SMP Interact

for **AQA, Edexcel** and **OCR**
two-tier GCSE mathematics

Answers for *Higher 1* practice

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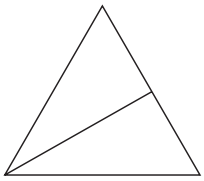
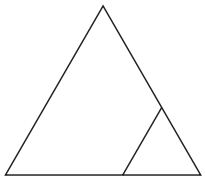
1 Triangles and polygons

A Special triangles and quadrilaterals (p 7)

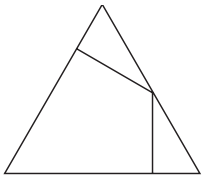
1 (a) (i)



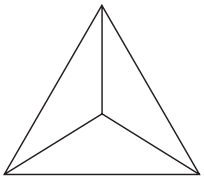
(ii)



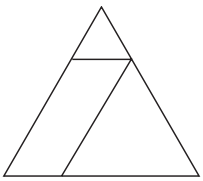
(iii)



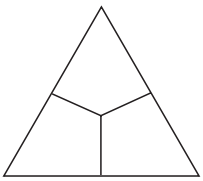
(iv)



(v)



(vi)



(b) (i) One line of reflection symmetry

(ii) One line of reflection symmetry

(iii) One line of reflection symmetry

(iv) Three lines of reflection symmetry, rotation symmetry of order 3

(v) None

(vi) Three lines of reflection symmetry, rotation symmetry of order 3

B Angles of a triangle (p 7)

1 (a) Equilateral

(b) Isosceles

(c) $a = 60°$, $b = 60°$, $c = 66°$, $d = 54°$, $e = 234°$

2 135°

3 $x = 37$, $y = 29$

C Angles of a polygon (p 8)

1 $a = 92°$, $b = 110°$, $c = 77°$

2 (a) 70° **(b)** 160° **(c)** 130°

3 (a) 15 **(b)** $a = 24°$, $b = 78°$, $c = 156°$

4 8

D Mixed questions (p 8)

1 (a) A rhombus

(b) Two are 36° and the other two are 144°.

2 A regular nonagon (9-sided polygon)

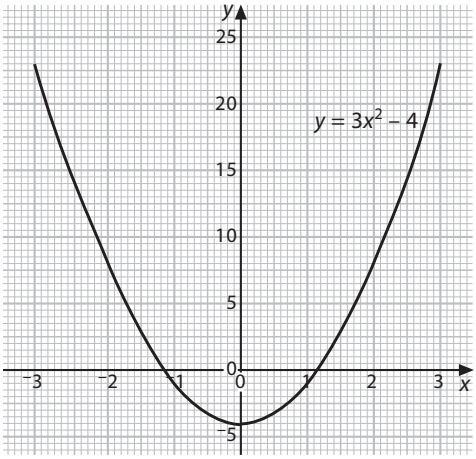
2 Drawing and using quadratic graphs

A Parabolas and quadratic functions (p 9)

1 (a)

x	-3	-2	-1	0	1	2	3
x^2	9	4	**1**	**0**	1	**4**	9
$3x^2$	27	12	**3**	**0**	3	**12**	**27**
$y = 3x^2 - 4$	23	8	**-1**	**-4**	-1	**8**	**23**

(b)



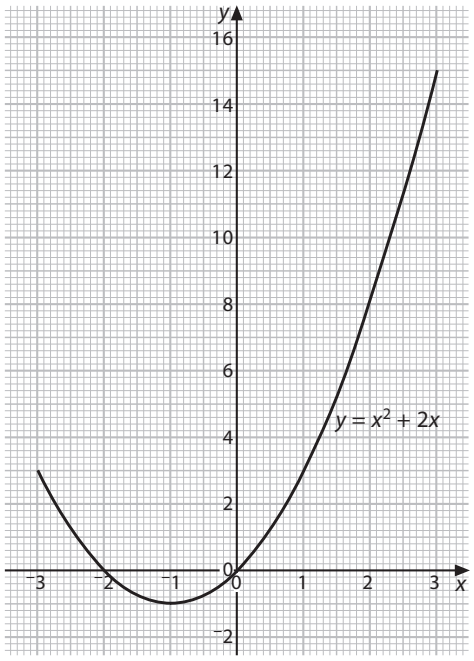
(c) $x = -2.5$ and 2.5

(d) -4

2 (a)

x	-3	-2	-1	0	1	2	3
x^2	9	**4**	**1**	**0**	1	**4**	**9**
$2x$	-6	**-4**	**-2**	**0**	2	**4**	**6**
$y = x^2 + 2x$	3	**0**	**-1**	**0**	3	**8**	**15**

(b)



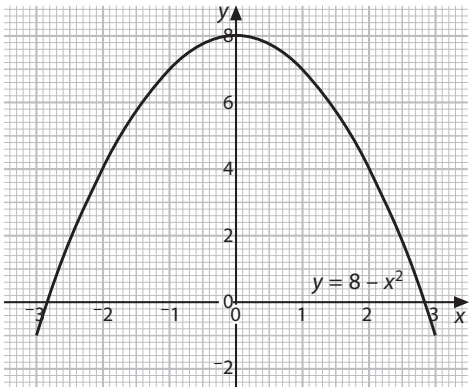
(c) $x = -2.7$ and 0.7

(d) -1

3 (a)

x	-3	-2	-1	0	1	2	3
x^2	9	4	**1**	**0**	**1**	**4**	**9**
$y = 8 - x^2$	-1	**4**	**7**	**8**	**7**	**4**	$\mathbf{-1}$

(b)



(c) The whole graph lies below the line $y = 9$.

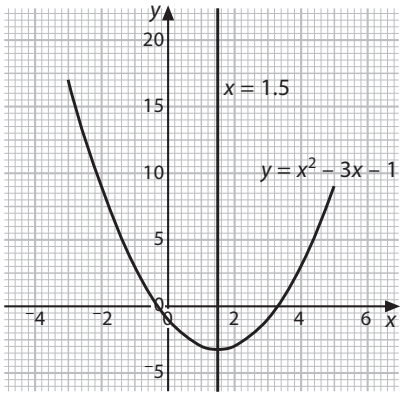
(d) **(i)** 8 **(ii)** 0

(e) **(i)** $x = -2.8, 2.8$ **(ii)** 2.8 (to 1 d.p.)

4 (a)

x	-3	-2	-1	0	1	2	3	4	5
y	17	**9**	**3**	$\mathbf{-1}$	$\mathbf{-3}$	$\mathbf{-3}$	$\mathbf{-1}$	**3**	**9**

(b), (d)



(c) $x = -0.3$ and 3.3

(d) The line $x = 1.5$ on the graph as above

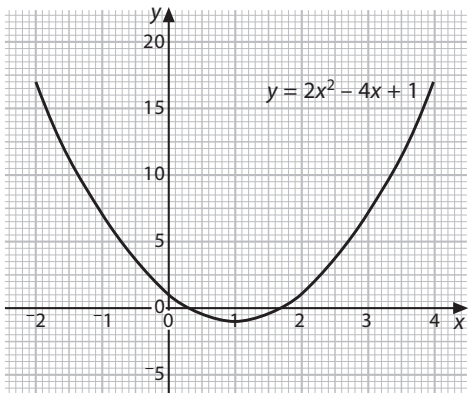
(e) **(i)** 1.5 **(ii)** -3.25

(iii) Comment on accuracy of graph

5 (a)

x	-2	-1	0	1	2	3	4
y	17	**7**	**1**	$\mathbf{-1}$	**1**	**7**	**17**

(b)



(c) $x = 1$

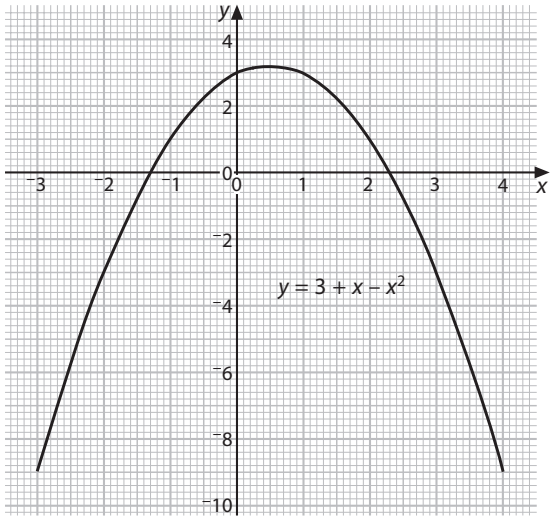
(d) -1

(e) $x = -0.2$ and 2.2

6 (a)

x	-3	-2	-1	0	1	2	3	4
y	-9	$\mathbf{-3}$	**1**	**3**	**3**	**1**	$\mathbf{-3}$	$\mathbf{-9}$

(b)



(c) $x = 0.5$

(d) 3.25

(e) $x = -1.3$ and 2.3

(f) The whole graph lies below the line $y = 6$.

B Using graphs to solve problems (p 11)

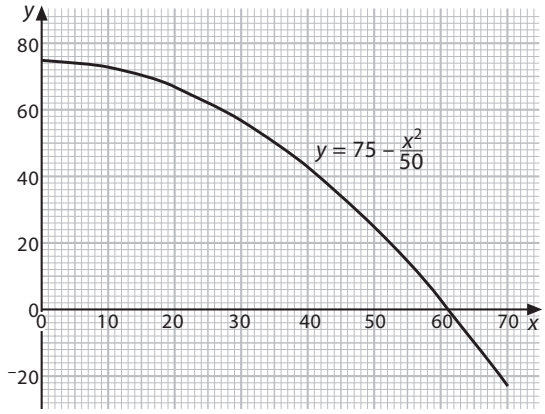
1 (a) **(i)** 9 **(ii)** 9 metres

(b) **(i)** 0 **(ii)** 360 metres

2 (a)

x	0	10	20	30	40	50	60	70
y	**75**	73	**67**	**57**	43	**25**	**3**	**−23**

(b)

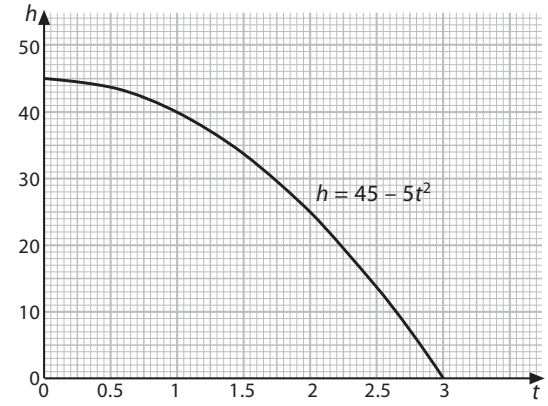


(c) 61 metres (to the nearest metre)

3 (a)

t	0	0.5	1	1.5	2	2.5	3
h	**45**	**43.75**	**40**	**33.75**	**25**	**13.75**	**0**

(b)



(c) **(i)** $x = 2.1$ (to 1 d.p.)

(ii) A comment such as:
'After about 2.1 seconds the stone is 22.5 m above the ground' or 'After about 2.1 seconds the stone has fallen halfway down the tower'.

(d) Keeley is confusing the shape of the graph with the path of the stone. The stone is dropped, so it falls vertically to the ground in a straight line and lands close to the tower.

3 Distributions and averages

A Review: mean, median, range and mode (p 12)

1 (a) **(i)** 7.1 **(ii)** 7 **(iii)** 7 **(iv)** 6

(b) Mean 7.8, median 8, mode 7, range 6

(c) Class 10T did better, as the mean and median are higher with the mode and range being the same.

2 (a)

0	8 9	
1	1 2 3 5 7 8 9 9	
2	1 1 1 3 4 5 6 9	
3	1	stem = 10 ounces

(b) Median 19 ounces

(c) Range 23 ounces

(d) 24.5 ounces

(e) The median weight of trout caught in the second stretch of river is greater but the range is also greater with the smallest fish caught in the second stretch.

3 (a) 16 **(b)** 12 **(c)** 20

4 The average speed on the winding road is less than that on the straight road (medians 46, 34.5 m.p.h.).
The speeds on the straight road are more spread out than those on the winding road (ranges 39, 20 m.p.h.).

5 (a) 55 **(b)** 165 **(c)** 3

6 60.5 g (to 1 d.p.)

7 Mean 8.8 (to 1 d.p.), median 9, mode 9, range 7

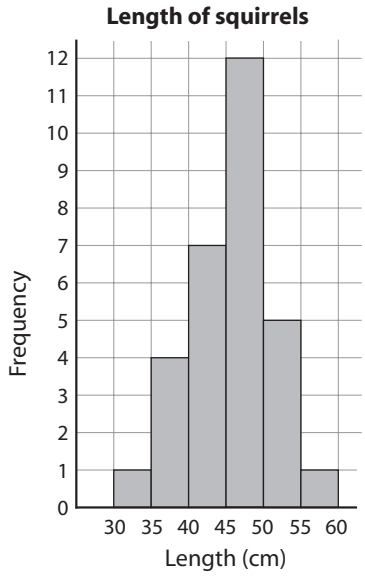
B Grouped frequencies

C Choosing class intervals (p 14)

1 (a)

Length (l cm)	Tally	Frequency
$30.0 \leq l < 35.0$	I	**1**
$35.0 \leq l < 40.0$	IIII	**4**
$40.0 \leq l < 45.0$	𝍸 II	**7**
$45.0 \leq l < 50.0$	𝍸 𝍸 II	**12**
$50.0 \leq l < 55.0$	𝍸	**5**
$55.0 \leq l < 60.0$	I	**1**
	Total	**30**

(b)



(c) $45.0 \leq l < 50.0$

2 (a)

Weight (kg)	Frequency
$40 \leq w < 50$	11
$50 \leq w < 60$	17
$60 \leq w < 70$	10
$70 \leq w < 80$	2
Total	40

The modal group is $50 \leq w < 60$.

(b)

Weight (kg)	Frequency
$40 \leq w < 45$	4
$45 \leq w < 50$	7
$50 \leq w < 55$	8
$55 \leq w < 60$	9
$60 \leq w < 65$	6
$65 \leq w < 70$	4
$70 \leq w < 75$	2
Total	40

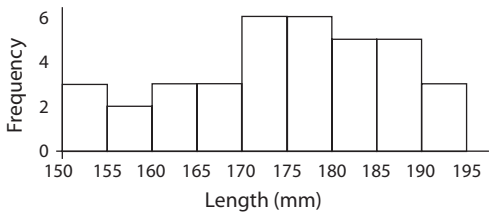
The modal group is $55 \leq w < 60$.

(c) The intervals in (b) give a clearer picture.

3 (a) This is a possible table.

Length (l)	Frequency
$150 < l \leq 155$	3
$155 < l \leq 160$	2
$160 < l \leq 165$	3
$165 < l \leq 170$	3
$170 < l \leq 175$	6
$175 < l \leq 180$	6
$180 < l \leq 185$	5
$185 < l \leq 190$	5
$190 < l \leq 195$	3

(b) This is the frequency chart corresponding to the table above.



D Estimating a mean using mid-interval values (p 15)

1 (a) 67 records lasted three minutes or more.

(b)

Time (t min)	Freq.	Mid-interval value	Group total estimate
$1 \leq t < 2$	1	1.5	$1 \times 1.5 =$ 1.5
$2 \leq t < 3$	3	2.5	$3 \times 2.5 =$ 7.5
$3 \leq t < 4$	27	3.5	$27 \times 3.5 =$ **94.5**
$4 \leq t < 5$	32	**4.5**	**$32 \times 4.5 = 144$**
$5 \leq t < 6$	8	**5.5**	**$8 \times 5.5 = 44$**
Total	71		**Total = 291.5**

(c) (i) Estimate of show length 291.5 minutes or 290 minutes

(ii) Estimate of mean record length 4.1 minutes or 4 minutes

2 (a)

Weight (w grams)	Freq.	Mid-interval value	Group total estimate
$60 \leq w < 65$	5	62.5	312.5
$65 \leq w < 70$	19	67.5	1282.5
$70 \leq w < 75$	23	72.5	1667.5
$75 \leq w < 80$	35	77.5	2712.5
$80 \leq w < 85$	12	82.5	990
$85 \leq w < 90$	6	87.5	525
Total	100		7490

(b) 74.9 grams

3 (a)

Rainfall (r)	Frequency
$0 < r \leq 5$	10
$5 < r \leq 10$	7
$10 < r \leq 15$	5
$15 < r \leq 20$	5
$20 < r \leq 25$	1

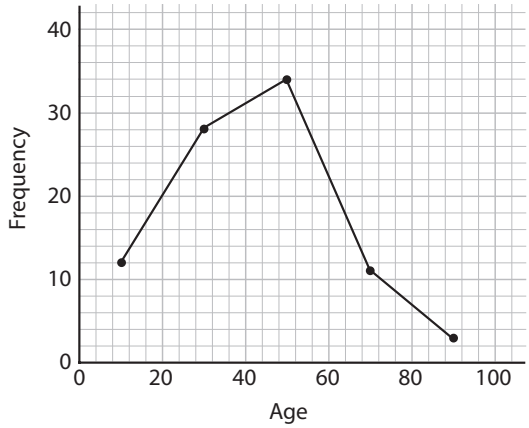
(b) $[(2.5 \times 10) + (7.5 \times 7) + (12.5 \times 5) + (17.5 \times 5) + (22.5 \times 1)] \div 28 = 8.9$ mm

(c) 9.1 mm (close to the estimate)

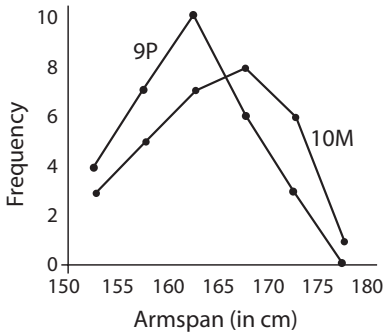
4 $[(5 \times 18) + (15 \times 20) + (25 \times 3) + (35 \times 4) + (45 \times 3) + (55 \times 4)] \div 52 = 18.5$ mm

E Frequency polygons (p 16)

1



2 (a)



(b) 10M $[(152.5\times3) + (157.5\times5) + (162.5\times7) + (167.5\times8) + (172.5\times6) + (177.5\times1)] \div 30 = 4935 \div 30 = 164.5$ cm

9P $[(152.5\times4) + (157.5\times7) + (162.5\times10) + (167.5\times6) + (172.5\times3)] \div 30 = 4860 \div 30 = 162$ cm

(c) For example:
Both the mean armspan and modal interval are lower for 9P. More students in 9P have shorter armspans than in 10M, and more in 10M have longer armspans. The students in 10M have a greater range of armspans.

