1.1 Solving real-life problems

HOMEWORK 1A

1 25 × 12 = 300. 300 + 60 (20%) = 360. He buys 384 tiles, so he has enough.

2 No. £30 ÷ 85p = 35.29, so she can buy 35 packets of balloons, which is only 875.

3 Yes, the shop covers its costs, as 10% is £11, so £110 + £11 = £121 per TV. Rental is £3.50 × 40 weeks = £140 (£140 − £110 = £30 profit per TV).

4 27

5 £728

6 No. 860 ÷ 15 = 57.333... weeks, which is more than one year. Or: £860 ÷ 52 = £16.54 per week to save enough for one year. Or: £15 × 52 weeks = £780 saved in a year; £860 − £780 = £80 short. 80 ÷ £15 = 5.333 ... more weeks to save.

7 £2664

8 Mutya earns £84 each week. Neil earns £280 each week. Mutya will need to work for four weeks to earn over £280.

9 No, Mary is €30 short. She has enough money for only three presents.
£504 ÷ 36 = £14 per person per ticket. Mary has £150 − £14 = £136.
£136 × €1.25 = €170

10 1536

11 23

12 **a** £1000 **b** £912

13 **a** 24 m² **b** £12.50

14 28

15 Comparing over one year, 52 × 38 = 1976; 12 × 150 =1800 So stock is decreasing.

1.2 Multiplication and division with decimals

HOMEWORK 1B

1 **a** 3.3 **b** 0.09 **c** 64.816
d 81.95 **e** 512.1 **f** 954.67
g 9.4 **h** 7.914

2 **a** 0.25 **b** 7.56 **c** 5.04
d 1.68 **e** 3.9

3 **a** **i** 8 **ii** 8.88 **iii** 0.88
b **i** 15 **ii** 14.88 **iii** 0.12
c **i** 20 **ii** 21.42 **iii** 1.42
d **i** 21 **ii** 16.25 **iii** 4.75

4 **a** 240
b **i** 2.4 **ii** 2.4 **iii** 7.2

5 **a** 24.48 **b** Subtract 3.4 (answer 21.08)

6 **a** 17.25 **b** 48

7 **a** 43.68 **b** 78.6 **c** 29.92
d 188.25 **e** 867.2

8 **a** £22.08 **b** £5.76 **c** £31.50

9 20

10 **a** 16
b **i** 160 **ii** 0.16 **iii** 0.16

11 19.74 ÷ 2.1 (Answer 9.4. This is approximately 20 ÷ 2 = 10)

1.3 Approximation of calculations

HOMEWORK 1C

1 **a** 50 000 **b** 60 000 **c** 30 000
d 90 000 **e** 90 000 **f** 50
g 90 **h** 30 **i** 100
j 200 **k** 0.5 **l** 0.3
m 0.006 **n** 0.05 **o** 0.0009
p 10 **q** 90 **r** 90
s 200 **t** 1000

2 Hellaby: 850 to 949; Hook: 645 to 654; Hundleton: 1045 to 1054

3 **a** 6700 **b** 36 000 **c** 69 000
d 42 000 **e** 27 000 **f** 7000
g 2200 **h** 960 **i** 440
j 330

4 **a** 50 000 **b** 6200 **c** 89.7
d 220 **e** 8 **f** 1.1
g 730 **h** 6000 **i** 67
j 6 **k** 8 **l** 9.75
m 26 **n** 30 **o** 870
p 40 **q** 0.085 **r** 0.009 9
s 0.08 **t** 0.0620

5 95 or 96

6 650 − 549 = 101

7 63

HOMEWORK 1D

1 **a** 30 000 **b** 24 **c** 8
d 900 **e** 125 **f** 0.42
g 60 000 **h** 5600

2 **a** 200 **b** 40 **c** 800
d 40 000 **e** 15 000 **f** 2000
g 150 **h** 52 500

3 **a** 37 800 **b** 180

4 20 × 80 000 = 1 600 000; 6000 × 300 = 1 800 000; 500 × 7000 = 3 500 000; 10 000 × 900 = 9 000 000

5 100 000 km ($\frac{400000}{8}$ × 2; i.e. to and from Earth)

HOMEWORK 1E

1 **a** 28 000 **b** 42 000 **c** 210
d 20 000 **e** 2000 **f** 2100
g 5 **h** 9 **i** 700
j 75 **k** 50 **l** 8

2 **a** 600 **b** 10 **c** 1 **d** 40 **e** 30

3 **a** £4000 **b** £2000 **c** £1500

4 **a** £30 000 **b** £36 000

5 £1400

6 **a** 72 000 **b** 2000 **c** 1000
d 24 000 **e** 9900

7 Yes. £50 ÷ 250 = 20p per apple; he pays only £47 ÷ 250 = 18.8p per apple.

8 **a** 105 km **b** 450 km **c** 5000 km

9 6 litres

10 £10 (£20 ÷ 2)

11 **a** 1.6 m **b** 20 min **c** 3 kg
d 1.2 °C **e** 24 000

12 25 jars

13 65 minutes

14 £140 a day (45 weeks × 5 days a week = 225 days; £31 500 ÷ 225 = £140)

15 £217

16 I left home at 10 minutes past 2, and walked for 50 minutes.
The temperature was 13 °C. I could see an aeroplane overhead at 3000 feet. Altogether I walked three miles.

17 70 mph

1.4 Multiples, factors, prime numbers, powers and roots

HOMEWORK 1F

1 **a** 28, 36, 64, 56, 60 **b** 60, 15, 45
c 19, 43, 53, 29, 61 **d** 36, 60, 15, 45

2 3

3 **a** −6 **b** −9 **c** −10
d −30 **e** −19 **f** −13
g −15 **h** −1000 **i** −21
j −35

4 **a** 2 **b** 4 **c** 5
d 10 **e** 30 **f** −3
g −1 **h** −6 **i** −20
j −7

5

	Square number	Factor of 40
Cube number	64	8
Multiple of 5	25	20

6 2197 (13^3)

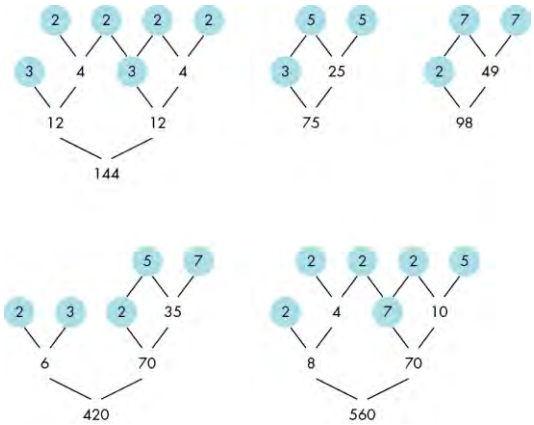
7 18

8 **a** ±0.6 **b** ±0.9 **c** ±1.3
d ±0.3 **e** ±0.1 **f** ±1.2
g ±1.5 **h** ±1.4 **i** ±2.1
j ±3.5

1.5 Prime factors, LCM and HCF

HOMEWORK 1G

1



2 **a** $2^4 \times 3$ **b** 2×3^3 **c** $2^3 \times 3^3$
d $2^3 \times 5^3$ **e** $3^3 \times 5^2$

3 **a** $2 \times 2 \times 3 \times 3$ **b** $2^2 \times 3^2$
c $18 = 2 \times 3^2$ and $72 = 2^3 \times 3^2$

4 **a** $7^2 \times 17^2$ **b** $7^3 \times 17^3$ **c** $7^{10} \times 17^{10}$

5 £3, £6, £9 or £6, £6, £6

6 Because 7 is the third odd prime number and is therefore a factor of 105.

HOMEWORK 1H

1 **a** 35 **b** 24 **c** 18
d 60 **e** 30 **f** 48
g 48 **h** 105

2 **a** 7 **b** 9 **c** 5
d 5 **e** 12 **f** 36
g 18 **h** 33

3 **a** x^5 **b** x^9 **c** x^7
d x^{10} **e** x^9

4 1355

5 1296

6 Three packs of nuts and two packs of bolts

7 15 and 150

1.6 Negative numbers

HOMEWORK 1I

1 **a** −68 **b** 68° **c** 6 × 4

2 **a** −8 **b** −18 **c** −35
d 12 **e** 16 **f** 7
g 4 **h** −5 **i** 2
j 2 **k** −21 **l** −18
m −28 **n** 27 **o** 14
p −7 **q** −4 **r** −5
s 5 **t** −25 **u** 24
v −7 **w** −63 **x** 6
y −56

3 **a** 2 **b** 3 **c** 2
d −7 **e** −10 **f** −12
g −12 **h** 30 **l** −8
j −4 **k** −4 **l** 3
m 3 **n** −12 **o** −9
p 32 **q** 15 **r** −48
s −12 **t** 52 **u** −11
v 48 **w** −1 **x** −20
y 1

4 **a** −5 **b** 6 **c** −10 **d** 20 **e** −15

5 −18 ÷ 12; 0.3 × (−2); −21 ÷ (−14); −0.5 × (−4)

HOMEWORK 1J

1 **a** −12 **b** −8 **c** 6 **d** 36
e 15 **f** 6 **g** 12 **h** −9

2 **a** 23 **b** −4 **c** −1 **d** −4
e −17 **f** 36 **g** −25 **h** −7

3 **a** 4 × (−3 + 2) = −4 **b** (−6 ÷ (−3)) + 2 = 4
c −6 ÷ (−3 + 2) = 6

4 **a** 4 **b** −49 **c** −8 **d** 50

5 **a** 159 **b** 2 **c** − 39 **d** 9

6 For example: −4 × 6 ÷ 8 = −3

7 For example: (1 + 2) × (3 − 6) = −9

8 (1 + 2) × (3 ÷ 4) − 5 = −2.75

2.1 One quantity as a fraction of another

HOMEWORK 2A

1 **a** $\frac{1}{4}$ **b** $\frac{1}{3}$ **c** $\frac{1}{2}$
d $\frac{7}{15}$ **e** $\frac{3}{7}$ **f** $\frac{1}{6}$

2 $\frac{3}{8}$

3 $\frac{8}{13}$

4 Mark saves $\frac{40}{120} = \frac{1}{3}$

Bev saves $\frac{60}{150} = \frac{2}{5}$ which is greater than $\frac{1}{3}$, so Bev saves the greater proportion of her earnings.

5 $\frac{7}{10} = \frac{14}{20}$, so Sally's mark is better.

6 $\frac{1}{5}$

7 34 to 37

2.2 Adding, subtracting and calculating fractions

HOMEWORK 2B

1 **a** $\frac{7}{10}$ **b** $\frac{5}{6}$ **c** $\frac{13}{30}$ **d** $\frac{17}{24}$
e $\frac{19}{20}$ **f** $\frac{11}{15}$ **g** $\frac{39}{40}$ **h** $\frac{9}{10}$

2 **a** $\frac{3}{4}$ **b** $\frac{1}{2}$ **c** $\frac{7}{10}$ **d** $\frac{7}{8}$

3 **a** $\frac{1}{8}$ **b** $\frac{3}{10}$ **c** $\frac{7}{15}$ **d** $\frac{7}{20}$

4 **a** $1\frac{3}{8}$ **b** $1\frac{1}{10}$ **c** $1\frac{1}{12}$

5 **a** $\frac{1}{12}$ **b** 36

6 $\frac{1}{10}$

7 13 125

8 97

9 $\frac{5}{12} + \frac{1}{4} + \frac{1}{3} = \frac{5}{12} + \frac{3}{12} + \frac{4}{12} = \frac{12}{12} = 1$

10 To make a 2-m pipe, use two $\frac{3}{4}$-m pipes and one $\frac{1}{2}$-m pipe.

2.3 Multiplying and dividing fractions

HOMEWORK 2C

1 **a** $\frac{1}{3}$ **b** $\frac{3}{10}$ **c** $\frac{3}{10}$ **d** $\frac{2}{7}$
e $\frac{5}{9}$ **f** $\frac{1}{5}$ **g** $\frac{7}{15}$ **h** $\frac{3}{20}$
i $\frac{1}{6}$ **j** $\frac{7}{20}$

2 **a** $\frac{3}{5}$ **b** $1\frac{3}{5}$ **c** $1\frac{1}{5}$ **d** $\frac{9}{14}$
e $2\frac{2}{3}$ **f** $1\frac{4}{11}$ **g** $4\frac{4}{7}$ **h** $4\frac{4}{5}$
i $4\frac{1}{8}$ **j** $2\frac{13}{16}$ **k** $1\frac{1}{4}$ **l** $\frac{64}{75}$

3 $2\frac{1}{4}$ km

4 $\frac{2}{5}$

5 $\frac{1}{20}$ metre

6 $\frac{1}{16}$

7 $\frac{1}{3}$

8 **a** 3 **b** $2\frac{1}{3}$ **c** 2 **d** $2\frac{1}{6}$
e $5\frac{1}{5}$ **f** $4\frac{2}{3}$ **g** $4\frac{1}{12}$ **h** 12

9 **a** $\frac{1}{5}$ **b** 7 **c** $\frac{5}{2}$ **d** $\frac{5}{9}$

10 **a** $-\frac{1}{3}$ **b** 4 **c** $-\frac{11}{7}$ **d** $\frac{5}{4}$

11 $\frac{2}{3}$ of $4\frac{2}{5} = 2\frac{14}{15}$

12 Yes: 66 litres

13 $\frac{1}{24}$

14 The first statement is inaccurate as two-thirds is not an exact number (of people).

15 400

16 48

17 15

18 80

19 $\frac{2}{15}$

20 4

21 23

22 **a** $\frac{3}{20}$ **b** $\frac{7}{16}$ **c** $\frac{1}{2}$
d 1 **e** $\frac{125}{176}$ **f** 1

2.4 Fractions on a calculator

HOMEWORK 2D

1 **a** $\frac{17}{12}$ **b** $\frac{3}{2}$ **c** $\frac{41}{40}$ **d** $\frac{29}{60}$ **e** $\frac{25}{24}$

2 **a** $7\frac{7}{20}$ **b** $7\frac{29}{30}$ **c** $7\frac{47}{48}$ **d** $2\frac{11}{24}$ **e** $2\frac{289}{560}$

3 $\frac{2628}{5375}$

4 $\frac{1}{3}$, $\frac{2}{3}$

5 **a** $\frac{9}{28}$ **b** $\frac{5}{33}$ **c** $\frac{3}{2}$
d $\frac{18}{5}$ **e** $\frac{75}{11}$ **f** $\frac{22}{65}$

6 **a** $8\frac{5}{8}$ **b** $110\frac{46}{55}$ **c** $96\frac{1}{4}$
d $2\frac{31}{145}$ **e** $2\frac{74}{305}$

7 $31\frac{9}{20}\,m^2$

8 36

2.5 Increasing and decreasing quantities by a percentage

HOMEWORK 2E

1 **a** 1.07 **b** 1.02 **c** 1.3 **d** 1.06 **e** 1.15

2 **a** 0.91 **b** 0.86 **c** 0.65 **d** 0.88 **e** 0.78

3 **a** £84 **b** 14.84 kg **c** £43.26

4 **a** 374 g **b** 67.2 m **c** £49.20

5 £35 568

6 15 336

7 907

8 £15

9 $\frac{6}{40}$ × 100 = 15

10 Items that costs £20 or less

11 **a** £18 **b** £120 **c** 440 m **d** £247
e 232 g **f** £327.25 **g** £39.69

12 £6384

13 2112

14 £459

15 No, he is £1.60 short. (£24 + £104 + £33.60 = £161.60)

16 Seven absentees

17 680 units

18 Goods are cheaper, for example, £100 + 10% = £100 + £10 = £110
£110 − 10% = £110 − £11.00 = £99.00

19 Students should show all workings for proof. See the answer to question 18.

2.6 Expressing one quantity as a percentage of another

HOMEWORK 2F

1 **a** 20% **b** 25% **c** 10% **d** 75%
e 80% **f** 46% **g** 33.3% **h** 30%
i 67.5% **j** 23.8%

2 **a** 75% **b** 37.5%

3 **a** 60% **b** 40%

4 29.3%

5 **a** Micro hi-fi system: 66.7%

b Mp3 player : 50.0%
c CD player : 50.0%
d Cordless headphones: 66.6%

6 Paul 33.3% ($\frac{10}{30} \times 100$), Val 39.2% ($\frac{11}{28} \times 100$)
Val has the greater percentage increase.

7 60

8 1000

9 Maths 84%, English 70%, Science 62.5%, French 45%

10 22%

3.1 Statistical representation

HOMEWORK 3A

1

Time in minutes	10 or less	Between 10 and 30	30 or more
Angle on pie chart	48°	114°	198°

2

GCSE passes	9 or more	7 or 8	5 or 6	4 or less
Angle on pie chart	40°	200°	100°	20°

3 **a** 25% **b** Rarely
c No, it only shows proportions.
d What is your age? How often do you exercise? How often do you see a doctor?

4 **a**

Main use	E-mail	Internet	Word processing	Games
Angle on pie chart	50°	130°	30°	150°

b Most used the computer for playing games and only a few used it for word processing.
c Not enough in sample, only a small age range of people, probably only boys, and so on.

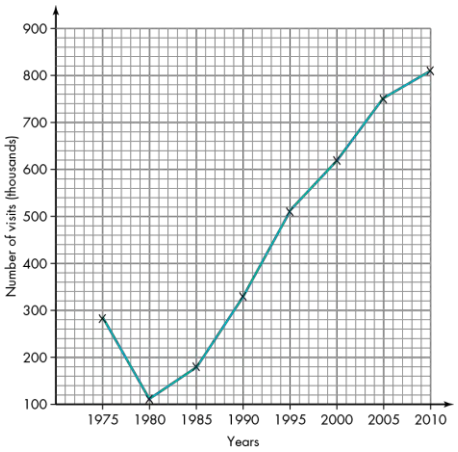
5 **a**

Type of programme	Comedy	Drama	Films	Soaps	Sport
Angle on pie chart	54°	33°	63°	78°	132°

b No; only asked people who are likely to have similar interests, such as sport.

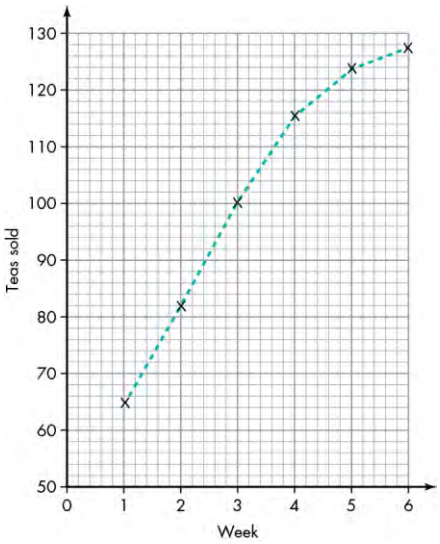
HOMEWORK 3B

1 **a**



b 700 000 **c** 1990−1995
d Reduction from 1975 to 1980, advent of video. Increase from 1980 to 2005, due to many multi-screen cinemas being developed.

2 **a**



b 128
c The same people keep coming back and tell others, but new customers each week becomes more difficult to find.

3 **a** Students should use a graph to estimate 600 g.
b It is outside the range of the data so we cannot be sure how the kitten will continue to grow.

4 All the temperatures were presumably higher than 10 degrees.

3.2 Statistical measures

HOMEWORK 3C

1 **a** **i** Mode 6, median 4, mean 4
ii Mode 15, median 15, mean 15.1
iii Mode 32, median 32, mean 33

b **i** Mean, balanced data
ii Mode, appears six times
iii Median, 46 is an extreme value

2 **a** Mode 135 g, median 141 g, mean 143 g
b Mean, takes all masses into account

3 **a** 71 kg **b** 70 kg
c Median, 53 kg is an extreme weight

4 **a** 59 **b** 54
c Median, the higher average

5 Kathy − mean, Connie − median, Evie − mode

6 **a** For example: 1, 4, 4
b For example: 1.5, 3, 4.5

7 The teacher might be quoting the mean, while the student might be quoting the mode.

HOMEWORK 3D

1 **a** Mode 16, median 15, mean 15.3
b Mode 5, median 5, mean 4.67

2 **a** 289 **b** 2 **c** 142 **d** 1.7

3 Find where the middle number of the data is located by dividing the total frequency (52) by two (26). The 26th value is three days a week and is the median.

4 **a** 256 **b** 3.53 **c** 72 **d** 28%

5 Eggs: 3 and 4; Frequency: 6 and 4

HOMEWORK 3E

1 **a** **i** 61−80 **ii** 57.87
b **i** 20.01−30.00 **ii** £27.39

2 **a** 79 **b** 34 minutes
c Mode **d** 94%

3 **a** 114 **b** 9.4 **c** Mode **d** 5.3%

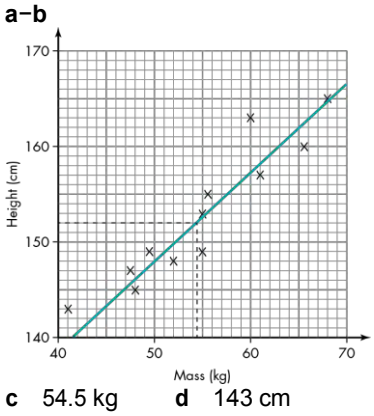
4 The 15 and the 10 are the wrong way around.

5 Find the midpoint of each group, multiply that by the frequency and add those products. Divide that total by the total frequency.

3.3 Scatter diagrams

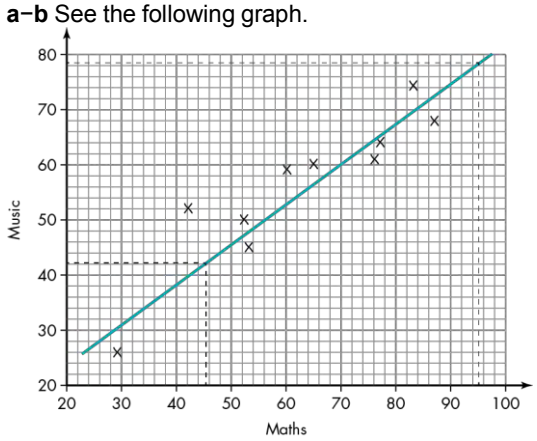
HOMEWORK 3F

1 **a−b**



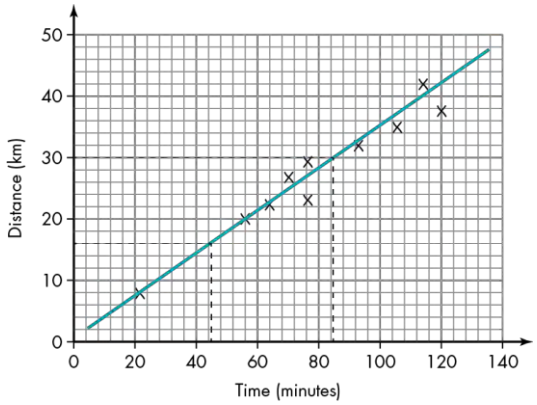
c 54.5 kg **d** 143 cm

2 **a−b** See the following graph.



c Isabel **d** 42 **e** 95

3 **a−b**



c 12 km **d** 86 min

4 133 miles

5 Points showing a line of best fit sloping up from bottom left to top right.

4.1 Patterns in number

HOMEWORK 4A

1 2 x 11 = 22
22 x 11 = 242
222 x 11 = 2442
2222 x 11 = 24 442
22 222 x 11 = 244 442
222 222 x 11 = 2 444 442
Pattern 2s on each end one less 4 than 2

2 99 x 11 =1089
999 x 11 =10 989
9999 x 11 = 109 989
99 999 x 11 = 1 099 989
999 999 x 11 = 10 999 989
9 999 999 x 11 = 109 999 989
10 … 89 plus 2 fewer 9s than in the question

3 7 x 9 = 63
7 x 99 = 693
7 x 999 = 699
7 x 9999 = 69 993
7 x 99 999 = 699 993
7 x 999 999 = 6 999 993
6 … 3 one less 9 than in the question

4 11 =11
11 x 11 = 121
11 x 11 x 11 = 1331
11 x 11 x 11 x 11 = 14 641
11 x 11 x 11 x 11 x11 = 161 051
11 x 11 x 11 x 11 x 11 x 11 = 1 771 561
Number formed by adding adjacent digits (watch out for carry when 10 or more)

5 9 x 2 = 18
9 x 3 = 27
9 x 4 = 36
9 x 5 = 45
9 x 6 = 54
9 x 7 = 63
9 x 8 = 72
Digits always add to 9

6 **a**

1
1 2 1
1 3 3 1
1 4 6 4 1
1 5 10 10 5 1
1 6 15 20 15 6 1
1 7 21 35 35 21 7 1
1 8 28 56 70 56 28 8 1

b Add adjacent digits in the line above
c Many patterns eg 1 s, counting numbers, triangular numbers

4.2 Number sequences

HOMEWORK 4B

1 **a** 12, 14, 16: + 2 **b** 15, 18, 21: + 3
c 32, 64, 128: × 2 **d** 33, 40, 47: + 7
e 30 000, 300 000, 3 000 000: × 10
f 25, 36, 49: square numbers

2 **a** 34, 55: add previous two terms
b 23, 30: add one more each time

3 **a** 112, 224, 448: × 2
b 38, 45, 52: + 7
c 63, 127, 255: add twice the difference each time or × 2 + 1
d 30, 25, 19: subtract one more each time
e 38, 51, 66: add two more each time
f 25, 32, 40: add one more each time
g 13, 15, 16: + 2, + 1
h 20, 23, 26: + 3
i 32, 40, 49: add one more each time
j 0, −5, −11: subtract one more each time
k 0.32, 0.064, 0.012 8: ÷ 5
l 0.1875, 0.093 75, 0.046 875: ÷ 2

4 The fractions are $\frac{2}{3}$, $\frac{3}{5}$, $\frac{4}{7}$, $\frac{5}{9}$, $\frac{6}{11}$, $\frac{7}{13}$, $\frac{8}{15}$, $\frac{9}{17}$ which as decimals are 0.6666…, 0.6, 0.571..., 0.5555…, 0.54545..., 0.5384..., 0.53333…, 0.529..., so only $\frac{3}{5}$ gives a terminating decimal. The denominators that give terminating decimals are powers of 5, i.e. 5, 25, 125, 625, and so on.

