x	−3	−2	−1	0	1	2	3
y	9	4	1	0	1	4	9

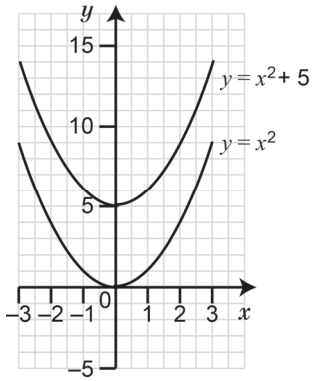
b



c

x	−3	−2	−1	0	1	2	3
y	14	9	6	5	6	9	14

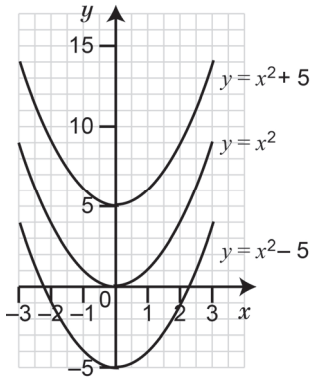
d



e They are the same shape and size.

f The y-intercepts are different.

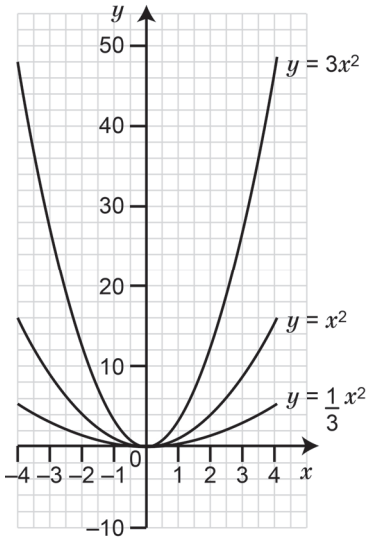
g



2 **a**

x	−4	−3	−2	−1	0	1	2	3	4
y	48	27	12	3	0	3	12	27	48

b



c They are all 'U' shaped.

d The steepness of the graphs is different.

3 **a** **i** Graph C **ii** Graph A **iii** Graph E
iv Graph D **v** Graph F **vi** Graph B

b A (0, 0) minimum; B (0, 5) maximum
C (0, 0) minimum; D (0, 0) maximum
E (0, 5) maximum; F (0, 0) maximum

10.3 Simultaneous equations

1 **a** $x = 5.5, y = 11$

b $x = 8, y = 32$

c $x = 3.25, y = 6.5$

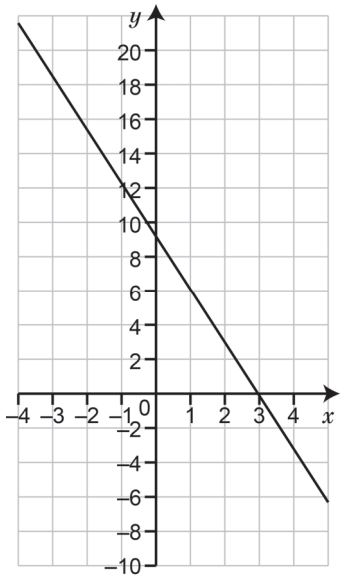
d $x = 5.6, y = 16.8$

2 **a** $x = 5, y = 3$ **b** $x = 7, y = 4$

3 **a** $x = 4, y = 2$ **b** $x = 7, y = 2$

10.4 Using $y = mx + c$

1 **a**



b gradient = −3, y-intercept = (0, 9)

c $y = -3x + 9$

d $y = -3x + 9$
The answers to parts **c** and **d** are the same.

2 **a** **i** $y = 5x + 2$ **ii** $y = \frac{3}{4}x + \frac{7}{4}$ **iii** $y = -6x + 8$

b $y = -6x + 8$

3 **a** Yes, y-intercept = 5

b Yes, y-intercept = −6

4 **a** $y = 4x - 6$ **b** $y = 2x - 10$

10.5 More simultaneous equations

1 **a** $x = 7, y = 9$ **b** $x = 5, y = 8$ **c** $x = 4, y = 7$
d $x = 11, y = 2$ **e** $x = 3, y = 10$

