21

A ⎯ 7 cm ⎯ B
5 cm ⎯ 6 cm
R
C

R is the required region.

22 a) 4·8 **b)** 0·35
c) 0·06 **d)** 470
e) 360 **f)** 1470

23 a) 23·46 **b)** 833·805
c) 4·8505 **d)** 615
e) 7206 **f)** 198·6

24 0·37 metres per minute
25 $51·51
26 6·89 m^2
27 5·4 cm

28 a) 0·05 **b)** 0·$\dot{8}$
c) 0·21$\dot{2}\dot{5}$ **d)** 0·1$\dot{3}$
e) 0·41$\dot{8}$ **f)** 0·84$\dot{0}\dot{9}$

29 a) $\frac{2}{25}$ **b)** $\frac{4}{9}$
c) $\frac{4}{90} = \frac{2}{45}$ **d)** $\frac{17}{20}$
e) $\frac{3}{500}$ **f)** $2\frac{3}{8}$ (or $\frac{19}{8}$)

Revision exercise E2 (page 30)

1 41·5 litres, 40·5 litres
2 555·5 g, 554·5 g
3 152·5 cm, 153·5 cm
4 2650, 2550
5 2·15 m, 3·65 m
6 a) 5^6 **b)** 7^5
c) 11^{10} **d)** 4^{12}
e) 9^5 **f)** 7^4
g) 6^4 **h)** 2^6
i) 4^8
7 a) a^9 **b)** b^4
c) $10c^5$ **d)** $2d^3$
8 a) 14 **b)** 169
c) 15 **d)** 5
9 $x = 1·7$ to 1 d.p.
10 a) $3^3 – 12 \times 3 = {}^-9$, $4^3 – 12 \times 4 = 16$, 5 is between $^-9$ and 16 so one solution is between $x = 3$ and $x = 4$.
b) $x = 3·7$ to 1 d.p.

11 $x = 3·8$ to 1 d.p.
12 a) 1, 3, 5, 7 **b)** 4, 8, 12, 16
c) 7, 12, 17, 22 **d)** 17, 14, 11, 8
e) 4, 7, 12, 19 **f)** 3, 8, 15, 24
13 a) $2n + 2$ **b)** $10n$
c) $n + 14$ **d)** ^-n
e) $23 – 3n$
14 a) $x^2 + 6x + 5$ **b)** $x^2 + 5x – 24$
c) $a^2 – 4a – 21$ **d)** $b^2 – 8b + 16$
e) $x^2 – 22x + 40$ **f)** $p^2 – 25$
g) $y^2 + 12y + 36$ **h)** $x^2 – 121$
15 a) 628 cm^3 **b)** 408 cm^2
16 15·6 cm
17 a) 2142 mm^2
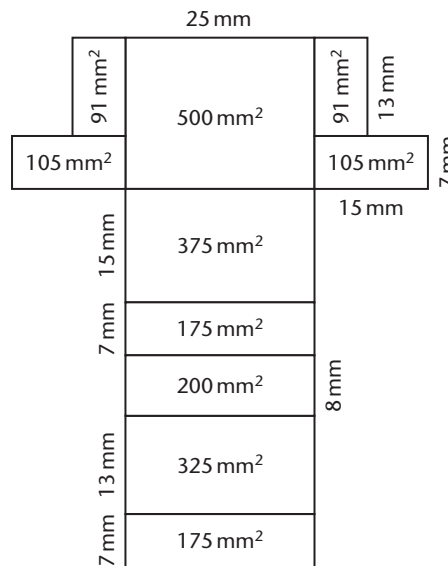
b) 4900 mm^3
18 a) 108 cm^3 **b)** 186 cm^2
19 35 m^2
20 54 cm^2
21 a) 805 cm **b)** 63·10 m
c) 72 000 cm^2 **d)** 0·0485 m^2
e) 2 700 000 cm^3 **f)** 0·059 m^3
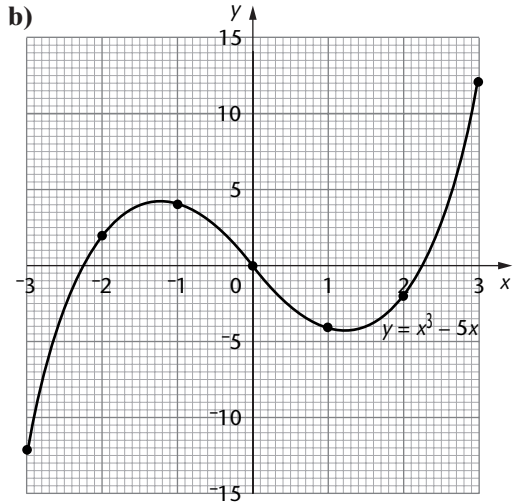**22** 43·2 litres
23 3000

Stage 8

Revision exercise A2 (page 32)

1 a) $6\frac{1}{6}$ **b)** $5\frac{1}{18}$
c) $2\frac{14}{15}$ **d)** $1\frac{2}{3}$
e) $1\frac{13}{30}$ **f)** $7\frac{3}{5}$
g) 4 **h)** $1\frac{7}{10}$
i) $1\frac{3}{4}$

2 $3\frac{21}{40}$ inches

STAGE
8

3 a)

x	$^-3$	$^-2$	$^-1$	0	1	2	3
x^3	$^-27$	$^-8$	$^-1$	0	1	8	27
$-5x$	15	10	5	0	$^-5$	$^-10$	$^-15$
y	$^-12$	2	4	0	$^-4$	$^-2$	12

b)

c) $x = ^-2.3$ to $^-2.2$, 0 or 2.2 to 2.3.

