1 Factorising, simplifying and sequences

What you need to know

1 **a** 23 **b** 35 **c** 35

2 Both answers are the same

3 **a** **i** $3 \times 5 \times 7$ **ii** $2 \times 3 \times 7$ **b** 21

4 $5a + 10b + 3a^2$

5 **a** $5a$ **b** 7 and b

Exercise 1.1A

1 **a** $2x + 14$ **b** $3y + 12$ **c** $6d - 30$ **d** $8c + 16$ **e** $6z - 36$ **f** $5h - 5$
g $12 + 3a$ **h** $18 + 6c$ **i** $18 - 2t$ **j** $21 + 7b$ **k** $45 - 9h$ **l** $66 + 11k$

2 **a** $8x + 20$ **b** $30e - 5$ **c** $18 - 8p$ **d** $21c + 35$ **e** $45 + 30b$ **f** $80h - 8$
g $10c - 35d$ **h** $15f + 9g$ **i** $28x - 63y$ **j** $27m - 18n$ **k** $60s + 24t$ **l** $42u + 30v$

3 **a** $-2x - 6$ **b** $-8y - 4$ **c** $-5d + 10$ **d** $-14c + 21$ **e** $-6z + 6$ **f** $-9h + 12$
g $-k + 1$ **h** $-4 + 2x$ **i** $-2h - 5$

4 **a** £16 000(10 + 15) or (£16 000 × 10 + £16 000 × 15) = £400 000
b 12(1·5 + 2·5) hours or (12 × 1·5 + 12 × 2·5) hours = 48 hours
c Doing the addition in the bracket first as this gives only one multiplication calculation to do

Exercise 1.1B

1 **a** $7(x + 8) = 7x + 56$ **b** $5(3x + 7) = 15x + 35$ **c** $5(2a + 6) = 10a + 30$ **d** $4(y - 6) = 4y - 24$

2 **a** $3(4a + 5b)$ grams **b** $12a + 15b$ grams

3 **a** Scots mile = $m + x$ metres **b** League = $3(m + x)$ metres
c League = $3m + 3x$ metres
i $3m$ metres in 3 UK miles
ii 3 Scots miles are $3x$ metres longer

4 **a** $4(c + 4b)$ **b** $4c + 16b$

5 **a** $T = 200(d + p + s)$ **b** $T = 200d + 200p + 200s$
c **i** $T = 200(45 + 60 + 25) = 200 \times 130 = 26\,000$ kB
or $T = 200 \times 45 + 200 \times 60 + 200 \times 25 = 9000 + 12\,000 + 5000 = 26\,000$ kB
ii Formula with the brackets

6 **a** $6(4p + 7)$ **b** $24p + 42$
c **i** $2(n - 1)$ **ii** $7n + 2(n - 1)$ **iii** $9n - 2$

7 **a** $x + 3y + 180 + 150 + 170 = x + 3y + 500$
b $12\,000 - 12(x + 3y + 500)$ **c** $6000 - 12x - 36y$

8 **a** $x^2 + 2x$ **b** $e^2 - e$ **c** $3p^2 - p$ **d** $4c^2 + 3c$ **e** $3b + 2b^2$ **f** $2h^2 - 5h$
g $3c^2 - 4cd$ **h** $2fg + g^2$ **i** $x^2 - 2xy$ **j** $mn - n^2$ **k** $-5t^2 - 2st$ **l** $4u^2 + u^2v$

9 **a** $5x^2 - 40x$ **b** $15a^2 + 9a$ **c** $4m^2 - 14m$ **d** $12p^2 + 16pq + 8p$
e $30ab - 36ac + 18a$ **f** $-50c^2 - 30c - 70$ **g** $-4x^2 + 20x + 16$

10 **a** 5000(30 + 10) pence or (5000 × 30 + 5000 × 10) pence
b $C = 30nb + 10ni$

Exercise 1.2A

1 **a** 4 **b** d **c** 2 **d** y **e** $4b$ **f** $3d$

2 **a** 1, 3, 5, 15 **b** 1, 2, 4, 7, 14, 28 **c** 1, 2, 4, 8, 16, m, $2m$, $4m$, $8m$, $16m$
d 1, 2, 17, 34, k, $2k$, $17k$, $34k$ **e** 1, 7, x, $7x$, x^2, $7x^2$ **f** 1, 3, 9, a, $3a$, $9a$, b, $3b$, $9b$, ab, $3ab$, $9ab$

3 **a** 2 **b** 5 **c** 4 **d** 7 **e** 4 **f** 28

4 **a** $5(y+1)$ **b** $7(b+c)$ **c** $9(1-f)$ **d** $3(p-q)$ **e** $2(t-4)$ **f** $2(3+2k)$
g $3x(2+3y)$ **h** $3d(5+4e)$ **i** $2(4e-5)$ **j** $9v(3+2u)$ **k** $5z(7-4xy)$ **l** $8(2a-3b)$
m $2x(5+4y)$ **n** $7s(2+t)$ **o** $7g(6f-5)$ **p** $11m(5m+4)$ **q** $9z(4z-5)$ **r** $16b(2a-b)$

5 **a** $19{\cdot}3(0{\cdot}8+9{\cdot}2)$ **b** 193 grams

6 **a** $2{\cdot}5\left(2\frac{35}{60}+1\frac{25}{60}\right)$ **b** 10 miles

7 **a** 700 **b** 12 **c** 235 **d** 37·9

8 **a** **i** Check **ii** 5, 3 **iii** 15
b **i** 1215 **ii** 12
c **i** Any number such as $2^1 . 3^6$ or $5^1 . 4^6$ **ii** $3^1 . 2^6$

Exercise 1.2B

1 **a** $1, 2, 3, 6, x+3, 2(x+3), 3(x+3), 6(x+3)$
b 1 and $6(x+3)$; 2 and $3(x+3)$; 3 and $2(x+3)$; 6 and $(x+3)$
c **i** $1, 5, 2y-1$; 1 and $5(2y-1)$; 5 and $(2y-1)$
ii $1, 5, 8m+9$; 1 and $5(8m+9)$; 5 and $(8m+9)$
iii $1, 3, c, 3c, 3+4d$; 1 and $3c(3+4d)$; 3 and $c(3+4d)$; c and $3(3+4d)$; $3c$ and $(3+4d)$

2 **a** $6c+18b$ **b** $6(c+3b)$
c **i** $c+3b$ **ii** $2c+6b$ **iii** $3c+9b$

3 **a** $150(2t+5)$ **b** $2t+5$ cm

4 **a** **i** $T=20+40c$ **ii** $T=20+40b$ **b** Time difference $=40c-40b$
c Time difference $=40(c-b)$ **d** Start the turkey 240 min or 4 hours before the chicken

5 **a** $6\times 15{\cdot}50+12\times 3{\cdot}30+6\times 7{\cdot}90$ **b** $6(15{\cdot}50+2\times 3{\cdot}30+7{\cdot}90)=£180$

6 **a** $F=mv_1-mv_2$ **b** $F=m(v_1-v_2)$

7 **a** **i** $A=\frac{1}{2}Hw$ **ii** $B=\frac{1}{2}bw$
b $\frac{1}{2}Hw+\frac{1}{2}bw=\frac{1}{2}w(H+b)$ **c** $10{\cdot}2\ \text{m}^2$

8 **a** 6(B2+C2*2)

9 **a** B3*3.68+C3*3.68*1.5 **b** 3.68(B2+C2*1.5) **c** 500 units of time

Exercise 1.3A

1 **a** $11b$ **b** xy **c** $8y(y+1)$ **d** $c(6-5b)$ **e** pq
f $z^2(1-z)$ **g** $6mn$ **h** $6x^2$ **i** $6bc$ **j** $11pq$

2 **a** $7x$ **b** $3d$ **c** $8m$ **d** $18r$ **e** $9st$
f $7t^2$ **g** $18ab$ **h** $8gh$ **i** $2k+3h$

3 **a** $4x+2y$ **b** $11f+4g$ **c** $10z+4y-4$ **d** $13r+3+3k$ **e** $13g^2+8g+3$
f 1 **g** t^2+3t **h** y^3-2y^2 **i** $12w-2vw$ **j** $7cd+2d$
k $8b+cb$ **l** $qr-r+1$ **m** $23pq-13p+2$

4 $6t+2h+5t-3t=8t+2h$ grams

5 **a** $4x+12$ **b** $4y-5$ **c** $3x$ **d** $6y+10k+1$ **e** $11x+23$
f $23x-8$ **g** $17x-14$ **h** $30-z$ **i** $4y+6$

6 **a** $£[50x+5(x-1)+(3x+7)+20]$
b $£(58x+22)$
c Nearest answer is when $x=10$, cost $=£602$. Other answers are £22 more or less than £602, so £600 is impossible.

7 **a** $15x-12$ **b** *Top row:* $4x-3, 9x-8$, *bottom row:* $8x-7, x, 6x-5$
c $x=3$ **d** 18, 33, 48, 63, ... any birthday of form $15n-12$, $n=2, 3, 4, 5, 6, 7$

Exercise 1.3B

1 **a** $3d+7e$ **b** $10g-6h$ **c** $6v-w$ **d** $l+8m$ **e** $3r+3s$

2 **a** $2a+10b$ **b** $20x+10y$ **c** $14p+17q$ **d** $10r+24s$
e $6s-t$ **f** $3k+4l$ **g** $15l-30m$ **h** $22n-3m$

3 **a** $10x+27y$ **b** $14l+7m$ **c** $24j-2k$ **d** $42a-12b$
e $31m$ **f** $-7p+5q$ **g** $-5r-9s$ **h** $-18a-b$

4 **a** $V_1 = 2 \,.\, 3(x + 4)$, $V_2 = 4 \,.\, 3(2x - 1)$
b $x = 2$
c Box 1 = 2 cm × 3 cm × 6 cm, box 2 = 4 cm × 3 cm × 3 cm

5 **a** $A + 0{\cdot}04A$ **b** $A(1 + 0{\cdot}04)$ or $1{\cdot}04A$ **c** 1·04

6 **a** $L + 0{\cdot}0001L$ **b** $L(1 + 0{\cdot}0001)$ or $1{\cdot}0001L$ **c** 1·00025 km

7 **a** **i** $21x + 4$ **ii** $x = 4$ **iii** 24, 15, 6, 1
iv No. If $21x + 4 = 100$, then $x = \frac{32}{7}$. For this value of x none of the original expressions is a whole number.
b $p + 3q + 3r + s$
c **i** $(x + 1) + 3(2x + 1) + 3(2x - 1) + (5x + 2)$ **ii** $18x + 3$
iii $18x + 3 = 3(6x + 1)$, 3 is a factor, therefore top number is divisible by 3
d **i** $23x - 17$, $12x + 16$ **ii** $x = 3$

Exercise 1.4A

1 **a** 7, 10, 13, 16, 19 **b** 6, 13, 20, 27, 34 **c** 8, 16, 24, 32, 40
d 4, 13, 22, 31, 40 **e** 9, 8, 7, 6, 5 **f** 17, 14, 11, 8, 5

2 **a** $4 \times 1 + 2012 = 2016$ **b** 2052 **c** 2042

3 **a** **i** 124 mm **ii** 142 mm
b 100 mm
c 100, 106, 112, 118

4 **a** 32 °F, 41 °F, 50 °F, 59 °F, 68 °F **b** 0 °C, 5 °C, 10 °C, 15 °C, 20 °C
c **i** $n = 13$ **ii** 60 °C

5 **a** **i** $3n + 2$ **ii** 302
b **i** $9n - 2$ **ii** 898
c **i** $57 - 7n$ **ii** −643
d **i** $2n + 2$ **ii** 202
e **i** $8n - 7$ **ii** 793
f **i** $102 - 2n$ **ii** −98

6 **a** 11 **b** $2011 - 11n$ **c** 1351 ml

7 **a** $7n - 2$ **b** 103rd day
c **i** $30n - 14$ **ii** 196th day
d **i** 166th day **ii** 24th Sunday

Exercise 1.4B

1 **a** $\frac{1}{2}n(n + 1)$ **b** 55 **c** 21

2 **a** 1, 4, 9, 16, 25, 36 **b** 3, 5, 7, 9, 11 **c** $2n + 1$ (odd numbers)

3 **a** n; $2n + 3$ **b** $n(2n + 3)$ **c** 9, 13, 17, 21, ... nth term is $4n + 5$

4 **a** 5 **b** 1, 4, 9, 16, 25, ...
c **i** n^2 **ii** $5n^2$
d 500 metres **e** 145 metres

5 **a** 0, 3, 8, 15, 24, 35, ... **b** $n^2 - 1$ **c** 3, 5, 7, 9, ... nth term is $2n + 1$ (odd numbers)

Preparation for assessment

1 **a** $7(5w + 4s)$ cm **b** $35w + 28s$ cm

2 **a** **i** $(c + 2f + 25)$ grams **ii** $30(c + 2f + 25)$ grams **b** $30c + 60f + 750$ grams

3 **a** $3(x - c)$ km **b** $2(x + c)$ km **c** **i** $3(x - c) + 2(x + c)$ km **ii** $5x - c$ km

4 40(5+C2)

5 **a** $7(4t + 6 \times 22)$ kg **b** $3(2t + 4 \times 22)$ kg
c **i** $7(4t + 6 \times 22) + 3(2t + 4 \times 22)$ kg **ii** $34t + 1188$ kg

6 $102x + 208$ cm^2

7 **a** 1, 4, 7, 10, 13, ... **b** 75 **c** $3n + 1$

8 Area of fireplace $= \frac{1}{2} \times 5{\cdot}39 \times 2{\cdot}14 + \frac{1}{2} \times 4{\cdot}61 \times 2{\cdot}14 = \frac{1}{2} \times 2{\cdot}14(5{\cdot}39 + 4{\cdot}61) = \frac{1}{2} \times 2{\cdot}14 \times 10 = \frac{1}{2} \times 21{\cdot}4 = 10{\cdot}7\ \text{cm}^2$

If we are looking for a number with 14 factors its table must have 2 rows and 7 columns ...

×	1	b^1	b^2	b^3	b^4	b^5	b^6
1							
a^1							

so factors must be $a^1 \times b^6$, where a and b are prime numbers.

Making $b = 2$ and $a = 3$ will produce the smallest such number: $3^1 \times 2^6 = 3 \times 64 = 192$.

×	1	2^1	2^2	2^3	2^4	2^5	2^6
1	1	2	4	8	16	32	64
3^1	3	6	12	24	48	96	192

2 Perimeter, area and volume

What you need to know

1 Rectangle: 450 cm^2, square: 900 cm^2

2 140 square units, 94 square units

3 Area of each triangle is 36 cm^2. Areas are same because each has same base BC and same height 9 cm.

4 **a** Both have perimeter of 38 cm
b Square has side 4 units

Exercise 2.1A

1 **a** 30 cm^2 **b** 40 cm^2 **c** 90 cm^2

2 **a** 82·5 cm^2 **b** 35 cm^2 **c** 32 cm^2

3 **a** Area of trapezium is 87·5 cm^2, area of kite is 75 cm^2. Area of trapezium is greater by 12·5 cm^2.
b Both shapes have an area of 36 cm^2
c 10 cm (to give both an area of 245 cm^2)

4 **a** 1600 m^2 **b** £19 200

Exercise 2.1B

1 **a** **i** Shovel A
ii Area of shovel A = 202 500 mm^2 or 2025 cm^2; area of shovel B = 192 500 mm^2 or 1925 cm^2, shovel A has the greater area by 10 000 mm^2 or 100 cm^2
b 285 calories

2 **a** 960 mm^2 **b** £57·60 **c** £129·60

3 **a** 3150 cm^2 and 787·5 cm^2
b **i** ×4
ii No, the larger kite requires four times the material of the smaller one
c ×9

4 **a** 1520 cm^2 + 1440 cm^2 = 2960 cm^2 **b** 445 cm^2 each side **c** £1·78

5 **a** 6 m^2 and 4·8 m^2 **b** £216

6 **a** 21 100 cm^2
b From the left: £73·69, £112·29, £242·13, £238·62

7 **a** 144 m^2 **b** £10 080 **c** 7·2 m **d** 15 120 watts

8 **a** 4·5 cm **b** 2·4 cm

Exercise 2.2A

1 **a** 31·4 m **b** 110·0 cm **c** 23·6 mm

2 **a** 78·5 cm **b** 1570·8 mm **c** 51·8 m

3 $C = 2\pi r$

4 **a** 282·7 cm **b** 88·0 cm **c** 26·7 cm

5 301·6 m

6 **a** 377·0 m **b** 11·8 m **c** 1450 s or 24·2 min

7 **a** 1·7 m **b** 864 m **c** **i** 424·1 cm **ii** 3

8 **a** 141·4 cm **b** Yes, its circumference and hence its diameter are less than those of the ring

Exercise 2.2B

1 3140 m or 3·14 km

2 **a** 399 m **b** 6·28 m **c** Each lane must have a stagger of 6·28 m from its inside lane

3 **a** Circle has diameter 8·28 cm **b** Circle has diameter 2·71 cm

4 **a** 15·9 cm **b** 0·159 cm

5 **a** 40 090 km **b** 39 930 km

6 6·283 m, orange 6·283 m

7 **a** 7110 km **b** 44 673 km **c** 6·283 km

Exercise 2.3A

1 **a** 314 cm^2 **b** 177 m^2 **c** 9160 mm^2

2 **a** 1020 m^2 **b** 75·4 cm^2 **c** 0·785 km^2

3 **a** $P = 10{\cdot}1$ cm, $A = 8{\cdot}04$ cm^2 **b** $P = 11{\cdot}3$ m, $A = 10{\cdot}2$ m^2 **c** $P = 61{\cdot}7$ cm, $A = 226$ cm^2

4 **a** **i** 11 700 cm^2 **ii** 468 cm^2 **b** 584 cm^2, 1402 cm^2 or 1400 cm^2 (3 s.f.)

5 **a** 707 cm^2 **b** 452 cm^2 **c** 113 cm^2

6 **a** 1260 m^2 **b** 5030 m^2. If the length is doubled, the area is quadrupled, so the energy is also quadrupled.

7 Surface area = 200 m^2 − (0·785 + 2·01 + 4·52) m^2 = 200 − 7·32 = 193 m^2 (to 3 s.f.)

8 **a** 336 m^2 **b** 269 m^2

Exercise 2.3B

1 4·91 m^2 − 3·58 m^2 = 1·33 m^2

2 6225 m^2 + 2359 m^2 = 8584 m^2

3 1130 cm^2

4 9·17 cm

5 **a** **i** 70·7 mm **ii** 398 mm^2 **b** **i** £2025 **ii** £491 ±£4 depending on rounding

6 **a** 471 cm **b** 18 100 cm^2

7 **a** 804 m^2 **b** 154 m^2

8 **a** Circle (square: 36 × 36 = 1296 m^2, circle = 1650 m^2) **b** 354 m^2

Exercise 2.4A

1 **a** **i** 8 cm **ii** 6 cm **iii** 6 cm **iv** 10 cm **v** 8 cm **vi** 6 cm
b 376 cm^2 **c** There are various nets **d** 376 cm^2 **e** They are the same

2 **b** Two triangular faces each 12 cm^2, two rectangular faces each 15 m^2, one rectangular face 18 m^2
c 72 cm^2

3 **a** 5 **b** 2 triangular and 3 rectangular shapes **c** There are various nets **d** 672 cm^2

4 **a** Length of label is equal to circumference of lid, which is 23·6 cm (to 3 s.f.)
b 118 cm^2 **c** 206 cm^2

5 **a** 9420 cm^2 **b** 13 400 cm^2

6 **a** A rectangle **b** 151 cm^2

7 **a** Various nets **b** **i** 50 m^2 **ii** 80 m^2 **iii** 60 m^2 **c** 380 m^2

Exercise 2.4B

1 (1267 + 223) mm^2 = 1490 mm^2

2 **b** 5360 cm^2 **c** £10·72

3 (6·16 + 3·08) m^2 = 9·24 m^2

4 22·8 m^2

5 **a** Various nets **b** 8·4 mm^2

6 **a** 8·14 m^2 **b** 814 tins

7 **a** 23·5 m^2 **b** 131 litres, £1965

8 **a** 942 cm^2 **b** 1450 cm^2

9 If you are only allowed 1 layer of tins:

No. of tins along width	No. of tins along length	Width (cm)	Length (cm)	Base (no lid) (cm^2)	Front/back (cm^2)	Left/right (cm^2)	Surface area (cm^2)
1	36	7	252	1764	5040	140	6944
2	18	14	126	1764	2520	280	4564
3	12	21	84	1764	1680	420	3864
4	9	28	63	1764	1260	560	3584
6	6	42	42	1764	840	840	3444
9	4	63	28	1764	560	1260	3584
12	3	84	21	1764	420	1680	3864
18	2	126	14	1764	280	2520	4564
36	1	252	7	1764	140	5040	6944

If more layers are allowed similar searching leads to ... arrangement using least cardboard is 4 rows of 3 on bottom layer and 3 layers. Dimensions of box are 28 cm by 21 cm by 30 cm, giving 3528 cm^2 as area of cardboard required ... which is bigger than the 1 layer answer.