5 **a** £290 **b** £490 **c** 6
d Four sessions plus 3 sessions cost 160 + 125 = 285 Seven sessions cost 255, so he would have saved £30

4.3 Finding the *n*th term of a linear sequence

HOMEWORK 4C

1 **a** $2n + 3$ **b** $8n - 5$ **c** $5n + 1$
d $6n - 3$ **e** $3n + 1$ **f** $7n - 4$

2 **a** 101 **b** 201 **c** 253
d 296 **e** 152 **f** 345

3 **a** **i** $3n + 1$ **ii** 301 **iii** 103
b **i** $2n + 5$ **ii** 205 **iii** 99
c **i** $5n - 2$ **ii** 498 **iii** 98
d **i** $4n - 3$ **ii** 397 **iii** 101
e **i** $8n - 6$ **ii** 794 **iii** 98
f **i** $n + 4$ **ii** 104 **iii** 100

4 **a** $\frac{2n+1}{3n+2}$
b 0.6, 0.625, 0.636, 0.643
c **i** 0.6656 **ii** 0.667
d 0.667

5 **a** **i** 13
ii By adding the 8th and 9th terms
b $4n - 3$

6 **a** $2k + 2.5$ **b** $2k + 3$ **c** $2k + 4$
d $2k + 5$ **e** £2

7 **a** $2n + 1$ **b** $3n + 4$
c **i** $\frac{2001}{3004}$ **ii** 0.666112
d No, as the bottom has a +4 and the top is only +1 so it will always be less than 2

4.4 Special sequences

HOMEWORK 4D

1 **a** Odd **b** Either **c** Even
d Odd **e** Even **f** Odd
g Even **h** Either

2 **a** 243, 729, 2187
b **i** $3^n - 1$ **ii** 2×3^n

3 **a** The numerical value of the power is one more than the number of zeros after the decimal point.
b 7

4 **a**

+	Prime	Odd	Even
Prime	Either	Either	Either
Odd	Either	Even	Odd
Even	Either	Odd	Even

b

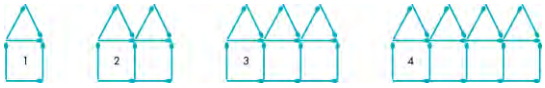
×	Prime	Odd	Even
Prime	Either	Either	Even
Odd	Either	Odd	Even
Even	Even	Even	Even

5 **a** 27 cm
b Perimeter is 36 cm
c Perimeter is 48 cm
d 64
e When n = 100, P = 6.31×10^{13} = 63 139 143 790 000 cm or 631 million km

4.5 General rules from given patterns

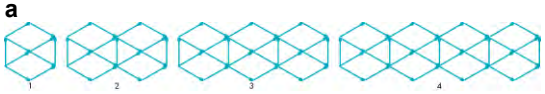
HOMEWORK 4E

1 **a**



b $5n + 1$ **c** 126 **d** Diagram 39

2 **a**



b $9n + 1$ **c** 541 **d** 11

3 **a** 12 **b** $3n$ **c** 17

4 **a** 14
b **i** 57 **ii** Add 3 more each time

5 **a** 11, 23, 35 **b** $12n - 1$

4.6 and 4.7 (Finding) The nth term of a quadratic sequence

HOMEWORK 4F

1 **a** 10, 13, 18, 25, 34, 45, 58
b 5, 8, 13, 20, 29, 40, 53
c −5, −2, 3, 10, 19, 30 43
d 3, 6, 11, 18, 27, 38 ,51
e −2, 1, 6, 13, 22, 33, 46
All sequences progress by adding 3 then 5 then 7 … as the term to term rules

2 **a** 1,4,9,16,25 **b** 0,3,8,15,24
c 4, 10,20, 34,52 **d** 0, 9, 24, 45, 72
e 0, 5, 14, 27, 44

3 **a** 0, 8, 22, 42, 68
b 1st differences 8, 14, 20, 26 up in 6 s
2nd differences 6, 6, 6 same difference
c 1st differences make a linear sequence term to term rule +6
2nd differences constant 6.

4 **a** $2n^2 - 1$ **b** $n^2 + 4$ **c** $3n^2 + 1$
d $2n^2 + 5$ **e** $4n^2 - 3$

5 **a** White 100 black 8
b White 256 black 8
c White = n^2 black = 8
Total tiles = $n^2 + 8$

5.1 Ratio

HOMEWORK 5A

1 **a** 1 : 3 **b** 1 : 5 **c** 1 : 6
d 1 : 3 **e** 2 : 3 **f** 3 : 5
g 5 : 8 **h** 15 : 2 **i** 2 : 5
j 5 : 2

2 **a** 1 : 4 **b** 3 : 4 **c** 1 : 8
d 2 : 5 **e** 2 : 5 **f** 8 : 15
g 10 : 3 **h** 1 : 3 **i** 3 : 8

3 **a** $\frac{1}{4}$ **b** $\frac{3}{4}$

4 **a** $\frac{2}{5}$ **b** $\frac{3}{5}$

5 **a** $\frac{1}{10}$ **b** $\frac{9}{10}$

6 2 :1

7 $\frac{1}{16}$

8 3 : 7

HOMEWORK 5B

1 **a** £2 : £8 **b** £4 : £8 **c** £10 : £30
d 10 g : 50 g **e** 1 h : 9 h

2 **a** 300 **b** 100

3 2 m and 18 m

4 400

5 45

6 £6

7 £36 for gas and £30 for electricity

8 **a** 1 : 1.5 **b** 1 : 2.5 **c** 1 : 1.25
d 1 : 1.6 **e** 1 : 2.1

9 $\frac{1}{30}$

10 £8

11 £324

HOMEWORK 5C

1 20 years

2 80

3 **a** 15 litres **b** 25 litres

4 **a** 80 kg **b** 5 kg

5 90

6 **a** 200 g **b** 320 g

7 Fred's, at 4 : 1; Jodie's is only 3.5 : 1

8 2

9 17

5.2 Direct proportion problems

HOMEWORK 5D

1 £8

2 £2.16

3 £49.60

4 **a** €2.25 **b** 20

5 **a** £27.20
b No, she will need £20.40 to buy 12 tickets.

6 **a** 6 litres **b** 405 miles

7 48 seconds

8 **a** **i** 50 g, 2, 40 g, 100 g
ii 200 g, 8, 160 g, 400 g
iii 250 g, 10, 200 g, 500 g
b 60

9 6

10 6

11 3

5.3 Best buys

HOMEWORK 5E

1 **a** Both work out at same price: £1.99 for two (to nearest penny)
b £1.20 for 20 is better value

2 **a** Large size, 4.0 g/p
b 200 g bar, 2.2 g/p
c 500 g tin, 0.64 g/p
d Large jar, 3.8 g/p

3 Large size

4 **a** 72p, 66p, 70p, 65p
b The 3-litre bottle is best value for money

5 The larger pack is better value at 3.77 g/p

6 Hannah got the better mark, since it is equivalent to 85 out of 100. John's mark is equivalent to 80 out of 100.

5.4 Compound measures

HOMEWORK 5F

1 **a** £300 **b** £170.10 **c** £237.50 **d** £10 260

2 **a** £9 **b** £8 **c** £17.25 **d** £15.86

3 **a** 40 **b** 60 **c** 45 **d** 32

4 **a** £717.50 **b** £963.50

5 £8.50

6 40 hours, £6/h

HOMEWORK 5G

1 15 mph

2 180 miles

3 46 mph

4 2 pm

5 **a** 30 mph **b** 50 km/h **c** 20 miles
d 50 km **e** $3\frac{1}{4}$ hours
f 3 hours 36 minutes

6 **a** 130 km **b** 52 km/h

7 **a** 30 minutes **b** 12 mph

8 **a** 1.25 hour **b** 45 miles

9 24 mph

10 40 mph

11 30 minutes

HOMEWORK 5H

1 0.9 g/cm^3

2 62.5 g/cm^3

3 4 Pa

4 2 N

5 30 g

6 500 cm^3

7 1350 g

8 909 cm^3

9 5.25 g/cm^3

10 996 tonnes

11 1.11 g/cm^3

12 **a** 13.04 m^3 **b** 5.2 tonnes

13 275 grams

14 Different metals vary in density, resulting in more or less mass, even though the volume may be the same.

15 $\frac{1}{20}$ m^2

5.5 Compound interest and repeated percentage change

HOMEWORK 5I

1 **a** 5.5 cm **b** 6.05 cm **c** 7.32 cm **d** 9.74 cm

2 **a** £32 413.50 **b** 7 years

3 **a** £291.60 **b** £314.93 **c** £367.33

4 **a** 1725 **b** 1984 **c** 2624

5 After 11 years, the sycamore is 93.26 cm tall and the conifer is 93.05 cm tall. After 12 years, the sycamore is 100.73 cm tall and the conifer is 107 cm tall.

6 Two years

7 Four weeks

5.6 Reverse percentage (working out the original quantity)

HOMEWORK 5J

1 **a** 800 g **b** 96 m **c** 840 cm

2 **a** 70 kg **b** £180 **c** 40 hours

3 Jumper £12, Socks £1.60, Trousers £20

4 £15

5 £180

6 **a** £22 454 **b** 6.8%

7 100% (still twice as many)

8 £1800

6.1 Angle facts

HOMEWORK 6A

1 **a** 60° **b** 45° **c** 300°
d 120° **e** 27° **f** 101°
g 100° **h** 60° **i** 59°
j 50° **k** 100° **l** 138°
m 63° **n** 132°

2 Yes, they add up to 180°.

3 **a** 120° **b** 45° **c** 50°

4 **a** 60° **b** 75° **c** 40°

5 **a** $x = 60°$, $y = 120°$ **b** $x = 30°$, $y = 140°$
c $x = 44°$, $y = 58°$

6 3 × 120° = 360°

7 40°, 120° and 200°

6.2 Triangles

HOMEWORK 6B

1 **a** 70° **b** 60° **c** 10°
d 43° **e** 5° **f** 41°

2 **a** Yes, total is 180° **b** No, total is 190°
c No, total is 160° **d** Yes, total is 180°
e Yes, total is 180° **f** No, total is 190°

3 **a** 70° **b** 40° **c** 88°
d 12° **e** 42° **f** 118°

4 **a** 60° **b** Equilateral triangle
c All sides equal in length

5 **a** 55° **b** Isosceles triangle
c Equal in length

6 $x = 30°$, $y = 60°$

7 22°

8 **a** 119° **b** 70°

9 Check students' sketches for A, B and D.
A true, B true, C false (more than 180° in the triangle), D true, E false (more than 180° in the triangle)

10 ∠ABC = 140° (angles on a line), a + 15° + 140° = 180° (angles in a triangle),
so a = 25° (or use the fact that 40° is the exterior angle, so is equal to the sum of the two interior angles)

11 65°

6.3 Angles in a polygon

HOMEWORK 6C

1 **a** pentagon divided into 3 triangles, 3 × 180° = 540°
b 80°

2 **a** 112° **b** 130°

3 135°

4 $x = 20°$

5 Paul thinks that there are 365° in a quadrilateral (or he thinks the top and bottom are parallel), x = 57°

HOMEWORK 6D

1 **a** 70° **b** 120° **c** 65°
d 70° **e** 70° **f** 126°

2 **a** no, total is 350° **b** yes, total is 360°
c yes, total is 360° **d** no, total is 370°
e no, total is 350° **f** yes, total is 360°

3 **a** 90° **b** 80° **c** 80°
d 46° **e** 30° **f** 137°

4 **a** 290° **b** reflex **c** kite or arrowhead

6.4 Regular polygons

HOMEWORK 6E

1 **a** $x = 60°$, $y = 120°$ **b** $x = 90°$, $y = 90°$
c $x = 108°$, $y = 72°$ **d** $x = 120°$, $y = 60°$
e $x = 135°$, $y = 45°$

2 **a** 18 **b** 12 **c** 20 **d** 90

3 **a** 8 **b** 24 **c** 36 **d** 15

4 Octagon

5 A square

6 Angle AED = 108° (interior angle of a regular pentagon),
angle ADE = 36° (angles in an isosceles triangle)

7 B and C

6.5 Parallel lines

HOMEWORK 6F

1 **a** $a = 60°$ **b** $b = 50°$ **c** $c = 152°$
d $d = e = 62°$ **e** $f = g = 115°$ **f** $h = i = 72°$

2 **a** $a = b = c = 55°$ vertically opposite, corresponding, alternate
b $d = 132°$ corresponding , $e = 48°$ vertically opposite
c $f = 78°$, $g = 102°$ complementary/allied

3 **a** 70° **b** 68°

4 **a** $x = 30°$, $y = 110°$ **b** $x = 20°$, $y = 120°$

5 76°

6 $360° - p - q$

7 $a = 47°$ (alternate angles)

$b = 180° - 64° = 116°$ (allied or interior angles)

$a + b = 47° + 116° = 163°$

6.6 Special quadrilaterals

HOMEWORK 6G

1 **a** $a = 110°$, $b = 100°$ **b** $c = 68°$, $d = 108°$
c $e = 90°$, $f = 105°$

2 **a** $a = c = 130°$, $b = 50°$
b $d = f = 45°$, $e = 135°$
c $g = i = 139°$, $h = 41°$

3 **a** $a = 120°$, $b = 50°$ **b** $c = d = 90°$
c $e = 96°$, $f = 56°$

4 **a** $a = c = 125°$, $b = 55°$
b $d = f = 70°$, $e = 110°$
c $g = i = 117°$, $h = 63°$

5 The angles add up to 180° (angles in a quadrilateral, or interior angles between parallel lines). The acute angle between AD and the perpendicular from D to AB must be no less that 20°, so the obtuse angle at D must be at least 110°; the angle at A can be no greater than 70°.

6 **a** Angle B = 75° and angle ACD = 15° (opposite angles in a parallelogram are equal), so $x = 90°$ (angles in a triangle = 180°)
b 90 + 15 = 105°

7 e.g. only one pair of parallel sides, opposite angles are not the same, no rotational symmetry, diagonals do not bisect each other.

6.7 Scale drawings and bearings

HOMEWORK 6H

1 **a** **i** 90 cm by 60 cm
ii 90 cm by 60 cm
iii 60 cm by 60 cm
iv 90 cm by 45 cm
b 10 800 cm^2

2 **a** Check student's scale drawing. **b** 4.12 m

3 **a** 10.5 km **b** 12.5 km **c** 20 km
d 13 km **e** 4 km

4 **a** Check student's scale drawing.
b about 134 m, 8040 bricks

5 **a** 4.5 km **b** 10 km **c** 7.5 km
d 16 km **e** 9.5 km

6 **a** **ii**, 1 : 10 000 **b** 550 m

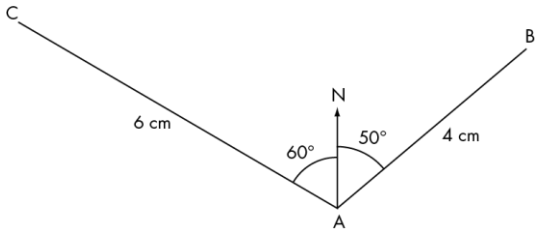
7 **a** 062° **b** 130° **c** 220° **d** 285°

8 **a** 160° **b** 095° **c** 005° **d** 275°

9 **a** 160° **b** 250 km **c** 340°

10 **a** $180° + x°$ **b** $y° - 180°$

11 **a**



b 093°

12 126° clockwise

13 120°

7.1 Congruent triangles

HOMEWORK 7A

1 **a** Yes − SAS **b** Yes − SSS **c** Yes − ASA

2 Student's diagrams; triangles that are congruent to each other: ABC, CDA, DAB and DCB (Note: if the point of intersection of AC and DB is T, then ATB, BTC, CTD and DTA are also congruent)

3 Student's diagrams; depending on how the kite figure is oriented and labelled, EFG and GHE or HFE and HFG are congruent

4 Student's diagrams: triangles that are congruent to each other: ABC and ACD; ABD and BCD

5 Student's diagrams: Triangles that are congruent to each other: ATC, CTB and ATB (and if the mid-points of AB, BC and CA are P, Q and R respectively, also ATP, PTB, BTQ, CTQ, CTR and RTA)

6 For example: AB = CD (given), $\angle ABD = \angle CDB$ (alternate angles), $\angle BAC = \angle DCA$ (alternate angles), so $\Delta ABX \equiv \Delta CDX$ (ASA)

7 AB and PQ are the corresponding sides to the 50° angle, but they are not equal in length.

7.2 Rotational symmetry

HOMEWORK 7B

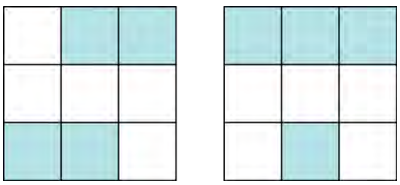
1 **a** 2 **b** 2 **c** 2 **d** 3 **e** 2

2 **a** 5 **b** 6 **c** 2 **d** 2 **e** 8

3 **a** 2 **b** 2 **c** 4 **d** 4 **e** 5

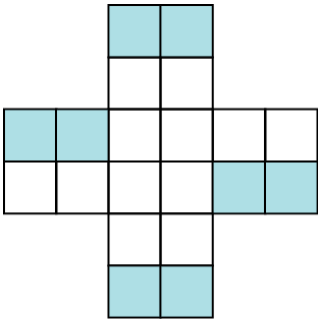
4 **a** 1 **b** 2 **c** 2 **d** 1 **e** 2
f 1 **g** 2 **h** 2

5 **a** **b** For example:

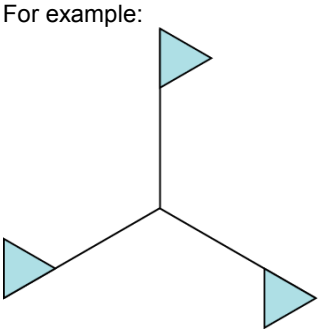


6 **a** 6 **b** 2 **c** 8 **d** 4

7



8 For example:

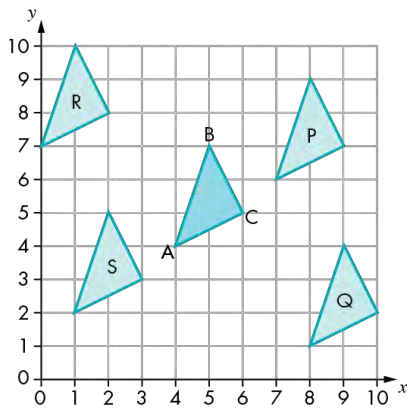


7.3 Transformations

HOMEWORK 7C

1 **i** $\begin{pmatrix}1\\7\end{pmatrix}$ **ii** $\begin{pmatrix}10\\-2\end{pmatrix}$ **iii** $\begin{pmatrix}3\\-2\end{pmatrix}$
iv $\begin{pmatrix}-7\\-1\end{pmatrix}$ **v** $\begin{pmatrix}3\\-3\end{pmatrix}$ **vi** $\begin{pmatrix}-4\\-3\end{pmatrix}$

2 **a-e**



3 **a** $\begin{pmatrix}1\\5\end{pmatrix}$ **b** $\begin{pmatrix}-8\\6\end{pmatrix}$ **c** $\begin{pmatrix}1\\-5\end{pmatrix}$
d $\begin{pmatrix}6\\4\end{pmatrix}$ **e** $\begin{pmatrix}7\\-1\end{pmatrix}$ **f** $\begin{pmatrix}7\\-1\end{pmatrix}$
g $\begin{pmatrix}8\\-6\end{pmatrix}$ **h** $\begin{pmatrix}-6\\-4\end{pmatrix}$

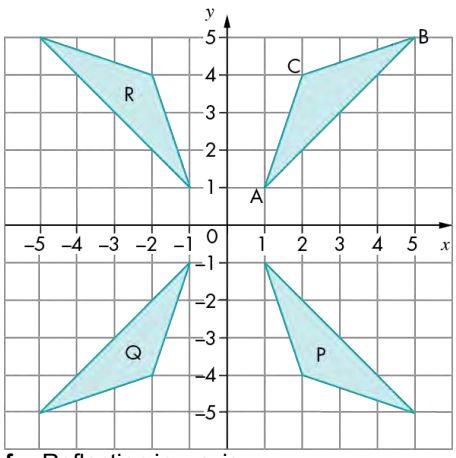
4 $\begin{pmatrix}6\\2\end{pmatrix}$

5 $\begin{pmatrix}3\\3\end{pmatrix}\begin{pmatrix}3\\3\end{pmatrix}$

6 No, it is $\begin{pmatrix}3\\-2\end{pmatrix}$

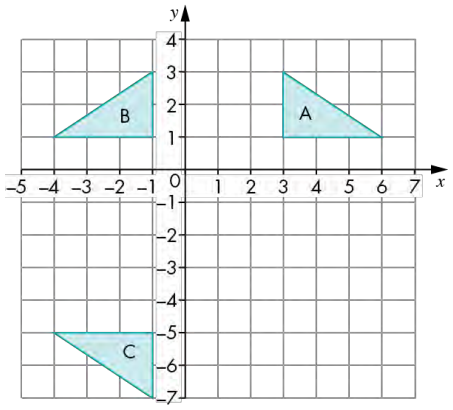
HOMEWORK 7D

1 **a–e**

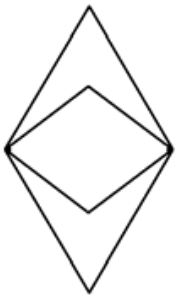


f Reflection in y-axis

2 **a–b**



3

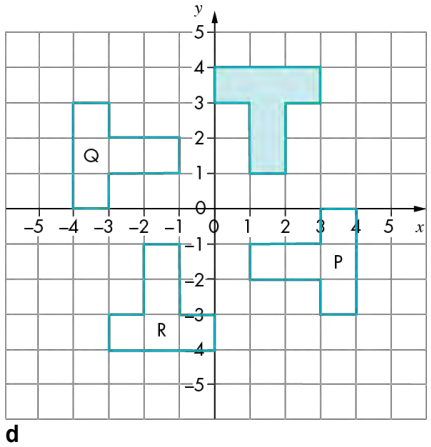


4 $(6 - a, b)$

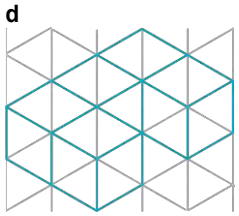
5 **a–e** Student's diagrams
f Reflection in $y = -x$

HOMEWORK 7E

1 **a–c**



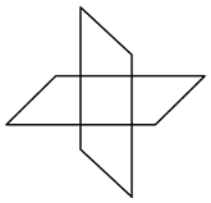
d



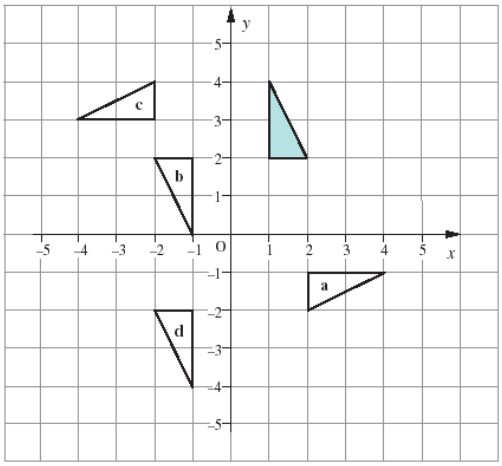
Rotation 180° about (0, 0)