4 a)

x	$^-12$	$^-6$	$^-4$	$^-3$	$^-2$	$^-1$	1	2	3	4	6	12
y	$^-1$	$^-2$	$^-3$	$^-4$	$^-6$	$^-12$	12	6	4	3	2	1

b)

c) $x = 1.5$

5 a)

b)

c)

6 a) (iii)   **b) (iv)**
c) (ii)   **d) (i)**

7 0·8

8 0·56

9 a)
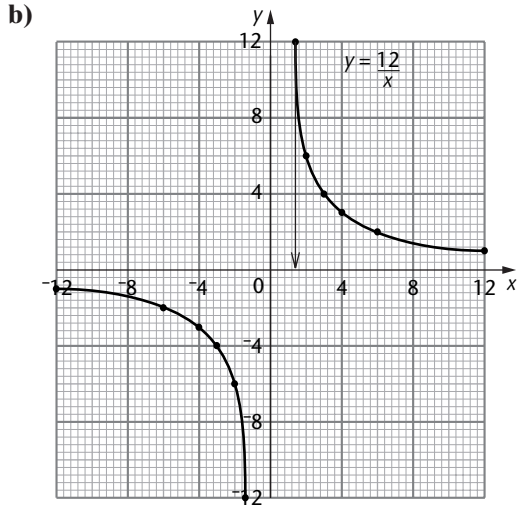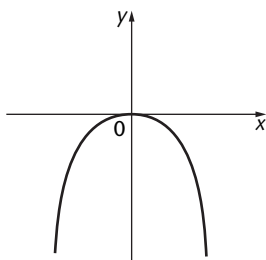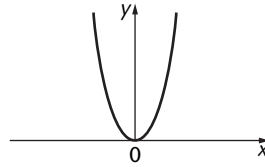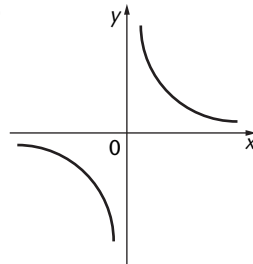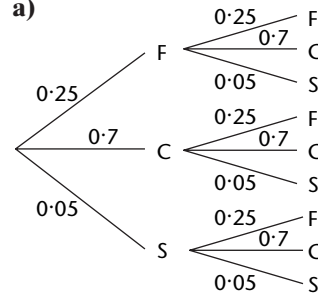
b) (i) 0·0625   **(ii)** 0·555

10 a)
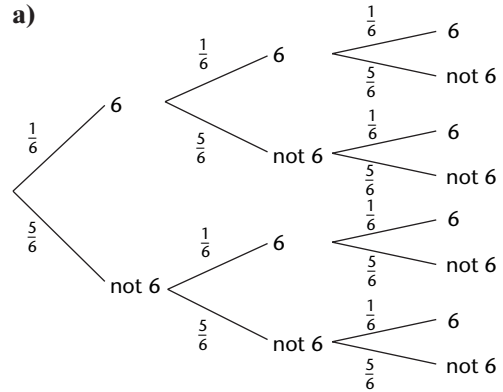
b) (i) $\frac{1}{216}$ **(ii)** $\frac{15}{216} = \frac{5}{72}$

11 $\frac{1}{7776}$

12 a) $\frac{1}{36}$ **b)** $\frac{16}{36} = \frac{4}{9}$

c) $\frac{9}{36} = \frac{1}{4}$

13 a) $x = \frac{8}{9}$ **b)** $x = 1.5$

c) $x = 4$ **d)** $x = \frac{3}{8}$

e) $x = 72$ **f)** $x = 41$

g) $x = 6.2$ **h)** $x = 2.5$

i) $x = 7$ **j)** $x = ^-9$

14 a) $x \leqslant 4$ **b)** $x \leqslant 12$

c) $x \leqslant 4$ **d)** $x < ^-1$

e) $x < 10$ **f)** $x \leqslant 6$

g) $x \geqslant ^-1.5$ **h)** $x > 4.6$

15 a) $x + \frac{1}{4}x + 15 + \frac{1}{2}x + 25 = 180$ which simplifies to $1\frac{3}{4}x + 40 = 180$ or $7x + 160 = 720$

   b) $x = 80$, angles are 80º, 35º, 65º

16 $\frac{4}{5}x = 36$
   $x = 45$ metres

17 a) $\frac{1}{2}x + 7$, $x + 7$

   b) $\frac{1}{2}x + 7 > \frac{2}{3}(x + 7)$

   c) $x < 14$, so, Hassan's sister is less than 14 years old i.e. max age 13 years and 364 days
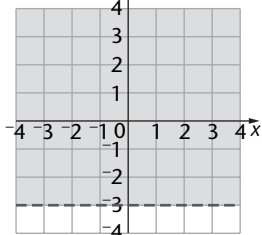
Revision exercise B2 (page 35)
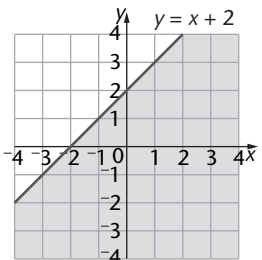
1 86p

