

# Answers

## Chapter 1 The language of number

### Exercise 1.1 (page 9)

- 1 a 16  
b 49  
c 81  
d 196
- 2 a  $\pm 3$   
b  $\pm 8$   
c  $\pm 10$   
d  $\pm 15$
- 3 a 1  
b 8  
c 1000
- 4 a 3  
b 4  
c 5
- 5 a  $3^5$   
b  $7^4$   
c  $2^3 \times 5^4$
- 6 a 625  
b 24  
c 68
- 7 64
- 8  $\pm 11$
- 9 9
- 10  $\pm 1$
- 11 150
- 12 64
- 13 900
- 14 35
- 15 0.6
- 16  $n = \frac{1}{2}$  is one example.
- 17 4 and 20
- 18 5
- 19 8, 9 and 10
- 20 2, 3, 5, 7, 89 and 641
- 21 13 and 14

### Exercise 1.2 (page 12)

- 1 a  $5^2 \times 17$   
b  $2^2 \times 3^2 \times 5$   
c  $3^3 \times 7$   
d  $2^3 \times 5$   
e  $2 \times 3^2 \times 11$   
f  $3^2 \times 13$   
g  $2 \times 3 \times 5 \times 7$   
h  $2^5 \times 3^2$   
i  $3^5$   
j  $3^2 \times 7 \times 11$   
k  $2^5 \times 5^3$   
l  $2^2 \times 3^3 \times 5 \times 13$
- 2  $a = 2, b = 4, c = 3$

### Exercise 1.3 (page 15)

- 1 a 6  
b 12  
c 14  
d 18  
e 16  
f 22  
g 7  
h 1050
- 2 a 45  
b 40  
c 120

- d 120  
e 144  
f 950  
g 630  
h 198
- 3 882
- 4 84
- 5 a  $2 \times 2 \times 2 \times 3 \times 5 \times 5 \times 13$  or  $2^3 \times 3 \times 5^2 \times 13$   
b  $2 \times 3 \times 13 = 78$
- 6 a  $2 \times 2 \times 2 \times 2 \times 2 \times 3 \times 3$  or  $2^5 \times 3^2$   
b  $2 \times 3 = 6$
- 7 280 seconds or 4 minutes 40 seconds
- 8 24 students

### Summary exercise 1 (page 16)

- 1 2, 3 and 5
- 2 3, 6, 12 and 24
- 3 100
- 4 36
- 5  $2^2 \times 3^4 \times 11$
- 6 126
- 7 144
- 8 98
- 9  $a = 0$  or  $a < 0$
- 10  $2 + 3 = 5$
- 11 3.20p.m.
- 12 10

## Examination questions (page 17)

- 1 a 125  
b 25
- 2  $2^3 \times 5^2 = 8 \times 25 = 200$
- 3 a 64  
b 8
- 4 a  $6 \div 2 = 3$  is one example.  
b  $\pm 5$
- 5 2 and 3;  $2^3 \times 3^3$
- 6 a 2 is even  
b 0
- 7 180 seconds or 3 minutes
- 8  $x = -3$ ,  $y = -2$  is one example.  
 $-3 < -2$  but  $(-3)^2 > (-2)^2$   
since  $9 > 4$ .
- 9 a 1.5  
b 13.69
- 10 64
- 11 a  $2^3 \times 5$   
b 280  
c 4
- 12 No;  $6^3 - 5^3 = 216 - 125 = 91$  (not prime – it is divisible by 13)

## Chapter 2 Whole numbers

### Exercise 2.1 (page 19)

- 1 a 1090  
b 9100  
c 1154  
d 123 982  
e 99 375  
f 4115
- 2 a 2999  
b 2073  
c 2228  
d 9024
- 3 a 853  
f 2876
- 3 a 3487  
b 4572  
c 4571  
d 3488
- 4 140 passengers
- 5 31 652 people

### Exercise 2.2 (page 24)

- 1 a 63  
b 24 000  
c 360  
d 400  
e 80 000  
f 540 000
- 2 a 12 000  
b 18  
c 80  
d 304 000  
e 600  
f 7440
- 3 a 3015  
b 13 122  
c 27 384  
d 140 213  
e 150 332  
f 267 344

- 4 a 54  
b 96  
c 54  
d 243  
e 451  
f 354

- 5 a 680  
b 230
- 6 a 22 236  
b 22 236 000

- 7 74 cartons
- 8 4380 miles
- 9 21 stamps, with 17p change
- 10 £12 370

## Summary exercise 2 (page 25)

- 1 a 972  
b 2097  
c 23 628  
d 9436
- 2 951 students
- 3 a 76 000  
b 89  
c 340 000  
d 25 200  
e 900  
f 175 000
- 4 a 1568  
b 489  
c 15 577  
d 108 342  
e 365  
f 36
- 5 a 2300  
b 560  
c 1150
- 6 5400 sit-ups
- 7 15 lengths, with 5 cm left

## Examination questions (page 26)

- 1 a 7108  
b i 57 and 43  
ii 39 and 89
- 2 17; 55p

## Chapter 3 Decimals

### Exercise 3.1 (page 30)

- 1 a 88.947  
b 718.889  
c 85.774  
d 40.83  
e 59.22  
f 810.493
- 2 a 28.08  
b 0.136

- c** 22.68  
**d** 9.158  
**e** 0.0678  
**f** 205.8232  
**g** 5.423  
**h** 0.0057  
**i** 0.248  
**j** 20.832  
**k** 14.964  
**l** 3.5
- 3 a** 12.6  
**b** 24.6  
**c** 18.3  
**d** 8.9  
**e** 0.2335  
**f** 200  
**g** 36.8  
**h** 56.8  
**i** 2.6  
**j** 12.5  
**k** 16  
**l** 65.4
- 4 a** >  
**b** <  
**c** >  
**d** >  
**e** <  
**f** >
- 5** 2.725 m  
**6** 24.975 kg  
**7** 10.03 seconds  
**8** £14.20  
**9** £2.04  
**10** 0.055 cm

### Summary exercise 3 (page 31)

- 1 a** 19.727  
**b** 16.87  
**c** 11.972  
**d** 0.74  
**e** 6.916  
**f** 0.7854

- 2 a** less  
**b** greater  
**c** greater
- 3 a** 37 380  
**b** 37.38  
**c** 37 380
- 4** 13 pieces  
**5** £1.38  
**6** 11.25 km  
**7**  $0.49\text{m}^2$   
**8** 17 miles

### Examination questions (page 32)

- 1 a** 0.12  
**b** 2.47  
**c** 1.81  
**d** 0.49
- 2** 0.14
- 3 a** 1.81  
**b** 0.08  
**c** 16.1
- 4** 42.6
- 5 a** 0.117  
**b** 1099.8
- 6** £1.30  
**7** 10 days  
**8 a** 4270 kroner  
**b** £55.33  
**9** £1.90

### Chapter 4 Negative numbers

#### Exercise 4.1 (page 34)

- 1 a** -5  
**b** 1  
**c** 0  
**d** -19

- e** 6  
**f** 15  
**g** -8  
**h** -16  
**i** -4  
**j** -12  
**k** -10  
**l** 14  
**m** -4  
**n** -15  
**o** -18  
**p** 0
- 2 a** 3  
**b** -4  
**c** 6  
**d** 2  
**e** 15  
**f** -9  
**g** 22  
**h** 0  
**i** -9
- 3 a** 170 m  
**b** 15 m
- 4** £2050

#### Exercise 4.2 (page 36)

- 1 a** -15  
**b** -16  
**c** 35  
**d** 9  
**e** -5  
**f** 6  
**g** 18  
**h** 4  
**i** 16  
**j** 4  
**k**  $-\frac{1}{2}$   
**l** 2  
**m** -36  
**n** 6  
**o** -48  
**p** -24
- 2 a** -100  
**b** -2  
**c** 4

- d 80
- e -144
- f 8
- g  $\pm 9$
- h -4
- i -3

### Summary exercise 4 (page 37)

- 1 a -8
- b -10
- c 10
- d 0
- e 8
- f -5
- g 30
- h 2
- i 24
- j 21
- k -23
- l 5
- 2 a 30
- b -5
- c -6
- d -13
- e 16
- f -1
- g -24
- h 23
- i 3.6
- j -7
- k -11.2
- l -47.3
- 3 a 36
- b -1000
- c 56
- d -4
- e 8
- f -600
- g -10
- h 0
- i -64
- j -12.6
- k -10.2
- l  $\frac{1}{2}$

## Chapter 5 Fractions

### Exercise 5.1 (page 40)

- 1 a  $\frac{4}{5} = \frac{16}{20}$
- b  $\frac{8}{11} = \frac{24}{33}$
- c  $\frac{1}{3} = \frac{17}{51}$
- d  $\frac{5}{8} = \frac{20}{32}$
- e  $\frac{10}{16} = \frac{5}{8}$
- f  $\frac{24}{36} = \frac{2}{3}$
- 2 a  $\frac{4}{5}$
- b  $\frac{5}{8}$
- c  $\frac{6}{7}$
- d  $\frac{1}{3}$
- e  $\frac{4}{5}$
- f  $\frac{3}{5}$
- g  $\frac{3}{4}$
- h  $\frac{2}{5}$
- i  $\frac{6}{7}$
- j  $\frac{3}{7}$
- k  $\frac{7}{8}$
- l  $\frac{4}{5}$
- 3 a  $\frac{3}{10}, \frac{9}{20}, \frac{1}{2}, \frac{4}{5}$
- b  $\frac{2}{5}, \frac{8}{15}, \frac{11}{20}, \frac{7}{12}$
- 4 a  $4\frac{4}{5}$
- b  $5\frac{1}{6}$
- c  $2\frac{1}{2}$
- d  $2\frac{2}{7}$

- e  $7\frac{1}{4}$
- f  $3\frac{1}{3}$
- g  $7\frac{5}{7}$
- h  $8\frac{1}{3}$
- 5 a  $\frac{5}{3}$
- b  $\frac{23}{4}$
- c  $\frac{41}{7}$
- d  $\frac{17}{2}$
- e  $\frac{57}{7}$
- f  $\frac{22}{5}$
- g  $\frac{17}{6}$
- h  $\frac{31}{3}$

### Exercise 5.2 (page 42)

- 1 a  $5\frac{7}{12}$
- b  $3\frac{11}{12}$
- c  $4\frac{4}{15}$
- d  $1\frac{17}{24}$
- e  $4\frac{3}{5}$
- f  $4\frac{1}{6}$
- g  $7\frac{5}{12}$
- h  $7\frac{13}{20}$
- 2  $\frac{1}{6}$
- 3  $6\frac{1}{4}$  hours
- 4  $\frac{1}{10}$  litre
- 5  $1\frac{7}{10}$  miles

- 6  $\frac{5}{21}$   
 7  $\frac{19}{20}$  tonnes

### Exercise 5.3 (page 45)

- 1 a  $\frac{1}{6}$   
 b  $4\frac{1}{2}$   
 c  $6\frac{7}{8}$   
 d 9  
 e 3  
 f  $5\frac{1}{4}$   
 2 a  $\frac{4}{9}$   
 b  $\frac{2}{3}$   
 c  $2\frac{5}{8}$   
 d  $1\frac{1}{3}$   
 e 10  
 f  $1\frac{2}{7}$

### Exercise 5.4 (page 47)

- 1 a 4.95 kg  
 b 5.6 m  
 c £10.50  
 2  $3\frac{3}{4}$  miles  
 3  $\frac{3}{10}$   
 4  $11\frac{1}{10}$  m<sup>2</sup>  
 5  $\frac{1}{6}$   
 6 £1.60  
 7 £9500  
 8 12.5 cm by 7.5 cm  
 9 £87.50  
 10  $\frac{3}{10}$   
 11 a  $x = 3, y = 8$  is one

- example.  
 b Yes; any two numbers whose product is 24.

### Summary exercise 5 (page 48)

- 1 a  $\frac{5}{6}$   
 b  $\frac{4}{7}$   
 c  $\frac{7}{10}$   
 2 a  $8\frac{1}{3}$   
 b  $5\frac{1}{7}$   
 c  $1\frac{2}{3}$   
 3 a  $\frac{17}{3}$   
 b  $\frac{17}{7}$   
 c  $\frac{37}{3}$   
 4  $\frac{2}{5}, \frac{1}{2}, \frac{7}{12}, \frac{3}{4}, \frac{5}{6}$   
 5 a  $4\frac{2}{3}$   
 b  $\frac{5}{9}$   
 c  $\frac{1}{30}$   
 d  $1\frac{2}{3}$   
 e  $5\frac{5}{12}$   
 f  $4\frac{1}{24}$   
 g  $4\frac{6}{7}$   
 h  $6\frac{1}{2}$   
 i  $3\frac{9}{14}$   
 j  $\frac{5}{6}$   
 k  $\frac{2}{3}$   
 l 1  
 6 £27 600

- 7 11  
 8 £1.60  
 9  $1\frac{13}{18}$   
 10 £2000  
 11  $4 \div 6\frac{2}{5}, \frac{1}{16} + \frac{9}{16}, 1\frac{1}{2} - \frac{7}{8}, \frac{5}{6} + \frac{3}{4}$

12

$\frac{5}{6}$	$1\frac{2}{3}$	$\frac{1}{2}$
$\frac{2}{3}$	1	$1\frac{1}{3}$
$1\frac{1}{2}$	$\frac{1}{3}$	$1\frac{1}{6}$

- 13 180 litres  
 14  $\frac{1}{8}$   
 15 1.536 m

### Examination questions (page 49)

- 1  $\frac{3}{5} = \frac{36}{60}, \frac{7}{10} = \frac{42}{60}, \frac{13}{20} = \frac{39}{60}$   
 and  $\frac{17}{30} = \frac{34}{60}$ .  
 So  $\frac{7}{10}$  is the largest.  
 2  $\frac{3}{10} = \frac{18}{60}, \frac{11}{60}, \frac{1}{5} = \frac{12}{60}, \frac{7}{30} = \frac{14}{60}$   
 and  $\frac{1}{4} = \frac{15}{60}$ .  
 So  $\frac{7}{30}$  is the closest.  
 3 4 jars  
 4  $\frac{2}{3}$   
 5  $\frac{1}{15}$   
 6  $\frac{3}{10}$   
 7 a 8  
 b  $\frac{6}{35}$

8  $1\frac{11}{15}$

9 9 cans

10  $\frac{7}{20}$

11 9 days

## Chapter 6 Approximation and estimation

### Exercise 6.1 (page 52)

- 1 a 5.68  
b 0.1  
c 56.35  
d 0.008  
e 4.51  
f 2.90  
g 4.0  
h 14.988  
i 0.04  
j 14.5  
k 23.66  
l 30.0
- 2 a 4  
b 4  
c 2  
d 3 (or 2 or 1)  
e 4  
f 5  
g 4 (or 3 or 2)  
h 4  
i 2  
j 4 (or 3 or 2 or 1)  
k 2  
l 3
- 3 a 2.35  
b 0.007  
c 7000  
d 0.009  
e 2.07  
f 20.0  
g 10.0  
h 0.007  
i 4.1  
j 700

- k 0.05  
l 0.050

### Exercise 6.2 (page 53)

- 1 a 1621.32 (option B)  
b 315.4 (option A)  
c 456 (option B)  
d 4.1064 (option C)  
e 3.22 (option C)  
f 1317.5 (option C)  
g 27.6 (option B)  
h 35.2 (option A)

Note that for questions 2, 3 and 4 there are alternatives to some of the estimates given here.

- 2 a 35  
b 7  
c 320  
d 40  
e 600  
f 80  
g 0.5  
h 1000
- 3 a 200  
b 40  
c 5  
d 70  
e 30  
f 30  
g 4000  
h 81
- 4 a 600 km  
b 16p per mile  
c 20 minutes  
d 6 cm  
e £14400

### Summary exercise 6 (page 54)

- 1 a 2400  
b 460  
c 2640  
d 6000  
e 35000  
f 3250  
g 3300

- h 800  
i 350  
j 300

- 2 a 2.6  
b 45.80  
c 18.5  
d 6350  
e 0.07  
f 0.31  
g 0.06  
h 53.00  
i 0.031  
j 4000

Note that for questions 3 to 6 there are alternatives to some of the estimates given here.

- 3 a 35  
b 19  
c 75  
d 900  
e 4  
f 75  
g 40  
h 0.5  
i 180  
j 0.2
- 4 £180
- 5 500 km
- 6 60 sheets

### Examination questions (page 55)

Note that for questions 1 to 6 there are alternatives to some of the estimates given here.

- 1 a 2000  
b 30
- 2 a 800  
b 20
- 3 8000
- 4 1600
- 5 100
- 6 60

## Chapter 7 The order of operations

### Exercise 7.1 (page 58)

- 12
- 11
- 25
- 10
- 30
- 10
- 0
- 51
- 10
- 0
- 20
- 44
- 15
- 16
- 2.65
- 4.2
- 6
- 45.6
- 1
- $1\frac{1}{2}$
- 8
- 3
- $9\frac{11}{12}$
- $1\frac{11}{40}$
- $-\frac{5}{12}$

### Exercise 7.2 (page 59)

Note that there are alternative correct solutions to some of these.

- $4 \times 5 + 10$
- $18 - 14 \div 7$
- $20 - 4 \times 4$
- $5 \times 3 + 12$
- $12 + 8 \times 9$
- $41 - 10 \times 2$
- $21 + 40 \div 5$
- $24 - (4 + 8 \times 2)$
- $12 + 4 - 1 \times 6$
- $20 + 6 \times 8 - 10$
- $20 \div (2 + 1 \times 3)$
- $20 - 30 \div 10 + 7$

### Exercise 7.3 (page 60)

- 4.9
- 0.774
- 15.625
- $\pm 6.2$
- 11
- 9
- 8.55
- 205
- 6.73
- 3
- 1.25
- $5\frac{11}{12}$

### Exercise 7.4 (page 62)

- 3000
- 17.47
- 24.89
- 3.800
- 11.67
- 4.132
- 10.45

- 1.606
- 14.96
- 15.26
- 1.020
- 2.720
- 0.4396
- 19.92
- 2.688
- 1.627
- 3.164
- 9.251
- 144.0
- 10.87
- 5.235
- 1.794
- 7.804
- 7.492
- 2676
- 2.053

### Summary exercise 7 (page 62)

- 7
  - 36
  - 26
  - 1
  - 0
  - 7
  - 24
  - $40\frac{1}{4}$
- Note that there are alternative correct solutions to some of these.
  - $6 + 2 \times 3 + 2$
  - $18 + 6 \div 3$
  - $4 + 3 \times 2 - 1$
  - $12 \div 4 \times 3 + 1$
  - $18 - 6 \times 3$
  - $40 - 3 \times 7 - 2$

3 Jack, Kate and Janet

4 a 21.16

b 6.5

c 2.2

d  $2\frac{5}{12}$

e 9.7

f 1024

g 6

h 0.03125

5 a 7.15

b 0.11

c 4.19

d 0.34

e 2.81

f 46.02

g 0.35

h 2.21

### Examination questions (page 63)

1 a 15

b 22.82

2 28.01

3 a 15.5

b 6.25

4 0.246

## Chapter 8 Ratio

### Exercise 8.1 (page 65)

1 a 8:13

b 4:5

c 5:9

d 2:3

e 10:3

f 2:5

g 9:7

h 2:3

i 1:5

j 1:5

k 5:3

l 4:15

m 3:2

n 130:9

o 44:15

2 a 1:4

b  $1:\frac{3}{7}$

c  $1:2\frac{1}{2}$

d  $1:\frac{3}{10}$

3 8:7

4 3:2

5 4:1

### Exercise 8.2 (page 66)

1 £250, £550

2 48°, 60°, 72°

3 5:3

4 £48, £60

5 1m

6 144 cards

7 0.8kg

### Exercise 8.3 (page 69)

1 a 2km

b 16cm

2 3.84m by 4.8m

3 81.6 cm

4 1:15 000

5 27 cm

6 1.875 kg

7 280 animals

8 200 g sugar, 40 g cocoa

9 a about 15 kg

b about 14 pints

10 a 5:4

b 5:4

c 25:16

### Summary exercise 8 (page 70)

1 a 7:8

b 1:16

c 4:5

d 18:7

e 2:3

f 17:50

g 2:5

h 6:1

i 1:5000

j 9:500

k 1:40

l 16:1

2 a  $1:1\frac{1}{2}$

b  $1:\frac{1}{4}$

c  $1:\frac{3}{10}$

d  $1:\frac{3}{5}$

3 4:5

4 a £105, £175

b 46 minutes,  
69 minutes, 69 minutes

5 5:2

6 £360

7 8 cm

8 45 hectares barley,  
135 hectares oats

9 8.75 litres

10 11:4

11 40 mm

12 about 18.75 miles

13 6:5

### Examination questions (page 71)

1 1000 ml milk, 5 eggs,  
 $437\frac{1}{2}$  g flour

2 about 67.2 km

3 £295, £177

4 45 g protein, 90 g  
carbohydrate, 20 g fibre,  
1.125 g sodium



5 21 km on cycle paths,  
15.75 km on A roads,  
5.25 km on B roads

6 a £450  
b 81 minutes

7 £220, £198, £132

## Chapter 9

### Percentages and finance

#### Exercise 9.1 (page 75)

1 a  $\frac{11}{50} = 0.22$

b  $\frac{2}{25} = 0.08$

c  $1\frac{9}{20} = 1.45$

d  $\frac{1}{40} = 0.025$

e  $\frac{1}{2000} = 0.0005$

2 a  $\frac{3}{100} = 3\%$

b  $\frac{4}{5} = 80\%$

c  $\frac{3}{500} = 0.6\%$

d  $1\frac{1}{4} = 125\%$

e  $\frac{5}{8} = 62\frac{1}{2}\%$

3 a  $26\% = 0.26$

b  $41\frac{2}{3}\% = 0.41\bar{6}$

c  $60\% = 0.6$

d  $3\frac{1}{2}\% = 0.035$

e  $22.\dot{2}\% = 0.\dot{2}$

4  $\frac{17}{25}$

5 a  $\frac{2}{5}, 42\%, 0.45$

b  $0.3, 31\%, \frac{1}{3}$

c  $\frac{7}{11}, 0.64, 70\%$

d  $0.1\%, \frac{1}{100}, 0.1$

6  $77.\dot{7}\%$

7  $33\frac{1}{3}\%$

8 0.036

9  $\frac{3}{500}$

10  $\frac{1}{15}$

11 a 85%

b 6%

c 12%

d 85%

#### Exercise 9.2 (page 78)

1 a £54

b 144 g

c 544

d 52.5 g

e 2 litres

f £14.40

g 102 minutes  
(or 1 hour 42 minutes)

h 1.5 m

2 a 42.4 m

b 325.5 kg

c 210 kg

d 1416 m

3 £42.75

4 £13.25

5 a 0.765 kg

b £1.02

c 28 litres

d 276 hectares

e 4.5p (or 5p)

f 44

g 0.2 km

h 6.82 kg

i £23.40

j 19.2 miles

6 a £3.38

b 41.36 m

c £4387.50

d 78.28 m

7 £11.28

8 £6080

9 3.22 kg

10 £118.94

#### Exercise 9.3 (page 80)

1 80%

2 7.14%

3 75%

4 27.1%

5 2.2%

6 35.4%

7 a 15%

b 32.25%

8 18%

9  $5\frac{1}{3}\%$

10 0.53%

11  $33\frac{1}{3}\%$

12 5.26%

#### Exercise 9.4 (page 82)

1 £300

2 1480 students

3 £36

4 £340

5 £36 000

6 £235.52

7 280 ml

8 12 cm, 8 cm

9 50 questions

10 £84

#### Exercise 9.5 (page 88)

1 £63

2 £4913

- 3 £29 866.88  
 4 7%  
 5 £2471.04  
 6 22.05%  
 7 15 years  
 8 £710  
 9 The bank is cheaper by £47.24.  
 10 13.5%  
 11 £51.78

### Summary exercise 9 (page 89)

- 1 a  $\frac{9}{50} = 0.18$   
 b  $\frac{3}{8} = 0.375$   
 c  $1\frac{1}{2} = 1.5$   
 2 a  $\frac{17}{25} = 68\%$   
 b  $\frac{29}{200} = 14\frac{1}{2}\%$   
 c  $1\frac{4}{5} = 180\%$   
 3 a  $24\% = 0.24$   
 b  $5\frac{1}{2}\% = 0.055$   
 c  $55.5\% = 0.55$   
 4 60%  
 5  $37\frac{1}{2}\%$   
 6 a £19.84  
 b 6.21 kg  
 c \$40  
 7 £499.10  
 8  $32\frac{1}{2}\%$   
 9 15%  
 10 a £52.73  
 b 12.12%

- 11 550 people  
 12 £590  
 13 £450  
 14 £218.83  
 15 7.52%  
 16 4.68%  
 17 16.64%  
 18 8:9  
 19 £100.80 more in simple interest account

- 20 15 years  
 21 14.26%  
 22 7.5%  
 23 \$858  
 24 19.85%

### Examination questions (page 90)

- 1 53%, 0.56,  $\frac{15}{25}$   
 2 a 160  
 b 69%  
 3 55%  
 4 £512.50  
 5 19.4 m  
 6 Yumi by £1.83  
 7 a £161.42  
 b £169.49  
 8 14p  
 9 £731  
 10 25%  
 11 £254  
 12 £4570.90  
 13 £6069

## Chapter 10 Reciprocals

### Exercise 10.1 (page 93)

- 1 a  $2\frac{2}{3}$   
 b  $1\frac{1}{4}$   
 c  $\frac{3}{5}$   
 d  $\frac{2}{7}$   
 e  $8\frac{1}{3}$   
 f  $-\frac{1}{5}$   
 g  $\frac{y}{x}$   
 h  $\frac{1}{k}$   
 i  $\frac{1}{100}$   
 j  $-2\frac{1}{3}$   
 k  $-\frac{5}{9}$   
 l  $\frac{3r}{2p}$   
 2 a  $4\frac{1}{2}$   
 b  $\frac{4}{27}$   
 c  $-\frac{2}{5}$   
 d  $\frac{q}{p}$   
 e  $\frac{2}{21}$   
 f  $5\frac{5}{9}$   
 g  $-1\frac{4}{5}$   
 h  $-\frac{5}{9}$   
 3 a False – the reciprocal of 1 is 1.  
 b False – zero has no reciprocal.  
 c True – the reciprocal of  $a$  is  $\frac{1}{a}$  and the reciprocal of  $\frac{1}{a}$  is  $a$ .

- d False – for example,  
 $3 > 2$  but  $\frac{1}{3} < \frac{1}{2}$ .

### Summary exercise 10 (page 94)

- 1 a  $1\frac{3}{5}$   
 b  $\frac{6}{11}$   
 c  $\frac{2}{a}$   
 d  $1\frac{2}{3}$   
 e  $\frac{1}{-3}$   
 f  $\frac{1}{p^2}$   
 g  $\frac{4}{5}$   
 h  $2\frac{6}{7}$   
 i  $\frac{1}{p^3}$   
 j  $-\frac{1}{100}$   
 k 50  
 l c
- 2 a  $a = \frac{1}{8}$   
 b  $b = 1\frac{2}{7}$   
 c  $c = 1$   
 d  $d = 2$
- 3 0.0036

### Examination questions (page 94)

- 1 50  
 2  $\frac{3}{5}$

## Chapter 11 Standard form

### Exercise 11.1 (page 96)

- 1 The numbers in **a**, **c**, **f** and **h** are in standard form.

- 2 a  $3.45 \times 10^4$   
 b  $4.5 \times 10^7$   
 c  $8.1 \times 10^3$   
 d  $6.75 \times 10^{10}$   
 e  $5.4 \times 10^{-6}$   
 f  $7 \times 10^{-5}$   
 g  $6 \times 10^4$   
 h  $3 \times 10^{-3}$   
 i  $1.24 \times 10^{-1}$   
 j  $8.67542 \times 10^7$   
 k  $3.4 \times 10^{-9}$   
 l  $9 \times 10^{-1}$

- 3 a 15670  
 b 0.0000456  
 c 2000  
 d 234000000  
 e 156.78  
 f 0.041  
 g 25000000  
 h 0.00157  
 i 0.0008  
 j 31  
 k 0.7  
 l 6200000000

- 4 a  $3 \times 10^8$  m/s  
 b 36000000 kg  
 c  $2.3 \times 10^8$   
 d 5 zeros  
 e  $5.2 \times 10^8$  km<sup>2</sup>  
 f  $2 \times 10^{-10}$  mm  
 g 9460000000000000 m  
 h 11 zeros  
 i  $2.65 \times 10^8$   
 j 0.00000001 m

- 5 a  $1.12 \times 10^2, 1.2 \times 10^2, 2.3 \times 10^4, 2.2 \times 10^5$   
 b  $1.3 \times 10^{-2}, 2.13 \times 10^{-2}, 3.2 \times 10^1, 2.3 \times 10^3$   
 c  $1.25 \times 10^{-4}, 5.5 \times 10^{-4}, 2.45 \times 10^{-3}, 6.5 \times 10^{-2}$

### Exercise 11.2 (page 100)

- 1 a  $2.94 \times 10^3$   
 b  $4.62 \times 10^2$   
 c  $3.607 \times 10^5$   
 d  $8.14 \times 10^{-3}$

- e  $9.406 \times 10^{-2}$   
 f  $4.14 \times 10^7$   
 g  $9.67584 \times 10^2$   
 h  $4.12 \times 10^7$   
 i  $9.454 \times 10^5$   
 j  $2.75 \times 10^6$

- 2 a  $6.804 \times 10^5$   
 b  $1.3 \times 10^2$   
 c  $2 \times 10^3$   
 d  $1.4 \times 10^{-3}$   
 e  $5.145 \times 10^{-5}$   
 f  $5 \times 10^{13}$   
 g  $6.0976 \times 10^{-4}$   
 h  $8 \times 10^{-14}$   
 i  $2.04 \times 10^{-6}$   
 j  $2.5 \times 10^5$

- 3  $2.52 \times 10^{12}$   
 4  $2.592 \times 10^{10}$  km  
 5  $7.2 \times 10^8$  km  
 6 13 minutes  
 7 a  $7.54 \times 10^3$  mm  
 b  $6.12 \times 10^5$  mm<sup>2</sup>

- 8 2.7648 m  
 9  $8.92 \times 10^7$  people  
 10  $7.3 \times 10^{22}$  kg  
 11 71%  
 12  $1.42 \times 10^{-1}$  kg

### Exercise 11.3 (page 102)

- 1 See answers to questions 1 and 2 from Exercise 11.2.  
 2 a  $9.072 \times 10^{13}$   
 b  $1.024 \times 10^{-7}$   
 c  $1.2 \times 10^{-2}$   
 d  $3.416 \times 10^8$   
 e  $7.44 \times 10^3$   
 f  $2.8 \times 10^0$   
 g  $5.276 \times 10^{-5}$   
 h  $6.348 \times 10^{-5}$

- 3  $5 \times 10^{-3}$   
 4  $1.098 \times 10^{21}$  m<sup>3</sup>  
 5  $1.336 \times 10^{-23}$  kg

- 6 a  $1.24513 \times 10^{27}$  kg  
 b 117 times  
 c  $1.819 \times 10^{27}$  kg  
 d Venus
- 7 about  $5\frac{1}{2}$  hours
- 8  $5.83 \times 10^{12}$  miles

- d  $6.384 \times 10^3$   
 e  $5.29 \times 10^{20}$   
 f  $1.75616 \times 10^{14}$   
 g  $8.16 \times 10^{10}$   
 h  $8 \times 10^4$   
 i  $5.64 \times 10^{-6}$   
 j  $1.35 \times 10^{17}$

13  $9.109 \times 10^{-31}$  g

14 13 000 km/h

- i rational – a recurring decimal  
 j rational – a terminating decimal

2 a irrational – the square root of a non-square number

b rational – a recurring decimal =  $\frac{41}{90}$

c rational – a terminating decimal =  $\frac{6}{5}$  or  $\frac{11}{5}$

d rational – an integer =  $\frac{4}{1}$

e rational – an integer =  $\frac{5}{1}$

f rational – a terminating decimal =  $\frac{7}{25}$

g rational – a mixed number =  $\frac{11}{4}$

h rational – a terminating decimal =  $-\frac{5}{2}$  or  $-2\frac{1}{2}$

i rational – a terminating decimal =  $\frac{913}{200}$  or  $4\frac{113}{200}$

j rational – an integer =  $\frac{2}{1}$

3 a  $\sqrt{3}$  is one example.

b  $\sqrt{4}$  is one example.

4  $\frac{3\pi}{2\pi}$  or  $\frac{\sqrt{12}}{\sqrt{3}}$  are two examples.

5 0.2 and  $0.\dot{3}$  is one example.

$0.2 = \frac{1}{5}$  is terminating and

$0.\dot{3} = \frac{1}{3}$  is recurring but

$0.2 + 0.\dot{3} = \frac{1}{5} + \frac{1}{3} = \frac{8}{15}$

which is rational.

## Summary exercise 11 (page 103)

- 1 a  $3.45 \times 10^5$   
 b  $8.9 \times 10^{-6}$   
 c  $5.67 \times 10^8$   
 d  $9 \times 10^{-4}$   
 e  $5 \times 10^4$   
 f  $1.23 \times 10^{12}$
- 2 a 230 000  
 b 0.0001  
 c 860  
 d 0.000 000 04  
 e 5623.4  
 f 0.000 000 986
- 3 6 zeros
- 4  $6.023 \times 10^{23}$
- 5  $2.52 \times 10^8$
- 6 2 300 000
- 7 a  $1.3 \times 10^2$   
 b  $5.91 \times 10^7$   
 c  $8 \times 10^2$   
 d  $6.241 \times 10^{13}$   
 e  $6.77 \times 10^{-3}$   
 f  $2.8561 \times 10^{20}$   
 g  $7.4 \times 10^5$   
 h  $3.83 \times 10^{-5}$   
 i  $1.856 \times 10^5$   
 j  $9.88 \times 10^{-1}$
- 8  $4.2 \times 10^{-18}$  g
- 9  $7 \times 10^{-2}$  mm
- 10  $3.059 \times 10^6$  km<sup>2</sup>
- 11  $2.2 \times 10^3$  kg/m<sup>3</sup>
- 12 a  $2.465 \times 10^5$   
 b  $2.9 \times 10^2$   
 c  $1.59 \times 10^{-3}$

## Examination questions (page 104)

- 1 a  $3.245 \times 10^6$   
 b 0.000 432
- 2 a i  $1.467 \times 10^{11}$   
 ii  $8.67 \times 10^{-7}$   
 b i  $\pounds 2.067 \times 10^9$   
 ii  $\pounds 43.40$
- 3 a  $1.08 \times 10^{-19}$  g  
 b about 16 times
- 4 2167 seconds

## Chapter 12 Rational and irrational numbers

### Exercise 12.1 (page 108)

- 1 a rational – a terminating decimal  
 b rational – the square root of a square number  
 c irrational – involves  $\pi$   
 d rational – a fraction in the form  $\frac{a}{b}$   
 e rational – a recurring decimal  
 f rational =  $\frac{3}{5} - a$  fraction in the form  $\frac{a}{b}$   
 g rational – the cube root of a cube number  
 h irrational – involves  $\pi$

- 6 rational
- 7 a rational –  $\sqrt{6\frac{1}{4}} = \sqrt{\frac{25}{4}}$   
 $= \frac{5}{2}$  – a fraction
- b irrational – involves the square root of a non-square number
- c rational –  $(1\frac{1}{2})^2 = \frac{9}{4}$  – a fraction
- d irrational – involves the square root of a non-square number
- e rational –  $\pi \times \frac{2}{\pi} = 2$  – an integer
- f rational –  $(\sqrt{3})^2 = 3$  – an integer
- g rational –  $0.2^3 = 0.008$  – a terminating decimal
- h rational –  $\frac{2.5}{0.2} = 12.5$  – a terminating decimal
- i irrational –  $\sqrt{4\frac{1}{4}} = \sqrt{\frac{17}{4}}$  – involves the square root of a non-square number
- 8 a irrational – involves  $\pi$
- b rational – an integer
- c irrational – the square root of a non-square number
- d rational – a fraction
- 9 Yes; for example  $\pi$  and  $\frac{5}{\pi}$ .  
 Both these are irrational but  $\pi \times \frac{5}{\pi} = 5$ , which is rational. Another pair of numbers is  $\sqrt{2}$  and  $\sqrt{50}$ . Both these are irrational but  $\sqrt{2} \times \sqrt{50} = \sqrt{100} = 10$  which is rational.
- 10 a  $\sqrt{5}$  or  $\frac{1}{\sqrt{5}}$
- b  $\pi$

- c  $\frac{1}{\sqrt{2}}$  or  $\sqrt{2}$
- 11 a  $\frac{3}{11}$
- b  $\frac{523}{495}$  or  $1\frac{28}{495}$
- c  $\frac{4}{11}$
- d  $\frac{169}{330}$

### Summary exercise 12 (page 109)

- 1 a rational – a recurring decimal =  $\frac{8}{9}$
- b rational – an integer = 8
- c rational –  $\sqrt{2\frac{1}{4}} = \sqrt{\frac{9}{4}}$  =  $\frac{3}{2}$  – a fraction
- d irrational – the square root of a non-square number
- e rational – the cube root of a cube number =  $\frac{2}{1}$
- f rational – a recurring decimal =  $\frac{37}{45}$
- g rational – a terminating decimal =  $\frac{128}{25}$
- h rational – a mixed number =  $\frac{14}{3}$
- i irrational – involves  $\pi$
- j rational – a fraction =  $\frac{1}{10}$
- 2 a One example is  $0.26 = \frac{13}{50}$ .
- b Not possible as any terminating decimal will be rational.
- c One example is  $0.\dot{5} = \frac{5}{9}$ .