3 (a) The adults had the longer mean time. (There are more of them with long times and fewer with short times.)

(b) 32

(c) Children 55.9 s, adults 61.9 s (to 1 d.p.)

4 Fractions

B Reciprocals (p 17)

1 (a) $\frac{1}{7}$ **(b)** $\frac{15}{8}$ **(c)** 9 **(d)** $\frac{4}{5}$ **(e)** $\frac{2}{7}$

2 (a) 5 **(b)** $\frac{5}{4}$ or 1.25 **(c)** 25

(d) $\frac{5}{8}$ or 0.625 **(e)** $\frac{2}{25}$ or 0.08

C Dividing by a fraction (p 17)

1 (a) 36 **(b)** 9 **(c)** 20 **(d)** $\frac{10}{3}$ **(e)** $\frac{20}{3}$

2 (a) $\frac{6}{7}$ **(b)** $\frac{9}{10}$ **(c)** $\frac{6}{5}$ **(d)** 6 **(e)** $\frac{3}{2}$

D Mixed questions (p 17)

1 (a) $\frac{19}{40}$ **(b)** $1\frac{7}{30}$ **(c)** $\frac{5}{12}$ **(d)** $\frac{3}{20}$ **(e)** $2\frac{4}{15}$

(f) $1\frac{13}{30}$ **(g)** $\frac{11}{20}$ **(h)** $4\frac{2}{3}$ **(i)** $\frac{16}{21}$ **(j)** $3\frac{1}{3}$

2 16

3 75

4 (a) $\frac{13}{20}$ **(b)** $\frac{1}{15}$ **(c)** $\frac{1}{3}$ **(d)** $\frac{5}{8}$ **(e)** $\frac{29}{60}$

5 (a) $x = \frac{15}{4}$ **(b)** $x = \frac{7}{6}$ **(c)** $x = \frac{15}{7}$ **(d)** $x = \frac{8}{15}$

6 (a) 420 **(b)** 7

5 Accuracy

A Lower and upper bounds (p 18)

1 (a) 56 370 **(b)** 56 400 **(c)** 56 000 **(d)** 60 000

2 (a) 65 **(b)** 2 **(c)** 421 **(d)** 110

3 (a) 63.5 mm, 64.5 mm **(b)** 49.5 cm, 50.5 cm
(c) 245 m, 255 m **(d)** 405 cm, 415 cm
(e) 5350 m, 5450 m

4 (a) 143.5 cm, 144.5 cm **(b)** 345 ml, 355 ml
(c) 1450 g, 1550 g **(d)** 55 500, 56 500

5 215 °C, 225 °C

6 4450 ml, 4550 ml

7 1369.5 mm, 1370.5 mm

8 17 950, 18 050

9 The washing machine could be a maximum of 60.5 cm wide and the gap could be a minimum of 59.5 cm, so it may not fit.

10 The bedroom could be a minimum of 205 cm wide, and the length of the bed is between 207.5 cm and 208.5 cm so it may not fit.

6 Linear equations 1

A Solving equations (p 19)

1 **(a)** $p = \frac{1}{2}$ **(b)** $n = 5$ **(c)** $x = 2$
(d) $k = \frac{3}{4}$ **(e)** $y = 3$ **(f)** $d = -2$
(g) $m = \frac{5}{6}$ **(h)** $a = 3$ **(i)** $q = -\frac{7}{3}$ or $-2\frac{1}{3}$

2 **(a)** $x = 4$ **(b)** $x = 39$
(c) $x = 2.5$ or $\frac{5}{2}$ or $2\frac{1}{2}$ **(d)** $x = 0.5$ or $\frac{1}{2}$
(e) $x = -0.25$ or $-\frac{1}{4}$ **(f)** $x = 10$
(g) $x = -2$ **(h)** $x = 3.5$ or $\frac{7}{2}$ or $3\frac{1}{2}$
(i) $x = \frac{11}{3}$ or $3\frac{2}{3}$

3 **(a)** $n = 8$ **(b)** $n = 2$ **(c)** $n = 4$
(d) $n = -2$ **(e)** $n = -1$ **(f)** $n = 3$

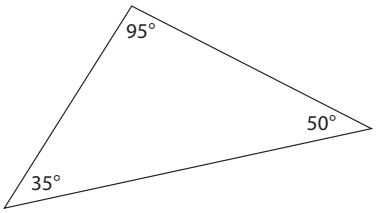
B Forming equations (p 19)

1 **(a)** 7.5 or $7\frac{1}{2}$ **(b)** -3

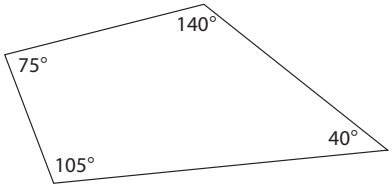
2 **(a)** R: $6x + 6$ or $6(x + 1)$
S: $8x - 4$ or $4(2x - 1)$
(b) $6x + 6 = 8x - 4$ with solution $x = 5$
(c) 36 units

3 **(a)** -10 **(b)** 9

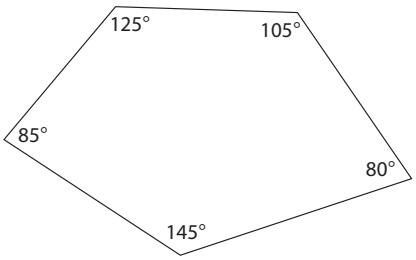
4 **(a)**



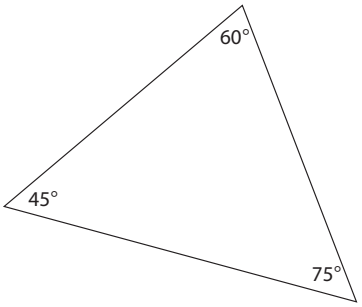
(b)



(c)



(d)



5 **(a)** 10 **(b)** -2

C Equations that involve a fraction
D More than one fraction (p 21)

1 **(a)** $x = 27$ **(b)** $x = -6$
(c) $x = 16$ **(d)** $x = 1.4$ or $\frac{7}{5}$ or $1\frac{2}{5}$
(e) $x = -0.5$ or $-\frac{1}{2}$ **(f)** $x = -5$

2 **(a)** $x = 2$ **(b)** $x = -4$
(c) $x = 2$ **(d)** $x = -5$
(e) $x = 7$ **(f)** $x = 2.5$ or $\frac{5}{2}$ or $2\frac{1}{2}$

3 **(a)** 15 **(b)** -2 **(c)** 2

4 **(a)** $x = 14$ **(b)** $x = 11$
(c) $x = 3$ **(d)** $x = -4$
(e) $x = \frac{8}{3}$ or $2\frac{2}{3}$ **(f)** $x = 1.5$ or $\frac{3}{2}$ or $1\frac{1}{2}$

5 **(a)** $x = 7$ **(b)** $x = \frac{1}{3}$ **(c)** $x = 7$ **(d)** $x = \frac{1}{2}$

6 **(a)** $x = 20$ **(b)** $x = 10$ **(c)** $x = 6$

7 $x = 10.5$ or $10\frac{1}{2}$

8 $\frac{1}{3}$

7 Area and perimeter

A Parallelogram (p 22)

1 **(a)** 54 cm^2 **(b)** 35 cm^2

2 **(a)** **(i)** 19.8 cm^2 **(ii)** 23.4 cm^2
(b) **(i)** 18.8 cm **(ii)** 21.0 cm

3 $a = 1.8$ m, $b = 1.5$ m, $c = 60$ cm

B Triangle (p 22)

1 **(a)** 10 cm^2 **(b)** 81 cm^2 **(c)** 70.9 cm^2

2 $a = 6.0$ cm, $b = 8.0$ cm, $c = 5.0$ cm

C Composite shapes and algebra (p 23)

1 **(a)** 96.8 cm^2 **(b)** 764.2 cm^2

2 **(a)** $\frac{x^2}{2}$ cm^2 **(b)** $\frac{xy}{2}$ cm^2 **(c)** x^2 cm^2

3 **(a)** $21a + 14$, $25a$ **(b)** $a = 3.5$

D Trapezium (p 24)

1 **(a)** 32.2 cm^2 **(b)** 42 cm^2 **(c)** 47.0 m^2

2 $a = 2$ cm, $b = 10.4$ cm

E Circle (p 24)

1 **(a)** **(i)** 25.1 cm **(ii)** 50.3 cm^2
(b) **(i)** 55.9 cm **(ii)** 248.8 cm^2
(c) **(i)** 75.4 mm **(ii)** 452.4 mm^2
(d) **(i)** 11.9 m **(ii)** 11.3 m^2

2 **(a)** 12π **(b)** 16π **(c)** 25π **(d)** $7\pi + 14$

3 **(a)** 7.6 cm **(b)** 3.8 cm

4 59.2 cm

5 **(a)** 25.5 cm
(b) 509.3 cm^2 (using the unrounded answer to part (a))

6 **(a)** 3.4 cm **(b)** 4.1 cm

7 **(a)** 150.0 cm
(b) 98 : 25 or an equivalent ratio

F Population density (p 25)

1 **(a)** 112 per km^2 (to 3 s.f.) **(b)** 82 500 000 (to 3 s.f.)

2 **(a)** 82 kg
(b) 24 kg (to the nearest kg)
(c) 20
(d) 5.8 m^2
(e) 1.3 m^2 for aubergines, giving 6.5 kg, and 5.2 m^2 for French beans, giving 13.0 kg

G Converting units of area (p 26)

1 **(a)** 36 000 cm^2 **(b)** 3.6 m^2

2 **(a)** 0.27 m^2 **(b)** 2700 cm^2

3 **(a)** 45.9 cm^2 **(b)** 4590 mm^2

4 **(a)** 4 500 000 m^2 **(b)** 4.5 km^2

5 52.5 cm^2

H Mixed questions (p 26)

1 **(a)** 34.8 cm^2 (to the nearest 0.1 cm^2)
(b) 3480 mm^2 (to the nearest 10 mm^2)

2 **(a)** 77.4 cm^2 (to 1 d.p.) **(b)** 34.3 cm^2 (to 1 d.p.)

3 **(a)** 16π **(b)** 36π **(c)** 144π **(d)** 40π **(e)** 5 : 13

8 Percentages

A Review: percentage change (p 27)

1 **(a)** 0.46 **(b)** 0.08 **(c)** 0.352
(d) 1.12 **(e)** 0.075

2 **(a)** £147.50 **(b)** £117

3 £118.80

4 £9.03

5 24%

6 **(a)** 51.5% (to 1 d.p.) **(b)** 32.7% (to 1 d.p.)
(c) 12.4% decrease (to 1 d.p.)

B Successive percentage changes (p 27)

1 **(a)** 26.5% increase **(b)** 19.5% decrease
(c) 1.44% decrease **(d)** 8.2% decrease
(e) 6.29% decrease (to 2 d.p.)

2 14 700

3 £3250

4 27.1%

5 2.6%

6 9.6% (to 1 d.p.)

C Compound interest (p 28)

1

Years	Amount
0	£650.00
1	£689.00
2	**£730.34**
3	**£774.16**
4	**£820.61**

2 £1322.14

3 $£500 \times 1.04^3 = £562.43$
$£500 \times 1.03^4 = £562.75$
£500 for 4 years at 3% gives more.

4 7 years

5 16.9% (to 1 d.p.)

6 23.9%

D Percentage change in reverse (p 28)

1 15 200

2 £339.57

3 £32

4 £17.50

5 £99.99

6 0.7 million

7 4429 copies

E Mixed questions (p 29)

1 **(a)** £77.55 **(b)** £128

2 **(a)** 8% **(b)** 1458 **(c)** 1157

3 **(a)** 4.8% (to 1 d.p.) **(b)** £5549
(c) 11.9% (to 1 d.p.)

4 2.6% increase

Mixed practice 1 (p 30)

1 **(a)** $n = 37$

(b) When $n = 37$, $2n - 37 = 37$ so two of the angles are 37° making it an isosceles triangle.

2 **(a)** 5 matches **(b)** 48.2 matches

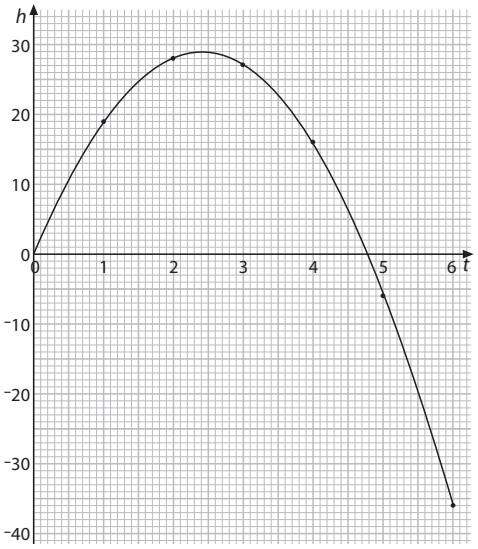
3 £4502.04

4 $\frac{3}{7}$

5 **(a)**

t	0	1	2	3	4	5	6
$h = 24t - 5t^2$	0	19	**28**	**27**	**16**	**$^-$5**	**$^-$36**

(b)



(c) **(i)** About 29 m **(ii)** About 2.4 s

(d) At 4.8 s

6 Upper bound 1505 grams, lower bound 1495 grams

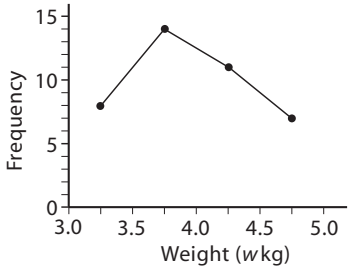
7 30 sides

8 **(a)** Trapezium **(b)** 46 cm^2

9 18.5 cm

10 **(a)** $3.5 < w \leq 4.0$

(b)



(c) 4.0 kg (to the nearest 0.1 kg)

11 **(a)** $x = \frac{1}{3}$ **(b)** $x = ^-1$ **(c)** $x = ^-3\frac{1}{2}$

12 **(a)** $\frac{11}{12}$ **(b)** $\frac{1}{2}$ **(c)** $\frac{9}{10}$ **(d)** $\frac{7}{2}$

(e) 6 **(f)** $\frac{5}{3}$ **(g)** $\frac{4}{3}$ **(h)** $\frac{4}{3}$

13 £175.30

14 $1\frac{1}{15}$

15 **(a)** $r = 5$ **(b)** $x = ^-4$ **(c)** $x = 4$

(d) $p = ^-2$ **(e)** $n = \frac{1}{7}$ **(f)** $y = 10$

16 **(a)** **(i)** 8.6 m^2 **(ii)** 86 000 cm^2

(b) 32% to the nearest 1%

(c) 9.66 m (to 2 d.p.)