2 £323

3 £192

4 80

5 £4400

6 a) $x < 5$

   b) $8x + 5y \geqslant 40$

7 a)

   b)

$y = x + 2$

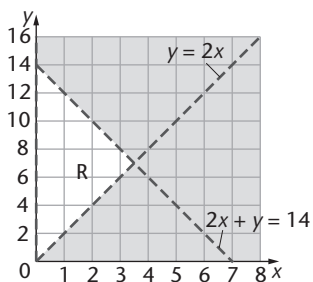**8**

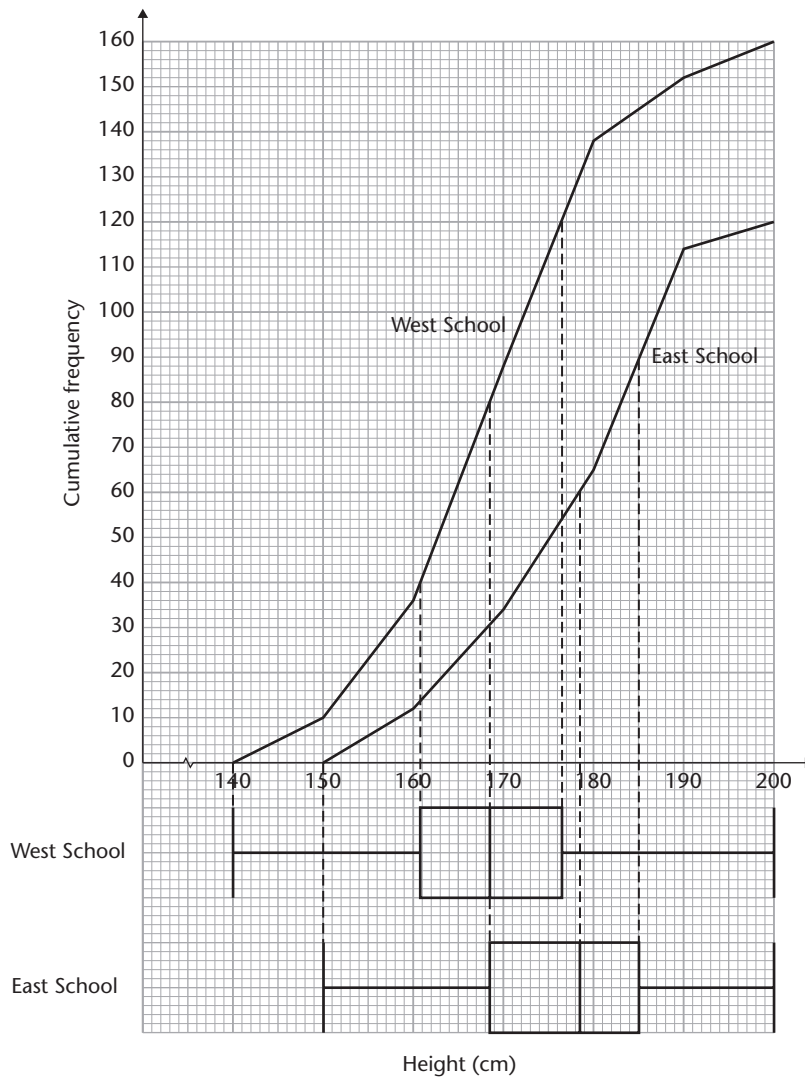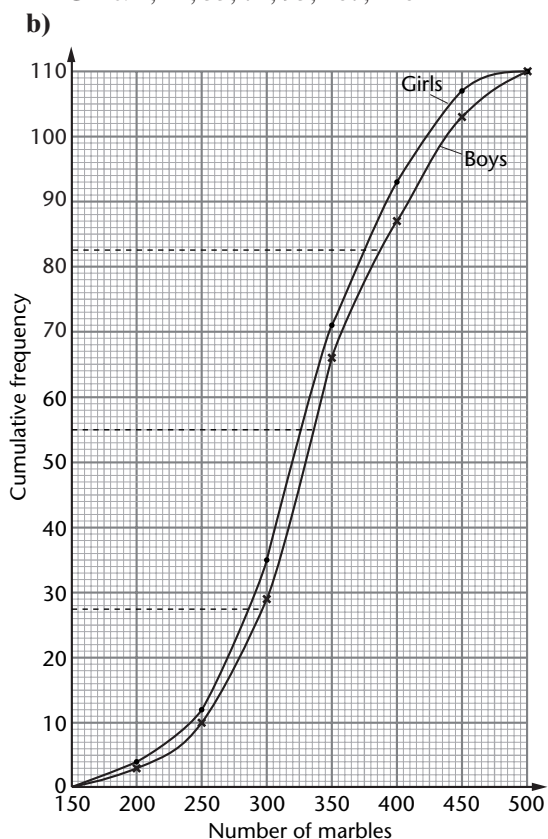$y = 2x - 7$

9

$y = 2x$

$2x + y = 14$
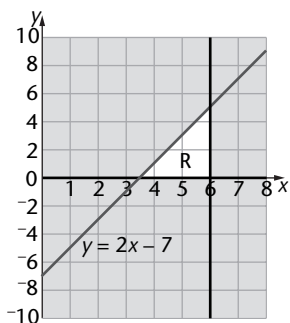
10 a)

b) On average students at East School are taller than students at West School.
The spread (IQR) is about the same but the range is greater at West School.