- 3 a irrational
- b rational
- 4 3 (or  $\sqrt{9}$ ) is one example.
- 5 a 1.23 is one example.
- b  $\sqrt{1.5}$  is one example.
- 6 a rational –  $36\text{ cm}^2$  – an integer
- b irrational –  $\sqrt{72}\text{ cm}$  – the square root of a non-square number
- c rational –  $24\text{ cm}$  – an integer
- d rational –  $6\text{ cm}$  – an integer
- e irrational –  $36\pi\text{ cm}^2$  – involves  $\pi$
- f irrational –  $12\pi\text{ cm}$  – involves  $\pi$
- 7 a  $0.8\dot{3}$
- b i  $\frac{5}{12}$  (half of  $0.8\dot{3}$ )
- ii  $\frac{209}{600} (0.34 + \frac{0.8\dot{3}}{100})$
- 8 11.56 is one example.
- 9 For example,  $(2 + \sqrt{3}) + (3 - \sqrt{3}) = 2 + 3 = 5$  which is rational.
- 10 a Possible answers are  $9.1, 9\frac{1}{2}, 9.88$ .
- b Possible answers are  $\sqrt{85}, \sqrt{90}, \sqrt{95}$ .

### Examination questions (page 110)

- 1 a  $x = \pm 3$ , rational – integers
- b  $x = \pm\sqrt{\frac{15}{2}}$ , irrational – involves the square root of non-square numbers
- c  $x = \pm 2.5$ , rational – terminating decimal

- 2 a equation **iii**  
 $2x^2 = 18$  so  $x^2 = 9$  and  
 $x = \pm 3$  which are both  
rational.
- b  $\frac{347}{1110}$
- 3 a  $0.\dot{7}$
- b  $\frac{7}{198}$
- 4  $\pi \times \pi = \pi^2$  is one  
example. The square of  $\pi$   
is still irrational.

## Chapter 13 Surds

### Exercise 13.1 (page 111)

- 1  $15\sqrt{2}$
- 2  $7\sqrt{3}$
- 3 18
- 4  $5\sqrt{2}$
- 5  $2\sqrt{13}$
- 6  $12\sqrt{2}$
- 7  $12\sqrt{10}$
- 8  $40\sqrt{2}$
- 9  $100\sqrt{10}$
- 10  $54\sqrt{2}$
- 11  $9\sqrt{5}$
- 12  $6\sqrt{11}$

### Exercise 13.2 (page 112)

- 1 a 6  
b 9  
c 2  
d 9  
e  $2\sqrt{15}$   
f 5  
g  $\sqrt{5}$   
h 2  
i  $10\sqrt{10}$   
j 1  
k  $90\sqrt{15}$

- 1  $18\sqrt{3}$
- 2 a  $\sqrt{5}$   
b  $4\sqrt{3}$   
c  $5\sqrt{2}$   
d  $4\sqrt{3}$   
e  $\sqrt{15}$   
f  $11\sqrt{2}$
- 3 a  $9 + 4\sqrt{5}$   
b  $7 - 2\sqrt{6}$   
c  $\sqrt{7} - 1$   
d 6  
e  $49 + 12\sqrt{5}$
- 4  $a = 54, b = -14$
- 5 a irrational  
b irrational  
c rational
- 6 One possible value for  $x$  is  
8.

### Exercise 13.3 (page 114)

- 1 a  $2\sqrt{3}$   
b 2  
c  $\sqrt{13}$   
d  $4\sqrt{2}$   
e  $3\sqrt{2}$   
f  $\frac{2\sqrt{3}+3}{3}$   
g  $1 + 2\sqrt{5}$   
h  $\frac{\sqrt{21}+6}{3}$
- 2 a  $\frac{17\sqrt{2}}{10}$   
b  $\frac{25\sqrt{2}}{2}$   
c  $\frac{5\sqrt{2}}{2}$
- 3 a false  
b true  
c true  
d false  
e true  
f false

## Summary exercise 13 (page 114)

- 1 a  $6\sqrt{2}$   
b  $10\sqrt{3}$   
c  $12\sqrt{3}$   
d  $3\sqrt{2}$   
e  $5\sqrt{5}$   
f  $4\sqrt{6}$   
g  $3\sqrt{5}$   
h  $13\sqrt{2}$   
i  $6\sqrt{10}$   
j  $25\sqrt{3}$   
k  $20\sqrt{2}$   
l  $10\sqrt{2}$   
m  $10\sqrt{6}$   
n  $25\sqrt{10}$   
o  $55\sqrt{2}$
- 2 a  $2\sqrt{5}$   
b 18  
c  $12\sqrt{10}$   
d  $5\sqrt{2}$   
e 5  
f 1  
g  $8\sqrt{3}$   
h  $8\sqrt{2}$   
i  $18\sqrt{10}$   
j  $6\sqrt{2}$   
k  $12\sqrt{2}$   
l  $2\sqrt{21}$   
m  $72\sqrt{3}$   
n  $16\sqrt{2}$   
o 12
- 3 a  $\frac{3\sqrt{5}}{5}$   
b  $\frac{2\sqrt{7}}{7}$   
c  $2\sqrt{2}$   
d  $10\sqrt{2}$   
e  $\frac{\sqrt{2} + \sqrt{6}}{2}$

f  $5\sqrt{2}$

g  $\frac{2\sqrt{5} - 5\sqrt{2}}{5}$

h  $\frac{\sqrt{6}}{3}$

4 a  $4\sqrt{2}$

b  $2\sqrt{7}$

c  $7\sqrt{10}$

d  $5\sqrt{5}$

e 0

f  $9\sqrt{2}$

5 a  $14 + 6\sqrt{5}$

b  $5 - 2\sqrt{6}$

c  $4\sqrt{3} - 20$

d  $7 - 2\sqrt{10}$

e  $4 + 4\sqrt{2} + \sqrt{3} + \sqrt{6}$

6 a  $\frac{11\sqrt{3}}{3}$

b  $\frac{8\sqrt{5}}{5}$

c  $\frac{7\sqrt{3}}{3}$

7  $\sqrt{40} = \sqrt{8} \times \sqrt{5}$

$$2 = \frac{\sqrt{40}}{\sqrt{10}}$$

$$3\sqrt{4} = 6$$

$$\frac{\sqrt{8}}{4} = \frac{1}{\sqrt{2}}$$

8  $\sqrt{32} = \sqrt{16 \times 2} = 4\sqrt{2}$

$$\frac{6}{\sqrt{2}} = \frac{6\sqrt{2}}{2} = 3\sqrt{2}$$

$$\text{So, } \sqrt{32} + \frac{6}{\sqrt{2}} = 4\sqrt{2} + 3\sqrt{2}$$

$$3\sqrt{2} = 7\sqrt{2}$$

### Examination questions (page 115)

1  $\frac{\sqrt{2}}{2}$

2 a  $3\sqrt{5}$

b 6

3  $4\sqrt{2}$

4  $28 - 10\sqrt{3}$

5 a  $(\sqrt{12} + \sqrt{3})^2$   
 $= (\sqrt{4 \times 3} + \sqrt{3})^2$   
 $= (2\sqrt{3} + \sqrt{3})^2$   
 $= (3\sqrt{3})^2$   
 $= 9 \times 3 = 27$

b  $\frac{1}{75} \sqrt{15}$

6  $-9 + 7\sqrt{5}$

## Chapter 14 Algebra review

### Exercise 14.1 (page 118)

1 a  $-2a$

b  $3x + 10y$

c  $-4k - 3$

d 0

e  $9ab$

f  $7p + 10q$

g  $11t - 19r$

h  $8e - 8e^2$

i  $-12a + 4k$

j  $16p^2 - 9p$

k  $2a + 3b - 16$

l  $-8pq + 15$

m  $11abc + 2bc$

n  $-k - 5t - 3tk$

o  $6a^2b + 2a^2 - 9b^2$

p  $-5t^2 - 1$

q  $8a^2 + b^2 - 9$

r  $-8w^3 + 2w^2$

s  $10 + 3pq + p^2 - q^2$

t  $10 - h^3$

u  $n^6$

v  $k^7$

w  $a^2 \times b^4$

x  $28m^3$

2 expressions **b** and **c**

3 a  $2a + 2b$

b  $ab$

4  $18a$

5 a  $-3y$

b  $-2x^2 + 7x - 2y$

c  $-6 - x - 4y$

d  $5x$

### Exercise 14.2 (page 120)

1 a  $\frac{1}{62}$

b  $-2$

c  $\frac{x}{2} + 4$

2 a 16

b 20

c 12

d  $-8$

e 1

f  $-1$

g 50

h 100

i 10

j  $-\frac{1}{2}$

k  $-4$

l 5

3 a  $-2$

b  $-9$

c  $-32$

d  $\frac{1}{4}$

e 10

f 14

g 2

h  $-24$

i  $-4$

j  $-80$

k  $-1\frac{1}{2}$

l  $-6$

4 a  $-30$

b  $-36$

c  $-10$

d  $-6$

e 36

f 44

g  $-729$

h  $\frac{1}{2}$

i 4

j  $-3\frac{1}{2}$

k -6

l ±6

5  $6\frac{3}{4}$

6  $-1\frac{4}{15}$

### Summary exercise 14 (page 121)

1  $(6w + 6)$  cm

2  $\mathcal{L}(4.25A)$

3  $\frac{k}{5}$

4  $t - 8$

5 a  $-a - 2b + 6c$

b  $pq + 8qr$

c  $3x^2 + 5$

d  $-2a^2 + a - 2$

6  $2a + 2b + 48$

7 a 250

b 100

c  $2\frac{1}{2}$

d -5

e 1

f  $\frac{1}{8}$

g 200

h 400

i 0

8 a -6

b -18

c 0

d  $2\frac{1}{4}$

e 19

f 108

g  $\frac{5}{6}$

h 135

i 144

9 a -9

b 0

c  $3(k + 2)$

### Examination questions (page 122)

1  $3d + 7e$

2 -3

3 a 40

b -3

4  $2p + 3q$

5 26

### Chapter 15 Indices

#### Exercise 15.1 (page 126)

1 a  $2^4$

b  $3^2 \times 4^3$

c  $t^6$

2 a  $x^8$

b  $p^8$

c  $a^8$

d  $t^{20}$

e  $n$

3 a  $8g^5$

b  $54k^9$

c  $3k^4$

d  $6r^4$

e  $\frac{4y^4}{3}$

f  $25g^4$

g  $8n^6$

h  $4a^6$

i  $108a^5$

j  $a^7y^5$

k  $p^2q^5$

l  $27m^6n^9$

4 a  $2^6$

b  $5^2$

5 a  $\frac{1}{y^2}$

b  $w^7$

c  $\frac{1}{x^2}$

d 1

e  $y^{12}$

f 1

g  $a^{\frac{1}{5}}$

h  $x^3$

i  $x^2$

j  $\sqrt{x}$

k  $\frac{1}{\sqrt{x^5}}$

l  $\frac{1}{\sqrt[3]{p^8}}$

m 1

n  $\sqrt[4]{t}$

o  $k$

6 a 1

b  $\frac{1}{27m^3}$

c  $4w^3$

d  $\frac{1}{64c^4}$

e  $5y$

f  $\frac{1}{8h^3}$

g  $\frac{3}{p}$

h  $\frac{5}{y^3}$

i  $4k^2$

j  $4x$

k  $4n$

l  $p^4q^4$

m  $\frac{t^2}{u^4}$

n  $\frac{3}{xy^3}$

o  $3b^2c$

7 a 1

b  $4^{a+b+c}$

c  $2^{c+d-e}$

d  $\frac{1}{4e^7}$

8 a  $3^{7x}$

b  $2^{b-2c-a}$

9 a 36

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

c 81



**Exercise 15.2 (page 127)**

- 1 64  
 2 3  
 3 1  
 4  $\frac{1}{16}$   
 5 81  
 6 32  
 7  $\frac{1}{125}$   
 8 16  
 9 9  
 10 4  
 11 3  
 12  $\frac{1}{16}$   
 13 0.001  
 14 1  
 15  $\frac{1}{7}$   
 16  $\frac{1}{2}$   
 17  $\frac{1}{2}$   
 18  $\frac{1}{5}$   
 19  $\frac{1}{25}$   
 20 27  
 21 1  
 22 5  
 23 16  
 24 100  
 25 8  
 26  $3\frac{1}{3}$   
 27  $\frac{1}{32}$   
 28  $2^9$   
 29  $100^8$   
 30 16  
 31 343  
 32 a  $\frac{1}{2}$

b  $3\frac{1}{2}$

c  $-\frac{1}{3}$

33  $2^{-6}, 6^{-2}, 6^{\frac{1}{2}}, 6^2, 2^6$

34  $16^{0.25}, 4^{\frac{1}{2}}$  and 2

35 8

36 64

37  $100^{\frac{5}{2}}$

**Exercise 15.3 (page 129)**

- 1 5  
 2  $-\frac{1}{3}$   
 3 3  
 4 0  
 5 81  
 6  $\frac{1}{3}$   
 7 2  
 8 3  
 9 16  
 10 1  
 11  $\frac{2}{3}$   
 12  $-1\frac{1}{2}$   
 13 -3  
 14 -1  
 15 32  
 16  $-2\frac{1}{2}$   
 17 4  
 18 -1  
 19 1  
 20 10  
 21 -3  
 22  $\frac{1}{2}$   
 23  $\frac{7}{3}$   
 24 2

25  $-1\frac{1}{2}$

26 2

27 6

28  $1\frac{1}{3}$

29  $-\frac{1}{6}$

30  $\frac{1}{3}$

**Summary exercise 15 (page 130)**

- 1 a  $10^4$   
 b  $k^5$   
 c  $10^{-2}$   
 d  $y^{-2}$   
 e  $20^2$   
 f  $t^4$   
 g  $7^{\frac{3}{2}}$   
 h  $(ab^2)^2$   
 2 a  $k^4$   
 b  $t^{12}$   
 c  $x^8$   
 d  $\frac{1}{m^8}$   
 e  $64c^6$   
 f  $n^6$   
 g  $6a^3$   
 h  $m^{12}$   
 i  $a^3$   
 j  $x$   
 k  $\sqrt{x}$   
 l  $x^4$   
 3 a  $12t^{10}$   
 b  $5h^6$   
 c  $15a^3b^3$   
 d  $12y$   
 e  $\frac{1}{x^2}$   
 f  $k^6$   
 g  $\frac{7mn}{10}$   
 h  $\frac{64}{a^6}$   
 i  $3a^4$

- j**  $\sqrt{x}$   
**k**  $9a^2b^4$   
**l** 30  
**4 a** 1  
**b**  $\frac{1}{64}$   
**c** 27  
**d** 32  
**e**  $\frac{1}{6}$   
**f** 0.1  
**g** 2  
**h**  $\frac{1}{243}$   
**i**  $\frac{3}{5}$   
**j** 8  
**k** 4  
**l** 1.5  
**5 a** 13  
**b** 6  
**6**  $2^{18}$   
**7**  $a^{-6}, a^0, \sqrt[6]{a}, a, a^6$   
**8**  $2^{6a+b}$   
**9 a** -2  
**b** 2  
**c**  $\frac{3}{5}$   
**d** 6  
**e** -2  
**f**  $1\frac{1}{2}$   
**g** -1  
**h**  $1\frac{1}{2}$   
**i**  $\frac{3}{2}$   
**j** -2  
**k** -5  
**l**  $-\frac{1}{6}$

### Examination questions (page 131)

- 1 a**  $x^{10}$   
**b**  $2x^2$   
**c**  $x^{15}$   
**d**  $\frac{4x^3}{5y}$

**2**  $27x^6$

**3 a**  $\frac{1}{16}$   
**b** 1

**4 a**  $\frac{1}{100}$   
**b** 1  
**c** 7

**5 a** 6  
**b** 2  
**c** 8  
**d**  $\frac{1}{25}$

**6 a** 8  
**b**  $\frac{1}{9}$

**7**  $\frac{1}{16}$

**8**  $a^{-3}, \frac{1}{a}, a^2, a$

The order would be reversed when  $0 < a < 1$ .

**9 a i**  $t^9$   
**ii**  $\frac{1}{r^3}$   
**iii**  $9a^2b^4$   
**b**  $x = \frac{2}{3}$

**10 a**  $4x^5y^4$   
**b**  $\frac{1}{m^5}$

**11**  $5a^4b^6$

## Chapter 16 Brackets

### Exercise 16.1 (page 134)

- 1 a**  $6x - 15$   
**b**  $20x - 8$   
**c**  $6a + 30$   
**d**  $8 - 6a$   
**e**  $15k - 5$   
**f**  $35d - 21$   
**g**  $24z - 16$   
**h**  $25p + 25$   
**i**  $12t + 20s$   
**j**  $6a - 4b$   
**k**  $1000 - 10x$   
**l**  $7a - 21c$

- 2 a**  $-8a + 12$   
**b**  $-21c + 3$   
**c**  $-25a - 10$   
**d**  $-6t + 30$   
**e**  $-3x - 3y$   
**f**  $-12 - 8y$   
**g**  $-4c - 7$   
**h**  $-10a + 15b$   
**i**  $-72y - 64$   
**j**  $-3 + 9x$   
**k**  $-5k - 5m$   
**l**  $-10 + 100a$

- 3 a**  $x^2 + 2x$   
**b**  $3x^2 - x$   
**c**  $xy - 2x$   
**d**  $2y^2 + 3y$   
**e**  $6x^2 - 2x$   
**f**  $a^2b + ac$   
**g**  $3xy + 2y^2$   
**h**  $-2a^2 - a$   
**i**  $a^2b + ab^2$   
**j**  $8k^2 - 12k$   
**k**  $-3b^2 - 18b$   
**l**  $6x^3 - 21x^2$

- 4 a**  $6a + 17$   
**b**  $10t - 3$   
**c**  $14r - 15$   
**d**  $18a - 8$   
**e**  $18 - 12x$   
**f**  $6m - 9$   
**g**  $15a - 16$   
**h**  $-b - 2$   
**i**  $-t - 5$   
**j**  $22 - u$   
**k**  $10 - 3x$   
**l**  $15y - 7$

- 5 a**  $5x^2 - x$   
**b**  $6a^2 - 3a$   
**c**  $8x^2 - 10$   
**d**  $11y^2 - 3y + 2$   
**e**  $8k^2 - k$   
**f**  $1 - 4p^2$   
**g**  $2p - 4p^2$   
**h**  $6t^2 + 12t$   
**i**  $12a^2 + 26a$   
**j**  $-4x$   
**k**  $xy^2 - 2y$   
**l**  $17e^2 - 3e$

- 6 a  $26a + 16$   
 b  $23x - 9$   
 c  $10x - 12$   
 d  $x + 8$   
 e  $11a - 20$   
 f  $31t - 4$   
 g  $7x - 15$   
 h  $5a^2 + 7a$   
 i  $6x^2 + 9x$   
 j  $6a - 12$   
 k  $3y - 2y^2$   
 l  $5t^3 + 14t^2$

7  $x^2 + 5x + 12$  square units

8  $(14y^2 + 32y)$  cm<sup>2</sup>

### Exercise 16.2 (page 138)

- 1 a  $x^2 + 6x + 8$   
 b  $a^2 + 8a + 15$   
 c  $t^2 - 8t + 7$   
 d  $y^2 + 2y - 15$   
 e  $u^2 - 11u + 30$   
 f  $p^2 + 8p + 12$   
 g  $a^2 - 3a + 2$   
 h  $c^2 - 9$   
 i  $g^2 - 16g + 63$   
 j  $a^2 + ax - ay - xy$   
 k  $r^2 - 6r + 9$   
 l  $c^2 - d^2$

- 2 a  $6x^2 - x - 2$   
 b  $5a^2 - 3a - 2$   
 c  $6t^2 + 19t + 15$   
 d  $12e^2 + 4e - 1$   
 e  $16y^2 - 8y + 1$   
 f  $49k^2 - 9$   
 g  $12b^2 + 7b - 10$   
 h  $24 - 14d - 3d^2$   
 i  $6a^2 + ax - x^2$   
 j  $18p^2 - 27pq - 5q^2$   
 k  $8 + 2x - 3x^2$   
 l  $30y^2 - 85y + 50$

- 3 a  $x^2 + 14x + 49$   
 b  $16e^2 - 24e + 9$   
 c  $9d^2 + 12d + 4$   
 d  $x^2 - 2x + 1$   
 e  $4x^2 - 4x + 5$   
 f  $1 - 25x^2 + 30x$   
 g  $8y^3 + 12y^2 + 6y + 1$   
 h  $36a^2 - 78a + 36$   
 i  $2x^2 + 18$   
 j  $3a^2 + 4a - 7$   
 k  $x^3 - x^2 - x + 10$   
 l  $a^3 - a^2b - ab^2 + b^3$

4  $6x^2 + 7x - 3$

5  $12a^2 + 5a - 3$

6  $(4x^2 + 140x)$  cm<sup>2</sup>

7  $(x + 2)^2 = (x + 2)(x + 2)$   
 $= x^2 + 2x + 2x + 4$   
 $(x - 2)^2 = (x - 2)(x - 2)$   
 $= x^2 - 2x - 2x + 4$

So  $(x + 2)^2 - (x - 2)^2$   
 $= x^2 + 2x + 2x + 4 - (x^2 - 2x - 2x + 4)$   
 $= x^2 + 2x + 2x + 4 - x^2 + 2x + 2x - 4$   
 $= x^2 - x^2 + 2x + 2x + 2x + 2x - 4 + 4$   
 $= 8x$

8  $n(n + 2)(n + 4)$   
 $= n(n^2 + 4n + 2n + 8)$   
 $= n(n^2 + 6n + 8)$   
 $= n^3 + 6n^2 + 8n$

### Summary exercise 16 (page 139)

- 1 a  $4y + 12$   
 b  $6x - 2$   
 c  $-6a - 15$   
 d  $-3y + 2$   
 e  $42g + 18$   
 f  $-10 + 15p$   
 g  $6x^2 + 7x$   
 h  $6y^2 + y$   
 i  $3x^2 + 2xy$   
 j  $-4c^2 + 12c$   
 k  $-6k - 10k^2$   
 l  $7t^3 - 35t^2$

- 2 a  $8n - 9$   
 b  $11 - 7x$   
 c  $6y^2 + 3y$   
 d  $3x^2 - 2x$   
 e  $11x^2 - 9x$   
 f  $3 - 10a$

g  $11 - 13e$

h  $10a - 2$

i  $x^2$

j  $25 - 13g$

k  $-4y^2 - 3y$

l  $3 - 8p - 3p^2$

3 a  $x^2 + 3x - 18$

b  $a^2 + 13a + 42$

c  $d^2 + 8d + 15$

d  $4a^2 + 20a + 21$

e  $6p^2 + 7p - 5$

f  $30 - 17y - 2y^2$

g  $24k^2 + 4k - 4$

h  $a^2 + 6a + 9$

i  $25t^2 + 30t + 9$

j  $18e^2 + 12e + 2$

k  $2 - 9y^2 + 12y$

l  $8x$

4 a  $(x + 8)$  cm

b  $(5x + 2)$  cm

5 36 square units

### Examination questions (page 139)

1  $8c - 7d$

2 a  $4x^3 - 12x$

b  $23 - 2c$

3  $x^2 + 2x - 15$

4  $(2n + 3)(3n - 2)$   
 $= 6n^2 - 4n + 9n - 6$   
 $= 6n^2 + 5n - 6$   
 $6(1 - n)(1 + n)$   
 $= 6(1 + n - n - n^2)$   
 $= 6(1 - n^2)$   
 $= 6 - 6n^2$   
 $(2n + 3)(3n - 2) + 6(1 - n)$   
 $(1 + n)$   
 $= 6n^2 + 5n - 6 + 6 - 6n^2$   
 $= 5n$

5  $c = 36, d = -6$

6  $x^2 - 10x + 25$

7  $3(x - 1)$

8  $(x + 1)^2 - 2x - (x + 1)$   
 $= x^2 + 2x + 1 - 2x - x - 1$   
 $= x^2 + 2x - 2x - x + 1 - 1$   
 $= x^2 - x$

20  $2\frac{1}{2}$

21  $-1\frac{1}{2}$

22  $2\frac{1}{2}$

23  $-1$

24  $\frac{3}{4}$

24  $-1$

25  $\frac{3}{7}$

26  $-11$

## Chapter 17 Linear equations

### Exercise 17.1 (page 142)

1 5

2 11

3  $-3$

4 2

5  $\frac{2}{3}$

6  $-2$

7  $2\frac{2}{3}$

8  $1\frac{2}{5}$

9  $\frac{1}{2}$

10  $\frac{2}{3}$

11  $-1$

12  $-1$

13  $\frac{3}{7}$

14  $\frac{1}{3}$

15  $\frac{7}{9}$

16 7

17  $-16$

18  $-30$

19  $-\frac{5}{6}$

### Exercise 17.2 (page 143)

1  $-2$

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

3 1

4 2

5  $-3$

6  $\frac{4}{5}$

7  $-4$

8  $-2$

9 0

10  $-1\frac{1}{2}$

11 1

12  $\frac{1}{7}$

13  $-\frac{1}{2}$

14  $\frac{5}{6}$

15 8

16 2

17 2

18 0

19 1

20  $-7$

21 0

22 2

23 10

### Exercise 17.3 (page 145)

1 1

2 1

3  $-5\frac{1}{2}$

4  $1\frac{1}{5}$

5  $-3\frac{3}{5}$

6  $\frac{1}{2}$

7 0

8 2

9 1

10  $-4$

11 3

12 3

13  $\frac{17}{30}$

14 10

15  $\frac{7}{10}$

16  $-1\frac{3}{7}$

17 29

18 3

### Exercise 17.4 (page 147)

1 6

2 10

3 60

4 4

5 1

- 6  $-\frac{1}{2}$   
 7  $4\frac{3}{8}$   
 8  $4\frac{3}{8}$   
 9  $3\frac{1}{3}$   
 10  $-5\frac{1}{4}$   
 11  $-16$   
 12  $6$   
 13  $-18$   
 14  $10\frac{1}{2}$   
 15  $2$   
 16  $6$   
 17  $36$   
 18  $3$   
 19  $1\frac{3}{7}$   
 20  $3\frac{4}{5}$   
 21  $\frac{6}{13}$   
 22  $-2\frac{1}{2}$

### Exercise 17.5 (page 148)

- 1  $-1\frac{1}{8}$   
 2  $\frac{1}{42}$   
 3  $-45\frac{1}{2}$   
 4  $3$   
 5  $-2$   
 6  $-2$   
 7  $4.5$   
 8  $-1$

### Exercise 17.6 (page 150)

- 1  $9$   
 2  $63, 65$  and  $67$   
 3  $4$  packets

- 4  $105^\circ, 45^\circ$  and  $30^\circ$   
 ( $x = 35^\circ$ )  
 5 Jack  $5$ , Martin  $8$ , Rob  $12$   
 6  $42$  units  
 7  $94.5 \text{ cm}^2$   
 8  $25$  and  $42$   
 9  $16$  passengers  
 10  $4 \text{ km}$  ( $4000 \text{ m}$ )  
 11  $\pounds 24\,000$   
 12  $10 \text{ cm}, 8 \text{ cm}$  and  $6 \text{ cm}$   
 13  $15 \text{ cm}$

### Summary exercise 17 (page 152)

- 1 a  $6$   
 b  $-1\frac{2}{3}$   
 c  $7\frac{1}{2}$   
 d  $-1\frac{1}{2}$   
 e  $-1$   
 f  $\frac{2}{5}$   
 2 a  $-9$   
 b  $-2$   
 c  $1\frac{1}{2}$   
 d  $-\frac{4}{9}$   
 e  $1$   
 f  $2\frac{2}{5}$   
 3 a  $1\frac{5}{6}$   
 b  $\frac{1}{24}$   
 c  $1\frac{1}{2}$   
 d  $\frac{1}{7}$   
 e  $-\frac{1}{13}$   
 f  $\frac{4}{7}$   
 4 a  $4$   
 b  $-\frac{4}{5}$

- c  $-4\frac{1}{2}$   
 d  $6$   
 e  $\frac{2}{3}$   
 f  $-\frac{11}{14}$   
 5  $123$   
 6  $40^\circ, 70^\circ$  and  $70^\circ$   
 7  $24 \text{ cm}$   
 8  $70 \text{ km/h}$   
 9  $114, 117, 120$  and  $123$   
 10 twenty-six  $20\text{p}$  coins

### Examination questions (page 153)

- 1  $x = 2\frac{1}{2}$   
 2 a  $x = 7$   
 b  $y = \frac{1}{10}$   
 3  $x = 1\frac{3}{4}$   
 4  $x + x + 30 + 2x + 70 = 360$  or  $4x + 100 = 360$ ;  
 $x = 65$   
 5  $x = -7\frac{1}{2}$   
 6  $x = \frac{1}{4}$   
 7  $x = -5\frac{1}{2}$   
 8 a  $x = 3$   
 b  $x = 9$   
 9  $15x + 320 = 1250$ ;  
 $62$  pence  
 10  $3x + 4x + 185 = 500$ ;  
 $x = 45$

## Chapter 18 Sequences

### Exercise 18.1 (page 157)

- 1 a  $6$   
 b  $36$

- c 16  
d 20  
e 40
- 2 a add 5 to the previous term  
b halve the previous term  
c subtract 3 from the previous term  
d multiply the previous term by 3  
e subtract 1 more than was previously subtracted
- 3 a 42, 50  
b 41, 51  
c 20, 16  
d 55, 47  
e 47, 65  
f -4, -10  
g 11, 15  
h  $7\frac{1}{2}, 3\frac{3}{4}$   
i 29, 39  
j 56, 81
- 4 a 81, 130, 197  
b 37, 50, 65  
c 218, 345, 514  
d 222, 350, 520  
e 204, 329, 496  
f 37, 49, 63  
g 67, 93, 123  
h 211, 338, 507  
i 324, 539, 832  
j 134, 186, 246

### Exercise 18.2 (page 161)

- 1 a  $4n - 3; 77$   
b  $-2n + 8; -32$   
c  $12n; 240$   
d  $7n - 2; 138$   
e  $1.5n + 0.5; 30.5$   
f  $-3n + 16; -44$   
g  $5n + 2; 102$   
h  $-n + 11; -9$   
i  $-5n + 105; 5$   
j  $-2n - 1; -41$

- 2 a  $n^2 + 1; 101$   
b  $n^2 - n + 1; 91$   
c  $3n^2 - 2; 298$   
d  $n^2 + 2n + 3; 123$   
e  $-n^2 + 4n + 1; -59$   
f  $n^2 - 2; 98$   
g  $5n^2 + n - 3; 507$   
h  $20n^2; 2000$   
i  $n^2 - 1; 99$   
j  $-\frac{1}{2}n^2 + \frac{1}{2}n + 10; -35$
- 3  $2n + 4; 34$
- 4  $3n - 1; 299$
- 5  $2n^2 + n - 1; 299$
- 6 17th term
- 7 24th term
- 8 The second difference is 2 so  $a = 1$ .

The original sequence is      2 6 12 20 30  
Subtracting the sequence  $n^2$  results in the

linear sequence	$\frac{-1}{1}$	$\frac{4}{2}$	$\frac{9}{3}$	$\frac{16}{4}$	$\frac{36}{5}$
-----------------	----------------	---------------	---------------	----------------	----------------

This sequence follows the rule  $n^2 + n$ , or  $n(n + 1)$ .

Alternatively, having found  $a = 1$ , working back to  $n = 0$  gives  $c = 0$ .

$$\begin{aligned} \text{1st term} &= a + b + c = \\ &1 + b + 0 \end{aligned}$$

But the 1st term is 2, so  $1 + b = 2$ , and so  $b = 1$ .

Hence the rule for the  $n$ th term is  $n^2 + n$ , or  $n(n + 1)$ , as before.

### Exercise 18.3 (page 164)

- 1 a 18 pegs  
b 24 towels
- 2  $(1000 - 0.5t) \text{ cm}^3$
- 3 a 8 chairs  
b  $C = 2T + 2$

- c 26 chairs  
d 47 tables
- 4 a  $P = 4n - 3$   
b  $T = 3n + 5$
- 5 a  $\frac{n}{n+1}, \frac{20}{21}$   
b  $n \times n^2$  or  $n^3; 20 \times 20^2 = 20^3 = 8000$   
c  $\frac{2n}{n^2+1}, \frac{40}{401}$
- 6 9 bricks
- 7 465
- 8 a  $\frac{1}{2}n^2 - 1\frac{1}{2}n$   
b 54 diagonals
- 9 a True; the number of chords forms a quadratic sequence with the given rule for the  $n$ th term.  
b False; for 6 or 7 points, the number of regions does not follow the given rule for the  $n$ th term. For example, 6 points creates 31 regions but  $2^6 - 1 = 2^5 = 32$ .
- 10 No; the sequence 10, 12, 14, 16, 18, 20, ... is a suitable counter example.

### Summary exercise 18 (page 165)

- 1 a Subtract 1 more than was previously subtracted.  
b Add 2 more than was previously added.  
c Add 3 more than was previously added.
- 2 a 10, 20, 40, 80, 160  
b  $10, 5, 2\frac{1}{2}, 1\frac{1}{4}, \frac{5}{8}$   
c 10, 6, 2, -2, -6
- 3 a 12, 2, -10  
b 30, 41, 54  
c 13, 8, 14
- 4 a 46, 62

- b** 437, 683  
**c** 341, 510  
**5 a**  $2n - 3$ ; 27  
**b**  $2n^2 + 3n$ ; 495  
**c**  $-3n + 19$ ;  $-26$   
**d**  $3n^2 - 2n$ ; 645  
**e**  $n^2 - 2n$ ; 195  
**6** 81  
**7** 126 terms  
**8** 18.75 cm  
**9** 1889  
**10 a** 28 cubes  
**b**  $2n^2 - n$   
**c** 190 cubes

### Examination questions (page 166)

- 1 a i** 18  
**ii** shape number  $\times 3$   
**b** 1,  $-9$   
**2 a** 8, 11, 16  
**b i**  $11n$   
**ii**  $4n - 1$   
**3 a**  $-2n + 7$   
**b**  $\frac{n}{n+1}$   
**c**  $\frac{n}{n^2+3}$   
**4** 3,  $-7$   
**5 a** 25  
**b**  $3n + 1$   
**c** 76  
**6 a**  $4n - 3$   
**b i**  $\frac{4n-3}{n^2}$   
**ii** The equation  $\frac{4n-3}{n^2} = 1$  has only two solutions,  $n = 1$  and  $n = 3$ .