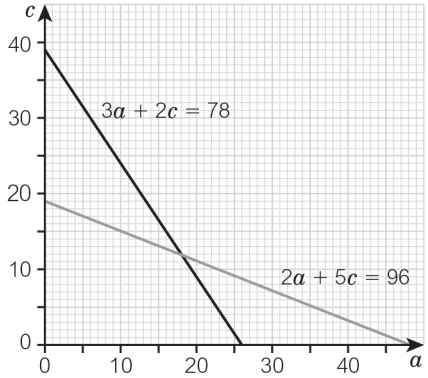
2 **a** $x = 12, y = 5$ **b** $x = 7, y = 4$
c $x = 6, y = 11$

10.6 Graphs and simultaneous equations

1 $x = 3, y = 1$

2 **a** $3a + 2c = 78$, $2a + 5c = 96$

b



c Adult £18, Child £12

3 $x = -1$, $y = 2$ and $x = 2$, $y = -1$

4 **a** For example, $x + y = 5$

b For example, substituting $y = -x + 5$ into $y = -x^2 + 3$ gives $-x + 5 = -x^2 + 3$; this rearranges to give $-x^2 + x - 2 = 0$, which does not have any solutions.

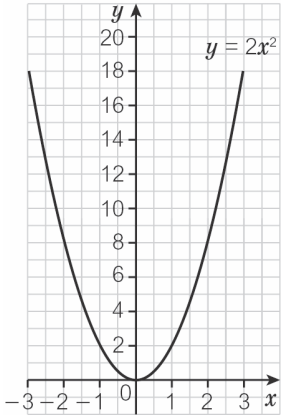
10 Strengthen
Quadratic graphs

1 **a**

x	−3	−2	−1	0	1	2	3
x^2	9	4	1	0	1	4	9
$y = 2x^2$	18	8	2	0	2	8	18

b (−3, 18), (−2, 8), (−1, 2), (0, 0), (1, 2), (2, 8), (3, 18)

c

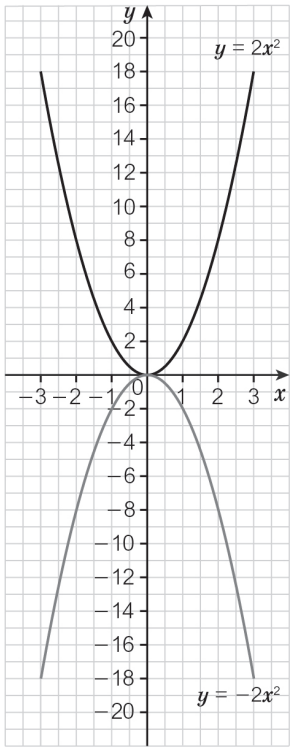


d (0, 0) **e** Minimum

2 **a**

x	−3	−2	−1	0	1	2	3
$y = 2x^2$	18	8	2	0	2	8	18
$y = -2x^2$	−18	−8	−2	0	−2	−8	−18

b

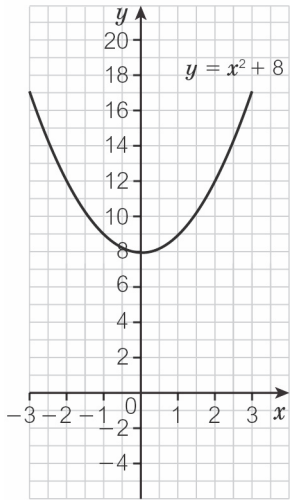


c (0, 0) **d** A reflection in the x-axis

3 **a**

x	−3	−2	−1	0	1	2	3
x^2	9	4	1	0	1	4	9
$y = x^2 + 8$	17	12	9	8	9	12	17

b



c **i** (0, 8) **ii** When $x = 0$, $y = 8$

d **i** (0, 3) **ii** (0, 10)

4 **i** graph C **ii** graph D

iii graph B **iv** graph A

Simultaneous equations

5 **a** $x = 1, y = 5$ **b** $x = 8, y = 4$ **c** $x = 2, y = 6$

6 **a** $8x = 56$

b They are eliminated as $y + -y = 0$.

c $x = 7$ **d** $y = 6$

7 **a** $2x = 24$

b They are eliminated as $y - y = 0$.