Exercise 2.5A

1 **a** 16·8 m^3 **b** 66·6 cm^3

2 **a** 720 cm^3 **b** 434 cm^3 **c** 136 cm^3 **d** 10·5 m^3

3 **a** 14·1 m^3 **b** 60 cm^3 **c** 160 cm^3

4 **a** 481 cm^2 **b** 563 cm^3

5 **a** 404 cm^3 **b** 95 600 cm^3 **c** 168 tins **d** 27 700 cm^3

6 **a** 560 cm^3, 303 cm^3, 294 cm^3 **b** 504 g, 272 g, 265 g
c **i** 5·04 kg **ii** £22·18 **iii** £2·22, £1·20, £1·17

7 **a** 785 mm^3 **b** 798 mm^3

Exercise 2.5B

1 1620 cm^3

2 **a** A: 283 cm^3, B: 275 cm^3; A has greater volume by 8 cm^3
b A:1·41 cm^3 per pence; B: 1·53 cm^3 per pence; B (Sea Salt) is the better buy

3 2·26 tonnes

4 **a** Both volumes are100 cm^3
b Surface area of cuboid = 175 cm^2, surface area of cylinder = 155 cm^2, cylinder should last longer as it has smaller surface area

5 5·28 cm^3, 5·28 cm^3, 5·43 cm^3, 4·03 cm^3, volume of kite chocolate is smaller

6 0·72 m^3

7 **a** Full tank holds 954 259 cm^3 or ml, full tank will empty in 8·28 days
b 106 cm

8 **a** 62·8 litres **b** 31·4 minutes

Preparation for assessment

1 Parallelogram 60 cm^2, kite 4800 cm^2, trapezium 3·6 m^2

2 **a** 157 cm **b** 1960 cm^2

3 0·5 m^2

4 **b** Circular prism (cylinder), triangular prism, trapezoidal prism
c 2410 cm^2, 144 cm^2, 168 cm^2 **d** 9050 cm^3, 96 cm^3, 216 cm^3

5 **a** **i** 283 cm **ii** 4750 cm^2 **b** 3330 cm^3

6 **a** 17·2 mm **b** 40·9 mm^3

7 **a** 157·1 litres **b** 785 cups

8 **a** Triangular prism **b** 96 m^3

9 **a** 15 000 m^3 **b** 13 600 m^3

3 Gradients and straight lines

What you need to know

1 **a** $\frac{21}{25}$ **b** $\frac{5}{7}$ **c** $\frac{31}{75}$

2 **a** $\frac{4}{10}$ **b** $\frac{125}{1000}$ **c** $\frac{175}{100}$

3 **a** **i** 0·9 **ii** 90% **b** **i** 0·8 **ii** 80% **c** **i** 0·444 **ii** 44.4%

4 5 : 3

5 **a** A(−3, −1), B(5, 4) **b** 8 units **c** 5 units **d** x-axis, y-axis

Exercise 3.1A

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

2 **a** 0·45 **b** 1·1 **c** 0·4

3 **a** AW = 9, BW = 6, CW = 4·5, DW = 3·6 **b** AW, BW and CW

4 **a** $\frac{1}{3}$ **b** $\frac{2}{3}$ **c** $\frac{1}{2}$ **d** 1 **e** $\frac{3}{4}$ **f** $\frac{3}{8}$

5 **a** $\frac{14}{15}$ or 0·933 **b** $\frac{8}{9}$ or 0·889 **c** Yes

Exercise 3.1B

1 **a** Road C **b** Road A: 5%, Road B: 4.75%, Road C: 6% **c** Road B

2 **a** **i** $\frac{1}{7}$ **ii** 14·3% **b** It is steeper than Bougilie Hill **c** 28·6 m

3 **a** Yes **b** 420 m

4 **a** $\frac{2}{3}$ or $66\frac{2}{3}$% **b** Black **c** No more than 80 m

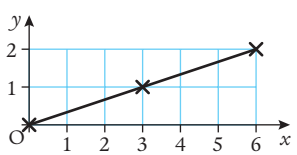
5 **a** $26\frac{2}{3}$ m **b** 40 m

6 **a** Low **b** Wood

Exercise 3.2A

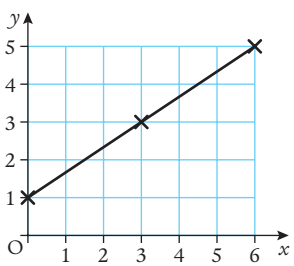
1 **a** $\frac{4}{5}$ **b** 3 **c** $\frac{3}{8}$

2 **a** **i**



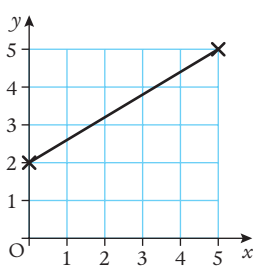
ii $\frac{1}{3}$

b **i**



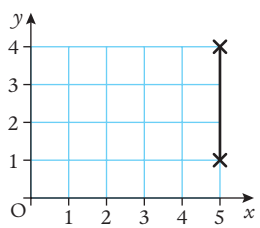
ii $\frac{2}{3}$

c **i**



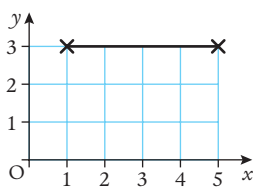
ii $\frac{3}{5}$

d **i**



ii Undefined

e **i**



ii 0

3 **a** $-\frac{3}{4}$ **b** $\frac{1}{5}$ **c** $-\frac{2}{3}$ **d** Undefined **e** $-\frac{1}{5}$ **f** 0

4 **a** $(3, 2), (1, -4), (-5, -2), (-3, 4)$ **b** $3, -\frac{1}{3}, 3, -\frac{1}{3}$ **c** Same gradients

5 **a** **i** $-\frac{1}{6}$ **ii** $\frac{1}{6}$ **b** $\frac{1}{4}$ **c** **i** 1 **ii** $-0{\cdot}5$ **d** $-0{\cdot}1$ **e** 0 **f** Undefined

6 **a** $\frac{1}{3}$ **b** 1 **c** $-\frac{1}{3}$ **d** $\frac{1}{4}$ **e** $-\frac{1}{5}$

7 **a** Section A **i** $(-11, 0), (-5, 5)$ **ii** $\frac{5}{6}$; section B **i** $(1, 1), (4, 0)$ **ii** $-\frac{1}{3}$; section C **i** $(12, 1), (18, -3)$ **ii** $-\frac{1}{3}$

b **i** Same gradient **ii** They are the same part of the roof

Exercise 3.2B

1 **a** **i** $\frac{3}{2}$ **ii** $\frac{1}{9}$ **iii** $-\frac{1}{2}$ **iv** -5 **v** Undefined **b** **i** 8 **ii** -4 **iii** 1

2 **a** **i** $\frac{6}{5}$ **ii** $-\frac{3}{4}$ **iii** $\frac{6}{7}$ **iv** $-\frac{1}{5}$ **v** $\frac{6}{7}$ **b** **iii** and **v**, because they have the same gradient

c Parallel lines always have the same gradient

3 **a** PQ $= \frac{1}{4}$, QR $= -2$, RS $= \frac{1}{4}$, PS $= -2$ **b** Parallelogram

4 **a** $\frac{25}{4}$ **b** 14 **c** -5

5 **a** 2·5 metres per second **b** 10 m

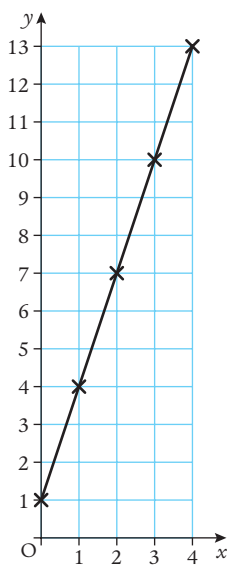
6 **a** £3000 **b** **i** 375 **ii** Instalments are £375 per month

Exercise 3.3A

1 **a**

x	0	1	2	3	4
$y = 3x + 1$	1	4	7	10	13
(x, y)	(0, 1)	(1, 4)	(2, 7)	(3, 10)	(4, 13)

b

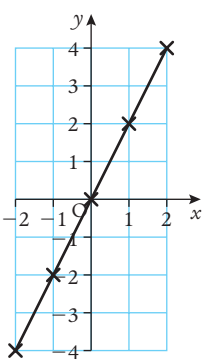


c **i** 3 **ii** 1

2 **a**

x	-2	-1	0	1	2
$y = 2x$	-4	-2	0	2	4
(x, y)	$(-2, -4)$	$(-1, -2)$	(0, 0)	(1, 2)	(2, 4)

b

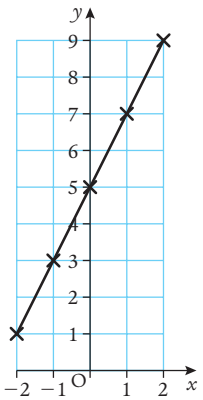


c **i** 2 **ii** 0

3 i a

x	-2	-1	0	1	2
$y = 2x + 5$	1	3	5	7	9
(x, y)	$(-2, 1)$	$(-1, 3)$	$(0, 5)$	$(1, 7)$	$(2, 9)$

b

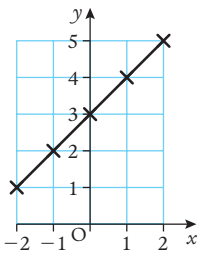


c Gradient = 2, y-intercept = 5

ii a

x	-2	-1	0	1	2
$y = x + 3$	1	2	3	4	5
(x, y)	$(-2, 1)$	$(-1, 2)$	$(0, 3)$	$(1, 4)$	$(2, 5)$

b

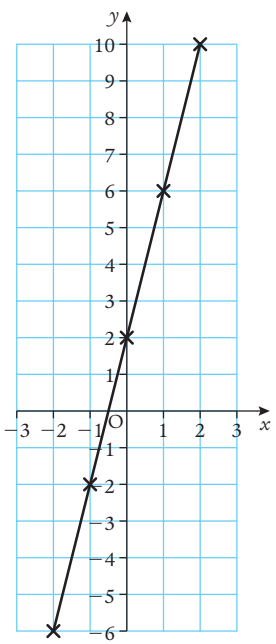


c Gradient = 1, y-intercept = 3

iii a

x	-2	-1	0	1	2
$y = 4x + 2$	-6	-2	2	6	10
(x, y)	$(-2, -6)$	$(-1, -2)$	$(0, 2)$	$(1, 6)$	$(2, 10)$

b

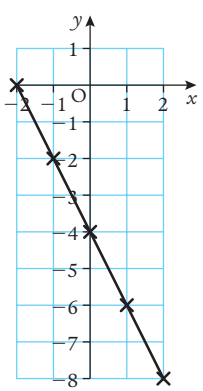


c Gradient = 4, y-intercept = 2

iv a

x	-2	-1	0	1	2
$y = -2x - 4$	0	-2	-4	-6	-8
(x, y)	$(-2, 0)$	$(-1, -2)$	$(0, -4)$	$(1, -6)$	$(2, -8)$

b



c Gradient = −2, y-intercept = −4

4 **a** **i** m is the gradient **ii** c is the y-intercept **b** $m = 6, c = -5$

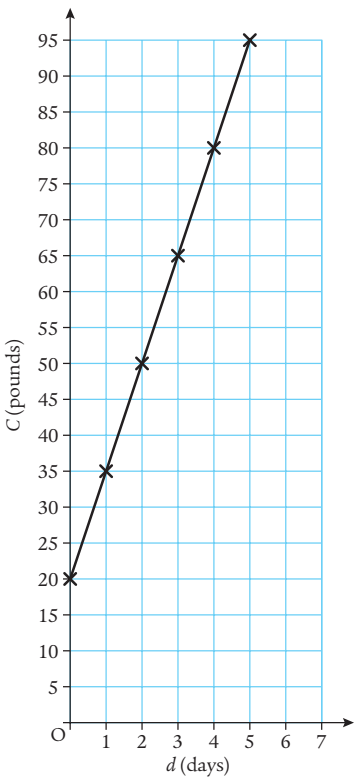
5 **a** **i** 1 **ii** 0 **b** **i** 2 **ii** 6 **c** **i** -3 **ii** -5 **d** **i** 5 **ii** 0

e **i** $-0{\cdot}5$ **ii** 2·4 **f** **i** $\frac{3}{4}$ **ii** -1

6 **a**

d (days)	1	2	3	4	5
C (pounds)	35	50	65	80	95

b



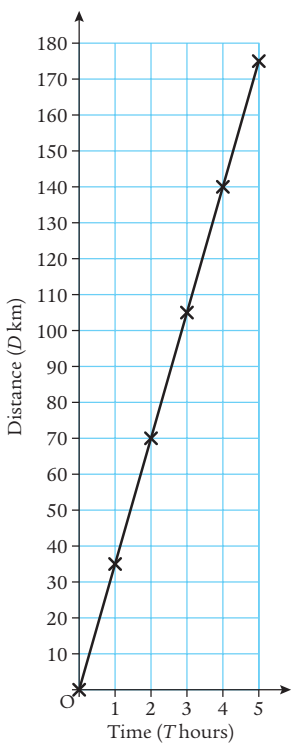
c $m = 15, c = 20$ **d** **i** Daily rate **ii** Basic charge

e £125

7 **a**

Time (T hours)	0	1	2	3	4	5
Distance (D km)	0	35	70	105	140	175

b



c **i** $m = 35$ **ii** $c = 0$

d $D = 35T$

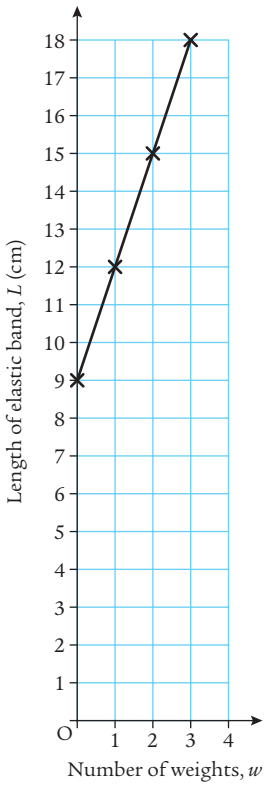
e **i** 87·5 km **ii** 166·25 km

f 35 km/h

g Constant speed

Exercise 3.3B

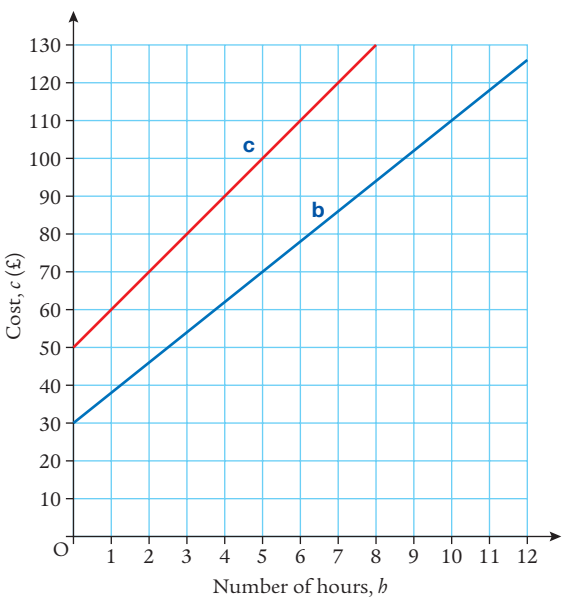
1 a



b **i** 3 **ii** 9 **c** $L = 3w + 9$ **d** $L = 27$ cm

2 a

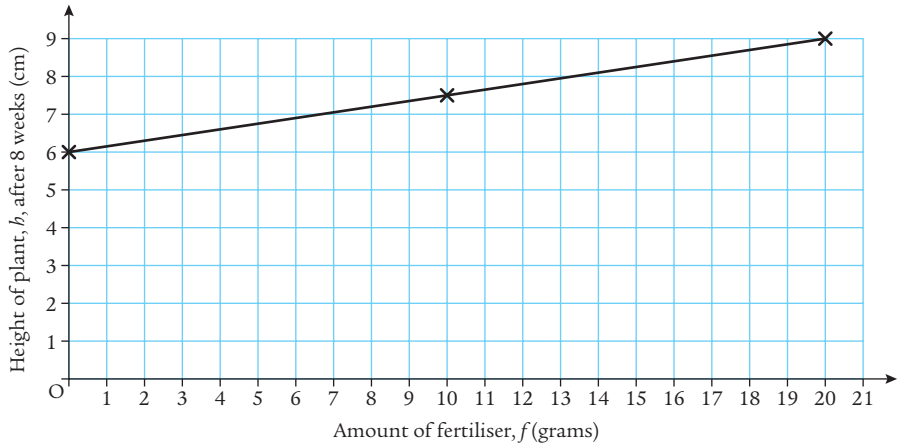
Number of hours, h	1	2	3	4	5
Cost, c (£)	38	46	54	62	70



d Normal working hours: $C = 8h + 30$; outside normal working hours: $C = 10h + 50$

e £70

3 a

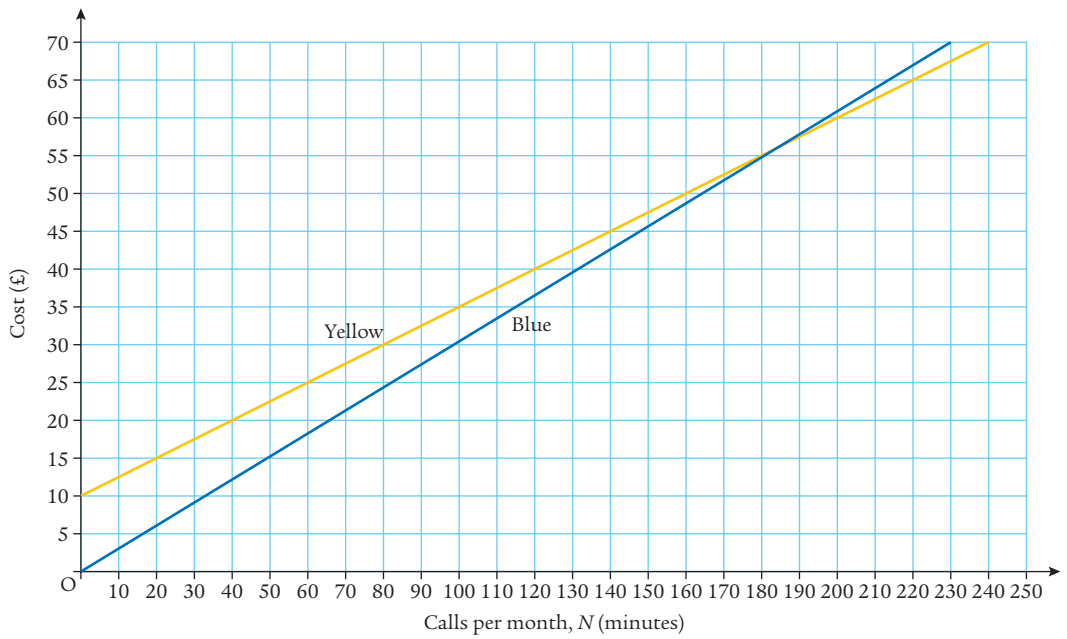


b $h = 0{\cdot}15f + 6$ **c** 40 grams

4 a

Calls per month, N (minutes)	0	20	40	60	80	100
Yellow costs, Y (£)	10	15	20	25	30	35
Blue costs, B (£)	0	6	12	18	24	30

b



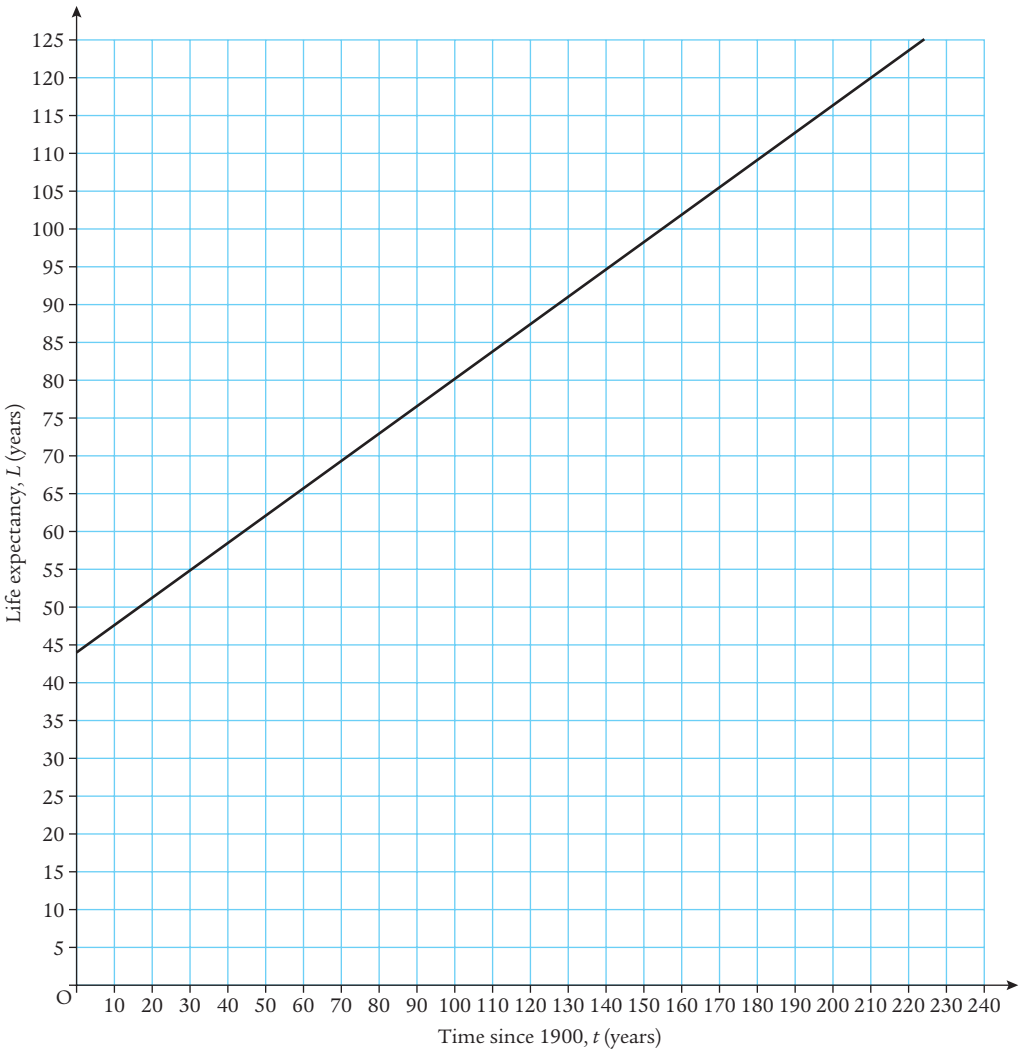
c i Blue **ii** Yellow **d** 200 minutes **e** $Y = 0{\cdot}25N + 10$, $B = 0{\cdot}3N$

5 **a** **i** 36 years **ii** 9 years

b

Year	1900	1950	2000	2025	2050	2075	2100
Time since 1900, t (years)	0	50	100	125	150	175	200
Life expectancy, L (years)	44	62	80	89	98	107	116

c



d 2050–2060 **e** $L = 0{\cdot}36t + 44$ **f** $L = 96{\cdot}2$ years

g No, as there will be a medical limit to how long you can live

Preparation for assessment

1 **a** **i** $\frac{3}{5}$ **ii** $\frac{2}{7}$ **iii** Undefined **iv** $-\frac{7}{2}$ **v** 0 **vi** -3 **vii** $\frac{1}{2}$ **viii** -3 **ix** $\frac{10}{3}$

b **vi** and **viii**

2 **a** $m_{AB} = 5, m_{BC} = -1, m_{CD} = 0, m_{AD} = -1$

b Trapezium; two of its sides have the same gradient so are parallel

3 **a** $m_{AB} = \frac{1}{8} = 0{\cdot}125, m_{BX} = \frac{1}{6} = 0{\cdot}167$

b $m_{CD} = \frac{2}{5} = 0{\cdot}4, m_{DX} = \frac{2}{7} = 0{\cdot}29$

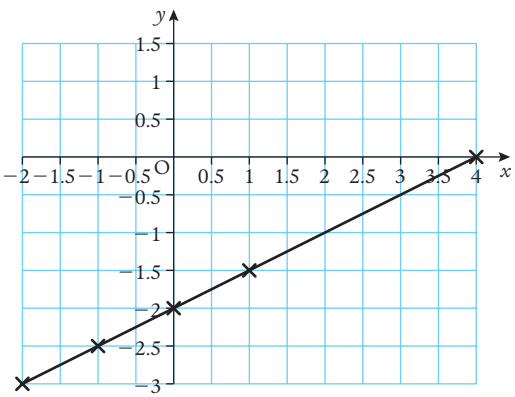
c A to X route has an easier gradient but is longer; C to X is shorter but has a steeper gradient

4 a

x	−2	−1	0	1	4
y	−3	−2·5	−2	−1·5	0

c $m = \frac{1}{2}, c = -2$

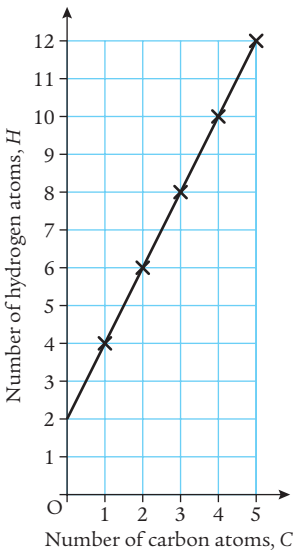
b



5 a

Number of carbon atoms, C	1	2	3	4	5
Number of hydrogen atoms, H	4	6	8	10	12

b



c **i** 2 **ii** 2 **d** $H = 2C + 2$ **e** 22

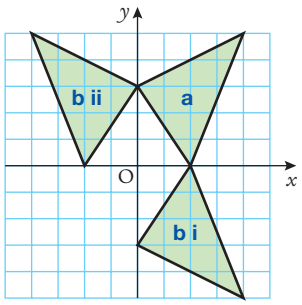
6 In order to make sure the gradient was low enough for pedestrians, the engineers increased the horizontal distance by making the bridge go 'squiggly', hence the nickname, the 'Squiggly Bridge' (see diagram opposite).