## Chapter 19 Factorisation

### Exercise 19.1 (page 168)

- 1 a**  $4(x + 2)$   
**b**  $4(4 + n)$   
**c**  $3(4k + 3)$   
**d**  $5(2x - 3)$   
**e**  $3(7 + 2p)$   
**f**  $8(5x + 3)$   
**2 a**  $12(2a - 3)$   
**b**  $4(x - 5)$   
**c**  $5(n + 1)$   
**d**  $4(3 + 4p)$   
**e**  $8(1 - k)$   
**f**  $7(x + 3)$   
**g**  $8(1 + 2y)$   
**h**  $3(3x - 1)$   
**i**  $8(4 - 5n)$   
**j**  $6(3y + 4)$   
**k**  $5(5t - 8)$   
**l**  $6(g - 3)$   
**3 a**  $2x(2x + 1)$   
**b**  $a(y - b)$   
**c**  $h(2h + 1)$   
**d**  $3x(2x + 1)$   
**e**  $4a(a - 2)$   
**f**  $4pq(2p + 1)$   
**4 a**  $5n(3 - 4n)$   
**b**  $k^2(k + 1)$   
**c**  $5a(2a - 1)$   
**d**  $ab(a + b)$   
**e**  $2r^2(4 - 5r)$   
**f**  $6a(3 - a)$   
**g**  $\pi r(r + 2h)$   
**h**  $6cd(2c + 3d)$   
**i**  $2xz(y + 2x)$   
**j**  $5p^2(6p - 5)$   
**k**  $xy(x + w)$   
**l**  $2k^2(2k - 5)$   
**5 a**  $m(m + 4)$   
**b**  $2e(8 - e)$   
**c**  $x(6 - x)$   
**d**  $7x(8 + 3x)$   
**e**  $r(4r - 1)$   
**f**  $5x(2 - 5x)$   
**g**  $p^2(p - 3)$   
**h**  $3y(5 - 3y)$   
**i**  $\pi r(r + 2)$   
**j**  $ab(b - c)$   
**k**  $4a^2(2a + 1)$   
**l**  $2q(2p + 1)$

- m**  $2c(2a^2 + 3)$   
**n**  $ad(a^2 - d)$   
**o**  $a^2b(5a + 2)$   
**p**  $2x(3y + z - 2w)$   
**q**  $a(wx + ax + a^2y)$   
**r**  $2xy(3y + 2 - y)$

### Exercise 19.2 (page 170)

- 1**  $(b + a)(y + z)$   
**2**  $(x - w)(y - z)$   
**3**  $(x^2 + y)(a + b)$   
**4**  $(e + d)(f + g)$   
**5**  $(x + y)(x + a)$   
**6**  $(c - 1)(d^2 + 1)$   
**7**  $(5d - 2f)(3c + 2e)$   
**8**  $(2y - 1)(x + 3)$   
**9**  $(1 + t^2)(1 + t)$   
**10**  $(y - x)(a + b)$   
**11**  $(a + 2b)(3y + x)$   
**12**  $(u - 5)(4u - v)$   
**13**  $(e^2 + 2)(e - 3)$   
**14**  $(3g + n)(2g - h)$   
**15**  $(c - 5e)(3d + 2f)$   
**16**  $(4p^2 - 3t)(6 - t)$   
**17**  $(a - 5)(k + 1)$   
**18**  $(x - 1)(y^2 + 1)$

### Exercise 19.3 (page 171)

- 1 a**  $(c - d)(c + d)$   
**b**  $(a - y)(a + y)$   
**c**  $(10 - p)(10 + p)$   
**d**  $\left(c - \frac{1}{d}\right)\left(c + \frac{1}{d}\right)$   
**e**  $(6y - 1)(6y + 1)$   
**f**  $(8 - t)(8 + t)$   
**g**  $(3k - m)(3k + m)$   
**h**  $(4a - 7b)(4a + 7b)$   
**i**  $(9a - 5)(9a + 5)$   
**2 a** 135  
**b** 2.4

c 8

d 128016

3 a  $(y - z)(2x + y + z)$

b  $(3n - 1)(5n - 1)$

c  $(x + 1)(5x + 3)$

4 a  $9999 = 100^2 - 1^2$

b  $9999 = 99 \times 101 = 3^2 \times 11 \times 101$

### Exercise 19.4 (page 174)

1 a  $(x + 9)(x + 5)$

b  $(x + 5)(x - 7)$

c  $(x - 5)(x + 4)$

d  $(a - 10)(a - 3)$

e  $(p + 2)(p - 15)$

f  $(y + 8)(y + 3)$

g  $(a + 3)(a - 7)$

h  $(k + 1)^2$

i  $(x + 3)(x - 8)$

j  $(p - 1)(p - 9)$

k  $(m - 5)(m + 7)$

l  $(t + 4)(t - 9)$

2 a  $(3a + 2)(a + 5)$

b  $(3x - 8)(x + 1)$

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

d  $(3y + 11)(y + 1)$

e  $(2p - 1)(p - 5)$

f  $(3x + 4)(x - 5)$

g  $(3p - 1)(p - 10)$

h  $(5y - 4)(2y + 1)$

i  $(3x + 4)(2x - 5)$

j  $(4y - 1)(3y + 4)$

k  $(4n - 1)(n + 3)$

l  $(5x - 2)^2$

3 a  $x(5x - 3)$

b  $(a - 11)(a + 11)$

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

d  $(x + 3)(x - 7)$

e  $(p - 3)(p + 3)$

f  $(3x - 2)(x - 3)$

g  $5x(2x - 1)$

h  $(5x + 2)(2x + 1)$

i  $(7x - 6)(7x + 6)$

j  $(4p + 1)(2p - 3)$

k  $4p(1 - 2p)$

l  $(y - 2)(y - 3)$

### Exercise 19.5 (page 176)

1 a  $5(a^3 + 3)$

b  $(1 - 8y)(1 + 8y)$

c  $(q + s)(p + r)$

d  $(x - 1)(x + 5)$

e  $(5y - 2)(3y + 1)$

f  $(3p + 1)(p - 6)$

g  $x(x^2 + y)$

h  $(x - k)(x + y)$

2 a  $2(x + 1)(x - 3)$

b  $2(x - 3)(x + 3)$

c  $2(2y - 1)(x + 3)$

d  $5(x + 4)(x - 3)$

e  $4(a - b)(a + b)$

f  $10ab(a - 4b)$

g  $2(k - 2)(k - 3)$

h  $4(p - 2)(q + 2)$

3 a  $\frac{2b}{3a}$

b  $\frac{k - 2}{k + 3}$

c  $\frac{a + b}{4b}$

d  $\frac{3(2a + 1)}{(3a + 1)}$

4  $2y + 5x$

5 208

6 Area =  $\pi(20^2 - 18^2) = \pi(20 - 18)(20 + 18) = \pi \times 2 \times 38 = 76\pi \text{ cm}^2$

### Summary exercise 19 (page 177)

1 a  $2(3a + 10)$

b  $4(3x - 5)$

c  $5(2x + 1)$

d  $x(x - 3)$

e  $5y(2y + 1)$

f  $3k(2k - 3)$

g  $2b(2a - 3c)$

h  $mn(n - m)$

i  $5y(3x - 4)$

j  $3x(x + 2y + 3z)$

k  $x(x^2 + 3x - 2)$

l  $6d^2(d^2 + 1)$

2 a  $(a + b)(h + k)$

b  $(3y + x)(2w - h)$

c  $(x^2 + y)(a + b)$

d  $(m - p)(2n + 3k)$

e  $(z - a)(5y - x)$

f  $(a + b)(b + c)$

g  $(c + 2d)(c - 5)$

h  $(x - 3y)(3x - a)$

i  $(4b - 3)(2b + a)$

j  $(3z + y)(6x - y)$

3 a  $(p - q)(p + q)$

b  $(10 - t)(10 + t)$

c  $(5h - 1)(5h + 1)$

d  $(b - 0.1)(b + 0.1)$

e  $(6 - y)(6 + y)$

f  $\left(\frac{1}{10} - a\right)\left(\frac{1}{10} + a\right)$

g  $(2x - 5y)(2x + 5y)$

h  $\left(1 - \frac{1}{c}\right)\left(1 + \frac{1}{c}\right)$

i  $(5k - 6d)(5k + 6d)$

j  $\left(7x - \frac{y}{5}\right)\left(7x + \frac{y}{5}\right)$

k  $x(3x + 2)$

l  $-4ab$

4 a  $(a + 2)(a + 5)$

b  $(d + 3)(d - 7)$

c  $(2x - 3)(x + 7)$

d  $(p - 5)(p + 8)$

e  $(3k - 2)(k - 4)$

f  $(x + 9)(x - 2)$

g  $(6h - 1)(h + 4)$

h  $(4x + 3)(2x - 5)$

i  $(m - 2n)(m - 3n)$

j  $(4 - x)(2 + x)$

5 a  $4(x - 3)(x + 5)$

b  $5(x - 5)(x + 5)$

c  $3(c + 2)(a + b)$

d  $2(3x + 2)(x - 5)$

e  $10(x - 3)(x + 3)$

f  $4(5 - 2y)(4 + y)$

6 a  $9b(b + 3)$

b  $(a + 3)(a + 9)$

c  $(n - 1)(m + 2)$

d  $(ab - 1)(ab + 1)$

e  $(4x + 3)(x + 5)$

f  $(5a + 4)(a - 2)$

g  $4(a - b)(x - 2y)$

h  $(5p + 4)(3p + 2)$



$$\text{i } 2\pi r(2r + h)$$

$$\text{j } \left(\frac{x}{2} - 5\right)\left(\frac{x}{2} + 5\right)$$

$$7 \text{ a } \frac{2a + 1}{2}$$

$$\text{b } \frac{3(x + 3)}{(x - 2)}$$

$$\text{c } \frac{c - 2}{2(d - 3)}$$

$$8 \text{ } 28000$$

$$9 \text{ } 890$$

$$10 \text{ } 20^2 - 3^2; 17 \times 23$$

$$11 \text{ } 2(x - 1) + (2x + 1)^2 + (2x - 1)^2$$

$$= 2x - 2 + (4x^2 + 4x + 1) + (4x^2 - 4x + 1)$$

$$= 4x^2 + 4x^2 + 2x + 4x - 4x - 2 + 1 + 1$$

$$= 8x^2 + 2x$$

$$= 2x(4x + 1)$$

### Examination questions (page 178)

$$1 \text{ a } 3c(2d - 3c)$$

$$\text{b } 3(a + 3d)(a - 3d)$$

$$2 \text{ } (y + 2)(y - 6)$$

$$3 \text{ a } 2p(3q + p)$$

$$\text{b } \frac{x - 4}{2x - 1}$$

$$4 \text{ a } (a - 3b)(a + 3b)$$

$$\text{b } \frac{1}{2x + 1}$$

$$5 \text{ a } 3(b - 4c)$$

$$\text{b } \gamma(\gamma - 9)$$

$$\text{c } w(w + 1)$$

$$6 \text{ a } p(p + 5)$$

$$\text{b } k(2k - 1)$$

$$\text{c } (p - 5q)(p + 5q)$$

$$7 \text{ a } (x - 3)(\gamma + 5)$$

$$\text{b i } 3(x - 4)(x + 4)$$

$$\text{ii } \frac{3(x-4)}{2x+1}$$

## Chapter 20 Formulae

### Exercise 20.1 (page 181)

$$1 \text{ } 312\text{m}$$

$$2 \text{ } 104^\circ\text{F}$$

$$3 \text{ } -3\frac{1}{3}$$

$$4 \text{ } 1.8 \times 10^{14}$$

$$5 \text{ } 338350$$

$$6 \text{ } \frac{24}{35}$$

$$7 \text{ } 80\text{m}$$

$$8 \text{ } 37.5$$

$$9 \text{ } 8.98$$

$$10 \text{ } 283\text{cm}^2$$

$$11 \text{ } 1\frac{1}{2}$$

$$12 \text{ a } W = 160.40 + 5.5g$$

$$\text{b } \pounds 242.90$$

$$13 \text{ } P = \frac{100(S - C)}{C}$$

### Exercise 20.2 (page 183)

$$1 \text{ a } \frac{P}{k}$$

$$\text{b } x = c + t$$

$$\text{c } x = \frac{e + d}{c}$$

$$\text{d } x = \frac{c - d - b}{a}$$

$$\text{e } x = g - f$$

$$\text{f } x = \frac{\gamma + 3}{4}$$

$$\text{g } x = \frac{t + u}{3}$$

$$\text{h } x = \frac{w - 2\gamma - 3z}{\gamma}$$

$$\text{i } x = N\gamma - \gamma$$

$$\text{j } x = \frac{D - E}{t}$$

$$\text{k } x = \frac{p^2 - q^2}{3}$$

$$\text{l } x = \frac{Q - T}{P}$$

$$2 \text{ a } \gamma = z - k$$

$$\text{b } \gamma = \frac{b}{a}$$

$$\text{c } \gamma = \frac{d - a}{t}$$

$$\text{d } \gamma = 4 - k$$

$$\text{e } \gamma = \frac{L - H}{G}$$

$$\text{f } \gamma = \frac{a - d}{c}$$

$$\text{g } \gamma = \frac{A - B}{M}$$

$$\text{h } \gamma = \frac{3 - e - f}{t}$$

$$\text{i } \gamma = h + j$$

$$\text{j } \gamma = \frac{z}{x}$$

$$\text{k } \gamma = \frac{5 - r}{t}$$

$$\text{l } \gamma = \frac{A}{bc}$$

$$3 \text{ a } r = \frac{A}{\pi l}$$

$$\text{b } r = \frac{C}{2\pi}$$

$$\text{c } r = \frac{d}{2}$$

$$4 \text{ } a = \frac{v^2 - u^2}{2s}$$

$$5 \text{ } T = \frac{pV}{R}$$

### Exercise 20.3 (page 186)

$$1 \text{ a } a = \frac{xy - b}{x}$$

$$\text{b } a = \frac{D - BC}{C}$$

$$\text{c } a = \frac{\gamma - hn}{h}$$

$$\text{d } a = \frac{b + 5}{5}$$

$$\text{e } a = \frac{c - kt}{k}$$

$$\text{f } a = \frac{6 - r}{6}$$

$$\text{g } a = \frac{g + de}{d}$$

$$\text{h } a = \frac{qn - px}{p}$$

$$\text{i } a = \frac{L - 2l}{lt}$$

$$\text{j } a = \frac{100p - T}{100}$$

$$\text{k } a = \frac{P - 2b}{2}$$

$$\text{l } a = \frac{5m - b}{3}$$

$$2 \text{ a } b = \frac{4A}{\pi}$$

$$\text{b } b = \frac{ma - Ft}{m}$$

$$\text{c } b = \frac{c}{a}$$

$$\text{d } b = \frac{2E - VA}{V}$$

$$\text{e } b = \frac{100(k - e)}{c}$$

$$\text{f } b = \frac{f}{T}$$

$$\text{g } b = \frac{4I}{3m}$$

$$\text{h } b = \frac{5a - 40t}{t}$$

$$\text{i } b = 2ah - a$$

$$\text{j } b = \frac{3L + c}{8}$$

$$\text{k } b = \frac{T - a}{T}$$

$$\text{l } b = \frac{Q - 5PA}{5P}$$

$$3 \text{ h } = \frac{3V}{\pi r^2}$$

$$4 \text{ h } = \frac{A - 2\pi r^2}{2\pi r}$$

$$5 \text{ n } = \frac{T - a + d}{d}$$

### Exercise 20.4 (page 188)

$$1 \text{ a } a = \pm\sqrt{c^2 - b^2}$$

$$\text{b } a = \pm\sqrt{c - 5}$$

$$\text{c } a = \pm 2\sqrt{b}$$

$$\text{d } a = d^2$$

$$\text{e } a = b^2 - x$$

$$\text{f } a = \frac{t}{\sqrt{b}}$$

$$\text{g } a = k^2 + p$$

$$\text{h } a = \pm\sqrt{\frac{bd}{e}}$$

$$\text{i } a = \frac{2s}{t^2}$$

$$\text{j } a = \sqrt[3]{\frac{h}{g}}$$

$$\text{k } a = b\left(\frac{c}{2\pi l}\right)^2$$

$$\text{l } a = \frac{m^2}{n^2}$$

$$2 \text{ a } x = \pm\sqrt{C}$$

$$\text{b } x = \sqrt[3]{D}$$

$$\text{c } x = \pm\sqrt{\frac{t}{k^2}}$$

$$\text{d } x = (E - T)^2$$

$$\text{e } x = \left(\frac{d}{c}\right)^2 - a$$

$$\text{f } x = \pm\sqrt{q - p}$$

$$\text{g } x = \left(\frac{r}{2\pi}\right)^2 - t$$

$$\text{h } x = c - a^2$$

$$\text{i } x = \sqrt[3]{w - y}$$

$$\text{j } x = \sqrt[3]{\frac{3r}{\pi}}$$

$$\text{k } x = \frac{9}{4k^2}$$

$$\text{l } x = \frac{p}{\sqrt[3]{t}}$$

$$3 \text{ b } = \pm\sqrt{ac}$$

$$4 \text{ r } = \sqrt{\frac{A}{4\pi}}$$

$$5 \text{ l } = \left(\frac{T}{2\pi}\right)^2 g$$

### Exercise 20.5 (page 189)

$$1 \text{ a } x = \frac{c}{a + b}$$

$$\text{b } x = \frac{ef}{d - e}$$

$$\text{c } x = \frac{f}{2g - h + k}$$

$$\text{d } x = \frac{y - 1}{y + 1}$$

$$\text{e } x = \frac{c - 3a}{3b + 1}$$

$$2 \text{ a } \gamma = \frac{u}{t + 4}$$

$$\text{b } \gamma = \frac{qn}{2q + p}$$

$$\text{c } \gamma = \frac{m + n}{a - 1}$$

$$\text{d } \gamma = \frac{-2}{6 - p}$$

$$\text{e } \gamma = \frac{100b}{x + 100}$$

$$3 \text{ n } = \frac{IR}{E - Ir}$$

$$4 \text{ y } = \frac{an}{p - a}$$

### Summary exercise 20 (page 190)

$$1 \text{ } -25^\circ\text{C}$$

$$2 \text{ } 31.25$$

$$3 \text{ } \frac{1}{2}$$

$$4 \text{ a } a = \frac{\gamma - 3}{4}$$

$$\text{b } a = \frac{t - z}{y}$$

$$\text{c } a = \frac{\gamma - b - c}{d}$$

$$5 \text{ a } b = \frac{5c + 2}{6}$$

$$\text{b } b = \frac{km - r}{k}$$

$$\text{c } b = \frac{p + 3q - p^2}{q}$$

$$6 \text{ a } c = \frac{b}{a - d}$$

$$\text{b } c = \frac{P - Qd}{Q}$$

$$c \quad c = \frac{Dm + fe}{fN}$$

7 a  $f = \frac{v - u}{t}$   
 b  $c = \frac{a}{b + d}$   
 c  $a = \frac{p^2 - qrx}{p}$   
 d  $g = \frac{4m - 3b}{3}$

8 a  $k = \pm\sqrt{x} + d$   
 b  $k = 2y - 1$   
 c  $k = \sqrt[3]{\frac{pq}{r}}$

9 a  $e = \frac{a(1 - y)}{1 + y}$   
 b  $e = \frac{n(m + 1)}{5 + m}$   
 c  $e = \frac{D - A}{C}$

10 a  $p = \frac{x}{k^2}$   
 b  $p = \frac{4 - yt}{t - 1}$   
 c  $p = \pm\sqrt{1 - x^2}$

11 a  $k = \frac{c}{d - 1}$   
 b  $k = \frac{h^2}{16}$   
 c  $k = \frac{3}{m - h - 2}$

12 a  $d = \pm \sqrt{\frac{kL}{R}}$   
 b  $d = \pm 3$

13 a  $x = \frac{7y}{5}$   
 b  $a = \frac{z - h^2}{t}$   
 c  $x = B \pm \frac{\sqrt{K}}{A}$   
 d  $t = \pm \sqrt{\frac{F^2}{P^2} - 1}$

$$e \quad a = \frac{mgx}{2mg - T}$$

$$f \quad m_1 = \frac{3 + 4m_2}{4 - 3m_2}$$

$$g \quad z = \frac{x - w}{1 + y}$$

$$h \quad w = \pm\sqrt{u^2 - v^2}$$

$$i \quad t = \frac{a^2}{y^2}$$

$$j \quad s = \frac{v}{u + w - x}$$

14 172 cm

### Examination questions (page 191)

1  $49\frac{1}{2}$   
 2 a 5  
 b 120  
 3 a  $c = \frac{d - 15}{10}$   
 b  $g = \frac{7h - 12}{4 + 2h}$   
 4  $y = \frac{3x + 7}{3x - 2}$   
 5 a 19  
 b 2  
 6  $p = \frac{r - q}{2}$   
 7 a  $u = \pm \sqrt{v^2 + 2gh}$   
 b  $x = \frac{1 - y}{y + 1} + 1$

## Chapter 21 Proportion and variation

### Exercise 21.1 (page 193)

1 £2.88  
 2 3150 km  
 3  $22\frac{1}{2}$  m

4 12 bottles  
 5 2 hours 24 minutes  
 6 15 days  
 7 28 hours  
 8 a 30 CDs  
 b 16 200 CDs  
 9  $\frac{xn}{n + 5}$   
 10 £14p/11

### Exercise 21.2 (page 196)

1  $P = 3.2Q$   
 2 a  $y = 3\sqrt{x}$   
 b 18  
 3  $4000 \text{ cm}^3$   
 4 a 8 amperes  
 b 6.25 volts  
 5 15 m/s  
 6 a 9  
 b 7  
 7 a  $a = 1.25\sqrt{b - 3}$   
 b 6.24  
 c 2.5  
 8 1411.2 m  
 9  $y \propto x^3$   
 10 a  $p$  is multiplied by 4  
 b  $p$  is divided by 16  
 11 a  $H = 36I^2t$   
 b 4608 J  
 c 4 amperes

### Exercise 21.3 (page 200)

1  $T = \frac{3}{2}M$   
 2 a  $y = \frac{36}{x}$   
 b 16  
 3  $720 \text{ cm}^3$   
 4 a 7.5 amperes  
 b  $1.8 \times 10^5$  ohms

- 5 32 units
- 6 **a** 0.8  
**b** 11.6
- 7 350m
- 8 **a**  $A = \frac{3}{\sqrt{B-4}}$   
**b**  $\frac{3}{4}$   
**c** 4.04
- 9 25mm
- 10 **a** 75 swings per minute  
**b** 0.36m
- 11 0.22mm
- 12 **a** The force is divided by 8.  
**b** The force is 200 times greater.

### Summary exercise 21 (page 201)

- 1 40 litres
- 2 12 minutes
- 3  $\frac{12x}{x+2}$  days
- 4 **a**  $E = 4w^2$   
**b** 9  
**c** 7
- 5 1638.4g
- 6 **a** **i**  $y$  is multiplied by 9  
**ii**  $y$  is divided by 4  
**b** **i**  $p$  is doubled  
**ii**  $p$  is divided by 4
- 7 5 minutes
- 8  $n = 3$  and  $k = 640$ ; missing values in the table are  $p = 5120$ ,  $q = 4$
- 9 27.8% decrease
- 10 **a** **ii**  $y$  varies directly as the cube of  $x$   
**b** **iii**  $y$  varies inversely as  $x$   
**c** **i**  $y$  varies directly as the square of  $x$

### Examination questions (page 203)

- 1 **a**  $P = \frac{60}{V}$   
**b**  $P = 0.2$
- 2 **a**  $p = \frac{1}{4}q^3$   
**b** 8
- 3 **a**  $R = \frac{5760}{d^2}$   
**b** **i** 118 (3 s.f.)  
**ii** 6

### Chapter 22 Trial and improvement

#### Exercise 22.1 (page 207)

- 1 **a** 5.7  
**b** 1.5  
**c** 4.7  
**d** 2.3  
**e** 3.5  
**f** 3.8  
**g** 3.7  
**h** 5.9  
**i** 4.1  
**j** 3.1
- 2 **a** 3.11  
**b** 6.58  
**c** 4.62  
**d** 1.62  
**e** 2.57  
**f** 3.31  
**g** 1.06  
**h** 2.45  
**i** 3.19  
**j** 2.64

#### Exercise 22.2 (page 209)

- 1 6.4
- 2 5.88 cm
- 3 13.5 cm
- 4 **a**  $w^2 + 6w - 16$   
**b**  $w = 6.2$  (1 d.p.)

- 5 **a** 10m  
**b** 22m  
**c** 21m  
**d** 4.6 seconds

### Summary exercise 22 (page 210)

- 1 **a** 2.0  
**b** 4.2  
**c** 2.9
- 2 **a** 2.63  
**b** 4.49  
**c** 3.33
- 3 4.8

### Examination questions (page 210)

- 1  $x = 3.2$
- 2  $x = 4.7$
- 3  $x = 2.7$

### Chapter 23 Algebraic fractions

#### Exercise 23.1 (page 212)

- 1 **a**  $\frac{2}{5}$   
**b**  $\frac{7}{8}$   
**c**  $\frac{7}{8}$
- 2 **a** 2  
**b**  $\frac{a}{2}$   
**c**  $\frac{2q}{3}$   
**d**  $\frac{7a}{12c}$   
**e**  $\frac{2}{5t}$   
**f**  $a$
- 3 **a**  $\frac{3a+1}{a}$

- b  $\frac{2p+1}{p}$   
 c  $\frac{x+1}{x}$   
 d  $\frac{x+2y}{3xy}$   
 e  $\frac{2(p+2q)}{p}$   
 f  $\frac{4+5k}{5}$   
 g  $\frac{m}{m-n}$   
 h  $\frac{e-2}{e+3}$   
 i  $\frac{3y-1}{3}$   
 j  $\frac{a}{b}$   
 k  $\frac{2(t-3)}{(t-1)}$   
 l  $\frac{a}{a+7}$
- 4 a  $\frac{a}{a+2}$   
 b  $\frac{p}{p+1}$   
 c  $\frac{a}{a-3}$   
 d  $\frac{x+1}{x+2}$   
 e  $\frac{h+2}{h-5}$   
 f  $\frac{k-2}{k}$   
 g  $\frac{y+3}{2y+1}$   
 h  $\frac{a-4}{2}$   
 i  $\frac{b}{3+2a^2}$   
 j  $\frac{a+4}{2(a-5)}$   
 k  $\frac{a}{b}$   
 l  $\frac{a-y}{y}$

### Exercise 23.2 (page 214)

- 1 a  $\frac{5x}{8}$   
 b  $\frac{3a}{4}$   
 c  $\frac{5a}{8}$   
 d  $\frac{23p}{20}$   
 e  $\frac{13x}{12}$   
 f  $\frac{5x+4}{6}$
- 2 a  $\frac{7}{10x}$   
 b  $\frac{1}{6x}$   
 c  $\frac{13}{2x}$   
 d  $\frac{8x-9}{3x^2}$   
 e  $\frac{2p+3}{p^2}$   
 f  $\frac{13c}{3d}$
- 3 a  $\frac{5x+18}{12}$   
 b  $\frac{5p-19q}{6}$   
 c  $\frac{-t-9u}{20}$   
 d  $\frac{3a+8}{10}$   
 e  $\frac{7x+15}{10}$   
 f  $\frac{11x+8}{12}$
- 4 a  $\frac{7a+5}{a(a+1)}$   
 b  $\frac{2a-7}{(2a-1)(a-2)}$   
 c  $\frac{13-2x}{(x+1)(x-2)}$   
 d  $\frac{t(t-3)}{(t+1)(t-1)}$   
 e  $\frac{31k-5}{30k^2}$   
 f 1

- 5 a  $\frac{2a^2+7a-7}{(a-2)(a+1)}$   
 b  $\frac{y-5}{(y+1)(y-1)}$   
 c  $\frac{4a^2+9}{(2a+3)(2a-3)}$   
 d  $\frac{7p-1}{p(p+1)(p-1)}$
- 6  $\frac{10-200}{x(x-4)}$

### Exercise 23.3 (page 216)

- 1 a  $4b$   
 b  $\frac{5c}{3d}$   
 c  $2p^2q$   
 d  $\frac{a}{b}$   
 e  $\frac{x^2y}{15}$   
 f  $\frac{4(a-b)}{5}$
- 2 a  $\frac{4(a-b)}{3}$   
 b  $\frac{1}{2(x-3)}$   
 c 1  
 d  $2(p+1)$   
 e  $\frac{k-2}{k(k+2)}$   
 f  $1\frac{1}{2}$
- 3 a  $3\frac{3}{4}$   
 b  $3-2x$   
 c  $\frac{p}{8(p-1)}$   
 d  $\frac{(x+1)(x+2)}{2}$   
 e 2  
 f  $\frac{x(x+b)}{2}$
- 4 a  $1\frac{3}{5}$   
 b  $\frac{p+q}{15}$   
 c  $\frac{a-2}{a}$   
 d  $\frac{8z}{3y(x+2y)}$

## Summary exercise 23 (page 217)

- 1 a  $\frac{2}{p-1}$   
 b  $\frac{1}{x-3}$   
 c  $\frac{2y-3z}{12yz}$   
 d  $1\frac{1}{2}$   
 e  $\frac{3c}{2d}$   
 f  $-\frac{2}{3}$
- 2 a  $\frac{13a}{15}$   
 b  $\frac{31}{20x}$   
 c  $\frac{2-a}{a(a+1)}$   
 d  $\frac{a+9b}{4}$   
 e  $\frac{5(a+2)}{(a-2)(2a+1)}$   
 f  $\frac{6}{(x+1)(x-1)}$
- 3 a  $\frac{2}{5(x-4)}$   
 b  $\frac{5a(a+1)}{a+7}$   
 c  $\frac{3(k+2)(k+1)}{2k}$   
 d  $\frac{-4(y-3)}{3}$   
 e  $\frac{4p^3}{9}$   
 f  $\frac{4-c}{c}$
- 4 a  $\frac{a}{x}$   
 b  $\frac{a}{x+2}$   
 c  $2a$   
 d  $\frac{2a(x+1)}{x(x+2)}$   
 e  $\frac{x(x+2)}{x+1}$

## Examination questions (page 217)

- 1  $\frac{2x^2-1}{x(x+1)}$
- 2 a  $(x-3y)(x+3y)$   
 b  $\frac{x+3y}{x-6y}$
- 3  $\frac{x-y}{x+y} - \frac{y}{x-y} + \frac{2xy}{x^2-y^2}$   
 $= \frac{(x-y)^2 - y(x+y) + 2xy}{x^2-y^2}$   
 $= \frac{x^2 - 2xy + y^2 - xy - y^2 + 2xy}{x^2-y^2}$   
 $= \frac{x^2 - xy}{x^2-y^2}$   
 $= \frac{x(x-y)}{(x+y)(x-y)}$   
 $= \frac{x}{x+y}$

## Chapter 24 Quadratic equations

### Exercise 24.1 (page 220)

- 1 a  $x = -3, x = 4$   
 b  $a = 7, a = -1$   
 c  $x = -1\frac{1}{2}, x = 2$   
 d  $t = -1\frac{1}{4}, t = -3\frac{1}{3}$   
 e  $x = 3, x = -3$   
 f  $x = \frac{1}{2}, x = 3$   
 g  $x = 0, x = 1\frac{1}{4}$   
 h  $a = 0, a = \frac{1}{2}$   
 i  $x = 0, x = -2$   
 j  $x = -\frac{1}{2}$
- 2 a  $x = -2, x = -1$   
 b  $y = \frac{1}{2}, y = 3$   
 c  $x = -\frac{1}{3}, x = \frac{1}{2}$   
 d  $x = 13, x = 1$   
 e  $a = -2, a = 4$   
 f  $p = 8, p = 3$   
 g  $y = \frac{1}{3}, y = 3$

- h  $k = -1\frac{1}{4}, k = 2$   
 i  $a = \frac{3}{4}, a = -\frac{1}{2}$   
 j  $m = \frac{3}{4}, m = -1\frac{1}{3}$
- 3 a  $x = \frac{1}{3}, x = -\frac{1}{3}$   
 b  $x = 0, x = \frac{1}{2}$   
 c  $a = 0, a = -\frac{1}{3}$   
 d  $x = 5, x = -5$   
 e  $y = 0, y = -1\frac{1}{2}$   
 f  $y = 0, y = \frac{1}{12}$   
 g  $a = \frac{1}{2}, a = -\frac{1}{2}$   
 h  $y = 0, y = -1$   
 i  $t = 3, t = -3$   
 j  $x = 0, x = 4\frac{1}{2}$
- 4 a  $x = 2, x = 3$   
 b  $x = 1\frac{1}{2}, x = -5$   
 c  $a = 2\frac{1}{2}, a = -2$   
 d  $x = \pm 1$   
 e  $x = 1, x = 3$   
 f  $a = -3, a = 11$   
 g  $p = 4, p = 5$   
 h  $x = -1, x = 6$   
 i  $k = 6, k = -10$   
 j  $n = 0, n = \frac{1}{6}$
- 5 a  $x = -3\frac{1}{2}, x = 2$   
 b  $x = \frac{1}{2}, x = -3$   
 c  $a = 2, a = 6$   
 d  $a = \frac{3}{4}, a = -1\frac{1}{2}$   
 e  $x = 0, x = -1\frac{1}{2}$   
 f  $n = \pm 1\frac{2}{3}$   
 g  $x = 0, x = 1$   
 h  $x = -\frac{5}{6}, x = 1$   
 i  $a = 2, a = -5$   
 j  $a = 0, a = \frac{1}{25}$

### Exercise 24.2 (page 223)

- 1 a  $x = 3.73, x = 0.27$   
 b  $x = 0.44, x = -3.44$   
 c  $x = 0.85, x = -1.18$

**d**  $x = -0.61, x = -4.89$   
**e**  $y = 1.43, y = 0.23$   
**f**  $x = 1.13, x = -0.88$   
**g**  $x = 0.53, x = -1.65$   
**h**  $x = -0.28, x = 3.61$   
**i**  $x = 0.64, x = -1.00$   
**j**  $y = 2.14, y = -0.47$

**2 a**  $x = 1 \pm \sqrt{6}$

**b**  $x = \frac{3 \pm \sqrt{7}}{2}$

**c**  $y = 6 \pm \sqrt{31}$

**d**  $x = \frac{-3 \pm \sqrt{3}}{2}$

**e**  $k = \frac{-5 \pm \sqrt{33}}{4}$

**f**  $x = -3 \pm 2\sqrt{2}$

**g**  $x = \frac{6 \pm \sqrt{15}}{7}$

**h**  $y = 2 \pm \sqrt{11}$

**i**  $t = 3 \pm \sqrt{3}$

**j**  $a = \frac{-5 \pm \sqrt{17}}{8}$

**3 a**  $x = 2.85, x = -0.351$

**b**  $x = 1.45, x = -3.45$

**c**  $x = 4.27, x = -3.27$

**d**  $y = 0.452, y = 1.55$

**e**  $x = 1.61, x = -3.11$

**f**  $x = 2.47, x = -0.135$

**g**  $y = -2.59, y = -5.41$

**h**  $a = 1.64, a = -0.24$

**i**  $x = 7.87, x = 0.127$

**j**  $a = 3.41, a = 0.586$

### Exercise 24.3 (page 225)

**1**  $x = \frac{5}{21}$

**2**  $a = 2$

**3**  $x = 3$

**4**  $a = -1, a = 8$

**5**  $p = 4, p = 2$

**6**  $a = -2, a = 6$

**7**  $x = 2, x = -4$

**8**  $p = -2, p = 5$

**9**  $x = 0, x = 3$

**10**  $x = -4\frac{1}{2}, x = 5$

**11**  $y = 2.49, y = -1.69$

**12**  $a = 0.63, a = -2.38$

### Exercise 24.4 (page 228)

**1** 32 and 35

**2** 24p

**3** 2.5 cm by 8.5 cm

**4**  $\frac{4}{5}$

**5** 29 and 31

**6** 2 discs

**7** 45 km/h

**8** 3.14 seconds

**9** 18th term

**10** 22 people

**11** 24th triangular number

**12** 30.73 m

**13** 35 cm

**14** 24 cm and 56 cm

**15** 18.5 cm

**16** 5 km/h

### Summary exercise 24 (page 230)

**1 a**  $a = -1\frac{1}{3}, a = 1\frac{1}{2}$

**b**  $x = 0, x = 5$

**c**  $a = 3, a = -4$

**d**  $x = 2, x = -8$

**e**  $x = -\frac{1}{2}, x = 3$

**f**  $x = \pm\frac{3}{7}$

**g**  $x = 1, x = 12$

**h**  $t = \frac{1}{3}, t = 4$

**i**  $y = -2, y = 5$

**j**  $x = \pm\frac{1}{5}$

**2 a**  $a = 0.37, a = -1.37$

**b**  $x = 1.18, x = -0.43$

**c**  $x = 2.82, x = 0.18$

**d**  $x = -1.40, x = 0.90$

**3 a**  $a = 1 \pm 2\sqrt{5}$

**b**  $y = \frac{3 \pm \sqrt{6}}{3}$

**c**  $a = \frac{1 \pm \sqrt{10}}{2}$

**d**  $x = \frac{3 \pm 5\sqrt{3}}{3}$

**4 a**  $y = 1, y = 2$

**b**  $x = \pm\frac{1}{2}$

**5 a**  $a = 1.70, a = -0.07$

**b**  $x = 3.27, x = -4.27$

**6** 12 cm

**7** 8 balls

**8** 6 and 4

**9** 8.5 cm

**10** 2.62 cm

### Examination questions (page 231)

**1**  $x = -15, x = 1$

**2**  $x = 1\frac{1}{3}, x = 5$

**3**  $(x-1)^2 + (2x+3)^2 = (3x-2)^2 + (x+3)^2$ ,  
giving  $x = 3$

**4**  $x = -\frac{1}{3}, x = 1\frac{1}{2}$

**5**  $x = 0, x = -2$

**6 a** perimeter =  
2(length + width)  
therefore width =  
10 - x  
area = length × width  
therefore  $6 = x(10 - x)$   
 $6 = 10x - x^2$   
so  $x^2 - 10x + 6 = 0$

b 9.36 cm and 0.64 cm

7 a  $12x + 8$  or  $4(3x + 2)$

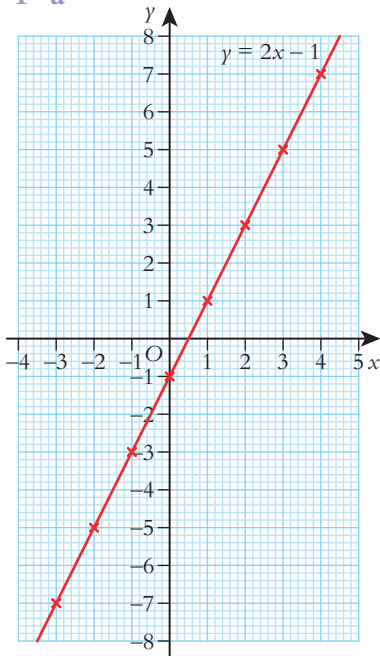
b  $3x^2 + 21x$  or  $3x(x + 7)$

c 34.1 units (3 s.f.)