2 **a** (1, 1), (3, 1), (3, 3), (1, 3)
b (1, −1), (3, −1), (3, −3), (1, −3)
c (−1, −1), (−3, −1), (−3, −3), (−1, −3)
d (−1, 1), (−3, 1), (−3, 3), (−1, 3)
e Same numbers, different signs

3



4 **a–d**



5 **a** Rotation 90° anticlockwise about (0, 0)
b Rotation 180° (anti-)clockwise about (0, 0)
c Rotation 90° clockwise about (2.5, 0.5)
d Rotation 180° (anti-)clockwise about (2, −1)

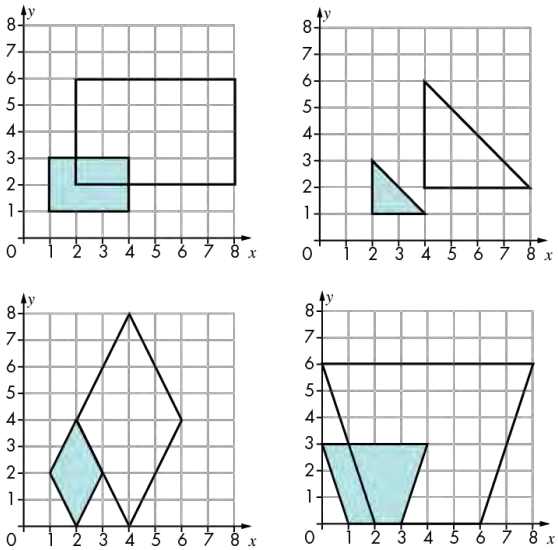
6 **a** $(b, -a)$ **b** $(-a, -b)$ **c** $(-b, a)$

7 A rotation 90° anticlockwise about (2, 2)

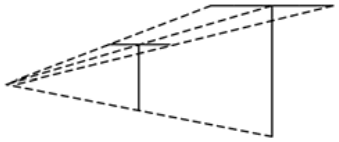
HOMEWORK 7F

1 Student's diagrams; check centre of enlargement and scale factor.

2



3



4 (1, 1), (3, 1) and (3, 2)

5 **c** an enlargement of scale factor −3 about (1, 2)

7.4 Combinations of transformations

HOMEWORK 7G

1 **a** Reflection in x-axis **b** Reflection in y-axis

c Translation of $\begin{pmatrix} 6 \\ -1 \end{pmatrix}$

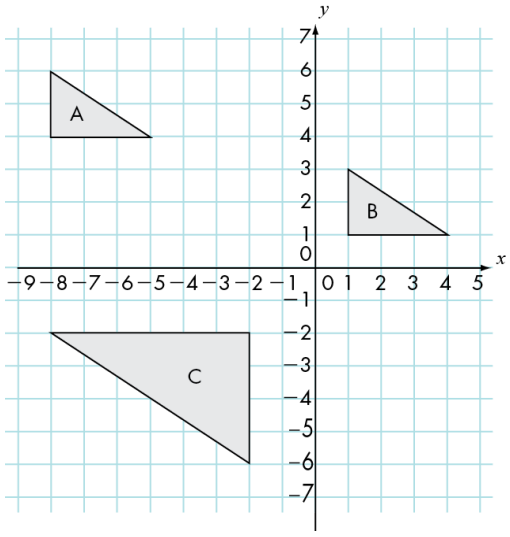
d Rotation of 180° (anti-)clockwise about (0, 0)
e Rotation of 90° clockwise about (0, 0)
f Reflection in $y = -x$
g Reflection in $y = x$

2 **a–d** Student's diagrams
e 90° clockwise about (0, 0)

3 **a** (−5, −2) **b** $(-b, -a)$

4 **a** (−3, 4) **b** $(-b, a)$

5 **a**



b Enlargement of scale factor $-\frac{1}{2}$ about (−6, 2)

7.5 Bisectors

HOMEWORK 7H

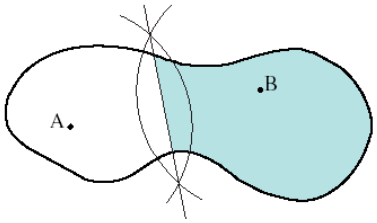
1 Student's own drawings

2 **a–c** Student's own drawings

3 **a–c** Student's own drawings

4 **a–c** Student's own drawings

5



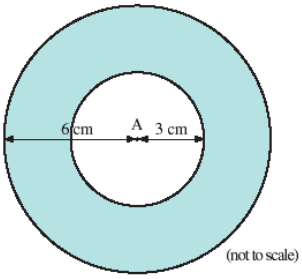
6 **a** Bisect 60, then bisect the 30 to get 15.

7 **b** Create a 60° angle, then on top of that, create the 15° to make 75°.
Each angle bisector is the locus of points equidistant from the two sides bisected − hence, where they all meet will be the only point that is equidistant from each of the three sides.

7.6 Defining a locus

HOMEWORK 7I

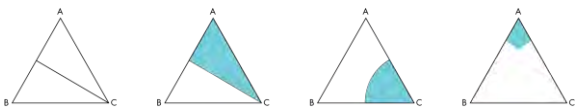
1



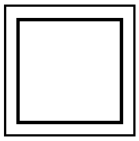
2 **a** **b**

3 Sphere radius 1 metre

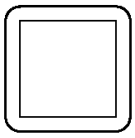
4



5



6



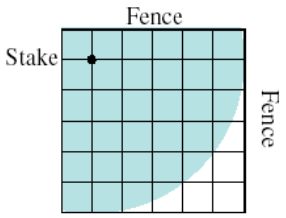
7 **a–b** Student's own drawings

8 Student's own drawings − starting point may be any point along the locus

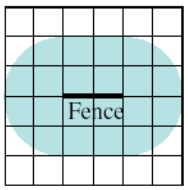
7.7 Loci problems

HOMEWORK 7J

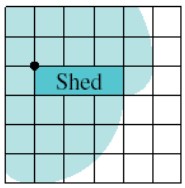
1



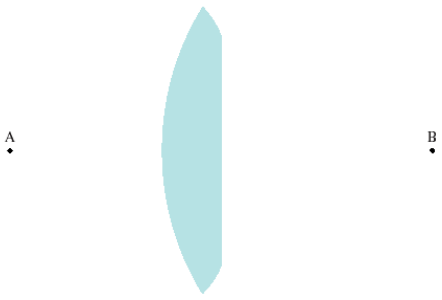
2



3



4



5 **b** could be true − the locus is just two points

6 **a** Student's diagram **b** No **c** No

7 No

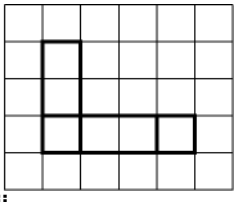
8 **a** Student's diagram **b** No

9 Between 180 and 280 km

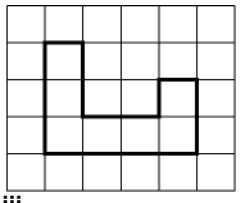
7.8 Plans and elevations

HOMEWORK 7K

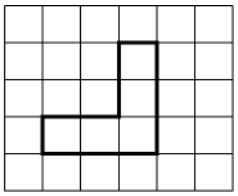
1 **a** **i**



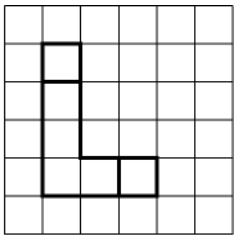
ii



iii



b **i**



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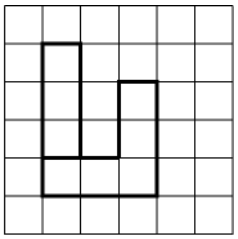

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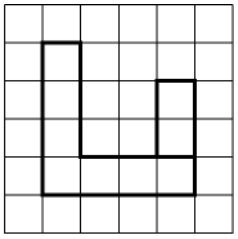
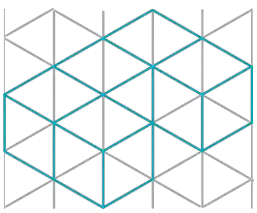
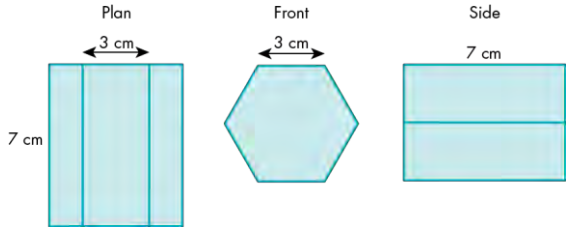


2 **a** F **b** D **c** E

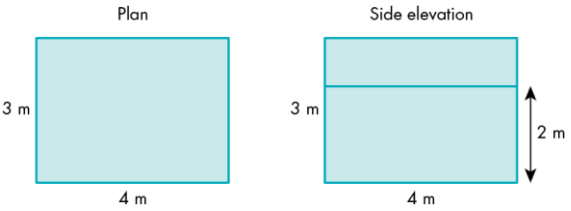
3



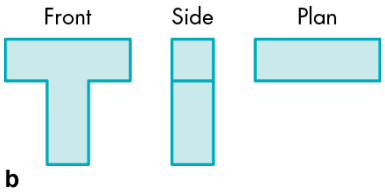
4



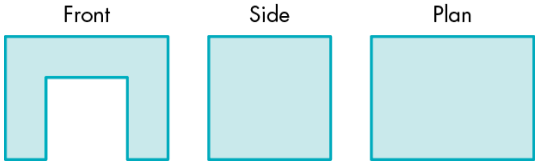
5



6 a



b



8.1 Basic algebra

HOMEWORK 8A

1 **a** 15 **b** 27 **c** 47

2 **a** 5 **b** 14 **c** 29

3 **a** 9 **b** 12 **c** 19

4 **a** 2 **b** −4 **c** −16

5 **a** 0.5 **b** 6.5 **c** 26.5

6 **a** −8 **b** −3 **c** 109.5

7 **a** −11 **b** −15 **c** 7

8 **a** 13 **b** 16 **c** 5.4

9 **a** 11 **b** −14 **c** −0.75

10 **a** 3.5 **b** 19.4 **c** 8.03

11 **a** 25 **b** 169

12 **a** 16 **b** 21

13 **a** 51 **b** 36 **c** 19

14 **a** 17 **b** 28

15 **a** 624 **b** 217

16 **a** 102 **b** 791

17 162 m by 27 m by 16.2 m

18 **a** $4a + 6b - 5c$ and $4a - 4b + c$ **b** 48

19 **a** 20 °C **b** $F = \frac{9}{5}C + 32$

20 **a** £155.25 **b** £20.25 in debit

21 **a** 64.4 **b** 76 **c** 57.2

22 **a** 3p
b Basic charge of £4.50 plus 2p profit (5 − 3) per page
c £44.50

23 **a** Expression **b** Formula
c Identity **d** Equation

HOMEWORK 8B

1 **a** $12 + 3m$ **b** $18 + 6p$
c $16 - 4y$ **d** $18 + 21k$
e $12 - 20f$ **f** $8 - 46w$
g $7g + 7h$ **h** $8k + 16m$
i $12d - 6n$ **j** $t^2 + 5t$
k $m^2 + 4m$ **l** $k^2 - 2k$
m $4g^2 + g$ **n** $3y^2 - 21y$
o $7p - 8p^2$ **p** $2m^2 + 10m$
q $3t^2 - 6t$ **r** $15k - 3k^2$
s $8g^2 + 6g$ **t** $8h^2 - 12h$
u $12t - 10t^2$ **v** $12d^2 + 20de$
w $12y^2 + 15ky$ **x** $18m^3 - 6m^2p$
y $y^3 + 7y$ **z** $h^4 + 9h$
aa $k^3 - 4k$ **bb** $3t^3 + 9t$
cc $5h^4 - 10h$ **dd** $4g^4 - 12g$
ee $10m^3 + 5m^2$ **ff** $8d^3 - 2d^4$
gg $12w^3 + 4wt$ **hh** $15a^3 - 3ab$
ii $14p^4 - 16mp$ **jj** $3m^2 + 5m^3$
kk $t^4 + 3t^4$ **ll** $4g^2t - 3g^4$
mm $14t^3 + 2mt^2$ **nn** $12h^3 + 15gh^2$

2 **a** −4 °C **b** $F = 2(C + 15)$

3 $y + y = 2y$, $3y + 6 = 3(y + 2)$, $5y - 10 = 5(y - 2)$

4 Correct answers such as: $2(6x + 12y)$, $12(x + 2y)$, $6(2x + 4y)$

5 **a** $9t$ **b** $7m$ **c** $7y$
d $10d$ **e** $2e$ **f** $3g$
g $2p$ **h** $4t$ **i** $5t^2$
j $3y^2$ **k** $7ab$ **l** a^2d

6 **a** $18 + 7t$ **b** $22 + 24k$
c $13 + 32m$ **d** $17 + 13y$
e $28 + 12f$ **f** $20 + 33g$
g $2 + 2h$ **h** $9g + 5$
i $6y + 11$ **j** $7t - 4$
k $17k + 16$ **l** $6e + 20$
m $5m + 2p + 2mp$ **n** $4k + 5h + 3hk$
o $t + 3n + 7nt$ **p** $p + 5q + 8pq$
q $6h + 12j + 11hj$ **r** $15y + 2t + 20ty$
s $4t^2 + 13t$ **t** $15y^2 + 7y$
u $11w^2 + 22w$ **v** $17p^2 + 6p$
w $m^2 + 8m$ **x** $14d - 3d^2$
y $2a^3 + 10a^2 + 15ab + 3ac$
z $4y^3 + 3y^2 + 12yw - 4ty$

7 **a** $100x + 300y$ **b** £1700

8 He has worked out 2×3 as 5 instead of 6. And he has worked out −2 + 15 as −13, not +13. Answer should be $16x + 13$

9 **a** **ii** $5(x + 0.75) + 3(x + 0.25)$
b £44.50

8.2 Factorisation

HOMEWORK 8C

1 **a** $3(3m + 4t)$ **b** $3(3t + 2p)$
c $4(m + 3k)$ **d** $2(2r + 3t)$
e $m(2n + 3)$ **f** $g(4g + 3)$
g $4(w - 2t)$ **h** $2(5p - 3k)$
i $2(6h - 5k)$ **j** $2m(2p + k)$
k $2b(2c + 3k)$ **l** $4a(2b + c)$
m $y(3y + 4)$ **n** $t(5t - 3)$
o $d(3d - 2)$ **p** $3m(2m - p)$
q $3p(p + 3t)$ **r** $4p(2t + 3m)$
s $2b(4a - 3c)$ **t** $4a(a - 2b)$
u $2t(4m - 3p)$ **v** $4at(5t + 3)$
w $2bc(2b - 5)$ **x** $2b(2ac + 3ed)$
y $2(3a^2 + 2a + 5)$ **z** $3b(4a + 2c + 3d)$
aa $t(6t + 3 + a)$ **bb** $3mt(32t - 1 + 23m)$
cc $2ab(3b + 1 - 2a)$ **dd** $5pt(t + 3 + p)$

2 **a** Does not factorise **b** $m(3 + 2p)$
c $t(t - 5)$ **d** Does not factorise
e $2m(4m - 3p)$ **f** Does not factorise
g $a(3a - 7b)$ **h** Does not factorise
i $b(7a - 4bc)$ **j** Does not factorise
k $3mt(2m + 3t)$ **l** Does not factorise

3 **a** Tess, as 9.99 − 1.99 = 8, so she will just have to work out 8 × 8
b Tom £48, Tess £64

4 **a** **i** $x - 4$ **ii** $3(x - 4)$ **iii** $x(x - 4)$
b They all have $(x - 4)$ as a factor

5 **a** Pairing 1 with 100, then 2 with 99, 3 with 98, and so on will account for all the numbers. Each pair has a sum of 101 and there are fifty such pairs, giving a total of 50 × 101.
b 5050

8.3 Quadratic expansion

HOMEWORK 8D

1 **a** $x^2 + 7x + 10$ **b** $t^2 + 5t + 6$
c $w^2 + 5w + 4$ **d** $m^2 + 8m + 12$
e $k^2 + 6k + 8$ **f** $a^2 + 4a + 3$
g $x^2 + 2x - 3$ **h** $t^2 + 2t - 24$
i $w^2 - w - 6$ **j** $f^2 - 3f - 4$
k $g^2 - 3g - 10$ **l** $y^2 + 3y - 10$
m $x^2 - x - 12$ **n** $p^2 - p - 6$
o $k^2 - 4k - 5$

HOMEWORK 8E

1 **a** $y^2 + 3y - 18$ **b** $a^2 + 2a - 8$
c $t^2 + t - 20$ **d** $x^2 - 5x + 6$
e $r^2 - 5r + 4$ **f** $m^2 - 8m + 7$
g $g^2 - 8g + 15$ **h** $h^2 - 8h + 12$
i $n^2 - 10n + 16$ **j** $x^2 + 7x + 12$
k $20 - t - t^2$ **l** $12 - 4b - b^2$
m $35 - 12y + y^2$ **n** $p^2 + p - 6$
o $8k - 15 - k^2$

HOMEWORK 8F

1 **a** $x^2 - 1$ **b** $t^2 - 4$ **c** $y^2 - 9$
d $k^2 - 9$ **e** $h^2 - 1$ **f** $9 - x^2$
g $49 - t^2$ **h** $16 - y^2$ **i** $a^2 - b^2$
j $36 - x^2$

2 $(x + 4)$ and $(x + 5)$

3 **a** B: $2 \times (x - 3)$; C: 2×3; D: $3 \times (x - 2)$
b $2x - 6 + 6 + 3x - 6 = 5x - 6$
c Area A = $(x - 2)(x - 3)$ = area of square minus areas (B + C + D) = $x^2 - (5x - 6) = x^2 - 5x + 6$

4 **a** $x^2 - 4$
b **i** 9996 **ii** 39 996

HOMEWORK 8G

1 **a** $12x^2 + 22x + 8$ **b** $6y^2 + 7y + 2$
c $12t^2 + 30t + 12$ **d** $6t^2 + t - 2$
e $18m^2 - 9m - 2$ **f** $20k^2 - 3k - 9$
g $12p^2 + p - 20$ **h** $18w^2 + 27w + 4$
i $15a^2 - 17a - 4$ **j** $15r^2 - 11r + 2$
k $12g^2 - 11g + 2$ **l** $12d^2 - 5d - 2$
m $15 + 32p + 16p^2$ **n** $15 + 19t + 6t^2$
o $2 + 11p + 15p^2$ **p** $21 - 2t - 8t^2$
q $20 + 3n - 2n^2$ **r** $20f^2 + 11f - 3$
s $10 - 7q - 12q^2$ **t** $6 + 7p - 3p^2$
u $5 + 17t - 12t^2$ **v** $15 - 32r + 16r^2$
w $4 - 21x + 5x^2$ **x** $25m - 6 - 14m^2$
y $3x^2 + 8xy + 5y^2$ **z** $12y^2 - 13yt - 4t$
aa $25x^2 - 10xy - 3y^2$ **bb** $x^2 - 5xy + 6y^2$
cc $4m^2 + 17mp - 15p^2$ **dd** $3t^2 - 13kt + 4k^2$

2 **a** $x^2 + 2x + 1$ **b** $x^2 - 2x + 1$
c $x^2 - 1$
d $p - q = (x + 1 - (x - 1)) = 2$, $(p - q)^2 = 2^2 = 4$, $p^2 - 2pq + q^2 = x^2 + 2x + 1 - 2(x^2 - 1) + x^2 - 2x + 1 = 2x^2 + 2x + 1 - 2x^2 + 2 + x^2 - 2x + 1 = 4$

4 **a** $(4x - 3)(3x + 2) = 12x^2 - x - 6$, $(2x - 1)(6x - 1) = 12x^2 - 8x + 1$, $(4x + 1)(3x - 1) = 12x^2 - x - 1$, $(x + 3)(12x + 1) = 12x^2 + 37x + 3$
b All the x^2 terms are $12x^2$, so just look at the constant term.

3 **a** $4a^2 - x^2$
b $2a + x$ by $2a - x$
c Areas are the same, so $4a^2 - x^2 = (2a + x) \times (2a - x)$

8.4 Expanding squares

HOMEWORK 8H

1 **a** $x^2 + 8x + 16$ **b** $m^2 + 6m + 9$
c $25 + 10t + t^2$ **d** $4 + 4p + p^2$
e $m^2 - 4m + 4$ **f** $t^2 - 8t + 16$
g $9 - 6m + m^2$ **h** $36 - 12k + k^2$
i $4x^2 + 4x + 1$ **j** $9t^2 + 12t + 4$
k $1 + 8y + 16y^2$ **l** $4 + 4m + m^2$
m $9t^2 - 12t + 4$ **n** $4x^2 - 4x + 1$
o $1 - 8t + 16t^2$ **p** $25 - 40r + 16r^2$
q $a^2 + 2ab + b^2$ **r** $x^2 - 2xy + y^2$
s $9t^2 + 6ty + y^2$ **t** $m^2 - 4mn + 4n^2$
u $x^2 + 6x + 5$ **v** $x^2 - 8x - 9$
w $x^2 + 10x - 11$ **x** $x^2 - 2x$

2 **a** Bernice has just squared the first term and the second term. She hasn't written down the brackets twice.
b Piotr has written down the brackets twice but has worked out $-4x + -4x$ as $+8x$ instead of $-8x$ and -1×-1 as -1 instead of $+1$.
c $16x^2 - 8x + 1$

8.5 More than two binomials

HOMEWORK 8I

1 **a** $x^3 + 9x^2 + 26x + 24$ **b** $x^3 - 7x - 6$
c $x^3 - 5x^2 - 9x + 45$ **d** $x^3 - 5x^2 - 8x + 48$
e $x^3 - x^2 - 5x - 3$

2 **a** $x^3 + 3x^2 + 3x + 1$ **b** $x^3 - 6x^2 + 12x - 8$
c $x^3 + 12x^2 + 48x + 64$

3 **a** $x^3 + ax^2 + bx^2 + cx^2 + abx + acx + bcx + abc = x^3 + x^2(a + b + c) + x(ab + ac + bc) + abc$
b $p = 0,\ q = -13,\ r = -12$

4 **a** Volume $x^3 - 6x^2 - 31x + 36$
b Surface area $6x^2 - 24x - 62$

5 **a** $x^3 + 6x^2 + 12x + 8$ **b** 8.120 601

6 **a** $2x^3 + 3x^2 - 17x + 12$
b $3x^3 + 11x^2 + 8x - 4$

7 **a** $24x^3 - 52x^2 + 4x + 8$
b $8x^3 - 64x^2 + 160x - 128$

8.6 Quadratic factorisation

HOMEWORK 8J

1 **a** $(x + 1)(x + 6)$ **b** $(t + 2)(t + 2)$
c $(m + 1)(m + 10)$ **d** $(k + 3)(k + 8)$
e $(p + 6)(p + 4)$ **f** $(r + 2)(r + 9)$
g $(w + 3)(w + 6)$ **h** $(x + 2)(x + 6)$
i $(a + 12)(a + 1)$ **j** $(k - 3)(k - 7)$
k $(f - 1)(f - 21)$ **l** $(b + 32)(b + 3)$
m $(t + 3)(t + 2)$ **n** $(m - 4)(m - 1)$
o $(p - 2)(p - 5)$ **p** $(x - 4)(x - 9)$
q $(c - 4)(c - 8)$ **r** $(t - 3)(t - 12)$
s $(y - 6)(y - 8)$ **t** $(j - 3)(j - 16)$
u $(p + 3)(p + 5)$ **v** $(y + 3)(y - 2)$
w $(t + 8)(t - 1)$ **x** $(x + 10)(x - 1)$
y $(m - 4)(m + 3)$ **z** $(r + 7)(r - 1)$
aa $(n - 9)(n + 2)$ **bb** $(m - 22)(m + 2)$
cc $(w - 8)(w + 3)$ **dd** $(t + 10)(t - 9)$
ee $(x - 9)(x + 8)$ **ff** $(t - 21)(t + 3)$
gg $(d - 1)(d - 1)$ **hh** $(y + 4)(y + 25)$
ii $(t - 2)(t - 8)$ **jj** $(m - 3)(m - 27)$
kk $(x - 6)(x - 24)$ **ll** $(d - 6)(d + 2)$
mm $(t + 5)(t - 4)$ **nn** $(q + 8)(q - 7)$
oo $(p - 2)(p + 1)$ **pp** $(v - 7)(v + 5)$
qq $(t - 3)(t - 1)$ **rr** $(m + 4)(m - 1)$

2 $(x + 1)(x + 9)$, giving areas of x and $9x$ *or* $(x + 3)(x + 3)$, giving areas of $3x$ and $3x$

3 **a** $x^2 - (a + b)x + ab$
b **i** $p + q = -9$ **ii** $pq = 18$
c 9 can be -1×-9 or -3×-3, and neither $-1 + -9$ or $-3 + -3 = -18$

HOMEWORK 8K

1 **a** $(x + 9)(x - 9)$ **b** $(t - 6)(t + 6)$
c $(2 - x)(2 + x)$ **d** $(9 - t)(9 + t)$
e $(k - 20)(k + 20)$ **f** $(8 - y)(8 + y)$

2 **a** $(x - y)(x + y)$ **b** $(a - 3b)(a + 3b)$
c $(3x - 5y)(3x + 5y)$ **d** $(3x - 4)(3x + 4)$
e $(10t - 2w)(10t + 2w)$ **f** $(6a - 7b)(6a + 7b)$
g $g = \dfrac{1}{2a + 3}$

3 **a** $4x^2$
b **i** $(2x - 3)$ **ii** $(2x + 3)$
iii $4x^2$ **iv** 9
c A + B − C = $4x^2 - 9$, which is the area of D, which is $(2x + 3)(2x - 3)$

4 **a** $9x^2 + 12x + 4 - (9x^2 + 6x + 1) = 6x + 3$

b $(a + b)(a - b)$

c $(3x + 2 + 3x + 1)(3x + 2 - 3x - 1)$
$= (6x + 3)(1)$
$= 6x + 3$

d Answers are the same.

e $(2x + 1 + 2x - 1)(2x + 1 - 2x + 1) = (4x)(2) = 8x$

8.7 Factorising $ax^2 + bx + c$

HOMEWORK 8L

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

2 $2x + 1$ and $3x + 4$

3 **a** All the terms in the quadratic have a common factor of 4.
b $4(x + 2)(x - 1)$ This has the highest common factor taken out.