11 a) Cumulative frequencies:
Boys: 3, 10, 29, 66, 87, 103, 110
Girls: 4, 12, 35, 71, 93, 107, 110

b)

Boys: median = 335,
interquartile range = 385 – 295 = 90
Girls: median = 325,
interquartile range = 375 – 285 = 90
The median value for the girls is lower but the IQR is the same.

c) Reading from the graph at 350 marbles suggests that 71 of the girls guessed this value or a value less so that 39 were overestimating while for the boys 66 guessed this value or a value less so 44 overestimated. Looking back at the figures, 58 boys and 58 girls guessed between 300 and 400. Overall there is little difference between the sexes.
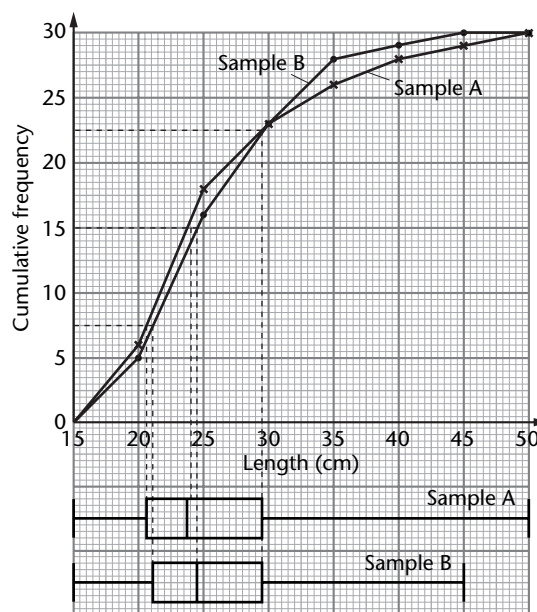
12 a) Sample A

Length (L cm)	Frequency	Cumulative frequency
$15 \leq L < 20$	6	6
$20 \leq L < 25$	12	18
$25 \leq L < 30$	5	23
$30 \leq L < 35$	3	26
$35 \leq L < 40$	2	28
$40 \leq L < 45$	1	29
$45 \leq L < 50$	1	30

Sample B

| Length (L cm)	Frequency	Cumulative frequency
$15 \leq L < 20$	5	5
$20 \leq L < 25$	11	16
$25 \leq L < 30$	7	23
$30 \leq L < 35$	5	28
$35 \leq L < 40$	1	29
$40 \leq L < 45$	1	30
$45 \leq L < 50$	0	30

b), c)

Sample A:
median = 24 cm
interquartile range = 29·5 – 20·5 = 9 cm
Sample B:
median = 24·5 cm
interquartile range = 29·5 – 21·5 = 8 cm

d) The fish in sample B are slightly longer and with less spread.

13 1351
14 £7369·50
15 86 seconds
16 Not quite doubled.
$1000 \times 1.07^{10} = 1967·15$
17 £4322·79

STAGE
8

Revision exercise C2 (page 38)

1 Rotation through 90º anticlockwise about (2, 1)

2 a) to **c)**
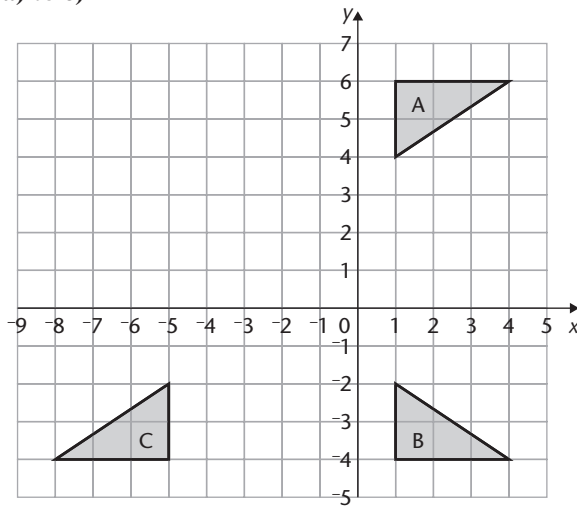
d) Rotation through 180° about (⁻2, 1)

3 a) to **c)**
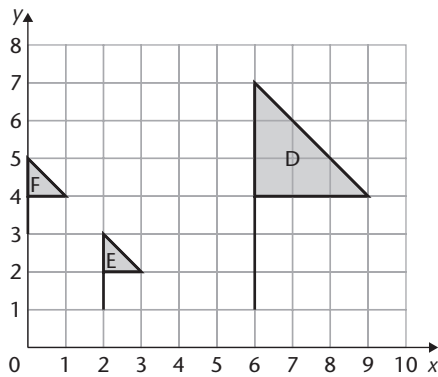
d) Enlargement, scale factor $\frac{1}{3}$, centre (⁻3, 4)