17 25π cm^2

9 Transformations

A Reflection

B Translation (p 32)

1 **(a)** B **(b)** G **(c)** F **(d)** G

2 **(a)** $x = 3$ **(b)** x-axis **(c)** $y = x$ **(d)** $y = 4$

3 **(a)** Reflection in the y-axis

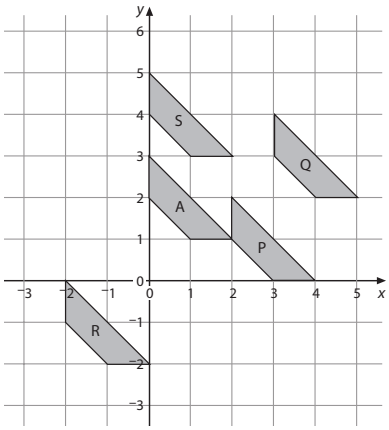
(b) Translation with vector $\begin{bmatrix} 0 \\ -6 \end{bmatrix}$

(c) Reflection in line $x = 3$

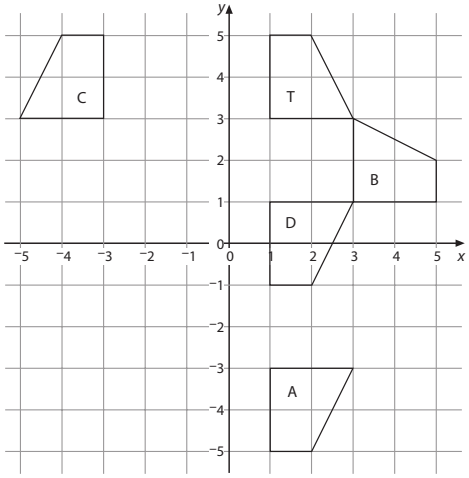
(d) Translation with vector $\begin{bmatrix} 6 \\ 6 \end{bmatrix}$

4 A to B $\begin{bmatrix} 2 \\ 3 \end{bmatrix}$ A to C $\begin{bmatrix} -3 \\ 1 \end{bmatrix}$ A to D $\begin{bmatrix} 2 \\ -4 \end{bmatrix}$

5



6 **(a)–(d)**



(e) Translation with vector $\begin{bmatrix} 0 \\ 4 \end{bmatrix}$

C Rotation (p 33)

1 **(a)** B **(b)** A **(c)** A **(d)** G

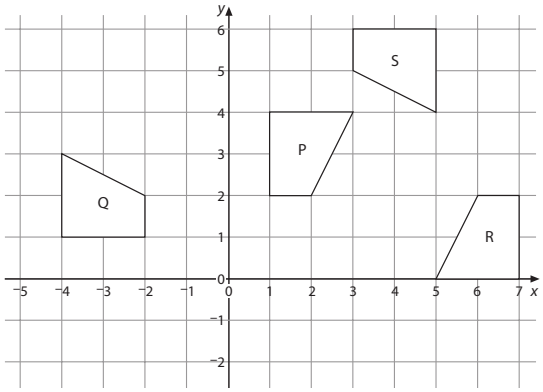
2 **(a)** Rotation 90° anticlockwise about (0, 0)

(b) Rotation 180° about (3, 0)

(c) Rotation 180° about (0, 3)

(d) Rotation 90° anticlockwise about ($^-1$, 0)

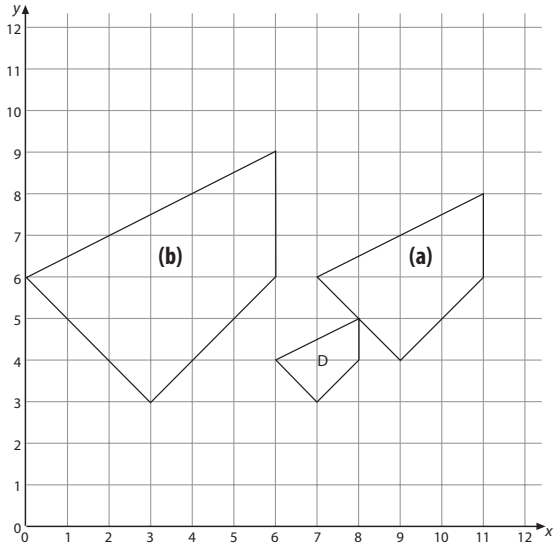
3 **(a)**



(b) Rotation 90° clockwise about (3, 2)

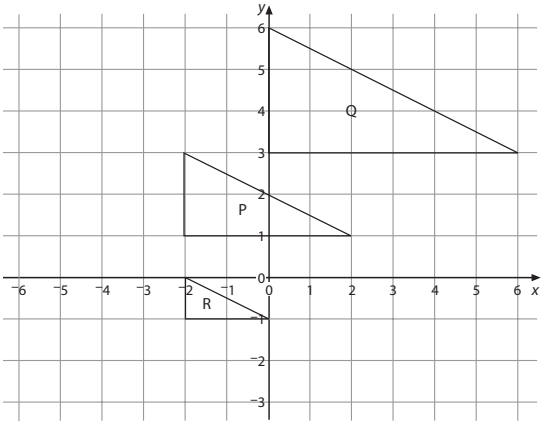
D Enlargement (p 33)

1



2 **(a)** Enlargement with scale factor $1\frac{1}{2}$, centre ($^-6$, $^-3$)

(b)



(c) Enlargement with scale factor $\frac{1}{3}$, centre ($^-3$, $^-3$)

E Mixed questions (p 34)

1 **(a)** Enlargement with scale factor 2, centre (0, 0)

(b) Reflection in the line $y = -1$

(c) Reflection in the y-axis

(d) Rotation 180° about (0, −1)

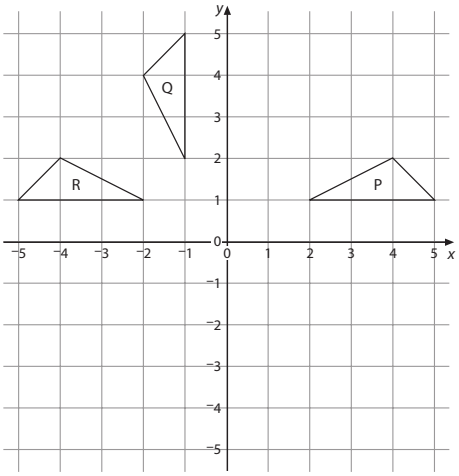
(e) Rotation 90° clockwise about (0, 0)

(f) Rotation 180° about (−2, 2)

(g) Translation $\begin{bmatrix} 4 \\ -6 \end{bmatrix}$

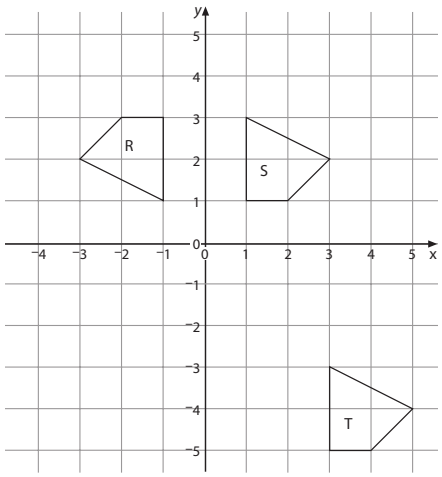
(h) Enlargement with scale factor $\frac{1}{2}$, centre (0, 0)

2 **(a), (b)**



(c) Reflection in the y-axis

3 **(a), (b)**



(c) Rotation 180° about (1, −1)

10 Powers and indices

A Calculating with powers (p 35)

1 **(a)** 27 **(b)** 81 **(c)** 3^{n-1}

2 **(a)** 1 **(b)** 125 **(c)** 2 **(d)** 16
(e) 27 **(f)** 5 **(g)** 32 **(h)** 81

3 **(a)** 24 **(b)** 36 **(c)** 9 **(d)** 27
(e) 100 **(f)** 4 **(g)** 125 **(h)** 7

4 **(a)** 2 **(b)** 6 **(c)** 54 **(d)** 162

5 **(a)** 5 **(b)** 3 **(c)** 11 **(d)** 9 or −9
(e) 0 **(f)** 3 **(g)** 1 **(h)** 10 or −10

6 **(a)** 12 **(b)** 16 **(c)** 4 **(d)** 32
(e) 48 **(f)** 3 **(g)** 48 **(h)** 32

7 **(a)** 2 **(b)** 3 **(c)** 2 **(d)** 3
(e) 4 **(f)** 3 **(g)** 5 or −5 **(h)** 3

B Multiplying powers

C Multiplying expressions with powers (p 36)

1 **(a)** 5^7 **(b)** 7^{11} **(c)** 5^{11} **(d)** 9^9
(e) 2^{15} **(f)** 4^{15} **(g)** 8^3 **(h)** 6^{11}

2 **(a)** 512 **(b)** 256 **(c)** 2048 **(d)** 4096

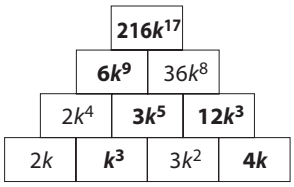
3 **(a)** 19 683 **(b)** 177 147 **(c)** 177 147 **(d)** 59 049

4 **(a)** a^3 **(b)** a^5 **(c)** a^{10} **(d)** a^4
(e) a^9 **(f)** a^7 **(g)** a^6 **(h)** a^{12}

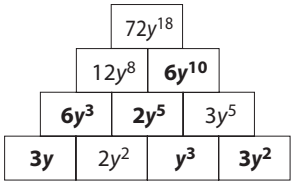
5 **(a)** 3^8 **(b)** 2^{15} **(c)** a^6 **(d)** b^3 **(e)** c^0 or 1

6 **(a)** $6a^4$ **(b)** $5e^5$ **(c)** $6f^9$ **(d)** $21h^8$
(e) $10d^9$ **(f)** $15g^8$ **(g)** $24p^6$ **(h)** $6m^{11}$

7 **(a)**



(b)



8 **(a)** $8c^6$ **(b)** 81 **(c)** $125b^{12}$ **(d)** $32v^{15}$

9 2^{12}

10 3^{19}

D Dividing powers

E Dividing expressions with powers (p 37)

1 **(a)** 5^5 **(b)** 4^3 **(c)** 6^2 **(d)** 3^3
(e) 2^4 **(f)** 5^6 **(g)** 4^4 **(h)** 7^1

2 **(a)** 3^7 **(b)** 5^1 **(c)** 6^2 **(d)** 7^2

3 **(a)** 3 **(b)** 5 **(c)** 0 **(d)** 7

4 **(a)** d^2 **(b)** e **(c)** b^3 **(d)** 1 **(e)** t^4

5 **(a)** 36 **(b)** 6 **(c)** 216 **(d)** 36
(e) 6 **(f)** 7776

6 **(a)** $7b^3$ **(b)** $3c^5$ **(c)** $5n^2$ **(d)** $8m$ **(e)** $6s^4$

7 **(a)** $\frac{1}{3^2}$ **(b)** $\frac{1}{2^5}$ **(c)** $\frac{1}{5^5}$ **(d)** $\frac{1}{4}$

8 **(a)** $\frac{1}{k^4}$ **(b)** $\frac{1}{m^4}$ **(c)** $\frac{1}{t}$ **(d)** $\frac{1}{s^3}$

9 **(a)** $\frac{4}{a^2}$ **(b)** $\frac{c^5}{3}$ **(c)** $\frac{3d^5}{2}$ **(d)** $\frac{1}{3e^4}$
(e) $\frac{2k^2}{3}$ **(f)** $\frac{6q^4}{5}$ **(g)** $\frac{2}{5r^5}$ **(h)** $\frac{3}{4p^4}$

F Negative indices (p 38)

1 **(a)** $5^{-3} = \frac{1}{5^3}$ **(b)** $\frac{1}{3^2} = 3^{-2}$
(c) $\frac{1}{4} = \frac{1}{2^2} = 2^{-2}$ **(d)** $\frac{1}{27} = \frac{1}{3^3} = 3^{-3}$
(e) $\frac{1}{64} = 4^{-3}$ **(f)** $\frac{1}{10\,000} = 10^{-4}$

2 **(a)** -3 **(b)** 3 **(c)** -1 **(d)** 16

3 **(a)** $\frac{1}{4}$ **(b)** $\frac{1}{32}$ **(c)** $\frac{1}{9}$ **(d)** $\frac{1}{25}$ **(e)** $\frac{1}{1000}$

4 **(a)** $\frac{1}{5^2}$ 10^{-1} $\frac{1}{9}$ 2^{-3} **(b)** 3^{-2} $\frac{1}{2^3}$ 4^{-1} $\frac{1}{2}$

5 **(a)** 0.1 **(b)** 0.001 **(c)** 0.000 01
(d) 0.000 000 01 **(e)** 0.0001

6 **(a)** 0.125 **(b)** 0.04 **(c)** 0.125
(d) 0.062 5 **(e)** 0.015 625

7 **(a)** 0.143 **(b)** 0.0278 **(c)** 0.0123
(d) 0.0909 **(e)** 0.556

8 **(a)** $\frac{1}{x^2}$ **(b)** $\frac{1}{z^4}$ **(c)** $\frac{1}{w}$ **(d)** $\frac{1}{n^2}$ **(e)** $\frac{1}{h^7}$

9 **(a)** $x = 11$ **(b)** $x = 10$ **(c)** $x = -1$ **(d)** $x = 0$
(e) $x = 8$ **(f)** $x = 1$ **(g)** $x = -4$ **(h)** $x = -7$

10 4

11 $\frac{8}{27}$

12 **(a)** $p = -3$ **(b)** $n = \frac{1}{4}$ **(c)** $m = \frac{2}{3}$ **(d)** $x = \frac{2}{3}$

G Extending the rules to negative indices (p 39)

1 **(a)** 4^2 **(b)** 7^2 **(c)** 2^{-2} **(d)** 3^0 (or 1)
(e) 6^{-3} **(f)** 8^{-1} **(g)** 5^{-4} **(h)** 2^0 (or 1)

2 **(a)** 4^{-2} **(b)** 3^{-1} **(c)** 2^{-3} **(d)** 5^{-2}
(e) 7^{-1} **(f)** 9^{-4} **(g)** 6^{-2} **(h)** 2^{-6}

3 **(a)** s **(b)** h^3 **(c)** k^0 (or 1) **(d)** x^{-5}
(e) n^{-6} **(f)** m^{-3} **(g)** x^{-4} **(h)** d^{-4}

4 **(a)** 3^{-6} **(b)** 2^{-12} **(c)** 7^{-5} **(d)** x^{-20} **(e)** k^{14}

5 **(a)** -3 **(b)** 3 **(c)** -3
(d) 5 **(e)** -4 **(f)** 2

6 **(a)** $15x$ **(b)** $8p^3$ **(c)** $6k^{-2}$ or $\frac{6}{k^2}$
(d) $5a^{-5}$ or $\frac{5}{a^5}$ **(e)** $2y^{-4}$ or $\frac{2}{y^4}$ **(f)** $\frac{1}{2}x^{-1}$ or $\frac{1}{2x}$
(g) $3h^{-6}$ or $\frac{3}{h^6}$ **(h)** $\frac{3}{4}m^{-1}$ or $\frac{3}{4m}$

7 **(a)** 2^6 **(b)** 3^2 **(c)** 5^{-3} **(d)** x^4 **(e)** h^{-1}

8 **(a)**

×	$\mathbf{5^3}$	5^{-2}	$\mathbf{1}$
$\mathbf{5^{-4}}$	$\mathbf{5^{-1}}$	5^{-6}	$\mathbf{5^{-4}}$
5^2	$\mathbf{5^5}$	$\mathbf{1}$	5^2
5^{-1}	5^2	$\mathbf{5^{-3}}$	$\mathbf{5^{-1}}$

(b)

×	$\mathbf{y^{-3}}$	y^3	y^{-4}
$\mathbf{y^3}$	1	$\mathbf{y^6}$	y^{-1}
1	$\mathbf{y^{-3}}$	$\mathbf{y^3}$	$\mathbf{y^{-4}}$
$\mathbf{y^{-3}}$	$\mathbf{y^{-6}}$	1	$\mathbf{y^{-7}}$

9 $\frac{3k^5}{2}$

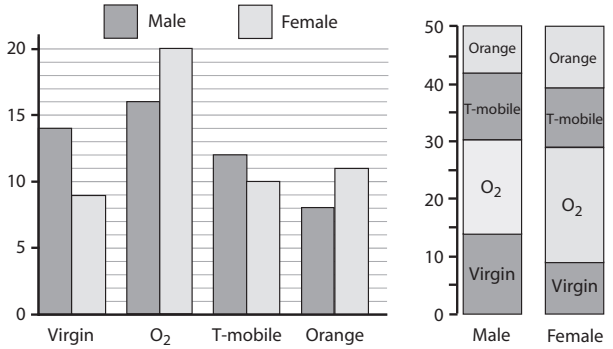
11 Surveys and experiments

B Surveys (p 40)

1 (a) Question A is better. By asking for the 'main' means of transport, it narrows the response down to one of three, making responses easier to classify. Question B could produce responses with irrelevant detail.

(b) 'How many times' makes no distinction between short and long periods. One better version would be: 'For how many days have you been away on holiday in the past 12 months?', with a choice of, say, 0–4, 5–9, 10–14, 15–19, 20 or more.

2 Two examples of suitable diagrams are shown here.



C Experiments (p 40)

1 To compare you could use stem-and-leaf tables and/or median or mean and range.

Paragraph

Did not attend		Attended
8 8 7	2	3 5 6 6 6 8 9 9
8 8 7 7 5 4 4 3 3 2	3	3 4 4 7 8 8 9
4 2	4	

Spreadsheet

Did not attend		Attended
7 6	2	5 6 7 7 8
8 8 7 5 4 3 3 0	3	0 1 1 2 4 4 5 6 7 8
5 3 3 1 0	4	

These tables show that those who attended did better on both the paragraph and the spreadsheet. In both cases their times were less spread out. The differences were greater for the spreadsheet. This is confirmed by the means, medians and ranges.

Paragraph

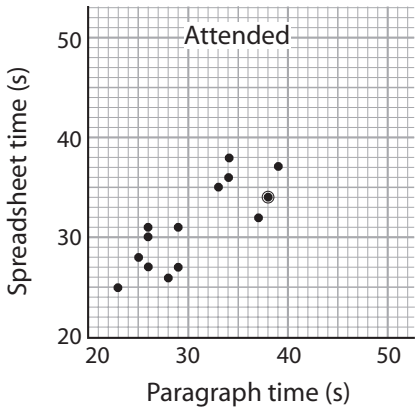
	Median	Mean	Range
Attended	29	31	16
Did not attend	34	34.7	17

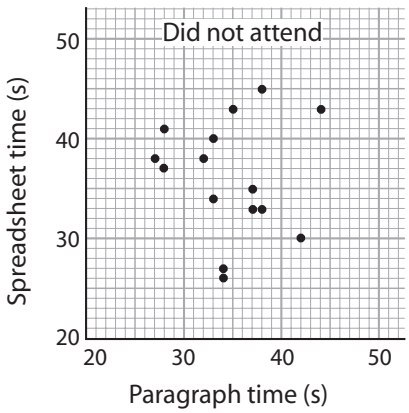
Spreadsheet

	Median	Mean	Range
Attended	31	31.4	13
Did not attend	37	36.2	19

2 The scatter diagrams show that

- for those attending the workshop, times for the two tasks were positively correlated
- for those not attending, there was no correlation between the times for the tasks





12 Speed, distance and time

A Calculating speed (p 41)

1 **(a)** 19 m.p.h. **(b)** 39 m.p.h.
(c) 96 km/h **(d)** 5 m/s

2 300 km/h

3 **(a)** 46 m.p.h. **(b)** 50 m.p.h. **(c)** 47.5 m.p.h.