4 Transformations

What you need to know

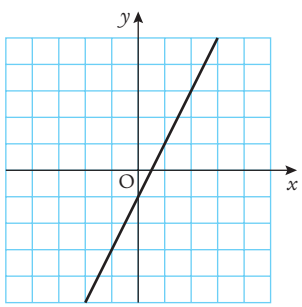
1 **a** 2 **b** 3 **c** 1

2

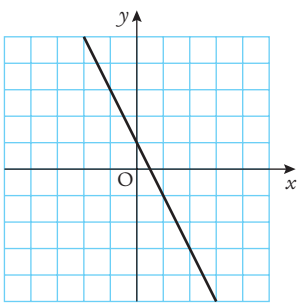


3 **b** **i** A′(−4, 0), B′(−2, −5), C′(0, 0) **c** **i** A″(4, 0), B″(2, −5), C″(0, 0) **d** Translation

4 **a**



b 3 **c** 3 **d** (2, −3) **e** (3, −5) **f**



Exercise 4.1A

1 **a** Reflection in vertical axis
b Reflection in horizontal axis
c 90° rotation anticlockwise
d 90° rotation clockwise
e Reduction, scale factor $\frac{2}{3}$
f Reduction, scale factor $\frac{3}{4}$
g Shrunk horizontally
h Shrunk vertically
i Reflected in horizontal axis, then shrunk vertically
j Translate right and up

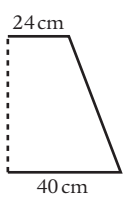
2 **a** Rotate left – **c**, Rotate right – **d**, Flip horizontal – **a**, Flip vertical – **b**
b Different scale factors
c **i** Pussycat
d Reflected in horizontal axis then shrunk vertically – **i**

3 **a** Distance horizontally and vertically **b** Degrees of turn and direction of turn

4 **a** **i** Reflection symmetry **ii** Reflection symmetry **iii** Reflection and rotation symmetry
iv Rotation symmetry **v** Translation symmetry

Exercise 4.1B

1 **a**



b 80 cm × 120 cm

2 **a** (−4, 0), (−5, 1), (−4, 1), (−2, 2), (−1, 2), (2, 1), (2, 3), (3, 4), (4, 4), (5, 2), (3, 3), (3, 0)
b (−4, 0), (−5, −1), (−4, −1), (−2, −2), (−1, −2), (2, −1), (2, −3), (3, −4), (4, −4), (5, −2), (3, −3), (3, 0)
c P(x, y) → P′$(x, -y)$

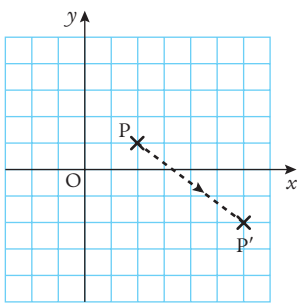
3 **a** $(-4, -4), (-3{\cdot}5, -3), (-4, -2), (-4, 2), (-3, 4), (-2, 4), (-1, 3), (0, 1), (0, 0)$;
image $(-4, -4), (-3, -3{\cdot}5), (-2, -4), (2, -4), (4, -3), (4, -2), (3, -1), (1, 0), (0, 0)$
b $P(x, y) \rightarrow P'(y, x)$
c Between $(1, -4)$ and $(-1, -2)$

4 **a** **i** A **ii** B **iii** D **b** **i** $\angle ACB$ **ii** $\angle CAD$ **iii** $\angle ADC$ **c** **i** $\angle ACB$ **ii** $\angle CAD$ **iii** $\angle ADC$
d AD is an axis of symmetry, so $\angle ADB = \angle ADC$, however since $\angle ADB + \angle ADC = 180°$ (BDC is a straight line) then $\angle ADB + \angle ADB = 180°$, thus $\angle ADB = 90°$
e It is the axis of symmetry

5 **a** A, D, C **b** $\angle ADB, \angle BDC, 110°$
c **i** As AC is the line of symmetry it splits the straight angles $\angle BED$ and $\angle AEC$ in half, the angles round E are all $\frac{180°}{2} = 90°$
ii Under reflection in AC, BE $\rightarrow$ ED, they are the same length and AC bisects BD
d $\angle BAC = 50°, \angle BCA = 20°$
e $\angle BAD = 100°, \angle ADC = 110°, \angle DCB = 40°, \angle CBA = 110°$

6 **a** By symmetry, the centre of a circle must lie on its axis of symmetry
b We are told that XY is an axis of symmetry of the diagram. So PR = QR. R is the midpoint of the chord. XY passes through centre of circle and bisects the chord. So XY is perpendicular to chord.
c 6 units
d 8 units

7 **a** $(6, -2)$
b **i**

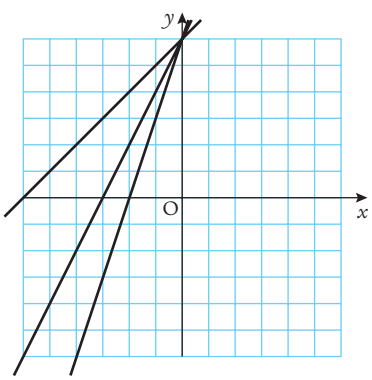


ii 5 units
c **i** $A'(4, -3), B'(2, 2), C'(5, 0)$ **ii** $A''(8, -6), B''(6, -1), C''(9, -3)$

8 **a** $(-3, -4) \rightarrow (2, -1), (-1, -4) \rightarrow (4, -1)$ **b** $P(x, y) \rightarrow P'(x + 5, y + 3)$ **c** $(6, 1), (9, 1), (6, -1)$

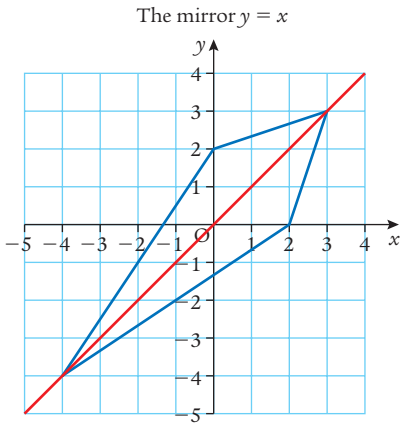
9 **a** ✓
b **i** $A'(0, -3), B'(1, -1), C'(2, 1), D'(3, 3)$ **ii** Line parallel to $y = 2x + 1$ **iii** $y = 2x - 3$
c **i** $A'(0, 1), B'(1, 3), C'(2, 5), D'(3, 7)$ **ii** $y = 2x + 1$
iii Under translational symmetry a line maps onto a parallel line but where the translation is equivalent to the gradient it maps onto itself

10 **a**



b $y = 6 + x, y = 6 + 2x, y = 6 + 3x$; the gradients have changed from negative to positive

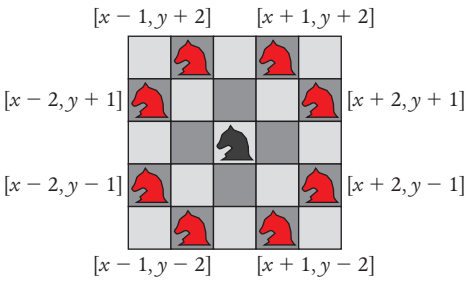
11 a



A′(3, 3), B′(0, 2), C′(−4, −4), D′(2, 0)

b Image is same as original shape as line $y = x$ is line of symmetry of the shape

12 a



b (8, 7), (6, 7), (5, 6), (5, 4), (6, 3), (8, 3)

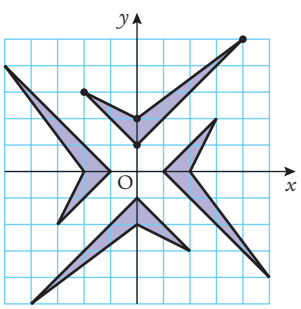
Exercise 4.2A

1 a 60° anticlockwise **b** 80° clockwise **c** 45° either clockwise or anticlockwise

2 a (1, 2), (2, 4), (5, 3), (5, 1), (7, 0), (9, 0), (10, 1)

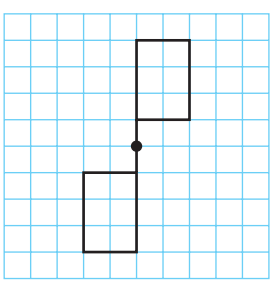
b (−2, 1), (−4, 2), (−3, 5), (−1, 5), (0, 7), (0, 9), (−1, 10)

3 a, b, c

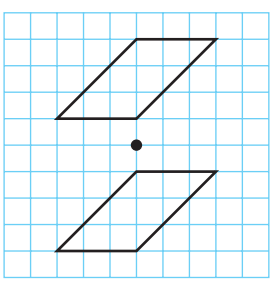


4 a **i** (−2, 1) **ii** 4 **iii** 90° **b** **i** (−2, −1) **ii** 2 **iii** 180° **c** **i** (−1, 1) **ii** 2 **iii** 180°
d **i** (−1, 0) **ii** 2 **iii** 180° **e** **i** (−2, 1) **ii** 4 **iii** 90° **f** **i** (−1, 0) **ii** 4 **iii** 90°

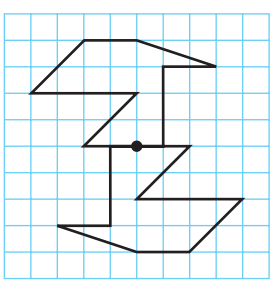
5 a

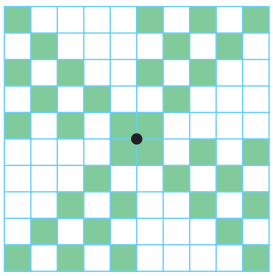
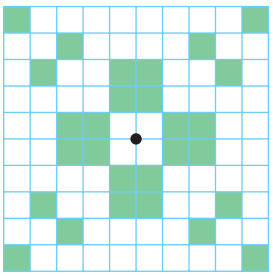
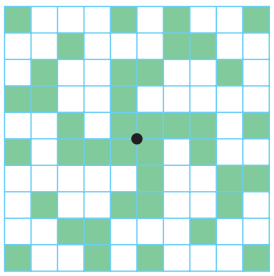
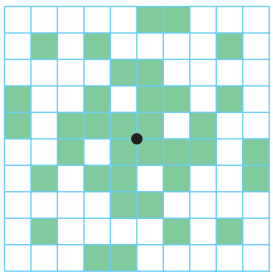


b



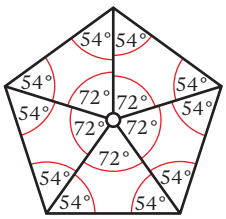
c



6 **a** **i**  **ii**  **iii**  **iv** 

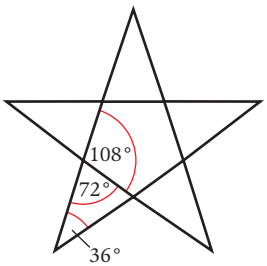
b Floor **iii**

7 **a**



b **i** ABFE **ii** 108°, 36°, 36°; 144°, 18°, 18°

c Five angles in pentagon are 108°, each triangle is 72°, 36°, 36°



8 **a** **i** Square **ii** Equilateral triangle **b** **i** 36 times **ii** 36

Exercise 4.2B

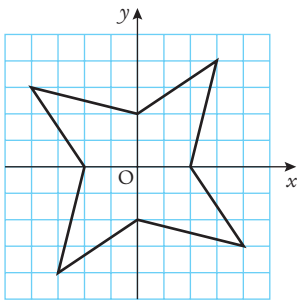
1 **a** A′(0, −6), B′(−3, −2), C′(0, −4), D′(3, −2)

b O′(0, 0), P′(−4, −2), Q′(−4, −5), R′(0, −3)

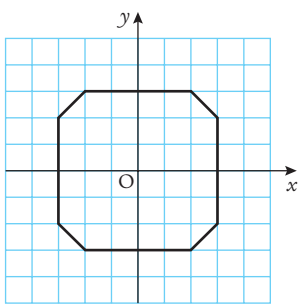
c S′(1, 2), T′(3, 1), U′(5, 2), V′(3, 4)

2 **a** x-coordinate of the image of P(x, y) = $-x$; y-coordinate of the image of P(x, y) = $-y$

3 **a** **iii** (0, 2) → (−2, 0), (3, 4) → (−4, 3), (2, 0) → (0, 2) **iv**

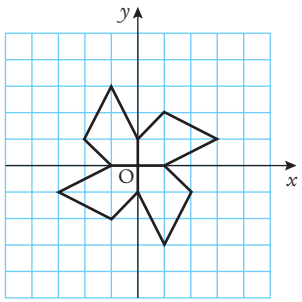


b **iii** (−3, 0) → (0, −3), (−3, 2) → (−2, −3), (−2, 3) → (−3, −2), (0, 3) → (−3, 0) **iv**



c **iii** $(-1, 0) \rightarrow (0, -1), (-2, 1) \rightarrow (-1, -2), (-1, 3) \rightarrow (-3, -1), (0, 1) \rightarrow (-1, 0)$

iv



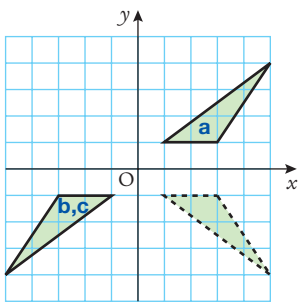
4 **a** **i, ii**

Red	x	y	Blue	x	y
A	0	0	A′	0	0
B	5	0	B′	0	5
C	5	4	C′	−4	5
D	3	4	D′	−4	3
E	3	2	E′	−2	3
F	0	2	F′	−2	0

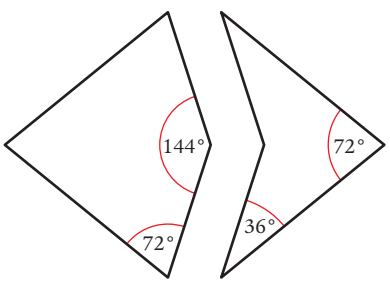
b x-coordinate of the image of $P(x, y) = -y$; y-coordinate of the image of $P(x, y) = x$

5 **a** $y = 2x$ **b** **i** $A'(-800, 400)$ **ii** $y = -\frac{1}{2}x$

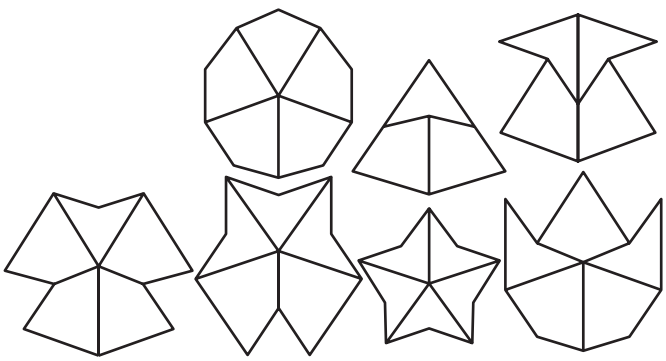
6 **d** The images are the same



7 **a**

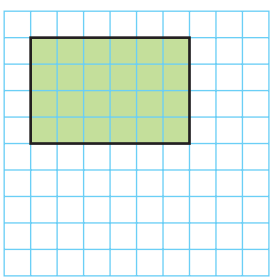


b

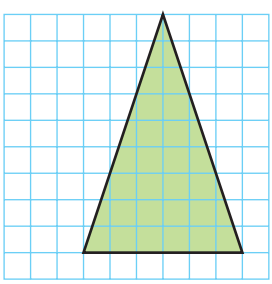


Exercise 4.3A

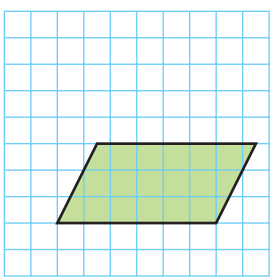
1 **a**



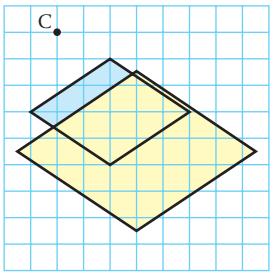
b



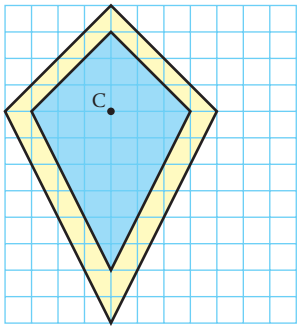
c



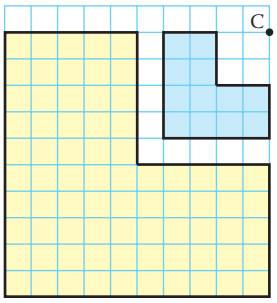
2 a



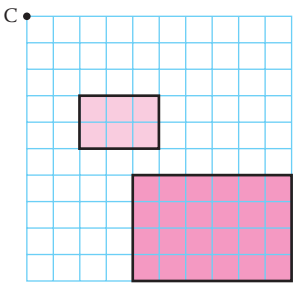
b



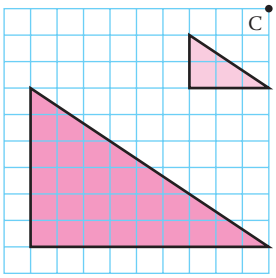
c



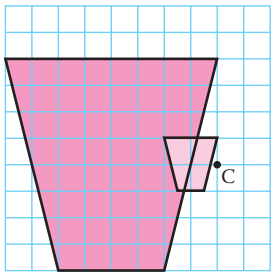
3 a



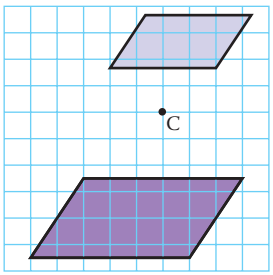
b



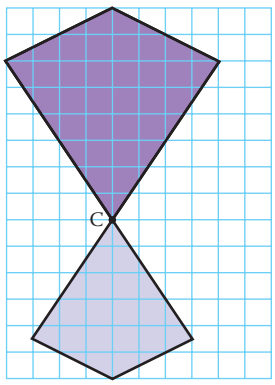
c



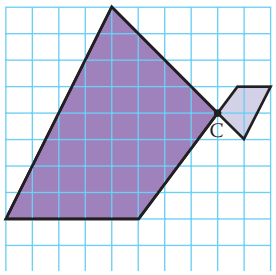
4 a



b



c



5 (Investigation)

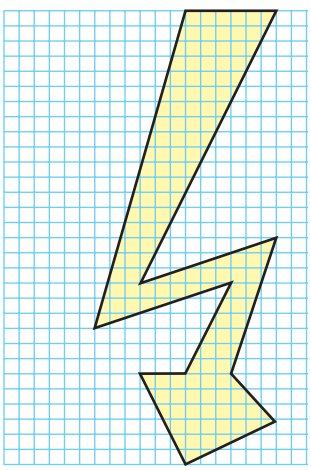
6 **a** 42 cm × 33·5 cm **b** 17 cm **c** 60 mm wide by 85 mm

7 **a** $-\frac{1}{20}$ **b** 15 cm **c** Child's image is 4·8 cm tall and is inverted **d** 2·4 m