c $x = 12$ **d** $y = 7$

8 **a** $x = 2, y = 6$ **b** $x = 2, y = 6$

9 Gold 12.4 kg, silver 1 kg

Straight-line graphs

10 **a** **i** $y = 7x + 2$ **ii** $y = 3x + 2$ **iii** $y = 4x + 5$

b **i** gradient = 7, y-intercept = (0, 2)

ii gradient = 3, y-intercept = (0, 2)

iii gradient = 4, y-intercept = (0, 5)

11 **a**

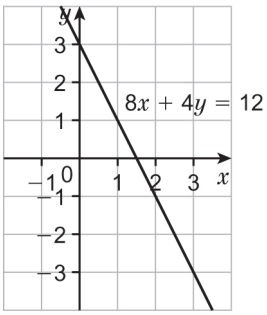
$y = mx + c$	Gradient m	y-intercept (0, c)
$y = 2x + 6$	2	(0, 6)
$y = -4x + 1$	−4	(0, 1)
$y = 2x + 1$	2	(0, 1)
$y = \frac{1}{4}x - 7$	$\frac{1}{4}$	(0, −7)

b $y = 2x + 6$ and $y = 2x + 1$

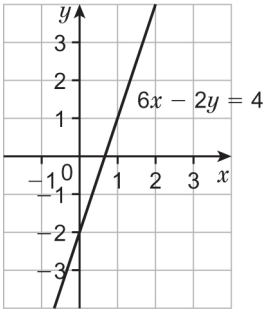
c $y = -4x + 1$ and $y = 2x + 1$

12 **a** **i** (0, 3) **ii** $(1\frac{1}{2}, 0)$

b



c



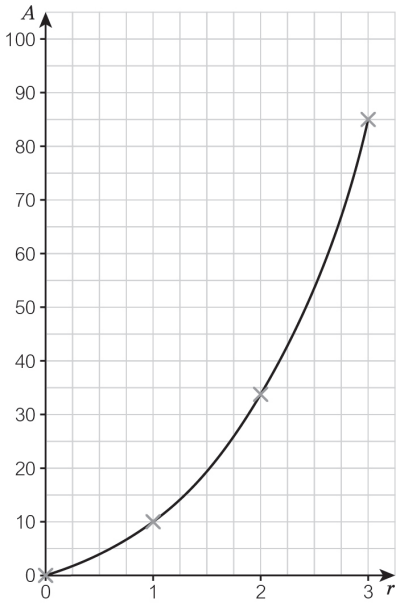
d (1, 1)

13 **a** $7 = 3m + c$ **b** $11 = 5m + c$

c $m = 2, c = 1$ **d** $y = 2x + 1$

10 Extend

1 **a**



b **i** about 21 cm²

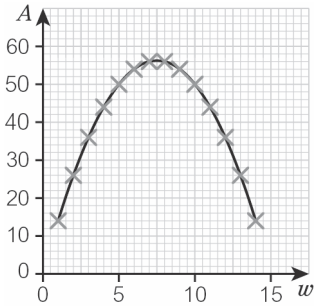
ii about 2.3 cm

2 **a** $x = 2, y = -6$ **b** $x = -3, y = 12$

3 $y = -3.5x - 39.5$

4 **a** $A = w(15 - w)$

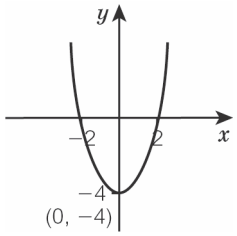
b



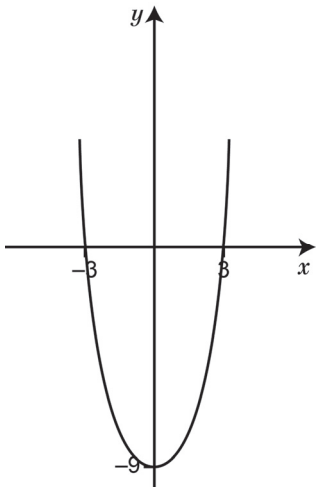
c **i** 56.25 cm² **ii** about 3.5 cm by 11.5 cm