4 Possible answers:

Translation by $\begin{pmatrix} ^-8 \\ 0 \end{pmatrix}$ followed by reflection in the *x*-axis

Rotation through 180° about (0, 0) followed by reflection in the line *x* = ⁻4

5 a) to **c)**

d) Enlargement centre (⁻2, 4), scale factor $\frac{^-1}{3}$

6 a) $x = 2, y = 1$ **b)** $x = 1, y = 4$

7 a) $x = 3, y = 5$ **b)** $x = 3, y = 1$
  c) $x = 4, y = 2$ **d)** $x = 3, y = 2$
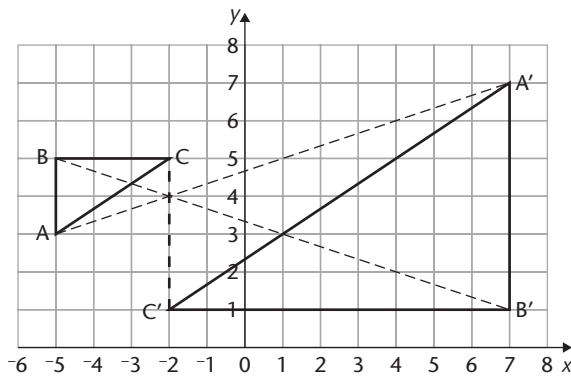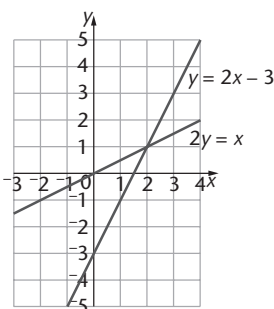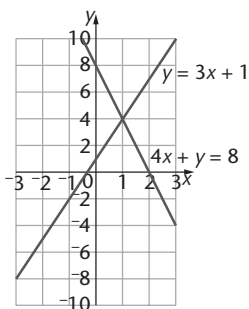 **e)** $x = -2, y = 3$ **f)** $x = 1, y = 8$
  g) $x = 2, y = 1$ **h)** $x = 1, y = 2\frac{1}{2}$
  i) $x = -1, y = -2$

8 $5x + y = 195$
  $4x + 2y = 210$
  Pen costs 30p, ruler costs 45p

9 a) 6700   **b)** 0·005 79
  c) 0·003 671   **d)** 93 200 000
  e) 0·004 90   **f)** 80 000
  g) 0·000 373   **h)** 154 000 000

10 a) $8·5 \times 10^2$ **b)** 3×10^3
  c) $8·72 \times 10^5$ **d)** $6·34 \times 10^3$
  e) $6·8 \times 10^{-3}$ **f)** $8·72 \times 10^6$
  g) $3·4 \times 10^{-4}$ **h)** $3·9 \times 10^{-5}$
  i) $4·2 \times 10^{-7}$ **j)** $5·4 \times 10^6$

11 a) 70 000   **b)** 6 000 000
  c) 0·000 08   **d)** 380
  e) 0·079   **f)** 0·000 531
  g) 62 900   **h)** 0·0098
  i) 68 300 000   **j)** 0·000 001 86

12 a) 8×10^9 **b)** $7·5 \times 10^5$
  c) 3×10^4 **d)** 4×10^7
  e) $1·5 \times 10^8$ **f)** 5×10^2
  g) $7·2 \times 10^5$ **h)** $8·95 \times 10^6$
  i) $4·7 \times 10^{-3}$

13 a) $1·63 \times 10^8$ **b)** $7·22 \times 10^4$
  c) $1·86 \times 10^4$ **d)** $6·83 \times 10^6$
  e) $4·76 \times 10^8$ **f)** $6·81 \times 10^{-7}$
  g) $5·51 \times 10^4$ **h)** $7·35 \times 10^8$
  i) $3·39 \times 10^{-3}$

14 a) $\frac{3}{4}$ **b)** $-2·5$
  c) 0

15 Coordinates of B must satisfy $y = 2x + 3$
  e.g. $(2, 7)$

16 a) $4, (0, -1)$ **b)** $\frac{1}{3}, (0, 0)$
  c) $0, (0, 5)$ **d)** $\frac{-1}{2}, (0, 1·5)$

17 a)
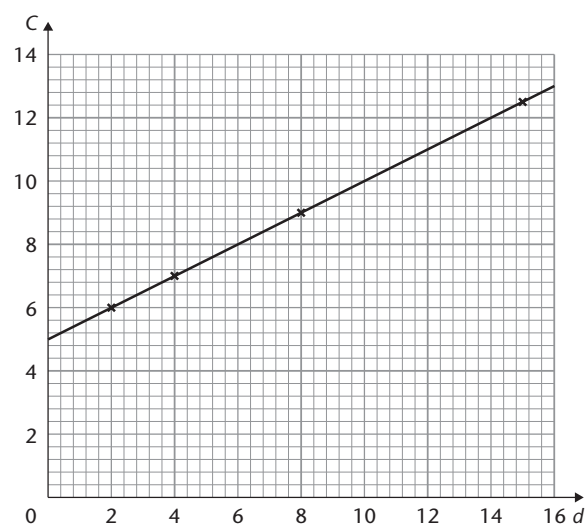
  b) (i) 0·5   **(ii)** Cost in £ per mile
  c) 5   **d)** $C = 0·5d + 5$