Exercise 4.3B

1 **a** 3

b



2 **a** 8 cm **b** 80 km

3 **a** **i** (4, 12), (4, 4), (8, 4) **ii** (3, 9), (3, 3), (6, 3) **iii** (1, 3), (1, 1), (2, 1) **iv** (6, 18), (6, 6), (12, 6)
v (−2, −6), (−2, −2), (−4, −2) **vi** (−1, −3), (−1, −1), (−2, −1)
b x-coordinate of image of P$(x, y) = nx$; y-coordinate of image of P$(x, y) = ny$

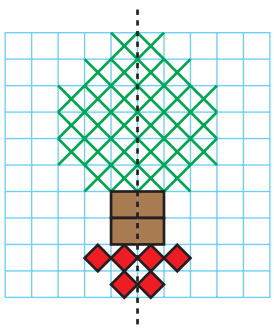
4 (Investigation)

5 **a** $\frac{7}{2}$ **b** 70 cm **c** 55 cm

6 (Investigation)

Preparation for assessment

1



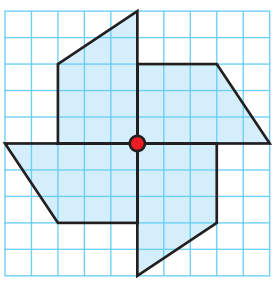
2 1 – rotation symmetry of order 4 and 4 axes of reflection symmetry; 2 – rotation symmetry of order 2 and 2 axes of reflection symmetry; 3 – rotation symmetry of order 2 and 2 axes of reflection symmetry; 4 – rotation symmetry of order 4 and 4 axes of reflection symmetry; 5 – rotation symmetry of order 4 and 4 axes of reflection symmetry; 6 – rotation symmetry of order 2 and 2 axes of reflection symmetry

3 MERRY XMAS

4 **a** $\frac{6}{10} = \frac{3}{5}$ **b** 25 cm **c** 325 cm right, 195 cm up

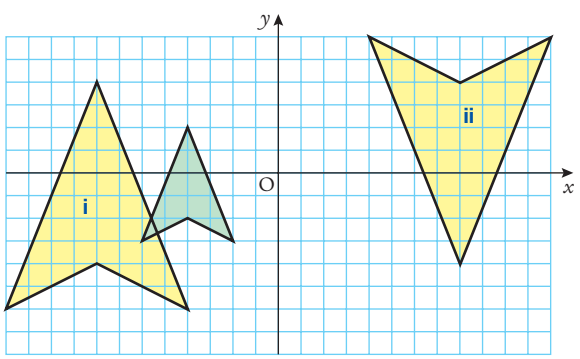
5 **c** 60° anticlockwise or 300° clockwise

6



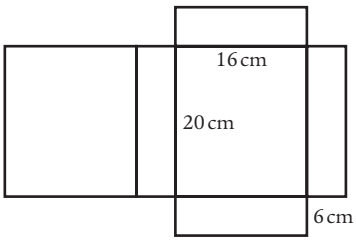
7 **a** A(−1, −3), B(−3, 2) and C(4, 3) **b** A(3, −1), B(−2, −3) and C(−3, 4)
c A(4, 2), B(6, −3) and C(−1, −4) **d** A(3, 1), B(−2, 3) and C(−3, −4)
e A(2, 6), B(6, −4) and C(−8, −6)

8 **a**



b Rotation of 180° about origin or half turn about origin

9 a



b 30 cm × 24 cm × 9 cm **c** 2·25 **d** 3·375

10 $P(x, y) \rightarrow P'(-x, y)$; $P(x, y) \rightarrow P'(x, -y)$; $P(x, y) \rightarrow P'(-x, -y)$; anticlockwise $P(x, y) \rightarrow P'(-y, x)$

5 Summary statistics

What you need to know

1

Speed (mph)	Frequency, f
28	2
29	3
30	3
31	4
32	3
35	2
37	1
38	2
Total	**20**

2 0·768, 4·2, 5·006, 5·01, 23·1, 143·1

3 **a** 148·6 **b** 40·66

Exercise 5.1A

1 **a** **i** 92 **ii** 92 **iii** 88
b **i** 3·65 **ii** 3·6 **iii** No mode
c **i** 215·25 **ii** 220 **iii** 220

2 **a** **i** 2·573 hours **ii** 2·57 hours
b **i** The mean and median are much greater for all the men's category
ii The mean and median are different because there are so many more competitors going at significantly slower pace

3 **a** **i** Stornaway
ii Stornaway is on an island so it would cost more to get the fuel over there
b Mean = 130·84p, median = 127·7p, mode = 127·7p
c **i** Mean= 128·17, median = 127·7, mode = 127·7
ii The mean was affected

4 **a** 6
b Mean = 3·03, median = 3, mode = 3

5 Cameron's score = 8·06, James' score = 7·72, so Cameron had the highest score

6 79

7 **a** **i** £18·20 **ii** £7·50 **iii** £20
b The median

8 **a** 9 days **b** 6

9 **a** Mean (water) = 7·25, mean (oil) = 12·95
b Oil is thicker as it takes longer, on average, to sink to the bottom
c No

Exercise 5.1B

1 **a** 40
b **i** 8·425 **ii** 8·5 **iii** 9
c The population of black grouse in the Cairngorms seems steady

2 **a** 30 **b** Size 9 **c** Size 7 **d** Size 7 **e** $\frac{1}{3}$

3 **a** Mean = 3·16, median = 3, mode = 3
b Very little effect – the measures would be: mean = 3·28, median = 3, mode = 3

4 **a** 40–59 **b** 40–59

c

No. of texts	Frequency, f	Mid-value, x	$f \times x$
0–19	6	9·5	$6 \times 9{\cdot}5 = 57$
20–39	8	**29·5**	$\mathbf{8 \times 29{\cdot}5 = 236}$
40–59	9	**49·5**	$\mathbf{9 \times 49{\cdot}5 = 445{\cdot}5}$
60–79	4	**69·5**	$\mathbf{4 \times 69{\cdot}5 = 278}$
80–99	2	**89·5**	$\mathbf{2 \times 89{\cdot}5 = 179}$
Totals	**29**		**1195·5**

Mean = 41·22

5 **a** 80–85 **b** 80–85 **c** 80·67 kg

6 **a**

Time (s)	Frequency, f	Mid-value, x (s)	$f \times x$
45–45·9	1	45·45	$1 \times 45{\cdot}45 = 45{\cdot}45$
46–46·9	2	46·45	$2 \times 46{\cdot}45 = 92{\cdot}9$
47–47·9	2	47·45	$2 \times 47{\cdot}45 = 94{\cdot}9$
48–48·9	9	48·45	$9 \times 48{\cdot}45 = 436{\cdot}05$
49–49·9	4	49·45	$4 \times 49{\cdot}45 = 197{\cdot}8$
50–50·9	2	50·45	$2 \times 50{\cdot}45 = 100{\cdot}9$
Totals	20		968

b 48·4 seconds **c** 48–48·9

Exercise 5.2A

1 **a** Referendum chart is a bar chart. The data is qualitative and ordinal, so the bar chart is the most suitable. The x-axis in this example is ordered but it doesn't have to be.
Fertiliser chart is a histogram. The data is quantitative, continuous and grouped, so the histogram is the most suitable graph for data of this sort. Note that 5 flowers had a stem whose length lay between 10 cm and 20 cm. The x-axis in this example is a number line increasing to the right.

b Nominal qualitative data

2 The data is qualitative. Only the mode is suitable.
The mean and the median can't be calculated but the mode is 'gymnastics' ... the most popular answer

3 **a** **i** Mean = 25 **ii** Median = 25

b **i** Student's own opinion

ii Running the 'shuffle' 10 times, the means ranged from 14 to 36 and the mean of the 10 results was 25·03. This sort of result is typical.

4 The **modal** number of players in a team is 11. What about the **mean**?
Some players in other games were red-carded and their teams ended the match with less than 11. No team ended the game with more than 11 ... so 11 must be more than the mean number of players at the end of a match. Depending on just how many teams had a red-carded player, the median might or might not be 11. So the average being spoken about is the mean. Because of sending-offs and injuries, many teams will end the game with fewer than 11 players. No team will end the game with more than 11 players. So 11 must be higher than the mean end-of-game team size.

5 **a** Mode of £25 000 **b** Mean of £32 000

6 **a** Student's own activity **b** Mean would be most affected

Exercise 5.2B

1 **a** Above average – the average score will not be the highest score

b Below average – you do better in golf with a lower score

c Below average – the average error count will be higher than the lowest number of errors

d Above average – you would prefer to have a higher income

e Average – you don't want it too high or too low

f Above average – the average would be less than 2 as some people have less than 2 ears

g Average – it isn't good to be too cold or too hot

h Below average – you would want to be in as little debt as possible

i Average – more people with the same blood type will make it easier if you need a blood transfusion

2 **a** **i** 21 million **ii** 600 000 **b** **i** Mode **ii** O+

3 **a** **i** Median **ii** Mean **iii** Mode **b** **i** 26 years **ii** 21·6 caps **iii** Glasgow
c **i** This is where the mean number of caps is plotted against the mean age
ii Yes, the older you are the more caps you are likely to have

4 **a** Mean = 158·81, median = 161, mode = 158 **b** Mode **c** Mean

5 **a** 4040·06 **b** 3337

c

Attendance	Frequency
3001–4000	13
4001–5000	1
5001–6000	1
6001–7000	3

d 3001–4000 **e** Modal class

6 The average used is the mean and, because there are a number of people with very high incomes, this makes the mean high and hence more than half the households would have below the average household income

Exercise 5.3A

1 **a** **i** Range = 11 **ii** $Q_1 = 88$, $Q_2 = 92$, $Q_3 = 96$
b **i** Range = 3·3 **ii** $Q_1 = 2{\cdot}4$, $Q_2 = 3{\cdot}6$, $Q_3 = 4{\cdot}4$
c **i** Range = 187 **ii** $Q_1 = 169{\cdot}5$, $Q_2 = 220$, $Q_3 = 244$

2 **a** $L = 2{\cdot}5$, $Q_1 = 2{\cdot}9$, $Q_2 = 3{\cdot}6$, $Q_3 = 4{\cdot}6$, $H = 6$ **b** **i** $\frac{2}{5}$ **ii** 2·6, $\frac{4}{5}$

3 **a** $L = 20$, $Q_1 = 29$, $Q_2 = 38$, $Q_3 = 43$, $H = 57$ **b** Mean of this sample is less than 40 mm

4 **a** $L = 1000$, $Q_1 = 2100$, $Q_2 = 3550$, $Q_3 = 4400$, $H = 5000$ **b** **i** 3550 hours **ii** $\frac{19}{50}$

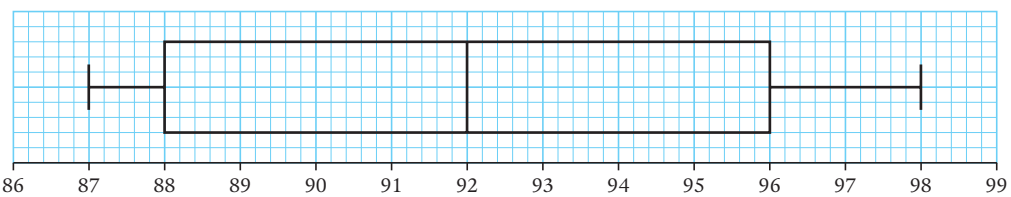
5 **a** $L = 1$, $Q_1 = 4$, $Q_2 = 6$, $Q_3 = 7$, $H = 12$ **b** 40% of 500 = 200 children

6 **a** $L = 58$, $Q_1 = 65$, $Q_2 = 80$, $Q_3 = 89{\cdot}5$, $H = 108$ **b** The last quarter

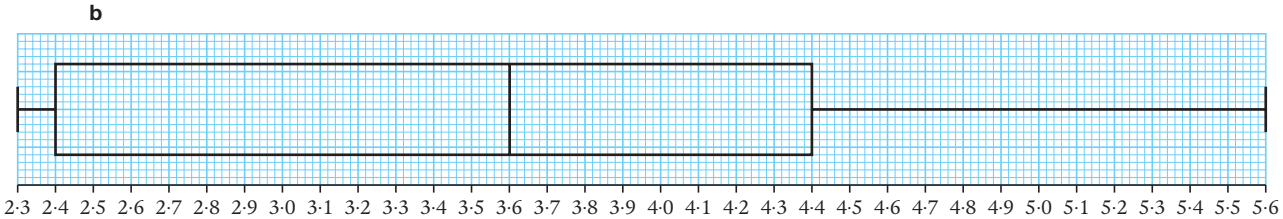
Exercise 5.3B

1 Box plots for questions in Exercise 5.3A:

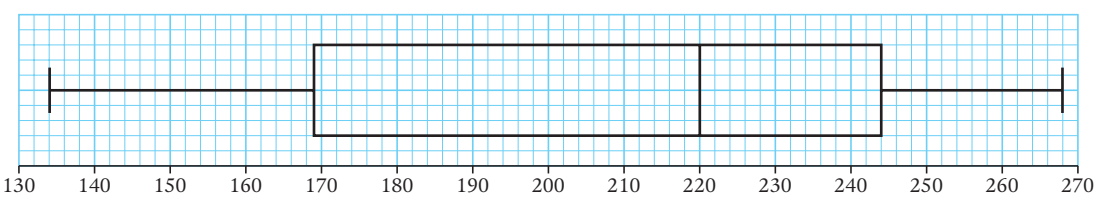
1 a



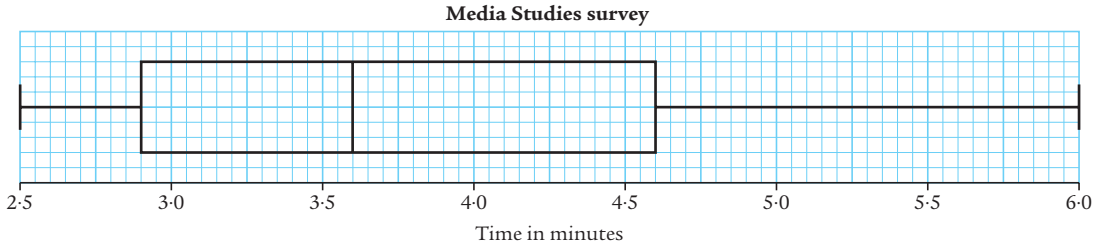
b



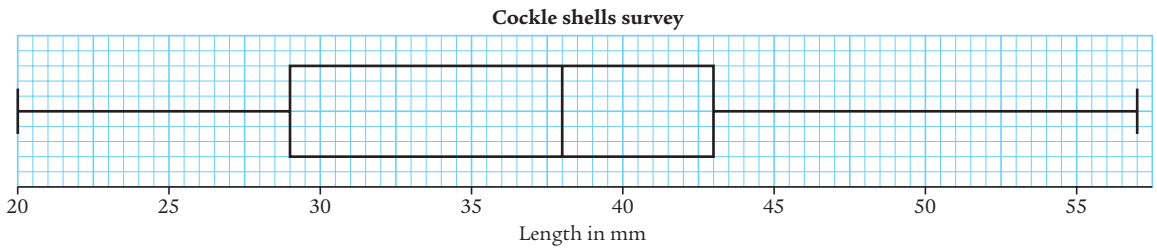
c



2



3



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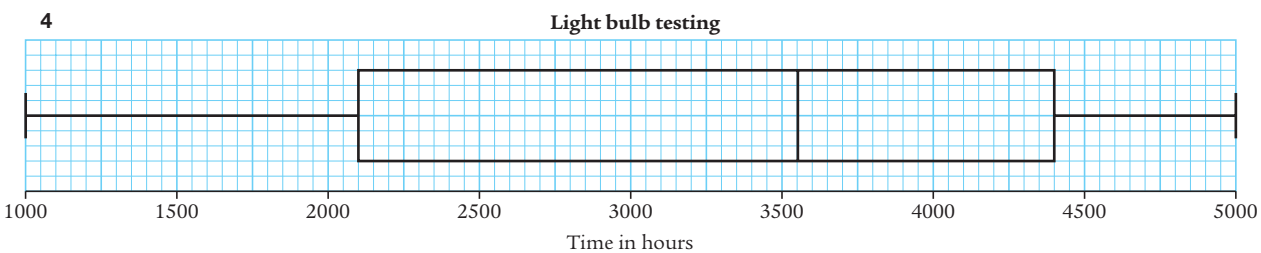

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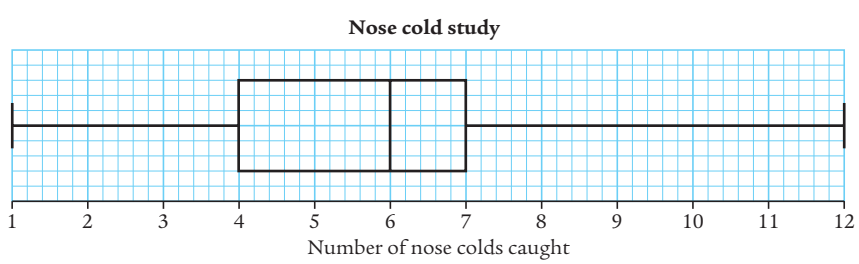

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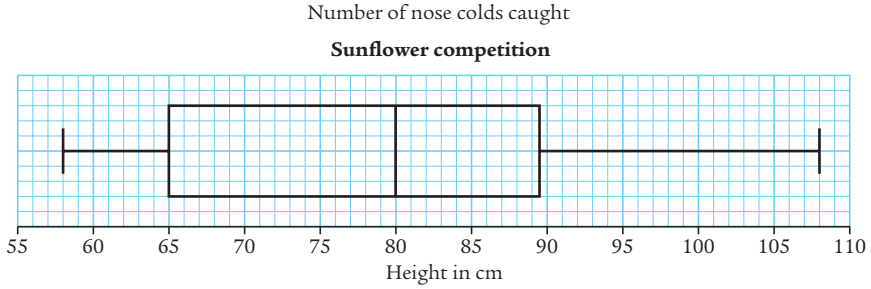
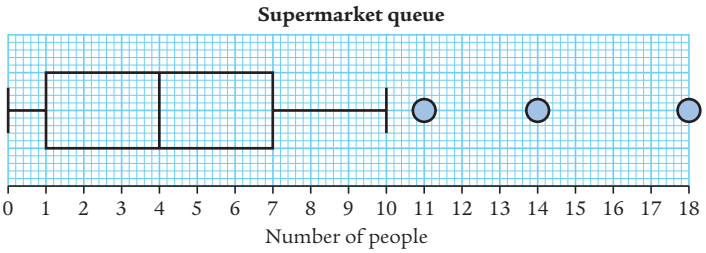


2 a

Number in checkout queue	Frequency
0	9
1	5
2	3
3	3
4	5
5	2
6	5
7	8
8	1
9	1
10	2
11	1
14	1
18	1

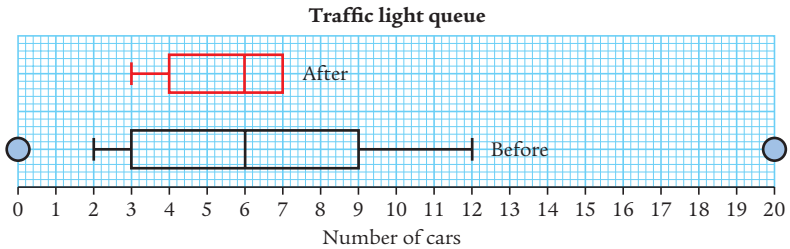
b $L = 0, Q_1 = 1, Q_2 = 4, Q_3 = 7, H = 10$

c



3 a $L = 2, Q_1 = 3, Q_2 = 6, Q_3 = 9, H = 12$

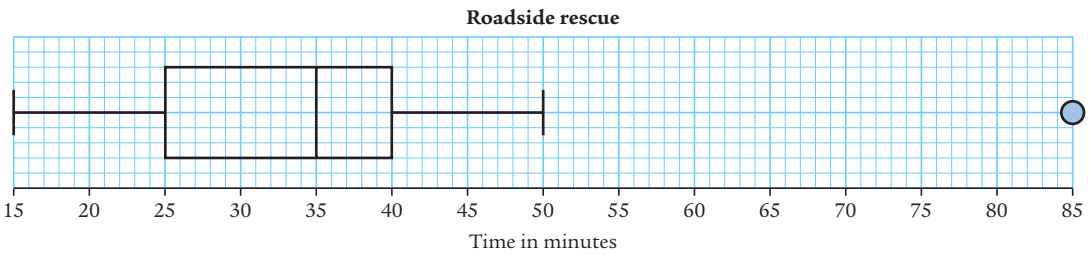
b and **c**



The change of phasing has changed the effect of the size of queue: it is generally less and there is less of a range between the number of cars in the queue

4 a 85 minutes

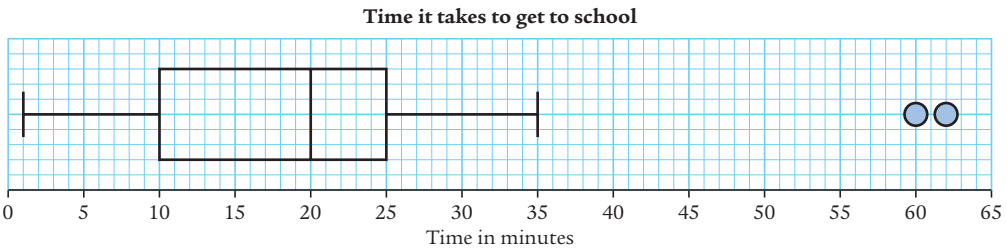
b



c Yes they are hitting their target

5 a $L = 1, Q_1 = 12, Q_2 = 20, Q_3 = 24, H = 35$

b



Exercise 5.4A

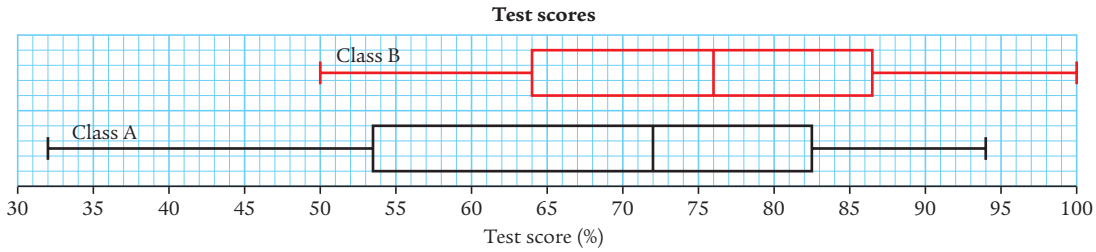
1 a

	Company X	Company Y
Mean	3·5	3·5
Mode	2	3
Range	5	3
Median	3·5	3·5

b Company Y as it has a smaller range so it is more consistent

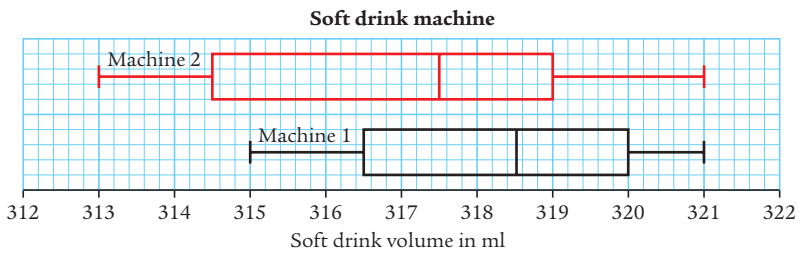
2 a Class A: $L = 32$, $Q_1 = 53{\cdot}5$, $Q_2 = 72$, $Q_3 = 82{\cdot}5$, $H = 94$, Class B: $L = 50$, $Q_1 = 64$, $Q_2 = 76$, $Q_3 = 86{\cdot}5$, $H = 100$

b



c Class B performed better in the test. Class A's results were more spread out than Class B's.