HOMEWORK 8M

1 **a** 4.30 pm **b** $n = \dfrac{T - 55}{10}$
c 6

2 **a** $6x = 9y - 90,\ y = \dfrac{6x + 90}{9}$
b 90p

3 First journey time = 1h 30 min; return takes 2 hours, so average speed = 45 mph

4 **a** $c = y - mx$ **b** $x = \dfrac{y - c}{m}$

5 **a** $u = v + 10t$ **b** $t = \dfrac{u - v}{10}$

6 **a** $x = \dfrac{T - 3y}{2}$ **b** $y = \dfrac{T - 2x}{3}$

7 $q = \sqrt{p}$

8 $q = \sqrt{p+3}$

9 $b = \sqrt{a-c}$

10 **a** 61.2 m/s **b** $t = \frac{v-u}{g}$ **c** 8.4 seconds

9.1 Circumference and area of a circle

HOMEWORK 9A

1 **a** 9.4 cm **b** 31.4 cm **c** 50.3 m
d 44.0 cm **e** 20.1 cm **f** 22.0 cm

2 200π m

3 **a** 15.7 cm **b** 1

4 1705 complete revolutions

5 **a** 153.9 cm^2 **b** 254.5 cm^2 **c** 1385.4 cm^2
d 0.6 cm^2 **e** 16π cm^2 **f** π m^2

6 18.0 cm

7 6π + 12 cm

8 3.82 cm

9 66 m^2

10 88.4 cm^2

11 3.99 m

12 49.7 cm^2

13 814 cm^2

14 329 m^2

15 110 metres

9.2 Area of a parallelogram

HOMEWORK 9B

1 **a** 15 cm^2 b 40 cm^2
c 16 m^2 **d** 240 cm^2

2 256 cm^2

3 The triangle and the parallelogram have the same area (36 cm^2)

4 24 cm

9.3 Area of a trapezium

HOMEWORK 9C

1 **a** 23.1 cm, 28 cm^2 **b** 36 cm, 66.5 cm^2

2 **a** 89 m^2 **b** 35.5 cm^2

3 **a** = 10 cm^2 ; **b** = 9.6 cm^2 so **a** has the largest area

4 57 cm^2

5 About 3 kg (3060 g)

6 5 cm

7 **a** 45 cm^2 **b** 24 cm^2

8 64.7%

9.4 Sectors

HOMEWORK 9D

1 **a** 8.7 cm, 43.6 cm^2 **b** 11 cm, 38.5 cm^2

2 2.5π cm 6.25π cm^2

3 **a** 51.4 cm **b** 80.5 cm

4 **a** 134 cm^2 **b** 222.7 cm^2

5 268 m^2

6 26.1 cm

7 707 cm^2

8 Unshaded part is 96.6 cm^2

9.5 Volume of a prism

HOMEWORK 9E

1 **a** 10.5 m^2, 42 m^3 **b** 25 m^2, 250 m^3

2 21.5 cm^2

3 **a** 90 cm^3 **b** 45 cm^3

4 **a** **i** is the heaviest (190 g)
b **ii** is the lightest (187.8 g) (**iii** weighs 189 g)

9.6 Cylinders

HOMEWORK 9F

1 **a** 100π cm^3 **b** 40π cm^2

2 **a** 3400 cm^3 **b** 850 cm^2

3 **a** **i** 785 cm^3 **ii** 471 cm^2
b **i** 393 cm^3 **ii** 314 cm^2

4 2 cm

5 18 cm

6 3 cm

7 159 cm^3

8 297 cm^2

9 125π cm^3

10 79.6 cm^3

11 10.4 cm

12 208 cylinders

9.7 Volume of a pyramid

HOMEWORK 9G

1 **a** 70 cm^3 **b** 2080 cm^3

2 600 cm^3

3 294 cm^3

4 6.95 million tonnes

5 120 m^3

6 3 cm

7 171.5 cm^3

9.8 Cones

HOMEWORK 9H

1 **a** **i** 8042 cm^3 **ii** 2513 cm^2
b **i** 302 cm^3 **ii** 302 cm^2

2 40π cm^2

3 96π cm^3

4 **a** 62.8 cm **b** 10 cm **c** 12 cm
d 120π cm^2 **e** 6.63 cm **f** 695 cm^3

5 6.8 cm

6 900 cm^2

7 2.8 cm

8 216

9.9 Spheres

HOMEWORK 9I

1 **a** 36π cm^3 **b** 4500π cm^3

2 **a** 64π cm^2 **b** 100π cm^2

3 Volume = 14 000 cm^3, surface area = 2800 cm^2

4 **a** 4.0 cm **b** 3.6 cm

5 4.6 cm

6 752 cm^3

7 108 cm^2

8 About 30 million

9 **a** 240π cm^3 **b** 132π cm^2

10.1 Drawing linear graphs from points

HOMEWORK 10A

1 Check student's straight-line graph with end points at: (0, 3) and (5, 13)

2 Check student's straight-line graph with end points at: (0, −1) and (5, 14)

3 Check student's straight-line graph with end points at: (0, −2) and (12, 4)

4 Check student's straight-line graph with end points at: (−2, −3) and (2, 5)

5 Check student's straight-line graph with end points at: (−6, 2) and (6, 8)

6 **a** Check student's straight-line graphs with end points at: (0, −1) and (5, 14), and (0, 3) and (5, 13)
b (4, 11)

7 **a** Check student's straight-line graphs with end points at: (0, −3) and (6, 21), and (0, 2) and (6, 20)
b (5, 17)

8 **a** Check student's straight-line graphs with end points at: (0, 1) and (12, 7), and (0, 2) and (12, 6)
b (6, 4)

9 **a** Check student's straight-line graphs with end points at: (0, 3) and (4, 11), and (0, −1) and (4, 7)
b No, the lines have the same gradient and so are parallel.

10 **a**

x	0	1	2	3	4	5	6
y	6	5	4	3	2	1	0

b Check student's graph of $x + y = 3$, through (0, 3) and (3, 0).

11 **a**

b 2 kilometres

12 Two lines with a sum or difference ($a \pm b$) of 2, e.g. $y = 1$, $x = 1$, or $x = 3$, $y = 5$.

10.2 Gradient of a line

HOMEWORK 10B

1 **a–f** Check student's diagrams.

2 **a** **i–viii** Check student's diagrams.
b **i–viii** Check student's diagrams.
c Check student's descriptions.

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

g $-\frac{1}{4}$ **h** $\frac{1}{6}$ **i** 7 **j** −4

4 a Approximately 225 feet in 0.6 of a mile (3168 feet), so gradient is about 0.07

b Approximately 500 feet in 0.4 miles (2112 ft), so gradient is about 0.24

c Category AS; approximately 1000 feet of climbing in 3.1 miles ≈ 322 feet of ascent on average

5 First line has a gradient of 1.2 and second has a gradient of 4.8, so ratio is 1 : 4

6 4 : 5, 5 : 7, 6 : 13, 3 : 7, 1 : 3, 2 : 9

10.3 Drawing Graphs by Gradient-Intercept and Cover-Up Methods

HOMEWORK 10C

1 a–h Check student's diagram(s).

2 a i–ii Check student's diagram

b $(-3, -7)$

3 a They have the same gradient: (4)

b They intercept the y-axis at the same point: (0, −3)

c (0, −3)

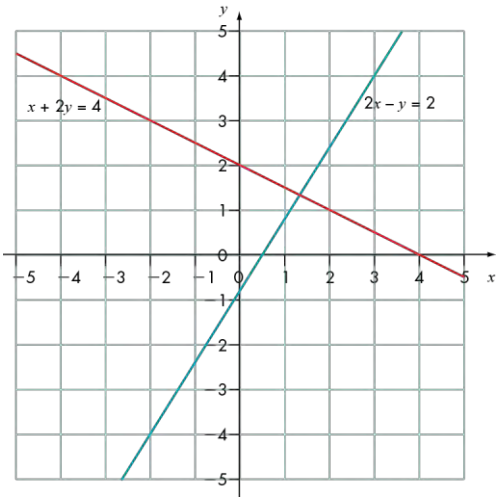
4 a −3 **b** $\frac{1}{3}$ **c** 90°

d Negative reciprocal **e** 2

HOMEWORK 10D

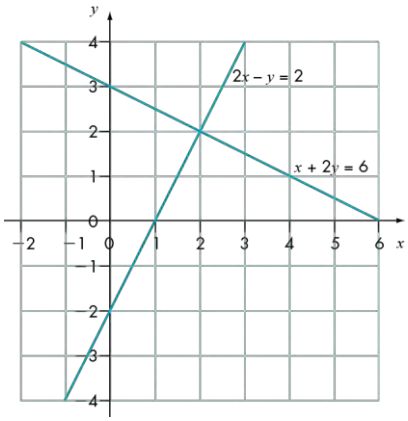
1 a–l Check student's diagrams.

2 a i–ii



b $x = 1.6$, $y = 1.2$

3 a i–ii



b $x = 2$, $y = 2$

4 a They both have a y-intercept of 3, so they intersect at: (0, 3)

b They both cross the x-axis (so they intersect) at: (3, 0)

c $a = 3$, $b = 8$, so $3x - 8y = 12$

5 a i $y = -3$ **ii** $x - y = 4$ **iii** $y = x + 5$ **iv** $x + y = -5$

b −2

10.4 Finding the equation of a line from its graph

HOMEWORK 10E

1 a i $y = x$, $y = -x$

ii Reflection in x- and y-axes

b i $y = \frac{1}{2}x + 2$, $y = -\frac{1}{2}x + 2$

ii Reflection in y-axis and $y = 2$

c i $2y = 5x + 3$, $2y = -5x + 13$

ii Reflection in $x = 1$ and $y = 4$

2 $y = 2x + 4$, $y = 2x - 6$, $y = -\frac{1}{2}x + 4$, $y = -\frac{1}{2}x + \frac{3}{2}$

3 a The x-coordinates go $-2 \rightarrow -1 \rightarrow 0$ and y-coordinates go $5 \rightarrow 3 \rightarrow 1$

b The x-step between the points is 1 and the y-step is −2

c $y = -3x + 2$

4 $3x + y = 12$

5 (3, 5)

6 Richard is correct. The equation of the line is $y = 2x - 3$, so when $x = 4$, $y = 5$

10.5 Real-life uses of Graphs

HOMEWORK 10F

1 a £4 **b** 0.06

c $C = 4 + (0.06 \times \text{number of units})$ or $C = 4 + 0.06x$

2 a £10 **b** 0.02

c $C = 10 + (0.02 \times \text{number of units})$

3 **a** £25 **b** 0.05
c $C = 25 + (0.05 \times \text{number of units})$

4 **a** **i** $y = -2x + 20$ **ii** $y = -x + 15$
iii $y = -\frac{1}{2}x + 10$
b 62.5 square units

10.6 Solving simultaneous equations using graphs

HOMEWORK 10G

1 **a** (5, −1) **b** (3, 7) **c** (−1, 3)
d Parallel **e** (4, −2) **f** (1.5, 6.5)
g (−3, 8) **h** (−1, 5) **i** (−3, 3)
j (−2, 4) **k** (2.5, 3.5) **l** (3.5, −1.5)

2 $2x + 3y = 7$, $2x + y = 4$
Graphs intersect at (1.25, 1.5), so cake costs £1.50 and coffee costs £1.25

3 **a** **i** R and S **ii** Q and S
iii P and R **iv** Q and P
b (6, −6)

10.7 Parallel and perpendicular lines

HOMEWORK 10H

1 **a** The line is parallel to the original line, intersecting the 'charge' axis at a point halfway to the origin.
b The line passes through the origin with the gradient double that of the original line.

2 **a** $y = 2x + 1$ **b** $y = -4x + 1$
c $y = \frac{1}{2}x + 1$ **d** $y = -\frac{1}{4}x + 1$

3 **a** $y = 3x + 4$ **b** $y = \frac{1}{4}x - 1$ **c** $y = -x + 2$

4 $y = -\frac{1}{2}x + 9$

11.1 Pythagoras' theorem

HOMEWORK 11A

1 **a** 5 cm **b** 4.41 cm **c** 10.6 cm
d 35.4 cm **e** 20 cm **f** 19.2 cm

2 **a** 40.15 m **b** 2100 m^3

3 15 cm, because $7.5^2 + 10^2 = 12.5^2$

4 3.81 metres, so the beam is long enough

11.2 Finding a shorter side

HOMEWORK 11B

1 **a** 23.7 cm **b** 22.3 cm **c** 6.9 cm **d** 32.6 cm
e 8.1 cm **f** 760 m **g** 0.87 cm **h** 12 m

2 **a** 10 m **b** 27.2 cm **c** 29.4 m **d** 12.4 cm

3 6.7 m

4 **a** 8.2 cm **b** 8.0 cm

5 9 cm and 12 cm

11.3 Applying Pythagoras' theorem in real-life situations

HOMEWORK 11C

1 Yes, because the ladder reaches 3.6 m so she can reach 4.6 metres

2 9 m

3 3.23 m

4 14.14 m

5 10 km

6 3.22 km

7 **a** 7.9 m **b** 3.9 m

8 $\sqrt{2}$

9 12 cm^2

10 Yes, $61^2 = 60^2 + 11^2$

11 76 units

12 **a** 1 cm represents 2.5 km or 1:250 000
b 40.4 km

13 7 metres

14 The diagonal of the drawer is $\sqrt{40^2 + 33^2} = 51.8$ cm, so it will fit in the drawer if it is put in at an angle.

11.4 Pythagoras' theorem and isosceles triangles

HOMEWORK 11D

1 32.8 cm^2, 9.17 cm^2

2 36.7 cm^2

3 43.3 cm^2

4 **a** 173.2 cm^2
b Only the lengths have doubled; the area has quadrupled.

5 **a** Student's sketches
b 8, 8, 6 has area 22.25 cm^2 and 6, 6, 8 has 17.9 cm^2

6 54.5 mm^2

7 56.7%

8 The string stretches to 49.2 cm; it stretches by 4.2 cm.

11.5 Pythagoras' theorem in three dimensions

HOMEWORK 11E

1 Yes

2 Yes

3 **a** 21 cm and 18.4 cm **b** 13.4 cm

4 14.1 m and 14.5 m

5 **a** DG = 11.2 cm **b** HA = 7.1 cm
c DB = 11.2 cm **d** AG = 12.2 cm

6 26 cm

7 14.1 cm

8 42 cm

9 **a** AC = 9.9 cm **b** EX = 10.9 cm
c EM = 11.5 cm

11.6 Trigonometric ratios

HOMEWORK 11F

1 **a** 0.788 **b** 0.719 **c** 0.972 **d** 1

2 **a** 0.616 **b** 0.695 **c** 0.237 **d** 0

3 **a** 1 **b** 1 **c** 1 **d** 1 **e** All 1

4 **a** 1.280 **b** 1.036 **c** 4.102 **d** 0

5 **a** 1.280 **b** 1.036 **c** 4.102
d 0 **e** same

6 **a** 4.915 **b** 4.950 **c** 11.967 **d** 15.626

7 **a** 7.325 **b** 9.899 **c** 14.123 **d** 25.599

8 Sin $x = \frac{5}{13}$, cos $x = \frac{12}{13}$, tan $x = \frac{5}{12}$

9 Draw a right-angled triangle and label angle x, the opposite side 5, and the hypotenuse $\sqrt{34}$. Use pythagoras to find the other side = 3. Then tan $x = \frac{5}{3}$

11.7 Calculating angles

HOMEWORK 11G

1 **a** 23.6° **b** 45.0° **c** 61.5° **d** 41.8°

2 **a** 66.4° **b** 45.0° **c** 28.5° **d** 70.5°

3 **a** 21.8° **b** 51.1° **c** 41.2° **d** 69.1°

4 **a** 22.0° **b** 19.5° **c** 17.5° **d** 38.7°

5 **a** 68.0° **b** 70.5° **c** 72.5° **d** 51.3

6 **a** 20.6° **b** 56.3° **c** 35.5° **d** 75.3°

7 36.0°

11.8 Using the sine and cosine functions

HOMEWORK 11H

1 **a** 15.7 **b** 21.3 **c** 80.9°
d 18.6 **e** 30° **f** 97.1

2 **a** 3.5 **b** 14.95 **c** 17.5

3 **a** 11.5 km **b** 230°

HOMEWORK 11I

1 **a** 67.4° **b** 11.3 **c** 42.8°
d 20.5 **e** 72.1 **f** 54.1°

2 **a** 14 **b** 45 **c** 3.5

3 **a** 6.71 km **b** 48.2°

11.9 Using the tangent function

HOMEWORK 11J

1 **a** 15.3 **b** 4.61 **c** 53.4°
d 7.64 **e** 29.1° **f** 29.9

2 **a** 6 **b** 30 **c** $\frac{10}{3}$

3 81.5°

11.10 Which ratio to use

HOMEWORK 11K

1 **a** 65.0° **b** 14.9 **c** 153.3
d 26.7° **e** 327 **f** 49.3°
g 48.2° **h** 230 **i** 45.8

2 6 cm

3 **a** 9.4 m **b** 65.9°

4 12.6 cm

11.11 Solving problems using trigonometry

HOMEWORK 11L

1 70.3°

2 2.74 m to 1.39 m; 7.52 m to 7.88 m

3 Use tan 42° to get a height of 54 m

4 5.04 m

5 29°

6 3.88 m

7 31 metres

8 The swing will rise to a maximum height of 86 cm, or 36 cm above its initial height.

HOMEWORK 11M

1 13.5 km

2 115 m

3 8.5 m

4 29.5° (30° to the nearest degree)

5 31°

6 0.4° (0° to the nearest degree)

7 **a** 64 m **b** 9.1° (9° to the nearest degree)

8 63 metres

9 It is probably between 23 and 28 metres high.

11.12 Trigonometry and bearings

HOMEWORK 11N

1 **a** 78.2 km **b** 33.2 km

2 **a** 010.3° **b** 190.3°

3 $90 + \tan^{-1}\left(\frac{80}{100}\right) = 129$

4 3.94 km

5 **a** 67.8 km **b** 15.9 km **c** 17.0 km
d 168.6°

6 **a** **i** Example of proof: Remaining angle at L between LA and the vertical is 180 − 136 = 44° (angles on a straight line). Therefore the angle at A between LA and the vertical (North) is 44° because LA is transversal between the two North parallel lines. Therefore x = 180 − 90 − 44 = 46° (angles on a straight line).
ii 226°
b 170 km
c **i** 28.1° **ii** 344.1°

7 286 kilometres

8 Yes; it is only 275 metres from the shore.

11.13 Trigonometry and isosceles triangles

HOMEWORK 11O

1 **a** 9.59 cm **b** 20.4°

2 17.4 m

3 **a** 30.1 cm^2 **b** 137.2 cm^2

4 63.6 cm^2, 59.7 cm^2

5 224 cm^2

6 34°

12.1 Similar triangles

HOMEWORK 12A

1 **a** 3.5 **b** 2.5

2 **a** Two sides in same ratio, included angle same
b 2 : 3 **c** Q **d** CA

3 **a** 4.8 cm **b** 4.88 cm

4 120 cm

5 BC is 10 cm; CD is 15 cm

6 AC = 12 cm

7 **a** One corresponding angle equal. Two corresponding sides are in the same ratio.
b 1 : 3 or scale factor 3
c 5 cm **d** 15 cm

HOMEWORK 12B

1 **a** ACD and ABE; 9.6 cm
b ABD and EDC; $1\frac{8}{9}$ cm

2 **a** x = 6.875 cm, y = 3.375 cm
b x = 12 cm, y = 12.5 cm

3 3.69 m

4 2 m

5 13.3 cm

6 No: corresponding sides are not in the same ratio; CD should be 12.5 cm

HOMEWORK 12C

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

2 **a** 20 cm **b** x = 5 cm, y = 7 cm
c x = 11.25 cm, y = 6 cm
d x = 20 cm, y = 20.4 cm
e x = 5 cm, y = 7 cm

12.2 Areas and volumes of similar shapes

HOMEWORK 12D

1 **a** 9 : 49 **b** 27 : 343

2

Linear scale factor	Linear ratio	Linear fraction	Area scale factor	Volume scale factor
4	1 : 4	$\frac{4}{1}$	16	64
$\frac{1}{2}$	2 : 1	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$
$\frac{1}{10}$	10 : 1	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$
6	1 : 6	$\frac{6}{1}$	36	216
5	1 : 5	$\frac{5}{1}$	25	125

3 320 cm^2

4 **a** 10 800 cm^3 **b** 50 000 cm^3

5 $\left(\frac{36}{12}\right)^3 \times 4 = 108$ litres

6 12.15 m^3

7 The large tin holds 2700 ml. He can fill 3 small tins.

8 **a** 21% **b** 33.1%

9 **d**, 810 cm^3

HOMEWORK 12E

1 **a** 13.8 cm, 25.2 cm **b** 63 cm^2, 30.1 cm^2

2 0.25 kg

3 **a** 6 m^2 **b** 20 000 cm^3

4 76.8 cm^3

5 16.2 cm

6 17.3 cm and 23.1 cm

7 **c** 27 : 125

13.1 Experimental probability

HOMEWORK 13A

1 **a** 0.2 0.3 0.36 0.42 0.384 **b** 0.4 **c** 2000

2 **a** 0.16 0.253 0.142 0.17 0.103 0.168
b 100 **c** No, 2 occurs too often

3 **a**

Red	White	Blue
0.31	0.52	0.17
0.272	0.48	0.248
0.255	0.508	0.238
0.254	0.504	0.242

b The last line of the relative frequency table is likely to be the closest to the truth because it results from the highest sample frequency (500). The likely ratio of balls in the bag is therefore R : W : B :: 127 : 252 : 121. We know there are 50 balls, so this likely ratio gives R : W : B :: 13 : 25 : 12. For example, (127/500) × 50 = 13 red balls (to the nearest whole number).

4 **a** C **b** A **c** C **d** A
e B **f** A **g** B

5 **a** **i** 0.2 **ii** 0.7 **iii** 0.6
b 10

6 Monday 0.145; Tuesday 0.166; Wednesday 0.134; Thursday 0.141; Friday 0.146

7 The spinner could be considered unfair since the 3 only landed 32 times and the majority of the other numbers landed over the anticipated 40 times.

8 Although you would expect the probability to be close to $\frac{1}{2}$ hence 25 tails, we know that there is more chance of the number of tails being **close to** 25 rather than **actually** 25.

13.2 Mutually exclusive and exhaustive events

HOMEWORK 13B

1 **a** Yes **b** Yes **c** Yes **d** No **e** No

2 Also exhaustive: **b** − Throwing an even number with a dice/throwing an odd number with a dice.

3 **a** **i** $\frac{4}{11}$ **ii** $\frac{2}{11}$ **ii** $\frac{4}{11}$
b **i** Yes **ii** Yes **iii** Yes
c **iii** − Picking an I / picking a consonant

4 **a** Ann, Joan; Ann, Jack; Ann, John; Ann, Arthur; Ann, Ethel; Joan, Jack; Joan, John; Joan, Arthur; Joan, Ethel; Jack, John; Jack, Arthur; Jack, Ethel; John, Arthur; John, Ethel; Arthur, Ethel
b **i** $\frac{1}{5}$ **ii** $\frac{1}{5}$ **iii** $\frac{4}{15}$ **iv** $\frac{11}{15}$
c **i, ii, iv**
d **ii**

5 $\frac{1}{6}$

6 **a** **i, iv, v**
b **i**: answers will vary regarding explanation about why they are not mutually exclusive.