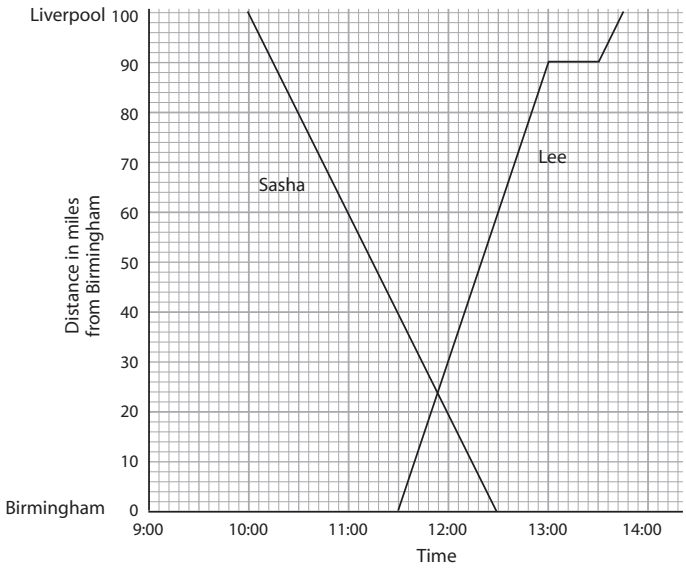
4 **(a)** 56 m.p.h. **(b)** 40 m.p.h.

B Distance–time graphs (p 41)

1 **(a)** Stage 1: 30 m.p.h. for 2 hours
Stage 2: stopped for 1 hour
Stage 3: 40 m.p.h. for 1 hour
(b) Stage 1: 40 m.p.h. away from home for 2 hours
Stage 2: 60 m.p.h. back towards home for 1 hour 20 minutes

2 **(a)** 100 miles **(b)** 10:30
(c) About 3 hours 20 minutes **(d)** 30 m.p.h.
(e) $\frac{1}{2}$ hour **(f)** About 11:42
(g) 10 miles **(h)** 50 m.p.h.
(i) About 20 minutes

3 **(a), (b)**



(c) At about 11:54 **(d)** 24 miles

4 **(a)** 12 km/h **(b)** 14 km/h

C Calculating distance and time
D Mixing units (p 43)

1 64 km

2 $2\frac{1}{2}$ hours

3 6 miles

4 45 minutes

5 15 m.p.h.

6 30 km

7 **(a)** 180 m **(b)** 540 m **(c)** 1080 m **(d)** 5400 m

8 **(a)** 12 km **(b)** 8 km **(c)** 2 km **(d)** 100 m

9 13 714

10 **(a)** 21 km **(b)** 36 km/h

11 $17\frac{1}{2}$ minutes

E Time on a calculator (p 44)

1 **(a)** 0.8 hour **(b)** 46.25 m.p.h.

2 7.1 km/h

3 **(a)** 2 hours 32 minutes **(b)** 4 hours 16 minutes
(c) 24 minutes

4 238.3 miles (to 1 d.p.)

5 10.2 m/s

6 88 800 km

7 515 km

8 21.2 km/h

9 **(a)** 33 hours 20 minutes **(b)** 0.0125 miles

10 5:40 p.m.

11 39.5 m.p.h. (to 1 d.p.)

13 Volume, surface area and density

A Volume of a cuboid (p 45)

1 **(a)** 44 cm^3 **(b)** 29 cm^3 **(c)** 190 cm^3 **(d)** 54 cm^3

2 All have volume 180 cm^3.
$a = 9$ cm, $b = 5$ cm, $c = 8$ cm

3 Three sets of dimensions that multiply to give 192 cm^3, for example 4 cm by 6 cm by 8 cm

B Volume of a prism (p 45)

1 **(a)** 55.1 cm^3 **(b)** 176 cm^3 **(c)** 126 cm^3

2 168 cm^3

3 4.3 mm (to 2 s.f.)

4 150 m^2

C Volume of a cylinder (p 46)

1 **(a)** 275 cm^3 **(b)** 138 m^3

2 2425 m^3, to the nearest m^3

3 20.3 cm

4 3.9 cm, to the nearest 0.1 cm

5 $a = 20$ cm, $b = 5.8$ cm, to the nearest 0.1 cm

6 **(a)** Volume of whole cylinder = 1244.07 cm^3
Volume of hole + card = 190.84 cm^3
Volume of paper = 1053 cm^3 (to 4 s.f.)
(b) Volume of one sheet = 3.8 cm^3 (to 2 s.f.)
Thickness = 0.03 cm (to 1.s.f.)

D Surface area (p 47)

1 **(a)** 22 cm^2, to the nearest cm^2
(b) A triangular prism

2 **(a)** 108 cm^2 **(b)** 40 cm^2 **(c)** 122 cm^2

3 **(a)** 197.9 cm^2 **(b)** 49.2 cm^2 **(c)** 8.1 cm^2
(all to the nearest 0.1 cm^2)

E Density (p 47)

1 **(a)** **(i)** 5000 cm^3 **(ii)** 0.84 g/cm^3
(b) **(i)** 1260 cm^3 **(ii)** 0.067 g/cm^3 (to 2 s.f.)
(c) **(i)** 628.3 cm^3 (to 4 s.f.)
(ii) 2.23 g/cm^3 (to 3 s.f.)

2 18.1 cm^3 (to 3 s.f.)

3 **(a)** 5200 g (or 5.2 kg) **(b)** 219 g
(c) 3.5 g (to 2 s.f.)

4 2.6 cm, to the nearest 0.1 cm

F Units of volume and liquid measure (p 48)

1 **(a)** **(i)** 2 400 000 cm^3 **(ii)** 270 000 cm^3
(b) **(i)** 2.4 m^3 **(ii)** 0.27 m^3

2 **(a)** 20.1 m^3 (to 3 s.f.)
(b) 20 100 000 cm^3 (to 3 s.f.)

3 **(a)** 7 m^3 **(b)** 24 m^3 **(c)** 3.87 m^3 **(d)** 0.05 m^3

4 12 800 mm^3

5 83

6 **(a)** 2262 ml **(b)** 2.262 litres

7 500

8 19.9 cm, to the nearest 0.1 cm

9 10.8 cm, to the nearest 0.1 cm

14 Cumulative frequency

B Cumulative frequency tables (p 49)

1 **(a)** 38 **(b)** 42 **(c)** 43

2 **(a)**

Test result (r)	Cum. freq.
$r \leq 20$	3
$r \leq 40$	10
$r \leq 60$	30
$r \leq 80$	62
$r \leq 100$	72

(b)

Weekly wage (£w)	Cum. freq.
$w \leq 160$	5
$w \leq 170$	15
$w \leq 180$	38
$w \leq 190$	54
$w \leq 200$	62

3 **(a)** 44 million

(b) **(i)** 12 million **(ii)** 9 million

(c)

Age (a years)	Frequency
$0 < a \leq 20$	9
$20 < a \leq 40$	12
$40 < a \leq 60$	14
$60 < a \leq 80$	6
$80 < a \leq 100$	3

C Cumulative frequency graphs (p 50)

1 **(a)** **(i)** 8 **(ii)** 23 **(iii)** 51 **(iv)** 72

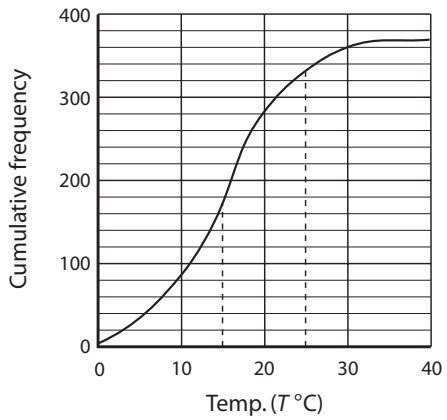
(b) **(i)** 11% **(ii)** 31% **(iii)** 32% **(iv)** 69% **(v)** 61%

(c) 80% of the mice weigh **70** g or less.

2 **(a)**

Temp. (T °C)	Cum. freq.
$T \leq 0$	3
$T \leq 10$	86
$T \leq 20$	282
$T \leq 30$	362
$T \leq 40$	365

(b)



(c) 160 days

(d) 12%

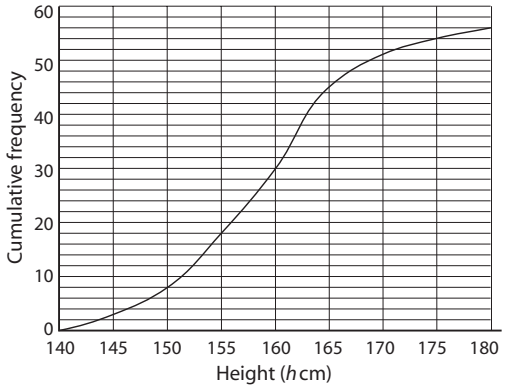
D Median, quartiles and interquartile range (p 51)

1 **(a)** 33 **(b)** 21 **(c)** 42 **(d)** 21 **(e)** 21 **(f)** 90

2 **(a)**

Height (h cm)	Cum. freq.
$h \leq 145$	3
$h \leq 150$	8
$h \leq 155$	18
$h \leq 160$	30
$h \leq 165$	45
$h \leq 170$	51
$h \leq 175$	54
$h \leq 180$	56

(b)



(c) **(i)** 159 cm

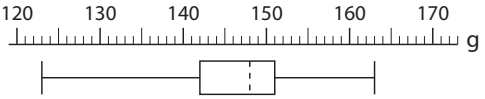
(ii) Lower quartile = 153 cm, upper quartile = 164 cm

(iii) 11 cm

3 Median speed ≈ 44 m.p.h., lower quartile ≈ 38 m.p.h., upper quartile ≈ 48.5 m.p.h.

E Box-and-whisker plots (p 52)

1 **(a)**

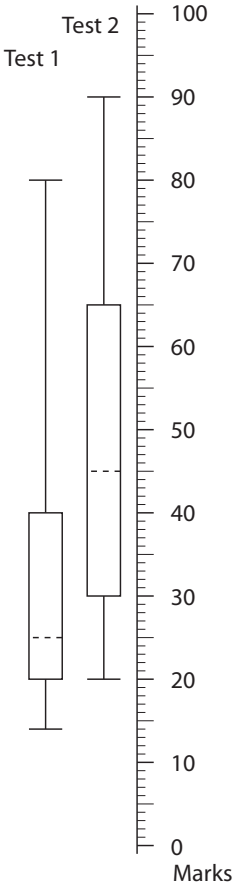


(b) 9 g

2 For example:
On average men work longer, although the longest time is worked by women. Men's hours are much less variable than women's, with about half of men working between 38 and 42 hours a week. Three-quarters of men work 38 hours or more, but three-quarters of women work 38 hours or less.

3 (a) Test 1: Median 25
LQ 20
UQ 40
Test 2: Median 45
LQ 30
UQ 65

(b)



(c) Test 1: IQR = 20
Test 2: IQR = 35

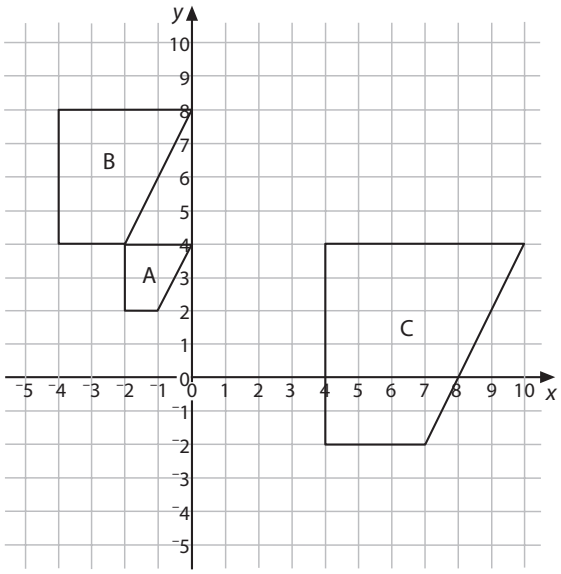
(d) Comparisons between the tests, for example:
Marks in test 2 were higher overall, as shown by the median marks of 25 for test 1 and 45 for test 2.
Marks on test 2 were more widely spread, as shown by the interquartile ranges of 20 marks for test 1 and 35 marks for test 2.

(e) Test 1: 10 passed
Test 2: 18 passed

Mixed practice 2 (p 53)

1 8

2



(a) Shape B as on the grid above

(b) Shape C as on the grid above

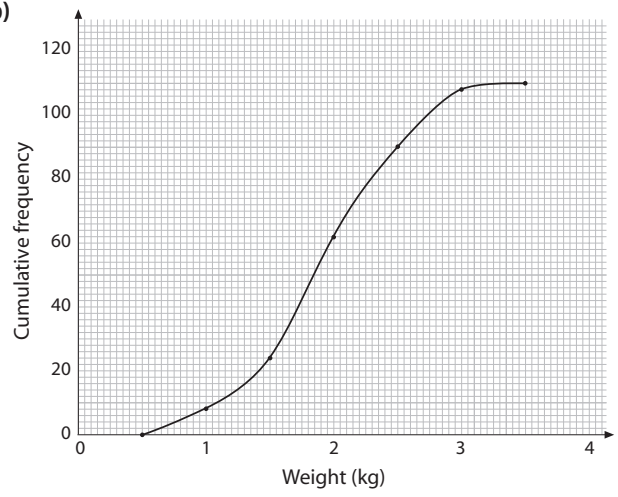
(c) Enlargement scale factor 3, centre (−5, 4)

3 It is a leading question and could be improved by removing 'which are more healthy than meat'.

4 (a) 1862 miles **(b)** 5 hours 54 minutes

5 (a) The values in the second row of the table are:
0, 7, 23, 62, 90, 108, 110

(b)

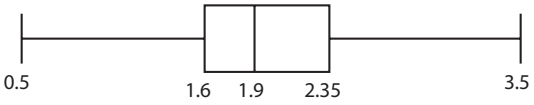


(c) About 40 bags

(d) 7% (to the nearest 1%)

(e) (i) 1.9 kg **(ii)** 0.75 kg

(f)

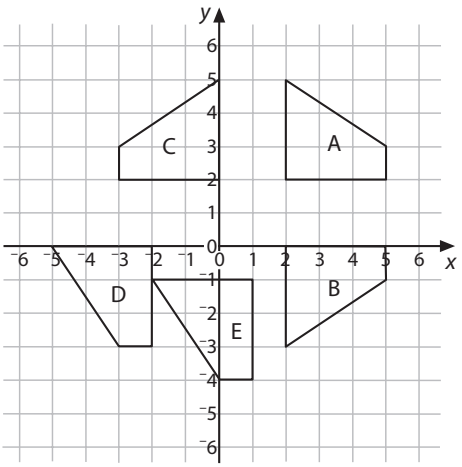


6 **(a)** $x = 2$ **(b)** $x = 0$ **(c)** $x = -3$ **(d)** $x = -1$

7 **(a)** **(i)** $0.804\,m^3$ **(ii)** $804\,000\,cm^3$ **(iii)** 2171 kg
(b) $5.03\,m^2$

8 **(a)** 7^8 **(b)** 9^2 **(c)** 4^6 **(d)** 3^{-1}

9



(a) **(i)** Shape B as on the grid above
(ii) Shape C as on the grid above
(iii) Reflection in the line $x = 1$
(b) **(i)** Shape D as on the grid above
(ii) Shape E as on the grid above
(iii) Rotation 90° clockwise about (1, 0)

10 **(a)** $30k^4$ **(b)** a^{-1} or $\frac{1}{a}$ **(c)** $2b^5$
(d) $\frac{3}{5}m^{-3}$ or $\frac{3}{5m^3}$ **(e)** $8x^{-9}$ or $\frac{8}{x^9}$

11 **(a)** 72 km/h **(b)** 4 seconds

12 4320 litres

13 $x = \frac{2}{3}$

15 Working with expressions

A Collecting like terms (p 55)

1 **(a)** $3p^2 - p$ **(b)** $3x^2 + 2x - 1$
(c) $5y^2 + 11y - 2$ **(d)** $5n^2 - 4n + 3$
(e) $4l^2 + 5l - 6$ **(f)** $4k^2 + 4k + 1$

2 **(a)** 16 **(b)** 12 **(c)** 17 **(d)** 35

3 **(a)** **(i)** A, D **(ii)** A, B **(iii)** C, D **(iv)** B, C
(b) A, B, D

B Multiplying and dividing expressions
C Factorising expressions (p 55)

1 **(a)** $x^2 + 6x$ **(b)** $12a + 20$ **(c)** $8m - 4m^2$
(d) $6n^2 + 2n$ **(e)** $12k^3 - 8k^2$ **(f)** $3p^4 - 3p^3$
(g) $8w^2 + 12w$ **(h)** $4x^5 - x^4$

2 **(a)** $n - 3$ **(b)** $2 - 3x$ **(c)** $p - 2p^2$ **(d)** $3 + k^3$

3 **(a)** $2n - 3$ **(b)** $2p - 6$ **(c)** $x - 3$ **(d)** $3k + 4k^2$

4 **(a)** $8x + 20$ **(b)** $n^2 - 5n$ **(c)** $2m^3 + 10m^2$

5 **(a)** $n \times (n - 1)$ **(b)** $4 \times n^2$ **(c)** $n \times (3n - 2)$
(d) $3n \times (n - 1)$ **(e)** $4 \times (3n - 2)$ **(f)** $3n \times (3n - 2)$
(g) $n^2 \times (3n - 2)$ **(h)** $n^2 \times (n - 1)$

6 **(a)** $4(x + 2)$ **(b)** $a(a - 3)$ **(c)** $k(3k^2 - 2)$
(d) $g(12 - g)$ **(e)** $3(y^2 - 2)$

7 **(a)** $p + 3$ **(b)** $2n + 1$ **(c)** $2x^2 + 3$ **(d)** $4y^2 + 3y$

8 **(a)** $2x(4x + 5)$ **(b)** $3d(d + 5)$
(c) $4y(1 + 3y)$ **(d)** $5h^2(2 - 5h)$

9 **(a)** $5(n + 2)$
(b) An explanation such as:
'$n + 2$ is an integer so $5n + 10$ is the product of 5 and an integer giving a multiple of 5.'