3 a

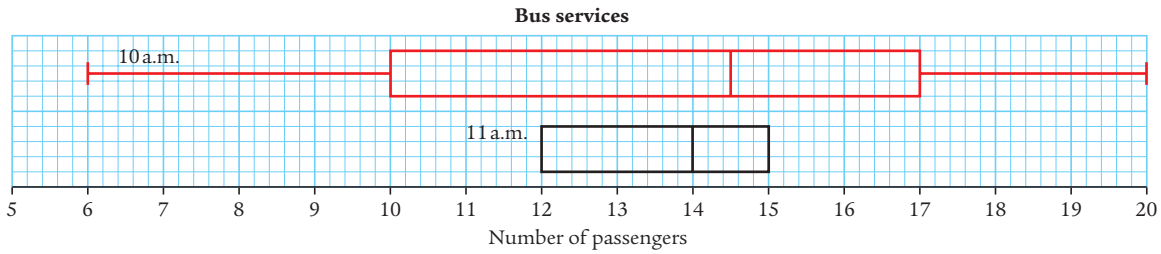


b Machine 1 is more consistent than Machine 2

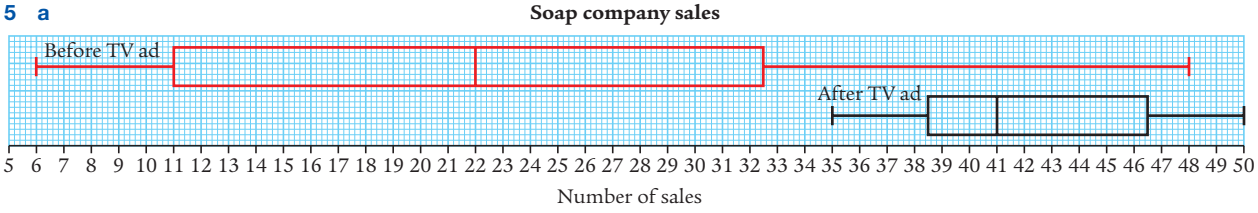
4 a 10 a.m. service: mean = 13·5, range = 14; 11 a.m. service: mean = 13·6, range = 3

b 10 a.m. service should be cut as the number of passengers varies too much

c



5 a



b Box plots show that the TV ad campaign is improving soap sales

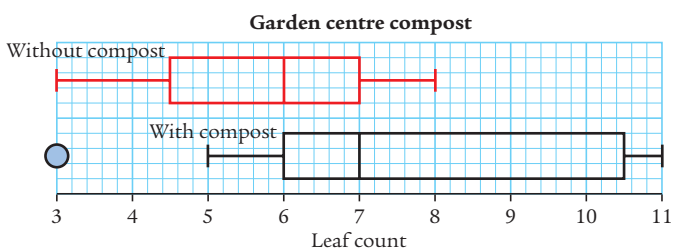
Exercise 5.4B

1 a 20 °C: mean = 48·375 minutes, range = 5·2 minutes; 30 °C: mean = 26·08 minutes, range = 5·6 minutes

b The higher the temperature, the faster the reaction rate. The data support the claim as the mean rate was lower for 30 °C.

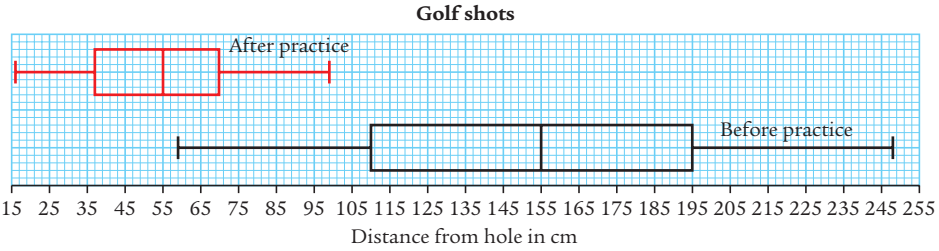
2 a Without compost: mean = 5·8, median = 6, range = 5; with compost: mean = 7·7, median = 7, range = 8

b



The compost does give more foliage. By considering 3 as an outlier for the 'with compost' sample you can see that 'with compost' does give more foliage.

3 Before practice: median = 155 cm, range = 189 cm; after practice: median = 55 cm, range = 83 cm
With practice, he is more consistent and closer to the hole. This supports his claim 'The more I practise, the luckier I get.'



4 **a** Before: median = 4·5 customers, range = 7 customers; after: median = 9 customers, range = 8 customers
b The flier campaign does boost customers. Although there is a bigger range of customers after the flier campaign, the number of customers is still much higher overall.

Preparation for assessment

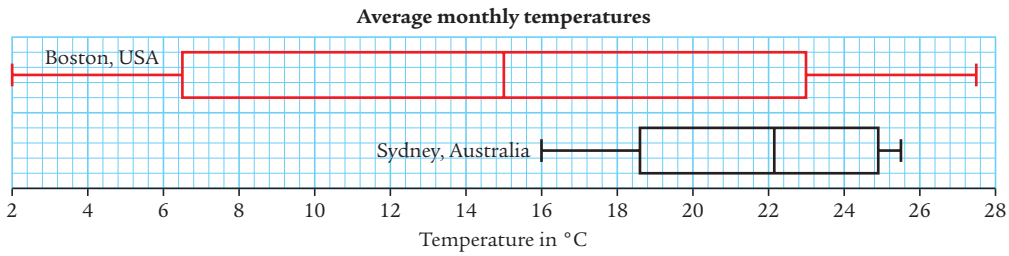
1 **a** 2010–11 **b** Because he only scored 2 goals **c** 14 goals

2 0.85%

3 42·5 kg

4 **a** Mode = 72; mean = 71·4, median = 72
b Yes, his modal score was lower and his scores were less spread out; his mean was 69·05

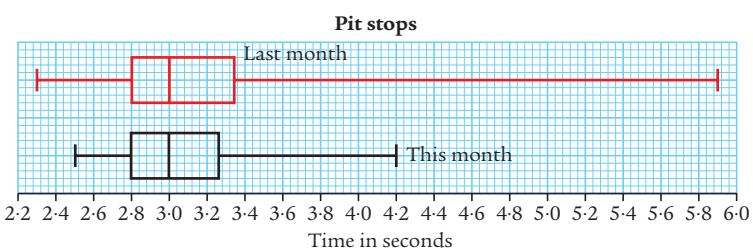
5 **a**



b Boston: median = 15·2 °C, range = 25·6 °C, Sydney: median = 22·15 °C, range = 9·6 °C.
Sydney has a higher median temperature and a lower range of temperatures.
c Boston has the highest monthly average temperature and the lowest monthly average temperature.
Sydney has a small range of temperatures across the year.

6

	First month (seconds)	Second month (seconds)
Mean	3·17	3·07
Mode	3	3
L	2·3	2·5
Q_1	2·8	2·8
Median, Q_2	3	3
Q_3	3·35	3·2
H	5·9	4·2
Range	3·6	1·7



They have the same median, 3 seconds, for both months but the second month has better consistency.
They are getting more consistent and have an 'average' of 3 seconds.

6 Frequency tables, charts and graphs

What you need to know

1 It looks like sales have rocketed in 2010 but the first four bars represent the amount of sales for one month and then the next two represent sales for whole years. Obviously sales for a whole year are going to be considerably more than sales for one month.

2 Angles drawn

3 **a** $\frac{1}{4}$ **b** $\frac{1}{3}$ **c** $\frac{5}{6}$

Exercise 6.1A

(Tally marks are not shown)

1

Class interval	Frequency
30–39	5
40–49	3
50–59	3
60–69	1

2 **a**

Class interval	Frequency
20–29	1
30–39	3
40–49	6
50–59	2

b

Class interval	Frequency
0–9	3
10–19	1
20–29	5
30–39	3

c

Class interval	Frequency
2·0–2·9	4
3·0–3·9	6
4·0–4·9	1
5·0–5·9	1

d

Class interval	Frequency
400–449	2
450–499	2
500–549	4
550–599	1
600–649	3

3 **a**

Mark (%)	Frequency
40–49	2
50–59	4
60–69	4
70–79	10
80–89	7
90–99	3

b 70–79%

4 a

Score	Frequency
65–69	2
70–74	6
75–79	8
80–84	5

c C grade

5 a

Journey time (min)	Frequency
0–4	1
5–9	3
10–14	14
15–19	6
20–24	4
25–29	1
30–34	0
35–39	1

b Most arrive between 8.40 a.m. and 8.44 a.m.

Exercise 6.1B

1 a

Speed (mph)	Frequency
$10 \leqslant v < 15$	8
$15 \leqslant v < 20$	9
$20 \leqslant v < 25$	3
$25 \leqslant v < 30$	5
$30 \leqslant v < 35$	5

b 17; **Note:** this is not readily seen from the frequency table. There are 9 in the interval $15 \leqslant v < 20$, 3 in the interval $20 \leqslant v < 25$, 5 in the interval $25 \leqslant v < 30$; and we must check the original data for possible cases of $v = 30$.

2 a

Weight lost (kg)	Frequency
$300 \leqslant w < 500$	4
$500 \leqslant w < 700$	3
$700 \leqslant w < 900$	6
$900 \leqslant w < 1100$	5
$1100 \leqslant w < 1300$	2
$1300 \leqslant w < 1500$	2

b

Weight lost (kg)	Frequency
$300 \leqslant w < 500$	1
$500 \leqslant w < 700$	5
$700 \leqslant w < 900$	4
$900 \leqslant w < 1100$	4
$1100 \leqslant w < 1300$	4
$1300 \leqslant w < 1500$	3
$1500 \leqslant w < 1700$	1

c Slimmers did better in second week: 8 slimmers lost 1100 g or more compared with only 4 in first week

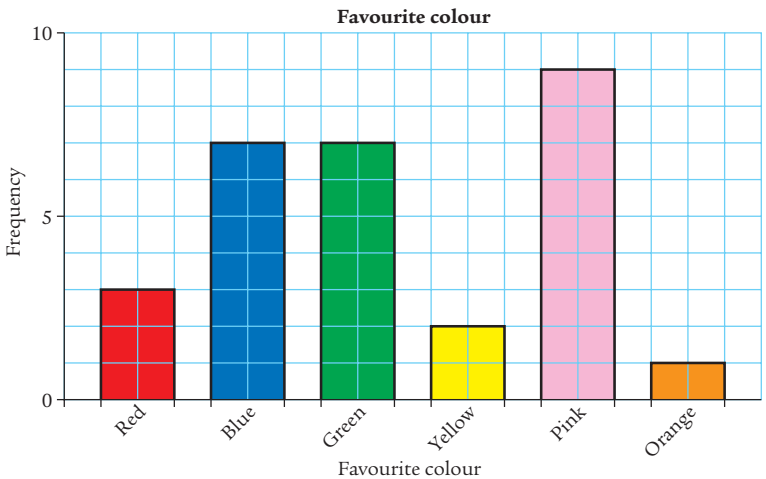
3 a

Time spent walking in one week (min)	Frequency
$140 \leqslant t < 150$	1
$150 \leqslant t < 160$	2
$160 \leqslant t < 170$	3
$170 \leqslant t < 180$	4
$180 \leqslant t < 190$	6

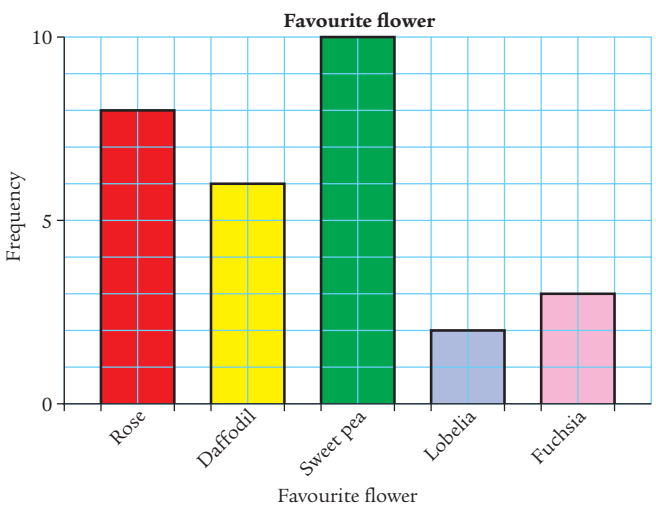
b 8th and 9th times (median) are in $170 \leqslant t < 180$ min interval, so the median provides the 150 minutes (5×30) required

Exercise 6.2A

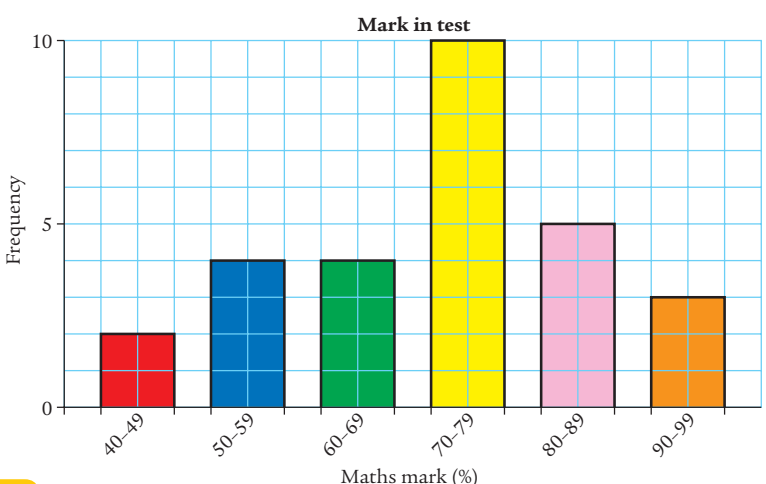
1 a



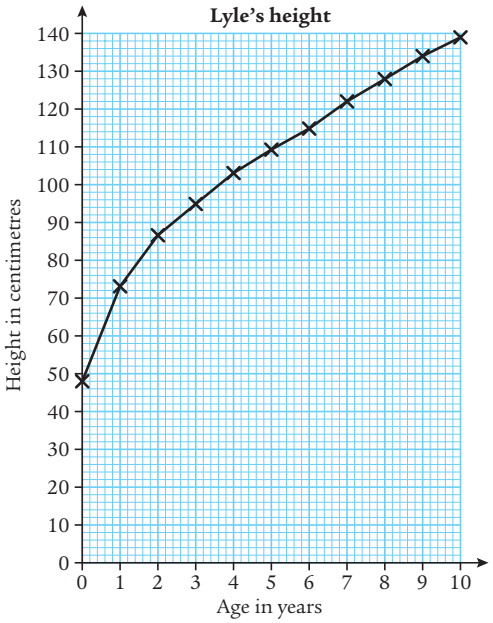
b



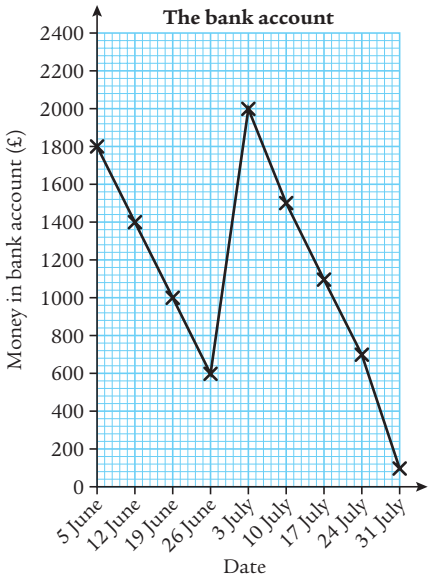
2



3

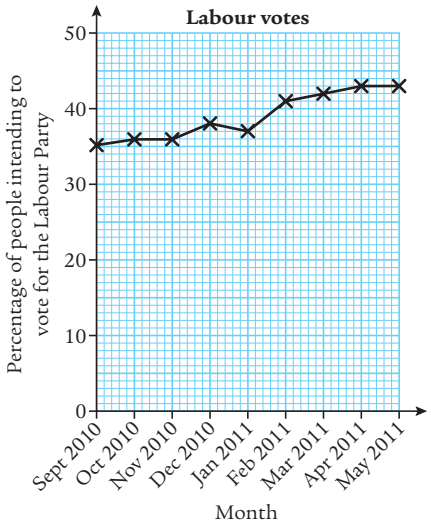


4 a



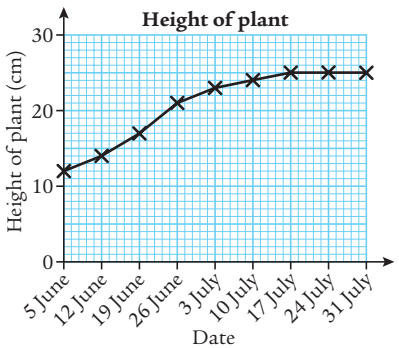
Money increases as the month progresses until near the end of the month when it increases (presumably the person has had wages paid into their bank account)

b



Percentage is steadily increasing over time

c



The height of the plant is gradually increasing until it reaches its maximum height of 25 cm

5 a i 125 cm **ii** 136 cm or 137 cm **b** Unlikely, he was probably just under 1 metre at this age

6 **a** 39·8 °C **b** 0·6 °C **c** 8·45 a.m.

d 9 a.m.; Tom's temperature dropped below 39·0 °C sometime before 9 a.m. but the nurses wouldn't know this until his temperature was taken at 9 a.m.

Exercise 6.2B

1 **a** 60 people had between 5 and 9 phones, 25 girls and 35 boys

b 2 more girls (22 − 20)

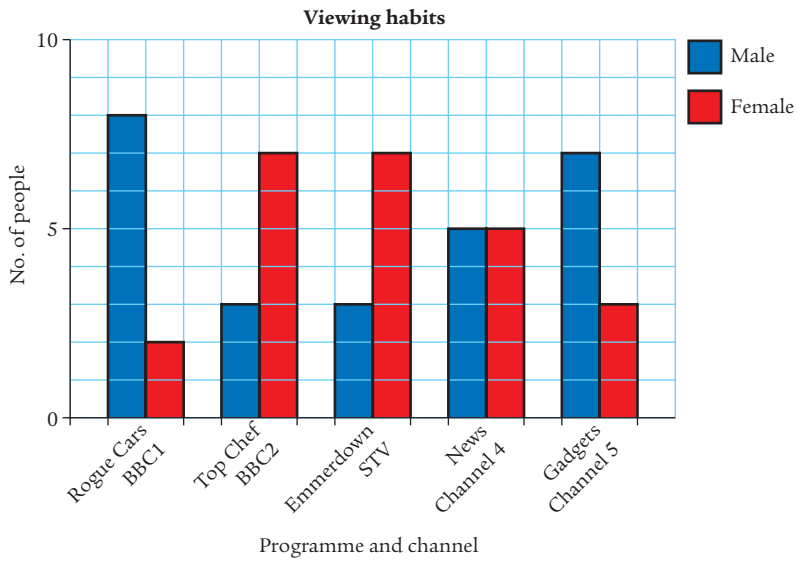
c 3 (10–14, 15–19, 20–24)

2 **a** **i** August and September **ii** April and May

b 19 more buttercups than harebells

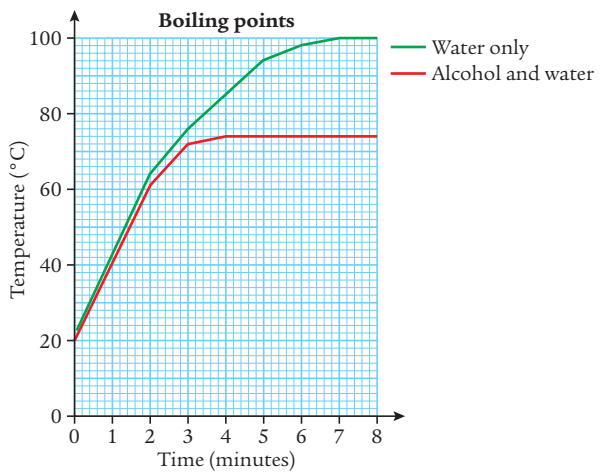
c **i** Buttercups: April to July **ii** Harebells: June to September

3 **a**



b **i** Male gender bias **ii** Female gender bias **iii** No gender bias

4 **a**



b Alcohol and water reached its maximum temperature while the water's temperature is still rising

c Water has now reached its maximum temperature

5 **a** Both averages are 7

b Advert: 9, no advert: 4·5

c Sales have improved in the area where the advert was run. In the other area sales have declined.