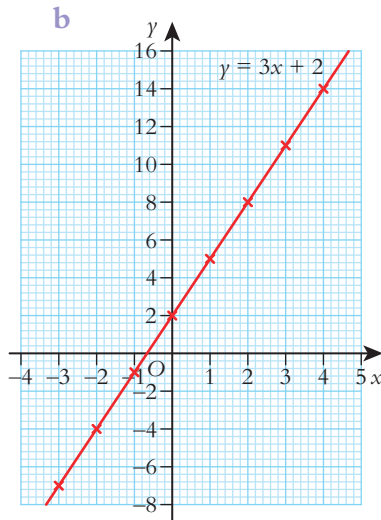
## Chapter 25 Straight lines and linear graphs

### Exercise 25.1 (page 234)

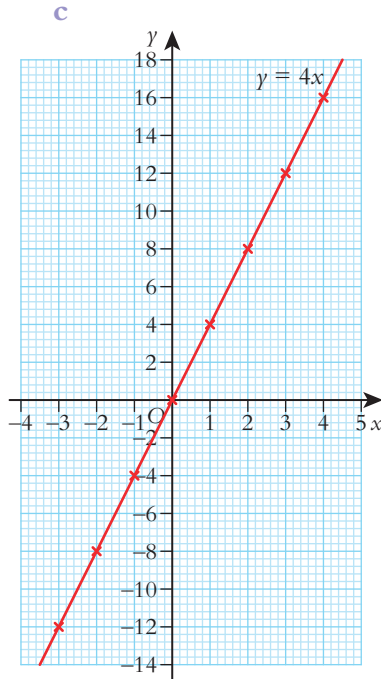
1 a



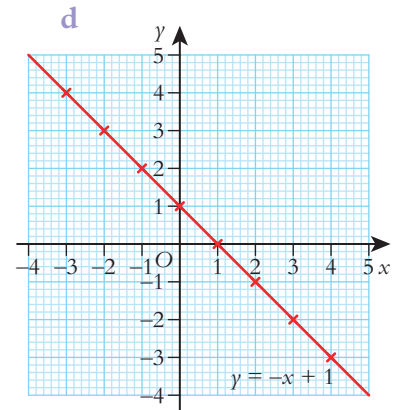
$x$	-3	-2	-1	0	1	2	3	4
$y$	-7	-5	-3	-1	1	3	5	7



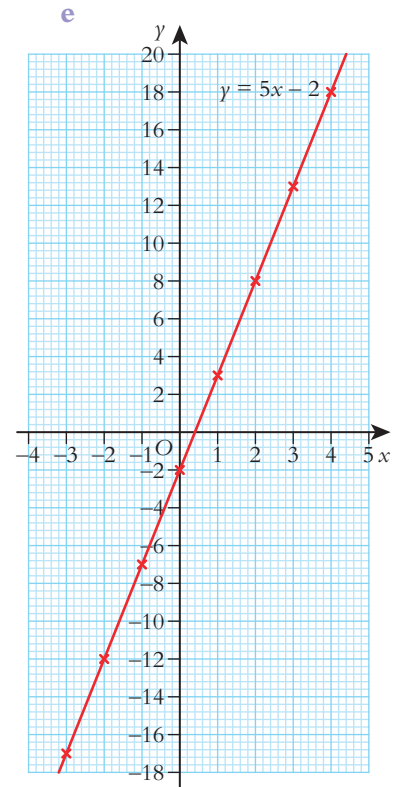
$x$	-3	-2	-1	0	1	2	3	4
$y$	-7	-4	-1	2	5	8	11	14



$x$	-3	-2	-1	0	1	2	3	4
$y$	-12	-8	-4	0	4	8	12	16

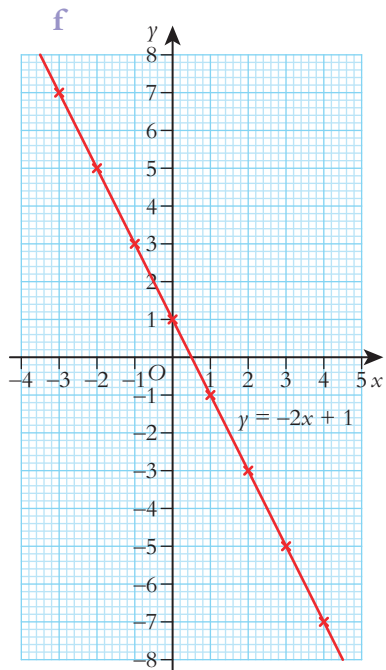


$x$	-3	-2	-1	0	1	2	3	4
$y$	4	3	2	1	0	-1	-2	-3



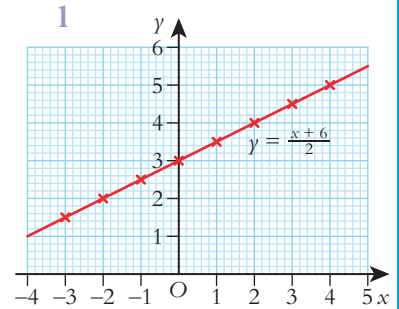
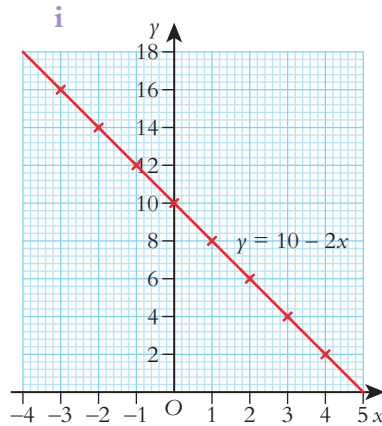
$x$	-3	-2	-1	0	1	2	3	4
$y$	-17	-12	-7	-2	3	8	13	18





x	-3	-2	-1	0	1	2	3	4
y	7	6	5	4	3	2	1	0

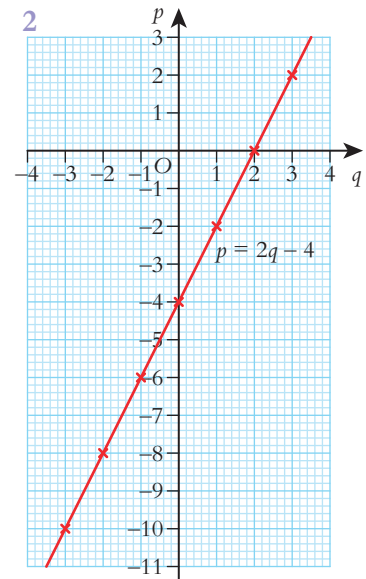
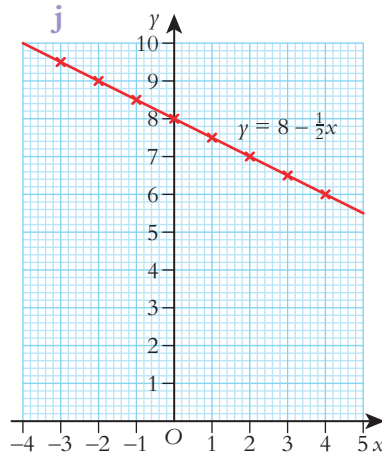
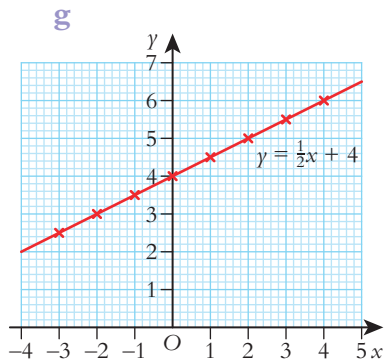
x	-3	-2	-1	0	1	2	3	4
y	9	6	3	0	-3	-6	-9	-12



x	-3	-2	-1	0	1	2	3	4
y	16	14	12	10	8	6	4	2

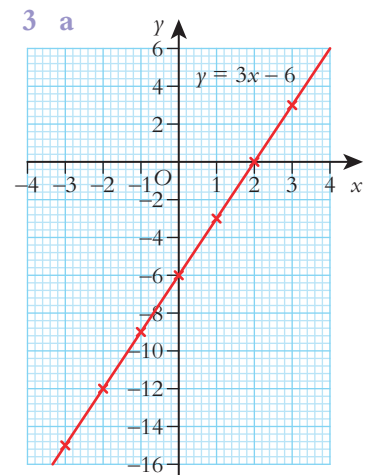
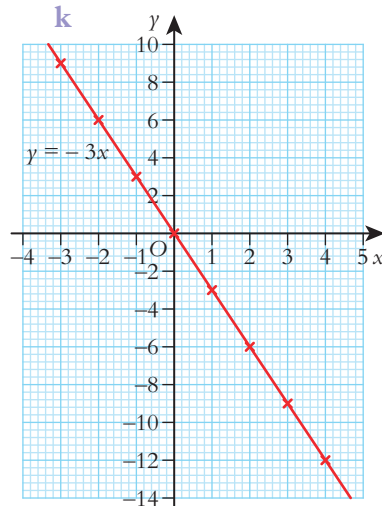
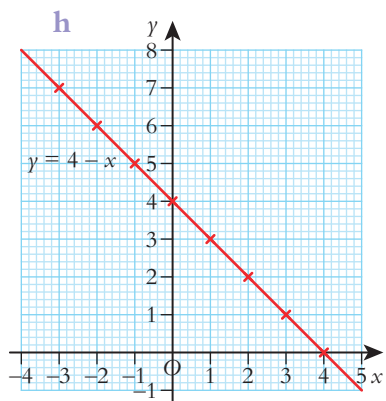
x	-3	-2	-1	0	1	2	3	4
y	1.5	2	2.5	3	3.5	4	4.5	5

x	-3	-2	-1	0	1	2	3	4
y	7	5	3	1	-1	-3	-5	-7



x	-3	-2	-1	0	1	2	3	4
y	2.5	3	3.5	4	4.5	5	5.5	6

x	-3	-2	-1	0	1	2	3	4
y	9.5	9	8.5	8	7.5	7	6.5	6



- b** (2, 0)  
**c** (0, -6)

- 4 a No  
b No  
c Yes
- 5  $y = x + 3$ ,  $y = 2x + 5$ ,  
 $y = \frac{1}{2}x + 2$  and  $x + 2y = 0$
- 6  $(-2\frac{1}{2}, 0)$
- 7 2
- 8 a 7  
b  $-\frac{1}{2}$   
c -13

### Exercise 25.2 (page 237)

- 1 a  $6\sqrt{5}$   
b  $5\sqrt{2}$   
c  $4\sqrt{10}$   
d  $\sqrt{74}$   
e  $4\sqrt{2}$
- 2 a  $(4, 3\frac{1}{2})$   
b (2, 4)  
c (-3, -4)  
d (-1, -7)  
e  $(\frac{1}{2}, -1)$
- 3 B(-3, 6)
- 4 Yes
- 5 4,  $\sqrt{13}$ ,  $\sqrt{13}$ ; isosceles since two sides are equal
- 6  $2^2 + 5^2 = (\sqrt{29})^2$ , satisfies Pythagoras' theorem – right-angled

### Exercise 25.3 (page 240)

- 1  $L_1 = \frac{7}{3}$        $L_2 = -\frac{4}{11}$   
 $L_3 = 0$        $L_4 = -\frac{1}{5}$   
 $L_5 = 1$        $L_6 = \infty$   
 $L_7 = 2$

2  $PQ = 2$        $QR = \frac{1}{2}$   
 $RS = 7$        $SP = -\frac{3}{4}$

- 3 a  $\frac{1}{3}$   
b 2  
c  $\frac{5}{3}$   
d  $-\frac{5}{2}$

4 a  $q = -8$   
b  $p = 2$

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

Yes, there is more than one possible set of values, e.g.  $a = 8$  and  $b = 7$ .  
 $a$  and  $b$  can take any values

such that  $\frac{b+3}{a-2}$  simplifies to  $\frac{5}{3}$ .

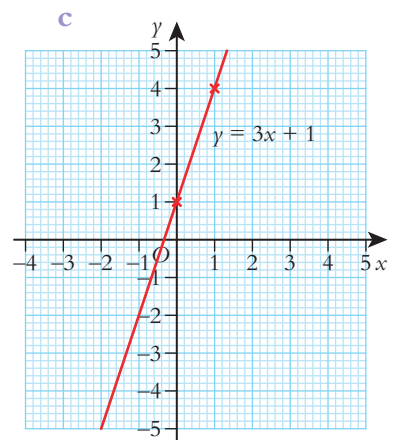
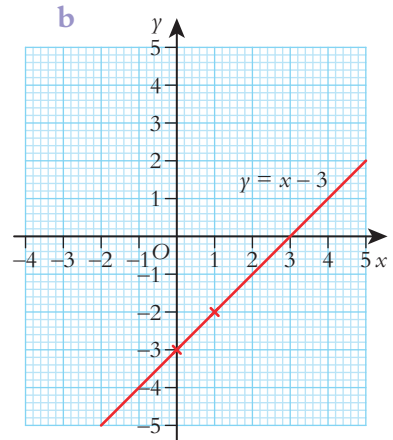
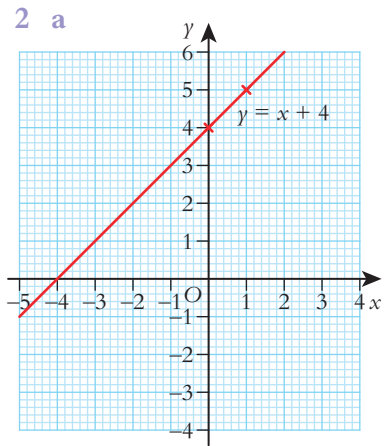
6 37.5 m

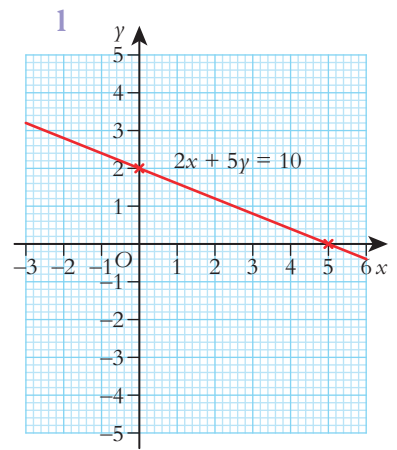
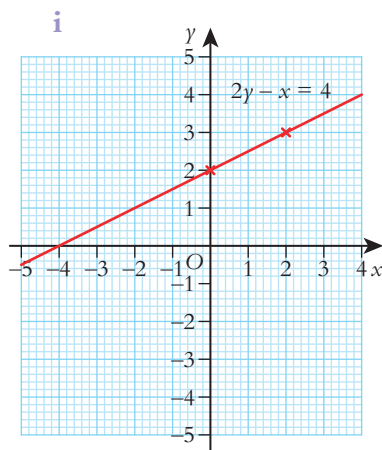
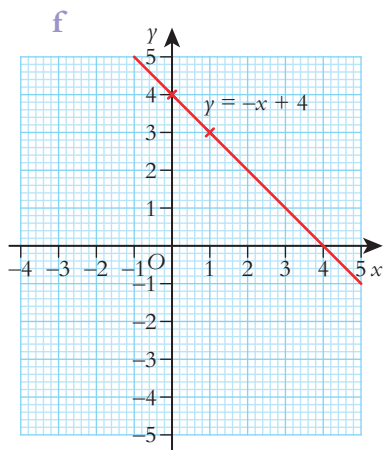
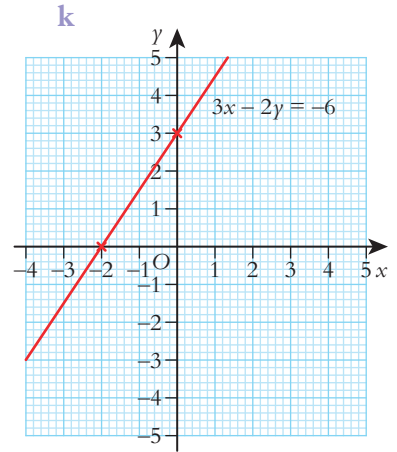
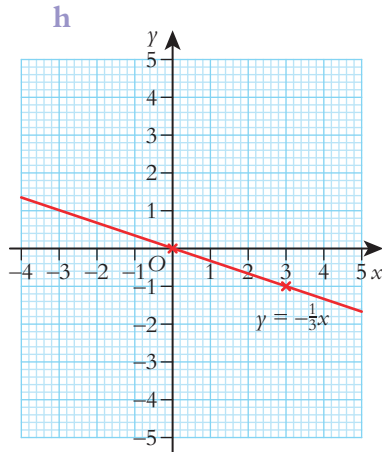
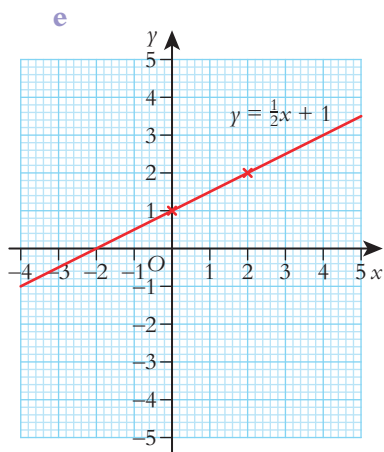
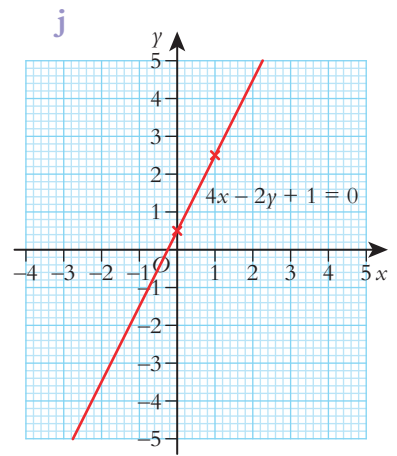
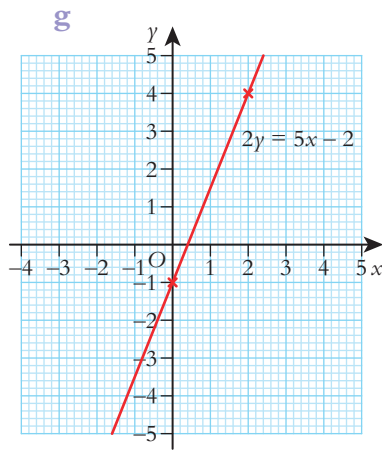
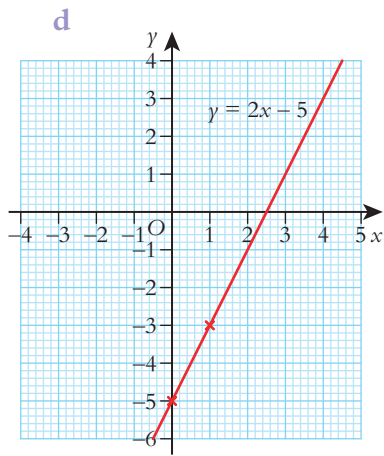
7  $\frac{5}{2}$

8  $y = 0$

### Exercise 25.4 (page 244)

- 1 a gradient = 2,  
y-intercept (0, -7)  
b gradient =  $\frac{1}{3}$ ,  
y-intercept (0, -1)  
c gradient = 6,  
y-intercept (0, 0)  
d gradient = 2,  
y-intercept (0, -3)  
e gradient =  $-\frac{1}{3}$ ,  
y-intercept (0, 3)  
f gradient = 2,  
y-intercept  $(0, -\frac{1}{2})$   
g gradient =  $-\frac{1}{2}$ ,  
y-intercept (0, 2)  
h gradient =  $-\frac{2}{3}$ ,  
y-intercept  $(0, \frac{1}{3})$





3  $k = \pm 2$

4  $y = 0$

5 a  $4x + 12y = 6$  and  $x + 3y = 6$  are parallel or  $y = 4 - 5x$  and  $5x + y = 10$  are parallel.

b  $2y = x - 4$  and  $y = 5 - 2x$  are perpendicular or  $y = -x + 6$  and  $y = x - 1$  are perpendicular.

6  $a = -\frac{1}{2}$

7  $y = -\frac{1}{2}x - 1$  or  $2y + x + 2 = 0$

8  $y = 3x - 2$

9  $y = -\frac{1}{3}x + 4$  or  $3y + x = 12$

10  $y = -\frac{1}{4}x - 2$  or  $4y + x + 8 = 0$

11  $y = -\frac{3}{2}x + 4$  or  $2y + 3x = 8$

12  $y = -\frac{3}{4}x + 9\frac{1}{2}$  or  $4y + 3x = 38$

### Exercise 25.5 (page 249)

- 1 line  $L_1, y = 8$   
 line  $L_2, y = x + 6$   
 line  $L_3, y = -\frac{1}{2}x + 1$  or  $2y + x = 2$   
 line  $L_4, y = \frac{3}{2}x - 4$  or  $2y = 3x - 8$   
 line  $L_5, x = -8$   
 line  $L_6, y = -\frac{1}{2}x + 5$  or  $2y + x = 10$

- 2 line A,  $y = -2x$   
 line B,  $x = 3$   
 line C,  $y = -\frac{1}{3}x + 7$  or  $3y + x = 21$   
 line D,  $y = \frac{3}{2}x + 3$  or  $2y = 3x + 6$   
 line E,  $y = -5$   
 line F,  $y = -\frac{5}{3}x - 10$  or  $3y + 5x + 30 = 0$

3  $y = -2x + 3$

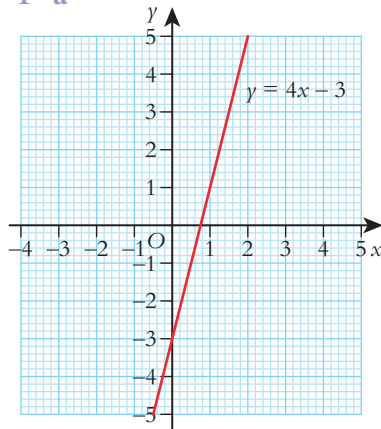
4  $y = -3x - 2$

5  $y = -\frac{1}{2}x$  or  $2y + x = 0$

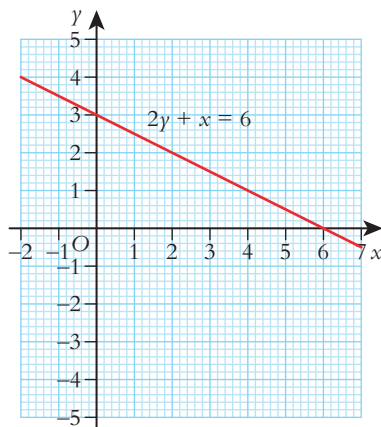
6  $y = 3x - 5$

### Summary exercise 25 (page 250)

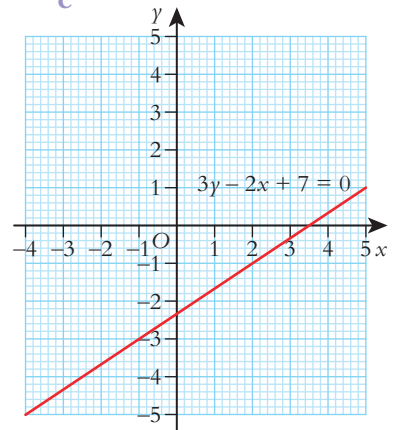
1 a



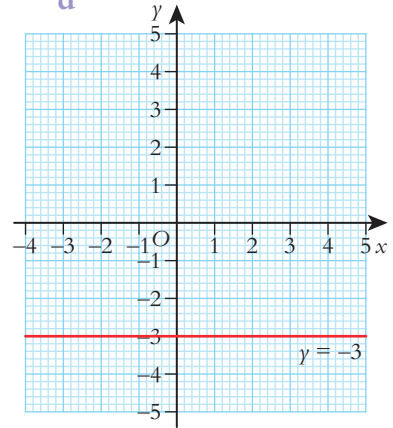
b



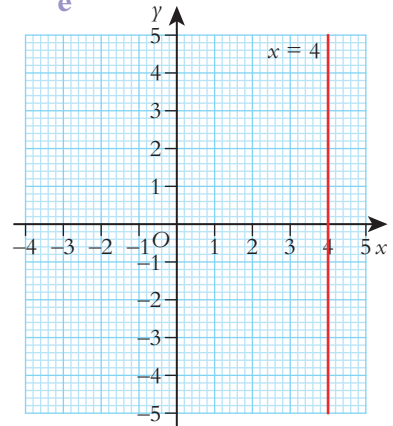
c



d



e



2  $(0, -3)$   $(-1, -7)$   $(3, 9)$

3  $y = 2x - 9$  or  $y = 3 - x$

4 a i  $\sqrt{34}$   
 ii  $(3\frac{1}{2}, 6\frac{1}{2})$

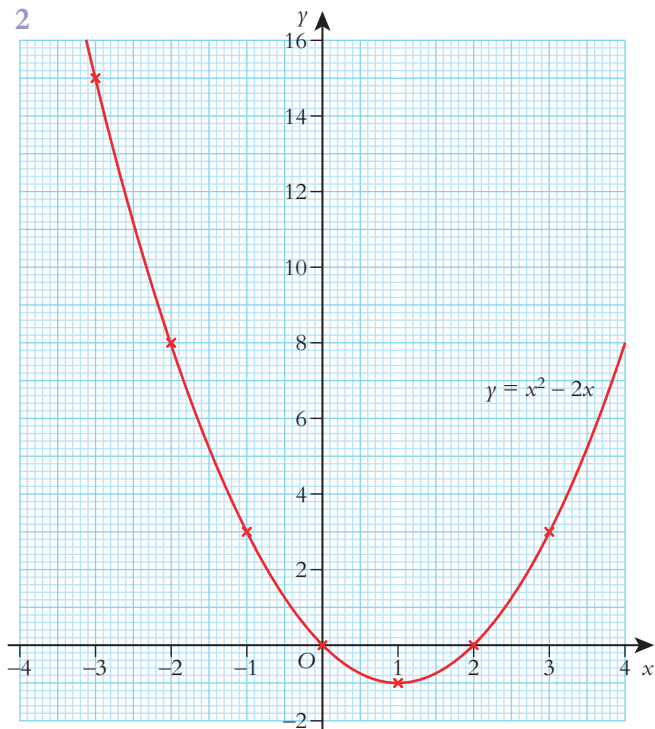
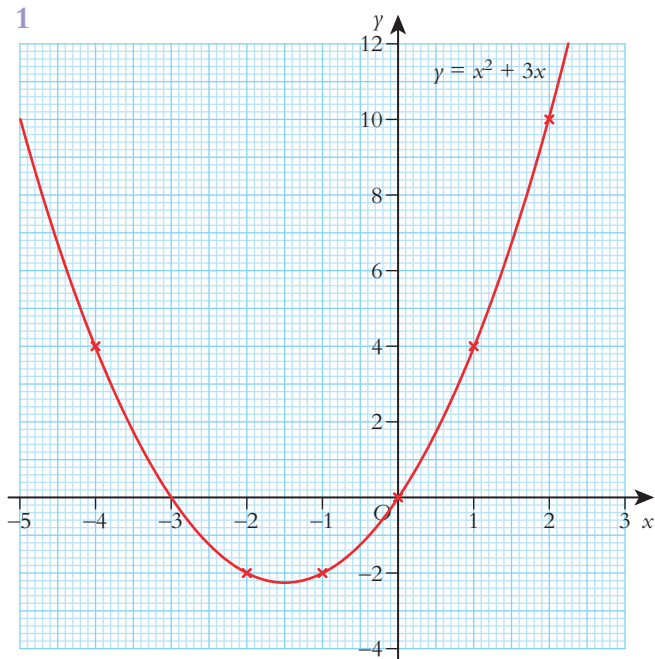
- b i**  $2\sqrt{5}$   
**ii** (1, 5)
- 5 a** (3, 2)  
**b**  $2\sqrt{5}$
- 6 a**  $-\frac{1}{5}$   
**b**  $-\frac{3}{8}$
- 7** Any co-ordinate pair such that  $2x + y = 14$ , for example (5, 4)
- 8 a** (5, 0), B(0,  $2\frac{1}{2}$ )
- 9** Line L<sub>1</sub>,  $x = -2$   
 Line L<sub>2</sub>,  $y = \frac{3}{2}x$  or  $2y = 3x$   
 Line L<sub>3</sub>,  $y = -x + 5$   
 Line L<sub>4</sub>,  $y = -5$   
 Line L<sub>5</sub>,  $y = \frac{1}{3}x - 3$  or  $3y = x - 9$
- 10**  $y = -3x + 8$
- 11**  $y = -\frac{1}{2}x - 4$  or  $2y + x + 8 = 0$
- 12 a**  $P = 0.8Q + 2.4$   
**b i** 21.6  
**ii** 32
- 13** Any co-ordinate pair such that  $6x + y = -2$ , for example (0, -2)
- 14**  $y = -\frac{1}{4}x$  or  $4y + x = 0$
- 15**  $y + x = 3$

### Examination questions (page 251)

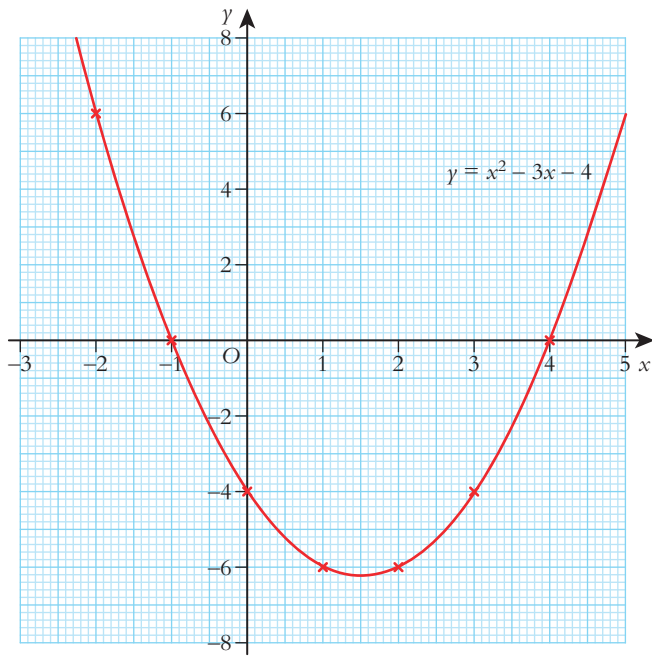
- 1 a**  $4\sqrt{5}$   
**b**  $y = 2x + 5$   
**c**  $y = -\frac{1}{2}x + 5$
- 2**  $y = 3x + 1$
- 3** ( $\frac{1}{2}$ , 0)
- 4** (0, 1)
- 5** 10 units

## Chapter 26 Non-linear graphs

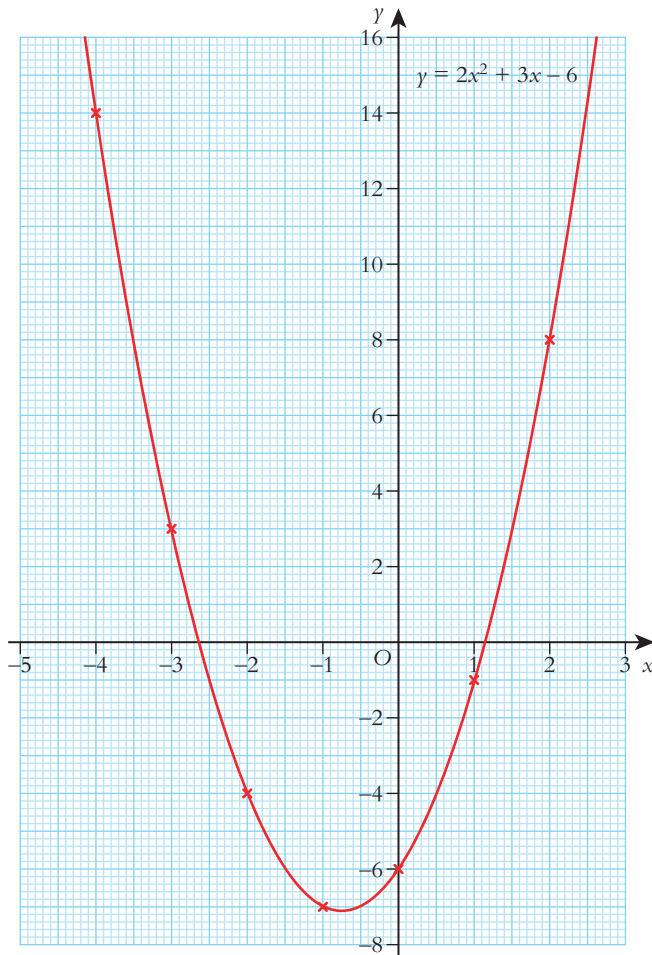
### Exercise 26.1 (page 254)