7 May be windy and rainy. Windy and rainy are not mutually exclusive events.

8 0.05

9 These are not mutually exclusive events

13.3 Expectation

HOMEWORK 13C

1 100

2 250

3 **a** 52 **b** 8 **c** 4 **d** 2

4 18

5 **a** 100 **b** 100 **c** 130 **d** 0

6 120

7 1667

8 **a** One cannot add probabilities for events like this.
b Increase, as he is more experienced

9 **a** 33 **b** 83

10 **a** 28 000
b 90% of 112 is 100.8 out of 200, so they should win.

11 Three times

12 Multiply the number of students by 0.14

13.4 Probability and two-way tables

HOMEWORK 13D

1 **a** 9 **b** 16 **c** 40% **d** 71.4%

2 **a** 18% **b** 13% **c** £170
d Female; there are about twice as many male students as female students, but two of the three highest categories have a much greater proportion of female earners.

3 **a**

	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**
5	7	8	9	10	11	12	13	14
6	8	9	10	11	12	13	14	15
7	9	10	11	12	13	14	15	16
8	10	11	12	13	14	15	16	17
9	11	12	13	14	15	16	17	18

b 7 or 18 **c** $\frac{1}{10}$ **d** $\frac{37}{40}$ **e** 0.5

4 $\frac{20}{36}$

5 Either Harold, as he had bigger tomatoes, or Connie, as she had more tomatoes.

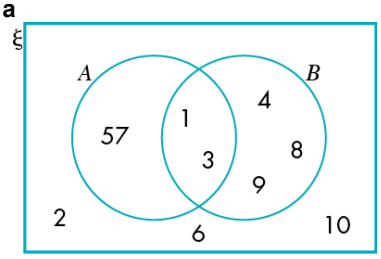
13.5 Probability and Venn diagrams

HOMEWORK 13E

1 **a** 0.8 **b** 0.4

2 **a** 0.65 **b** 0.55

3 **a**

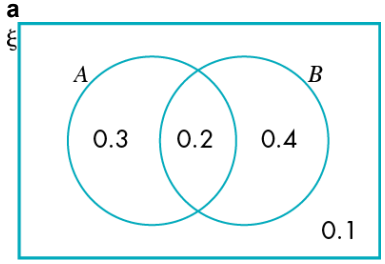


b **i** $\frac{4}{10}$ **ii** $\frac{6}{10}$ **iii** $\frac{3}{10}$
iv $\frac{7}{10}$ **v** $\frac{7}{10}$ **vi** $\frac{2}{10}$

4 **a** **i** $\frac{32}{100}$ **ii** $\frac{68}{100}$ **iii** $\frac{67}{100}$
iv $\frac{33}{100}$ **v** $\frac{87}{100}$ **vi** $\frac{12}{100}$

b $\frac{55}{100}$

5 **a**



b **i** 0.6 **ii** 0.9 **iii** 0.2

6 **a** 130
b **i** $\frac{15}{130}$
ii students who catch the bus to school and walk home
c $\frac{5}{13}$

7 0.5

8 0.67

9 **a** $P(A \cap B')$ **b** $P(A \cap B)$

14.1 Powers (indices)

HOMEWORK 14A

1 **a** 5^4 **b** 7^5 **c** 19^3 **d** 4^5
e 1^7 **f** 8^5 **g** 6^1 **h** 11^6
i 0.9^4 **j** 999^3

2 **a** $4 \times 4 \times 4 \times 4 \times 4$ **b** $8 \times 8 \times 8 \times 8$
c $5 \times 5 \times 5$
d $9 \times 9 \times 9 \times 9 \times 9 \times 9$
e $1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1$
f $7 \times 7 \times 7$
g $5.2 \times 5.2 \times 5.2$
h $7.5 \times 7.5 \times 7.5$
i $7.7 \times 7.7 \times 7.7 \times 7.7$
j $10\,000 \times 10\,000 \times 10\,000$

3 **a** 625 **b** 16 807 **c** 6859
d 1024 **e** 1 **f** 32 768
g 6 **h** 1 771 561 **i** 0.6561
j 997 002 999

4 **a** 1024 **b** 4096 **c** 125
d 531 441 **e** 1 **f** 343
g 140.608 **h** 421.875 **i** 3515.3041
j 1 000 000 000 000

5 **a** 1 m^3 **b** 0.28 m^3

6 **b** 4^2 or 2^4 **c** 5^3 **d** 8^2 or 4^3 or 2^6

7 **a** 1 **b** 9 **c** 1
d 1 **e** 100 000

8 **a** −8 **b** −1 **c** 81
d −125 **e** 1 000 000

9 **a** 125 **b** 625

14.2 Rules for multiplying and dividing powers

HOMEWORK 14B

1 **a** 7^5 **b** 7^9 **c** 7^7
d 7^6 **e** 7^{14} **f** 7^8

2 **a** 5^4 **b** 5^6 **c** 5^1
d 5^0 **e** 5^2

3 **a** a^3 **b** a^5 **c** a^7
d a^4 **e** a^2 **f** a^1

4 **a** Any two values such that: $x + y = 6$
b Any two values such that: $x - y = 6$

5 **a** $15a^6$ **b** $21a^5$ **c** $30a^6$
d $12a^9$ **e** $-125a^8$

6 **a** $4a^3$ **b** $3a^5$ **c** $5a^5$
d $8a^9$ **e** $3a^8$ **f** $6a^{-4}$

7 **a** $12a^6b^3$ **b** $14a^4b^8$ **c** $20a^7b^4$
d $3a^2b^4$ **e** $4ab^8$

8 **a** $2a^3b$ **b** $2ab^{-1}c^2$ **c** $9a^4b^5c^4$

9 **a** For example: $6x^3 \times 3y^4$ and $9xy \times 2x^2y^3$
b For example: $36x^3y^6 \div 2y^2$ and $18x^6y^8 \div x^3y^4$

10 36

11 Let $x = 0$ and $y = 1$, so

$$a^0 \div a^1 = \frac{a^0}{a^1} = a^{0-1} = a^{-1} = \frac{1}{a^1}$$

14.3 Standard form

HOMEWORK 14C

1 **a** 120 000 **b** 200 000 **c** 14 000
d 21 000 **e** 900 **f** 125 000
g 40 000 **h** 6000 **i** 300 000
j 7500 **k** 140 000

2 **a** 5 **b** 300 **c** 35
d 40 **e** 3 **f** 150
g 14 **h** 50 **i** 6
j 15 **k** 4 **l** 200

3 **a** 23 **b** 230 **c** 2300 **d** 23 000

4 **a** 54 **b** 540 **c** 5400 **d** 54 000

5 **a** 0.23 **b** 0.023 **c** 0.0023 **d** 0.000 23

6 **a** 0.54 **b** 0.054 **c** 0.0054 **d** 0.000 54

7 **a** 350 **b** 21.5 **c** 6740
d 46.3 **e** 301.45 **f** 78 560
g 642 **h** 0.67 **i** 85
j 79 800 **k** 658 **l** 21 530
m 889 000 **n** 35 214.7 **o** 37 284.1
p 34 280 000

8 **a** 45.38 **b** 43.5 **c** 76.459
d 64.37 **e** 42.287 **f** 0.2784
g 2.465 **h** 7.63 **i** 0.076
j 0.008 97 **k** 0.0865 **l** 0.015
m 0.000 000 879 9 **n** 0.234
o 7.654 **p** 0.000 073 2

9 **a** 730 **b** 329 000 **c** 7940
d 68 000 000 **e** 0.034 6 **f** 0.000 507
g 0.000 23 **h** 0.00089

10 Power 4 means more digits in the answer, so Saturn is the biggest.

11 $n = 4$

HOMEWORK 14D

1 **a** 0.23 **b** 0.023 **c** 0.0023 **d** 0.000 23

2 **a** 0.54 **b** 0.054 **c** 0.0054 **d** 0.000 54

3 **a** 23 **b** 230 **c** 2300 **d** 23 000

4 **a** 54 **b** 540 **c** 5400 **d** 54 000

5 **a** 350 **b** 41.5 **c** 0.005 7 **d** 0.038 9
e 4600 **f** 86 **g** 397 000 **h** 0.003 65

6 **a** 7.8×10^2 **b** 4.35×10^{-1}
c 6.78×10^4 **d** 7.4×10^9
e 3.078×10^{10} **f** 4.278×10^{-4}
g 6.45×10^3 **h** 4.7×10^{-2}
i 1.2×10^{-4} **j** 9.643×10^1
k 7.478×10^1 **l** 4.1578×10^{-3}

7 **a** 2.4673×10^7 **b** 1.5282×10^4
c 6.13×10^{11} **d** 9.3×10^7, 2.4×10^{13}
e 6.5×10^{-13}

8 1000

9 20 000

10 40

11 390 000 km

HOMEWORK 14E

1 **a** 3.68×10^4 **b** 9×10 **c** 4.17×10^{-1}
d 8×10^{-5} **e** 2.4×10^2 **f** 1.2×10^5
g 7.5×10^4 **h** 1.7×10^{-1} **l** 4.8×10^7

2 **a** 1.581×10^6 **b** 7.68×10 **c** 7.296×10^9
d 2.142×10^{-1} **e** 4.41×10^{10} **f** 6.084×10^{-5}
g 1.512×10^3 **h** 6.24×10^3 **l** 1.971×10^2

3 **a** 3×10^4 **b** 3×10^3

c 5×10^6 **d** 1.4×10^{-1}

4 **a** 2×10^2 **b** 4×10^2 **c** 4×10^{10}

5 800 million

6 Any value between $1.000\,000\,01 \times 10^6$ to 5×10^6, i.e. any value of the form $a \lozenge 10^6$ where $1 < a < 5$

7 **a** 1.68×10^{10} **b** $1.93 \lozenge 10^3$

8 5.3×10^9 miles^3

15.1 Linear equations

HOMEWORK 15A

1 **a** 18 **b** 28 **c** 64 **d** 6 **e** 12
f 12 **g** 1 **h** −2 **i** 18 **j** 15

2 Any valid equations

3 **a** 8 **b** 2 **c** 6 **d** 2 **e** 3
f −4 **g** 2.5 **h** −1.5

4 **a** $\frac{x-16}{8} = 11.25$ or $x = 8(11.25 + 2)$
b £106

5 Beth is correct. Arabella subtracted 3 before multiplying through by 6.

HOMEWORK 15B

1 **a** −1 **b** 10 **c** 1.5 **d** 3 **e** 1
f −0.5 **g** 2 **h** −1 **i** 7 **j** 7
k 4.5 **l** 2 **m** −5 **n** −3 **o** 0
p 5 **q** 0.25 **r** −1 **s** 1 **t** −2

2 Length is 9 m; width is 5 m; area is 45 m^2. Carpet costs £13.50 per square metre.

3 $a = 5$, $b = 2$, $c = 4$

4 Zak is wrong, as he has not multiplied the bracket correctly to get $10x + 3 = 13$ in both cases. First equation $x = -0.2$, second equation $x = 0.7$

HOMEWORK 15C

1 **a** $x = 1$ **b** $y = 1$ **c** $a = 2$
d $t = 5$ **e** $p = 3$ **f** k = 3
g $d = 7$ **h** $x = 21$ **i** $y = 6$

2 $5x + 120 = 3x + 908$, $2x = 788$, $x = 394$. The mass of a can of rice pudding is 394 g.

3 $x = 4$, perimeter = 27 cm

4 $5x + 2 = 3x - 6$, $x = -4$

5 **a** $b = 3$ **b** $c = 2$

6 $x = 9$

7 **a** Both sides contain $12x$ which if you solved leaves $20 = 6$ which is clearly not possible.
b Both sides of the equation are the same so x could be any number.

15.2 Elimination method for simultaneous equations

HOMEWORK 15D

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

2 **a** $a = 4, b = 3$ **b** $c = 6, d = 4$ **c** $e = 7, f = 3$

3 $x = 10, y = 6$

15.3 Substitution method for simultaneous equations

HOMEWORK 15E

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

2 **a** $x = 1, y = 4$ **b** $x = 5, y = 3$ **c** $x = 6, y = 2$

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

15.4 Balancing coefficients to solve simultaneous equations

HOMEWORK 15F

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

2 **a** $x = 3, y = 1$ **b** $x = 7, y = 2$
c $x = 2.5, y = 3$ **d** $x = 7, y = -1$

15.5 Using simultaneous equations to solve problems

HOMEWORK 15G

1 CD £10.50, book £3.50

2 **a** $2x + 3y = 2850$, $3x + 2y = 3150$
b x = £7.50, y = £4.50

3 12 g in cakes and 13 g in peanuts

4 £2.28

5 £1.21

6 11.5 kg

7 **a** My age minus 5 equals 2 times (my son's age minus 5)
b $x = 61$ and $y = 33$

8 $4a + 2n = 204$, $5a + n = 171$ gives $a = 23$, $n = 56$. Total cost for Marcus is £5.40, so he will get £4.60 change.

9 $5c + 4p = 340$, $3c + 5p = 321$, $c = 32$ kg, $p = 45$ kg.
The bags weigh 552 kg, so Carol cannot carry the bags safely on her trailer.

10 (5.4, 2.8) is the solution to equations A and B.
(4, 0) is the solution to equations A and C.

(−3, 28) is the solution to B and C.
(5, −4) is the solution to C and D.

15.6 Solving inequalities

HOMEWORK 15H

1 **a** $x < 5$ **b** $t > 8$ **c** $p > 8$ **d** $x < 3$
e $y < 6$ **f** $x < 13$ **g** $t > 37$ **h** $x < 10$
i $x < 2$ **j** $t > \frac{7}{4}$ **l** $t < 4$ **m** $y < 6$
n $x > \frac{1}{2}$ **k** $x > -6$ **o** $w < 3.5$ **p** $x < \frac{5}{8}$

2 **a** 5, 4, 3, 2, 1 **b** No answer
c 25, 16, 9, 4, 1 **d** 5, 3, 1
e 7, 5, 3, 2

3 $3x + 3.50 < 6$, $3x < 2.50$; so the most a can could have cost was 83p

4 **a** $2 < x < 3$ **b** $1 < x < 4$
c $-2 < x < 4$ **d** $2 \leq x < \frac{19}{3}$
e $3.5 \leq x < 7.5$ **f** $\frac{1}{2} \leq x < 3.75$
g $2 \leq x \leq 4$ **h** $\frac{5}{2} \leq x < 8$
i $\frac{4}{5} \leq x < 4.2$

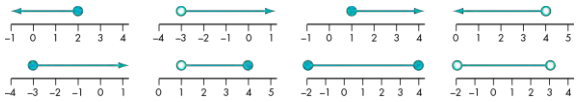
5 $6x - 2 > 10$, so $x > 2$ or $6x - 2 < 16$, so $x < 3$; hence the sides are 2 by 3 or 3 by 5, so the area is between 6 cm^2 and 15 cm^2

6 **a** **i** $x > 0$, $x = 2$, $x < 9$
ii $x = 3$, $x \geq 3$, $x < 2$
b Any value between 4 (inclusive) and 9 (not included)

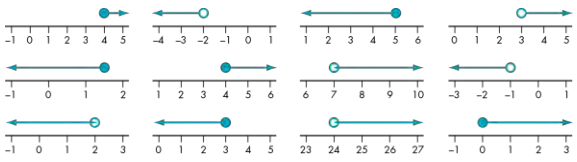
HOMEWORK 15I

1 Top row from left to right: $x \geq 1$; $x < 2$; $x > -2$

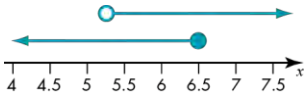
2 **a-h**



3 **a** $x \geq 4$ **b** $x < -2$ **c** $x \leq 5$ **d** $x > 3$
e $x \leq 1.5$ **f** $x \geq 4$ **g** $x > 7$ **h** $x < -1$
i $x < 2$ **j** $x \leq 3$ **k** $x > 24$ **l** $x \geq 0$



4 **a** Because 2 CDs plus the DVD cost more than £20; $x > 5.25$
b Because 2 CDs plus the lipstick cost less than £20; $x \leq 6.5$
c

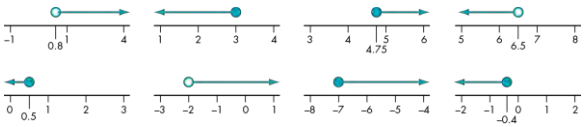


d £6

5 Any two inequalities that overlap only on the integers 5, 6, 7 and 8; for example, $x \geq 5$ and $x < 9$

6 $x = 3$

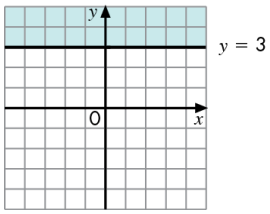
7 **a** $x > \frac{4}{5}$ **b** $x \leq 3$ **c** $x \geq \frac{19}{4}$ **d** $x < 6.5$
e $x \leq \frac{1}{2}$ **f** $x > -2$ **g** $x \geq -7$ **h** $x \leq -\frac{2}{5}$



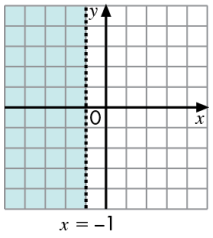
15.6 Graphical inequalities

HOMEWORK 15J

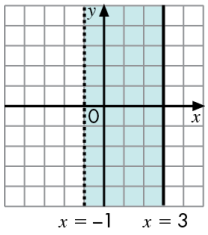
1 **a-b**



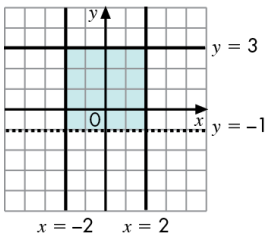
2 **a-b**



3 **a-c**

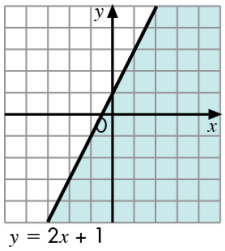


4 **a**

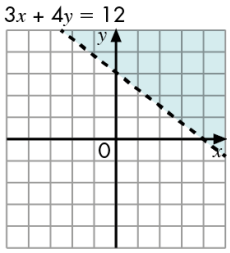


b **i** Yes **ii** Yes **iii** No **iv** Yes

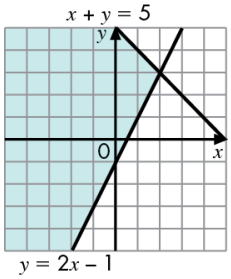
5 **a–b**



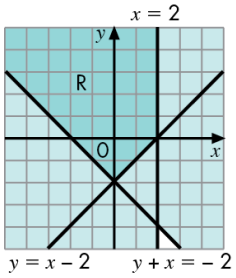
6 **a–b**



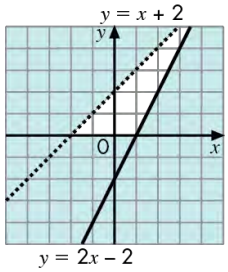
7 **a–c**



8 **a–b**

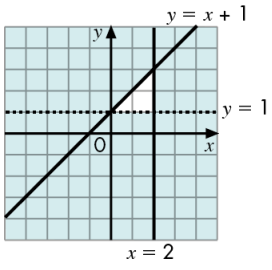


9 **a** The white below satisfies all three inequalities



b **i** No **ii** No **iii** Yes **iv** No

10 **a** The white area satisfies all three inequalities



b (1, 2) (2, 2) (2, 3)

11 For example, $y \geq 1$, $x \leq 2$ and $y \leq x$. There are many other valid answers.

15.7 Trial and Improvement

HOMEWORK 15K

1 **a** 1 and 2 **b** 3 and 4 **c** 4 and 5 **d** 4 and 5

2 **a** 3.2 **b** 4.6 **c** 5.4 **d** 7.0

3 3.7

4 4.7

5 3.3

6 10.7 and 18.7 cm

7 21.8 and 36.8 m

8 5.4 and 7.4 cm

9 12.6 and 9.6 cm

10 **a** $x^3 + 3x^2 = 1000$ **b** 9.1 cm

11 7.6 and 2.6

16.1 Rational numbers, reciprocals, terminating and recurring decimals

HOMEWORK 16A

1 **a** 0.75 **b** $0.0\dot{6}$ **c** 0.04 **d** $0.\dot{0}\dot{9}$ **e** 0.05

2 **a** $\frac{4}{13} = 0.\dot{3}07692\dot{}$; $\frac{5}{13} = 0.0\dot{3}84615\dot{}$;
$\frac{6}{13} = 0.\dot{4}61538\dot{}$; $\frac{7}{13} = 0.\dot{5}38461\dot{}$;
$\frac{8}{13} = 0.\dot{6}15384\dot{}$; $\frac{9}{13} = 0.\dot{6}92307\dot{}$;
$\frac{10}{13} = 0.\dot{7}69230\dot{}$; $\frac{11}{13} = 0.\dot{8}46153\dot{}$;
$\frac{12}{13} = 0.\dot{9}23076\dot{}$

b Repeating numbers are cyclic and belong to one of two sets of numbers

3 $\frac{1}{5}$; $\frac{2}{9}$; $\frac{23}{100}$; $\frac{3}{11}$; $\frac{2}{7}$

4 **a** $\frac{57}{100}$ **b** $\frac{11}{40}$ **c** $\frac{17}{20}$ **d** $\frac{3}{50}$ **e** $3\frac{13}{20}$

5 Reciprocal of 1 = 1 ÷ 1 = 1

6 **a** 4 **b** 5
c The reciprocal of a reciprocal is always the original number

7 **a** For example, the reciprocal of 2 is $\frac{1}{2}$

b For example, the reciprocal of $-\frac{1}{2}$ is −2

8 **a** 2.424 242 **b** 2.4 **c** 24

d $\frac{24}{990}$ **e** $\frac{4}{165}$

9 **a** $\frac{7}{9}$ **b** $\frac{19}{33}$ **c** $\frac{6}{11}$
d $\frac{275}{999}$ **e** $2\frac{5}{9}$ **f** $2\frac{4}{11}$
g $\frac{7}{110}$ **h** $2\frac{5}{66}$

10 **a** $\frac{17}{10}$
b **i** 17.7777… **ii** 16 **iii** $\frac{16}{9}$

16.2 Estimating powers and roots

HOMEWORK 16B

1 **a** 16 **b** 10 **c** 17 **d** 3

2 $2^2 + 5^3 + 3^3 = 156$

3 12 and 13

4 7 and 8

5 None are true

6 **a** Students generate a triple **b** Student's proof

7 Estimates:
a **i** 83 **ii** 7.5 **iii** 4 **iv** 60
b **i** 83.06 **ii** 7.42 **iii** 3.91 **v** 61.47

16.3 Negative and fractional powers

HOMEWORK 16C

1 $\frac{1}{1296}$

2 **a** $\frac{1}{25}$ **b** $\frac{1}{4}$ **c** $\frac{1}{1000}$
d $\frac{1}{27}$ **e** $\frac{1}{x^2}$ **f** $\frac{5}{t}$

3 **a** 2 **b** 7^{-1} **c** x^{-2}

4 **a** **i** 2^5 **ii** 2^{-2}
b **i** 10^4 **ii** 10^{-2}
c **i** 5^4 **ii** 5^{-3}

5 **a** **i** 9 **ii** $\frac{4}{3}$
b **i** $\frac{1}{25}$ **ii** $\frac{1}{125}$
c **i** $\frac{1}{8}$ **ii** 1

6 **a** $1\frac{1}{2}$ **b** $\frac{17}{72}$

7 $a = 5$ and $b = 2$

8 It could be either, since if d is even, d^3 is even, and if d is odd, d^3 is odd. c^2 is even, so even + even = even and even + odd = odd.

9 **a** $x^{-1}; x^0; x^1$ **b** $x^1; x^0; x^{-1}$
c $x^{-1}; x^1; x^0$

HOMEWORK 16D

1 **a** 6 **b** 12 **c** 5 **d** 14 **e** 2
f 5 **g** 2 **h** 12 **i** 3

2 **a** $\frac{5}{9}$ **b** 1.5 or $\frac{3}{2}$ or $1\frac{1}{2}$
c 0.75 or $\frac{3}{4}$ **d** $\frac{2}{3}$
e 0.4 or $\frac{2}{5}$ **f** 1.5 or $\frac{3}{2}$ or $1\frac{1}{2}$
g 1.25 or $\frac{5}{4}$ or $1\frac{1}{4}$ **h** 1.5 or $\frac{3}{2}$ or $1\frac{1}{2}$

3 $-25^{-\frac{1}{2}} = \frac{1}{5}$, others are both $\frac{1}{3}$

4 For example, the negative power gives the reciprocal, so $16^{-\frac{1}{4}} = \frac{1}{16^{\frac{1}{4}}}$. The power one-quarter means 'fourth root', so we need the fourth root of 16, which is 2 …, so $16^{\frac{1}{4}} = 2$ and $\frac{1}{16^{\frac{1}{4}}} = \frac{1}{2}$.