Exercise 6.3A

1 a **Age of people who bought product**

1	8
2	2 5 5 6 8 8 9
3	1 6 7 7 7
4	1 2
5	0
6	3 5 8 9
7	1 2 2 4 4 5

$n = 26$ 2|4 represents 24 years

b Median = 39; lower quartile = 28; upper quartile = 69 **c** Range = 57

2 a **Numbers on lottery balls drawn**

0	1 1 2 3 4 5 5 6 7 8
1	0 7 8 8 9
2	0 1 1 2 2 3 3 4
3	3 7 9
4	0 1 2 4 6 6 8 9 9

$n = 35$ 1|4 represents 14

b No **c** Lower quartile = 7; upper quartile = 40; median = 21

d 2nd quarter

3 a **Journey times to work**

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

$n = 15$ 1|7 represents 17 minutes

b Shortest journey time is 15 minutes and longest is 51 minutes. Median journey time is 25 minutes with half the workforce taking between 22 minutes (lower quartile) and 36 minutes (upper quartile).

Exercise 6.3B

1 a **Degree of difficulty**

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

$n = 15$ 1|7 represents 1·7

b Median = 3·3 **c** Mode = 3·8 **d** Range = 2·5

2 a 8 **b** 5 **c** 3·6 kg **d** 3·6 kg

3 a **Goals conceded**

1st Division				3rd Division		
	9	5	2			
	5	3	3	1		
9	9	1	4	0	3	6
		9	5	0		
		1	6	3	7	
	8	0	7	3		
			8	3	4	5

$n = 11$ $n = 11$

2|7 represents 27 goals

b **i** Yes **ii** 1st Division median = 49, 3rd Division median = 63. This supports Stella's view.

c 1st Division range = 53, 3rd Division range = 54; bigger range in 1st Division

4 a **Distance in centimetres beyond end of incline**

1	0	1	1	1	3	5	
2	0	1	1	3	3	7	7
3	2	3	5	5			
4	4	8	9				
5	1	4	5	9			

$n = 24$ 1|7 represents 1·7 cm

b Median = 27 cm; lower quartile = 17·5 cm; upper quartile = 46 cm

c **Distance in centimetres beyond end of incline**

30° incline								35° incline										
	5	3	1	1	1	0	1											
7	7	3	3	1	1	0	2	5										
			5	5	3	2	3	0	5	5	6	7	7					
				9	8	4	4	0	1	1	2	2	3	4	5	6	8	
			9	5	4	1	5	1	9									
							6	0	0	1	6	7						

$n = 24$ $n = 24$

3|7 represents 3·7 cm

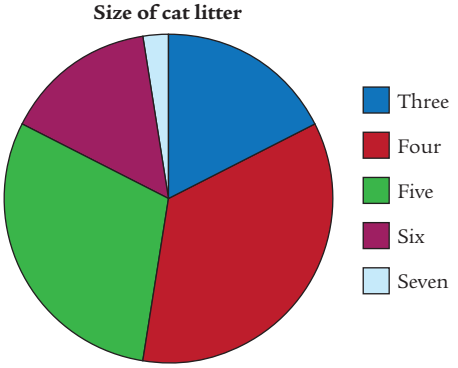
d On average the weight now travels further beyond the end of the incline

Exercise 6.4A

1 a

Size of cat litter	Frequency	Relative frequency	Angle at centre
3	7	$7 \div 40 = \frac{7}{40}$	$\frac{7}{40} \times 360° = 63°$
4	14	$14 \div 40 = \frac{7}{20}$	$\frac{7}{20} \times 360° = 126°$
5	12	$12 \div 40 = \frac{3}{10}$	$\frac{3}{10} \times 360° = 108°$
6	6	$6 \div 40 = \frac{3}{20}$	$\frac{3}{20} \times 360° = 54°$
7	1	$1 \div 40 = \frac{1}{40}$	$\frac{1}{40} \times 360° = 9°$

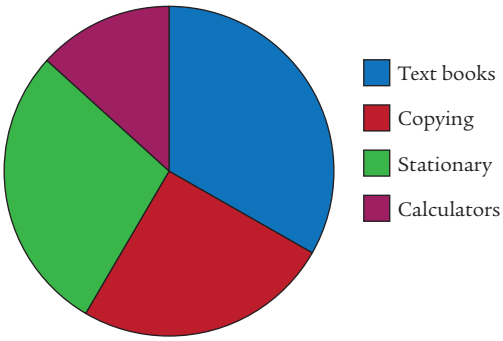
b



2 a **i** $1000 \div 3000 = \frac{1}{3}$ **ii** $750 \div 3000 = \frac{1}{4}$ **iii** $850 \div 3000 = \frac{17}{60}$ **iv** $400 \div 3000 = \frac{2}{15}$

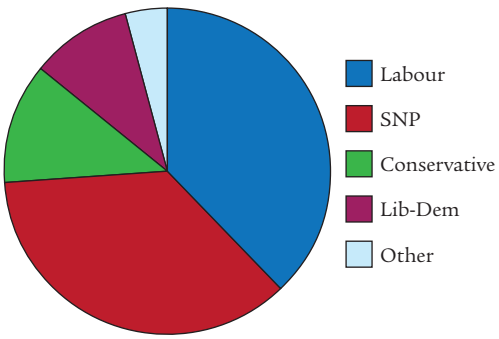
b **i** $\frac{1}{3} \times 360° = 120°$ **ii** $\frac{1}{4} \times 360° = 90°$ **iii** $\frac{17}{60} \times 360° = 102°$ **iv** $\frac{2}{15} \times 360° = 48°$

c Maths department budget



3 **a** 136·8° **b** SNP: 129·6°, Conservative: 43·2°, Lib-Dem: 36°, Others: 14·4°

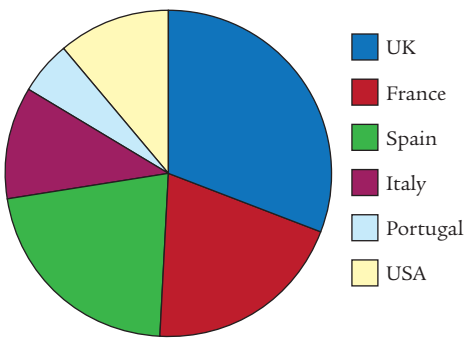
c Preferred party



4

Holiday destination	Frequency	Relative frequency	Angle at centre
UK	17	17 ÷ 55 = 0·309	0·309 × 360° = 111·3°
France	11	11 ÷ 55 = 0·2	0·2 × 360° = 72°
Spain	12	12 ÷ 55 = 0·218	0·218 × 360° = 78·5°
Italy	6	6 ÷ 55 = 0·109	0·109 × 360° = 39·3°
Portugal	3	3 ÷ 55 = 0·0545	0·0545 × 360° = 19·6°
USA	6	6 ÷ 55 = 0·109	0·109 × 360° = 39·3°

Holiday destinations



Exercise 6.4B

1 **a** 300 guests **b** 1100 guests **c** 2200 guests

2 **a** 48 hours **b** **i** 14 hours **ii** 8 hours **iii** 12 hours **iv** 8 hours
c 45° **d** 6 hours

3 90 hours

4 **a** Young adult **b** **i** 0 **ii** 2750 **iii** 1250 **c** 13 750 − 7250 = 6500
d Pop festival or pension scheme

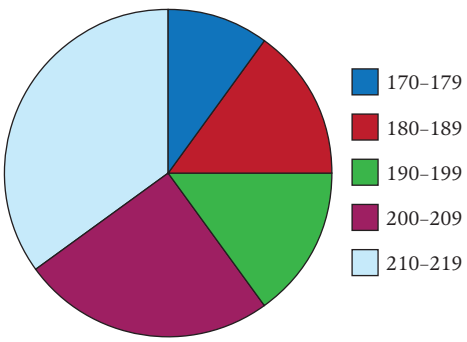
Preparation for assessment

1

Guess	Frequency
170–179	2
180–189	3
190–199	3
200–209	5
210–219	7

Angles at centre: 170–179, 36°; 180–189, 54°; 190–199, 54°; 200–209, 90°; 210–219, 126°

Guesses at how many sweeties in a jar



2 400 cars

3 **a** Smoothglide, 45; Progel, 45 **b** Progel

4 **a** 14 points **b** 11 points **c** 3 points, they scored a penalty **d** 8·5 points – not possible
e Graph is misleading if you use the dotted line between the dots to estimate the score at any time in the game

5 From Ralph's policy: **a** Expected sales of own company, £26 million **b** Total of all companies, £100 million
From Masoud's policy: expected sales of own company = 120 ÷ 360 = $\frac{1}{3}$ of total sales = 100 million ÷ 3 = £33·3 million
You should choose to follow Masoud's policy as it will provide more sales

7 Equations and formulae

What you need to know

1 **a** $6x + 8y$ **b** $2x + 6y$ **c** $3x + 3y - 7$ **d** $15x + 2y$

2 **a** $3a + 3b$ **b** $10m + 15n$ **c** $20x - 70$ **d** $12 - 8y$

3 **a** $14x + 13$ **b** $11p + 5$ **c** $27z - 1$ **d** $6y - 11$

4 **a** Subtract 2 **b** Add 7 **c** Subtract 15 **d** Add 3 **e** Subtract 1·5

5 **a** Divide by 4 **b** Multiply by 3 **c** Divide by (-12) **d** Multiply by (-10)

6 **a** 1 **b** -10 **c** -18 **d** -1

Exercise 7.1A

1 **a** $x = 6$ **b** $x = 4$ **c** $a = 3$ **d** $b = 8$ **e** $c = 6$

2 **a** $x = 3$ **b** $x = 8$ **c** $x = 24$ **d** $x = 3$ **e** $x = 7$
f $m = 11$ **g** $n = 60$ **h** $x = 19$ **i** $y = 99$ **j** $z = 38$

3 **a** $x = 8$ **b** $x = 9$ **c** $y = 43$ **d** $z = 3$ **e** $x = 29$
f $z = 88$ **g** $b = 49$ **h** $c = 9$ **i** $k = 100$ **j** $y = 52$

4 **a** 7 metres is the length, x metres is the breadth, length $\times$ breadth = area. Area = 28 m^2, so $7x = 28$
b Breadth is 4 metres

5 **a** Adding the no. of trees sold to the no. of trees left gives the no. of trees she started with, so $t + 7 = 25$
b $t = 18$, 18 trees sold
c **i** £10 for each tree sold, so no. of trees sold $\times$ 10 gives the money collected, so $10t = 180$
ii $t = 18$, 18 trees sold

6 **a** $D + 5 = 11$ **b** $D = 6$, D-Day was 6th June (1944)

Exercise 7.1B

1 **a** $x = 3$ **b** $a = 24$ **c** $b = 5$ **d** $c = 8$ **e** $m = 6$
f $n = 26$ **g** $p = 75$ **h** $y = 3$ **i** $y = 51$ **j** $y = \frac{29}{4}, 7\frac{1}{4}$ or 7·25

2 **a** $m = 13$ **b** $x = -4$ **c** $x = -2$ **d** $x = -4$ **e** $y = -4$
f $n = 78$ **g** $y = -6$ **h** $a = -23$ **i** $b = -37$ **j** $c = -50$

3 **a** $x = \frac{15}{2}$ **b** $y = \frac{17}{2}$ **c** $m = \frac{11}{2}$ **d** $z = \frac{3}{2}$ **e** $n = \frac{11}{2}$
f $p = 108$ **g** $g = 80$ **h** $p = 2$ **i** $b = 3$ **j** $m = \frac{1}{6}$

4 **a** $5 = x + 7$ **b** $x = -2$, temperature at 6 a.m. was -2 °C

5 **a** $3y = 75$ **b** $y = 25$, each instalment was £25

6 **a** No. of points after 3 weeks is equal to no. of points after 4 weeks minus points gained in week 4, so $73 = 92 - x$
b $x = 19$ **c** **i** $92 = 81 - y$ **ii** $y = -11$, he scored -11 points in week 5

7 **a** Cost for one edge is $5x$, as it is a square all 4 edges are the same, cost is $4 \times 5x = 20x$. So $C = 20x$.
b $300 = 20x$, $x = 15$, length of rug is 15 metres
c **i** To calculate the perimeter when we know the length of a side, we multiply by 4, so to calculate the length of side when we know the perimeter we do the inverse operation, which is divide by 4, so $x = \frac{P}{4}$
ii $P = 18 \times 4 = 72$ m

8 **a** $100 = \frac{240}{R}$, $R = 2{\cdot}4$ **b** 4·8 ohms

Exercise 7.2A

1 **a** $x = 3$ **b** $x = 4$ **c** $x = 7$ **d** $x = 6$ **e** $x = 2$ **f** $x = 4$ **g** $x = 2$ **h** $x = 3$

2 **a** $m = 4$ **b** $n = 16$ **c** $y = 17$ **d** $z = 3$ **e** $p = 12$ **f** $q = 14$ **g** $r = 33$ **h** $t = 2$

3 **a** $5c + 4 = 19$ **b** £3

4 **a** $2C + 2$ **b** $2C + 2 = 20$ **c** 9 carbon atoms

5 **a** $3x + 2$ **b** $3x + 2 = 23$ **c** $x = 7$

Exercise 7.2B

1 **a** $x = 0{\cdot}5$ **b** $x = 4$ **c** $x = 34$ **d** $x = 7$ **e** $y = 1$
f $y = 3$ **g** $y = 11$ **h** $y = \frac{4}{7}$

2 **a** $3x$ **b** $3x + 10$ **c** $3x + 10 = 76$ **d** $x = 22$, each paid £22

3 **a** $x = 7$, point is $(7, 11)$ **b** **i** $x = 1\frac{1}{2}$, point is $(1\frac{1}{2}, 0)$ **ii** x-axis **c** $(4, 5)$ and $(-1, 5)$

4 **a** $120 + 15w$ **b** **i** $120 + 15w = 270$ **ii** Turkey weighs 10 kg

5 **a** $y = 1951{\cdot}47$, so estimate 1951 **b** $y = 1954{\cdot}4117$, so estimate 1954 **c** No

Exercise 7.3A

1 **a** $x = 5$ **b** $x = 8$ **c** $x = 5$ **d** $y = 9$ **e** $y = 9$
f $y = 6$ **g** $p = 13$ **h** $q = 9$ **i** $m = 49$

2 **a** $15 + 5p$ **b** $25 + 3p$ **c** $15 + 5p = 25 + 3p$ **d** 5 parcels

3 **a** $5x + 4, 7x - 8$ **b** 6 m **c** 34 m

4 **a** $5x + 40$ **b** $x + 248$ **c** **i** $5x + 40 = x + 248$ **ii** 52 cm **iii** 300 cm **iv** 312 cm

5 **a** $10x + 100$ **b** $12x + 40$ **c** **i** $12x + 40 = 10x + 100$ **ii** £30 **iii** £400

6 **a** **i** $420 - 2x$ **ii** $70 + 5x$
b $70 + 5x = 420 - 2x$, 50 ml
c 320 ml
d There is the same amount of red dye in the blue beaker as there is blue dye in the red beaker

Exercise 7.3B

1 **a** $x = 5$ **b** $y = 2$ **c** $z = 8$ **d** $p = 8$ **e** $q = 12$ **f** $r = -1$

2 **a** $a = 5$ **b** $a = 2$ **c** $b = 3$ **d** $b = -1$ **e** $c = 10$

3 **a** $(8, 39)$ **b** $(6, 59)$ **c** $(6, 46)$ **d** $(3, 6)$

4 **a** $15h + 50 = 30h + 20$, 2 hours **b** Lawrie **c** Colin

5 **a** $1 + 0{\cdot}2t$ **b** $0{\cdot}5 + 0{\cdot}4t$ **c** 2·5 seconds

6 **a** $(3, 5)$ **b** $(2, 2)$
c $x = x + 2$, there is no value for x where this equation is true so the lines don't meet (they are parallel)

Exercise 7.4A

1 **a** $x = 1$ **b** $y = 3$ **c** $z = 7$ **d** $m = 3$ **e** $n = 1$ **f** $p = 4$
g $q = 6$ **h** $x = 2$ **i** $y = 4$ **j** $z = 1$ **k** $m = 6$ **l** $n = 2$

2 **a** $(4 + x)$ m **b** $2(4 + x)$ m^2 **c** $2(4 + x) = 12{\cdot}5$, needs to extend bed by 2·25 m

3 $3(x + 5) - 7 = 26, x = 6$

4 **a** $(x + 7 + 10)(1000 - 8) \div 992 - 17$
b 3
c We start by adding 17 (7 and 10) then we multiply by 992(= 1000 − 8) then divide by 992 then subtract 17. Since we carry out two operations followed by their inverse operations in reverse order we end up with the number we started with.

5 **a** $15(x - 10)$
b **i** $12(x + 10)$ **ii** $15(x - 10) = 12(x + 10)$ **iii** 90 m/min
c 1200 m

6 **a** $x + 5, 1{\cdot}4(x - 15)$ **b** 65 mph **c** 70 miles

Exercise 7.4B

1 **a** $y = \frac{11}{5}$ **b** $y = 5$ **c** $y = 1$ **d** $x = 2$ **e** $x = 2{\cdot}5$ **f** $x = -3$

2 **a** $b - 5$ **b** $b - 3$ **c** **i** $6(b - 5)$ **ii** $5(b - 3)$
d **i** $b = 15$ **ii** 15 bricks in each box initially

3 **a** $120(x - 30) = 90(x + 10), x = 150$ **b** $x = -7{\cdot}95$ gives a width of 2·05 cm, which is not practical
c $x = 32{\cdot}03$ (to 2 d.p.), so width = 2·03 cm, which is possible

4 **a** $5(x + 1) = 7(x - 2)$, current price is £9·50 **b** £52·50

5 Dad's age $= 38 + x$, son's age $= 6 + x$, $38 + x = 2(6 + x)$, 26 years

6 6 people at £65 and 12 people at £40

7 **a** $60(350 - 2x) = 20x$, length of arm is 300 cm **b** 50 cm

Exercise 7.5A

1 **a** 0 **b** 8 **c** 27 **d** 125 **e** 3 **f** −7
g 66 **h** 4 **i** 4 **j** 2 **k** 50
l 72 **m** 2 **n** −40 **o** $\frac{9}{10}$ **p** 1
q 13 **r** $\frac{1}{2}$ **s** $\frac{9}{4}$

2 **a** $N = 25$ **b** $V = 12$ **c** $l = 13$ **d** $s = 9$ **e** $C = 31{\cdot}2$
f $Q = 135$ **g** $L = 9{\cdot}5$ **h** $y = 16$ **i** $l = 15$ **j** $A = 61$

3 **a** **i** 3 **ii** 1 **b** **i** 24 **ii** 24

4 **a** 420 m^3 **b** 630 m^3

5 **a** 55 mph – no **b** 60·7 mph (to 1 d.p.) – yes **c** 70 mph – yes

6 **a** **i** 34·4 m/s **ii** 73·6 m/s **b** **i** 182·4 m **ii** 247·1 m **iii** 64·7 m **iv** 94·1 m

7 **a** 1 year
b 1·87 years (to 2 d.p.)
c Over 49 times bigger (Mercury 0·24 year, Jupiter 11·86 years)

Exercise 7.5B

1 **a** $v = 10{\cdot}25$ **b** $E = 58\,800$ **c** $E = 180$ **d** $Y = 5{\cdot}5$ (to 1 d.p.)

2 **a** $t = 5$ **b** $D = 178{\cdot}75$ **c** $x = 2$ **d** $h = 45$

3 $E = 22{\cdot}97 = 23$ joules (to nearest whole number), so yes

4 **a** 1847 cm^3 (to nearest whole number) **b** 9·95 cm (to 2 d.p.)

5 **a** 32·87 (to 2 d.p.) **b** 89·59 kg **c** 66·5 kg (to 1 d.p.)

Exercise 7.6A

1 **a** $b = a - c$ **b** $r = q - p$ **c** $t = s + u$ **d** $I = \frac{V}{R}$ **e** $T = \frac{D}{S}$ **f** $v = hn$
g $C = \pi d$ **h** $H = \frac{C - S}{5}$ **i** $H = \frac{F + D}{15}$

2 **a** **i** $t = v + u$ **ii** $t = 19$ **b** **i** $m = dv$ **ii** $m = 17\,880$

3 **a** $d = \frac{P - 20t}{80}$ **b** =(A2−20*B2)/80

4 **a** $I = \frac{V}{R}$ **b** **i** 4 amps **ii** 1·5 amps **iii** 2 amps **iv** 4 amps

5 **a** $H = \frac{F - 400}{50}$ **b** 4 hours

6 **a** $P = \frac{C}{A}$ **b** £31·25 per square metre

Exercise 7.6B

1 **a** $r = \sqrt{\frac{A}{\pi}}$ **b** 7 cm **c** 6 cm

2 **a** **i** $R = \frac{P}{I^2}$ **ii** 25 ohms **b** **i** $I = \sqrt{\frac{P}{R}}$ **ii** 12·5 amps

3 **a** $w = Bh^2$ **b** 74·52 kg **c** 53·76 kg

4 **a** $a = \dfrac{2A - bh}{h}$ **b** **i** 15 cm **ii** 14 cm **iii** 13 cm

5 **a** $L = \dfrac{5P + 5y}{4}$ **b** 70 **c** Decreased

6 **a** $X_{\text{old}} = \dfrac{X_{\text{new}}(N + 1) - x}{N}$ **b** $N = \dfrac{x - X_{\text{new}}}{X_{\text{new}} - X_{\text{old}}}$

Preparation for assessment

1 $x = \dfrac{y - 3d}{6}$

2 **a** $k = 5$ **b** $k = -2$

3 **a** $24x$ **b** $24x + 109{\cdot}99$ **c** $24x + 109{\cdot}99 = 949{\cdot}99$, £35

4 64 weeks

5 **a** 10 **b** $H = 2C + 2$ **c** 14 hydrogen atoms **d** 42 hydrogen atoms **e** 29 carbon atoms

6 Alan: rearrange formula to obtain formula for rent: $Y \times C = \dfrac{R}{C} \times C$; $YC = R$ or $R = YC$.

Substituting: $R = 0{\cdot}065 \times 90\,000 = 5850$; annual rent = £5850.