18
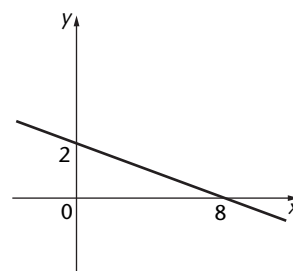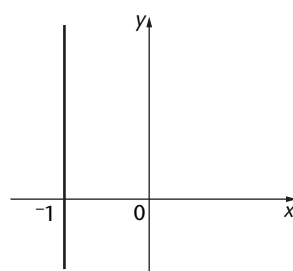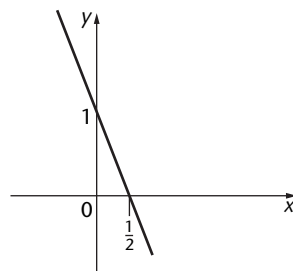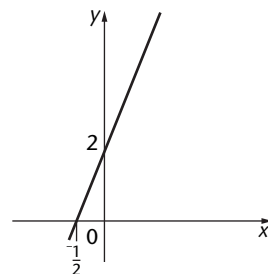
19 a) $y = 4x + k$ **b)** $y = -2x + k$
 **c)** $x = k$ **d)** $x + 4y = k$

Revision exercise D2 (page 41)

1 4·2 cm, 3·5 cm, 5·6 cm, 4·9 cm

2 No, the sides are not proportional, $5 \div 6 \neq 7 \div 8 \neq 6 \div 7$.

3 **a)** $180° - (90° + 50°) = 40°$ so the angles are the same in both triangles.
  b) 7·8 cm

4 6·24 cm

5 BDA, ADC, BAC (If the order of the letters in the first is different then the others must correspond.)

6 12 cm

7 Breed B give more milk on average but with a wider spread of amounts.

8 Both have a mean of 7·2 which suggests that, on average, there are the same number of peas per pod for the two types.
  Alternatively, the median of Biggapeas is 7·5 and and of WondaP is 8 so WondaP have slightly more peas per pod.
  Ranges: Biggapeas 4, WondaP 10; there is a much wider spread for WondaP.

9 A longer time is spent, on average, on English but with a wider spread of times.

10 Modes: Class A = 1, Class B = 2, which suggest, on average, that the students in Class B own more pets. Although the range is the same (6), the shape of the distribution suggests a wider spread of numbers in Class A.

11 **a)**
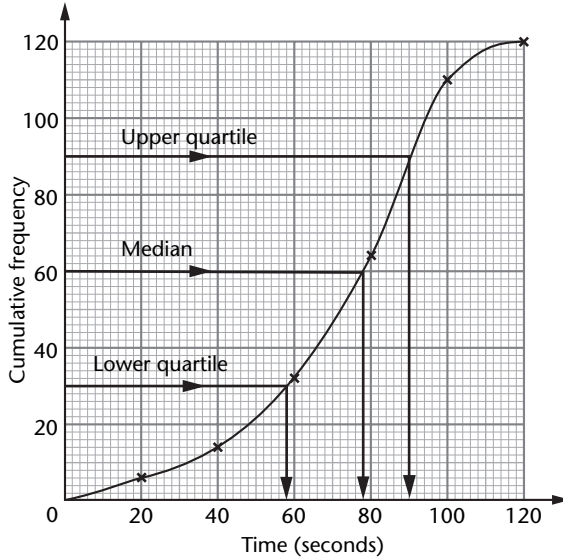
  b) Median 78, lower quartile 58, upper quartile 90

  c)
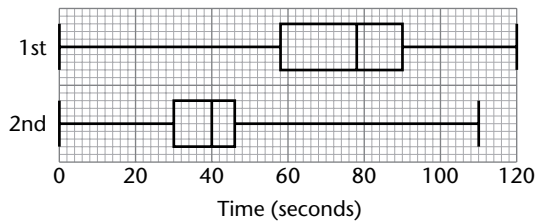
  d) If second bank's claim is true then the average response time is far less and the spread of times is also much less.

12 **a)** 55·2°   **b)** 31·0°   **c)** 43·4°   **d)** 4·69 cm
   e) 4·57 cm   **f)** 2·83 cm   **g)** 7·71 cm   **h)** 19·1 cm

13 79·6°

14 North 35·35 km, east 42·13 km

15 1879 m

16 Angle = 30·96°, just legal

17 **a)** Volume   **b)** Area   **c)** Area

18 **a)** 3   **b)** 2   **c)** 2

Revision exercise E2 (page 45)

1 a) $y^2 + 12y + 35$ b) $a^2 + 10a - 11$ c) $x^2 - 15x + 36$
   d) $x^2 - 20x + 100$ e) $a^2 + 5a - 20$ f) $p^2 - 36$
   g) $y^2 + 22y + 121$ h) $x^2 - 17x + 30$