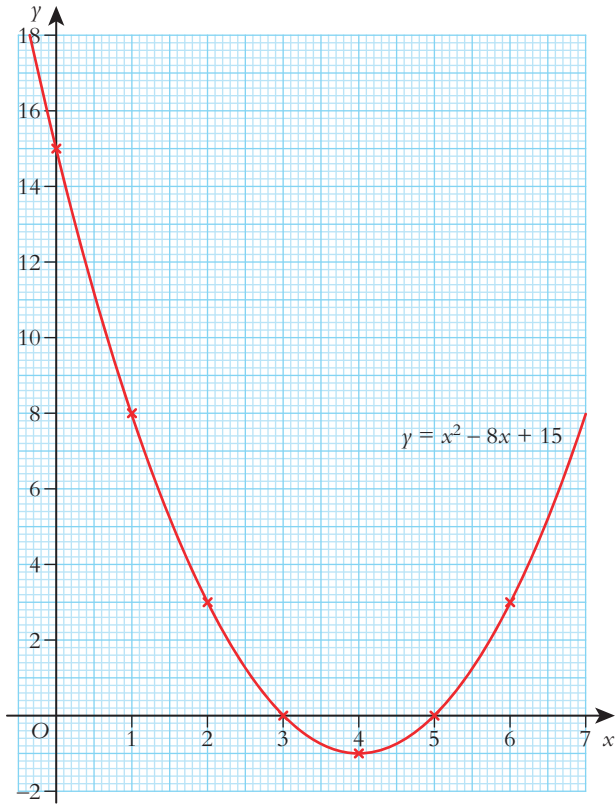
3



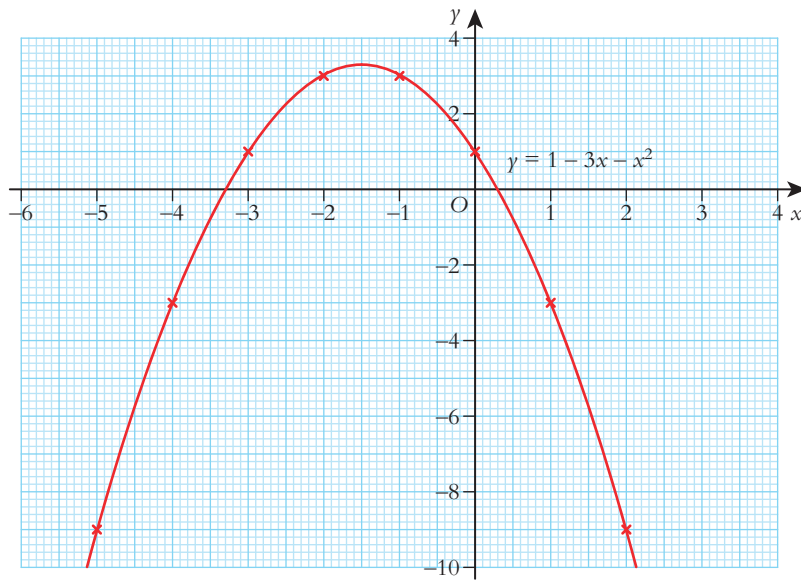
4



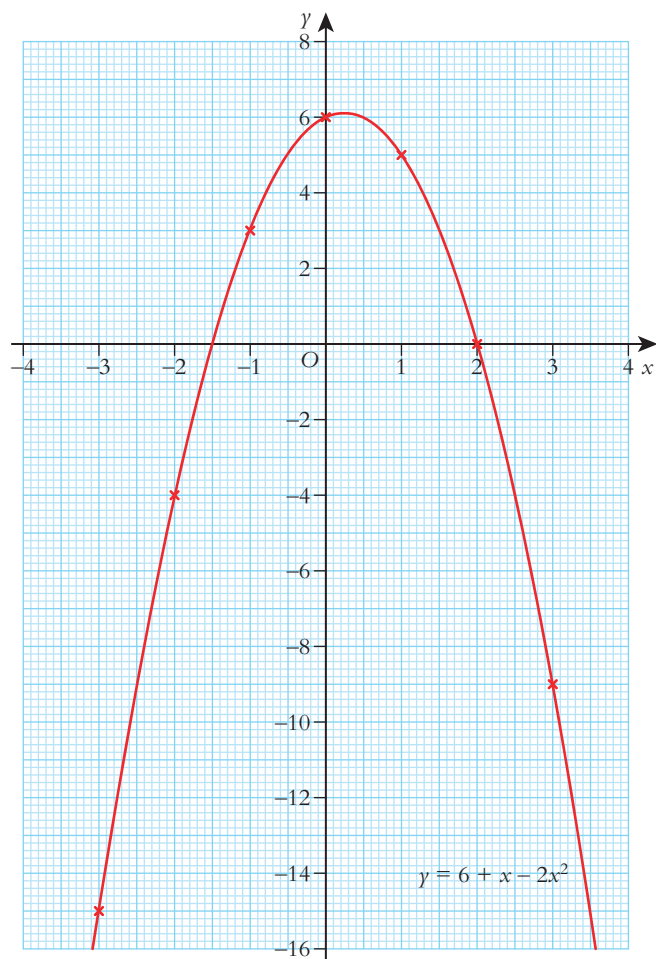
5



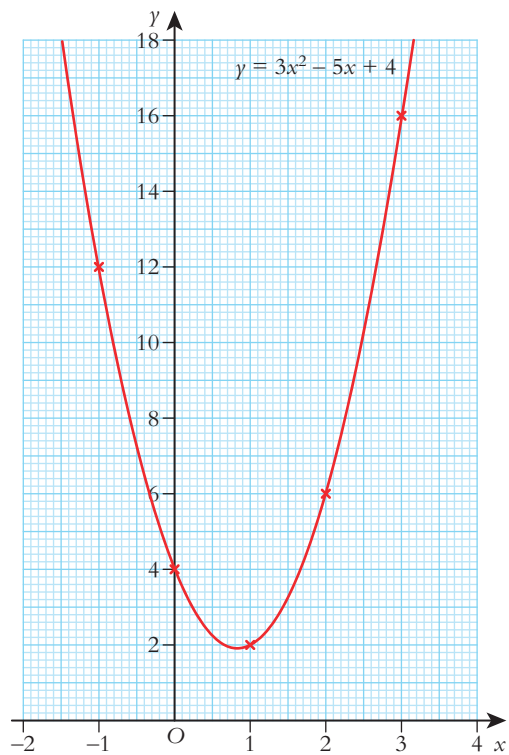
6



7

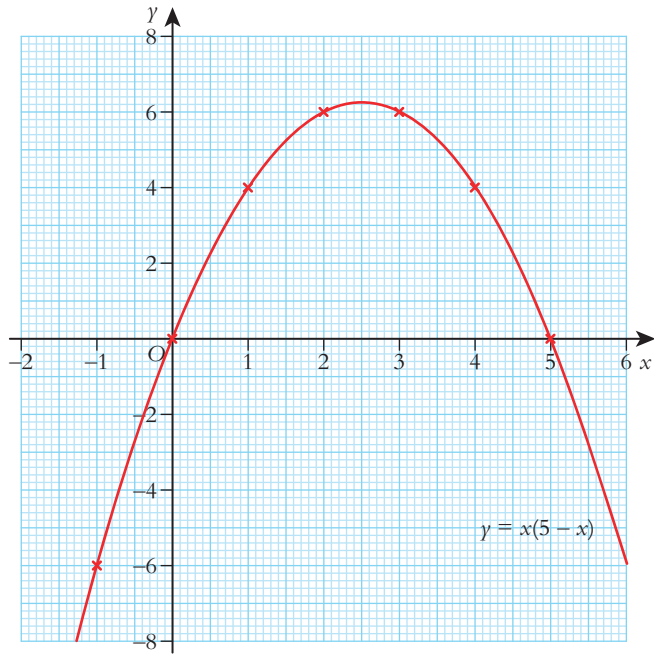


8

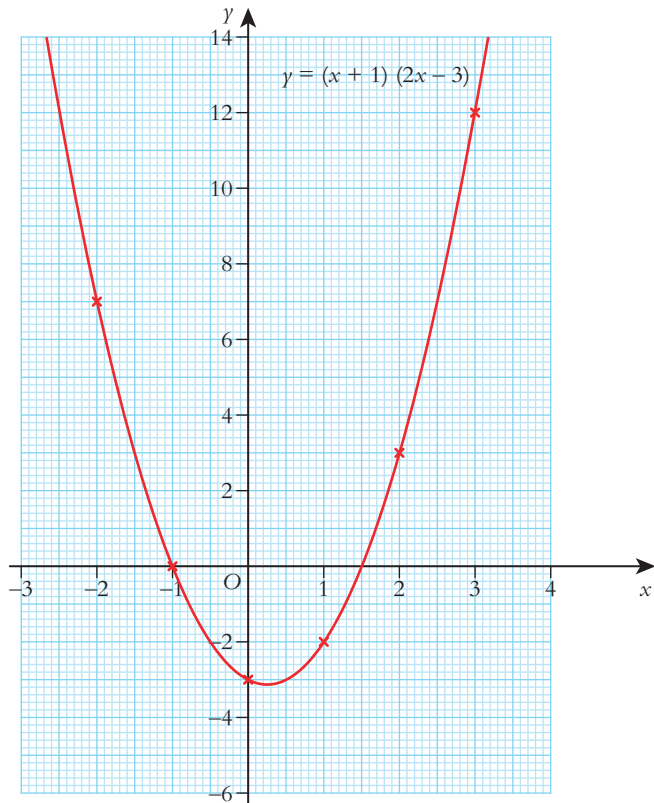




9

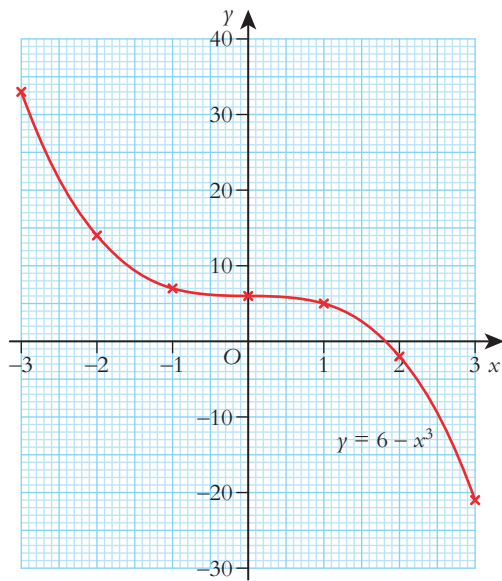


10

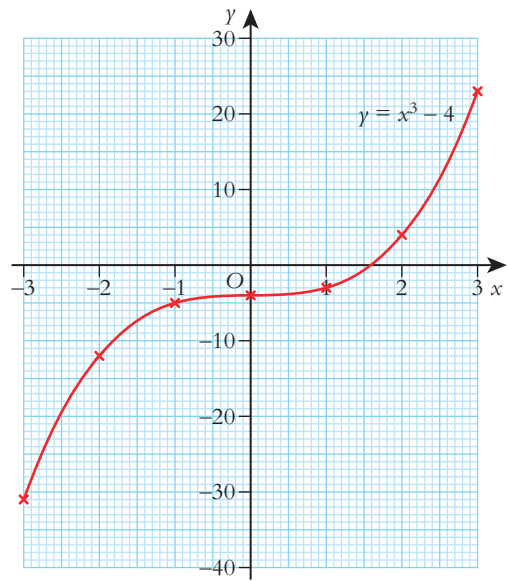


## Exercise 26.2 (page 256)

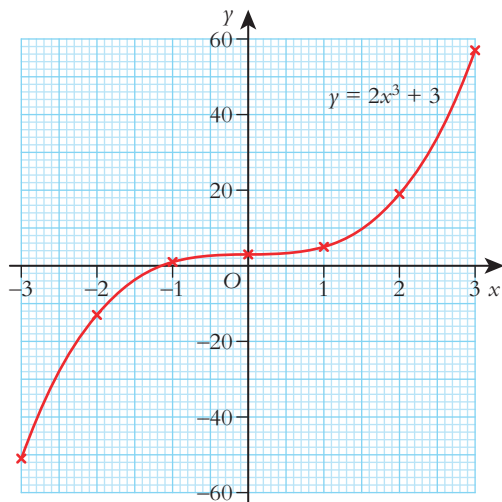
1



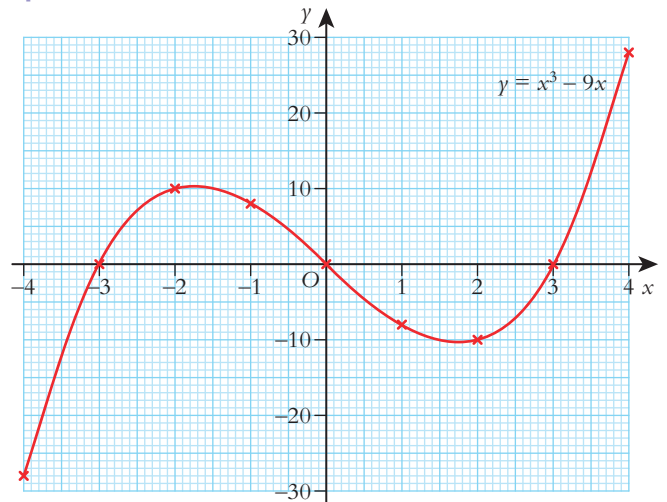
3



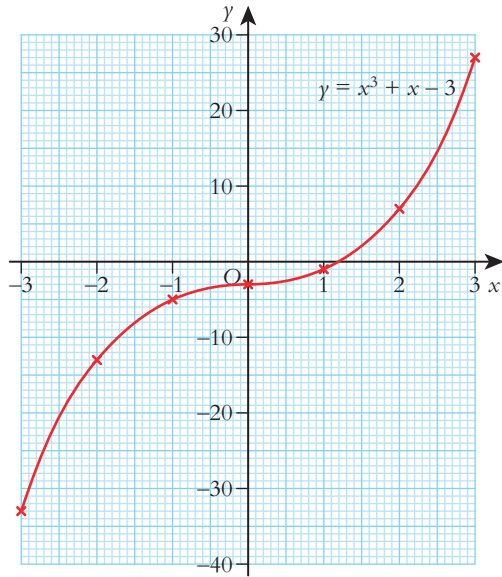
2



4

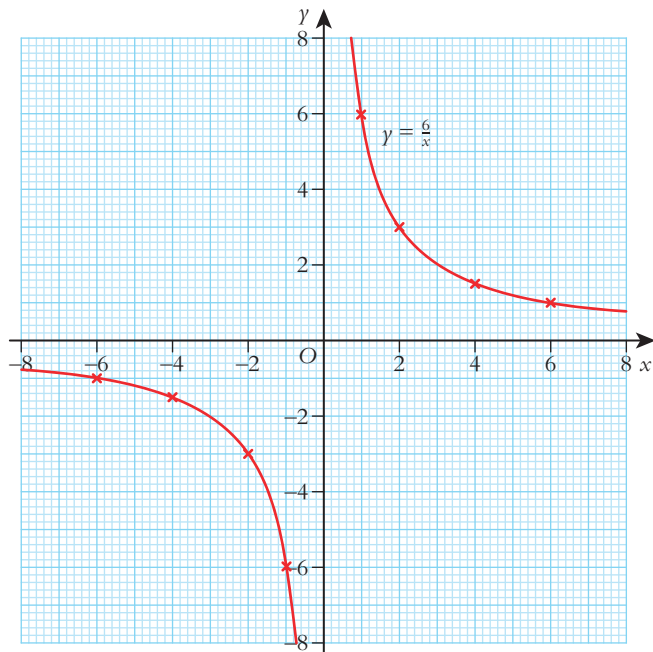


5

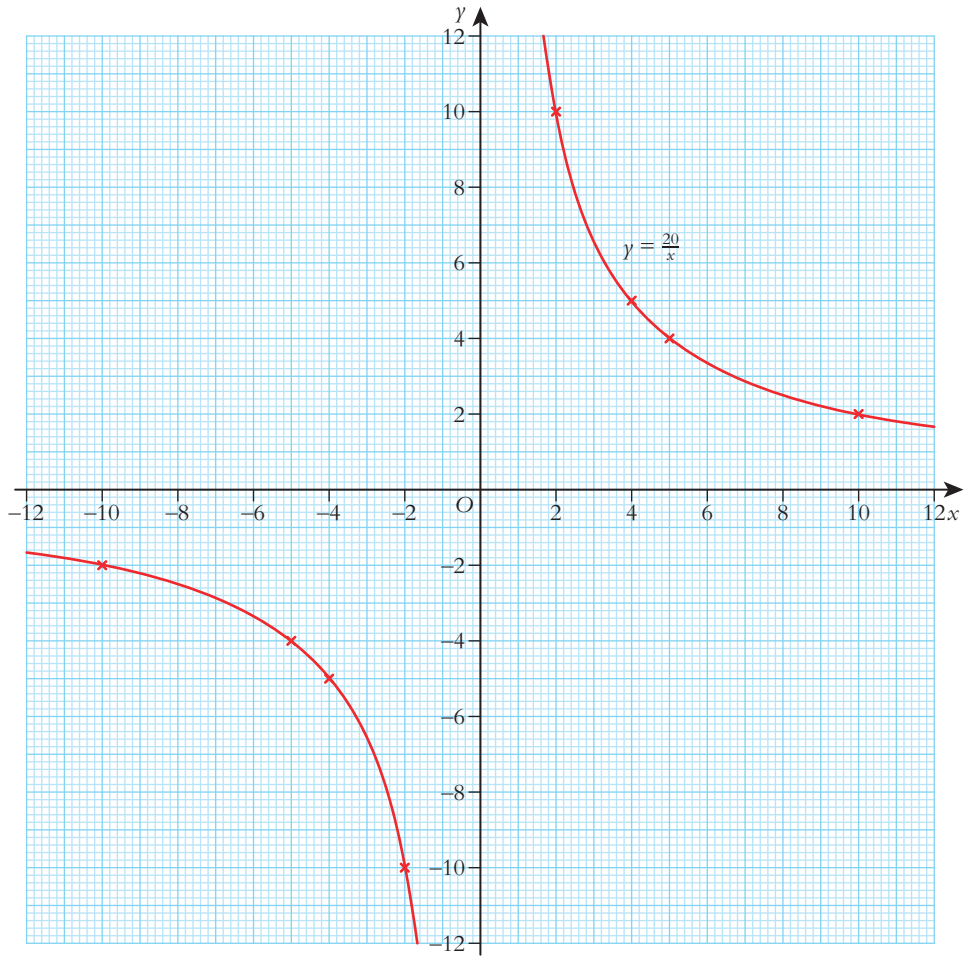


### Exercise 26.3 (page 258)

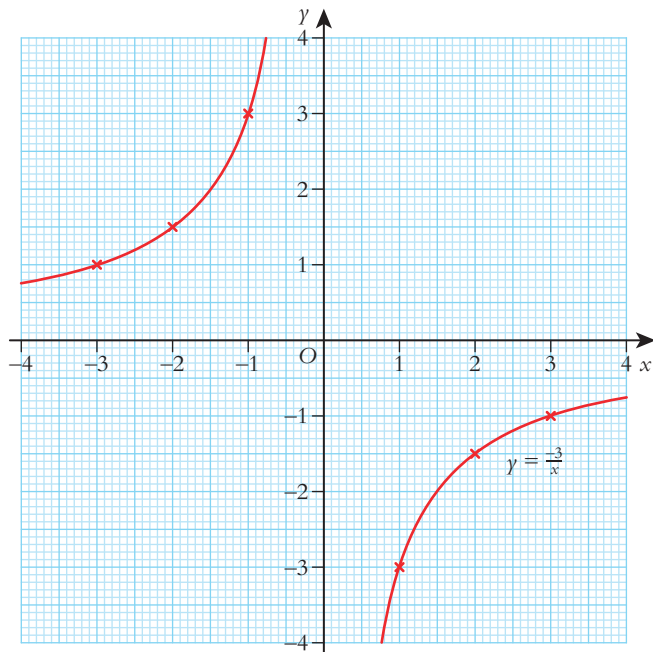
1



2



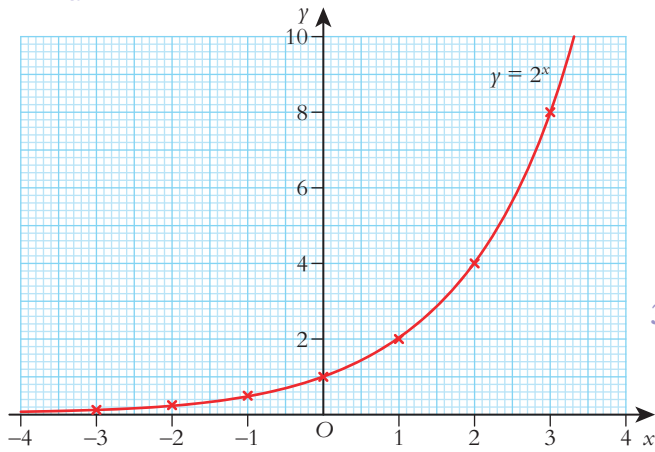
3



4  $x = -2$

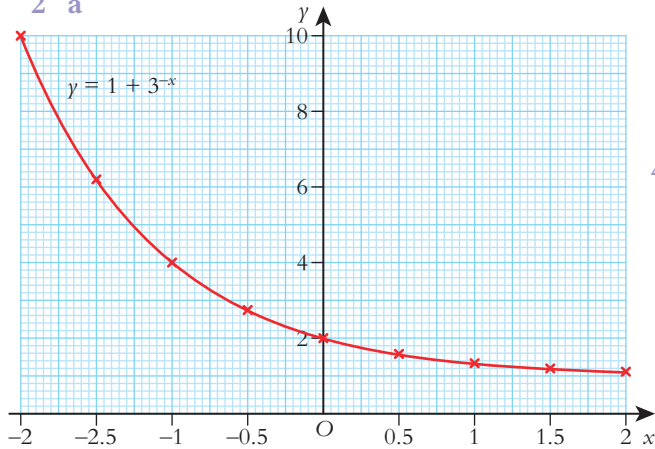
## Exercise 26.4 (page 259)

1 a



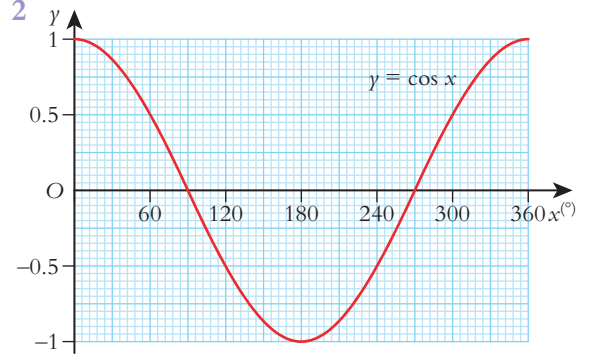
b  $x = 2.3$

2 a

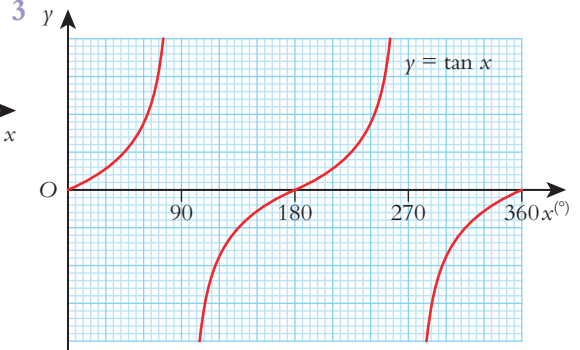


b  $y = 1$

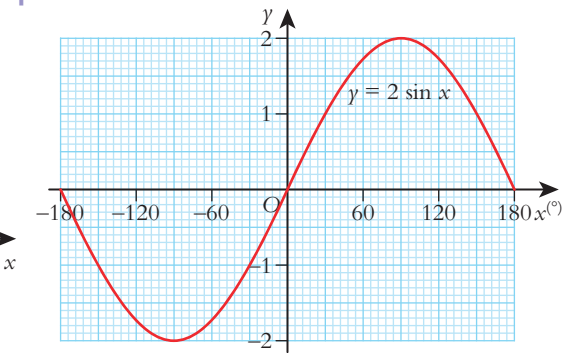
2



3

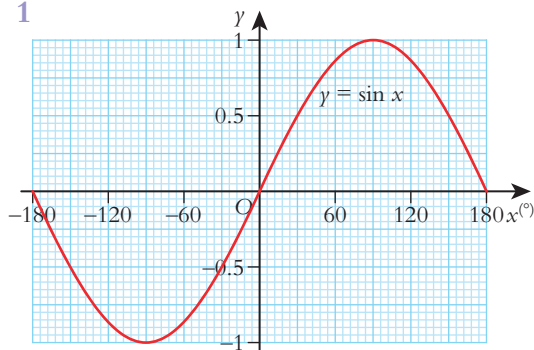


4

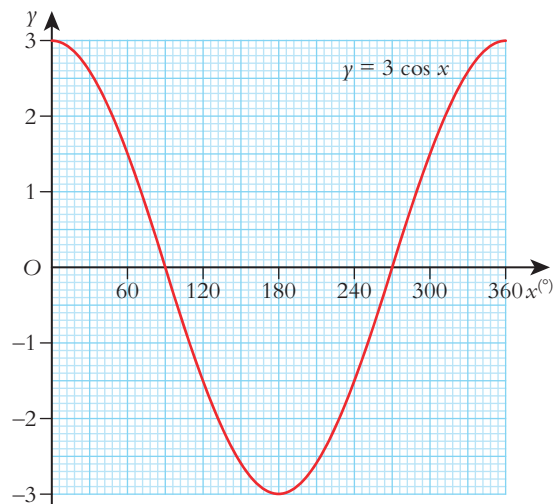


## Exercise 26.5 (page 262)

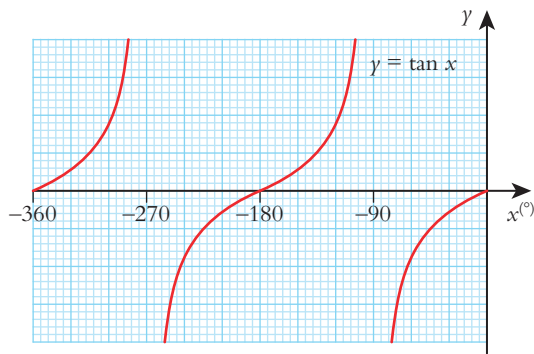
1



5



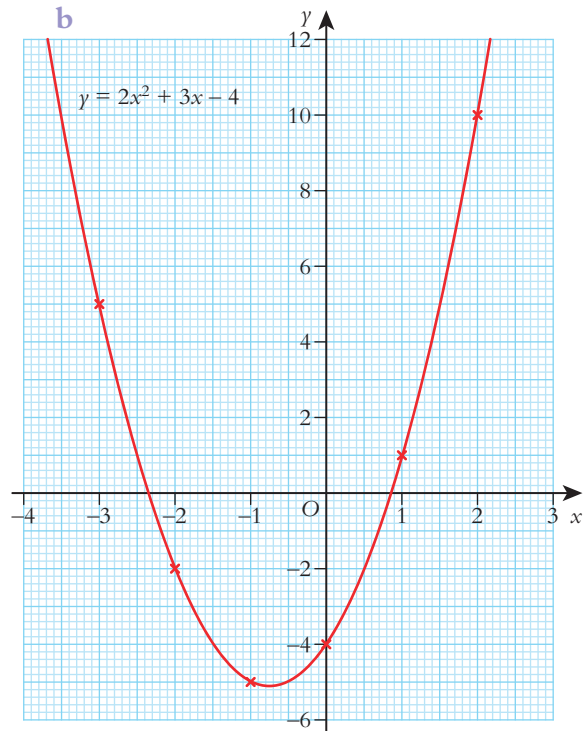
6



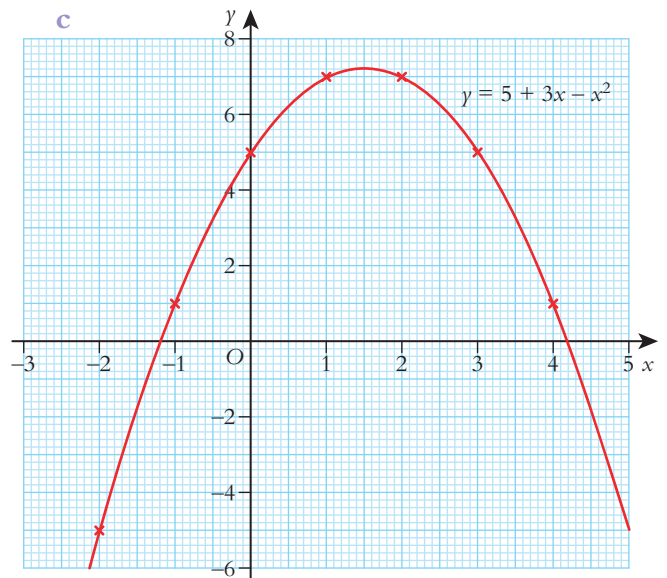
For the sine and cosine curves for questions 7 and 8, refer to pages 260 and 261 of the textbook.

- 7 a i 0.64  
 ii 0.98  
 iii -0.34  
 iv -0.77
- b i  $53^\circ, 127^\circ$   
 ii  $217^\circ, 323^\circ$
- 8 a i 0.64  
 ii -0.64  
 iii -0.34  
 iv 0.64
- b i  $73^\circ, 287^\circ$   
 ii  $134^\circ, 226^\circ$

b

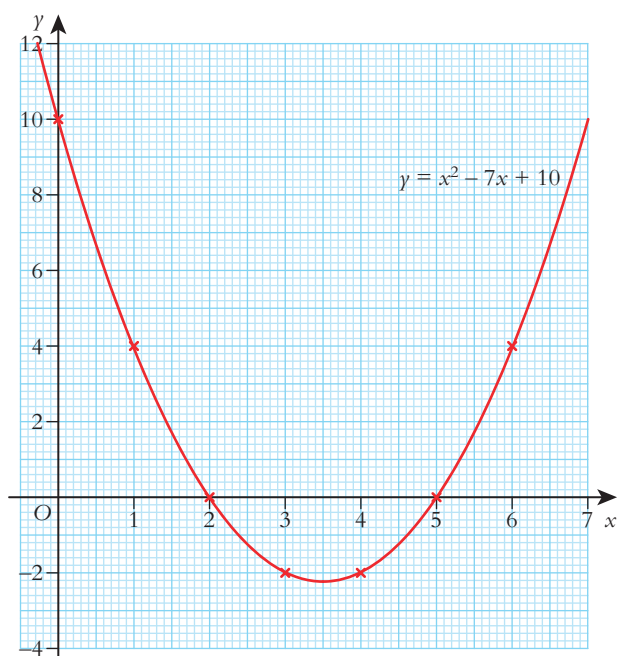


c

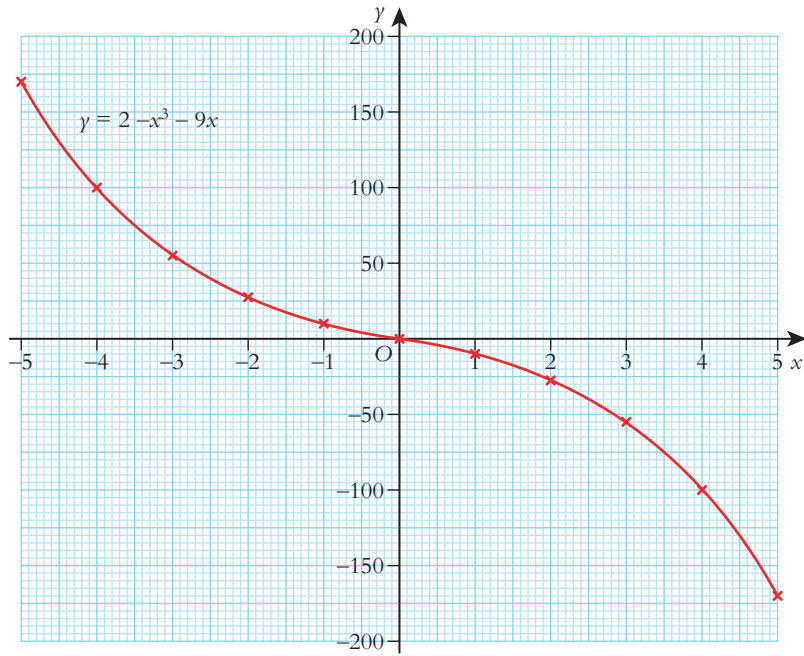


### Summary exercise 26 (page 265)

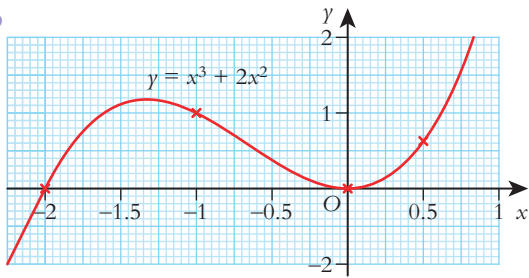
1 a



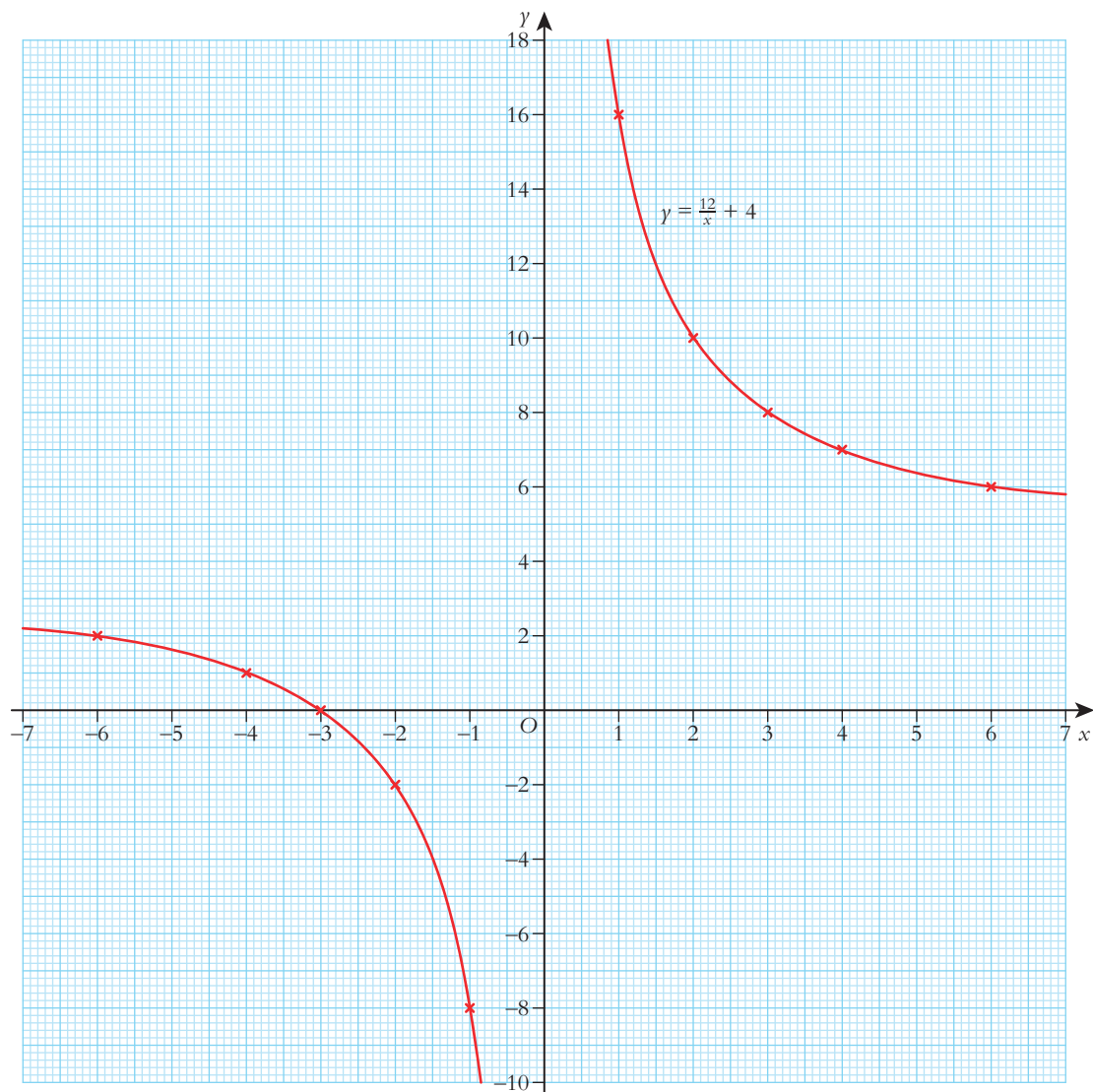
2a



b

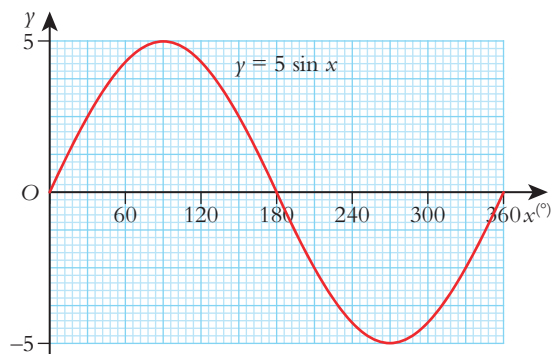


3

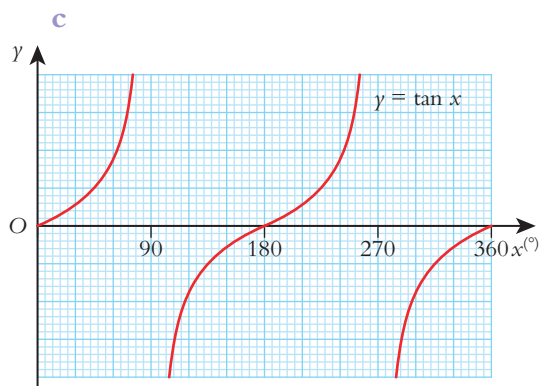
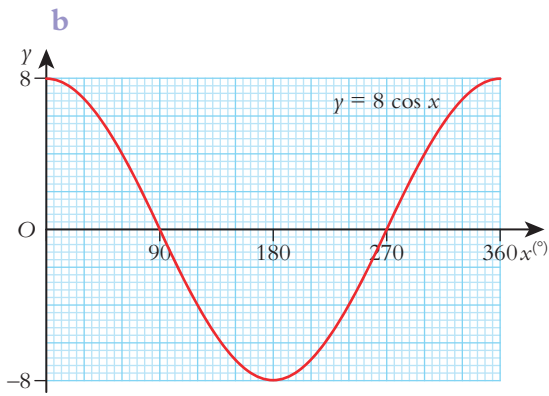


4  $x = 4$

5 a



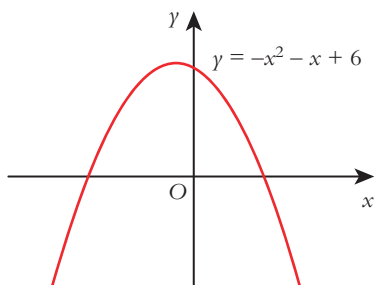




- 6 a** **i** 0.94  
**ii** 0.87  
**b** **i**  $46^\circ, 314^\circ$   
**ii**  $114^\circ, 246^\circ$

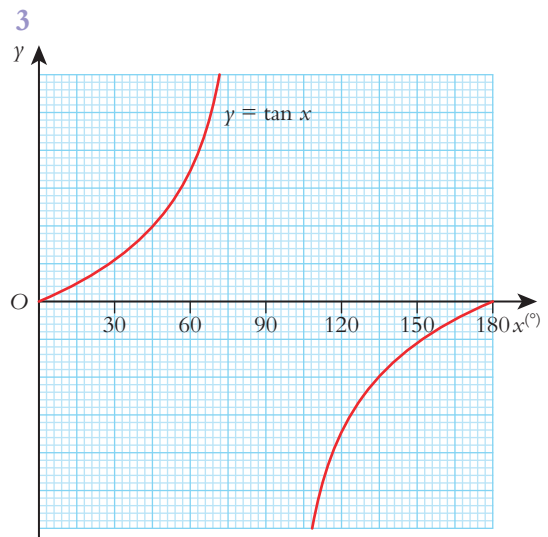
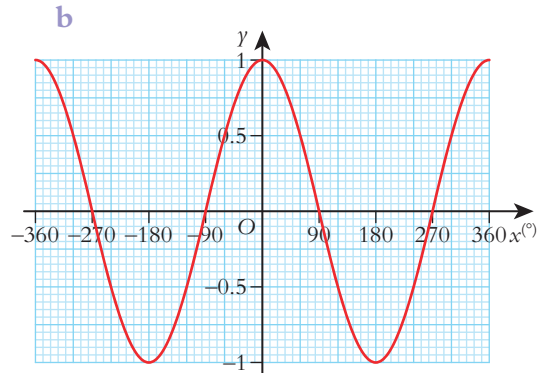
- 7 a**  $y = x - 2$   
**b**  $y = 3x - 2x^2$   
**c**  $y = 2x + 4$   
**d**  $y = \frac{1}{2}x$   
**e**  $y = -2x^2 - 3x + 8$   
**f**  $y = 2^x$

- 8 a**  $y = x^2 + 3x$   
**b**  $y = -x$   
**c**  $y = \frac{2}{x}$   
**d**  $y = x^3 + 5$   
**e**



## Examination questions (page 266)

- 1 a**  $y = 4 - x$   
**b**  $y = 4 + x^2$   
**c**  $y = \frac{4}{x}$
- 2 a** reading taken at  $-0.5$ ; values  $210^\circ$  and  $330^\circ$

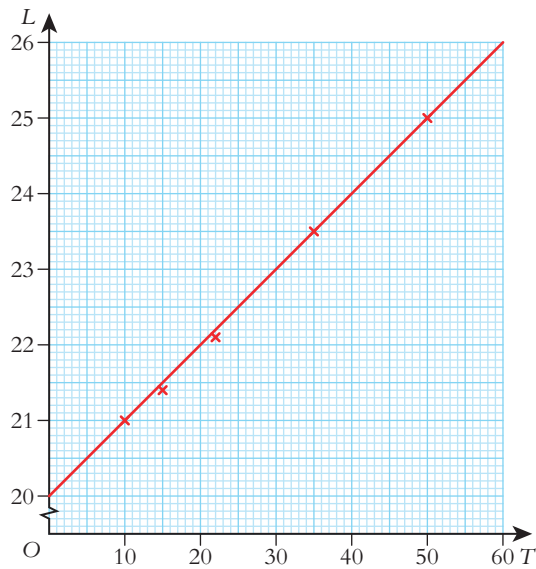


## Chapter 27 Real-life graphs

### Exercise 27.1 (page 269)

- 1 a**  $u = 5, a = 10$   
**b** 22 seconds

2 a



b Yes;  $L = 0.1T + 20$

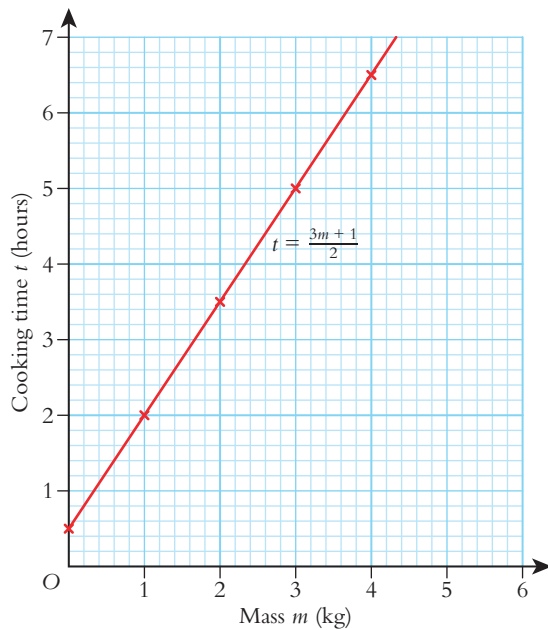
c 27.5 mm

3 a  $T = -3.75m + 30$

b 6 minutes 40 seconds

### Exercise 27.2 (page 274)

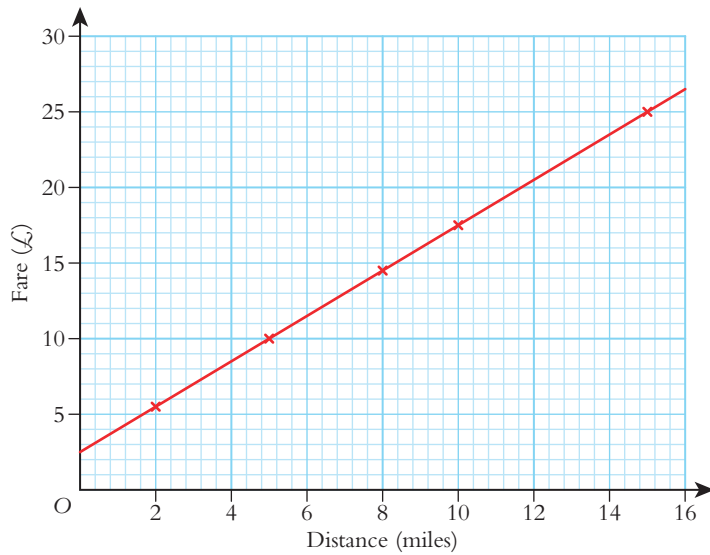
1 a



b  $4\frac{1}{2}$  hours

c 1.5 kg

2 a



b 6 miles

c £2.50

3 a Claire

b Claire 16.36 mph, Dermot 10 mph

c 13.30

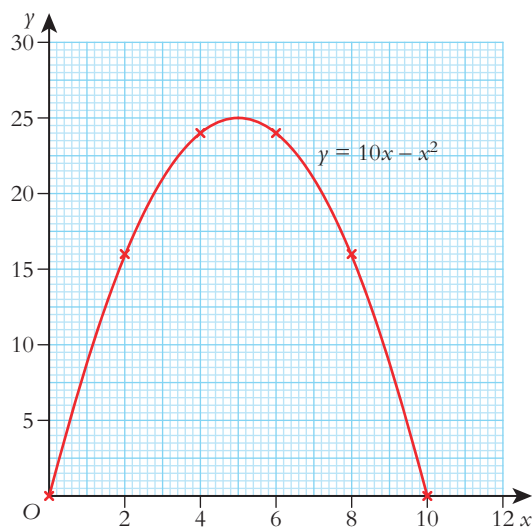
d They are both 10 miles from their destination.