Stevie: use formula as it stands and substituting: $Y = \dfrac{R}{C}$; $0{\cdot}065 = \dfrac{R}{90\,000}$; $R = 0{\cdot}065 \times 90\,000 = 5850$; annual rent = £5850.

Both Alan and Stevie are correct. George should charge an annual rent of £5850, which is £487·50 per month (£5850 ÷ 12).

8 Pythagoras' theorem

What you need to know

1 Yes, 36 cm^2, 1·44 cm^2, 11·56 cm^2

2 Yes, **a** 7 cm **b** 1·4 m **c** 2·7 km

3 12 m

Exercise 8.1A

1 **a** 10 cm **b** 13 cm **c** 17 cm

2 **a** 2 cm **b** 2·5 cm **c** 2·9 cm

3 **a** 40·3 cm **b** 11·1 cm **c** 17·0 cm

4 **a** 25·4 miles **b** Satnav gives distance by road, which is not a straight line

5 **a** 7·3 m **b** If three sides of a triangle are fixed, the angles are fixed ... the shape is rigid

6 **a** 1·7 m **b** 7 m **c** 7·1 m

7 **a** 23 m **b** 6·72 m (to 2 d.p.)

8 **a** 335·0 m **b** 332·0 m

Exercise 8.1B

1 **a** 140 cm **b** 176 cm **c** 154 cm **d** 240 cm

2 **a** 750 m **b** 3677 m
c To make walking comfortable, the climb/gradient has been reduced by making the path longer and hence the ascent more gradual

3 **a** 97 m **b** 234 m **c** £702

4 It should start at the point so that 40 + 80 = 96 + 24

5 **a** A: 17·5 cm and B: 17 cm **b** Triangle A **c** A: 30 cm and B: 30 cm **d** No

6 **a** 65 cm **b** 33 cm **c** 32 cm

7 If the roll is unravelled it will form a right-angled triangle with a base equal to 3 circumferences of the circle (36 cm) and a height equal to the length of the tube. The seam will be the hypotenuse of the triangle, viz. 45 cm.

Exercise 8.2A

1 **a** 20 cm **b** 28 cm **c** 5 cm

2 **a** 1·6 cm **b** 1·2 cm **c** 6 cm

3 **a** 9·6 cm **b** 18·3 cm **c** 20·9 cm

4 **a** 12 m **b** Assume ground is horizontal and house is vertical
c No, it would go 0·25 m higher (to 2 d.p.)

Exercise 8.2B

1 $x^2 = 50 \Rightarrow x = 7{\cdot}1$ (to 1 d.p.)

2 **a** 11·3 cm **b** 26·2 cm **c** 1 cm

3 20·3 cm (to 1 d.p.)

4 **a** 5·9 km **b** East and north are at right angles to each other

5 **a** **i** 14·5 m **ii** 8·9 m^2 **b** **i** 14·5 m **ii** 9·0 m^2

6 **a** 150·0 million km
b To 1 d.p. the distance from the Moon to the Sun is the same distance as from the Earth to the Sun (even to 3 d.p.)

Exercise 8.3A

1 **a** 5 units **b** 13 units **c** 25 units

2 9·2 units

3 **a** AB = 50 units **b** BC = 17·9 units (1 d.p.) **c** AC = 50 units, AB = AC so triangle is isosceles

4 **a** Using Pythagoras, GC = 5 units = 4·5 km, so 1 square = 0·9 km
b 5·1 units = 4·6 km

Exercise 8.3B

1 **a** 5 units **b** All sides = 5 units
c AC = 1·414 units, BD = 9·899 units, area = 7 units^2

2 **a** **i** Scarwood = 5 units **ii** Pickenhill = 5·10 units
b Queensview = 5·39 units, Ravenslaw = 5·39 units, so closest is Scarwood
c 2·5 km

3 **a** (94, 50) **b** 9·4 km **c** 10·2 km **d** 10·7 km

Exercise 8.4A

1 61 cm **2** 33·9 cm **3** 77·9 mm **4** 20·8 cm

5 **a** 5·2 cm **b** 20·8 cm

6 42 + 96 = 138 mm

7 **a** 7·3 cm **b** 45·6 cm

Exercise 8.4B

1 **a** 24 inches **b** 19·5 inches **c** Widescreen TV height is less than standard TV height
d Height = 1, length = 1·78, gives a size (hypotenuse) of 2·04, so 24 times this gives height = 24, length = 42·7, and a size (hypotenuse) of 49·0 = 49-inch

2 **a** 84·9 cm **b** You will be multiplying by 1000 so work to 3 d.p., 2828 cm more frill

3 9·1 cm

4 **a** 77·9 mm **b** 1403·1 mm^2 **c** $0{\cdot}5 \times 80 \times x = 1403{\cdot}1$, so $x = 35{\cdot}1$ mm

5 **a** 84·9 m **b** 116·6 m

6 **a** 30·5 cm **b** 57·6 cm

7 **a** **i** 59·5 m **ii** 60·8 m **b** Difference between the heights 116 m and 57 m **c** **i** 81·0 m **ii** 24·2 cm

Preparation for assessment

1 **a** 9·7 cm **b** 3·9 cm **c** 1 cm

2 **a** 125 cm **b** 8·8 cm
c If 2 is a shorter side, then 2·2 cm (to 1 d.p.), if 2 is the hypotenuse, then 1·7 cm (to 1 d.p.)

3 **a** 13 units **b** 61 units

4 14·5 m

5 **a** 1·4 cm **b** 2·54 cm

6 7·71 cm

9 Related angles

What you need to know

1 **a** ∠CBE, ∠EBD **b** ∠CBE, ∠EBA or ∠CBD, ∠DBA **c** ∠ABE

2 **a** ∠PQR = 75° (base angles of isosceles triangle are equal) **b** ∠PRQ = 30° (third angle in a triangle)

3 **a** 360° **b** 360°

4 $p = 57, q = 52, r = 38$

Exercise 9.1A

1 **a** 49 **b** 55 **c** 25

2 $d + e = 52$

3 $f = -10$ (impossible)

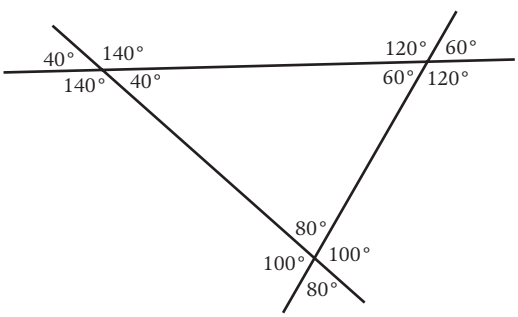
4 $g = 138{\cdot}7, h = 21{\cdot}5$

5 **a** $2j + k = 100$ **b** $j = 25, k = 50$

6 $q + 90 = 120$, so $q = 30$, $2r = 60$, so $r = 30$

7 **a** ∠ADF = 90°, ∠FDB = 90° so ∠ADB = 180°
b ∠DFC = 180°, ⇒ ∠EFD + ∠GFD = 180° (C and D are the same point in diagram 3)
c Co-interior angles

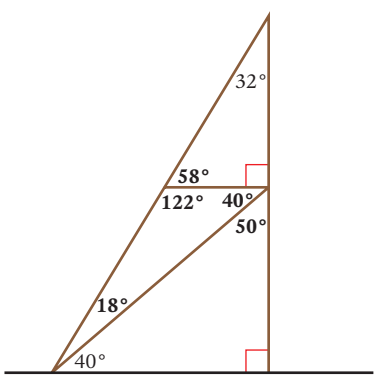
8 **a** $x = 40, x + 20 = 60, x + 40 = 80$



9 **a** $b + c = 180$ **b** $a = \frac{1}{2}(180 - c)$ **c** $a = \frac{1}{2}b$

Exercise 9.1B

1



2 Reflected beam will leave horizontally

3 $x° = 32°$

Exercise 9.2A

1 $a = 43$ (vertically opposite 43°), $b = 43$ (alternate to 43°), $c = 137$ (co-interior to 43°), $d = 137$ (supplement of 43°), $e = 43$ (corresponding to 43°)

2 **a** **i** 58° (corresponding to ∠CAB) **ii** 90° (co-interior to ∠ABE) **iii** 32° (angle sum in a triangle is 180°)
b **i** Add to 180° **ii** Add to 360°

3 **a** **i** 72° **ii** 72° **iii** 36° **b** ∠QTP **c** ∠SQP

4 **a** 112°, 68°, 112° **b** They are equal **c** They add up to 180°

Exercise 9.2B

1 **a** $p° = 116°, q° = 64°, r° = 58°, s° = 58°$ **b** $p = 124, q = 56, r = 62, s = 62$
c As angle decreases, $r°$ and $s°$ increase. Height of board is related to sin $r°$ and sin $s°$.

2 **a** 109° **b** 71° **c** 71° **d** 109°

3 110°

4 **a** $\angle DAB = (180 - a)°, \angle ADC = a°, \angle ABC = (40 + a)°, \angle DCB = (140 - a)°$
b Sum $= (180 - a) + (40 + a) + (140 - a) + a = 360$
c When x replaces 40: sum $= (180 - a) + (a + x) + (180 - a - x) + a = 360$

5 145°

6 **a** $a = 117, b = 103, c = 63$ **b** 63°, 77°, 103°, 117°

Exercise 9.3A

1 **a** ∠ABE **b** ∠BAQ **c** ∠BAL and ∠ABE, also ∠MAB and ∠SBA
d 109° (co-interior to 71°) **e** 251°

2 **a** $p° = 34°, q° = 34°, r° = 51°$ **b** 95° **c** 85° **d** 141° − 056° = 85°

3 **a** 47° **b** 133°

4 100°

Exercise 9.3B

1 **a** As they are moving parallel to each other and on different paths, they cannot collide
b If they were parallel on the same straight line (collinear)

2 **a** Student's scale drawing **b** 58 km **c** 274°

3 **a** 1 **b** 3 **c** 6

4 $(y - x)°$

Exercise 9.4A

1 **i** **a** Kite **b** Kite **c** Kite **d** V kite **e** Rhombus **f** Rhombus **g** Parallelogram
h Parallelogram **i** Trapezium **j** Trapezium
ii **a** $a° = 109°$ **b** $b° = 68°$ **c** $c° = 65°, d° = 100°$ **d** $e° = 16°$ **e** $f° = 123°, g° = 57°$
f $h° = 47°, i° = 43°, j° = 43°$ **g** $k° = 80°, m° = 100°$ **h** $n° = 49°, p° = 110°$
i $q° = 80°, x° = 60°, 2x° = 120°$ **j** $r° = 50°$

2 **a** $m + n = 140$ **b** $m = 70, n = 110$ **c** $m + n = 180$ **d** $m + n = 180, m = 110, n = 70$

3 ∠DAB = 44°, ∠DCB = 44°, ∠ABC = 136°, ∠ADC = 136°

4 **a** Rhombus **b** 61°, 119°, 61°, 119°
c **i** $m + n = 180$ **ii** $n = 52{\cdot}2$ **iii** $m°$ = 90° + forward angle, $n°$ = 90° − forward angle

5 **a** Parallelogram **b** 65°, 115°, 65°, 115° **c** **i** Arc of a circle

6 **a** ∠YXW = 103° **b** ∠XWZ = 77°

7 **a** 27° **b** 101° **c** 126°
d Check the angles of trapezium add up to 360° (= 54° + 126° + 128° + 52°)

8 **a** 77° **b** 103°

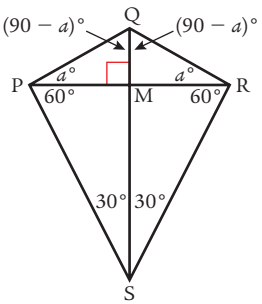
9 **a** 65° **b** 115°

Exercise 9.4B

1 A and B: 55°, 125°, 42°, 138°; C and D: 28°, 152°, 55°, 125°. Each of the angles of the frame is bisected by the joint.

2 **a** ∠DAB = ∠DCB = 143°, ∠ADC = 30°, ∠ABC = 44° **b** ∠BAC = 68°

3 **a**

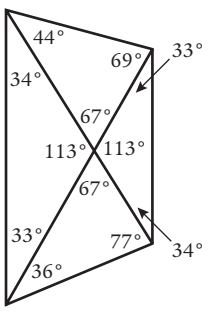


b ∠QPS = ∠QRS = (60 + *a*)°, ∠PQR = (180 − 2*a*)°, ∠PSR = 60°

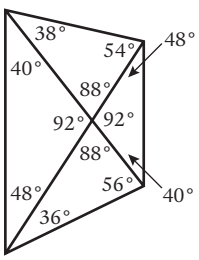
c The four right angles where the diagonals intersect do not get included

4 **a** 56°, 124°, 56°, 124°

b **i**



ii

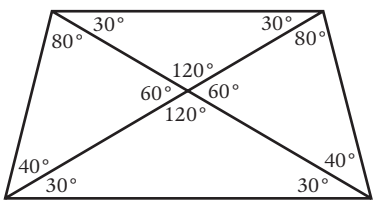


5 40°, 140°, 40°, 140°

6 **a** 70° **b** 76° **c** 36° **d** 112° **e** 68°

7 **a** 78° **b** 68° **c** 68° **d** 57°

8



9 **a** A is stable (100 < 1·5 × 80); B is unstable (138 > 1·5 × 42); C is unstable (114 > 1·5 × 66)

b 108°

Exercise 9.5A

1 **a** 50° **b** 45° **c** 44° **d** 55°

2 **a** ∠AEC and ∠ADC **b** $p + q = 180$, $p = 101{\cdot}8$

3 111°

4 **a** 28° **b** They are parallel

5 **a** **i** 30° **ii** 15° **b** **i** 60° **ii** 30° **c** **i** 90° **ii** 45° **d** **i** 120° **ii** 60°

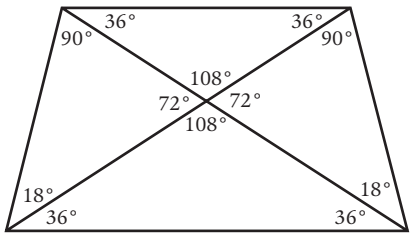
Exercise 9.5B

1 **a** 82° **b** 46°

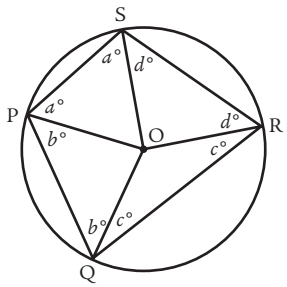
2 **a** A to B to C; C to B to A; A to E to C; C to E to A; A to D to C; C to D to A

b When B is diametrically opposite D

3



4 a



b $a + b + c + d = 180$
c $a + d + b + c$
d $b + c + a + d$
e Opposite angles in a cyclic quadrilateral add up to 180°

5 a i 45° **ii** 67·5° **iii** 90° **iv** 22·5°
b $\frac{1}{2}$ **c i** 90° **ii** 45° **iii** 90° **iv** 45° **d i** $\frac{1}{2}$ **ii** $\frac{1}{2}$

6 As the corners of the notebook are 90°, the botanist is setting up a right angle at the circumference. This means that AB is a diameter. Similarly, CD must be a diameter. Diameters intersect at the centre.

Exercise 9.6A

1 a 53° **b** 6 cm

2 ∠APT = 90°, ∠ATP = 40°

3 $a = 19, b = 38, c = 57, d = 57$

4 ∠OTC and ∠OTD (tangent CD is perpendicular to radius OT); ∠ATB (angle in a semicircle)

5 a 129° **b** $(180 - x)°$

Exercise 9.6B

1 148°

2 $x° = 37°$

3 a 30° **b** ∠BAC = $x°$
c Angle between a tangent and a chord will always be the same as the angle at the circumference standing on that chord

4 a Draw a chord on the circle: measure the chord and mark the midpoint: draw a perpendicular to the chord passing through the circle. Draw another chord (but not diametrically opposite). Repeat the process with midpoint and perpendicular. Where these two perpendiculars intersect is the centre of the circle. (The perpendicular bisector of every chord passes through the centre of the circle.)
b Tie a string between two of the standing stones: mark the halfway point on the string and then tie a string at the midpoint. Set this string at right angles to the original string. Repeat the process where a string is tied between a different pair of stones. Where the second perpendicular string cuts the first perpendicular will be the centre.

5 a i $x°$ (alternate to ∠FCD) **ii** $\frac{1}{2}(90 - x)°$ **iii** $\frac{1}{2}(90 - x)°$ **iv** $(180 - 2x)°$ **b** Always $(90 - x)°$

Preparation for assessment

1 a 23° **b** 67°

2 a 38° **b** 132°

3 a 116° **b** 64° **c** 52°

4 a Student's own diagram **b** 90° **c** 10 km

5 a 58° **b i** 58° **ii** 32° **iii** 90°

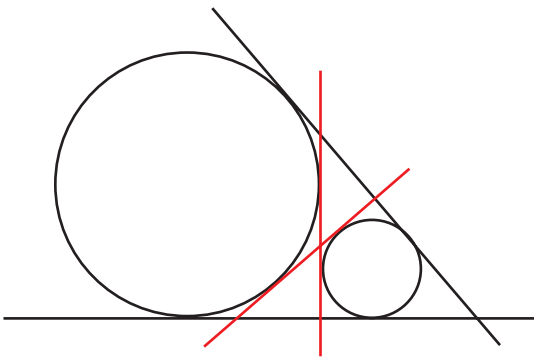
6 a i BKEJ, KFLE, LHME, MDJE **ii** They are all squares (every square is a kite)
b 169·7 mm **c i** 14 400 mm^2 **ii** 28 800 mm^2 **iii** 169·7 mm

7 **a** **i** 6 **ii** 36 **b** **i** 60° **ii** 12° **iii** 24°

8 **a** ∠GFM (tangent and radius at tangent point); ∠DFM (tangent and radius at tangent point); ∠QFT (angles in a semicircle)

b **i** 68° **ii** 44°

c



9 ∠A + ∠B = 180°; ∠C + ∠B = 180° (co-interior angles); ∠D = ∠E (alternate angles); parallelograms; trapezia; $\frac{7}{12}$ of the photo is above the rail

10 Trigonometry

What you need to know

1 **a** 3 times **b** $\frac{1}{3}$ **c** 4 cm **d** 24·3 cm
e Breadth = 9 cm, length = 27 cm **f** Breadth = 9 cm, length = 27 cm

2 **a** 6·4 cm ≡ 12·8 m **b** 4 m **c** 5 : 16 **d** 30°, 60°, 90° **e** Angles and ratios

3 **a** Angles the same **b** 1·4 cm **c** **i** 0·7 **ii** 0·7 **d** **i** CB **ii** AB **iii** EF **iv** DE
e Hypotenuse **f** **i** CB **ii** DE **iii** FE

Exercise 10.1A

1 **a** **i** BC, AB **ii** 2 **b** **i** FE, DF **ii** 0·513 **c** **i** PR, PQ **ii** 2·08

2 **a** 3·22 cm **b** 4·20 cm **c** 3·30 cm

3 4·08 m

4 **a** 17·8 m **b** 4·44 m **c** 5·68 m

5 **a** 17% **b** 14% **c** 9%

6 **a** 32° **b** 5·00 km

7 **a** 28° **b** 9·57 cm **c** 20·4 cm

8 **a** 11·9 m **b** 7·1 m **c** 148%

Exercise 10.1B

1 **a** 27·1 m **b** 9·08 m **c** 2·05 m

2 **a** **i** 6·4 cm **ii** 8 cm **b** **i** 29·5 cm **ii** 29·7 cm

3 **a** 74° **b** 87·2 m **c** **i** 103·9 m **ii** 128·9 m

4 **a** 37·6 cm **b** 5·87 cm

5 **a** 13·7 m **b** 6·09 m

6 **a** 2·97 km **b** **i** 5·96 km **ii** 2·99 km

7 **a** 0·721 AU **b** 1·52 AU **c** 9·51 − 5·19 = 4·32 AU

Exercise 10.2A

1 **a** 50·0° **b** 25·0° **c** 62·7°

2 **a** 38·7° **b** 26·6° **c** 114·7°

3 **a** **i** 66·8° **ii** 23·2° **b** 66·8°, 66·8°, 46·4°
c **i** 20·6°, 20·6°, 138·8° **ii** 25·6°, 25·6°, 128·8°

4 **a** 6·8° **b** 9·6° **c** 8·1° **d** 4·8°

5 **a** 76·0° **b** This is 1° less (perhaps thought easier to remember) **c** 1·25 m
d **i** 14·9°, safe **ii** 20·1°, unsafe **iii** 5°, safe **iv** 7·8°, unsafe

6 **a** **i** Going through the values from 1, 0·9, 0·8, etc., we get tangents 4, 4·44, 5·00, 5·71, 6·67, 8·00, 10·00, 13·3, 20·0, 40·0, then ERROR
ii Angles are 76°, 77·3°, 78·7°, 80·1°, 81·5°, 82·9°, 84·3°, 85·7°, 87·1°, 88·6°
b **i** Angle tends to 90° **ii** Tangent gets infinitely big and calculator can't cope ... the tangent is undefined at 90°

Exercise 10.2B

1 **a** 15·4 cm **b** ∠PRQ = 65·6°, ∠PQR = 42·4°

2 **a** 33·7° and 56·3° **b** 112·6° and 67·4°

3 97·1°, 97·1°, 53·2°, 112·6°

4 **a** 36·3° **b** 45° (wet), 33·7° (dry)

5 56·3°

6 **a** 34·4°, 90°, 55·6° **b** 124°

7 Angles are $a = 18{\cdot}4°$, $b = 11{\cdot}3°$, $c = 7{\cdot}1°$. They do not change by the same amount but get smaller each time.