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

3 a) $(p + 1)(p - 1)$ b) $(y + 4)(y - 4)$
   c) $(x + 8)(x - 8)$ d) $(s + 50)(s - 50)$

4 a), c) Graph not full-size
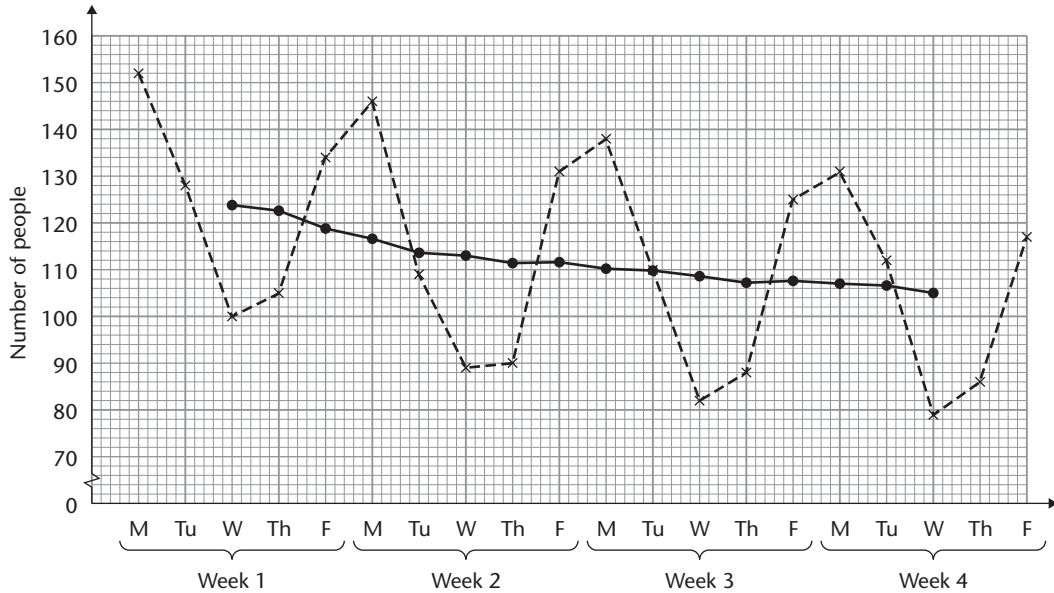
   b) Moving averages: 123·8, 122·6, 118·8, 116·6, 113·6, 113, 111·4, 111·6, 110·2, 109·8, 108·6, 107·2, 107·6, 107, 106·6, 105

   d) There is a general downward trend.
      Monday is always highest, Wednesday is always lowest.

5 a), c) Graph shown half-size.

STAGE
8
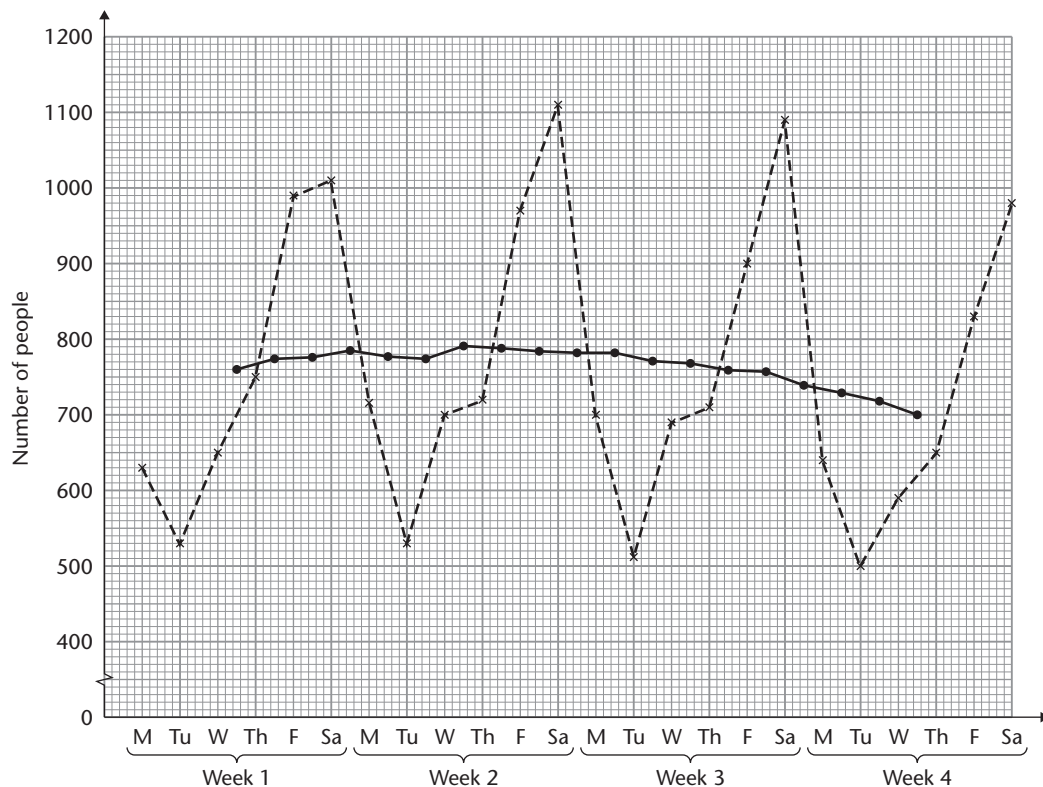
b) Moving averages: 760, 774, 776, 785, 777, 774, 791, 788, 784, 782, 782, 771, 768, 759, 757, 739, 729, 718, 700

d) There is a slight downward trend towards the end of the 4 weeks.
Saturday is always highest, Tuesday is always lowest.