5 **a** $(x + 2)(x - 2)$

b **i, ii**



c



6 $x = 6, y = 5$

7 **a** One solution, $x = -3, y = -5$

b Infinitely many y solutions

c One solution, $x = 0, y = -5$

8 Cake 75p, biscuit 30p

9 **a** $a = 5$ cm, $b = 8$ cm

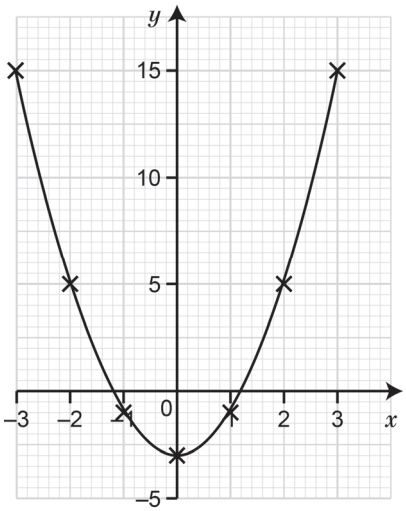
b $a = 13.4°, b = 7.4°$

10 Unit test

1 **a**

x	−3	−2	−1	0	1	2	3
y	15	5	−1	−3	−1	5	15

b



2 **a** **i** gradient = 2

ii y-intercept = (0, 9)

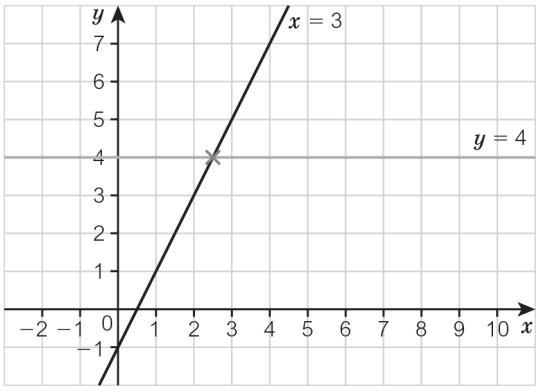
b **i** gradient = $\frac{1}{2}$

ii y-intercept = (0, −5)

3 $y = 4x - 16$

4 **a** $x = 10, y = 3$ **b** $x = 4, y = 7$ **c** $x = 2, y = 9$

5 **a**



b $(2\frac{1}{2}, 4)$

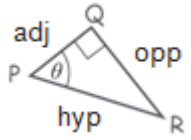
6 **a** $3x + y = 79$ **b** $7x + y = 151$

c $x = £18, y = £25$

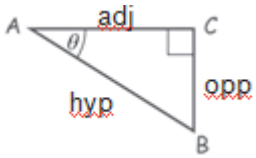
Unit 11 Trigonometry

11.1 The tangent ratio

1 b



c



2 a 2.1 **b** 0.8

3 a $\tan\theta = \frac{3}{4}$ **b** $\tan\theta = \frac{5}{6}$ **c** $\tan\theta = \frac{7}{5}$

4 a 4.8 cm **b** 4.2 cm **c** 8.0 cm
d 3.7 cm **e** 9.0 cm

11.2 The sine ratio

1 a 0.8 **b** 0.4 **c** 1.0

2 a $\sin\theta = \frac{5}{8}$ **b** $\sin\theta = \frac{7}{12}$ **c** $\sin\theta = \frac{9}{15}$

3 a 4.5 cm **b** 7.2 cm **c** 12.3 cm
d 5.9 cm **e** 16 cm

4 a i sine ratio **ii** 9.2 cm
b i tangent ratio **ii** 10 cm

11.3 The cosine ratio

1 a 0.9 **b** 0.1 **c** 0.7
d 1.0

2 a $\cos\theta = \frac{7}{9}$ **b** $\cos\theta = \frac{9}{12}$ **c** $\cos\theta = \frac{3}{10}$