D Dealing with more than one letter (p 56)

1 **(a)** 28 **(b)** 45 **(c)** 32 **(d)** 32
(e) 144 **(f)** 36 **(g)** 48 **(h)** 144

2 **(a)** 13 **(b)** -20 **(c)** 4 **(d)** 73
(e) -15 **(f)** -2

3 **(a)** $7n - 2m$ **(b)** $9n^2 + 4mn + 2$
(c) $2n^2 + 12m$

4 **(a)** A, D **(b)** A, B **(c)** B, C **(d)** C, D

5 **(a)** $3ab$ **(b)** $10xy$ **(c)** $6km$ **(d)** $12np$
(e) $20xy$ **(f)** $12x^2y$ **(g)** $12ab^3$ **(h)** $8x^3y^6$

6 **(a)** $4y$ **(b)** $3mn$ **(c)** $5p^3q^3$

7 **(a)** $4y \times x^3y$ **(b)** $5xy \times 3x^2y$ **(c)** $3x \times 4x^2$
(d) $4y \times 4x^2$ **(e)** $x^3y \times 3x^2y$ **(f)** $5xy \times x^3y$

8 **(a)** $11p + 2q$ **(b)** $2x^2 + 6x^2y - 5x^3$

9 **(a)** $16a^2b^2$ **(b)** $8m^3n^3$ **(c)** $64a^6b^9$ **(d)** $\frac{8p^3}{27r^3s^6}$

10 **(a)** $4x$ **(b)** $3y$ **(c)** $\frac{ab}{3}$ **(d)** $\frac{4x}{y^2}$
(e) $\frac{kl^2}{3}$ **(f)** $2a^3b$ **(g)** $\frac{21m^3n}{2}$ **(h)** $\frac{8b^6}{3a}$

11 **(a)** $a + 4$ **(b)** $4 + xy$ **(c)** $\frac{k}{2} + \frac{3}{k}$ **(d)** $\frac{1}{cd} + \frac{5}{d^2}$

E Expanding and factorising expressions (p 57)

1 **(a)** $12a + 8b$ **(b)** $4ab - 5b^2$
(c) $10a + 15b$ **(d)** $xy + x^3$

2 **(a)** $5(a - b)$ **(b)** $4(a + 3b)$
(c) $3(2n - 5m)$ **(d)** $x(y + 2)$
(e) $n(n - 5m)$ **(f)** $a(b + a)$
(g) $b(3ab - 7)$ **(h)** $a(1 - 7a^3b)$

3 **(a)** $3a^2b - 2ab^2$ **(b)** $6xy + 18x^2$
(c) $12k^2l + 15k^2$

4 **(a)** $5mn(n - 3m)$ **(b)** $xy(x + 3y^2)$
(c) $2kl(3kl - 2)$ **(d)** $3ab^2(1 + 2b)$
(e) $2p^2q(2q^2 + 5p)$ **(f)** $5y(x^2 + 2y^2)$
(g) $4x^2y^2(y + 3x^2)$ **(h)** $4xy(4xy^2 - 1)$
(i) $x^2y(5x^2 + y^2)$

5 **(a)** $xy(3x + 2y)$, $3x(xy - 1)$, $3(2x - y)$
IP EN CL → PENCIL
(b) $3y^2(2x - 5y)$, $3(x^2y + 2)$, $4x(xy - 1)$
OY CR AN → CRAYON
(c) $4x(x^2y + 2)$, $3x(x + y)$, $3x(x^2y + 2)$
AR ES ER → ERASER

F Forming and simplifying formulas (p 58)

1 **(a)** **(i)** $P = 6x + 8y$ or $P = 2(3x + 4y)$
(ii) $P = 12m + 4k + 2n$ or $P = 2(6m + 2k + n)$
(b) **(i)** $A = 12xy$
(ii) $A = 12mk + 3mn$ or $A = 3m(4k + n)$

2 **(a)** **(i)** $V = 12xy^2$ **(ii)** $V = 8a^3$
(b) **(i)** $S = 6y^2 + 32xy$ or $S = 2y(3y + 16x)$
(ii) $S = 28a^2$

3 **(a)** **(i)** $V = abc + 5abd$ or $V = ab(c + 5d)$
(ii) $V = 20x^2y$
(b) **(i)** $S = 10ab + 10ad + 2db + 2cb + 2ac$ or
$S = 2(5ab + 5ad + db + cb + ac)$
(ii) $S = 10x^2 + 16y^2 + 28xy$ or
$S = 2(5x^2 + 8y^2 + 14xy)$

16 Coordinates in three dimensions

A Identifying points (p 59)

1 (0, 0, 0), (3, 1, 0), (3, 0, 2), (3, 1, 2), (0, 1, 2)

2 **(a)** C
(b) A (1, 0, 1), B (3, 0, 0), D (3, 3, 0), E (2, 3, 2), F (2, 1, 1)

3 A (1, 0, 1), B (1, 3, 0), C (1, 2, 3), D (0, 1, 3)

4 **(a)** (1, 4, 1), (3, 4, 3), (1, 4, 3), (3, 1, 3)
(b) 12 cm^3

17 Cubic graphs and equations

A Cubic functions

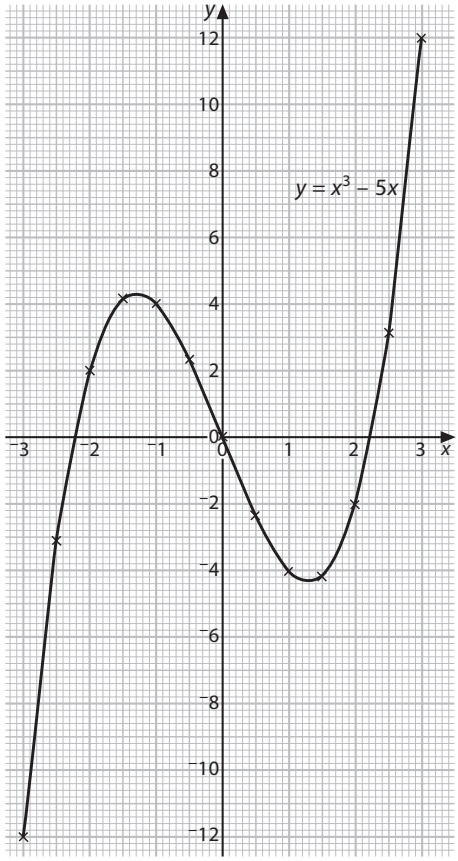
B Trial and improvement (p 60)

1 **(a)**

x	$^-3$	$^-2.5$	$^-2$	$^-1.5$	$^-1$	$^-0.5$	0
$y = x^3 - 5x$	**$^-12$**	**$^-3.125$**	**2**	**4.125**	**4**	**2.375**	**0**

0.5	1	1.5	2	2.5	3
$^-2.375$	**$^-4$**	**$^-4.125$**	**$^-2$**	**3.125**	**12**

(b)



(c) Rotation symmetry order 2, centre (0, 0)

(d) Estimates close to $^{-}1.8$, $^{-}0.7$, 2.5

(e) $y = 8$ intersects the graph at only one point so the equation $x^3 - 5x = 8$ has only one solution.

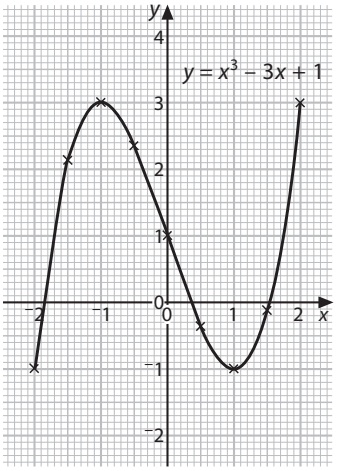
2 Table leading to $x = 2.5$

3 $x = 4.4$

4 (a)

x	$^{-}2$	$^{-}1.5$	$^{-}1$	$^{-}0.5$	0	0.5	1	1.5	2
$y = x^3 - 3x + 1$	$^{-}1$	**2.125**	**3**	**2.375**	**1**	**$^{-}0.375$**	**$^{-}1$**	**$^{-}0.125$**	**3**

(b)



(c) (i) The graph intersects the x-axis between $x = 1.5$ and $x = 2$ so there is a solution to $x^3 - 3x + 1 = 0$ between 1.5 and 2.

(ii) $x = 1.53$

18 Gradients and rates

A Gradient of a sloping line (p 61)

1 (a) 4 **(b)** 0.5 **(c)** 0.75 **(d)** 6
(e) 0.2 **(f)** 1.2 **(g)** 1.5

2 0.8

3 (a) 929 m **(b)** 0.726

B Positive and negative gradients (p 61)

1 (a) $^{-}4$ **(b)** 0.5 **(c)** $^{-}0.75$ **(d)** $^{-}1$
(e) $^{-}0.25$ **(f)** $^{-}0.8$ **(g)** $^{-}1.6$

2 (a) 0.4 **(b)** $^{-}1$ **(c)** 3 **(d)** $^{-}2$
(e) $^{-}1.5$ **(f)** $^{-}0.6$

C Interpreting a gradient as a rate (p 62)

1 (a) (i) 0.2 **(ii)** 0.5

(b) (i) The speed in kilometres per minute

(ii) The rate of flow into the tank in litres per second

2 (a) 2.2

(b) The number of pounds in 1 kilogram

3 (a) $^{-}0.005$

(b) The change in temperature in °C per metre climbed

4 Stage 1: sets off at 0930, walks for $\frac{1}{2}$ hour at speed of 4 km/h
Stage 2: stops for $\frac{1}{4}$ hour
Stage 3: at 1015 walks for $\frac{3}{4}$ hour at speed of 2 km/h
Stage 4: stops for $2\frac{1}{2}$ hours
Stage 5: at 1330 walks back at speed of 2 km/h taking $1\frac{3}{4}$ hours

D Calculating with rates (p 63)

1 £6.20

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

3 77 wingbeats per second to the nearest integer

4 (a) 8 revolutions per minute

(b) 1250 seconds = 20 minutes 50 seconds

5 (a) 0.75 stamps per second

(b) $1\frac{1}{3}$ seconds per stamp

6 3 minutes 20 seconds

7 7.5 minutes

19 Changing the subject

A Simple linear formulas

B Adding and subtracting algebraic expressions (p 64)

1 **(a)** $h = \frac{k}{10}$ **(b)** $x = \frac{y+19}{3}$ **(c)** $z = 5y - 6$

(d) $b = 11a + 9$ **(e)** $v = 5u - 1$ **(f)** $q = \frac{p-15}{2}$

(g) $k = \frac{7h-3}{2}$ **(h)** $c = \frac{3b+5}{8}$ **(i)** $k = \frac{4j-13}{9}$

2 **(a)** $x = \frac{y+35}{7}$ or $x = \frac{y}{7} + 5$ **(b)** $x = \frac{y-15}{20}$

(c) $x = \frac{y+2}{6}$

3 **(a)** $h = 2(g-3)$ **(b)** $g = 3(f+1)$ **(c)** $d = \frac{2(c+4)}{7}$

4 **(a)** $x = 7y + 2$ **(b)** $Q = \frac{P-9}{5}$

(c) $k = \frac{3h+7}{2}$ **(d)** $y = 4(z-1)$

(e) $B = \frac{A+10}{15}$ **(f)** $v = \frac{10(w-5)}{3}$

5 **(a)** $x = 7 - y$ **(b)** $G = \frac{5H+9}{2}$

(c) $k = h - 3$ **(d)** $b = 3(1-a)$

(e) $x = \frac{7-y}{5}$ **(f)** $q = \frac{30-p}{3}$ or $q = 10 - \frac{p}{3}$

(g) $s = \frac{8-t}{20}$ **(h)** $c = \frac{2-3b}{5}$

(i) $K = \frac{3(2-J)}{7}$

6 **(a)** 2 **(b)** $^{-}8$ or $(0, ^{-}8)$

(c) $x = \frac{y+8}{2}$ or $x = \frac{y}{2} + 4$ **(d)** 7

(e) 4 or $(4, 0)$

7 **(a)** $\frac{1}{2}$ or $\left(0, \frac{1}{2}\right)$ **(b)** $x = \frac{2y-1}{3}$ **(c)** $^{-}\frac{1}{3}$ or $\left(^{-}\frac{1}{3}, 0\right)$

C Formulas connecting more than two letters (p 65)

1 P, Q and R

2 **(a)** $s = \frac{r}{t}$ **(b)** $f = d - e$ **(c)** $h = g + p$ **(d)** $d = bc$

3 **(a)** $k = \frac{h-g}{4}$

(b) $z = \frac{y+5}{x}$

(c) $b = \frac{w-5c}{a}$

(d) $r = \frac{p-q}{q}$ or $r = \frac{p}{q} - 1$

(e) $g = k(h-9)$

(f) $z = \frac{2y-x}{3}$

(g) $n = \frac{mp-2}{2}$ or $n = \frac{mp}{2} - 1$

(h) $c = d(a-4b)$

(i) $x = y - v$

(j) $T = \frac{Q-P}{S}$

(k) $h = \frac{g(5n-m)}{7}$

(l) $Y = \frac{6X-ZW}{6}$ or $Y = X - \frac{ZW}{6}$

4 **(a)** $y = \frac{mx-r}{n}$ **(b)** $^{-}3$

5 **(a)** $n = \frac{C-sd}{u}$

(b) **(i)** 6540 units **(ii)** 1.3p per unit

D Squares and square roots (p 66)

1 **(a)** $x = \sqrt{\frac{A}{3}}$ **(b)** $x = \sqrt{5A}$

(c) $x = \sqrt{A+2}$ **(d)** $x = \sqrt{7(A-9)}$

2 **(a)** The area of each square end is $x \times x = x^2$.
The area of each rectangular face is $3x \times x = 3x^2$.
There are 2 square ends and 4 rectangular faces so the total surface area is
$2 \times x^2 + 4 \times 3x^2 = 2x^2 + 12x^2 = 14x^2$ as required.

(b) $x = \sqrt{\frac{A}{14}}$

(c) 2.7 cm by 2.7 cm by 8.0 cm

3 **(a)** $x = \pm\sqrt{y-7}$ **(b)** $x = \pm\sqrt{\frac{y-5}{7}}$

(c) $x = \pm\sqrt{7(y+3)}$ **(d)** $x = \pm\sqrt{y} - 7$

4 **(a)** $^{-}2$ **(b)** $x = \pm\sqrt{\frac{y+2}{18}}$ **(c)** $\left(\frac{1}{3}, 0\right), \left(^{-}\frac{1}{3}, 0\right)$

5 **(a)** $V = ab^2$ **(b)** $b = \sqrt{\frac{V}{a}}$

6 **(a)** $x = (y-5)^2$ **(b)** $x = y^2 + 5$

(c) $x = \frac{y^2}{5}$ **(d)** $x = \frac{y^2-1}{5}$

(e) $x = \frac{(y-1)^2}{5}$ **(f)** $x = 5y^2$

(g) $x = y^2 + z$ **(h)** $x = z(y+7)^2$

20 Probability

A Relative frequency (p 67)

1 (a)

Score	1	2	3	4
Relative frequency after 40 throws	0.25	0.3	0.225	0.225

(b) It seems to be a fair dice with each score coming up roughly $\frac{1}{4}$ of the throws.

(c) **(i)** 25 times **(ii)** 250 times

2 (a) 0.396 or $\frac{99}{250}$ **(b)** 0.052 or $\frac{13}{250}$

3 (a) **(i)** $\frac{22}{90} = 0.244$ (to 3 d.p.)

(ii) $\frac{37}{90} = 0.411$ (to 3 d.p.)

(iii) $\frac{49}{90} = 0.544$ (to 3 d.p.)

(b) 200

B Equally likely outcomes (p 68)

1 (a) $\frac{3}{8}$

(b) **(i)** $\frac{3}{10}$ **(ii)** $\frac{7}{10}$ **(iii)** $\frac{9}{20}$

2 (a) $\frac{4}{20} = \frac{1}{5}$ **(b)** $\frac{6}{20} = \frac{3}{10}$ **(c)** $\frac{6}{20} = \frac{3}{10}$

(d) $\frac{8}{20} = \frac{2}{5}$ **(e)** $\frac{16}{20} = \frac{4}{5}$ **(f)** $\frac{15}{20} = \frac{3}{4}$

3 (a) $\frac{11}{12}$ **(b)** $\frac{1}{7}$ **(c)** $\frac{3}{4}$

4 2 red, 5 blue, 1 green

C Listing outcomes (p 69)

1 (a)

Top	Shorts
B	B
B	W
W	B
W	W
S	B
S	W

B = black, W = white, S = striped

(b) $\frac{1}{3}$ (or $\frac{2}{6}$)

2 (a) Alan Bob, Alan Cara, Alan Dave, Alan Ella, Bob Cara, Bob Dave, Bob Ella, Cara Dave, Cara Ella, Dave Ella

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

(c) **(i)** $\frac{1}{10}$ **(ii)** $\frac{3}{10}$

3 (a)

Spinner A	Spinner B	Total Score
1	1	2
1	2	3
1	3	4
2	1	3
2	2	4
2	3	5
3	1	4
3	2	5
3	3	6

(b) $\frac{6}{9} = \frac{2}{3}$

4 (a)

EEEE	EEEO	EEOE	EOEE	OEEE
EEOO	EOEO	EOOE		
OEEO	OEOE	OOEE		
OOOE	OOEO	OEOO	EOOO	OOOO

(b) **(i)** $\frac{5}{16}$ **(ii)** $\frac{6}{16} = \frac{3}{8}$ **(iii)** $\frac{1}{2}$

D Showing outcomes on a grid (p 70)

1 (a) A grid such as this

7	**8**	**9**	**10**	**11**	**12**	**13**	**14**
6	**7**	**8**	**9**	**10**	**11**	**12**	**13**
5	**6**	**7**	**8**	**9**	**10**	**11**	**12**
4	**5**	**6**	**7**	**8**	**9**	**10**	**11**
3	**4**	**5**	**6**	**7**	**8**	**9**	**10**
2	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
+	1	2	3	4	5	6	7

(b) 8

(c) **(i)** $\frac{28}{49} = \frac{4}{7}$ **(ii)** $\frac{16}{49}$

2 (a)

Score on white dice						
6	**6**	**6**	**6**	**6**	**6**	**6**
5	**5**	**5**	5	**5**	**5**	**6**
4	**4**	**4**	**4**	4	**5**	**6**
3	**3**	**3**	**3**	**4**	**5**	**6**
2	**2**	**2**	**3**	**4**	**5**	**6**
1	**1**	**2**	**3**	**4**	**5**	**6**
	1	2	3	4	5	6

Score on black dice

(b) **(i)** $\frac{5}{36}$ **(ii)** $\frac{4}{36} = \frac{1}{9}$ **(iii)** $\frac{20}{36} = \frac{5}{9}$

3 (a)

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

1st spin

(b) **(i)** $\frac{10}{36} = \frac{5}{18}$ **(ii)** $\frac{21}{36} = \frac{7}{12}$ **(iii)** $\frac{1}{36}$

4 $\frac{7}{10}$

Mixed practice 3 (p 71)

1 $\frac{2}{5}$

2 **(a)** $7p - 7q$ **(b)** $4a + 12c$

(c) $p^2 - 3pq$ **(d)** $15x^2y - 20xy$

3 A: (0, 0, 4); B: (5, 0, 4); C: (5, 3, 0); D: (5, 3, 4)

4 3

5 $\frac{21}{100}$ or 0.21

6 **(a)** The length of the base is $8x$ and the height is $2x$.
So base × height = $16x^2$ and half of this is $8x^2$.
So $A = 8x^2$ as required.