Exercise 10.3A

1 **a** 5·6 cm **b** 5·6 cm **c** 6·7 cm
2 **a** 23·9 cm **b** 2·22 cm **c** 3·18 cm
3 **a** 49·5° **b** 33·4° **c** 62·7°
4 **a** 26·1°, 63·9°, 5·3 cm **b** 41·8 cm, 34·2 cm, 55° **c** 12·4 cm, 11·6 cm, 43°
5 8·44 km
6 **a** 2840 mm **b** 3672 mm
7 **a** 11·5 **b** 23·6 **c** Material 1
8 **a** **i** 30·9 cm **ii** 11·6 cm **b** 42·5 cm

Exercise 10.3B

1 **a** 24·3 cm **b** 26·2 cm
2 **a** 2·65 km from A, 0·34 km from B **b** 2·99 km
3 **b** 53·1°, 36·9°
4 **a** 33·96 cm **b** **i** 30° **ii** 34·2°
5 **a** 61° **b** 490·5 m
6 40·2 m
7 **a** 2·51 m **b** 5·7° **c** 84·3° **d** 78·6° **e** 2·49 m × 0·25 m

Exercise 10.4A

1 **a** 4·5 cm **b** 7·38 cm **c** 0·95 cm
2 **a** 13·3 cm **b** 276·5 cm **c** 22·1 cm
3 **a** 56·5° **b** 66·0° **c** 44·9°
4 **a** 70·5°, 19·5°, 67·9 cm **b** 49·5 cm, 30·5 cm, 52° **c** 2·0 cm, 2·4 cm, 40°
5 **a** 11·6 m **b** 9·9 m
6 **a** 5·3 km **b** **i** 6·3 km **ii** 1 km further south
7 **a** 99·3 m **b** **i** 99·6 m **ii** It's larger; the smaller the angle, the closer the length gets to 100 m

Exercise 10.4B

1 **a** 32° **b** 5·90 m **c** 3·48 m
2 **a** 53·1° **b** 36·9° **c** 8 cm
3 **a** 78·5° **b** 4·90 m
4 **a** 85·4° **b** 249 m
5 **a** 32·6 m **b** 51·2 m
6 **a** 8·66 cm **b** 2·55 m
7 Student's own findings

Preparation for assessment

1 **a** 5·6 **b** 4·6 **c** 17·6
2 **a** 53·1 **b** 67·2 **c** 18·7
3 **a** 2·1 **b** 9·6 **c** 41·8
4 12·6°
5 **a** 90° **b** 19·5° **c** 11·3 cm
6 **a** 41·7 m **b** 12·3 m
7 **a** 8·5 cm **b** **i** 23·0° **ii** 21·7 cm
8 133·6 m

11 Probability

What you need to know

1 $\frac{5}{25}$

2 **a** Black Jack

b How many races they had each run in, the distance of the races, the quality of the other horses, the weight they were carrying, the ground conditions

3 **a** Both as likely

b 10th toss is independent of previous 9: both H and T have a probability of $\frac{1}{2}$ for 10th toss

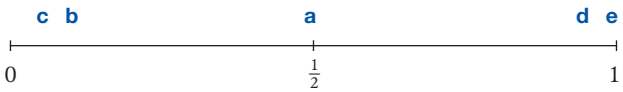
4 **a** 7 **b** There are 6 ways you can score 7 but only 3 ways to score 4

5 **a** Yes or slightly higher **b** 8

6 **a** Company B **b** Size of company, product produced, annual turnover

c Company's exposure to risk: drilling for oil has greater risk than producing chocolate bars

7



Exercise 11.1A

1 **a** $\frac{1}{9}$ **b** $\frac{8}{9}$ **c** $\frac{3}{9} = \frac{1}{3}$ **d** 0

2 **a** $\frac{1}{60}$ **b** $\frac{1}{30}$ **c** Probability halves as the number of chances doubles

3 $\frac{1}{4}$

4 **a** $\frac{7}{40}$ **b** $\frac{13}{40}$

5 **a** $10\% = \frac{1}{10}$ **b** $80\% = \frac{4}{5}$

6 $\frac{1}{3}$

Exercise 11.1B

1 **a** $\frac{80}{100} = \frac{4}{5}$ **b** $\frac{20}{100} = \frac{1}{5}$ **c** $\frac{60}{100} = \frac{3}{5}$ **d** $\frac{1}{1000}$

2 **a** **i** $0{\cdot}95 = \frac{19}{20}$ **ii** $0{\cdot}05 = \frac{1}{20}$ **b** $0{\cdot}8 = \frac{4}{5}$ **c** $0{\cdot}05 = \frac{1}{20}$

3 **a** $\frac{6}{18} = \frac{1}{3}$ **b** **i** 2 **ii** 8 **c** $\frac{8}{18} = \frac{4}{9}$

4 **a** $\frac{2}{8} = \frac{1}{4}$ **b** $\frac{14}{20} = \frac{7}{10}$ **c** **i** $2n + 2$ **ii** $\frac{n}{3n + 2}$

Exercise 11.2A

1 a

Red dice \ Blue dice	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

b i $\frac{6}{36} = \frac{1}{6}$ ii $\frac{1}{36}$ iii $\frac{6}{36} = \frac{1}{6}$ iv $\frac{10}{36} = \frac{5}{18}$ v $\frac{31}{36}$

2 a $\frac{3}{8}$ **b** $\frac{1}{8}$ **c** Defining the order as well as the outcomes

3 a $\frac{5}{13}$ **b** $\frac{2}{6} = \frac{1}{3}$ **c** $\frac{5}{39}$ **d** Expensive way to get a coconut

4 a $\frac{5}{36}$ **b** $\frac{5}{36}$ **c** 13

5 a $\frac{1}{2}$ **b** $\frac{7}{36}$

6 a $\frac{1}{40}$ **b** $\frac{5}{40} = \frac{1}{8}$ **c** $\frac{1}{20}$

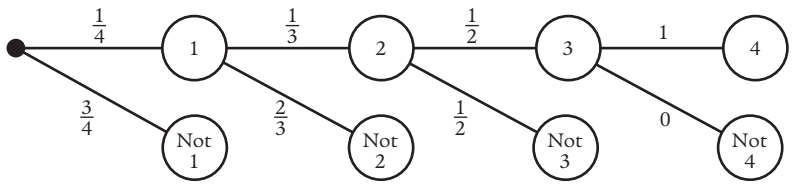
Exercise 11.2B

1 a $\frac{1}{4400}$ **b** $\frac{19}{4400}$ **c** $\frac{1}{660}$

2 a $\frac{48}{100} = \frac{12}{25}$ **b** $\frac{16}{50} = \frac{8}{25}$ **c** $\frac{1}{5}$

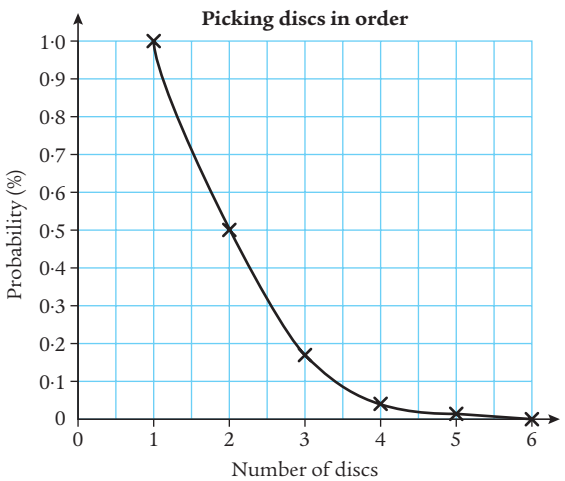
3 a Student's own sketch **b** $\frac{1}{6}$ **c** $\frac{2}{6} = \frac{1}{3}$ **d** $\frac{3}{6} = \frac{1}{2}$

4 a



$\frac{1}{4} \times \frac{1}{3} \times \frac{1}{2} \times 1 = \frac{1}{24}$

b $\frac{1}{720}$ **c** Makes it much smaller **d**



Exercise 11.3A

1 7 **2** 5 **3** 5 **4** 44

5 **a** 1500 **b** £45 000 **c** Up by £5000

6 **a** 3 **b** 2752 **c** 3 or 4

Exercise 11.3B

1 **a** 105 or 106 **b** 36 **c** 7 or 8 **d** 47 or 48

2 **a** 90 **b** $\frac{19}{100}$ **c** 38

3 4 sets = 8 twins

4 **a** 62 or 63 **b** 2

Exercise 11.4A

1 **a** 30 **b** Weak positive

2 **a** 13 **b** Weak positive

3 **a** **i** 15·3 km/l **ii** Strong negative over a confined data set

b Most car engines are designed to work at maximum efficiency when the speed is between 80 km/h and 90 km/h

4 **a** No correlation so no line of best fit **b** Any question relating to these data is meaningless

5 **a** 39 m **b** 71 km/h **c** Student's own investigation

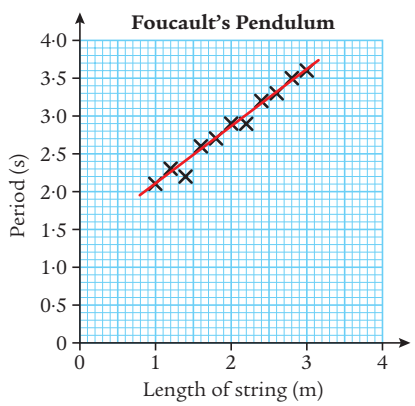
d Relationship is dependent on the driver, efficiency of brakes, tyre condition, road conditions, etc.

6 72% or 73%

Exercise 11.4B

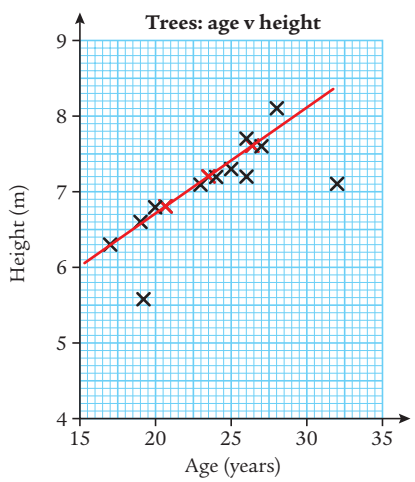
1 **a** **i** Strong negative correlation **ii** 38·5 s **b** Heat adds energy to the reaction

2 **a**



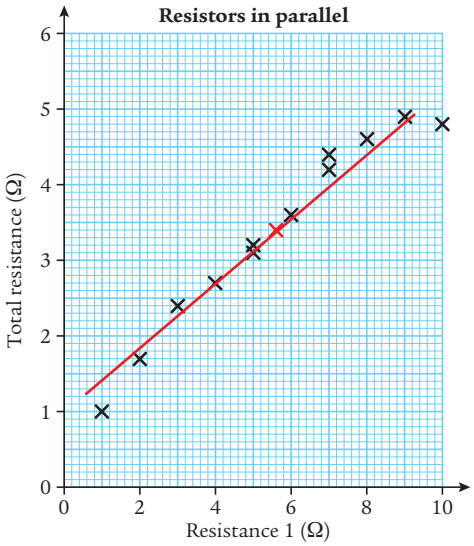
b 17·1 s **c** Student's own investigation

3 **a**



b (19, 5·6), (32, 7·1) **c** (20·6, 6·8), (26·4, 7·6) **d** (23·5, 7·2)

4 a



b (5·6, 3·4) **c** Yes

Exercise 11.5A

1 a $\frac{1}{20}$ **b** 600 000 **c** Rises and peaks in the 25–45 age group before decreasing significantly

d A large number of the under 18 age group are not permitted on the site

2 a Yes, but with a lot of caution **b** Probably not

c The jump took place in Mexico City, which is 2200 metres above sea level. Here the air is not as dense, so jumping does not have the same resistances as at sea level.

3 a Discs as scorpions are very dangerous **b** Discs as there is still $\frac{1}{4}$ chance of being seriously injured

c The value of the prize and whether you are allowed to wear steel reinforced gloves

4 a Fireworks are dangerous but a snapped rope will almost always result in death

b This is still very high for a life or death event

c Depends on your need for adventure, but at least 1 in 1 million.

5 There are a lot of moral issues to be considered, relating to family, life and death, government policy and perception

6 One in 14 million is huge and verges on almost never happening, but an aeroplane crash has life and death consequences. In the lottery, you only lose £1.

Exercise 11.5B

1 a $\frac{1}{125}$ **b** £1650

c Low chance of hole-in-one but consequence of paying £12 000 is considerable

2 a 900 **b** 1 in 15 000

c Very selfish with huge consequences and bordering on criminally reckless

3 a £9120 **b i** £16 000 **ii** Householder saves £4880

c £19 600 **d** Major gamble with severe consequences if things do go wrong

4 a Saves company $402 million

b People would die and it would be indiscriminate and socially wrong

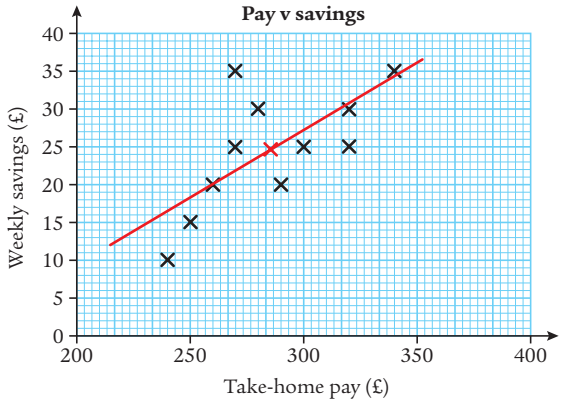
c Increase the pay-out to huge levels

Preparation for assessment

1 a $\frac{3}{10}$ **b** $\frac{7}{10}$ **c** $\frac{4}{10}$ **2** 1200 **3** $\frac{4}{25}$

4 a $\frac{39}{2000}$ **b** $\frac{2197}{8000}$ **c** $\frac{507}{2000}$

5 a



b About £26 **c** 8.5%

6 *For:* 4 new tyres with long life expectancy for £255 and no worries for an extended period of time
Against: £38 now with rest paid over time. May change car, better offer in a few months

7 a Small probability with very little chance of happening
b Consequences could be devastating with tens/hundreds of millions killed
c Hugely important
d This is only one asteroid: each week millions of tickets are sold for the lottery

12 Time trials

What you need to know

1 4 h 15 min

2 18 h 11 min

3 **a** **i** Swimming **ii** Cycling **iii** Running
b The greater the speed, the greater the slope on a distance/time graph
c 14 min, 18 min, 11 min
d 800 m, 7200 m, 2000 m

Exercise 12.1A

1 **a** 7·7 m/s **b** 7·1 m/s **c** 6·8 m/s **d** 5·1 m/s

2 **a** **i** 5·4 hours **ii** 10·67 hours **iii** 1·08 hours
b **i** 6·25 minutes **ii** 4·75 minutes **iii** 8·33 minutes

3 **a** 13 mph **b** 18 ft/s **c** 138·5 km/h **d** 10·2 m/s
e 622·2 mph **f** 16 km/h **g** 700 m/h

4 **a** Angela's **b** 0·1 mph

5 16·3 m/s

6 **a** 87·75 m/s **b** 315·9 km/h

7 552 km/h

8 373·0 mph

Exercise 12.1B

1 0·048 km/h

2 **a** 56 km/h **b** 48 km/h **c** 51·72 km/h

3 **a** **i** 43·2 km/h **ii** 32·4 km/h **iii** 37·0 km/h
b 3.50 p.m.

4 **a** 21·9 km/h **b** 21 km/h

5 472 m/min (28·32 km/h), 8 m/s (28·8 km/h), 30 km/h, 0·51 km/min (30·6 km/h)

6 **a** 0·21 m/s **b** 0·754 km/h **c** 12 degrees per minute

7 **a** 22·2 m/s **b** 11·1 m

8 **a** 28 km **b** 1 h 18 min **c** 21·5 km/h **d** 20 km/h **e** 20·7 km/h

9 Less than 46·2 mph

Exercise 12.2A

1 **a** 160 km **b** 161 miles **c** 54 m **d** 24 m **e** 288 miles **f** 360 m

2 **a** Mary 480 m, Peter 360 m, Fatima 490 m, Scott 440 m **b** Fatima, Mary, Scott, Peter

3 6750 cm or 67·5 m

4 **a** Tom **b** 9 miles

5 **a** 72 km **b** 9 km

6 377·5 miles

7 **a** 62 m **b** 558 m

Exercise 12.2B

1 **a** **i** 0·2 **ii** 0·3333...
b Mon 2·2 km, Tue 3·67 km, Wed 2·75 km, Thur 5·5 km, Fri 3·3 km

2 **a** Susie **b** 0·13 km or 130 m

3 **a** 1080 km **b** 236·25 km

4 Short: 10 km, long: 12·83 km

5 814·0 miles

6 **a** 7 km **b** 10·9 km **c** 32·7 km/h

7 3·78 m

8 **a** 584·4 million miles **b** 93·01 million miles

9 **a** 9 m **b** 18 m
c 20 mph: 6 m, 30 mph: 9 m, 40 mph: 12 m, 50 mph: 15 m, 60 mph: 18 m, 70 mph: 21 m

Exercise 12.3A

1 **a** 3 hours **b** 7 hours **c** 2 hours 30 minutes
d 5·5 seconds **e** 4 hours 15 minutes

2 **a** 16 seconds **b** 40 seconds **c** 6·5 seconds **d** 2·40 minutes

3 **a** 5 minutes **b** 6 minutes 40 seconds

4 1 hour 23 minutes 20 seconds

5 01 18

6 **a** 2 minutes 3·1 seconds **b** 5·5 seconds

Exercise 12.3B

1 **a** 20 min **b** 12 min **c** 10 s **d** 7·5 s

2 8·69 s

3 **a** **i** 0·1466 h **ii** 8·799 min **b** 5·7574 s

4 **a** 13 06 **b** Yes, she arrives at 14 24, 6 minutes before the meeting begins

5 **a** 500 s or $8\frac{1}{3}$ min **b** 5·87 billion million miles (5·87 trillion miles)

6 **a** About 2.10 p.m. **b** About 5 h 6 min

7 **a** 22 s **b** 3 s

Preparation for assessment

1 **a** 27 km/h **b** 720 m **c** 40 s **d** 240 mph **e** 10 min **f** 126 km

2 **a** 1·083 h **b** 91·0 km

3 78 km/h

4 107·0 km

5 **a** 2·5 h **b** 10 miles

6 **a** 50 metres per day **b** 6·25 m/h

7 **a** 72 mph, 70·0 mph, 74·8 mph **b** 15 40 **c** 16 06

8 **a** 24 min **b** 5·2 km **c** 13 km/h **d** 1 h 18 min **e** 8·7 km/h

9 26·7 km/h, because the times for the two journeys are different – the car is driven at 20 km/h for longer than at 40 km/h

10 **a** Students' own graph **b** **i** 31·25 mph **ii** 50 mph **iii** 56·25 mph
c **i** 48 km/h **ii** 64 km/h **iii** 112 km/h **d** Student's own investigation

11 **a** **i** 3·41 mph **ii** 15 mph **iii** 34·1 mph **iv** 51·1 mph
b **i** 14·7 ft/s **ii** 44 ft/s **iii** 66 ft/s **iv** 102·7 ft/s
c Student's own investigation

12 **a** 69·06 mph **b** **i** Under **ii** 0·94 mph

13 185·838 km/h

Preparation for assessment

Exercise Test A

1 **a** 55·67 **b** 603·82 **c** 3004·8 **d** 738

2 **a** 1300 **b** 4800 **c** 602 **d** 399

3 **a** **i** 6·05 **ii** 7270 **iii** 45·1
b **i** 14·21 **ii** 7·18 **iii** 0·02

4 **a** 40 **b** 596 **c** 375

5 **a** £3 **b** 6·4 kg **c** £7·50 **d** 3·6 m **e** 122 days
f 2·725 s **g** 9 g **h** 99 h **i** 14

6 **a** 20% **b** 25%

7 50 words per minute

8 **a** 12 h 48 min **b** 4 h 59 min

9 **a** £60 : £24 **b** £60

10 **a** 0·05 m **b** 58·52

11 **a** £6·12 **b** 13 120

12 21 °C

Exercise Test B

1 **a** Add the number of males and females or add the first three given categories in the table
b 58 830 400 **c** 10 752 120 **d** 31 722 075
e 58 830 000, 11 947 000, 36 092 000, 10 791 000, 28 619 000, 30 212 000
f 1 592 600

2 **a** Africa **b** Asia **c** 126·2 °C **d** 65·3 °C **e** 134·8 °C

3 **a** Talk-Tel **b** Com-Com

4 **a** **i** 2006 **ii** 2010 **iii** 2007 **b** **i** £45 300 000 **ii** £28 600 000 **iii** £11 700 000
c 169 600 tonnes **d** £190 600 000 **e** 4200 tonnes **f** £7 900 000 **g** £74 200 000
h £77 910 000

5 **a** **i** 1 h 49 min **ii** £3 **b** $£C = 1{\cdot}5 \times T$ **c** £9

6 20·8 miles

7 0·201 s

8 **a** 190 km **b** Coach A: 100 km, coach B: 70 km **c** Coach A: 1 h 30 min, coach B: 1 h 45 min
d Coach A: $66\frac{2}{3}$ km/h, coach B: 40 km/h **e** About 1.15 p.m. **f** About 120 km
g Coach A: 3.15 p.m., coach B: 3.30 p.m. **h** Coach A: 36 km/h, coach B: 53·3 km/h

9 **a** $x = 2$ **b** $x = 36$

10 **a** 96 cm^2 **b** 42·2 cm (to 1 d.p.)

11 **a** S(−3, 1) **b** 20 square units
c **i** Student's own enlargement **ii** Q′(4, −7), R′(−6, −7), S′(−8, 1)
d Area of PQ′R′S′ = 80 square units. Although the sides are double those of PQRS, its area is 4 times greater.

12 **a** $2s + 3(s - 5) = 430$ **b** First speed: 89 km/h, second speed: 84 km/h

13 **a** $S = 8f - 4$ **b** 44 sticks **c** 13

14 58·2 yards

15 **a** 42·75 m^3 **b** **i** 1·7 m **ii** 17 m^2 **c** 25°

16 **a** 90°. ∠DRN is 105° being supplement of ∠NDR, $x = 360 - 105 - 165 = 90$ (angles round a point).
b *Daisy* 17·4 km, *Flying Swan* 4·7 km

17 **a** Mean = 10·49 s, range = (10·2 − 10·9) s or 0·7 s
b Median = 13·65 s, range = (14·0 − 13·4) s or 0·6 s
c **i** Student's own scatter diagram **ii** 13·99 s **iii** 10·26 s