5 Any values where $x = y^2$. For example $x = 16$, $y = 4$.

HOMEWORK 16E

1 **a** 8 **b** 625 **c** 27

2 **a** $t^{\frac{3}{4}}$ **b** $m^{\frac{2}{5}}$

3 **a** 9 **b** 16 **c** 216 **d** 243

4 **a** 2.285 **b** 0.301

5 **a** 2 **b** 2^{-5} **c** $\frac{1}{5}$

6 $8^{-\frac{2}{3}} = \frac{1}{4}$; the others are both $\frac{1}{8}$

7 For example, the negative power gives the reciprocal, so $27^{-\frac{2}{3}} = \frac{1}{27^{\frac{2}{3}}}$.
The power one-third means 'cube root' so we need the cube root of 27, which is 3; and the power 2 means square, so $3^2 = 9$, so
$27^{-\frac{2}{3}} = 9$ and $\frac{1}{27^{\frac{2}{3}}} = \frac{1}{9}$

16.4 Surds

HOMEWORK 16F

1 **a** $2\sqrt{3}$ **b** $\sqrt{35}$ **c** 5 **d** 8

2 **a** $\sqrt{3}$ **b** 3 **c** 4 **d** $\sqrt{\frac{3}{2}}$

3 **a** $3\sqrt{2}$ **b** $5\sqrt{15}$ **c** $8\sqrt{2}$ **d** $4\sqrt{5}$

4 **a** $2\sqrt{3}$ **b** 3 **c** $4\sqrt{2}$ **d** $3\sqrt{3}$

5 **a** $3\sqrt{10}$ **b** $4\sqrt{2}$ **c** $3\sqrt{7}$ **d** $10\sqrt{3}$
e $5\sqrt{6}$ **f** $3\sqrt{30}$ **g** $4\sqrt{6}$ **h** $5\sqrt{5}$

6 **a** 80 **b** 32 **c** 120 **d** 36
e $10\sqrt{15}$ **f** 18 **g** 24 **h** 36
i $8\sqrt{2}$ **j** 9 **k** 15 **l** 1
m $5\sqrt{2}$ **n** 9 **o** 15

7 **a** 80 **b** 48 **c** 5

8 **a** $\frac{2}{9}$ **b** $\frac{16}{3}$

9 **a** $6\sqrt{2}$ **b** 16 **c** $9\sqrt{2}$

10 Statement is false: $a = 3$, $b = 4$, $\sqrt{(a^2 + b^2)} = 5$, $a + b = 7$

11 For example: $2\sqrt{3} \div \sqrt{3}$ (= 2)

HOMEWORK 16G

1 **a** $\frac{\sqrt{7}}{7}$ **b** $\frac{\sqrt{2}}{4}$ **c** $\frac{2\sqrt{5}}{5}$
d $\frac{\sqrt{2}}{4}$ **e** $\frac{5}{3}$ **f** $\frac{2\sqrt{6}}{3}$
g $\frac{3+\sqrt{3}}{3}$ **h** $\frac{3\sqrt{2}-2}{4}$

2 Student's proofs

3 **a** $3\sqrt{5} - \sqrt{10}$ **b** $6\sqrt{2} - 16$
c $24 + 24\sqrt{2}$ **d** $-1 - \sqrt{3}$
e $1 - \sqrt{5}$ **f** $8 + 2\sqrt{2}$

4 **a** $\sqrt{15}$ cm **b** 2 cm

5 **a** $\sqrt{2}$ cm^2 **b** $2\sqrt{3} + \sqrt{21}$ cm^2

6 **a** 22 **b** 34

7 **a** For example $3 + \sqrt{2}$ and $3 - \sqrt{2}$

b For examples $\sqrt{2}$ and $\sqrt{3}$

8 $\sqrt{3}$ is more than 1 and less than 2, since $\sqrt{1}$ = 1 and $\sqrt{4}$ = 2. So 1 + $\sqrt{3}$ is more than 2 and less than 3

16.5 Limits of accuracy

HOMEWORK 16H

1 **a** 4.5 cm to 5.5 cm
b 45 mph to 55 mph
c 15.15 kg to 15.25 kg
d 72.5 km to 77.5 km

2 **a** 45.7 **b** 20 **c** 0.32

3 **a** 6.5−7.5 **b** 17.5−18.5
c 29.5−30.5 **d** 746.5−747.5
e 9.75−9.85 **f** 32.05−32.15
g 2.95−3.05 **h** 89.5−90.5
i 4.195−4.205 **j** 1.995−2.005
k 34.565−34.575 **l** 99.5−105

4 **a** 5.5−6.5 **b** 33.5−34.5
c 55.5−56.5 **d** 79.5−80.5
e 3.695−3.705 **f** 0.85−0.95
g 0.075−0.085 **h** 895−905
i 0.695−0.705 **j** 359.5−360.5
k 16.5−17.5 **l** 195−205

5 If the estimate of how many will fail to turn up is correct, 266 seats will be taken with advanced sales. This leaves 99 seats free. If 95 to 99 extra people turn up, they all get seats. If 100 to 104 turn up, some will not get a seat.

6 A: The parking space is between 4.75 and 4.85 metres long and the car is between 4.25 and 4.75 metres long, so the space is big enough.

7 95 cl

8 **a** 15.5 cm **b** 14.5 cm **c** 310 cm **d** 290 cm

9 445−449

16.7 Problems involving limits of accuracy

HOMEWORK 16I

1 Minimum: 2450 grams or 2 kg 450 g; Maximum: 2550 grams or 2 kg 550 g

2 58

3 94, 95, 96 or 97

4 **a** 18.75−29.75 cm^2

b 20.002 5−20.962 5 cm^2

c 147.477 625−147.744 025 cm^2

5 **a** 7.5−8.5, 4.5−5.5 **b** 46.75 m^2
c 24 m

6 1401.75−1478.75 m^2

7 388.125−584.375 cm^3

8 10.5 − (1.75 + 2.75 + 3.75) = 2.25 metres

9 4 pm

10 16.12−17.23 m

11 13.67−18.66 cm^2

12 **a** 12.25 seconds, 12.35 seconds
b 99.995 m, 100.005 m
c 8.164 m/s

13 2.98 cm, 3.02 cm

14 24.93 cm, 25.07 cm

15 48.7°

16.8 Choices and outcomes

HOMEWORK 16J

1 38

2 **a** 40 320 **b** 2.65×10^{32}

3 10 000

4 **a** 120 **b** 70

5 **a** 60 **b** 35

6 **a** 10000 **b** 24

7 3360

8 **a** $\frac{1}{169}$ **b** $\frac{4}{663}$

9 12

10 5

17.1 Plotting quadratic graphs

HOMEWORK 17A

1 **a**

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

b $y = 4$ **c** ±2.2

2 **a**

x	−5	−4	−3	−2	−1	0	1	2	3	4	5
$y = x^2 + 3$	28	19	12	7	4	3	4	7	12	19	28

b y = 9.2 or 9.3 **c** ±2.6

3 **a**

x	−3	−2	−1	0	1	2	3	4
$y = x^2 - 3x + 2$	20	12	6	2	0	0	2	6

b 8.75 **c** −0.15, 3.15

4 B and C

17.2 Solving quadratic equations by factorisation

HOMEWORK 17 B

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

2 **a** $(x + 5)(x + 1) = 0$, $x = -1, -5$
b $(x + 3)(x + 6)=0$, $x = -3, -6$
c $(x - 8)(x + 1) = 0$, $x = 8, -1$
d $(x - 7)(x + 3)= 0$, $x = 7, -3$
e $(x + 5)(x - 2) = 0$, $x = -5, 2$
f $(x + 5)(x - 3) = 0$, $x = -5, 3$
g $(t - 6)(t + 2) = 0$, $t = 6, -2$
h $(t - 6)(t + 3) = 0$, $t = 6, -3$
i $(x + 2)(x - 1) = 0$, $x = -2, 1$
j $(x - 2)(x - 2) = 0$, $x = 2$
k $(m - 5)(m - 5) = 0$, $m = 5$
l $(t - 8)(t - 2) = 0$, $t = 8, 2$
m $(t + 3)(t + 4) = 0$, $t = -3, -4$
n $(k - 6)(k + 3) = 0$, $k = 6, -3$
o $(a - 4)(a - 16) = 0$, $a = 4, 16$

3 **a** $x(x + 4) = 1020$; $x^2 + 4x - 1020 = 0$
b $(x - 30)(x + 34) = 0$, $x = 30$. Ella is 30 years old.

4 $4 \times 60 \times 200 = 48\,000$, $x(x + 140) = 48\,000$, $x^2 + 140x - 48\,000 = 0$. $(x - 160)(x + 300) = 0$. The field is 160 m by 300 m.

HOMEWORK 17C

1 **a** Both are the same equation

b They all have the same solution: $x = 2$

2 **a** $(2x + 1)^2 = (2x)^2 + (x + 1)^2$, when expanded and like terms collected gives the required equation.

b Area $= 0.5(x+1)(2x) = x^2 + x$

3 **a** **i** $(2x + 1)(x + 2) = 0$, $x = x = \frac{1}{2}, -2$

ii $(7x + 1)(x + 1) = 0$, $x = -1, -\frac{1}{7}$

iii $(4x + 7)(x - 1) = 0$, $x = x = -7, \frac{1}{4}$

iv $(3x + 5)(2x + 1) = 0$, $x = -\frac{5}{3}, -\frac{1}{2}$

v $(3x + 2)(2x + 1) = 0$, $x = -\frac{2}{3}, -\frac{1}{2}$

b **i** 3, −2 **ii** $-\frac{1}{4}, -\frac{3}{2}$ **iii** 6, −5

iv $\frac{3}{2}, -7$ **v** $-\frac{3}{4}, 3$

c **i** $\frac{x+3}{3}$ **ii** $\frac{3}{4}, \frac{4}{3}$

17.3 Solving a quadratic equation by using the quadratic formula

HOMEWORK 17D

1 **a** 1.14, −1.47 **b** −0.29, −1.71
c 3.19, −2.19 **d** 0.43, −0.77
e −0.57, −1.77 **f** −0.09, −5.41
g −0.22, −2.28 **h** 2.16, −4.16
i 1.65, −3.65

2 $x^2 + 5x - 60 = 0$, x = 5.64 and −10.64, so lawn is 5.64 + 5 = 10 m 64 cm long

3 $3x^2 - 4x - 8 = 0$

4 Eric gets $x = \frac{12 \pm \sqrt{0}}{18}$ and June gets $(3x - 2)^2 = 0$. Both find that there is only one solution: $x = \frac{2}{3}$.

The x-axis is a tangent to the curve.

5 6.14, −1.14

HOMEWORK 17E

1 **a** −11, none **b** −8. none **c** 84, two
d 0, one **e** 81, two **f** 144, two

2 1008

4 $-3 \pm \sqrt{6}$

3 $x^2 + x - 4$, $x^2 + 3x - 2$ *[Please note there are two possible solutions as stated. This will be corrected at reprints]*

17.4 Solving quadratic equations by completing the square

HOMEWORK 17F

1 **a** $(x + 5)^2 - 25$ **b** $(x + 9)^2 - 81$
c $(x - 4)^2 - 16$ **d** $(x + 10)^2 - 100$
e $(x + 3.5)^2 - 12.25$

2 **a** $(x + 5)^2 - 26$ **b** $(x + 9)^2 - 86$
c $(x - 4)^2 - 13$ **d** $(x - 2.5)^2 - 7.25$

3 **a** $-5 \pm \sqrt{26}$ **b** $-9 \pm \sqrt{86}$
c $4 \pm \sqrt{13}$ **d** $-10 \pm \sqrt{93}$
e $\frac{5}{2} \pm \sqrt{\left(\frac{29}{4}\right)}$

4 0.36, −8.36

5 **a** $(x + 2)^2 - 10$ **b** $x = -2 \pm \sqrt{10}$

6 $p = 6$, $q = -8$

7 C, B, D, E, A

17.5 The significant points of a quadratic curve

HOMEWORK 17G

1 **a**

x	−1	0	1	2	3	4	5	6
$y = x^2 - 5x + 4$	10	4	0	−2	−2	0	4	10

b 1, 4

2 **a**

x	−1	0	1	2	3	4	5
$y = x^2 - 3x + 2$	6	2	0	0	2	6	12

b 1, 2

3

x	−5	−4	−3	−2	−1	0	1	2
$y = x^2 + 4x - 6$	−1	−6	−9	−10	−9	−6	−1	6

b 1.15, −5.15

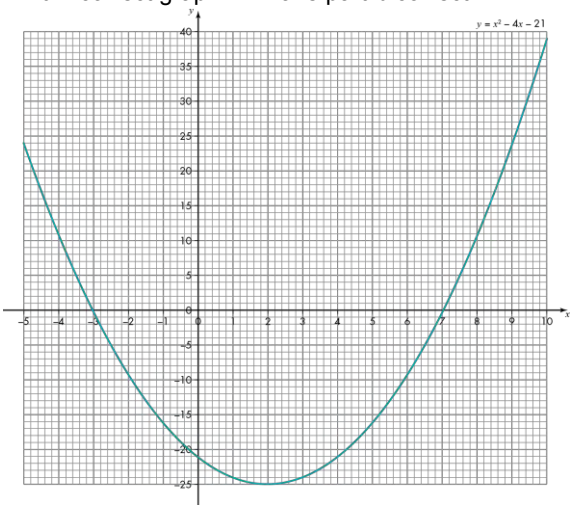
4 **a** (0, 4) **b** (2.5, −2.25)

5 **a** (0, 2) **b** (1.5, −0.25)

6 **a** (−2, −10)
b $(x + 2)^2 - 10 = 0$
c The minimum point is $(-a, b)$
d (−3, −14)

HOMEWORK17H

1 **a** correct graph will have part **b** correct



b **i** (0, −21) **ii** −3, 0), (7, 0) **iii** (2, −25)

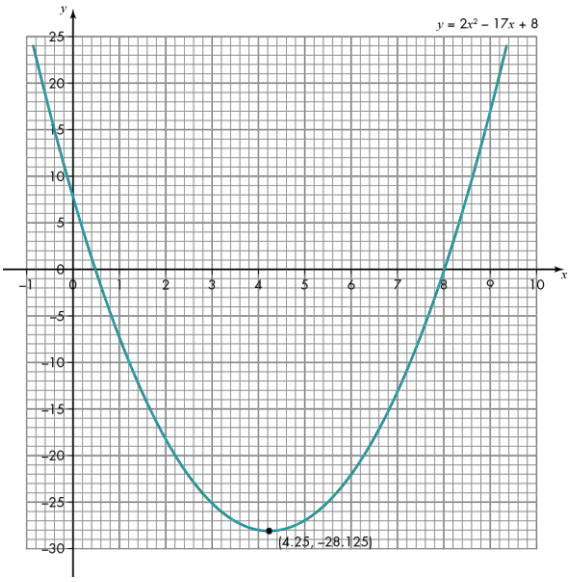
2 **a** roots −4,4 y intercept −16
b roots 0, 8 y intercept 0
c roots 6, −1, y intercept −6

3 (4, −14)

4 minimum: −4

5 **a** turning point at (−1,0)
b single root at $x = -1$

6



Roots 0.5,8; y intercept 8; minimum (4.25, −28.1)

7 p =-10, q = 15

8 p = −4, q = −2

17.6 Solving one linear and one non-linear equation using graphs

HOMEWORK 17I

1 **a** (0.65, 0.65), (−4.65, −4.65)
b (4.4, −2.4), (−2.4, 4.4)
c (4, 6), (0, 2)
d (3.4, 6.4), (−2.4, 0.6)

2 **a** (1, 2)
b Only one intersection point
c $x^2 + x(2 - 4) + (-1 + 2) = 0$
d $(x - 1)^2 = 0 \Rightarrow x = 1$
e Only one solution as line is a tangent to the curve.

3 **a** No solution
b Do not intersect
c $x^2 + x + 6 = 0$
d $b^2 - 4ac = -23$
e There is no solution, as the discriminant is negative; we cannot find the square root of a negative number.

17.7 Solving quadratic equations by the method of intersection

HOMEWORK 17J

1 **a** −1.25, 3.25 **b** 4, −2 **c** 3, −1

2 **a** 2.6, 0.38 **b** 1.5 **c** 3.3, −0.3
d 3.4, 0.6 **e** 2.4, −0.4

3 **a** **i** −1.9 **ii** 1.4, −1.4, 0
b $y = x + 1$; −2, 1

4 **a** **i** −1.9, −0.3, 2.1 **ii** 1.7, 0.5, −2.2
b $y = x$, −2.1, −0.2, 2.3

5 **a** 1.7, 0.5 **b** 1.5, 0.3, −1.9

6 **a** C and E **b** A and D
c $x^2 + 4x - 6 = 0$ **d** (−2.5, −14.25)

17.8 Solving linear and non-linear simultaneous equations algebraically

HOMEWORK 17K

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

2 **a** (2, 3)
b Sketch **iii**, with the straight line tangent to the curve

3 a = 2 and b = 3

17.9 Quadratic inequalities

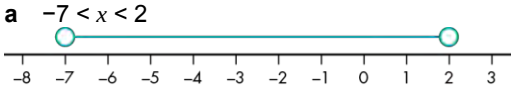
HOMEWORK 17L

1 **a** $x > 5$ or $x < -5$ **b** $9 \geq x \geq -9$
c $0 < x < 1$ **d** $x < 0$ or $x > 4$

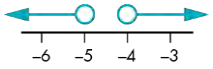
2 **a** -5,-4,-3,-2,-1,0,1,2,3,4,5 **b** 3,4,5

3 **a** $x > 6$ or $x < -2$ **b** $-9 < x < -5$
c $x \geq 3$ or $x \leq -0.4$ **d** $-1.33 \leq x \leq 3$

4 **a** $-7 < x < 2$

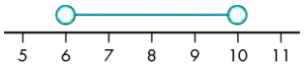


b $x < -5$ or $x > -4$



5 $-3 < x < -2$

6



18.1 Sampling

HOMEWORK 18A

1 **a** Secondary data
b Primary data
c Primary or secondary data
d Primary data
e Primary data

2 You will need to pick a sample from all ages.
You will need to ask a proportionate numbers of boys and girls.
Ask people with different interests, as sporty people may want to finish earlier.

3 **a** Likely to have an interest in religion, so opinions may be biased
b This would be quite reliable as the sample is likely to be representative.
c Younger children will not like the same sorts of games as older students, so the sample is likely to give a biased result.

4 **a** This is quite a good method. The sample is not random but should give reliable results.
b Not very reliable as people at a shopping centre are not likely to be sporty.
Better to ask a random sample at different venues and different times.
c Not everyone has a phone; people don't like being asked in the evening.
Need to do other samples such as asking people in the street.

5 Not everyone has a phone. People may not travel by train every week. 200 may not be a big enough sample.

6 **a** About 10% of the population

b

Year	Boys	Girls	Total
7	16	14	30
8	16	16	32
9	14	16	30
10	15	16	31
11	13	14	27
Total	**74**	**76**	**150**

7 Find the approximate proportion of men and women, girls and boys, then decide on a sample size and base your work on the proportion of each group multiplied by the sample size.

8 **a** Good questions might include: How many times in a week, on average, do you have your lunch out of school? (Responses: 'Never', '1 or 2 times', '3 or 4 times' or 'every day')

b

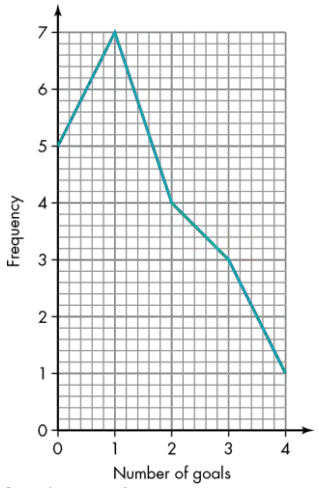
	Boys	Girls
Y12	13	14
Y13	12	11

9 315

18.2 Frequency polygons

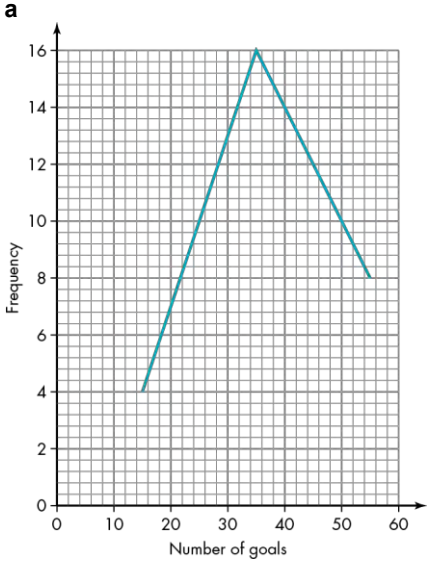
HOMEWORK 18B

1 **a**



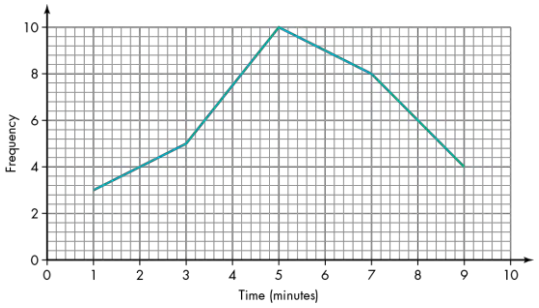
b 1.4 goals

2 **a**



b 37 seconds

3 **a**



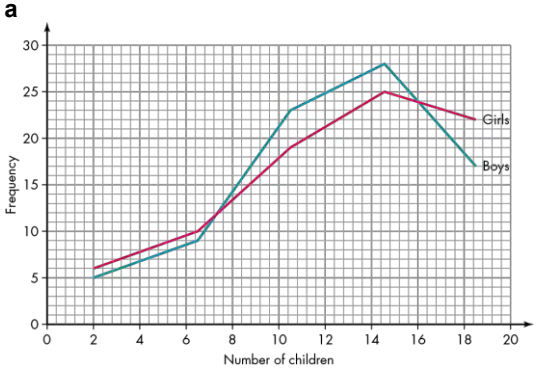
b 5.3 minutes

c The majority of customers (over 70%) wait longer than 5 minutes, open more checkouts.

4 2.39 hours

5 30 seconds is exactly in the middle of the zero to one minute group. These people are in that band, but it could be that no one actually waited for exactly 30 seconds.

6 **a**



b Boys 12.6, girls 12.8

c The girls had a higher mean score.

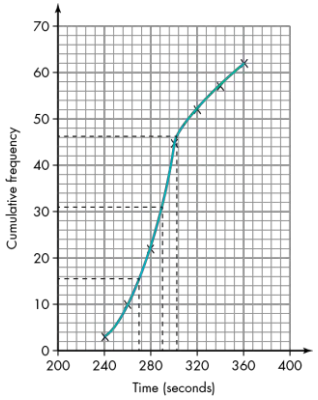
18.3 Cumulative frequency graphs

HOMEWORK 18C

1 a

Time (seconds)	Frequency	Cumulative frequency
$200 < t \leq 240$	3	3
$240 < t \leq 260$	7	10
$260 < t \leq 280$	12	22
$280 < t \leq 300$	23	45
$300 < t \leq 320$	7	52
$320 < t \leq 340$	5	57
$340 < t \leq 360$	5	62

b

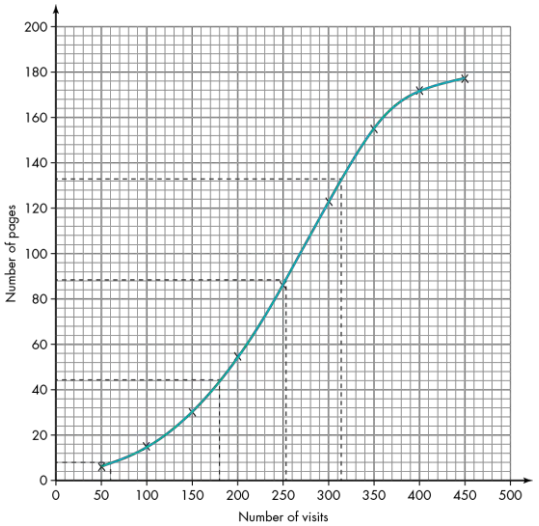


c Median = 283, IQR = 30

2 a

Number of visits	Frequency	Cumulative frequency
$0 < v \leq 50$	6	6
$50 < v \leq 100$	9	15
$100 < v \leq 150$	15	30
$150 < v \leq 200$	25	55
$200 < v \leq 250$	31	86
$250 < v \leq 300$	37	123
$300 < v \leq 350$	32	155
$350 < v \leq 400$	17	172
$400 < v \leq 450$	5	177

b



c Median = 250; IQR = 135 **d** Seven pages

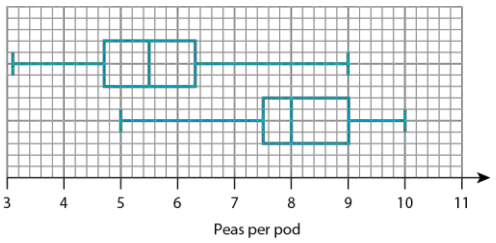
3 a Paper 1 – 70; Paper 2 – 53
b Paper 1 – 24; Paper 2 – 36
c Paper 2 is the harder paper because it has a lower median and lower quartiles.
d i Paper 1 – 35; Paper 2 – 25
ii Paper 1 – 84; Paper 2 – 86

4 Find the top 15% on the cumulative frequency scale, read along to the graph and read down to the marks.
The mark seen will be the minimum mark needed for this top grade.