(b) $x = \sqrt{\frac{A}{8}}$

(c) 5 cm

7 2.7

8 **(a)** $3n^2 - 2n$ **(b)** $n - 6$ **(c)** $b + 2a$

9 4.5 litres

10 **(a)** $a = \frac{b+4}{4}$ or $a = \frac{b}{4} + 1$

(b) $p = \frac{2q+1}{3}$

(c) $c = \frac{5-d}{3}$

(d) $s = 2(t - 8)$ or $s = 2t - 16$

11 0.83

12 **(a)** $30xyz$ **(b)** $24a^3b^5$ **(c)** f^9g **(d)** $\frac{3p^5r}{q^4}$

13 **(a)** 0.39 **(b)** 140

14 **(a)** $5x(x - y)$ **(b)** $2(4ab^2 + 1)$

(c) $3y(3y^2 - 4x^2)$ **(d)** $2pq(3p + 5q)$

15 485 km (to the nearest kilometre)

16 **(a)** $x = (y - z)^2$ **(b)** $b = \frac{ax - y}{3}$

(c) $u = wn + st$ **(d)** $q = \pm\sqrt{tr - p}$

17 **(a)**

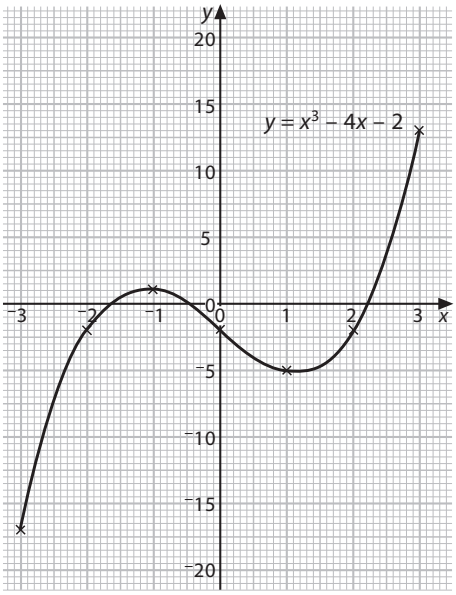
Second spinner \ First spinner	1	2	3	4	5	6
8	**9**	**10**	**11**	**12**	**13**	**14**
6	**7**	**8**	**9**	**10**	11	**12**
4	**5**	6	**7**	**8**	**9**	**10**
2	**3**	**4**	**5**	**6**	**7**	**8**

(b) **(i)** $\frac{1}{8}$ **(ii)** $\frac{3}{8}$ **(iii)** $\frac{1}{4}$

18 **(a)**

x	$^-3$	$^-2$	$^-1$	0	1	2	3
y	$^-17$	**$^-2$**	1	**$^-2$**	**$^-5$**	**$^-2$**	**13**

(b)



(c) **(i)** The graph cuts the x-axis between 2 and 3 so the equation $x^3 - 4x - 2 = 0$ has a solution between 2 and 3.

(ii) 2.2

21 Large and small numbers

A Powers of ten (p 73)

1 **(a)** 10^4 **(b)** 10^3 **(c)** 10^5 **(d)** 10^7

2 E, F, D, H, A, G, C, I, B

3 **(a)** 10^{11} **(b)** 10^6 **(c)** 10^3 **(d)** 10^3

4 **(a)** 1 700 000 **(b)** 52 600
(c) 619 000 **(d)** 7 230 000

B Writing large numbers in different ways (p 73)

1 **(a)** 2 300 000 **(b)** 5 000 000 000
(c) 510 000 000 **(d)** 380 000
(e) 2 330 000

2 **(a)**

Pacific Ocean	156 million km^2
Atlantic Ocean	77 million km^2
Indian Ocean	69 million km^2
Southern Ocean	20 million km^2
Arctic Ocean	14 million km^2
South China Sea	3 million km^2
Carribean Sea	3 million km^2

(b) 43% (to the nearest 1%)

C Standard form for large numbers (p 74)

1 **(a)** 4×10^6 **(b)** 2.8×10^4
(c) 6.03×10^5 **(d)** 3.2×10^{10}

2 **(a)** 300 000 **(b)** 100 000 000
(c) 6300 **(d)** 28 600 000

3 **(a)**

Material	Amount (tonnes)
Paper and card	1.271×10^6
Glass	5.68×10^5
Garden waste	1.36×10^6
Cans	4.3×10^4
Plastic	1.7×10^4

(b) 4.52×10^6 tonnes

4 40 000 000 m

5 149 000 000 km

D Using a calculator for large numbers in standard form (p 74)

1 **(a)** 4×10^{11} **(b)** 6.4×10^9 **(c)** 4×10^{11}
(d) 2×10^{10} **(e)** $2.500\,64\times10^{13}$

2 **(a)** 2.25×10^{11} **(b)** 2.92×10^{11} **(c)** 1.20×10^7

3 **(a)** 2.3×10^9 **(b)** 1.0×10^{15} **(c)** 1.8×10^{12}
(d) 6.9×10^5

4 **(a)**

Country	Population density (people per km^2)
Brazil	20
China	100
India	300
Russia	8
South Africa	40
United Kingdom	300
United States	30

(b) India, United Kingdom, China, South Africa, United States, Brazil, Russia

E Standard form for small numbers (p 75)

1 **(a)** 0.01 **(b)** 0.000 23
(c) 0.000 003 8 **(d)** 0.000 000 808

2 **(a)** 3×10^{-6} **(b)** 6.72×10^{-6}
(c) 3.008×10^{-4} **(d)** 4×10^{-12}

3 **(a)** B, D, E, F **(b)** 3.69×10^{-6}

4 0.000 021 4

F Using a calculator for small numbers in standard form (p 75)

1 **(a)** 1.56×10^{-4} **(b)** 7.60×10^{-7}
(c) 6.39×10^{-14} **(d)** 1.25×10^5

2 **(a)** 9.40×10^{-5} **(b)** 3.17×10^{-10}
(c) 1.11×10^{-15} **(d)** 3.87×10^{-2}

3 1.02×10^{-3} cm^2 (to 3 s.f.)

4 **(a)** 3.44×10^{-25} kg **(b)** 1.06×10^{-25} kg
(c) 3.05×10^{-27} kg (to 3 s.f.)

G Standard form without a calculator (p 76)

1 **(a)** 1.2×10^4 **(b)** 1×10^5 **(c)** 4.6×10^4
(d) 2×10^8 **(e)** 8×10^{-2}

2 **(a)** 2×10^{10} **(b)** 3.8×10^6 **(c)** 2.5×10^7
(d) 5×10^{-8}

3 **(a)** 300 000 000 **(b)** 15 000 **(c)** 0.000 105
(d) 0.036 **(e)** 4 000 000 **(f)** 384 000

4 **(a)** 2×10^7 **(b)** 2.5×10^{13}

5 **(a)** $A = 2\times10^8$, $B = 3\times10^{-7}$, $C = 5\times10^{-3}$, $D = 6\times10^{10}$
(b) **(i)** 6×10^1 **(ii)** 1.8×10^4 **(iii)** 1.5×10^{-9}
(iv) 3×10^2 **(v)** 5×10^{-18} **(vi)** 2.5×10^{-11}

22 The tangent function

A Finding an opposite side (p 77)

1 **(a)** 6.0 cm **(b)** 7.5 cm **(c)** 16.8 cm **(d)** 9.5 cm

B Finding an adjacent side (p 77)

1 **(a)** 11.5 cm **(b)** 14.4 cm **(c)** 12.3 cm **(d)** 21.3 cm

2 **(a)** 29.4 cm **(b)** 13.4 cm **(c)** 81.4 cm **(d)** 26.3 cm
(e) 27.7 cm **(f)** 26.1 cm **(g)** 12.0 cm **(h)** 17.3 cm

C Finding an angle (p 78)

1 $a = 35.3°$, $b = 37.8°$, $c = 64.1°$, $d = 22.0°$, $e = 34.3°$, $f = 19.0°$, $g = 42.4°$, $h = 38.4°$, $i = 49.1°$

D Mixed questions (p 78)

1 **(a)** 6.6 cm **(b)** 52.0° **(c)** 27.7 cm **(d)** 14.7°
(e) 62.4 cm **(f)** 17.3 cm **(g)** 8.8 cm **(h)** 55.3°
(i) 27.0 cm **(j)** 16.8 cm **(k)** 63.4°

2 1.59 m (to 2 d.p.)

3 25° (to the nearest degree)

4 114° (to the nearest degree)

5 60.3° (to 1 d.p.)

6 44.1 cm^2 (to 1 d.p.)

7 21.4 cm (to 1 d.p.)

8 544 cm^2 (to the nearest cm^2)

9 51.2° (to the nearest 0.1°)

10 45.0 cm^2 (to the nearest 0.1 cm^2)

23 Linear equations 2

B Forming equations to solve word problems (p 80)

1 **(a)** Pile B: $2x$
Pile C: $x - 6$
(b) $4x - 6$
(c) $4x - 6 = 94$; $x = 25$ so there are 25 stones in pile A.

2 **(a)** **(i)** $6t$ **(ii)** $3(t + 5)$ or $3t + 15$
(b) **(i)** $12t + 15 = 207$; $t = 16$
(ii) Pencil: 16p, rubber: 21p, sharpener: 48p

3 **(a)** $3b + 2 = 2b + 14$; $b = 12$ **(b)** 38

4 Greg is 10 years old and Eve is 3 years old.

C Mixed questions (p 81)

1 $^{-}5$

2 Angle A is 60°, angle B is 100°, angle C is 20°

3 40 cm

4 $3n + 2 = 185$; $n = 61$ so Sam ate 61 bananas.

5 $\frac{5(2x-1)}{2} = 40$; $x = 8.5$

6 **(a)** $3n + 2$
(b) 166th
(c) The equation $3n + 2 = 700$ does not have a whole-number solution ($n = 232\frac{2}{3}$) so 700 is not a term in this sequence. Alternatively, $700 - 2 = 698$ and 698 is not a multiple of 3 so 700 is not a term in this sequence.

24 Loci and constructions

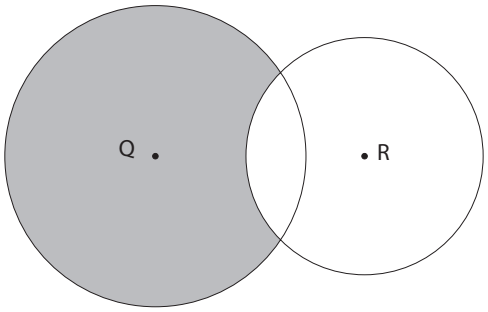
A The locus of points a fixed distance from a point or line (p 82)

1

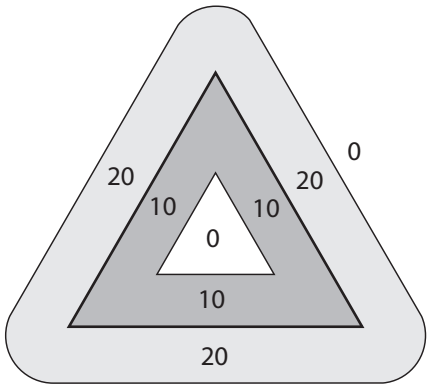
2 **(a)** Circle, radius 5 cm and centre Q

(b) Circle, radius 4 cm and centre R

(c) Shaded region as below



3



B The locus of points equidistant from two points

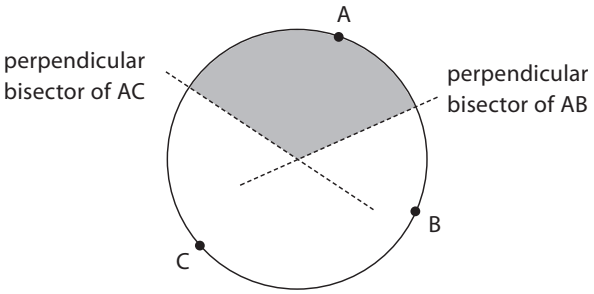
C The shortest route from a point to a line (p 82)

1 **(a)** A circle with any two points P, Q marked on the circumference and the perpendicular bisector of PQ constructed

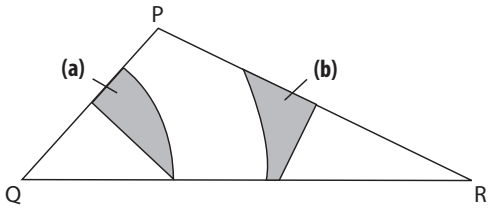
(b) Any two points R, S marked on the circumference with the perpendicular bisector of RS constructed

(c) The two constructed lines are diameters of the circle and meet at the centre O.

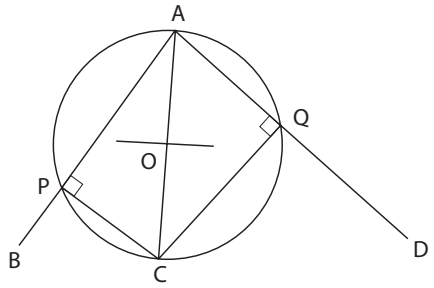
2



3



4



The circle should also pass through P and Q.

5 **(a)** The triangle with the line AD constructed, perpendicular to BC with D on BC.

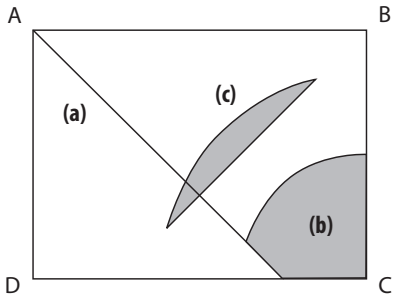
(b) AD = 7.1 cm to the nearest 0.1 cm, if drawn accurately. Area = 42.6 cm

(c) If you use this perpendicular to find the area you will use AB (8 cm) as the base. But AB is $\frac{2}{3}$ of BC. So the perpendicular needs to be 1.5 times AD to compensate (since $\frac{2}{3} \times 1.5 = 1$) and give the same area for the triangle.

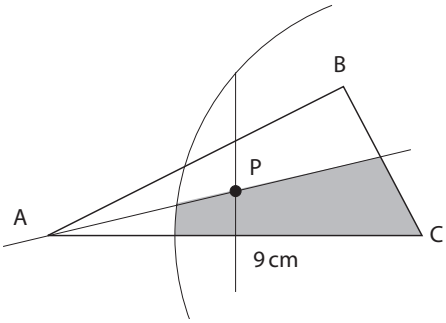
(d) The perpendicular should be 10.7 cm long to the nearest 0.1 cm, which is 1.5 times as long as 7.1 cm.

D The locus of points equidistant from two lines (p 84)

1



2



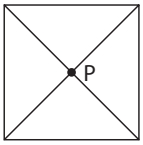
3 These are ways the angles can be constructed. There are other ways.

(a) Construct an equilateral triangle. Extend one side to make an exterior angle of 120°.

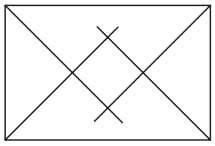
(b) Construct an angle of 90°. Bisect the angle then bisect one of the 45° angles.

(c) Construct an equilateral triangle to get a 60° angle. Bisect and bisect again to get 15°. Add on a construction of a 90° angle.

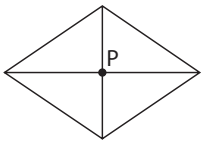
4 For a quadrilateral to contain such a point, all four angle bisectors must meet at the point.

(a) 

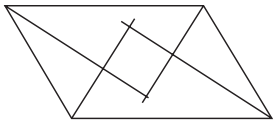
It could be a square.

(b) 

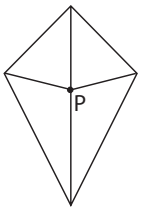
It could not be a rectangle that is not a square.

(c) 

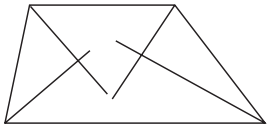
It could be a rhombus.