3 a 4.8 cm **b** 7.7 cm **c** 4.8 cm
d 21.3 cm **e** 12.4 cm **f** 11.7 cm

4 a i tangent ratio **ii** 4.7 cm
b i cosine ratio **ii** 10.6 cm

11.4 Using trigonometry to find angles

1 a i 24.6° **ii** 36.9°
b i 39.8° **ii** 54.5°
c i 38.9° **ii** 72.5°

2 a 50.2° **b** 56.3° **c** 57.0°
d 47.5°

3 5.7°

4 054°

11.5 Solving problems using trigonometry

1 a 54.0° **b** 65.0° **c** 46.2°

2 a 153.2 km **b** 128.6 km

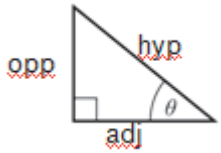
3 41.5 cm^2

4 24.2°

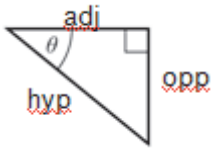
5 27.9°

11 Strengthen
Unknown sides

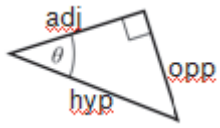
1 a



b



c



2 a i $\tan\theta = \frac{12}{16}$ **ii** $\sin\theta = \frac{12}{20}$
iii $\cos\theta = \frac{16}{20}$

b i $\tan\theta = \frac{36}{77}$ **ii** $\sin\theta = \frac{36}{85}$
iii $\cos\theta = \frac{77}{85}$

c i $\tan\theta = \frac{15}{8}$ **ii** $\sin\theta = \frac{15}{17}$
iii $\cos\theta = \frac{8}{17}$

3 a 17.2 cm **b** 7.0 cm **c** 6.8 cm

4 **a** x cm labelled 'opp' and 9 cm labelled 'hyp'
b Sine ratio
c $\sin 62^\circ = \frac{x}{9}$
d $x = 9 \sin 62^\circ$
e 7.9 cm

5 **a** 15.2 cm **b** 6.0 cm **c** 8.7 cm

Unknown angles

6 **a** 44.4° **b** 14.5°

7 **a** 51.3° **b** 36.9°

8 **a** 16.7° **b** 35.0°

9 **a** 32.0° **b** 36.9° **c** 54.3°

10 **a** 4 cm labelled 'adj' and 9 cm labelled 'hyp'.
b Cosine ratio **c** $\cos\theta = \frac{4}{9}$
d $\theta = \cos^{-1}\frac{4}{9}$ **e** 63.6°

11 **a** 47.2° **b** 52.4° **c** 45.6°

12 **a** $a = 36.9°$ **b** $b = 7$ cm **c** $c = 10$ cm
d $d = 60°$ **e** $e = 15.3$ cm

Solving problems

13 **a** sine ratio **b** 5.7 m

14 036°

15 5.9 cm

11 Extend

1 **a** 9.4 cm **b** 13.6 cm **c** 10.2 cm

2 **a** 52.4° **b** 51.1° **c** 45.4°

3 **a** 52.0 km **b** 13.9 km

4 **a** 33.7° **b** 56.4° **c** 89.9°

5 40.4°

6 **a** 5.35 m **b** 21.4°

7 **a** 8.9 cm **b** 29.2° **c** 10.2 cm

8 **a** 21.2 cm **b** 48.5° **c** 16 cm

9 **a** 357.4 m to 1 d.p.
b 1.5 m/s to 1 d.p.

11 Unit test

1 **a** $\sin\theta = \frac{20}{29}$ **b** $\cos\theta = \frac{21}{29}$
c $\tan\theta = \frac{20}{21}$

2 **a** 14.5 cm **b** 9.3 cm

3 **a** 57.8° **b** 54.8°

4 1.4 m

5 **a** 5.8 cm **b** 17.8 cm **c** 51.3 cm^2

6 12.3 cm

7 **a** 17 cm to 1 d.p.
b 35.3° to 1 d.p.
c 20.8 cm to 1 d.p.

Unit 12 Probability

12.1 Set notation and Venn diagrams

1 **a** P = {2, 3, 5, 7, 11}

b No, as 1 is not a prime number.

c No, as 2 is both an even and a prime number.