### Exercise 27.3 (page 276)

1 a

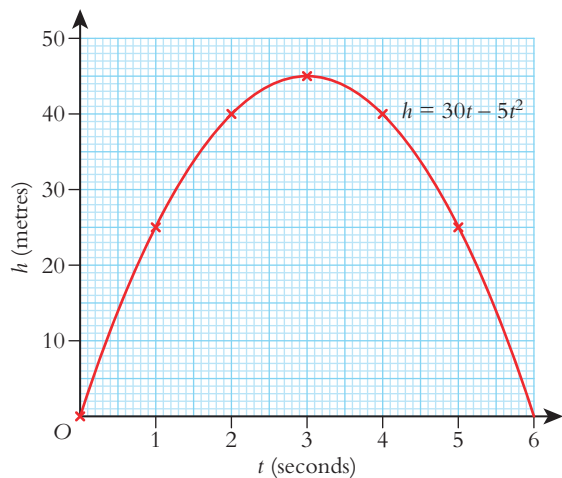
$x$	0	2	4	6	8	10
$10x$	0	20	40	60	80	100
$-x^2$	0	-4	-16	-36	-64	-100
$y$	0	16	24	24	16	0

b



c 25m

2 a



b 3 seconds

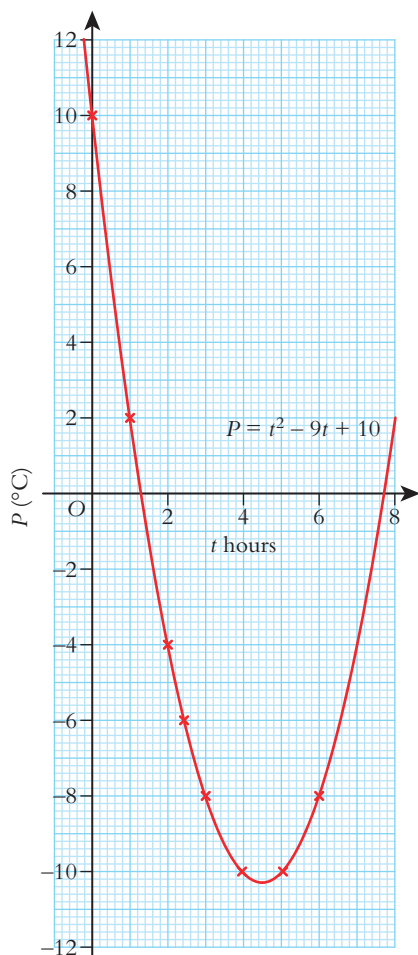
c 45 m

d  $3\frac{1}{2}$  seconds

3 a

$t$	0	1	2	3	4	5	6
$t^2$	0	1	4	9	16	25	36
$-9t$	0	-9	-18	-27	-36	-45	-54
<b>10</b>	10	10	10	10	10	10	10
<b>P</b>	10	2	-4	-8	-10	-10	-8

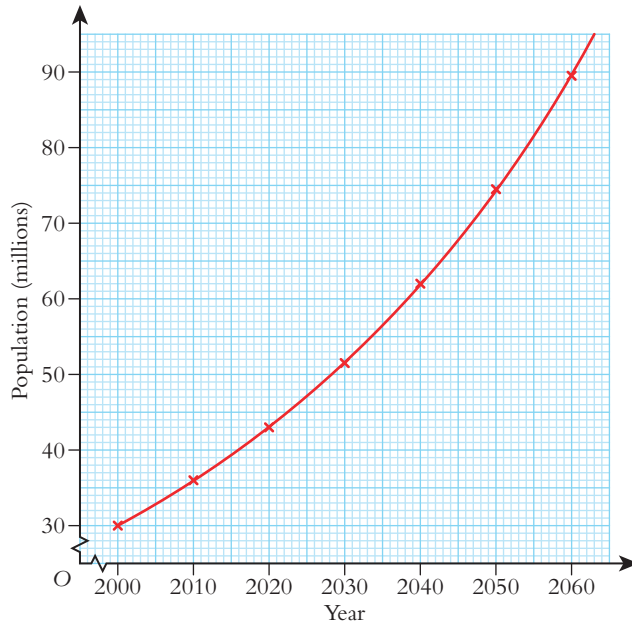
b



- c  $10^{\circ}\text{C}$
- d  $-6.25^{\circ}\text{C}$
- e 1 hour 18 minutes

### Exercise 27.4 (page 278)

1 a



b during the year 2023

2 a £10 200

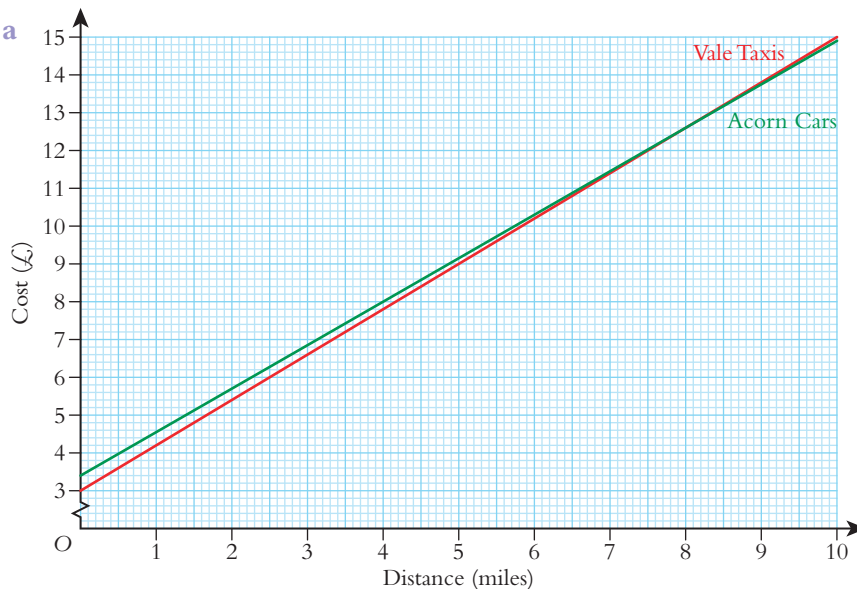
b £8670

c  $£12\,000 \times 0.85^t$

3 25 years

### Summary exercise 27 (page 279)

1 a

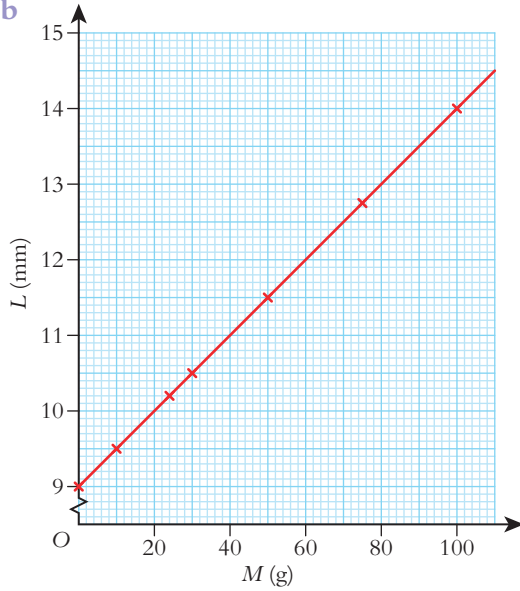


b 8 miles

2 a

Mass, $M$ (grams)	10	25	30	50	75	100
Length, $L$ (mm)	9.5	10.25	10.5	11.5	12.75	14

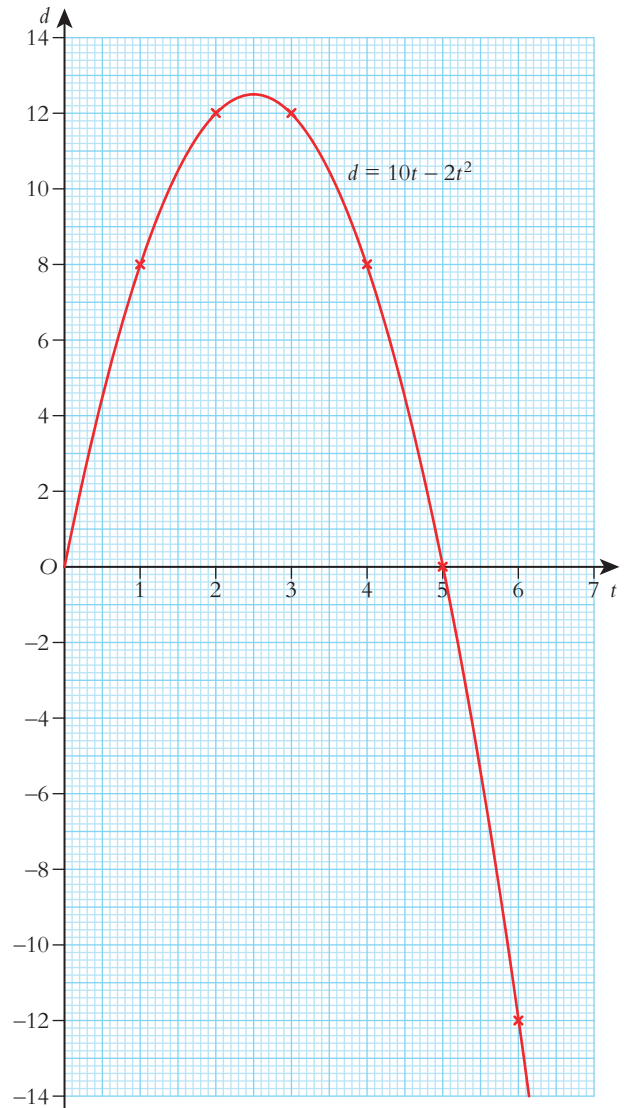
b



c 36 g

d 9 mm

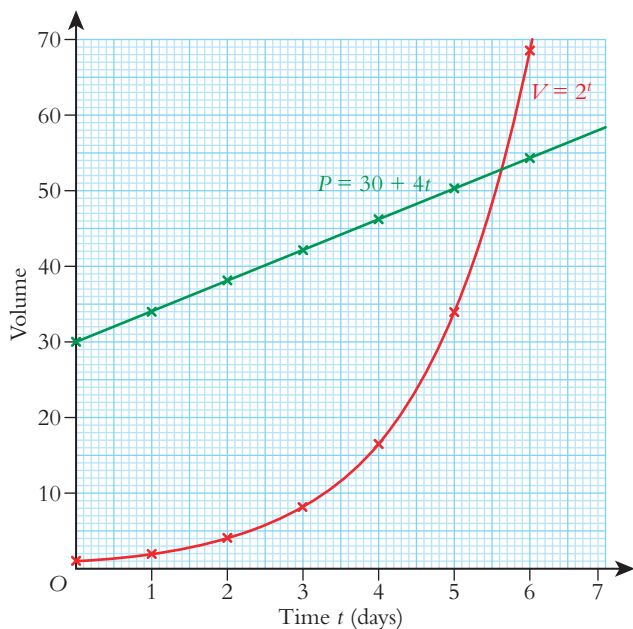
3 a



b after 2.5 seconds

c 36 m

4 a, b



c 5.6 days

### Examination questions (page 280)

- 1 a Gareth stopped cycling for 30 minutes between 1.30p.m. and 2.00p.m.
- b 5 km
- 2  $a = 0.1, b = 0.8$

## 28 Simultaneous equations

### Exercise 28.1 (page 284)

- 1 a  $x = 4, y = 4$
- b  $x = 9, y = 5$
- c  $x = 1, y = -2$
- 2 a  $x = 2, y = 3$
- b  $x = 2, y = 3$
- c  $x = 2, y = -1$
- d  $x = \frac{1}{2}, y = 3$
- 3 a  $x = 2, y = 3$
- b  $x = 6, y = 1$
- c  $x = 5, y = 5$
- d  $x = 2, y = -3$
- 4  $(0, 3), (2, 5), (5, 5)$  and  $(3, 1)$

### Exercise 28.2 (page 286)

- 1  $x = 9, y = 1$
- 2  $a = 2, b = -1$
- 3  $p = 1\frac{1}{2}, q = -2\frac{1}{2}$
- 4  $e = 3, f = -12$
- 5  $x = 4, y = 6$
- 6  $x = -1, y = 3$
- 7  $x = 1, y = 2$
- 8  $m = 4, n = -1$
- 9  $x = 2\frac{1}{2}, y = -5$
- 10  $x = 1, y = 3$
- 11  $x = 5, y = -3$
- 12  $x = -5, y = 4$

### Exercise 28.3 (page 289)

- 1 a  $x = 1\frac{1}{2}, y = -2\frac{1}{2}$
- b  $a = 9, b = 4$
- c  $c = -1, d = 3$
- d  $p = 2, q = -3$
- e  $x = 7, y = 1$
- f  $a = 5, b = -4$
- 2 a  $x = 0, y = -1$
- b  $a = 9, b = 1$
- c  $p = -2, q = 5$
- d  $a = 13, b = -7$
- e  $x = 3, y = 1$
- f  $p = -2\frac{3}{4}, q = 1\frac{1}{4}$
- 3 a  $x = 3, y = 2$
- b  $a = 3, b = 4$
- c  $x = 3, y = 3$
- d  $p = 7, q = 2$
- e  $a = -2\frac{3}{5}, b = 3\frac{2}{5}$
- f  $p = 3, q = -3$
- 4 a  $x = 2, y = 1$
- b  $x = 3\frac{3}{10}, y = 1\frac{1}{5}$
- c  $a = 3, b = 4$
- d  $x = 2, y = -2$
- e  $x = 2, y = -4$
- f  $x = 3, y = 2$

### Exercise 28.4 (page 292)

- 7 and 3
- rubber 6p, protractor 25p
- magazine £1.40, newspaper 72p
- length 12 cm, width 8 cm
- adult £17.50, child £12
- man 37 years, son 7 years
- 11 years old
- first number 37, second number 24
- 1500 books sold during promotion, 3500 books after
- £6.40
- 42 and 24
- $y = -3x + 5$
- 39 cm

### Exercise 28.5 (page 295)

- $x = 1, y = 1$
- $x = -3, y = 2$  or  $x = 4, y = 4\frac{1}{3}$
- $x = 5, y = 1$  or  $x = -7, y = -5$
- $x = 6, y = 2$  or  $x = -4, y = -3$
- $x = -3, y = 0$  or  $x = 4, y = 7$
- $x = 1 \pm \sqrt{3}, y = 5 \pm 3\sqrt{3}$
- $x = -1 \pm \sqrt{6}, y = -3 \pm 2\sqrt{6}$
- $x = \frac{-3 \pm \sqrt{69}}{5}, y = \frac{1 \pm 3\sqrt{69}}{5}$

- $x = -5 \pm \sqrt{57}, y = \frac{3 \pm \sqrt{57}}{4}$
- $x = \frac{9 \pm 4\sqrt{14}}{11}, y = \frac{3 \pm 6\sqrt{14}}{11}$
- (2, 0) and (3, -1)
- $(3\frac{1}{2}, 5)$  and  $(-3, 18)$

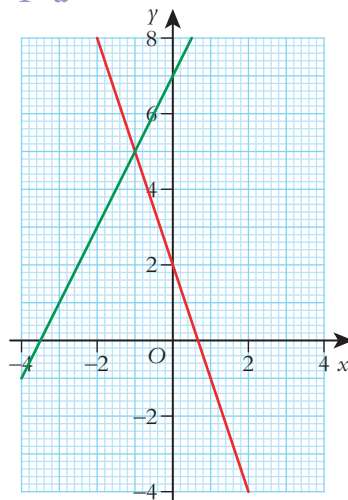
### Summary exercise 28 (page 296)

- $x = 4, y = -6$
  - $x = 6, y = 4$
  - $x = -3, y = 1$
- $x = -1, y = 1$
  - $x = 2, y = 3$
  - $x = \frac{1}{2}, y = 0$
  - $x = 1.6, y = 3.2$
- $a = 8, b = \frac{1}{2}$
  - $x = 3, y = 1$
  - $x = 4, y = 1$
  - $x = 0, y = 2$
  - $x = 6, y = 3$
  - $p = 4, q = 1$
- $a = 2, b = 3$
  - $x = 5\frac{2}{3}, y = -11\frac{1}{2}$
  - $p = 4, q = 3$
  - $a = 17, b = -5$
  - $x = 2, y = -1$
  - $a = 4, b = 3$
- any pair of equations such that when  $x = 4, y = -1$  for both equations, e.g.  $x + y = 3$  and  $2x - 3y = 11$
- adult £175, child £120
- $80^\circ$

- 33 years old
- 16 m
- $x = \frac{1}{2}, y = \frac{1}{2}$  or  $x = 4, y = 32$
  - $x = 3, y = 4$  or  $x = -1\frac{1}{2}, y = -\frac{1}{2}$
  - $x = 1.94, y = -0.89$  or  $x = 0.06, y = 2.89$
- (1, 2) and  $(-\frac{1}{2}, -2\frac{1}{2})$
- 15 and 24

### Examination questions (page 297)

1 a



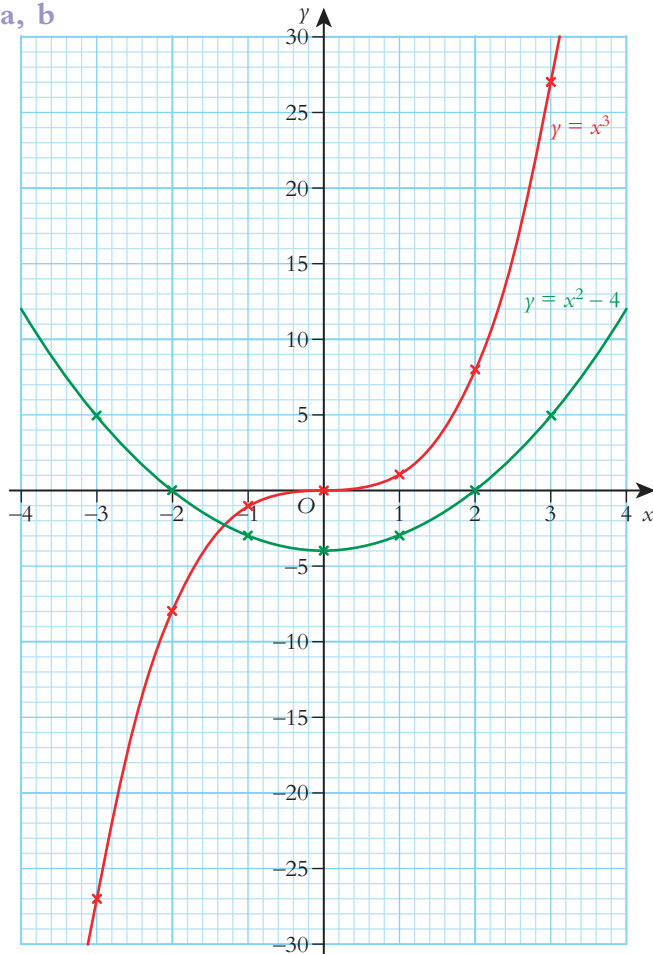
- $x = -1, y = 5$
  - $y = -3x$
- $5C + 4D = 150, C = D + 3; \text{Carrie } 18, \text{Deana } 15$
  - 65p
  - $x = 3, y = -2$
  - $x = 4.19, y = 17.58$  or  $x = -1.19, y = 1.42$
  - $(\frac{1}{3}, 4\frac{1}{3})$  and  $(-1, 7)$



## 29 Graphical solution of equations

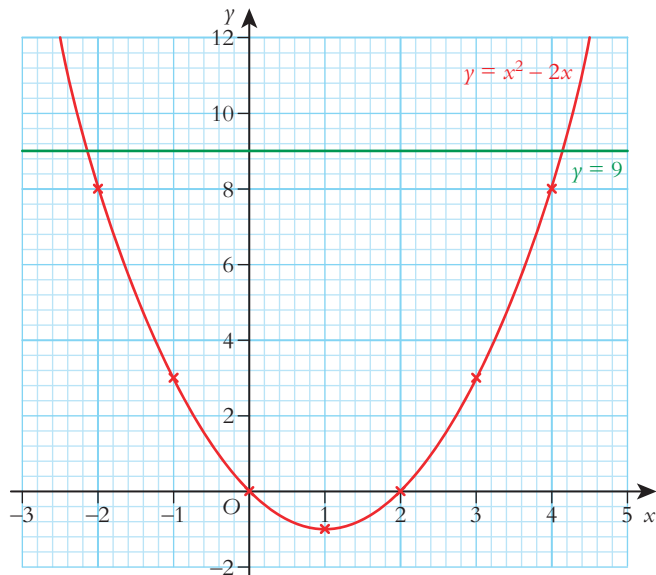
### Exercise 29.1 (page 303)

1 a, b



c  $x = -1.3$

2

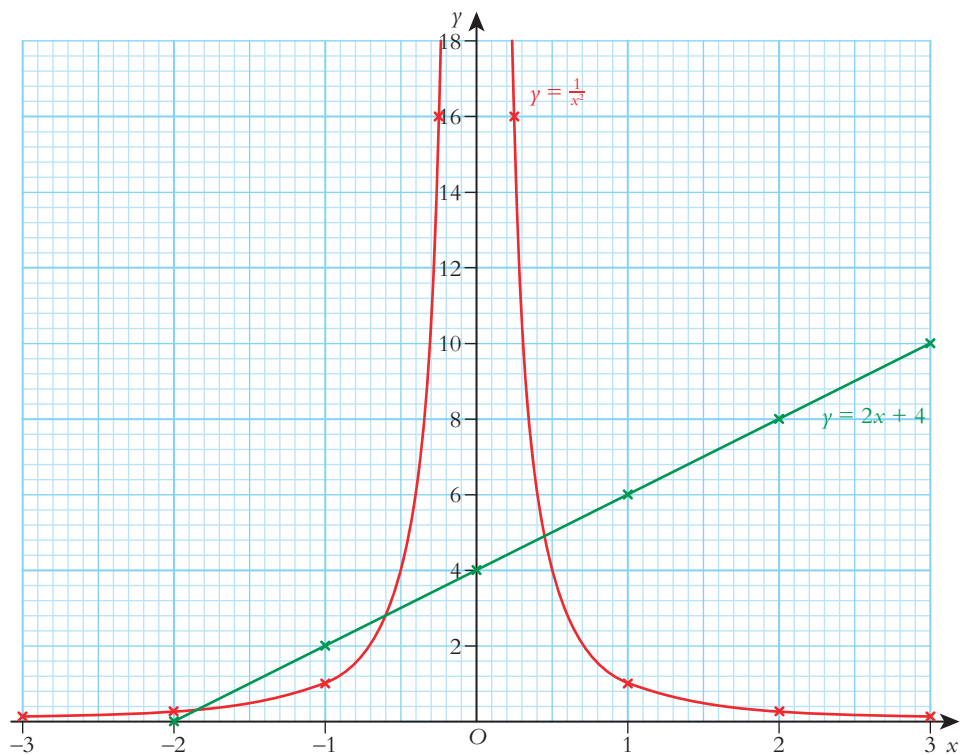


$x = 4.15$  and  $x = -2.15$

- 3 a  $x = 2$  and  $x = -3$   
 b  $x = 3.8$  and  $x = -0.8$
- 4 a  $x = 2.65$  and  $x = -2.65$   
 b  $x = 2.8$  and  $x = -1.8$   
 c  $x = 0.4$  and  $x = -2.4$

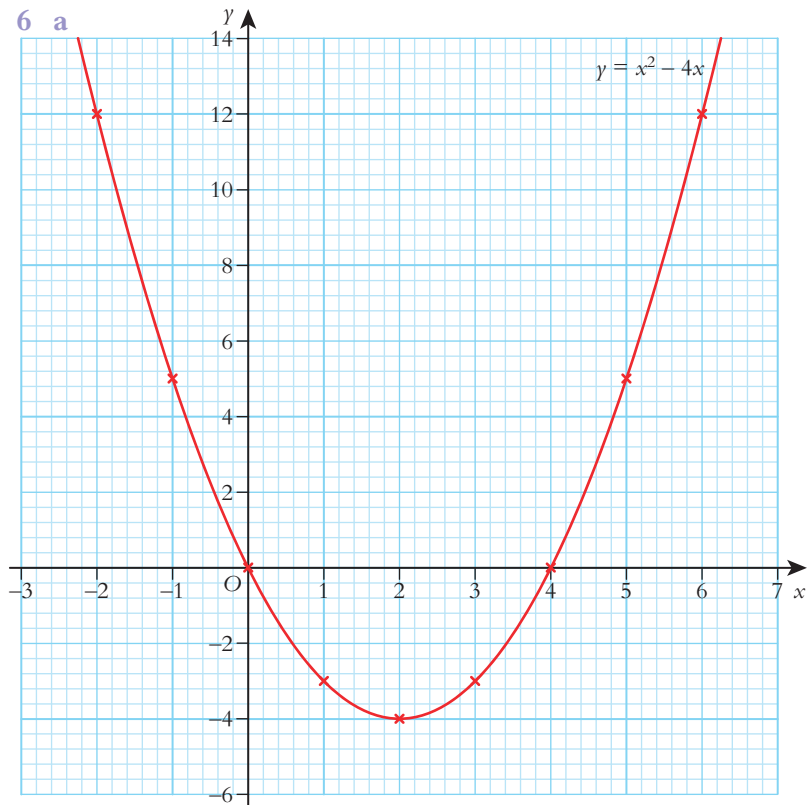
5 a

$x$	-3	-2	-1	-0.5	-0.25	0	0.25	0.5	1	2	3
$y$	0.11	0.25	1	4	16	-	16	4	1	0.25	0.11



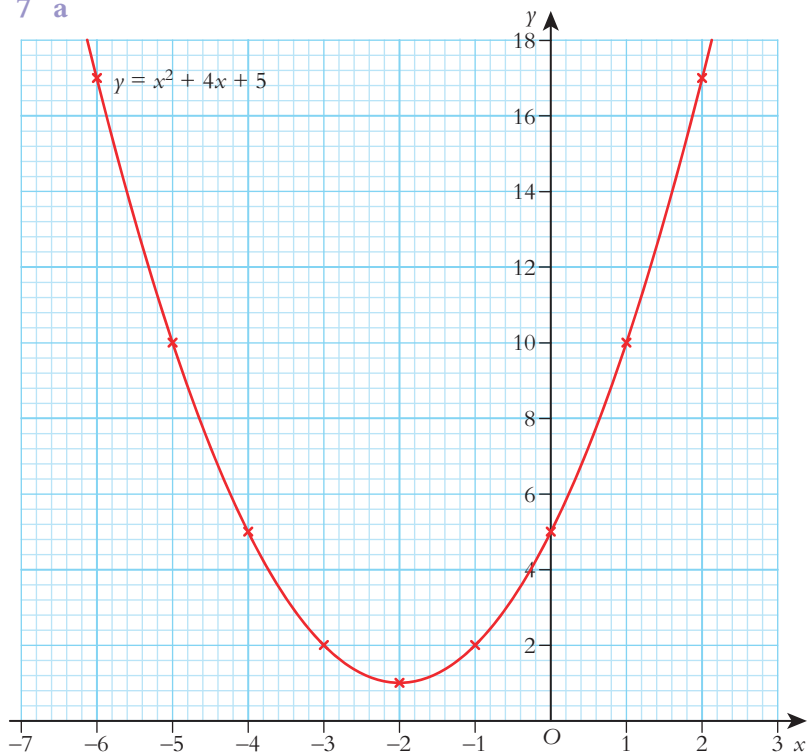
- b  $y = 2x + 4$   
 c  $x = 0.45, x = -0.6$  and  $x = -1.85$

6 a



- b**
- i**  $x = 0$  and  $x = 4$
  - ii**  $x = 5.15$  and  $x = -1.15$
  - iii**  $x = 1$  and  $x = 3$
  - iv**  $x = 2.6$  and  $x = 0.4$

7 a



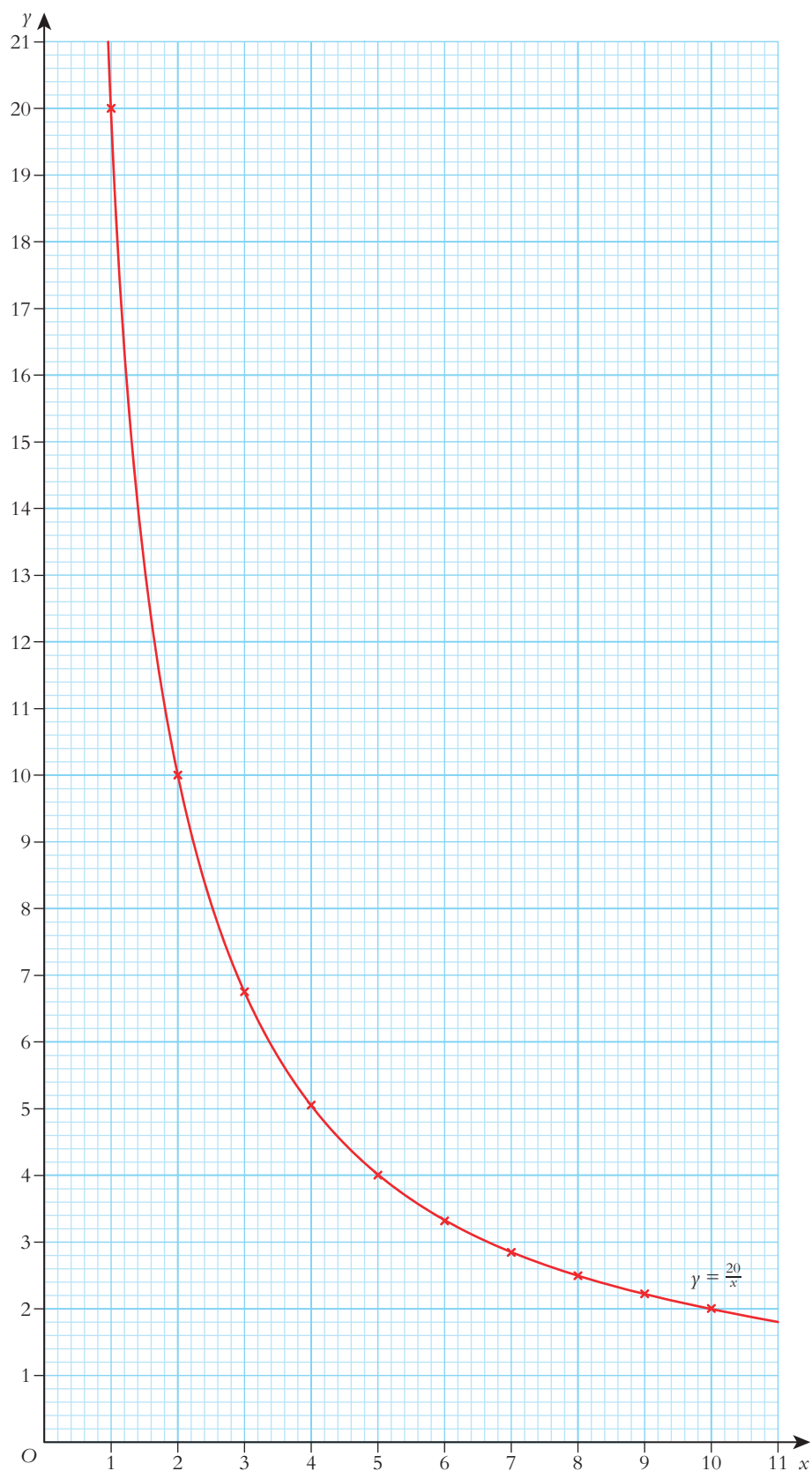
- b i**  $x = 0.3$  and  
 $x = -3.3$   
**ii**  $x = -0.45$   
and  
 $x = -4.55$

- 8 a**  $y = 3$   
**b**  $y = 2$   
**c**  $y = -3x$   
**d**  $y = x + 6$

- 9 a**  $y = 0$   
**b**  $y = -\frac{1}{2}$   
**c**  $y = -6x$   
**d**  $y = -4\frac{1}{2}x$

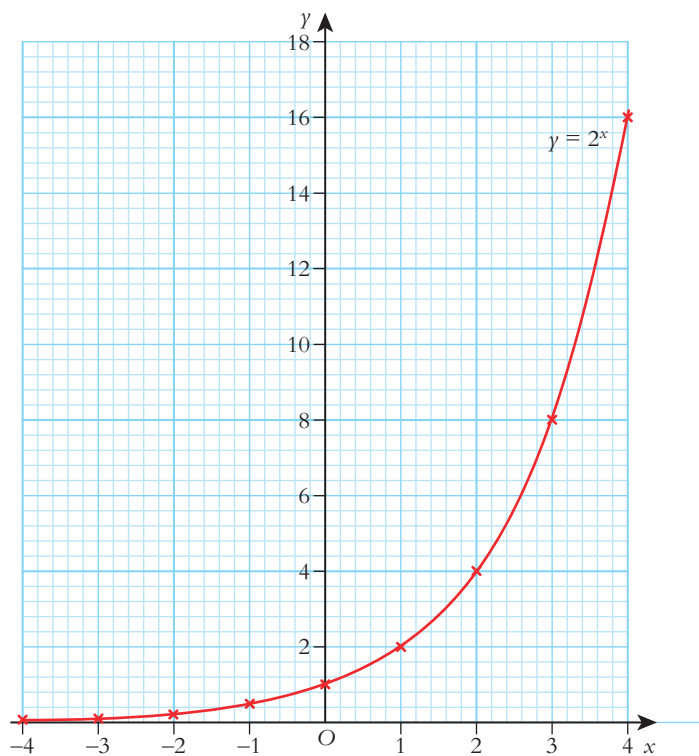
- 10 a**  $x^2 + 6x - 2 = 0$   
**b**  $x^3 - 4x - 1 = 0$   
**c**  $x^2 - 6x + 6 = 0$   
**d**  $2x^2 - 4x = 0$

**11 a**



- b** i  $x = 3.58$
- ii  $x = 2.76$  and  $x = 7.24$
- iii  $x = 4.47$

**12 a**

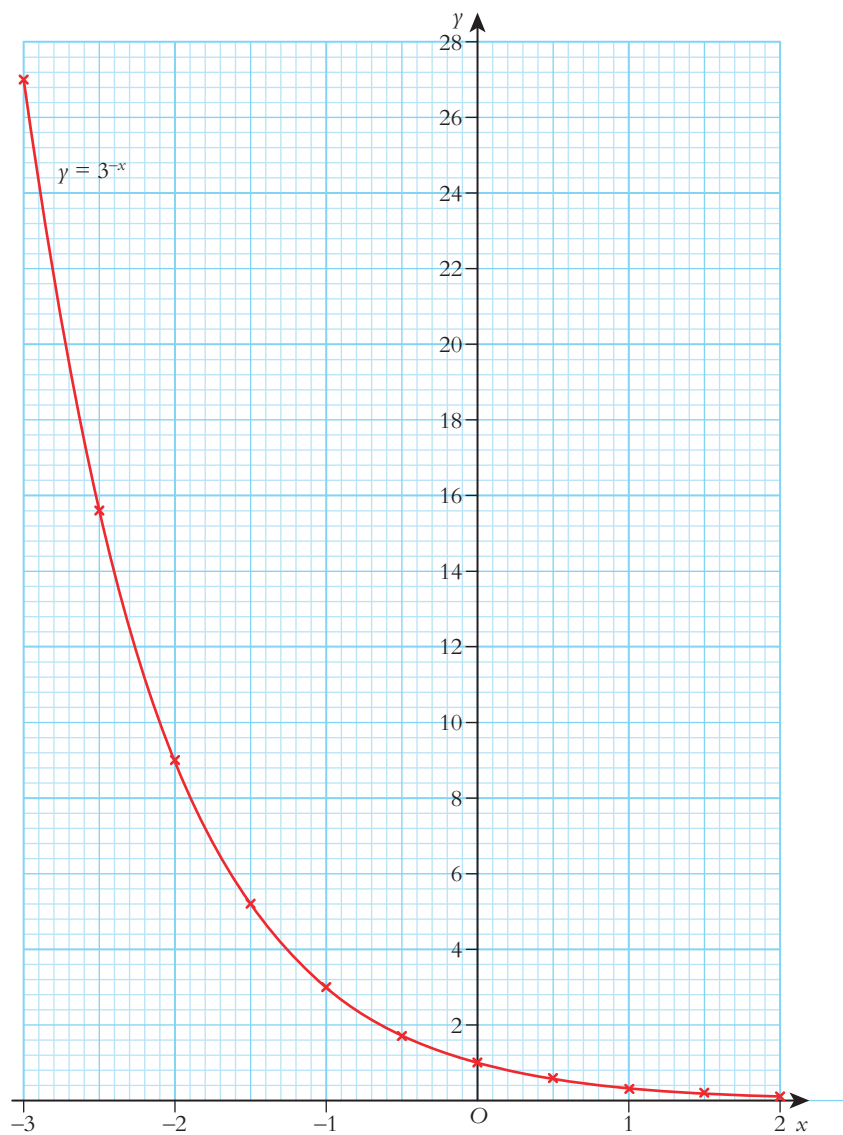


- b** i  $x = 2.8$
- ii  $x = 1$  and  $x = 2$
- iii  $x = 1$
- c**  $2^{1.5} = 2.8$