18.4 Box plots

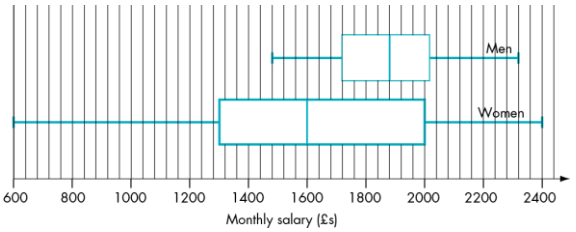
HOMEWORK 18D

1 a



b Distributions similar in shape, but the older gardener has about 2.2 peas more per pod

2 a

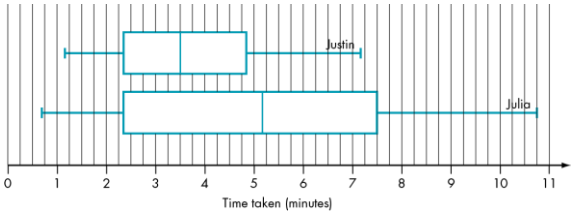


b Men's distribution is very compact; women's is more spread out and women generally get paid less than men.

3 **a** The Flying Bug batteries have a slightly higher median but are very inconsistent. The Ever Steady batteries are very consistent.

b Ever Steady, because they are very reliable

4 **a**



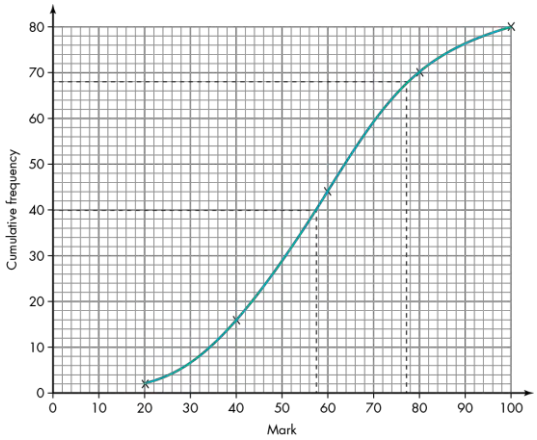
b Justin has lower median and a more consistent distribution.

c Julia, because she takes too long on the phone

5 **a** 57

b

Mark, x	$0 < x \leq 20$	$20 < x \leq 40$	$40 < x \leq 60$	$60 < x \leq 80$	$80 < x \leq 100$
Number of students	2	14	28	26	10
Cumulative frequency	2	16	44	70	80



c **i** 58 **ii** 78

d Students' box plots.
The second school has about the same median but a much more compact and symmetrical distribution.

6 Gabriel could see either doctor, but students should provide a plausible reason,
e.g. Dr Ball because patients never have to wait longer than 10 minutes, whereas they may have to wait up to 14 minutes for Dr Charlton; or Dr Charlton because the mean waiting time is less than for Dr Ball.

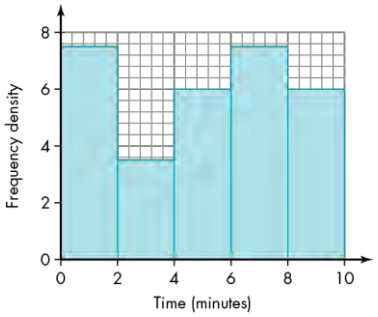
7 There will be many different possibilities, but each should contain no specific data – only general data such as: 'Scarborough generally had more sunshine than Blackpool', 'Blackpool tended to have more settled weather than Scarborough' or 'Scarborough had a higher amount of sunshine on any one day'.

8 62.5 – 53.75 = 8.75.

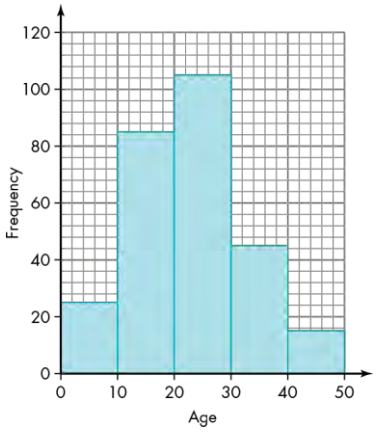
18.5 Histograms

HOMEWORK 18E

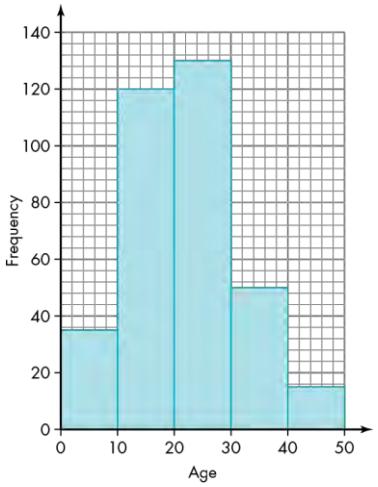
1 **a**



2 **a**



b

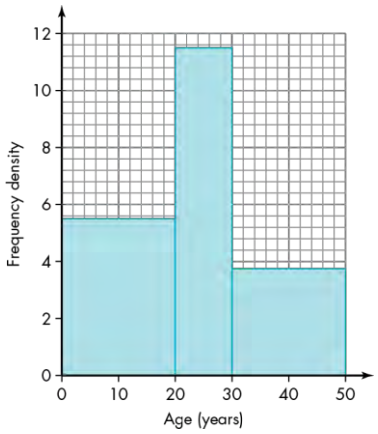


c The first film was seen by mainly 10–30 year-olds, whereas the second film was seen by mainly 30–50 year-olds.

b 5.1 minutes

3 **a**

Age	0–20	20–30	30–50
Frequency (area)	110	115	75
Frequency density	5.5	11.5	3.75



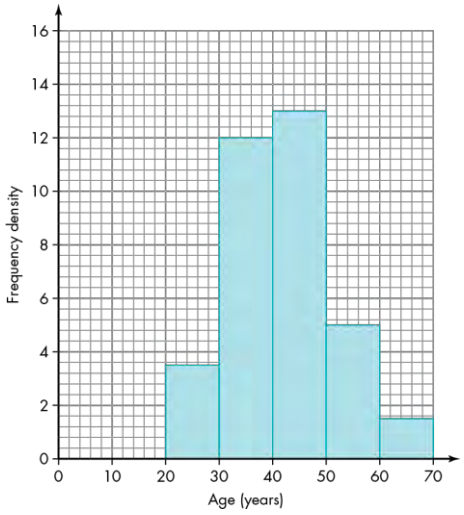
b The data is the same

4 a

$0 < t \leq 5$	25
$5 < t \leq 10$	37.5
$10 < t \leq 20$	100
$20 < t \leq 30$	50
$30 < t \leq 35$	37.5
$35 < t \leq 40$	12.5

b 18 minutes

5 a

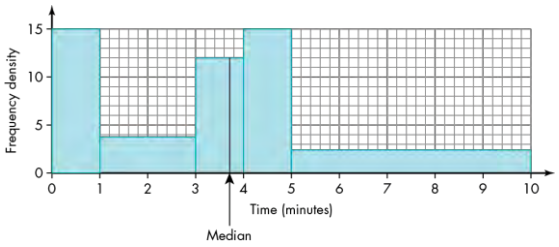


b $3 + (\frac{9}{12} \times 1) = 3.75$ minutes

6 Divide the frequency of the class interval by the width of the class interval.

7 a 61.8 **b** 21 **c** 62 **d** 85.7

8 0.3



19.1 Addition rules for outcomes of events

HOMEWORK 19A

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

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

3 a $\frac{1}{13}$ **b** $\frac{1}{13}$ **c** $\frac{2}{13}$

4 a $\frac{3}{10}$ **b** $\frac{3}{10}$ **c** $\frac{3}{5}$

5 a $\frac{1}{3}$ **b** $\frac{2}{5}$ **c** $\frac{11}{15}$
d $\frac{11}{15}$ **e** $\frac{1}{3}$

6 a i 0.75 **ii** 0.6 **iii** 0.25 **iv** 0.6
b i Because 3 only occurs on pink **ii** 0.5

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

8 a 3
b Not certain he has three double yolks to start with

9 a $\frac{11}{15}$ **b** $\frac{2}{3}$ **c** 0 **d** $\frac{2}{3}$

10 a i 0.1 **ii** 0.75 **iii** 0.85
b 0.5
c 2 hours 6 minutes

11 8

12 'Not blue' and 'not yellow' are not mutually exclusive events.

19.2 Combined events

HOMEWORK 19B

1 a

1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12
	1	2	3	4	5	6

b i $\frac{1}{6}$ **ii** $\frac{1}{4}$ **iii** $\frac{1}{6}$
iv $\frac{5}{18}$ **v** $\frac{1}{2}$ **vi** $\frac{29}{36}$

2

1	1, 1	1, 2	1, 3	1, 4	1, 5	1, 6
2	2, 1	2, 2	2, 3	2, 4	2, 5	2, 6
3	3, 1	3, 2	3, 3	3, 4	3, 5	3, 6
4	4, 1	4, 2	4, 3	4, 4	4, 5	4, 6
5	5, 1	5, 2	5, 3	5, 4	5, 5	5, 6
6	6, 1	6, 2	6, 3	6, 4	6, 5	6, 6
	1	2	3	4	5	6

a $\frac{1}{6}$ **b** $\frac{11}{36}$ **c** $\frac{1}{9}$ **d** $\frac{3}{4}$

e $\frac{1}{36}$ **f** $\frac{11}{36}$ **g** $\frac{5}{18}$

3 a

Score on second dice						
6	−4	−2	0	2	4	6
5	−3	−1	1	3	5	7
4	−2	0	2	4	6	8
3	−1	1	3	5	7	9
2	0	2	4	6	8	10
1	1	3	5	7	9	11
	1	2	3	4	5	6

Score on first dice

b i $\frac{1}{12}$ **ii** $\frac{1}{6}$ **iii** $\frac{1}{2}$

iv $\frac{1}{6}$ **v** $\frac{13}{36}$

4 a $\frac{1}{2}$ **b** $\frac{1}{2}$ **c** $\frac{3}{4}$

5 a $\frac{3}{4}$ **b** $\frac{3}{8}$ **c** $\frac{7}{8}$

6 a $\frac{1}{12}$ **b** $\frac{1}{4}$

7 a DD, TD, HD, TT, HH, TH

b

Hyacinth	DH	DH	TH	HH
Tulip	DT	DT	TT	HT
Daffodil	DD	DD	TD	HD
Daffodil	DD	DD	TD	HD
	Daffodil	Daffodil	Tulip	Hyacinth

c $\frac{1}{4}$

d More daffodils

8 a

	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

b $\frac{1}{36}$

c 36

d Three times

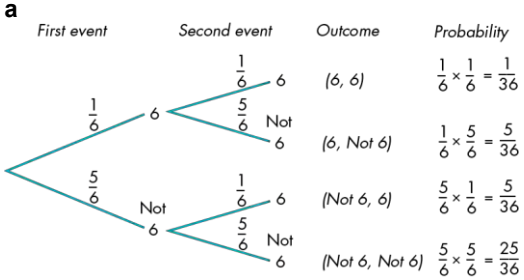
9 $\frac{5}{16}$

10 It's not possible to draw a diagram as there are too many different events to list.

19.3 Tree diagrams

HOMEWORK 19C

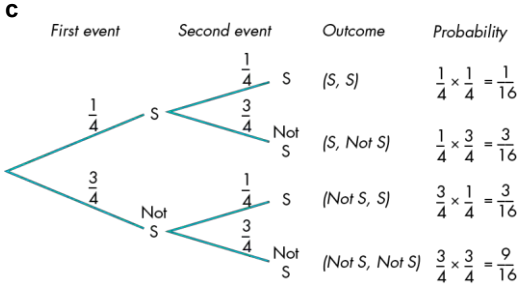
1 a



b i $\frac{1}{36}$ **ii** $\frac{5}{18}$ **iii** $\frac{25}{36}$

2 a $\frac{1}{4}$ **b** $\frac{3}{4}$

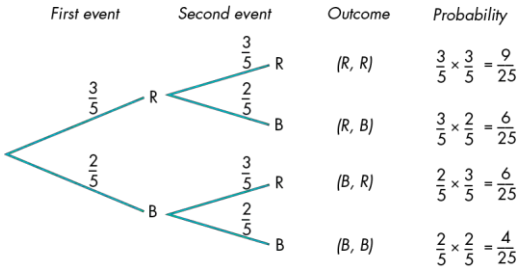
c



d $\frac{1}{16}$

3 a $\frac{3}{5}$

b



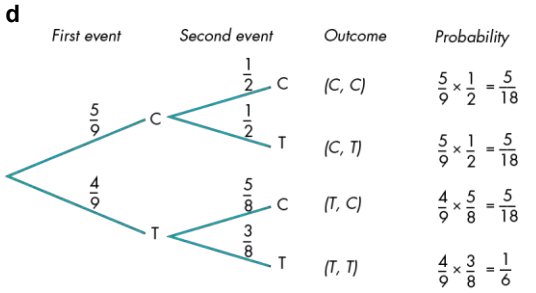
c i $\frac{9}{25}$ **ii** $\frac{12}{25}$ **iii** $\frac{21}{25}$

4 a i $\frac{5}{9}$ **ii** $\frac{4}{9}$

b i 8 **ii** 4

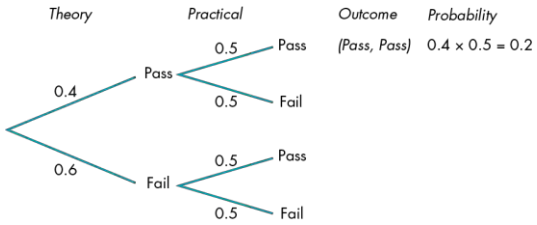
c i 8 **ii** 3

d



e **i** $\frac{4}{9}$ **ii** $\frac{5}{6}$

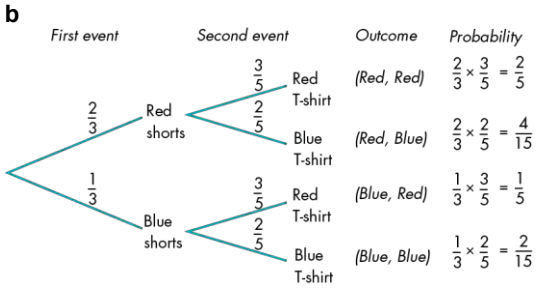
5 **a**



b 0.2

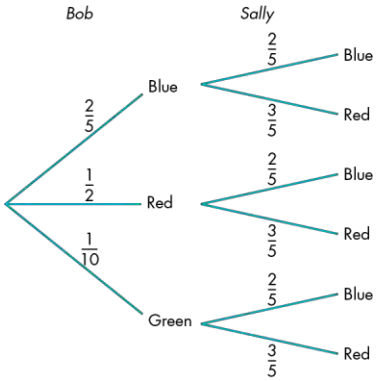
6 **a** $\frac{1}{3}$

b



c **i** $\frac{8}{15}$ **ii** $\frac{7}{15}$

6 **a**



b 0.16 ($\frac{4}{25}$) c 0.54

8 0.050

9 It will help to show all nine possible events and which ones give the two socks the same colour, then the branches will help you to work out the chance of each.

19.4 Independent events

HOMEWORK 19D

1 **a** $\frac{243}{1024}$ **b** $\frac{781}{1024}$

2 **a** $\frac{1}{8}$ **b** $\frac{7}{8}$

3 **a** $\frac{1}{40}$ **b** $\frac{39}{40}$

4 **a** $\frac{49}{100}$ **b** $\frac{9}{100}$ **c** $\frac{91}{100}$

5 **a** **i** $\frac{1}{8}$ **ii** $\frac{1}{8}$ **iii** $\frac{7}{8}$

b **i** $\frac{1}{16}$ **ii** $\frac{1}{16}$ **iii** $\frac{15}{16}$

c **i** $\frac{1}{32}$ **ii** $\frac{1}{32}$ **iii** $\frac{31}{32}$

d **i** $\frac{1}{2^n}$ **ii** $\frac{1}{2^n}$ **iii** $\frac{2^{n-1}}{2^n}$

6 **a** $\frac{8}{343}$ **b** $\frac{60}{343}$ **c** $\frac{150}{343}$ **d** $\frac{125}{343}$

7 **a** 0 **b** $\frac{1}{7}$ **c** $\frac{4}{7}$ **d** $\frac{2}{7}$

8 **a** 0 **b** $\frac{125}{216}$ **c** $\frac{75}{216}$

9 **a** 0.358 **b** 0.432

10 **a** 0.555 75 **b** 0.390 25 **c** 0.946

11 **a** 0.6 **b** 0.288 **c** Large population

12 The 20 possible combinations are shown in the following table.

1	B	R	B	B	R	R
2	B	B	R	B	R	R
3	B	B	B	R	R	R
4	B	B	R	R	B	R
5	B	B	R	R	R	B
6	B	R	B	R	R	B
7	B	R	R	B	R	B
8	B	R	R	R	B	B
9	B	R	B	R	B	R
10	B	R	R	B	B	R
11	R	R	R	B	B	B
12	R	R	B	B	R	B
13	R	R	B	B	B	R
14	R	B	R	B	B	R
15	R	B	B	R	B	R
16	R	B	B	B	R	R
17	R	B	R	R	B	B
18	R	R	B	R	B	B
19	R	B	R	B	R	B
20	R	B	B	R	R	B

a p(3 red, i.e. light grey, shirts next to each other) = $\frac{4}{20} = \frac{1}{5}$

b p(3 blue, i.e. dark grey, shirts next to each other) = $\frac{4}{20} = \frac{1}{5}$

13 a **ii** $\frac{7}{145}$ **ii** $\frac{7}{15}$

b $\frac{27}{58}$

14 a 0.0086 **b** 0.44 **c** 0.13

15 He has three cards already, so there are at most only 49 cards left. Therefore the denominator cannot be 52.

19.5 Conditional probability

HOMEWORK 19E

1 a $\frac{2}{16}$ **b** 3

2 a $\frac{8}{27}$ **b** $\frac{4}{9}$ **c** $\frac{26}{27}$

3 a 0.856 52 **b** 0.99356

4 a $\frac{2}{5}$

b **i** 0.010 24 **ii** 0.2592
iii 0.077 76 **iv** 0.922 24

5 0.3 or 0.7

6 a **i** $\frac{125}{512}$ **ii** $\frac{485}{512}$

b **i** $\frac{5}{28}$ **ii** $\frac{55}{56}$

7 $\frac{7}{16}$

8 $\frac{15}{34}$

9 a $\frac{57}{980}$ **b** $\frac{923}{980}$

10 0.2

11 a $\frac{2}{5}$ **b** $\frac{1}{15}$ **c** $\frac{7}{15}$ **d** $\frac{14}{15}$

12 a $\frac{1}{59049}$ **b** $\frac{32768}{59049}$ **c** $\frac{26281}{59049}$

13 0.0067

14 Find P(Y), P(G) and P(O).
Then P(Y) × P(Yellow second), remembering the numerator will be down by 1.
Then P(G) × P(Green second), remembering the numerator will be down by 1. Then P(O) × P(Orange second), remembering the numerator will be down by 1.
Then add together these three probabilities.

20.1 Circle theorems

HOMEWORK 20A

1 a 23° **b** 84° **c** 200°
d 54° **e** 62° **f** 60°

2 a 19° **b** 27° **c** 49°

3 a 78° **b** 29° **c** 78°

4 a $x = 20°$, $y = 105°$ **b** $x = 10°$, $y = 36°$

5 a 89° **b** 46°

6 Size of angle is **b**, 57°

7 Reflex angle BOC = $2x$ (angle at centre = twice angle at circumference) Obtuse angle BOC = $360° - 2x$ (angles at a point)
Angle CBO = $y = \frac{180° - (360° - 2x)}{2}$ (angles in an isosceles triangle) $= x - 90$

20.2 Cyclic quadrilaterals

HOMEWORK 20B

1 a $a = 68°$; $b = 100°$ **b** $d = 98°$; $e = 98°$; $f = 82°$
c $d = 95°$; $e = 111°$ **d** $m = 118°$; $n = 142°$

2 a $x = 89°$ **b** $x = 98°$
c $x = 82°$; $y = 33°$

3 a $x = 52°$; $y = 104°$ **b** $x = 120°$; $y = 120°$
c $x = 95°$; $y = 75°$

4 $x = 40°$ and $y = 25°$

5 Angle DAB = 64° (opposite angles in a cyclic quadrilateral)
Angle BOD = 128° (angle at centre = twice angle at circumference)

6 Students should show all workings for proof question.

20.3 Tangents and chords

HOMEWORK 20C

1 a $r = 48°$ **b** $x = 30°$

2 a 4 cm **b** 9.2 cm

3 a $x = 16°$, $y = 74°$ **b** $x = 80°$, $y = 50°$

4 a 18° **b** 16°

5 8.49 cm

6 Angle AXC = 90° (angle in a semicircle) and XC is the radius of the small circle, so the radius XC meets the line AE at X at 90°, so AE is a tangent.

20.4 Alternate segment theorem

HOMEWORK 20D

1 a $a = 68°$, $b = 62°$, $c = 50°$
b $d = 83°$, $e = 55°$, $f = 42°$

2 a 50° **b** 63°

3 a $x = 36°$, $y = 36°$ **b** $x = 70°$, $y = 70°$

4 a 18° **b** $x = 48°$, $y = 70°$, $z = 62°$

5 $x = 68°$, $y = 22°$, $z = 31°$

6 Size of angle OBA is: b 30°

7 Let BXY = x, angle YXA = 180° − x (angles on a line), angle YZX = 180° − x (alternate segment), angle XYC = 180° − (180° − x) = x (angles on a line), so angle BXY = angle XZC

21.1 Direct variation

HOMEWORK 21A

1 a 24 **b** 12.5

2 a 72 **b** 5

3 a 125 **b** 6

4 a 72 **b** 2

5 a 120 **b** 7.5

6 a 180 miles **b** 7 hours

7 a £24 **b** 48 litres **c** 28.75 litres

8 a 38 **b** 96 m^2 **c** £12 800

9 a 3 hours 45 minutes
b No; at this rate they would lay 308 stones in 2 days. 3 hours 45 minutes

10 a $x = 12$ **b** $y = 105$

HOMEWORK 21B

1 a 250 **b** 6.32

2 a 6.4 **b** 12.6

3 a 150 **b** 1.414

4 a 70 **b** 256

5 a 200 **b** 5.76

6 a 2 **b** 1253

7 Yes with 4.5 hours to spare

8 a graph B **b** graph A **c** graph C

9 a graph C **b** graph A

21.2 Inverse variation

HOMEWORK 21C

1 a 5.6 **b** 0.5

2 a 30 **b** 9

3 a 2.5 **b** 0.5

4 a 7.2 **b** 0.5

5 a 9.6 **b** 4096

6 a 71.6 **b** 4

7 a 1.25 **b** $\frac{1}{3}$

8 20 candle power

9

x	2	4	16
y	8	4	1

10 a 1.25 g/cm^3 **b** 2.5 cm

11 a $y = \frac{192}{x^2}$
b i 5.33 **ii** 2.31

12 a Yes, as they will complete it in $4\frac{2}{3}$ days
b They would probably get in each other's way and would not be able to complete the job in a very short time.