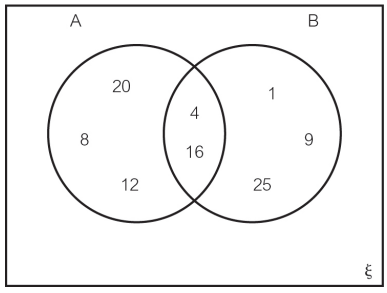
2 C = {4}

3 **a** A = {4, 8, 12, 16, 20}

b B = {1, 4, 9, 16, 25}

c A ∩ B = {4, 16}

d

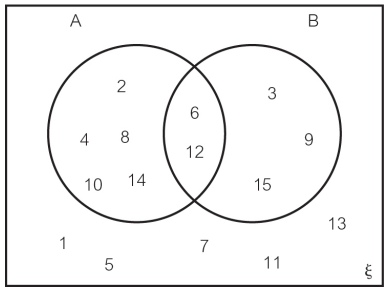


e A′ = {1, 9, 25}

f B′ = {8, 12, 20}

g A ∪ B = {1, 4, 8, 9, 12, 16, 20, 25}

4 **a**



b **i** A ∪ B = {2, 3, 4, 6, 8, 9, 10, 12, 14, 15}

ii A ∩ B = {6, 12}

iii A′ = {1, 3, 5, 7, 9, 11, 13, 15}

12.2 Probability diagrams

1 **a**

	H	T
1	H, 1	T, 1
2	H, 2	T, 2
3	H, 3	T, 3
4	H, 4	T, 4

b 8 outcomes

c **i** $\frac{2}{8} = \frac{1}{4}$ **ii** $\frac{2}{8} = \frac{1}{4}$

iii $\frac{3}{8}$

2 **a**

		First spin			
		1	**2**	**3**	**4**
Second spin	**1**	2	3	4	5
	2	3	4	5	6
	3	4	5	6	7
	4	5	6	7	8

b 16 outcomes **c** 5

d **i** $\frac{1}{16}$ **ii** $\frac{4}{16} = \frac{1}{4}$ **iii** $\frac{10}{16} = \frac{5}{8}$

3 **a** 3 students **b** 9 students **c** $\frac{17}{39}$

4 **a**

		First dart		
		3	**19**	**7**
Second dart	**3**	6	22	10
	19	22	38	26
	7	10	26	14

b **i** $\frac{1}{9}$ **ii** $\frac{4}{9}$ **iii** $\frac{5}{9}$

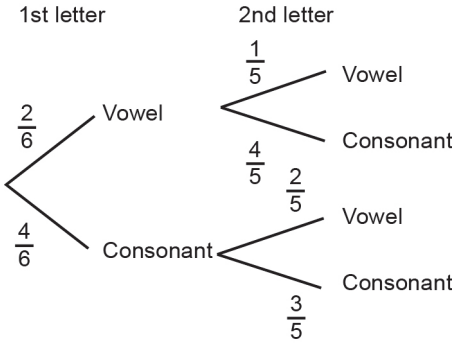
12.3 Tree diagrams

1 **a** The missing probabilities on the tree diagram are $\frac{3}{8}$ for blue and $\frac{5}{8}$ for red.

b $\frac{25}{64}$ **c** $\frac{30}{64} = \frac{15}{32}$

2 **a** $\frac{2}{6} = \frac{1}{3}$ **b** 5 letters **c** $\frac{1}{5}$

d



e **i** $\frac{2}{30} = \frac{1}{15}$

ii $\frac{8}{30} = \frac{4}{15}$

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

12.4 Experimental and theoretical probabilities

1 a 50

b i $\frac{37}{50}$ **ii** $\frac{13}{50}$

c about 74 times

2 a $\frac{4}{52} = \frac{1}{13}$ **b** $\frac{13}{52} = \frac{1}{4}$

3 a About 25 times

b About 25 times

c About 56 marbles

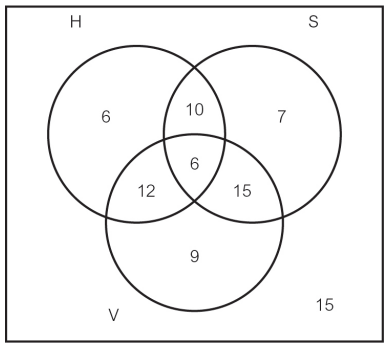
4 a $\frac{1}{3}$ **b** About 50 times

c Students' own answers (probably Yes); she could spin it more times.

12 Strengthen

Set notation and Venn diagrams

1 a



b 15 students aren't members of these sports clubs.