13 a

$x$	-3	-2.5	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2
$y$	27	15.6	9	5.2	3	1.7	1	0.6	0.3	0.2	0.1

b



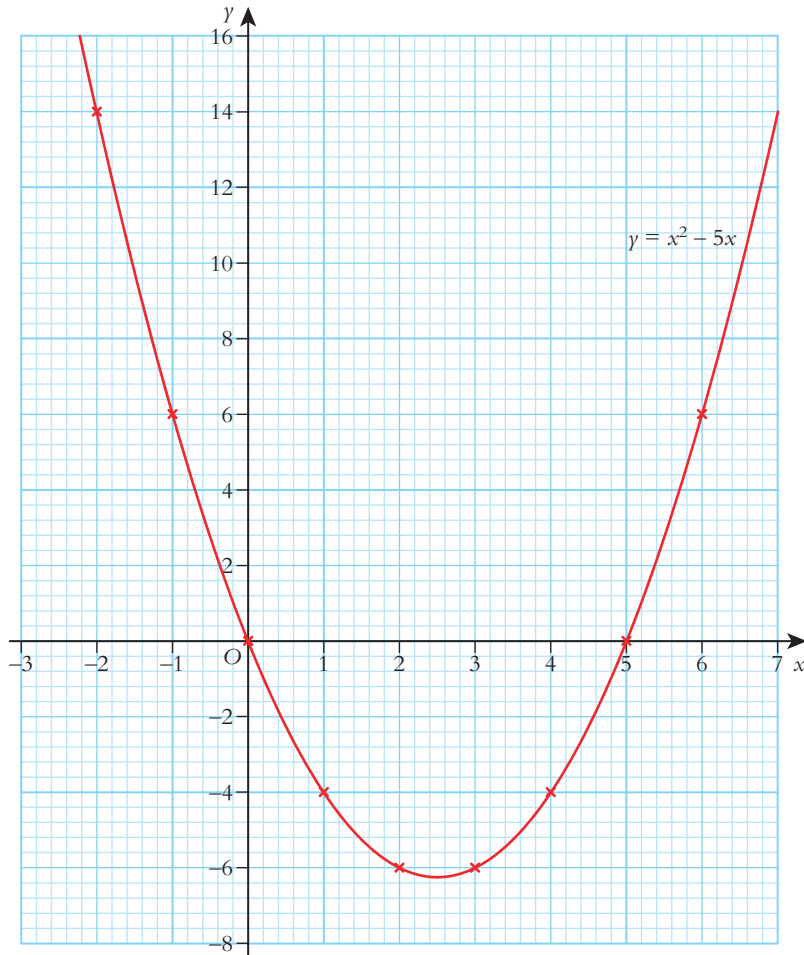
- c
- i  $x = -1.46$
  - ii  $x = -1.89$
  - iii  $x = -2.77$

- 14 a 1 solution  
 b 3 solutions  
 c 2 solutions  
 d 1 solution

### Summary exercise 29 (page 306)

- 1 a i  $x = 1.56$  and  $x = -2.56$   
 ii  $x = 1.41$  and  $x = -1.41$   
 b  $x^2 + 2x - 1 = 0$

2

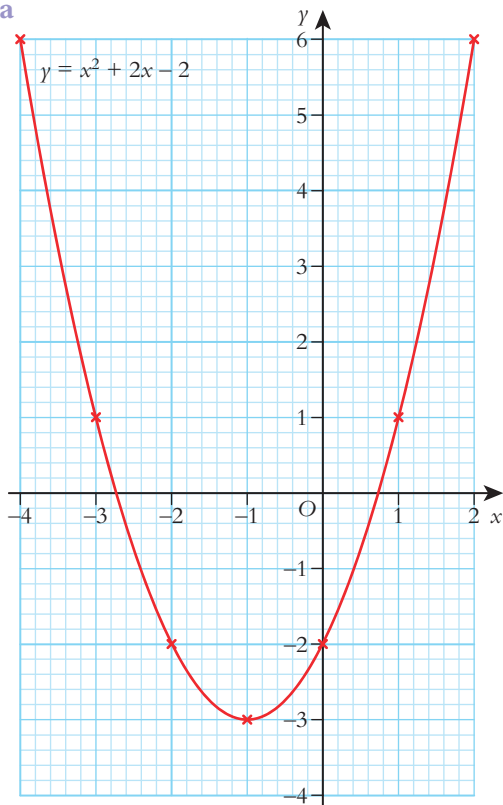


- a  $x = -0.7$  and  $x = 5.7$
  - b  $x = 0$  and  $x = 6$
  - c  $x = 3.7$  and  $x = 0.3$
- 3
- a  $y = 2$
  - b  $y = x - 2$
  - c  $y = -4x + 1$
- 4
- a  $y = 3$
  - b  $y = 2x$
  - c  $y = 5$
  - d  $y = 2x + 1$
- 5
- a 1 solution
  - b 2 solutions
  - c 2 solutions
  - d 2 solutions
  - e 3 solutions

### Examination questions (page 307)

- 1
- a  $x = 0.25$  and  $x = 1.85$
  - b  $x = -1.73$ ,  $x = 0$  and  $x = 1.73$  (straight line required is  $y = 1 - x$ )

2 a

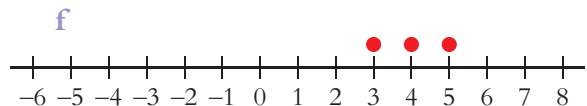
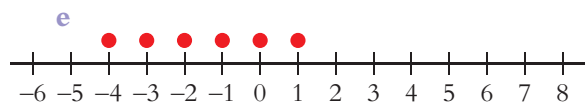
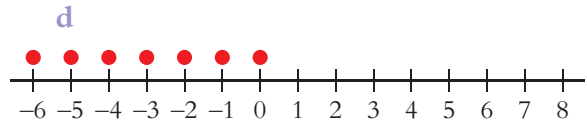
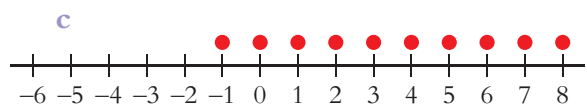
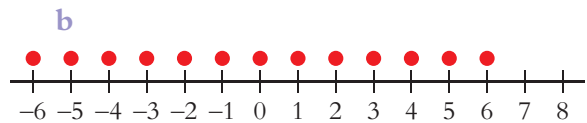
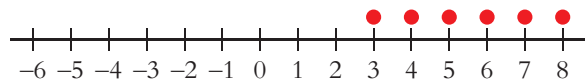


b  $x = -3.3$  and  $x = 0.3$  (straight line required is  $y = -x - 1$ )

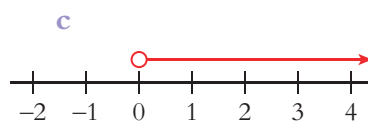
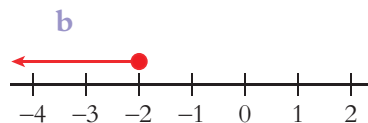
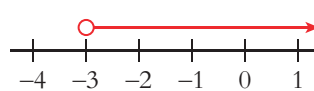
- 3 a **i** 7, 8, 9, 10 and 11  
**ii** -2, -3, -4, -5 and -6  
**iii** -4, -3, -2, -1 and 0  
**iv** 0, -1, -2, -3 and -4  
**b** **i** -3, -2, -1, 0, 1 and 2  
**ii** 0, 1, 2, 3, 4 and 5  
**iii** -5  
**iv** -2, -1, 0 and 1

- 4 a  $a < 12$   
**b**  $a \leq 4$   
**c**  $a < 6$   
**d**  $a \geq 3$   
**e**  $4 < a < 8$

5 a



6 a

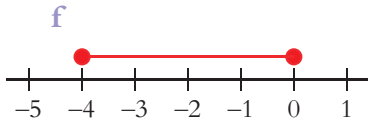
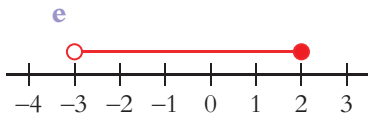
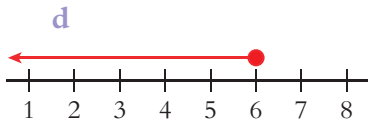


## Chapter 30 Inequalities

### Exercise 30.1 (page 310)

- 1 **a** true  
**b** false  
**c** true  
**d** false  
**e** false  
**f** true  
**g** true  
**h** true  
**i** true
- 2 **a** 5 or 4 or 3 ...  
**b** -2 or -3 or -4 ...  
**c** -4 or -3 or -2 ...  
**d** 10 or 11 or 12 ...  
**e** 20 or 19 or 18 ...  
**f** -6 or -5 or -4 ...  
**g** 5 or 6 or 7 ...  
**h** -5 or -6 or -7 ...  
**i** -2 or -1 or 0 ...





- 7 **a**  $x > 2$   
**b**  $x \leq 7$   
**c**  $-1 < x < 3$   
**d**  $-1 \leq x < 3$   
**e**  $x < 8$   
**f**  $-3 < x \leq 0$

- 8 **a** 6  
**b** 4  
**c** 2  
**d** -2  
**e** 3

9  $1 < x < 7$  and  $2 \leq x \leq 6$  are two examples.

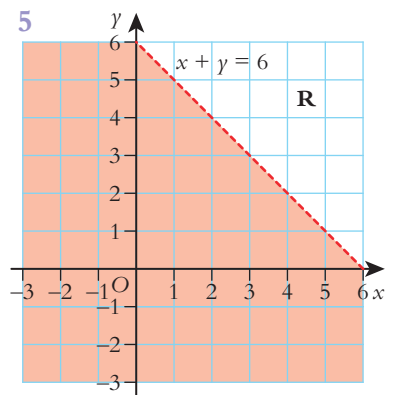
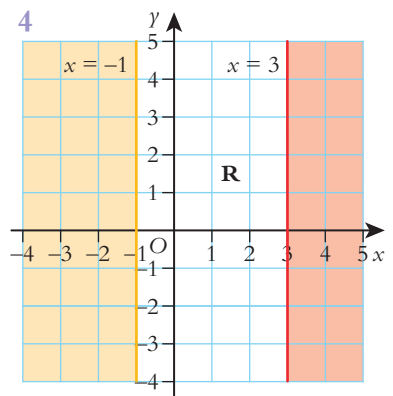
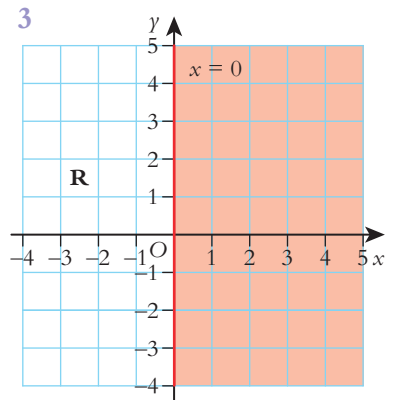
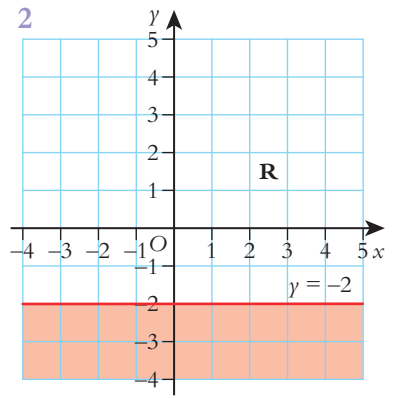
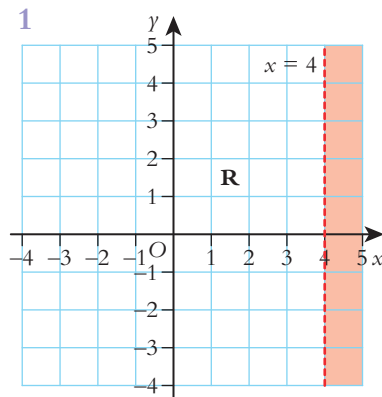
10  $2 \leq x < 4$

### Exercise 30.2 (page 315)

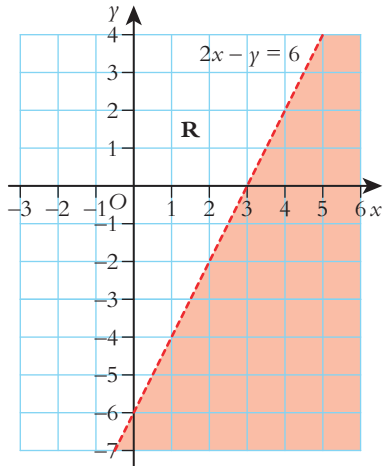
- 1  $x > 5$   
2  $x < 4$   
3  $x \leq 12$   
4  $t > 6$   
5  $a \leq 2$   
6  $x < 2$   
7  $n \leq -1\frac{3}{4}$   
8  $p < 2$   
9  $x < 3$   
10  $x \leq 1\frac{1}{4}$

- 11  $x < -2$   
12  $t < 17\frac{1}{2}$   
13  $x \geq 1\frac{1}{4}$   
14  $a > 1$   
15  $m > -\frac{1}{2}$   
16  $x > 10$   
17  $k > -\frac{5}{6}$   
18  $x < 2$   
19  $a \leq 2\frac{1}{4}$   
20  $x > -24$   
21  $2 \leq n < 4$ ; integer solutions are 2 and 3  
22  $-1 < n < 1$ ; integer solution is 0  
23  $-4 < n < 6$ ; integer solutions are -3, -2, -1, 0, 1, 2, 3, 4 and 5  
24  $a \leq -1$  and  $a > 1$   
25  $a \leq 3$  and  $a \geq 4$   
26 width  $< 5\frac{1}{2}$  cm  
27  $x < 3.8$   
28 £23.99

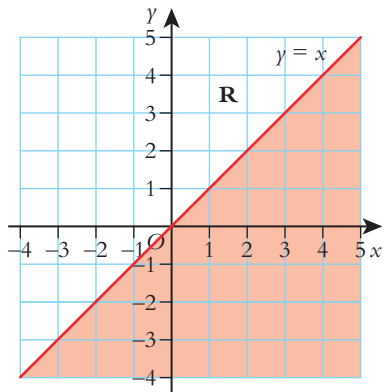
### Exercise 30.3 (page 318)



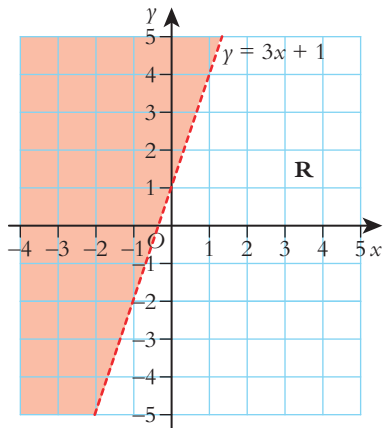
6



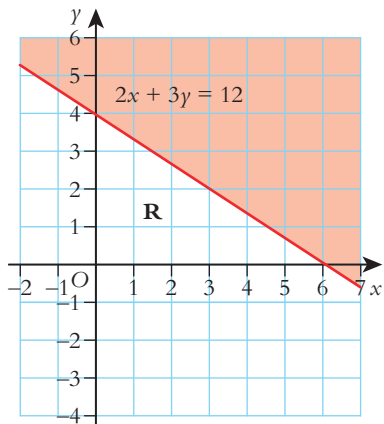
7



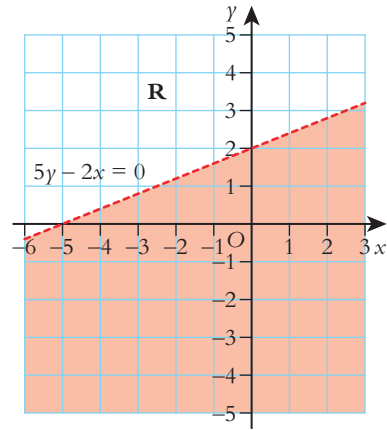
8



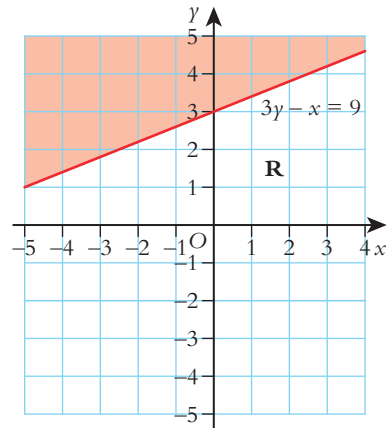
9



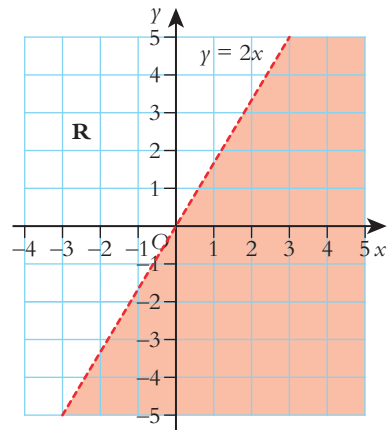
10



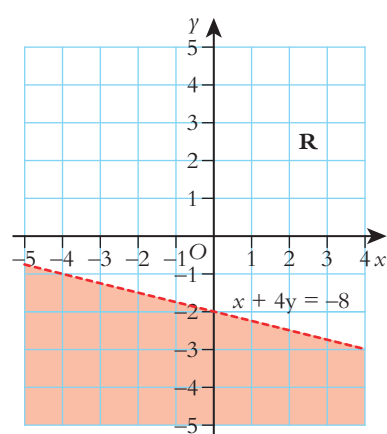
11



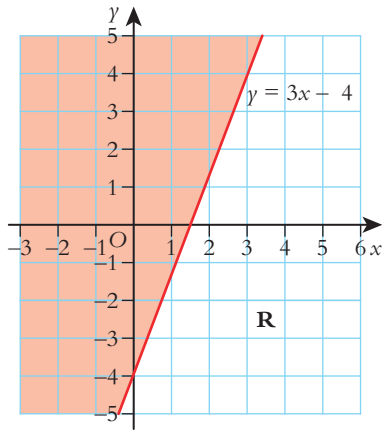
12



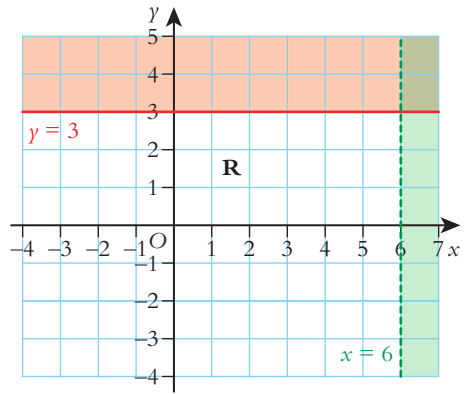
13



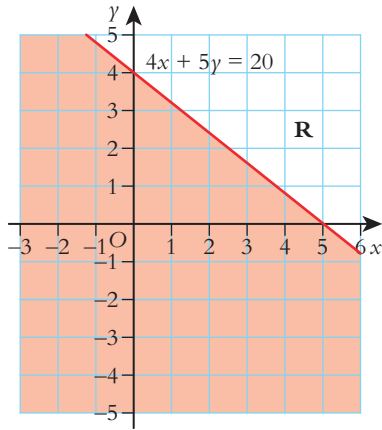
14



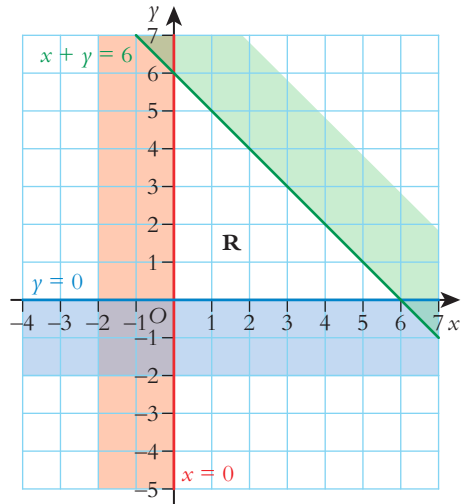
2



15

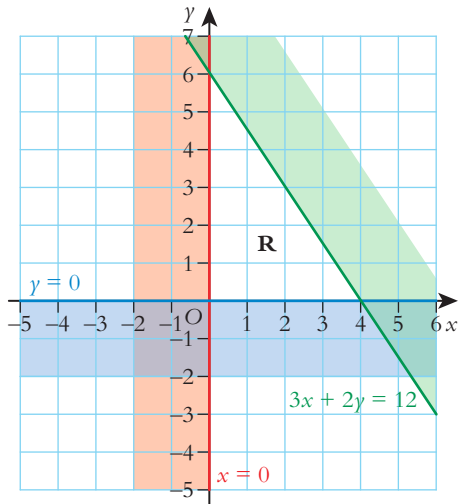


3

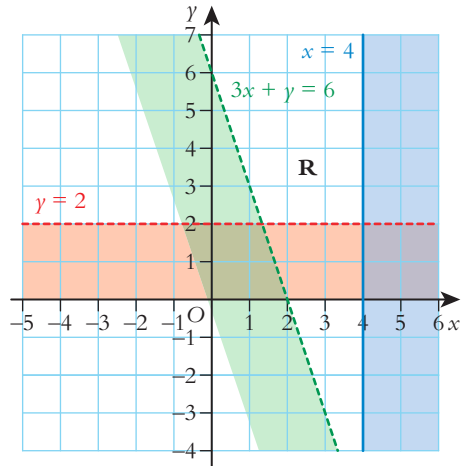


**Exercise 30.4 (page 319)**

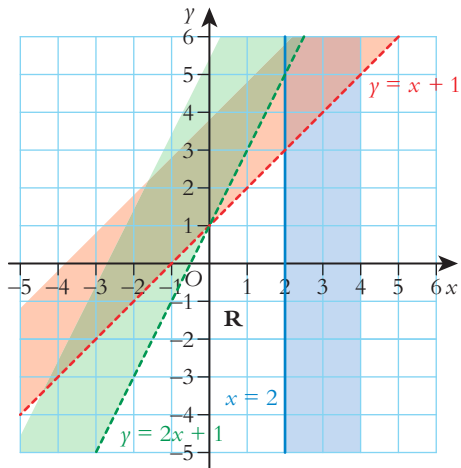
1



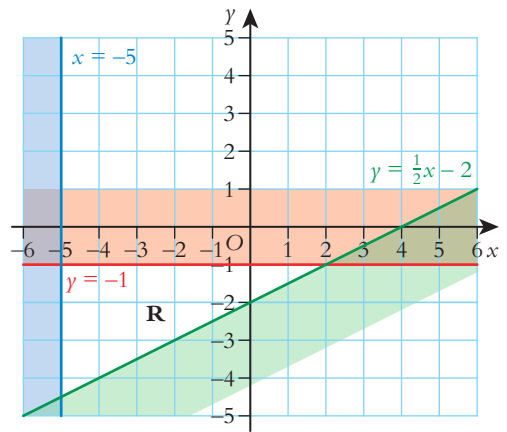
4



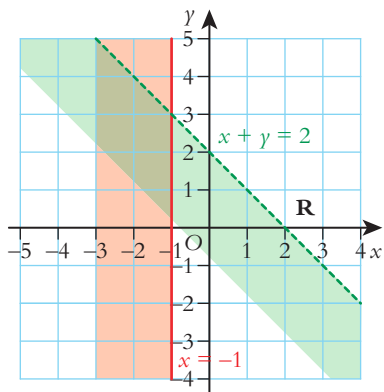
5



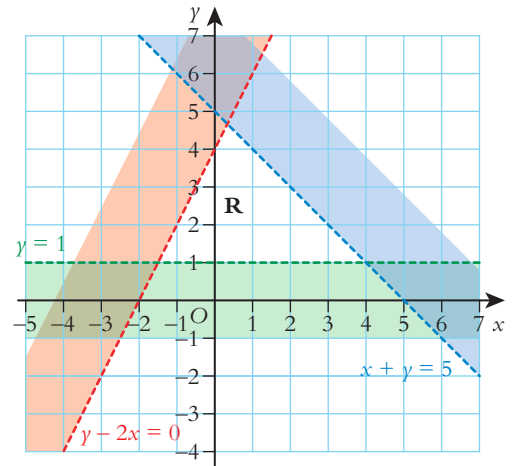
8



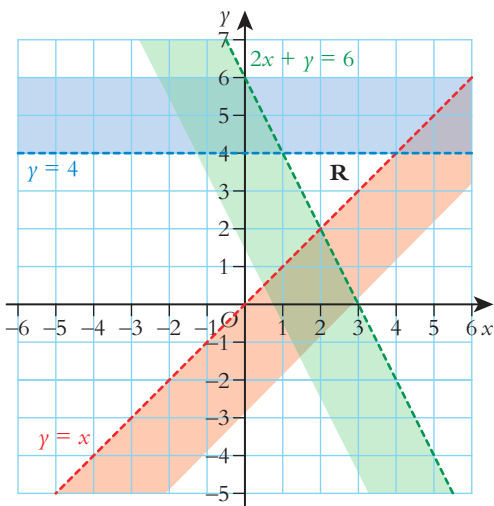
6



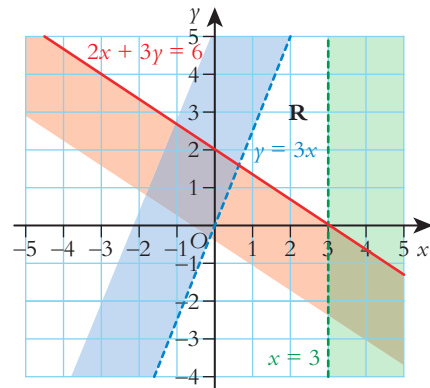
9



7



10



### Exercise 30.5 (page 321)

- 1  $y \leq 3$  and  $x \geq -1$
- 2  $x \leq 3$ ,  $y \geq 0$  and  $y \leq x + 1$
- 3  $y < 4$  and  $y \leq 2x$
- 4  $y \leq 2$ ,  $y \leq x$ ,  $y > x - 2$  and  $y + x \geq -2$
- 5  $y \geq 1$ ,  $x \geq -3$  and  $y < -\frac{1}{2}x + 2$

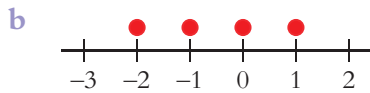
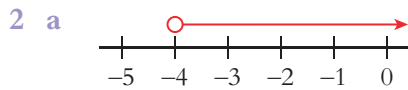
- 6  $y \geq 2$ ,  $x \leq 4$ ,  $y \geq -x + 3$   
and  $y \leq \frac{3}{4}x + 3$

### Exercise 30.6 (page 323)

- 1 (5, 6), maximum 17
- 2 (2, 4), minimum 4
- 3 (4, 7), maximum 11
- 4 (3, 2), minimum 9
- 5 (6, 5), maximum 13
- 6 (2, 6), maximum 2

### Summary exercise 30 (page 324)

- 1 -3, -2, -1, 0, 1, 2 and 3



- 3 a  $x > -8$

b  $-1 \leq x < 3$

- 4 a  $x < 2\frac{1}{2}$

b  $x < 3\frac{1}{2}$

c  $a \geq -7\frac{1}{2}$

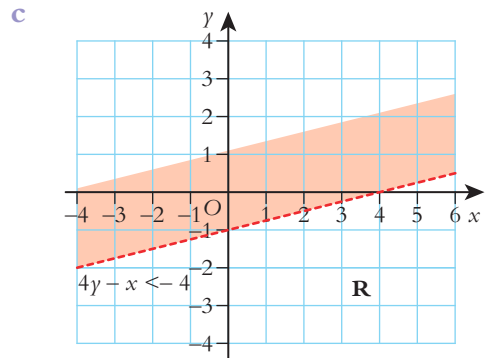
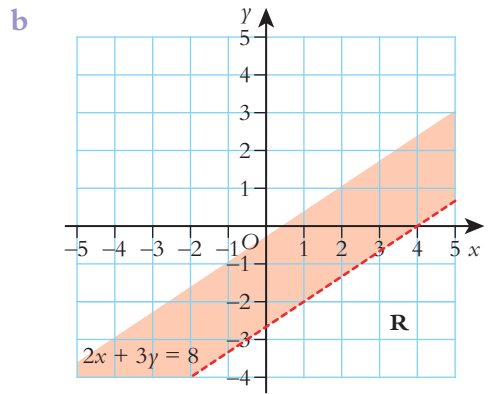
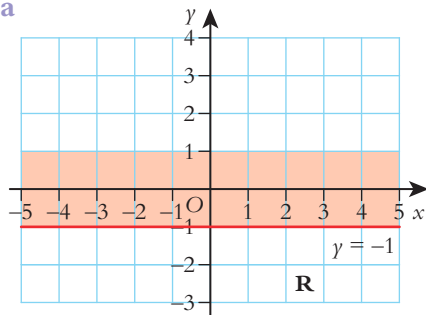
d  $p > 6$

- 5  $1 \leq n \leq 4$ ; integer solutions are 1, 2, 3 and 4

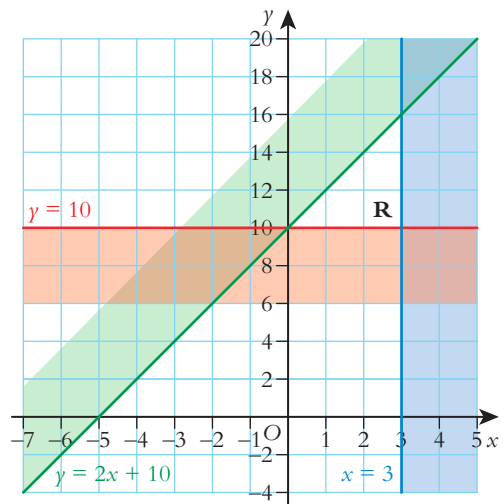
- 6  $k \leq -3$  and  $k \geq 1$

- 7 £241

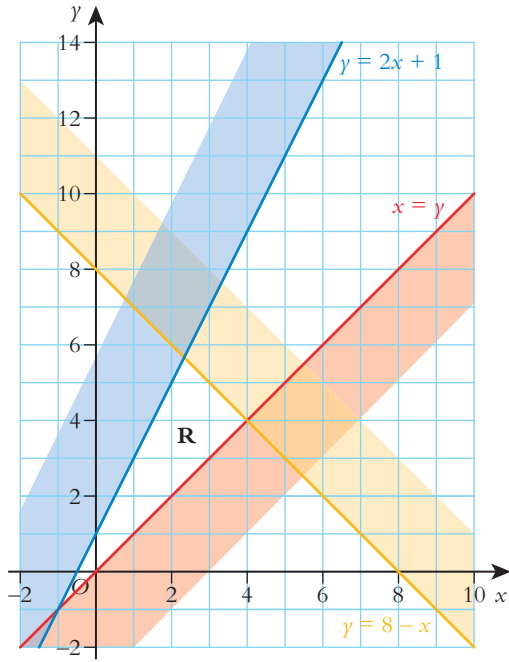
- 8 a



- 9



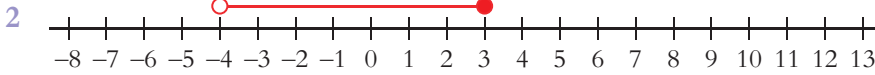
10



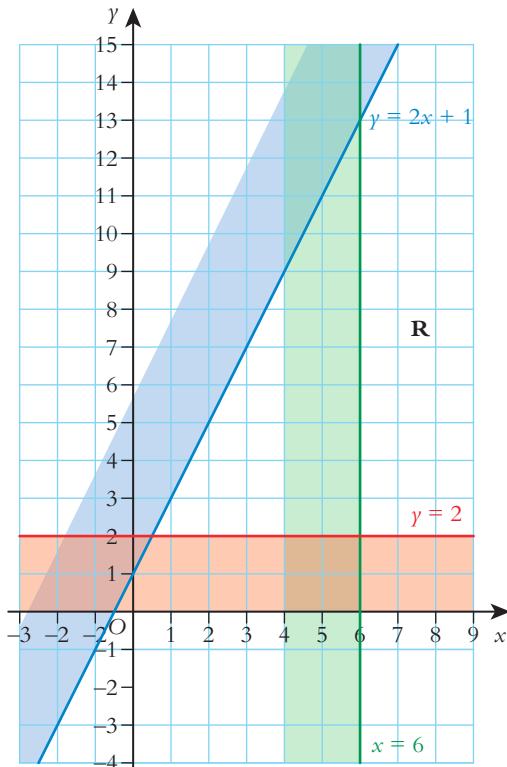
- 11  $y \geq 0, x < 3, y \geq -x$  and  $y \leq \frac{1}{3}x + 4$
- 12 (4, 4), maximum 8
- 13 (4, 2), minimum 10

**Examination questions (page 325)**

1 5, 6, 7, 8



3 a b



## 31 Angles in circles

### Exercise 31.1 (page 327)

- 5 **b**  $\text{OMP} = 90^\circ$   
6 **e** angle  $\text{POQ} = 2 \times$   
angle  $\text{PRQ}$   
7 **e** all equal  
8 **d** both angles  $90^\circ$   
9 **c** **ii**  $180^\circ$   
**d** **ii**  $180^\circ$   
10 **d**  $90^\circ$   
11 **e** both equal

### Exercise 31.2 (page 329)

- 1  $28^\circ$   
2  $162^\circ$   
3  $c = 18^\circ, d = 70^\circ, e = 70^\circ$   
4  $f = 55^\circ, g = 45^\circ, h = 45^\circ$   
5  $i = 96^\circ, j = 264^\circ, k = 132^\circ$   
6  $l = 58^\circ, m = 39^\circ, n = 83^\circ$

### Exercise 31.3 (page 331)

- 1  $a = 116^\circ, b = 65^\circ$   
2  $c = 127^\circ, d = 106^\circ$   
3  $e = 48^\circ, f = 118^\circ$   
4  $g = 65^\circ, h = 65^\circ, i = 115^\circ$   
5  $j = 46^\circ, k = 92^\circ$   
6  $l = 29^\circ, m = 151^\circ$

### Exercise 31.4 (page 332)

- 1  $a = 36^\circ, b = 108^\circ, c = 54^\circ$   
2  $d = 46^\circ, e = 67^\circ, f = 23^\circ$   
3  $g = 26^\circ, h = 52^\circ, i = 26^\circ$   
4  $j = 122^\circ, k = 61^\circ$   
5  $l = 74^\circ, m = 106^\circ$   
6  $n = 108^\circ, p = 36^\circ, q = 54^\circ,$   
 $r = 54^\circ$

### Exercise 31.5 (page 333)

- 1  $a = 74^\circ$   
2  $b = 35^\circ$   
3  $c = 38^\circ, d = 38^\circ$   
4  $e = 52^\circ, f = 26^\circ$   
5  $g = 77^\circ, h = 154^\circ$   
6  $i = 46^\circ, j = 29^\circ, k = 105^\circ$

### Exercise 31.6 (page 334)

- 1 **a**  $46^\circ$   
**b**  $23^\circ$   
**c**  $23^\circ$   
**d**  $67^\circ$   
2 **a**  $\text{AED} = 24^\circ$   
**b**  $\text{CAD} = 66^\circ$   
**c**  $\text{DAB} = 24^\circ$   
**d**  $\text{ABC} = 42^\circ$   
**e**  $\text{ADB} = 114^\circ$   
3 **a**  $\text{DCA} = 28^\circ$   
**b**  $\text{CAD} = 76^\circ$   
**c**  $\text{DAB} = 14^\circ$   
**d**  $\text{ADB} = 104^\circ$   
**e**  $\text{ABD} = 62^\circ$   
4 **a**  $\text{CAD} = 73^\circ$   
**b**  $\text{ACD} = 34^\circ$   
**c**  $\text{AED} = 17^\circ$   
**d**  $\text{DAB} = 17^\circ$   
**e**  $\text{DBA} = 56^\circ$   
5 **a**  $\text{CAD} = 69^\circ$   
**b**  $\text{ACD} = 42^\circ$   
**c**  $\text{AED} = 21^\circ$   
**d**  $\text{ADB} = 111^\circ$   
**e**  $\text{ABD} = 48^\circ$   
6 **a**  $\text{ACB} = 142^\circ$   
**b**  $\text{CAB} = 19^\circ$   
**c**  $\text{BAT} = 71^\circ$   
**d**  $\text{ATB} = 38^\circ$   
**e**  $\text{CBD} = 35.5^\circ$   
7 **a**  $\text{ADB} = 58^\circ$   
**b**  $\text{CAB} = 32^\circ$   
**c**  $\text{BAT} = 58^\circ$   
**d**  $\text{ATB} = 64^\circ$   
**e**  $\text{CBD} = 29^\circ$

- 8 **a**  $\text{BDE} = 126^\circ$   
**b**  $\text{ECB} = 108^\circ$   
**c**  $\text{CEB} = 36^\circ$   
9 **a**  $\text{EAB} = 48^\circ$   
**b**  $\text{ECB} = 96^\circ$   
**c**  $\text{CEB} = 42^\circ$   
10 **a**  $\text{ADB} = 24^\circ$   
**b**  $\text{ACB} = 48^\circ$   
**c**  $\text{CAB} = 66^\circ$   
11 **a**  $\text{TAB} = 32^\circ$   
**b**  $\text{ACB} = 64^\circ$   
**c**  $\text{CAB} = 58^\circ$

### Summary exercise 31 (page 335)

- 2  $a = 312^\circ, b = 24^\circ, c = 48^\circ$   
3  $d = 63^\circ, e = 30^\circ$   
4  $f = 58^\circ, g = 58^\circ, h = 64^\circ$   
5  $i = 106^\circ, j = 74^\circ, k = 106^\circ$   
6  $m = 15^\circ, n = 20^\circ$   
7  $a = 56^\circ, b = 62^\circ, c = 28^\circ$   
8  $f = 122^\circ, g = 61^\circ$   
9  $\text{TRS} + \text{QRS} = 180^\circ$   
 $\text{QPS} + \text{QRS} = 180^\circ$   
 $\therefore \text{TRS} = \text{QPS}$

### Examination questions (page 336)

- 1 Angle  $\text{ROP} = 2x$   
Reflex  $\text{ROP} = 2y$   
 $2x + 2y = 360^\circ$   
 $x + y = 180^\circ$   
2 **a**  $\text{OAB} = 37^\circ$   
**b**  $\text{ATB} = 74^\circ$   
**c**  $\text{CAO} = 31^\circ$