13 a B: $y \propto \frac{1}{x}$ **b** $y = \frac{3}{x}$

22.1 Further 2D problems

HOMEWORK 22 A

1 a 8.7 cm **b** 9.21 cm **c** 5.67 cm

2 a 19.4 m **b** 33°

3 a 49.3 km **b** 74.6 km **c** 146.5°
d 89.4 km

4 a 17° **b** 63.44 m **c** 29.6 m
d 27.5 m

5 a $\sqrt{3}$ cm
b i $\frac{1}{2}$ **ii** $\frac{\sqrt{3}}{2}$ **iii** $\sqrt{3}$

6 5.88 cm

22.2 Further 3D problems

HOMEWORK 22B

1 Use Pythagoras to find the distance to the mast, 3.61 km. Use tan 6° to find the height of the mast, 379 m

2 a 63.1° **b** 22.3 cm **c** 1902.4 cm^3
d 70.3°

3 a 25.1° **b** 53.1°

4 a 6.7 cm **b** 33.9° **c** 14.4°
d 10.55 cm

5 a i 6.93 cm **ii** 9.17 cm

b 23.9 cm

6 Student's own solution

7 He needs to find half of AC to make a right-angled triangle, i.e. $x = \cos^{-1}\frac{7.21}{10} = 43.9^{\circ}$

HOMEWORK 22C

1 **a** 23.6°, 156.4° **b** 26.7°, 153.3°
c 40.5°, 139.5° **d** 15.7°, 164.3°
e 26.9°, 153.1° **f** 203.6°, 336.4°
g 188.6°, 351.4° **h** 211.3°, 328.7°

2 30°, 150°

3 **a** 0.643 **b** −0.643 **c** 0.643
d −0.643

4 221.8°, 318.2°

5 Sin 320°, as the others are all positive

6 **a** 45.6°, 314.4° **b** 67.7°, 292.3°
c 51.9°, 308.1° **d** 67.9°, 292.1°
e 85.1°, 274.9° **f** 126.9°, 233.1°
g 116.7°, 243.3° **h** 102.9°, 257.1°

7 109.5°, 250.5°

8 **a** −0.643 **b** 0.643 **c** 0.643 **d** −0.643

9 99.6°, 260.4°

10 Cos 338°, as the others have the same numerical value

HOMEWORK 22D

1 **a** 0.454 **b** 0.454 **c** −0.454 **d** −0.454

2 **a** 0.358 **b** −0.358 **c** −0.358 **d** 0.358

3 Same values, different signs

4 **a** 23.6°, 156.4°, 203.6°, 336.4°
b 60°, 120°, 240°, 300°

5 **a** 1.14 **b** −1.41 **c** −0.121
d 0.564 **e** 1.54 **f** −0.556

6 **a** Sin(90 +25) = 0.906
b Sin(90 +130) = −0.642

7 **a** 90° **b** 109.5°, 250.5°

8 50°, 130°

9 **a** 6.87° **b** 50°

HOMEWORK 22E

1 **a** 27.8°, 207.8° **b** 38.7°, 218.7°
c 53.5°, 233.5° **d** 72.8°, 252.8°
e 111.4°, 291.4° **f** 171°, 351°
g 141.8°, 321.8° **h** 296.6°, 116.6°

2 **a** −2.05 **b** −2.05 **c** 2.05 **d** 2.05

3 tan(585) = 1 others = −1

4 −50 ,130

HOMEWORK 22F

1 **a** 4.42 m **b** 9.96 cm **c** 29.7° **d** 37.2°

2 66.7°, 113.3°

3 16.63 cm, 4.56 cm

4 **a** 47° **b** 88 m **c** 131.9 m

5 64.95 m

6 54.2 m

7 20.2 km

8 127°

HOMEWORK 22G

1 **a** 9.54 m **b** 53.94 cm

2 **a** 102.6° **b** 114.6°

3 **a** 11.86 cm **b** 37.7° **c** 27.3°
d 5.63 cm **e** 54.4 cm^2

4 1.65 km

5 66.2°

6 29.9°

7 **a** 16.16 km **b** 035°

8 29.7°

9 22.9 cm

HOMEWORK 22H

1 **a** 9.2 m **b** 125° **c** 23.4°
d 8.2 m **e** 76.8° **f** 63.4 cm

2 16.9 cm

3 **a** 66.8° **b** 9.4 cm

4 7 cm

5 ∠ABC = 87.3° and is the largest angle

22.5 Using sine to calculate the area of a triangle

HOMEWORK 22I

1 **a** 37.34 cm^2 **b** 9.74 cm^2

2 4.54 cm

3 **a** 42.8° **b** 21°

4 48.25 cm^2

5 533.3 cm^2

6 15 cm^2

7 **a** 341 m^2 **b** 68

8 Student's own proof

9 69 cm^2

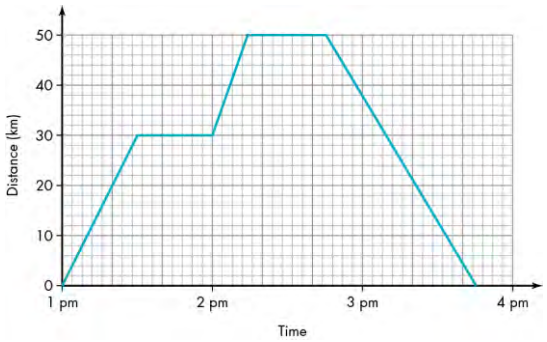
23.1 Distance–time graphs

HOMEWORK 23A

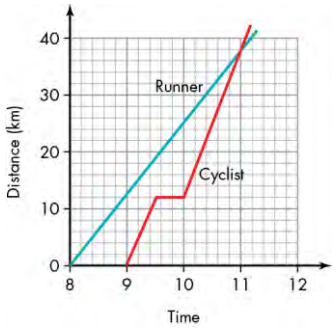
1 **a** **i** 10.30 pm **ii** 11.10 pm **iii** 12.00 noon
b **i** 50 km/h **ii** 75 km/h **iii** 50 km/h

2 **a** 20 km **b** 40 km **c** 60 km/h
d 100 km/h

3



4 11 am

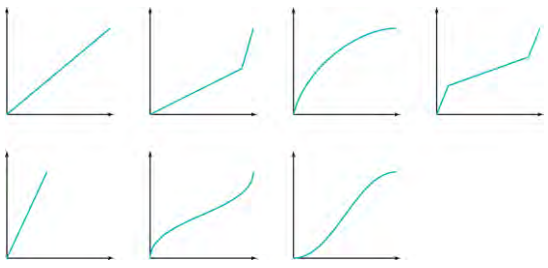


5 **a** 17.5 km/h **b** 30 mph

6 **a** 3 hours
b On the return journey as the line is steeper

HOMEWORK 23B

1 **a–g**



2 **a** A − B bath is filled
B − C Melvin gets into the bath
C − D Melvin relaxes in the bath
D − E water is added
E − F Melvin gets out of the bath
F − G Water is let out of the bath

b

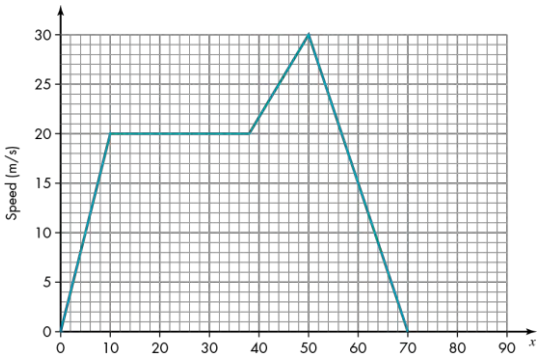
3 Students sketch and graph

23.2 Velocity–time graphs

HOMEWORK 23C

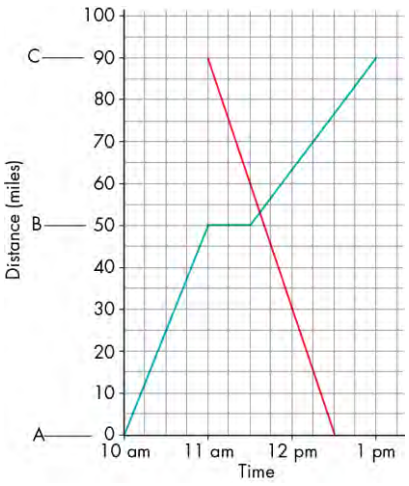
1 **a** 10 km/h
b Slower. The second part has a line that is less steep.
c 5 km/h

2 **a**



b 1250

3 **a** 50 km/h
b 30 minutes
c



d 53 km

HOMEWORK 23D

1 **a** 20 m/s^2 **b** 0 m/s^2

2 **a** 3 ms^{-2} **b** 4 ms^{-2} **c** 10 s
d 300 m **e** 1000 m

3 **a** 1st section a = 45 kmh^{-2}
2nd section a = 0
3rd section a = −30kmh^{-2}
4th section a = −20kmh^{-2}
b 108.75 km

4 **a** 3 m/s^2 **b** 2 m/s^2 **c** 2300 m

5 **a** $\frac{1}{5}v$ **b** 825 m

HOMEWORK 23E

1 **a** 625 m overestimate
b 740 m underestimate
c 180 miles overestimate
d 105 km overestimate
e 945 m underestimate

2 **a** **i** 10 m/s
ii 30 m/s
b 650 m underestimate
c smaller intervals on the time axis i.e. more trapeziums

3 Both cars travel approximately the same distance 1075 m

23.4 Rates of change

HOMEWORK 23F

1 **a** Tangent drawn **b** 8.5 m/s

2 **a** **i** 32 km/h **ii** 36 km/h
b 1 hour and 3.5 hours
c 40 km/h

3 **a** 1 m/s^2 **b** 1.6 m/s^2
c 20 seconds. The gradient is 0 at this point.
d Students' horizontal line across graph such as 5 s and 32 s speed is 40 m/s

23.5 Equation of a circle

HOMEWORK 23G

1 **a** 5 **b** $2\sqrt{2}$ **c** 17 **d** 23

2 **a** $10\sqrt{5}$ **b** 112 **c** 60 **d** $\frac{4}{5}$

3 **a** inside **b** inside **c** outside **d** on

4 **a** Any 3 of the points given in answer **b**
b (5,12), (-5,-12), (5,-12), (-5,12)
(12,5),(-12, −5),(12,-5), (-12,5)
(13,0), (0,13), (0,-13)(-13,0)

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

6 **a** $y = \frac{5}{2}x - 10$

7 **a** $y = 3x + 12$ **b** $y = 3x - 12$

8 **a** $y = x + 12$ **b** $y = x - 12$

9 **a** $9\frac{4}{9}$ **b** $x^2 + y^2 = 85$

23.6 Other graphs

HOMEWORK 23H

1 **a**

x	−3	−2	−1	0	1	2	3
$y = x^3 + 1$	-26	-7	0	1	2	9	28

2 **a**

x	−2	−1	0	1	2	3
$y = x^3 + 2x$	−12	−3	0	3	12	33

3 **a**

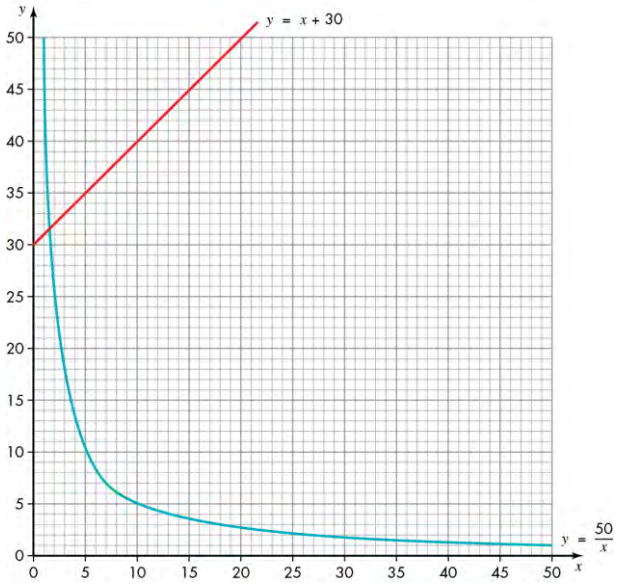
x	−12	−6	−4	−2	−1	−0.5
$y = \frac{12}{x}$	−1	−2	−3	−4	−6	−24

x	0.5	1	2	3	4	6	12
$y = \frac{12}{x}$	24	−12	−6	4	3	2	1

b **i** 8 **ii** 2.2

4 **a–b**

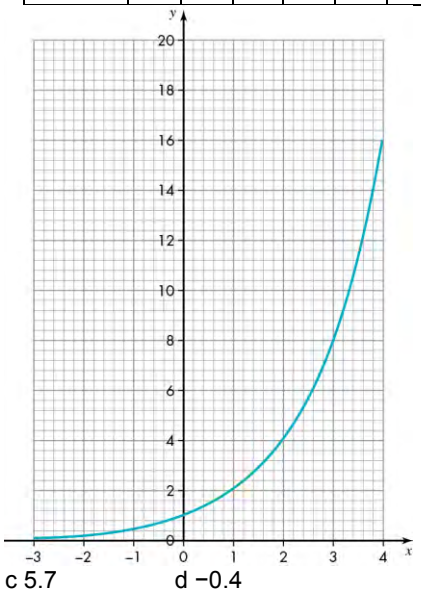
x	0.5	1	2	5	10	25	50
$y = \frac{50}{x}$	100	50	25	10	5	2	1



c 1.6

5 **a–b**

x	−3	−2	−1	0	1	2	3	4
$y = 2^x$	0.1	0.3	0.5	1	2	4	8	16



c 5.7 **d** −0.4

6 $a = 3$, $b = 4$

23.7 Transformations of the graph $y = f(x)$

HOMEWORK 23I

1 **a** Correct graphs plotted

b **ii** Translation $\begin{pmatrix}0\\2\end{pmatrix}$

iii Translation $\begin{pmatrix}-2\\0\end{pmatrix}$

2 **a** Correct graphs plotted

b **ii** Translation $\begin{pmatrix}0\\-3\end{pmatrix}$

iii Translation $\begin{pmatrix}0\\1\end{pmatrix}$

3 **a** Correct graphs plotted

b **ii** Translation $\begin{pmatrix}-4\\0\end{pmatrix}$

iii Reflection in the x-axis

iv Reflection in the x-axis and translation $\begin{pmatrix}0\\2\end{pmatrix}$

HOMEWORK 23J

1 **a** Correct graphs plotted

b **ii** Translation $\begin{pmatrix}0\\3\end{pmatrix}$

iii Translation $\begin{pmatrix}-30\\0\end{pmatrix}$

2 **a** Correct graphs plotted

b **ii** Translation $\begin{pmatrix}0\\2\end{pmatrix}$

iii Translation $\begin{pmatrix}-45\\0\end{pmatrix}$

3 **a** Correct graphs plotted

b **ii** Reflection in the x-axis

iii Translation $\begin{pmatrix}0\\4\end{pmatrix}$

4 **a** Correct graphs plotted

b **ii** Translation $\begin{pmatrix}-60\\0\end{pmatrix}$

iii Translation $\begin{pmatrix}0\\3\end{pmatrix}$

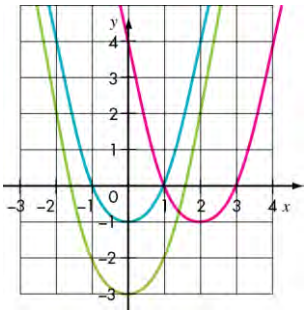
5 $\cos x = \sin(x + 90)$; therefore the graphs are the same.

6 **a** $y = x^2 + 3$ **b** $y = (x - 3)^2$

7 **a** For example: reflection in x-axis and translation by $\begin{pmatrix}-90\\0\end{pmatrix}$

b **i** and **ii** are equivalent to $y = -\sin x$

8



HOMEWORK 23K

1 **a–b** Correct graphs plotted

c Translation $\begin{pmatrix}2\\4\end{pmatrix}$

2 **a** $y = (x - 2)^2 + 2$; translation $\begin{pmatrix}2\\2\end{pmatrix}$

b $y = (x + 5)^2 - 10$; translation $\begin{pmatrix}-5\\-10\end{pmatrix}$

c $y = (x - 10)^2 - 10$; translation $\begin{pmatrix}10\\-10\end{pmatrix}$

3 **a** $y = (x + 2)^2 - 2$; sketch showing y-intercept = 2, minimum point (−2, −2)

b $y = (x - 4)^2 - 2$; sketch showing y-intercept = 14, minimum point (4, −2)

c $y = -(x - 4)^2$; sketch showing y-intercept = 16, minimum point (4, 0)

24.1 Algebraic fractions

HOMEWORK 24A

1 **a** $\frac{22x}{15}$ **b** $\frac{5x + 11}{6}$ **c** $\frac{16x - 11}{6}$

2 **a** $\frac{7x}{20}$ **b** $\frac{3x+8}{10}$ **c** $\frac{8x+5}{6}$

3 **a** $x = 7.5$ **b** $x = 9.8$ **c** $x = 4.75$

4 **a** $\frac{6x^2}{5}$ **b** $\frac{3}{8}$ **c** $\frac{4x-2}{3x-1}$

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

6 $6x - 3 + 5x + 10 = 2(x + 2)(2x - 1)$, $11x + 7 = 4x^2 + 6x - 4$, $4x^2 - 5x - 11 = 0$

7 **a** $x = 1.64$, $x = -1.34$

b $x = 1$, $x = -0.125$

c $x = -1.5$, $x = -3$

8 $\frac{x + 1}{2(x - 2)}$

24.2 Changing the subject of a formula

HOMEWORK 24B

1 **a** $x = \frac{-5y}{2}$ **b** $a = \frac{b(p+q)}{p-q}$

c $a = \frac{A}{2b^2 + c}$ **d** $r = \frac{s(t+1) - 3}{2}$

e $t = \frac{3r}{s+3}$

2 **a** $x = \frac{b}{a+c}$ **b** $x = \frac{b}{a-b-1}$

c $x = \frac{2a}{b+d}$ **d** $x = \frac{cd}{2c-d}$

3 **a** $r = \frac{p}{2\pi + 4}$ **b** $r = \sqrt{\frac{A}{\pi + 4}}$

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

5 $b = \frac{2}{a} + 5$

6 **a** $b = \frac{Ra}{a-R}$ **b** $a = \frac{Rb}{R-b}$

7 $x = \frac{1-2y}{y-1}$

8 **a** $x = \frac{-y}{y-1}$ **b** $x = \frac{z+1}{z-1}$ **c** $y = \frac{z+1}{2z}$

24.3 Functions

HOMEWORK 24C

1 **a** 25 **b** 62 **c** 6

2 **a** −2.5 **b** 2

3 **a** **i** 10 **ii** 73 **iii**
iv 46 **v** 7
b $k = 3, -3$

4 **a** **i** 4 **ii** −1 **iii** −28
iv −8 **v** 1 **vi** 7.75
b $x = 3, -3$

5 **a** **i** 12 **ii** 24 **iii** 24
b $x = 1, 2$

HOMEWORK 24D

1 **a** $f(x)^{-1} = \frac{x+1}{10}$ **b** $f(x)^{-1} = 3(x-4)$

c $f(x)^{-1} = \frac{x+10}{-5}$ **d** $f(x)^{-1} = \sqrt{x} + 3$

e $f(x)^{-1} = x^2 + 4$

2 $f(x)^{-1} = \frac{x+3}{2x-1}$

3 $f(x)^{-1} = \frac{3x+5}{2x-3}$

4 $f(x)^{-1} = \frac{4x+3}{x-4}$

5 Produces an identical function

24.4 Composite functions

HOMEWORK 24E

1 **a** 22 **b** −18 **c** −6 **d** 100 **e** 2

2 **a** $fg(x) = -9x^4 + 3$ **b** $fg(x) = 2x - 1$
c $fg(x) = x^2 - 6x + 16$ **d** $gf(x) = 16x^2 + 24x + 9$
e $gf(x) = x^2 - 9$

3 Wayne should have substituted −3 into $g(x)$ and then substituted the answer into $f(x)$. to give $fg(x) = 222$

24.5 Iteration

HOMEWORK 24F

1 **a** 0.83, 0.47, 0.41, 0.40, 0.40
b 4.60, 4.92, 4.984, 4.997, 4.999
c −1, −0.333 ,−0.375, −0.372 ,−0.372

2 0.85

3 0.62

4 8.77

5 **a** $(x - 3)(x + 4) = 26$ Multiplying out the brackets and rearranging gives the required equation.
b 2.68 cm, 9.68 cm

6 1.19 or −4.19 depending on the initial value chosen

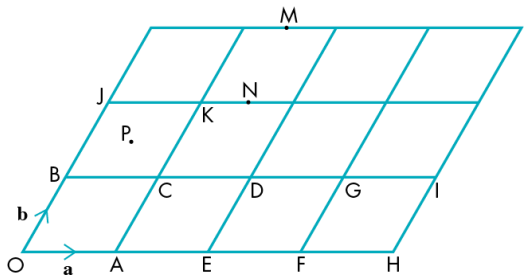
7 1.77

25.1 Properties of vectors

HOMEWORK 25A

1 **a** a + 2b **b** 3a + b **c** 4a **d** 3b
e 2a **f** − 2a **g** 2a + b **h** 2b − a
i 2b − 4a **j** b − a **k** a + b **l** 2a
m a + b **n** 4a + 3b **o** 2a + 2b **p** 3a + 2b

2



3 **a** **i** **b** − **a** **ii** $\frac{1}{2}$ (**b** − **a**) **iii** $\frac{1}{2}$ (**a** + **b**)

b i Student's diagram **ii** $\overrightarrow{XY} = \mathbf{b} - \mathbf{a}$

c $\overrightarrow{AB}$

4 a i $\frac{1}{2}\mathbf{b}$ **ii** $\frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{b}$ **iii** $\frac{3}{2}\mathbf{a}$

d Both are multiples of **a**

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

6 a $5\mathbf{p} - 10\mathbf{q}$ **b** $4\mathbf{p} - 8\mathbf{q}$ **c** $2\mathbf{q} + 4\mathbf{p}$

7 a i $\mathbf{b} - \mathbf{a}$ **ii** $-2\mathbf{a}$ **iii** $2\mathbf{b} - \mathbf{a}$ **iv** $2\mathbf{b} - \mathbf{a}$

b Parallel and equal in length

8 a They lie in a straight line, $\overrightarrow{AC} = \frac{3}{2}\overrightarrow{AB}$

b 2 : 1

25.2 Vectors in geometry

HOMEWORK 25B

1 a i $\frac{1}{3}(\mathbf{a} - \mathbf{b})$ **ii** $\frac{1}{3}\mathbf{a} + \frac{2}{3}\mathbf{b}$ **iii** $\mathbf{b} + \frac{1}{2}\mathbf{a}$

b They lie on a straight line

2 a i $-\mathbf{a} + \frac{1}{3}\mathbf{b}$ **ii** $-\mathbf{b} + \frac{2}{3}\mathbf{a}$

b OA + n(AP) **c** OB + m(BQ)

d When $n = \frac{3}{7}$, $a + n\text{AP} = a + \frac{3}{7}(-a + \frac{1}{3}b)$, which simplifies to $(4a + b) \div 7$. When $m = \frac{6}{7}$, b$a + m\text{BQ} = b + \frac{6}{7}(-b + \frac{2}{3}a)$, which also simplifies to $(4a + b) \div 7$

e $\frac{4}{7}\mathbf{a} + \frac{1}{7}\mathbf{b}$

3 a $\frac{1}{2}\mathbf{a} + \mathbf{b}$ **b** $\mathbf{b} - \frac{1}{2}\mathbf{a}$

c Along OR and OG = OQ + QG

d $n = \frac{2}{3}$ and $m = \frac{1}{3}$

e $\frac{1}{3}\mathbf{a} + \frac{1}{3}\mathbf{b}$

4 a i $\mathbf{b} - \mathbf{a}$ **ii** $2\mathbf{b} - 2\mathbf{a}$

b Parallel

5 a ii $-3\mathbf{p} + 3\mathbf{q}$ **ii** $-3\mathbf{p} + 12\mathbf{q}$

b $2\mathbf{p} - 4\mathbf{q}$

c Straight line

6 a i $\mathbf{c} - \mathbf{b}$ **ii** $\frac{1}{2}\mathbf{c}$ **iii** $\frac{1}{2}\mathbf{c}$

7 a $\mathbf{b} + \mathbf{r}$ **b** $\mathbf{b} - \mathbf{r}$ **c** $\frac{1}{2}(-\mathbf{a} + \mathbf{b} + \mathbf{r})$

8 a $\overrightarrow{AB} = \mathbf{b} - \mathbf{a}$, $\overrightarrow{AC} = 3\mathbf{b} - 3\mathbf{a}$, so $\overrightarrow{AC} = 3\overrightarrow{AB}$, and hence ABC is a straight line.

9 a i $6\mathbf{a} + 4\mathbf{b}$ **ii** $4\mathbf{b} - 3\mathbf{a}$

b $2\mathbf{a} + \frac{4}{3}\mathbf{b}$ **c** $\overrightarrow{OC} = 3\overrightarrow{OM}$