Probability diagrams

2 a

		Dice					
		1	**2**	**3**	**4**	**5**	**6**
Spinner	**1**	1, 1	2, 1	3, 1	4, 1	5, 1	6, 1
	1	1, 1	2, 1	3, 1	4, 1	5, 1	6, 1
	2	1, 2	2, 2	3, 2	4, 2	5, 2	6, 2
	2	1, 2	2, 2	3, 2	4, 2	5, 2	6, 2
	3	1, 3	2, 3	3, 3	4, 3	5, 3	6, 3
	3	1, 3	2, 3	3, 3	4, 3	5, 3	6, 3

36 outcomes

b i $\frac{1}{6}$ **ii** $\frac{2}{9}$ **iii** $\frac{5}{9}$

c 2 odd numbers

d

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

e 4, 5 or 6

f $\frac{5}{6}$

3 a

Spinner A \ Spinner B	1	1	2	2	3	3
1	0	0	1	1	2	2
2	1	1	0	0	1	1
3	2	2	1	1	0	0
4	3	3	2	2	1	1
5	4	4	3	3	2	2
6	5	5	4	4	3	3

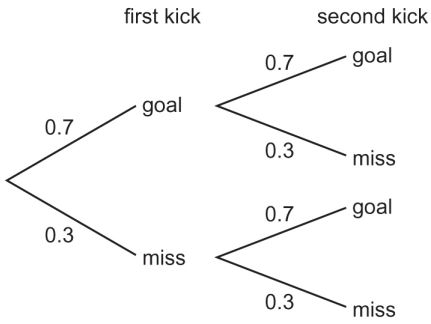
b i $\frac{1}{18}$ **ii** $\frac{2}{9}$ **iii** $\frac{1}{6}$

Tree diagrams

4 a 0.49

b i 0.21 **ii** 0.21 **iii** 0.42

5 a



b P(M, G) + P(G, M)
= 0.7 × 0.3 + 0.3 × 0.7 = 0.42

Experimental and theoretical probability

6 a

	Male	Female	Total
Adult	11	15	26
Child	20	4	24
Total	31	19	50

b 0.3

12 Extend

1 a 8

b Yes. 9 is not an element of B.

c No. 3 and 6 are elements of A.

2 a i 4 people **ii** 12 people

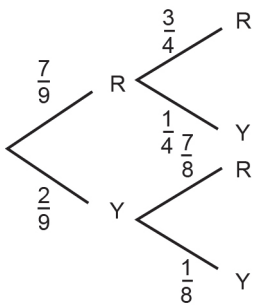
b 20 people **c** $\frac{1}{5}$

3 $\frac{3}{8}$

4 a $\frac{3}{28}$ **b** $\frac{11}{14}$

5 a No; e.g. if the marble had been replaced, the probability of the second marble being yellow would have been $\frac{2}{9}$ not $\frac{1}{4}$.

b



c $\frac{7}{18}$

6 Let x be the number of brown socks.

$$P(B \cap B) = \frac{x}{20} \times \frac{x-1}{19}$$

and since $P(B \cap B) = \frac{1}{19}$

$$\frac{x(x-1)}{380} = \frac{1}{19} \Rightarrow x(x-1) = 20$$

$$x^2 - x - 20 = 0$$

$$(x-5)(x+4) = 0$$

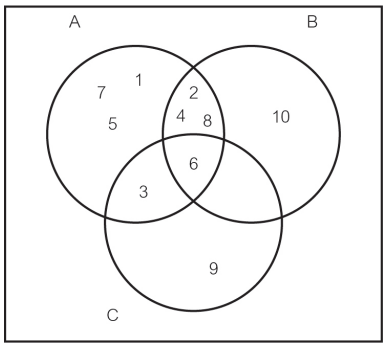
$$x = 5 \text{ or } x = -4$$

Since x is positive, $x = 5$

So there are 5 brown socks.

12 Unit test

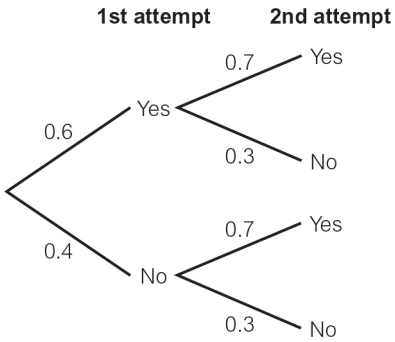
1



2 $\frac{3}{10}$

3 5, 6 or 7

4 a



b 0.42