(d) 

It could not be a parallelogram that is not a rhombus or a square.

(e) 

It could be any kite.

(f) 

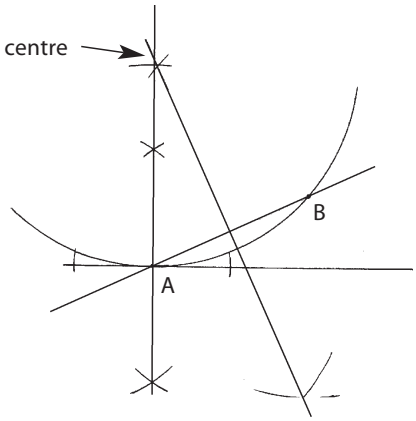
It could not be a trapezium that is not a rhombus or a square.

E The perpendicular from a point on a line (p 84)

1 The key steps in the construction are

- drawing a line from A, perpendicular to the tangent
- drawing the perpendicular bisector of AB

The centre is where the two lines meet.



25 Equations of linear graphs

A Gradient and intercept of a linear graph

B Finding the equation of a graph (p 85)

1 **(a)** **(i)** Gradient 2, y-intercept $^{-}2$
(ii) $y = 2x - 2$
(b) **(i)** Gradient 3, y-intercept 6
(ii) $y = 3x + 6$
(c) **(i)** Gradient $^{-}2$, y-intercept 2
(ii) $y = {}^{-}2x + 2$

2 $y = {}^{-}10x + 4$

3 Points (1, 9) and ($^{-}2$, $^{-}3$) plotted and joined.
The line has equation $y = 4x + 5$.

4 **(a)** **(i)** 3.5 **(ii)** $y = 3.5x - 6$
(b) **(i)** 7.5 **(ii)** $y = 7.5x + 10$
(c) **(i)** $^{-}1.5$ **(ii)** $y = {}^{-}1.5x + 6$

5 **(a)** Gradient 12, y-intercept $^{-}20$
(b) Gradient 1, y-intercept 7
(c) Gradient $^{-}6$, y-intercept $^{-}1$

6 $y = 1.5x + 7$

7 $y = 5 - 9x$

8 A: S B: Q C: P D: R

9 $y = 2x + 4$

10 $y = 9x - 5$

11 **(a)** Drawing of $y = {}^{-}3x + 4$ **(b)** $y = {}^{-}3x + 4$

C Equation of a line through two given points (p 86)

1 **(a)** $y = x + 4$ **(b)** $y = {}^{-}x + 6$
(c) $y = 4x + 54$ **(d)** $y = {}^{-}2x + 70$

2 **(a)** A sketch graph **(b)** $C = \frac{1}{2}T + 10$
(c) £10 **(d)** £115

D Fractional gradient (p 87)

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

2 **A** **(i)** $\frac{1}{2}$ **(ii)** 3 **(iii)** $y = \frac{1}{2}x + 3$
B **(i)** $\frac{1}{3}$ **(ii)** 1 **(iii)** $y = \frac{1}{3}x + 1$
C **(i)** $\frac{3}{2}$ **(ii)** $^{-}4$ **(iii)** $y = \frac{3}{2}x - 4$
D **(i)** $\frac{^{-}1}{2}$ **(ii)** 5 **(iii)** $y = \frac{^{-}1}{2}x + 5$
E **(i)** $\frac{^{-}3}{4}$ **(ii)** 3 **(iii)** $y = \frac{^{-}3}{4}x + 3$
F **(i)** $\frac{^{-}2}{3}$ **(ii)** $^{-}1$ **(iii)** $y = \frac{^{-}2}{3}x - 1$

3 $y = \frac{1}{2}x - 1$

4 **(a)** $y = \frac{2}{5}x + 2$ **(b)** $y = \frac{5}{3}x - 5$ **(c)** $y = \frac{^{-}5}{6}x + 5$

5 **(a)** A and F, B and G, C and E
(b) D

6 QR: $y = \frac{^{-}1}{5}x + 24$; PQ: $y = 5x - 80$; RS: $y = 5x - 236$

E Rearranging the equation of a graph (p 87)

1 **(a)** 1 **(b)** 2 **(c)** $^{-}1$ **(d)** 4 **(e)** $^{-}5$ **(f)** 3

2 A and C, B and F, D and E

3 **(a)** Gradient 3, y-intercept $^{-}2$
(b) Gradient $^{-}3$, y-intercept 2
(c) Gradient 3, y-intercept 2
(d) Gradient $^{-}4.5$, y-intercept 2
(e) Gradient $\frac{1}{5}$, y-intercept $^{-}2$
(f) Gradient $\frac{1}{2}$, y-intercept $\frac{3}{4}$
(g) Gradient 2, y-intercept $^{-}10$
(h) Gradient $\frac{1}{3}$, y-intercept 3

4 **(a)** A and F **(b)** B and D

5 $4x + 3y = 7$

F Perpendicular lines (p 88)

1 $^{-}2$

2 **(a)** $\frac{^{-}1}{4}$ **(b)** $y = \frac{^{-}1}{4}x + 7$

3 **(a)** $y = \frac{^{-}1}{2}x - 3$ **(b)** $y = \frac{1}{5}x + 6$ **(c)** $y = {}^{-}3x + 6$
(d) $y = \frac{4}{3}x + 4$ **(e)** $y = x + 2$

4 **(a)** Q: (0, 2); R: (4, 0)
(b) PQ: $y = 2x + 2$; RS: $y = 2x - 8$; PS: $y = \frac{^{-}1}{2}x - \frac{1}{2}$

5 **(a)** $y = {}^{-}2x + 13$ **(b)** $y = \frac{3}{7}x - 3$ **(c)** $y = \frac{^{-}6}{5}x + 8$

G Line of best fit (p 89)

1 **(a)** 10 **(b)** 3 **(c)** $v = 10t + 3$
(d) 53 m/s **(e)** 3 m/s

2 **(a)** Points plotted for the data with line of best fit
The equation is approximately $y = 0.7x - 4$
(b) **(i)** About 42 cm **(ii)** About 135 cm
(c) The first estimate as it lies in the range of the data

Mixed practice 4 (p 90)

1 **(a)** $y = 2x - 1$ **(b)** $y = {}^{-}\frac{1}{3}x + 2$

2 **(a)** 4.5×10^{8} **(b)** 2.7×10^{7}
(c) 4.83×10^{-5} **(d)** 7.2×10^{-3}

3 **(a)** 3.6 cm **(b)** 29.0° **(c)** 6.2 cm

4 Gradient is $\frac{3}{2}$ or 1.5, y-intercept is 4

5 **(a)** Accurate triangle with side lengths 8 cm, 7.5 cm and 6 cm
(b) **(i)** Perpendicular bisector of BR constructed
(ii) Perpendicular bisector of ER constructed
(c) Intersection of the perpendicular bisectors marked with an X; 8.4 km

6 **(a)** 260 000 **(b)** 48 660 000
(c) 0.0366 **(d)** 0.000 000 048 6

7 1.82 m (to the nearest 0.01 m)

8 20 cm

9 $5n - 2$

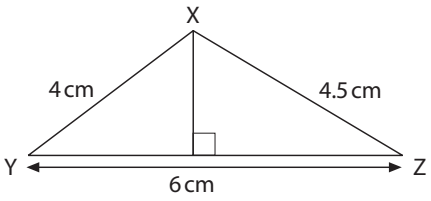
10 **(a)** 5.3×10^{8} **(b)** 4.6×10^{13} **(c)** 4.7×10^{-11}

11 **(a)** Sally: $3x$; Billy: $x - 4$
(b) $5x - 4 = 56$; $x = 12$
Molly is 12; Sally is 36; Billy is 8.

12 2.9 m (to the nearest 0.1 m)

13 **(a)** $y = 5x + 2$
(b) $y = {}^{-}\frac{1}{2}x + 4$ or $x + 2y = 8$
(c) $y = {}^{-}x + 2$ or $x + y = 2$
(d) $y = \frac{5}{3}x + 2$ or $3y - 5x = 6$

14 **(a)** Full-size drawing of XYZ below with the perpendicular constructed as shown



(b) 9 cm^2 (to the nearest cm^2)

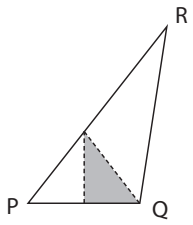
15 **(a)** $\frac{5}{18}$ **(b)** $\frac{1}{6}$

16 **(a)** 1400 cm^2 **(b)** 80.6 cm (or 81 cm)
(c) 34.7 cm (or 35 cm)

17 3 950 000 000 (to 3 s.f.)

18 14

19



20 $4x = 6x - 16$, $x = 8$
The dimensions of the rectangle are 4 cm by 12 cm.

21 17.0 m (to 3 s.f.)

22 Anil is 11; his dad is 43.

23 **(a)** 4.03×10^{5} **(b)** 1×10^{11} **(c)** 3×10^{6}

24 $3x^2$

25 **(a)** 48 **(b)** B is greater $\left(\frac{7}{16} > \frac{5}{12}\right)$
(c) 13

26 Quadratic expressions and equations

A Multiplying out expressions such as $(x + 1)(x + 3)$
C Multiplying out expressions such as $(x + 1)(x - 3)$ and $(x - 1)(x - 3)$ (p 93)

1 **(a)** $n^2 + 5n + 6$ **(b)** $n^2 + 8n + 7$
(c) $n^2 + 8n + 16$ **(d)** $n^2 + 5n - 6$
(e) $n^2 + 6n - 27$ **(f)** $n^2 - 3n + 2$
(g) $x^2 - 3x - 10$ **(h)** $x^2 - 4x - 12$
(i) $x^2 - 8x + 15$ **(j)** $x^2 - 1$
(k) $x^2 - 100$ **(l)** $x^2 - 18x + 81$

2 **(a)** $p^2 + 6p + 8$ **(b)** $s^2 + 2s - 3$

3 **(a)** Equation: $n = -6$

(b) Identity: $(n - 8)(n - 4) = n^2 - 4n - 8n + 32$
$= n^2 - 12n + 32$

(c) Identity: $(n + 5)(n - 2) = n^2 - 2n + 5n - 10$
$= n^2 + 3n - 10$
and $n(n + 3) - 10 = n^2 + 3n - 10$
so $(n + 5)(n - 2) = n(n + 3) - 10$

(d) Equation: $n = 3$

4 **(a)** 6, 8, 10 **(b)** 5, 12, 13

D Factorising quadratic expressions (p 93)

1 **(a)** $(n + 1)(n + 6)$ **(b)** $(n + 3)(n + 8)$
(c) $(n + 4)(n + 6)$ **(d)** $(n + 1)(n + 8)$
(e) $(n + 3)(n + 6)$ **(f)** $(n + 6)(n + 8)$
(g) $(n + 7)(n + 7)$ **(h)** $(n + 1)(n + 49)$
(i) $(n + 20)(n + 30)$

2 **(a)** $(n - 1)(n - 4)$ **(b)** $(n + 7)(n - 1)$
(c) $(n + 1)(n - 3)$ **(d)** $(n + 4)(n - 1)$
(e) $(n - 1)(n - 8)$ **(f)** $(n + 6)(n - 2)$
(g) $(x - 4)(x - 5)$ **(h)** $(x + 1)(x - 7)$
(i) $(x + 4)(x - 6)$ **(j)** $(x - 3)(x - 7)$
(k) $(x + 8)(x - 2)$ **(l)** $(x - 2)(x - 5)$
(m) $(x - 2)^2$ **(n)** $(x - 6)^2$
(o) $(x - 9)^2$

3 **(a)** $(x + 9)(x - 9)$ **(b)** $(y + 6)(y - 6)$
(c) $(n + 11)(n - 11)$

4 **(a)** $(n + 3)(n - 3)$
(b) **(i)** 40 **(ii)** 160 **(iii)** 9400

5 **(a)** $(n + 2)(n + 3)$
(b) $(n + 2)(n + 3)$ is the product of two consecutive integers. One of these must be even so the product will be even.

6 **(a)** 16, 25, 36, 49, 64
(b) $n^2 + 6n + 9 = (n + 3)^2$ which is a square so every term in the sequence must be a square number.

7 **(a)** $(n + 4)(n + 5)$
(b) **(i)** 90 **(ii)** 0 **(iii)** 0

E Solving quadratic equations (p 94)

1 **(a)** $x = 2, 3$ **(b)** $x = 0, 7$ **(c)** $x = -5, 6$
(d) $x = -7, 0$ **(e)** $x = -7, -3$ **(f)** $x = -5, -3$
(g) $x = 4, 6$ **(h)** $x = -1, 4$ **(i)** $x = -4, 2$
(j) $x = -5, -4$ **(k)** $x = -4, 5$ **(l)** $x = 4, 5$

2 **(a)** $x = -4, -2$ **(b)** $x = -3, -1$ **(c)** $x = -6, -3$
(d) $x = 3, 6$ **(e)** $x = 4, 8$ **(f)** $x = -8, -4$
(g) $x = 2, 10$ **(h)** $x = 2, 8$ **(i)** $x = -2, 5$
(j) $x = -1, 5$ **(k)** $x = 0, 2$ **(l)** $x = -6, 2$

F Graphs and the solutions of quadratic equations (p 95)

1 **(a)** **(i)** $(x + 3)(x + 5)$ **(ii)** $(x - 3)(x - 5)$
(iii) $(x - 4)(x - 6)$
(b) P: X Q: Y R: Z

2 **(a)** $-1, -4$ **(b)** 0, 7 **(c)** 2, 8
(d) $-1, 4$ **(e)** $-2, 2$ **(f)** $-4, 3$

3 Q

4 Sketches of parabolas through
(a) $(-5, 0)$, $(-1, 0)$ and $(0, 5)$
(b) $(-3, 0)$ and $(0, 0)$
(c) $(0, 10)$, $(2, 0)$ and $(5, 0)$
(d) $(0, 49)$ and just touching the x-axis at $(7, 0)$
(e) $(-1, 0)$, $(0, -7)$ and $(7, 0)$
(f) $(-5, 0)$, $(0, -25)$ and $(5, 0)$

G Solving problems (p 96)

1 **(a)** Area = length × width
So $(x + 5)(x + 3) = 63$
so $x^2 + 8x + 15 = 63$
so $x^2 + 8x - 48 = 0$ as required

(b) $x = -12, 4$
Length is 9 cm, width is 7 cm

2 **(a)** Area of square is x^2
Area of rectangle is $2(x + 3) = 2x + 6$
So $x^2 = 2(2x + 6)$
so $x^2 = 4x + 12$
so $x^2 - 4x - 12 = 0$ as required

(b) $x = -2, 6$
Perimeter is 24 cm

3 (a) Dividing the path into two rectangles by a vertical line gives one rectangle with area $5x$ and another with an area of $x(x + 4)$. This gives the equation $x(x + 4) + 5x = 36$.
Alternatively, dividing the path into two rectangles by a horizontal line gives one rectangle with area $4x$ and another with an area of $x(x + 5)$. This gives the equation $x(x + 5) + 4x = 36$.

(b) $x(x + 4) + 5x = 36$ simplifies to $x^2 + 4x + 5x = 36$
$x(x + 5) + 4x = 36$ simplifies to $x^2 + 5x + 4x = 36$
Both simplify to $x^2 + 9x - 36 = 0$.

(c) $x = {}^{-}12, 3$ so the width of the path is 3 m.

4 (a) 20 cm **(b)** 70 cm

5 12, 16, 20

6 (a) 35 **(b)** 15th

27 Handling secondary data

A Drawing conclusions from data (p 97)

1 2004 prices are used to make comparisons possible. Prices in general rise from year to year (this is called 'inflation'), so £1 ten years ago would have bought more than it does now.

2 (a) £1 399 000 000 **(b)** 28.9% (to the nearest 0.1%)

3 (a) Accidents involving serious injury; costs fell by nearly a half.

(b) 47.6% (to the nearest 0.1%)

4 The conclusion is not justified. Cars are the most numerous type of vehicle, so even if the risk were the same in every type of vehicle, one would expect more accidents involving cars than any other type.

B Percentages from a two-way table
E Using more than one table (p 98)

1 51.7% (to the nearest 0.1%)

2 38.6% (to the nearest 0.1%)

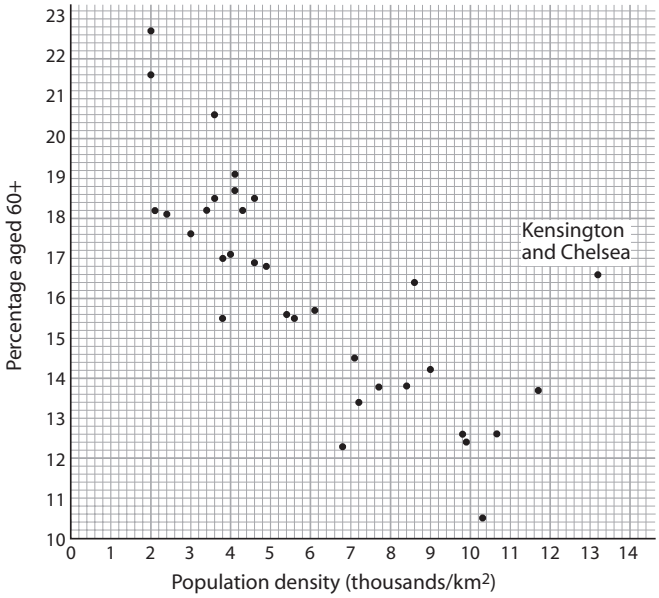
3 Inner 8.67, outer 3.52 (both to 2 d.p.)
The population density of Inner London is more than double that of Outer London.