6 a) $x = 1$ or 3
b) $x = {}^-2$ or ${}^-5$
c) $x = {}^-4$ or 2
d) $x = 6$ or 4
e) $x = {}^-5$ or ${}^-3$
f) $x = {}^-9$ or ${}^-1$
g) $x = 14$ or ${}^-1$
h) $x = {}^-6$ or ${}^-5$
i) $x = 8$ or 4
j) $x = {}^-12$ or ${}^-2$
k) $x = 9$ or 4
l) $x = {}^-7$ or 6

7 a) $x = 0$ or ${}^-1$
b) $x = 0$ or 2
c) $x = \pm 9$
d) $x = \pm 12$
e) $x = 0$ or 7
f) $x = 4$ or ${}^-1$
g) $x = {}^-7$ or 5
h) $x = 1$ or 4

8 a) $x = \sqrt{\dfrac{V}{y}}$

b) $b = \dfrac{d}{a + c}$

c) $x = \dfrac{z}{y + a}$

d) $x = \dfrac{ay - 3y}{a - 2}$

e) $a = \sqrt[3]{V + 3b^2 c}$

f) $x = \dfrac{2A}{2y + h}$

g) $a = \dfrac{bc - 10b}{5 - 2c}$

h) $l = \dfrac{gT^2}{4\pi^2}$

i) $T_2 = \dfrac{P_2 V_2 T_1}{P_1 V_1}$

j) $b = \dfrac{ax - ay}{2x + 3y}$

k) $r = \sqrt{\dfrac{3V}{3\pi a + \pi b}}$

l) $R_1 = \dfrac{RR_2}{R_2 - R}$

9 a) $t = \sqrt{\dfrac{2s}{g}}$

b) 2.86 seconds

Stage 9

Revision exercise A2 (page 47)

1 a) $100 \times 7 = 700$, 1095.15
b) $30 \div 6 = 5$, 5.69
c) $\dfrac{20 + 20}{40 \times 2} = 0.5$, 0.502
d) $10 \times (4^2 + 7^2) = 10 \times (16 + 49) = 10 \times 65 = 650$

2 a) 2.00×10^4 **b)** 4.26×10^7

3 a) $x^2 + 8x + 12$ **b)** $x^2 + x - 30$
c) $2x^2 + 5x - 12$ **d)** $6x^2 + x - 2$
e) $5a^2 - 7ab - 2b^2$ **f)** $20 - 17x + 3x^2$
g) $x^2 - 64$ **h)** $x^2 - 8xy + 16y^2$
i) $15x^2 + xy - 6y^2$

4 a) $4a^5$ **b)** $3a^2$
c) a^2 **d)** $6a^5 b^3$
e) $3yz^2$ **f)** $a^2 bc$

5 a) $5(a + 2b - 3c)$ **b)** $a(c + 2b)$
c) $2ab(a - 2b)$ **d)** Will not factorise
e) $ab(c + 4ab)$ **f)** $3a(3 + b - 2bc)$
g) $15(pq - 2)$ **h)** $a(1 - 5a + 7a^2)$
i) $5ac(b + 1)$

6 a) $(x - 3)(x + 3)$ **b)** Will not factorise
c) $(2y - x)(2y + x)$ **d)** $(1 - cd)(1 + cd)$
e) $(3x - 4y)(3x + 4y)$

7 a) $(x - 9)(x - 6)$ **b)** $3(x + 1)(x - 5)$
c) $(x - 2)(3x - 1)$ **d)** $(x + 5)(2x - 3)$
e) $4(x - 3)(x + 3)$ **f)** $2(x - 3)(x - 1)$
g) $(2x - 7)(x + 2)$ **h)** $(5x + 4)(x + 2)$
i) $(2x - 3)(2x - 3)$ **j)** $(3x + 2)(2x - 3)$

8 a) $\dfrac{3x}{x - 2}$ **b)** $\dfrac{x + 4}{2x - 3}$

c) $\dfrac{x + 2}{x - 2}$ **d)** $\dfrac{x + 2}{x}$

e) $\dfrac{2(x + 3)}{2x + 1}$

9 a) $x = {}^-\tfrac{1}{2}$ or ${}^-3$ **b)** $x = {}^-\tfrac{3}{2}$ or 5

c) $x = \tfrac{4}{3}$ or 3 **d)** $x = {}^-\tfrac{3}{2}$ or ${}^-6$

e) $x = \tfrac{4}{3}$ or ${}^-2$

10 6.5625, $L = 0.0019h^3$

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	x	y
	10	4
$y \propto x$	4	1.6
$y \propto x^2$	4	0.64
$y \propto x^3$	4	0.256
$y \propto \dfrac{1}{x}$	4	10
$y \propto \dfrac{1}{x^2}$	4	25