4 (a)

	Percentage in age group				
	0–19	20–39	40–59	60–79	80+
Inner London	24.0	41.3	20.9	11.2	2.6
Outer London	25.4	32.0	24.6	14.2	3.8

(b) The percentage of the population in the 20–39 age group is much higher in Inner than Outer London. Outer London has a slightly higher percentage of 0–19-year-olds and a higher percentage of over-40s.

5 (a), (b) The individual population densities and percentages aged 60+ are shown in this scatter diagram.



(c) There is a negative correlation between the percentage aged 60+ and population density.

(d) Kensington and Chelsea

28 Solving inequalities

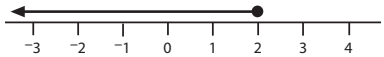
A Review: writing and interpreting inequalities (p 100)

1 (a) $3 < \pi$ **(b)** $7 > \sqrt{7}$ **(c)** $4^2 > 9$ **(d)** $3 < \sqrt{10}$

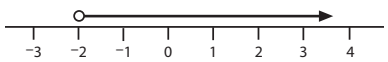
2 (a) $x \leq 3$ **(b)** $x > 3$

(c) $0 < x \leq 4$ **(d)** $-2 < x < 1$

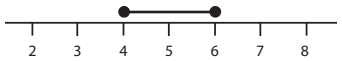
3 (a)



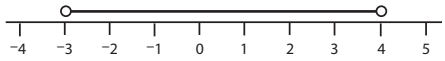
(b)



(c)



(d)



4 (a) 0, 1, 2, 3, 4, 5 **(b)** 2, 3, 4, 5

(c) 0, 1, 2 **(d)** $-3, -2, -1, 0, 1, 2, 3, 4$

5 $-2, -1, 0, 1, 2$

6 (a) (i) $a < 90$ **(ii)** $a > 180$

(b) (i) Acute **(ii)** Reflex

7 $w \leq 60$

B Manipulating inequalities

C Solving simple inequalities (p 100)

1 B, C, D and E

2 A and C

3 $3x \geq 9$ and $3 \leq x$ $x + 4 \leq 6$ and $x \leq 2$

$x \geq 2$ and $x - 1 \geq 1$ $\frac{x}{3} \leq 1$ and $x \leq 3$

4 (a) $n \leq 8$ **(b)** $m \geq 10$ **(c)** $g \leq 6$ **(d)** $h < 12$

(e) $x \geq -6$ **(f)** $y > 3\frac{1}{2}$ **(g)** $w < 4\frac{1}{2}$ **(h)** $p \leq 11$

5 $x \geq 5$

6 (a) $w \geq 5$ **(b)** $x \leq 4$

(c) $y > 4$ **(d)** $z \leq 5\frac{1}{2}$

(e) $x < -7$ **(f)** $h > 2$

(g) $t \leq -3$ **(h)** $n \geq -2$

(i) $k > 2$ **(j)** $f > -4$

(k) $x < 1\frac{1}{2}$ **(l)** $b \leq -4$

(m) $k > 2$ **(n)** $v \leq 1$

(o) $n \geq \frac{7}{5}$ or $1\frac{2}{5}$ or 1.4 **(p)** $h \geq -1\frac{1}{2}$

7 (a) $w \geq 2$ **(b)** $x < 4$ **(c)** $y > 3\frac{1}{2}$ **(d)** $x \leq 1$

8 (a) $b < 12$ **(b)** $a \geq 28$ **(c)** $x < -4$ **(d)** $n \leq -8$

(e) $k \geq 7$ **(f)** $p < 29$ **(g)** $h > 4$ **(h)** $m \leq -4$

D Unknown on both sides

E Multiplying or dividing by a negative number (p 101)

1 **(a)** $x < 4$ **(b)** $y > 2$ **(c)** $z \geq 4$
(d) $m < 4$ **(e)** $n \leq 3$ **(f)** $p > 2\frac{1}{2}$
(g) $q \leq 4$ **(h)** $w < 2$ **(i)** $k \geq 1\frac{1}{2}$
(j) $g > 8$ **(k)** $h \leq -2$ **(l)** $b \leq 6$
(m) $c > 3\frac{1}{2}$ **(n)** $d < -1$ **(o)** $a \geq -2\frac{1}{2}$

2 **(a)** $x \geq 6$ **(b)** $y \leq 2$ **(c)** $z \geq 1$
(d) $m < 9$ **(e)** $n \leq 4$ **(f)** $p > 3$

3 **(a)** $q \leq 4$ **(b)** $w > 3$ **(c)** $k < 6$
(d) $m \geq -3$ **(e)** $h \geq 2$ **(f)** $a \geq 4$
(g) $b \geq 4$ **(h)** $c > 4$ **(i)** $d > 3$
(j) $k > \frac{4}{5}$ or 0.8 **(k)** $p \geq -3$ **(l)** $x > 3\frac{1}{2}$

4 **(a)** $n > 3$ **(b)** $n \leq -1$ **(c)** $n < 8$
(d) $n > 7$ **(e)** $n > 7$ **(f)** $n \geq 2\frac{1}{2}$

5 **(a)** $x < 3$ **(b)** $t \geq -4$ **(c)** $r \leq 1\frac{1}{2}$
(d) $p < 5$ **(e)** $d \leq 2$ **(f)** $f < 3$
(g) $n \leq 3$ **(h)** $w \leq 2$ **(i)** $z > 3$
(j) $x > -2$ **(k)** $m \geq 1$ **(l)** $k < \frac{2}{5}$ or 0.4

6 **(a)** $n \geq 5$ **(b)** $n > 8$ **(c)** $n \leq -2$

F Combined inequalities (p 102)

1 $2 < x \leq 9$

2 **(a)** $3 \leq n < 7$ **(b)** $3 < n < 7$ **(c)** $4 < n \leq 5$
(d) $2 \leq n \leq 4$ **(e)** $4 < n < 8$ **(f)** $4 \leq n < 9$
(g) $-1 \leq x < 9$ **(h)** $2\frac{1}{2} < x \leq 5$ **(i)** $3 \leq x < 6$
(j) $1 < x < 4$ **(k)** $2 < x \leq 3$ **(l)** $-1 \leq x \leq 2\frac{1}{2}$

3 **(a)** $4 \leq x < 7$ **(b)** 4, 5, 6

4 **(a)** 3, 4, 5, 6, 7, 8 **(b)** 6, 7, 8, 9, 10
(c) 22, 23, 24, 25, 26 **(d)** 0, 1, 2, 3, 4
(e) 3, 4 **(f)** 4, 5, 6, 7

5 $-1 \leq x < 5$

6 Five integers from the set 2, 3, 4, 5, −2, −3, −4, −5

29 Simultaneous equations

B Solving equations 1 (p 103)

1 **(a)** $x = 2, y = 3$ **(b)** $x = 1, y = 3$
(c) $x = 4, y = 3$ **(d)** $x = 3, y = 1$
(e) $x = 2, y = 5$ **(f)** $x = 2, y = 6$
(g) $x = 1, y = 2$ **(h)** $x = 3, y = 3$
(i) $x = 7, y = 1$

2 **(a)** $x = 1.5, y = 3$ **(b)** $a = 4, b = -1$
(c) $m = -2, n = 5$ **(d)** $h = 3, k = -1$
(e) $p = 3, q = -2$ **(f)** $c = 2.5, d = 1$
(g) $u = 4, v = -2$ **(h)** $w = 2.5, z = 1.5$
(i) $f = 5, g = -3$

C Forming and solving equations (p 103)

1 **(a)** B
(b) $c = 150, h = 200$
A cheese sandwich costs £1.50.
A ham sandwich costs £2.00.

2 $3g + 5c = 335$
$9g + 3c = 705$
$g = 70, c = 25$
A gel pen costs 70p.
A coloured pencil costs 25p.

3 A bag of jelly beans weighs 130 g.
A bag of chocolate raisins weighs 140 g.

4 20

5 64 £1 coins and 36 50p coins

D Solving equations 2

E Substitution (p 104)

1 **(a)** $x = 10, y = 6$ **(b)** $x = 3, y = 1$
(c) $x = 7, y = 2$ **(d)** $x = 4, y = 3$
(e) $x = 5, y = 2$ **(f)** $x = 5, y = 3$
(g) $x = 8, y = 3$ **(h)** $x = 4, y = 5$
(i) $x = 20, y = 4$

2 **(a)** $x = 5, y = 1.5$ **(b)** $x = 1, y = -2$
(c) $x = 1.5, y = 0.5$ **(d)** $x = 15, y = -4$
(e) $x = 2, y = -1$ **(f)** $x = -1, y = 2$
(g) $x = 3.5, y = 1.5$ **(h)** $x = 2.5, y = -0.5$
(i) $x = -3, y = -4$

3 **(a)** $x = 5, y = 2$ **(b)** $h = 4, k = 2$
(c) $a = 2, b = 1$ **(d)** $m = \frac{7}{3}, n = \frac{-4}{3}$
(e) $p = 3, q = 2$ **(f)** $u = -1, v = -1$

4 $a = 30, b = 12$

5 **(a)** $x = 4, y = 11$ **(b)** $x = 1, y = 4$
(c) $x = 2.5, y = 4$ **(d)** $x = 1, y = \frac{1}{3}$
(e) $x = 1, y = -7$ **(f)** $x = 2, y = -5$

F Graphs and simultaneous equations (p 105)

1 **(a)** $x = 3, y = 7$ **(b)** $x = 1, y = 3$
(c) $x = 11, y = -1$

2 (2.5, 7.5)

3 **(a)** An estimate close to (1.7, 0.5)
(b) $\left(\frac{5}{3}, \frac{7}{15}\right)$

4 (3, 3)

5 An explanation that refers to graphs is:
'The first equation can be rearranged to $y = 4x + 1$ and the second can be rearranged to $y = 4x + 1.5$. The gradients of both lines are 4. The y-intercepts are 1 and 1.5 respectively. Hence we have distinct parallel lines that do not intersect.'
An algebraic explanation is:
'The second equation can be rearranged to $y - 4x = 1.5$ and subtraction leads to the contradiction $0 = 1.5$ (or $0 = -1.5$), showing that there is no solution to the simultaneous equations.'

6 By subtracting $\frac{1}{4}x$ from each side and multiplying each side by 4, the first equation becomes to $4y - x = 12$, which is the same as the second equation. As the equations give the same straight line there are infinitely many solutions to this pair of simultaneous equations (each point on the line representing a solution).

G Mixed questions (p 106)

1 **(a)** $x = 3, y = 2$ **(b)** $a = -1, b = 4$
(c) $h = 3, k = -2$ **(d)** $m = \frac{1}{4}, n = -\frac{3}{2}$
(e) $p = \frac{4}{5}, q = \frac{1}{10}$ **(f)** $x = 11, y = 28$

2 15p

3 2.8 kg of red potatoes and 3.2 kg of white potatoes

4 The length is 1 m and the width is 0.6 m.

5 2500

6 33 and 69

7 18 000

8 $\frac{3}{8}$

30 Sine and cosine

A Finding the adjacent or opposite side from the hypotenuse and angle (p 107)

1 **(a)** Opposite, 7.7 cm **(b)** Adjacent, 9.9 cm
(c) Adjacent, 5.4 cm **(d)** Opposite, 7.4 cm
(e) Adjacent, 7.5 cm **(f)** Adjacent, 8.0 cm
(g) Opposite, 9.1 cm **(h)** Opposite, 8.5 cm

B Finding the hypotenuse from another side and an angle (p 107)

1 **(a)** 10.5 cm **(b)** 13.3 cm **(c)** 9.9 cm **(d)** 11.4 cm
(e) 14.4 cm **(f)** 13.8 cm **(g)** 12.1 cm **(h)** 13.0 cm

C Finding an angle (p 108)

1 $a = \sin^{-1}\left(\frac{3}{5}\right) = 36.9°$ (to 1 d.p.)
$b = \cos^{-1}\left(\frac{7}{8}\right) = 29.0°$
$c = \sin^{-1}\left(\frac{7}{8}\right) = 61.0°$
$d = \cos^{-1}\left(\frac{3}{5}\right) = 53.1°$

2 $a = 29.1°$, $b = 33.6°$, $c = 51.8°$, $d = 50.6°$, $e = 18.8°$

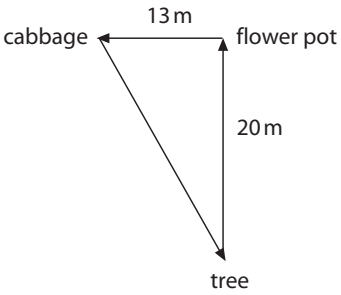
D Mixed questions, including tangent and Pythagoras (p 108)

1 **(a)** 32.0° **(b)** 28.4° **(c)** 28.8 cm **(d)** 27.6 cm
(e) 143.0 cm **(f)** 36.3° **(g)** 10.2 cm **(h)** 9.7 cm
(i) 30.2 cm **(j)** 2.4 cm

2 **(a)** 35° (to the nearest degree)
(b) 154 cm (to the nearest cm)

3 **(a)** 31 m (to the nearest metre)
(b) 96 m (to the nearest metre using the unrounded value for part (a))

4



(a) 23.85 m (to the nearest centimetre)
(b) 147° (to the nearest degree)

5 8.57 m (to the nearest centimetre)

6 **(a)** 59.0° **(b)** 121.0° **(c)** 5.8 cm

7 8.0 cm

Mixed practice 5 (p 110)

1 **(a)** $x^2 + 5x + 6$ **(b)** $x^2 + 6x + 9$
(c) $x^2 + 2x - 15$ **(d)** $x^2 - 9x + 20$

2 **(a)** 42.2% **(b)** 36.5%
(c) 46.2% (all to the nearest 0.1%)

3 **(a)** $x \leq 5$ **(b)** $x > {}^{-}3$
(c) $x > 2\frac{1}{2}$ or 2.5 **(d)** $x \geq 2$

4 Using £a for the cost of an adult ticket and £c for the cost of a child ticket, we have
$3a + 5c = 26$
$2a + 6c = 24$
The cost of a child ticket is £2.50.
The cost of an adult ticket is £4.50.

5 **(a)** 5.9 cm **(b)** 3.7 cm **(c)** 30.6 cm

6 **(a)** $(x + 7)(x - 7)$ **(b)** $(x + 5)(x + 3)$
(c) $(x + 6)(x - 2)$ **(d)** $(x + 2)(x - 9)$

7 **(a)** 13.5 m
(b) 24.1 m (both to the nearest 0.01 m)

8 $5 \leq x < 7$

9 **(a)** $x = 5, y = 3$ **(b)** $x = 4, y = {}^{-}2$ **(c)** $x = {}^{-}2, y = 4$

10 **(a)** $x = {}^{-}1, {}^{-}2$ **(b)** $x = {}^{-}1, 6$ **(c)** $x = 3, 5$

11 **(a)** 31° (to the nearest 1°) **(b)** 86.5 cm^2

12 ${}^{-}1, 0, 1$

13 $(1, 2)$

14 **(a)** $x = 0, 1$ **(b)** $x = {}^{-}2, 3$ **(c)** $x = 2, 3$

15 **(a)** $x \geq 8$ **(b)** $x > 11$
(c) $x \geq {}^{-}\frac{1}{4}$ or ${}^{-}0.25$ **(d)** $x \geq {}^{-}\frac{2}{3}$

16 **(a)** $60 = 2^2 \times 3 \times 5$
(b) $48 = 2^4 \times 3$ so the lowest common multiple of 60 and 48 is $2^4 \times 3 \times 5 = 240$.
(c) $105 = 3 \times 5 \times 7$ so the highest common factor of 60 and 105 is $3 \times 5 = 15$.

17 **(a)** The area of the rectangle is length × width so the area is $(x + 6)(x - 2)$ cm^2.
The area is 48 cm^2 so x satisfies the equation
$(x + 6)(x - 2) = 48$
so $x^2 - 2x + 6x - 12 = 48$
so $x^2 + 4x - 60 = 0$ as required
(b) $x = {}^{-}10, 6$ so, as we cannot have a negative length, we have $x = 6$.
(c) 12 cm by 4 cm

18 $x = 4, y = 4$

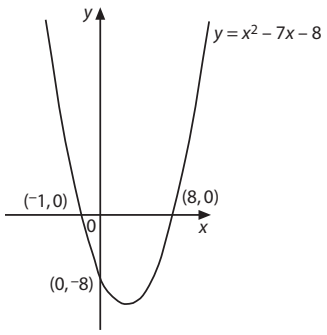
19 **(a)** $p - q$ **(b)** $4x^3y + 3x - 5xy^2$
(c) $a^2b + 2a^2c + 2bc$

20 **(a)** 8 cm **(b)** $\frac{2}{5}$ or 0.4 **(c)** 3.2 cm

21 $x = 3, 8$

22 ${}^{-}1, 0, 1, 2$

23

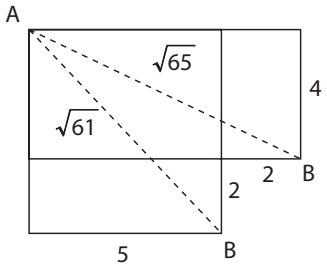


24 **(a)** **(i)** 6881 cm^3 (to the nearest whole cm^3)
(ii) 5.85 kg (to 3 s.f.)
(b) 0.735 g/cm^3 (to 3 s.f.)

25 12.5 ml with the method shown

26 8 hours

27 The shortest route corresponds to one of these straight lines on the net. The shorter of these routes is $\sqrt{61}$ cm or 7.8 cm (to the nearest 0.1 cm).



28 $2\frac{2}{3}$ minutes

29 The number of terminal zeros will be the same as the number of pairs of 2s and 5s in the prime factorisation. The number of 2s is greater than the number of 5s (every even number has 2 as a factor so there are at least 50 2s), so the number of terminal zeros is the same as the number of 5s. There are 20 numbers (5, 10, 15, … 100) with a factor of 5. In addition, 25, 50, 75 and 100 have an extra factor of 5.
So there are **24** terminal zeros.