## 32 Polygons

### Exercise 32.1 (page 338)

- 1  $a = 26^\circ, b = 71^\circ, c = 79^\circ,$   
 $d = 96^\circ, e = 88^\circ, f = 92^\circ$

- 2  $a = 122^\circ, b = 119^\circ,$   
 $c = 123^\circ, d = 121^\circ,$   
 $e = 117^\circ, f = 118^\circ, g = 62^\circ$
- 3  $a = 66^\circ, b = 117^\circ,$   
 $c = 55^\circ, d = 122^\circ, e = 86^\circ,$   
 $f = 148^\circ, g = 32^\circ$
- 4  $a = 38^\circ, b = 139^\circ,$   
 $c = 48^\circ, d = 132^\circ, e = 33^\circ,$   
 $f = 137^\circ, g = 41^\circ, h = 68^\circ,$   
 $i = 112^\circ$

### Exercise 32.2 (page 339)

- 1 a pentagon  
 b octagon  
 c nonagon
- 2  $120^\circ$
- 3  $135^\circ$
- 4  $162^\circ$
- 5  $165^\circ$
- 6 5 sides
- 7 10 sides
- 8  $360 \div 14$  is not a whole number
- 9 8 sides
- 10 The sum of the angles =  $90 + 120 + 135 = 345^\circ$  and not  $360^\circ$

### Exercise 32.3 (page 341)

- 1  $900^\circ$
- 2  $3060^\circ$
- 3 13 sides
- 4 38 sides
- 5  $82^\circ$
- 6  $111^\circ$
- 7  $23^\circ$
- 8  $126^\circ$
- 9  $54^\circ, 108^\circ, 108^\circ, 108^\circ, 162^\circ$
- 10  $30^\circ$

### Exercise 32.4 (page 341)

- 1 a  $\text{POQ} = 72^\circ$   
 b  $\text{OPQ} = 54^\circ$   
 c  $\text{QRS} = 108^\circ$
- 2 a  $\text{FOE} = 60^\circ$   
 b  $\text{FEO} = 60^\circ$   
 c equilateral  
 d  $\text{CBA} = 120^\circ$
- 3 12 sides
- 4 20 sides
- 5  $24^\circ$
- 6  $14.4^\circ$
- 7 a  $\frac{360}{n}$   
 b  $\frac{360}{n}$   
 c  $180 - \frac{360}{n}$
- 8 a  $180 - x$   
 b  $x$

### Summary exercise 32 (page 342)

- 1  $a = 74^\circ, b = 107^\circ, c = 113^\circ,$   
 $d = 70^\circ, e = 104^\circ, f = 76^\circ$
- 2  $a = 57^\circ, b = 126^\circ,$   
 $c = 119^\circ, d = 116^\circ,$   
 $e = 62^\circ, f = 118^\circ, g = 62^\circ$
- 3 a hexagon  
 b heptagon  
 c decagon
- 4  $108^\circ$
- 5  $140^\circ$
- 6  $156^\circ$
- 7 8 sides
- 8 36 sides
- 9 20 sides
- 10  $360 \div 50$  is not a whole number
- 11 12 sides

- 12  $2700^\circ$
- 13  $3240^\circ$
- 14 27 sides
- 15 43 sides
- 16  $103^\circ$
- 17  $32^\circ$
- 18 a  $54^\circ$   
 b  $243^\circ$
- 19  $x = 59^\circ$ ; angles are  $75^\circ,$   
 $35^\circ, 133^\circ, 108^\circ, 189^\circ$
- 20 a  $\text{AOD} = 144^\circ$   
 b  $\text{FCO} = 126^\circ$
- 21 16 sides
- 22  $7.2^\circ$

### Examination questions (page 343)

- 1 a  $360 \div 40 = 9$  sides
- 2 a  $108^\circ$   
 b 10

## 33 Pythagoras and trigonometry

### Exercise 33.1 (page 345)

- 1  $r^2 = p^2 + q^2$   
 $p^2 = r^2 - q^2$   
 $q^2 = r^2 - p^2$
- 2  $y^2 = x^2 + z^2$   
 $x^2 = y^2 - z^2$   
 $z^2 = y^2 - x^2$
- 3  $m^2 = l^2 + n^2$   
 $l^2 = m^2 - n^2$   
 $n^2 = m^2 - l^2$

### Exercise 33.2 (page 346)

- 1 2.5 cm
- 2 41 cm
- 3 19.5 cm



- 4 8.60 cm
- 5 8.54 cm
- 6 13.6 cm

### Exercise 33.3 (page 347)

- 1 15 cm
- 2 5.60 cm
- 3 10 cm
- 4 16.0 cm
- 5 2.95 cm
- 6 14.4 cm

### Exercise 33.4 (page 348)

- 1 7.75 cm
- 2 31.2 km
- 3 0.0862 m
- 4 9.85 cm
- 5 2.83 cm
- 6 5.59 cm

### Exercise 33.5 (page 349)

- 1  $\tan x = \frac{5}{4}$
- 2  $\cos x = \frac{2}{5}$
- 3  $\tan x = \frac{4}{7}$
- 4  $\cos x = \frac{7}{10}$
- 5  $\tan x = \frac{2}{5}$
- 6  $\sin x = \frac{4}{9}$

### Exercise 33.6 (page 351)

- 1 4.50 cm
- 2 9.10 cm
- 3 19.3 cm
- 4 13.9 cm
- 5 3.24 cm
- 6 2.80 cm

### Exercise 33.7 (page 352)

- 1 4.45 cm
- 2 29.2 cm
- 3 2.44 cm
- 4 19.9 cm
- 5 4.92 cm
- 6 2.89 cm

### Exercise 33.8 (page 353)

- 1 63.4°
- 2 16.6°
- 3 36.9°
- 4 26.4°
- 5 29.7°
- 6 68.0°
- 7 2.38 cm
- 8 3.99 cm
- 9 74.1°
- 10 3.17 cm
- 11 10.9 cm
- 12 36.9°
- 13 2.29 cm
- 14 6.49 cm
- 15 19.5°
- 16 4.88 cm

### Exercise 33.9 (page 356)

- 1 a 14 km  
b 126°
- 2 a 4.1 cm  
b 8.8 cm
- 3 a 8.90 cm  
b 13.8 cm
- 4 a 1200 m  
b 1500 m
- 5 a 120 m  
b 165 m

- 6 a 39°  
b 11 m

### Exercise 33.10 (page 358)

- 1 a 5.97 cm  
b 6.26 cm  
c 17.7°
- 2 a 25 cm  
b 23.7 cm  
c 69.2 cm
- 3 a 52.5°  
b 3.65 cm  
c 1.33 cm
- 4 a 10.6 cm  
b 21.2 cm  
c 40.3°  
d 13.5 cm
- 5 a 42.6 cm  
b 77.2 cm  
c 75.7 cm
- 6 a 19.8 cm  
b 37.9 cm  
c 31.8 cm
- 7 a 34.7 cm  
b 38.9°  
c 44.6 cm
- 8 a 15.8 cm  
b 22.9 cm  
c 20.9 cm

### Summary exercise 33 (page 359)

- 1 4 cm
- 2 76.8 cm
- 3 160 km
- 4 0.94 m
- 5 7.30 cm
- 6 68.7°
- 7 a 68.0 cm  
b 129 cm
- 8 a 4.29 km west from B  
b 3.60 km north from B

- 9 a 34.4 cm  
 b 32.4 cm  
 c 53.8 cm
- 10 a 17.2 cm  
 b 31.4 cm  
 c 27.6 cm

### Examination questions (page 360)

- 1 area =  $\frac{1}{2} \times$  (unknown side)  $\times 7.5$   
 unknown side =  
 $\sqrt{(8.5^2 - 7.5^2)} = \sqrt{16} = 4$  m  
 area =  $\frac{1}{2} \times 4 \times 7.5 = 15$  m<sup>2</sup>
- 2 a i  $AC = \sqrt{(4^2 - 1.2^2)}$   
 $= \sqrt{14.56}$   
 $= 3.8$  metres  
 ii  $\sin x^\circ = 0.3$   
 $x = 17.5$
- b height =  $4 \cos 65^\circ$   
 $= 1.69 \dots \rightarrow$   
 1.7 metres
- 3  $OB = \frac{1}{2} \sqrt{(9.6^2 \times 2)}$   
 $= 6.8$  (6.788...) cm  
 angle HBO  
 $= \tan^{-1}(14.5/6.788\dots)$   
 $= 65^\circ$  (64.91...)

## 34 Similarity

### Exercise 34.1 (page 362)

- 1 corresponding angles are equal, ratios of sides = 1.4
- 2 corresponding angles are equal, ratios of sides = 1.5
- 3 corresponding angles are equal, ratios of sides = 1.2
- 4 corresponding angles are equal, ratios of sides =  $\frac{5}{3}$
- 5 corresponding angles are equal, ratios of sides = 2.5

- 6 corresponding angles are equal, ratios of sides = 1.4
- 7 corresponding angles are equal, ratios of sides = 0.8
- 8 same shape – all radii the same so all corresponding measurements are in the same ratio
- 9 a corresponding angles are equal and all sides are equal in length  
 b the ratio of the corresponding sides can be different, e.g. a 7 by 5 rectangle is not similar to a 6 by 9 rectangle

### Exercise 34.2 (page 364)

- 1  $x = 12$  cm,  $y = 3.5$  cm
- 2  $x = 6.8$  cm,  $y = 5.2$  cm
- 3  $x = 1.38$  cm,  $y = 7.4$  cm
- 4  $x = 21.6$  cm,  $y = 8.5$  cm
- 5  $x = 7.2$  cm,  $y = 6.2$  cm
- 6  $x = 13$  cm,  $y = 1.1$  cm

### Exercise 34.3 (page 366)

- 1 corresponding angles A and D, B and F, E and C
- 2  $\frac{PQ}{XY} = \frac{PR}{XZ} = \frac{QR}{YZ} = 1.25$
- 3 corresponding angles C and J, B and K, D and H
- 4  $\frac{UW}{MN} = \frac{VW}{LN} = \frac{VU}{LM} = 1.15$
- 5 corresponding angles ACB and DCE, BAC and DEC, ABC and CDE
- 6  $\frac{YZ}{AC} = \frac{XZ}{AC} = \frac{XY}{AB} = 0.7$

### Exercise 34.4 (page 367)

- 1 P = P (common angles), T = R (corresponding angles), S = Q (corresponding angles)
- 2 P = Y (alternate angles), Q = X (alternate angles), POQ = YOX (vertically opposite angles)
- 3 AOD = BOC (vertically opposite angles), DAO = OCB (alternate angles), ADO = OBC (alternate angles)
- 4 COD = FOE (vertically opposite angles), C = F (alternate angles), D = E (alternate angles)

- 5 ratios all 1.25
- 6 ratios all 2.125

### Exercise 34.5 (page 369)

- 1 a 2.8 cm  
 b 4 cm
- 2 a 19 cm  
 b 16.5 cm
- 3 a 12 cm  
 b 1.68 cm
- 4 a 10 cm  
 b 2.88 cm
- 5 a 9.6 cm  
 b 7.2 cm
- 6 a 7 cm  
 b 3.2 cm
- 7 a corresponding angles A and E, B and F, C and D  
 b i AC = 4.8 cm  
 ii DF = 7.84 cm
- 8 a corresponding angles G and L, H and J, I and K

- b i GI = 5.8 cm  
ii JL = 5.46 cm

### Exercise 34.6 (page 371)

- 1 a 2:5  
b 8:125
- 2 a 3:7  
b 27:343
- 3 a 2:3  
b 4:9
- 4 a 3:8  
b 27:512
- 5 a 3:2  
b 27:8
- 6 a  $130.5 \text{ cm}^2$   
b  $76 \text{ cm}^3$
- 7 a 13.6 cm  
b  $445.5 \text{ cm}^2$
- 8 a 19 cm  
b  $1120 \text{ cm}^3$
- 9 a  $86.4 \text{ cm}^2$   
b  $4000 \text{ cm}^3$
- 10 a 7.4 cm  
b  $202.5 \text{ cm}^2$

### Summary exercise 34 (page 372)

- 1 triangles have three equal angles; ratio of sides = 1.2
- 2  $x = 15.36 \text{ cm}$ ,  $y = 14 \text{ cm}$
- 3 corresponding angles are equal; ratios of sides are  $\frac{XZ}{RP} = \frac{YZ}{QP} = \frac{XY}{RQ}$
- 4  $\frac{EF}{AB} = \frac{DE}{AC} = \frac{DF}{BC} = 0.9$ ; corresponding angles are A and E, B and F, C and D
- 5  $\frac{LM}{QP} = \frac{LN}{QN} = \frac{MN}{PN}$

- 6 a triangles have three equal angles  
b i 9.4 cm  
ii 11.18 cm
- 7 a triangles have three equal angles  
b i 1.96 cm  
ii 4.2 cm
- 8 a  $1504 \text{ cm}^2$   
b  $7020 \text{ cm}^3$
- 9 a 1.52 cm  
b  $48234.375 \text{ cm}^3$
- 10 a 6:7  
b 36:49

### Examination questions (page 373)

- 1  $\frac{AX}{8.5} = \frac{6}{10}$   
 $AX = 6 \times 8.5 \div 10$   
 $AX = 5.1 \text{ cm}$

## Chapter 35 Trig rules

### Exercise 35.1 (page 375)

- 1 14.3 cm  
2 6.64 cm  
3 4.77 cm  
4 3.56 cm  
5 7.16 cm  
6 3.64 cm

### Exercise 35.2 (page 376)

- 1 43.4°  
2 49.2°  
3 73.6°  
4 45.8°  
5 94.2°  
6 50.7°

### Exercise 35.3 (page 378)

- 1 6.38 cm  
2 5.65 cm  
3 5.04 cm  
4 10.2 cm  
5 7.56 cm  
6 4.26 cm

### Exercise 35.4 (page 379)

- 1 58.8°  
2 116.2°  
3 60.1°  
4 87.7°  
5 60.7°  
6 73.7°

### Exercise 35.5 (page 381)

- 1  $5.47 \text{ cm}^2$   
2  $89.4 \text{ cm}^2$   
3  $23.9 \text{ cm}^2$   
4  $16.6 \text{ cm}^2$   
5  $14.0 \text{ cm}^2$   
6  $31.5 \text{ cm}^2$   
7 8 cm  
8 4.76 cm  
9 56.4°  
10 19.5°

### Exercise 35.6 (page 381)

- 1 a 3.49 cm  
b  $14.3 \text{ cm}^2$
- 2 a 86°  
b 8.33 cm  
c  $18.5 \text{ cm}^2$

- 3 a  $74.3^\circ$   
b  $45 \text{ cm}^2$
- 4 a  $10.8 \text{ km}$   
b  $171.2^\circ$
- 5  $12.8 \text{ m}$
- 6 a  $7.26 \text{ cm}$   
b  $51.8 \text{ cm}^2$
- 7 a  $19.66 \text{ cm}$   
b  $22.6 \text{ cm}^2$

### Summary exercise 35 (page 382)

- 1  $7.92 \text{ cm}$
- 2  $44.2 \text{ cm}$
- 3  $98.6^\circ$
- 4  $38.3^\circ$
- 5  $27.2 \text{ cm}^2$
- 6  $50^\circ$
- 7  $19.5^\circ$
- 8 a  $7.52 \text{ km}$   
b  $188.3^\circ$
- 9  $10.1 \text{ m}$
- 10 a  $3.09 \text{ cm}$   
b  $2.49 \text{ cm}^2$

### Examination questions (page 383)

- 1 a  $\frac{140}{\sin 23^\circ} = \frac{LT}{\sin 126^\circ}$   
LT =  $289.87 \rightarrow$   
 $290 \text{ metres}$
- b  $\sin 31^\circ = \frac{TB}{290} \text{ m or}$   
 $\cos 59^\circ = \frac{TB}{290} \text{ m}$   
TB =  $149 \text{ m}$
- 2  $\frac{BD}{\sin 53^\circ} = \frac{9.5}{\sin 72^\circ}$   
BD =  $7.977 \dots \text{ cm}$

$$4.9^2 = 6.8^2 + 7.977^2 - 2 \times 6.8 \times 7.977 \times \cos \text{DBC}$$

$$\cos \text{DBC} = \frac{6.8^2 + 7.977^2 - 4.9^2}{2}$$

$$\times 6.8 \times 7.977$$

$$= 37.676 \dots \rightarrow 37.7^\circ$$

## Chapter 36 Perimeter, area and volume 1

### Exercise 36.1 (page 386)

- 1 a  $64 \text{ cm}$   
b  $76 \text{ cm}^2$
- 2 a  $40 \text{ cm}$   
b  $76 \text{ cm}^2$
- 3 a  $100 \text{ cm}$   
b  $216 \text{ cm}^2$
- 4 a  $86 \text{ cm}$   
b  $174 \text{ cm}^2$
- 5 a  $95 \text{ cm}$   
b  $264 \text{ cm}^2$
- 6 a  $76 \text{ cm}$   
b  $180 \text{ cm}^2$

### Exercise 36.2 (page 387)

- 1 a  $20\pi$   
b  $12\pi$   
c  $5.6\pi$   
d  $52\pi$   
e  $5\frac{3}{5}\pi$   
f  $18\pi$
- 2 a  $15 \text{ cm}$   
b  $28 \text{ cm}$   
c  $6.8 \text{ cm}$   
d  $3\frac{2}{3} \text{ cm}$
- 3 a  $18 \text{ cm}$   
b  $4.5 \text{ cm}$   
c  $4.2 \text{ cm}$   
d  $1\frac{3}{8} \text{ cm}$

### Exercise 36.3 (page 388)

- 1 a  $56.5 \text{ cm}$   
b  $107 \text{ cm}$   
c  $19.5 \text{ cm}$   
d  $9.8 \text{ cm}$   
e  $15.7 \text{ cm}$   
f  $34.6 \text{ cm}$   
g  $17.2 \text{ cm}$   
h  $157 \text{ cm}$   
i  $352 \text{ cm}$
- 2 a  $10.8 \text{ cm}$   
b  $3.06 \text{ cm}$   
c  $8.91 \text{ cm}$   
d  $15.9 \text{ cm}$   
e  $52.8 \text{ cm}$
- 3 a  $7.63 \text{ cm}$   
b  $0.40 \text{ cm}$   
c  $1.34 \text{ cm}$   
d  $5.57 \text{ cm}$   
e  $14.3 \text{ cm}$

### Exercise 36.4 (page 389)

- 1  $11.8 \text{ cm}$
- 2  $165 \text{ cm}$
- 3  $29.8 \text{ cm}$
- 4  $231 \text{ cm}$
- 5  $2.86 \text{ cm}$
- 6  $28.6 \text{ cm}$
- 7  $33.6 \text{ cm}$
- 8  $71.4 \text{ cm}$
- 9 a  $36.9 \text{ cm}$   
b  $33.3 \text{ cm}$   
c  $46.8 \text{ cm}$   
d  $59.4 \text{ cm}$

### Exercise 36.5 (page 391)

- 1  $129 \text{ cm}^2$
- 2  $150 \text{ cm}^2$
- 3  $23.1 \text{ cm}^2$

- 4 3.91 cm  
 5 1.38 cm  
 6 26.2 cm  
 7 a 1.69 cm  
   b 10.6 cm  
 8 a 14.9 cm  
   b 93.8 cm  
 9 0.716 cm<sup>2</sup>  
 10 682 cm<sup>2</sup>

### Exercise 36.6 (page 392)

- 1 190 cm<sup>2</sup>  
 2 6.28 cm<sup>2</sup>  
 3 2150 cm<sup>2</sup>  
 4 37.7 cm<sup>2</sup>  
 5 573 cm<sup>2</sup>  
 6 6360 cm<sup>2</sup>  
 7 22.9 cm<sup>2</sup>  
 8 1020 cm<sup>2</sup>  
 9 a 30.5 cm<sup>2</sup>  
   b 54.9 cm<sup>2</sup>  
   c 64.6 cm<sup>2</sup>  
   d 196 cm<sup>2</sup>

### Exercise 36.7 (page 393)

- 1 a 36 cm<sup>2</sup>  
   b 39.48 cm<sup>2</sup>  
   c 384 cm<sup>2</sup>  
   d 499.2 cm<sup>2</sup>  
 2 a 34.72 cm<sup>2</sup>  
   b 38.27 cm<sup>2</sup>  
   c 975 cm<sup>2</sup>  
   d 52.185 cm<sup>2</sup>  
 3 4.5 cm  
 4 13.6 cm  
 5 9.5 cm  
 6 3.36 cm

### Exercise 36.8 (page 395)

- 1 a 232 cm<sup>2</sup>  
   b 224 cm<sup>3</sup>  
 2 a 758 cm<sup>2</sup>  
   b 1386 cm<sup>3</sup>  
 3 a 162.78 cm<sup>2</sup>  
   b 133.38 cm<sup>3</sup>  
 4 a 4.7 cm  
   b 124.6 cm<sup>2</sup>  
 5 a 6.4 cm  
   b 390.4 cm<sup>2</sup>  
 6 a 14 cm  
   b 1288 cm<sup>2</sup>  
 7 a 4.2 cm  
   b 71.82 cm<sup>3</sup>  
 8 a 21 cm  
   b 11 760 cm<sup>3</sup>  
 9 a 5 cm  
   b 750 cm<sup>3</sup>  
 10  $a = 72x^2$  and  $V = 36x^3$  so

$$A = \frac{2V}{x}$$

### Exercise 36.9 (page 396)

- 1 19 800 cm<sup>3</sup>  
 2 294 cm<sup>3</sup>  
 3 18.2 cm  
 4 13 cm<sup>2</sup>  
 5 9.6 cm  
 6 88 cm<sup>2</sup>  
 7 a 1890 cm<sup>3</sup>  
   b 1368 cm<sup>2</sup>  
 8 a 3800 cm<sup>3</sup>  
   b 1779 cm<sup>2</sup>  
 9 a 7200 cm<sup>3</sup>  
   b 3840 cm<sup>2</sup>  
 10 a 23 040 cm<sup>3</sup>  
   b 5840 cm<sup>2</sup>

### Exercise 36.10 (page 398)

- 1 a 90 500 cm<sup>3</sup>  
   b 7540 cm<sup>2</sup>  
   c 9350 cm<sup>2</sup>  
 2 a 4630 cm<sup>3</sup>  
   b 965 cm<sup>2</sup>  
   c 1540 cm<sup>2</sup>  
 3 a 693 cm<sup>3</sup>  
   b 330 cm<sup>2</sup>  
 4 2800 cm<sup>3</sup>  
 5 92 800 cm<sup>3</sup>  
 6 1200 cm<sup>3</sup>  
 7 82.4 cm<sup>2</sup>  
 8 a 792 cm<sup>3</sup>  
   b 892 cm<sup>2</sup>  
 9 a 302 cm<sup>3</sup>  
   b 506 cm<sup>2</sup>  
 10 a 28 cm  
   b 36 cm

### Summary exercise 36 (page 399)

- 1 a 55.9 cm  
   b 249 cm<sup>2</sup>  
 2 336 cm<sup>2</sup>  
 3 a 6.94 cm  
   b 2.86 cm<sup>2</sup>  
 4 198 cm<sup>2</sup>  
 5 33.36 cm<sup>2</sup>  
 6 a 39.36 cm<sup>2</sup>  
   b 15.12 cm<sup>3</sup>  
 7 a 2880 cm<sup>2</sup>  
   b 5376 cm<sup>3</sup>  
 8 a 2930 cm<sup>3</sup>  
   b 697 cm<sup>2</sup>  
   c 919 cm<sup>2</sup>  
 9 993 cm<sup>3</sup>

- 10 a 6.76 cm  
b 8.81 cm

### Examination questions (page 400)

- 1 a  $\frac{1}{2}(0.8 + 2.4)(1.2)$   
= 1.92 m<sup>2</sup>  
b  $1.92 \times 4 = 7.68 \text{ m}^3$
- 2 a  $\pi(2.5)^2 = 19.634\dots$   
appropriate degree of  
accuracy 19.6 or 20 m<sup>2</sup>  
b  $\pi(4)^2 - 19.634\dots$   
= 50.2 - 19.6...  
= 30.6 or 50 - 20  
= 30 m<sup>2</sup>
- 3  $\pi dh = \pi(8 \times 13) = 352$   
(351.858...) cm<sup>2</sup>
- 4 a  $\pi \times 1.8^2 = 10.18$   
(10.1828) m<sup>2</sup>  
b  $10.18 \times 0.45 = 4.58$   
(4.582...) m<sup>3</sup>

## 37 Perimeter, area and volume 2

### Exercise 37.1 (page 404)

- 1 a 226 cm<sup>2</sup>  
b 290 cm<sup>2</sup>  
c 326 cm<sup>3</sup>
- 2 a 234 cm<sup>2</sup>  
b 326 cm<sup>2</sup>  
c 388 cm<sup>3</sup>
- 3 a 96 cm<sup>2</sup>  
b 134 cm<sup>2</sup>  
c 103 cm<sup>3</sup>
- 4 a 416 cm<sup>2</sup>  
b 612 cm<sup>2</sup>  
c 967 cm<sup>3</sup>
- 5 a 70.9 cm<sup>2</sup>  
b 91.6 cm<sup>2</sup>  
c 58.1 cm<sup>3</sup>
- 6 a 1630 cm<sup>2</sup>  
b 2710 cm<sup>2</sup>  
c 7530 cm<sup>3</sup>

### Exercise 37.2 (page 405)

- 1 3310 cm<sup>3</sup>  
2 251 cm<sup>2</sup>  
3 109 cm<sup>3</sup>  
4 1960 cm<sup>2</sup>  
5 44.8 cm<sup>2</sup>  
6 86.9 cm<sup>3</sup>  
7  $A = 4\pi r^2$  and  $V = \frac{2\sqrt{2}\pi r^3}{3}$   
So  $\frac{V}{A} = \frac{2\sqrt{2}\pi r^3}{3} \div 4\pi r^2$   
=  $\frac{\sqrt{2}r}{6}$

### Exercise 37.3 (page 408)

- 1 545 cm<sup>3</sup>  
2 240 cm<sup>3</sup>  
3 462 cm<sup>3</sup>  
4 139.5 cm<sup>3</sup>  
5 484.5 cm<sup>3</sup>  
6 10.6 cm<sup>3</sup>  
7 252 cm<sup>3</sup>  
8 1054 cm<sup>3</sup>  
9 1332 cm<sup>3</sup>  
10 1947 cm<sup>3</sup>

### Exercise 37.4 (page 409)

- 1 a 3630 cm<sup>2</sup>  
b 20 600 cm<sup>3</sup>
- 2 a 266 cm<sup>2</sup>  
b 408 cm<sup>3</sup>
- 3 a 5540 cm<sup>2</sup>  
b 38 800 cm<sup>3</sup>
- 4 a 33 900 cm<sup>2</sup>  
b 452 000 cm<sup>3</sup>
- 5 a 339 cm<sup>2</sup>  
b 452 cm<sup>3</sup>
- 6 72.8 cm<sup>3</sup>

- 7 70 cm<sup>2</sup>  
8 40.3 cm<sup>2</sup>  
9 205 cm<sup>3</sup>  
10 85.4 cm<sup>2</sup>

### Exercise 37.5 (page 410)

- 1 a 207 cm<sup>3</sup>  
b 210 cm<sup>2</sup>
- 2 a 23.2 cm<sup>3</sup>  
b 59.3 cm<sup>2</sup>
- 3 45 spheres
- 4 148 cm<sup>3</sup>
- 5 a 50.3 cm<sup>3</sup>  
b 68.6 cm<sup>2</sup>
- 6 87 cm<sup>3</sup>
- 7 1810 cm<sup>3</sup>

### Exercise 37.6 (page 412)

- 1 a 10.1 cm  
b 45.2 cm<sup>2</sup>
- 2 a 15.7 cm  
b 56.5 cm<sup>2</sup>
- 3 a 3.13 cm  
b 10 cm<sup>2</sup>
- 4 a 57.2 cm  
b 572 cm<sup>2</sup>
- 5 a 31.8 cm  
b 556 cm<sup>2</sup>
- 6 a 17.1 cm  
b 120 cm<sup>2</sup>

### Exercise 37.7 (page 413)

- 1 a 49.1°  
b 10.3 cm<sup>2</sup>
- 2 a 6.42 cm  
b 8.40 cm
- 3 a 8.56 cm  
b 55.6 cm<sup>2</sup>
- 4 a 20.1°  
b 25.3 cm<sup>2</sup>

- 5 a  $75.5^\circ$   
b 8.43 cm
- 6  $240 \text{ cm}^2$
- 7 4.72 cm
- 8  $9.21 \text{ cm}^2$
- 9 16.5 cm
- 10  $\frac{\pi x t}{180} : \frac{\pi x t^2}{360} = 2 : t$

### Exercise 37.8 (page 415)

- 1 9.97 cm,  $1.30 \text{ cm}^2$
- 2 7.43 cm,  $0.958 \text{ cm}^2$
- 3 8.35 cm,  $0.607 \text{ cm}^2$
- 4 7.01 cm,  $1.47 \text{ cm}^2$
- 5 0.778 cm,  $14.1 \text{ cm}^2$
- 6 0.0894 cm,  $2.66 \text{ cm}^2$

### Exercise 37.9 (page 416)

- 1 length
- 2 area
- 3 area
- 4 volume
- 5 area
- 6 length
- 7 volume
- 8 area
- 9 volume
- 10 volume

### Exercise 37.10 (page 418)

- 1 length
- 2 area
- 3 volume
- 4 volume
- 5 none of these

- 6 length
- 7 area
- 8 none of these
- 9 area
- 10 none of these
- 11 length
- 12 none of these
- 13 volume
- 14 area

### Summary exercise 37 (page 418)

- 1 a 70 cm  
b  $91.1 \text{ cm}^2$   
c  $57.6 \text{ cm}^3$
- 2  $65.9 \text{ cm}^2$
- 3 a  $302 \text{ cm}^2$   
b  $493 \text{ cm}^3$
- 4  $63.5 \text{ cm}^3$
- 5 a  $62.9 \text{ cm}^3$   
b  $80.1 \text{ cm}^2$
- 6 217
- 7 a 2.5 cm  
b  $3.46 \text{ cm}^2$
- 8 a  $34.6^\circ$   
b 7.85 cm
- 9 5.59 cm,  $0.352 \text{ cm}^2$
- 10 in order: length, volume, none of these, length, none of these, volume, area

### Examination questions (page 420)

- 1 volume of cone =  $\left(\frac{1}{3}\right)\pi \times 6^2 \times 8 = 301.59... \text{ cm}^3$   
volume of hemisphere =  $\left(\frac{2}{3}\right)\pi \times 6^3 = 452.38... \text{ cm}^3$

volume of toy = 754  
(753.98...)  $\text{cm}^3$

- 2 a  $\frac{106}{360} \times \pi \times 1.5^2 = 2.08$   
(2.081...)  $\text{m}^2$   
b Area of triangle =  $\frac{1}{2} (1.5^2) \sin 106^\circ = 1.08 \text{ m}^2$   
Area of mahogany =  $2.08 - 1.08 = 1.0 \text{ m}^2$
- 3 a  $\frac{8}{16} = \frac{DE}{7}$   
DE = 3.5 cm  
b  $\left(\frac{1}{3}\pi \times 8^2 \times 16\right) - \left(\frac{1}{3}\pi \times 3.5^2 \times 7\right) = 1072.33... - 89.797... = 983 (982.533...) \text{ cm}^3$
- 4 volume, length, area

## 38 Constructions, loci, plans and elevations

### Exercise 38.1 (page 423)

All other answers are constructions.

- 9 b i 72.4 km  
ii 037

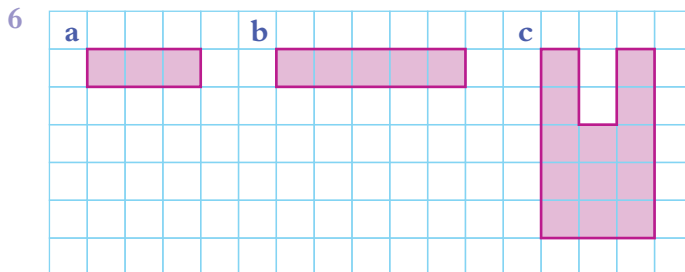
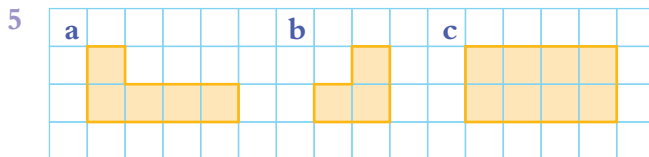
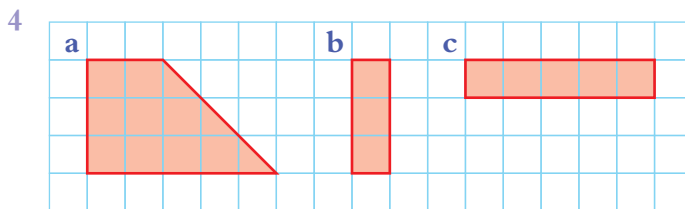
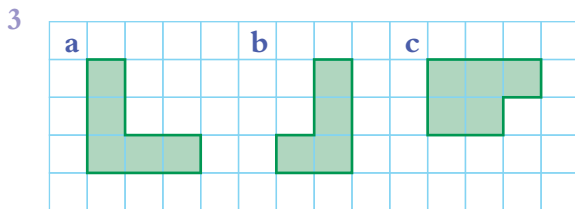
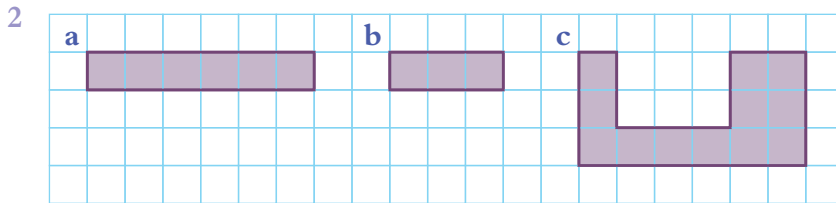
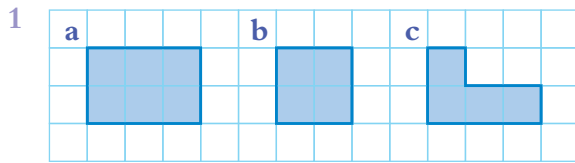
### Exercise 38.2 (page 425)

These are all constructions; no answers supplied.

### Exercise 38.3 (page 427)

These are all constructions; no answers supplied.

### Exercise 38.4 (page 431)

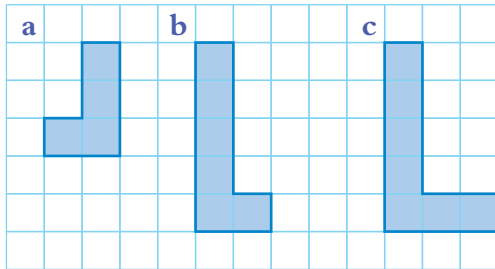


### Summary exercise 38 (page 431)

- 4 b i 20.7 km  
ii  $217^\circ$

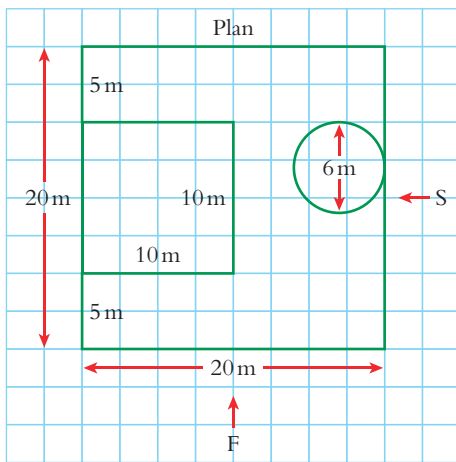


10

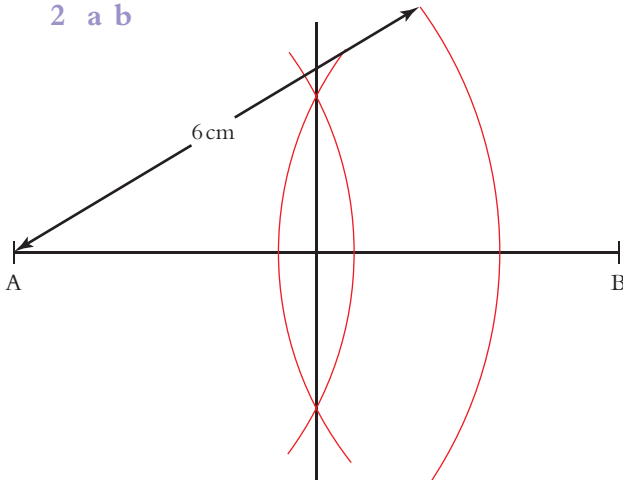


**Examination questions (page 432)**

1



2 a b



**Chapter 39 Compound measures**

**Exercise 39.1 (page 434)**

- 1 301 miles
- 2 47 km/h

- 3 5 hours
- 4 8 hours
- 5 62 km/h
- 6 8 hours
- 7 8 hours
- 8 216 miles
- 9 7 hours
- 10 53 km/h

**Exercise 39.2 (page 436)**

- 1 119 miles
- 2 30 km/h
- 3 4 h 15 min
- 4 210 miles
- 5 3 h 40 min
- 6 7 h 32 min
- 7 65 km/h
- 8 198 miles
- 9 45 km/h
- 10 355 miles

**Exercise 39.3 (page 438)**

- 1 56 mph
- 2 39 miles
- 3 15.25
- 4 152 miles
- 5 55 mph
- 6 10.55
- 7 55 miles
- 8 65 mph
- 9 22.37
- 10 76 miles

**Exercise 39.4 (page 439)**

- 1 38 mph
- 2 26 mph

- 3 23 mph
- 4 48 mph
- 5 42 mph
- 6 40 mph
- 7 12 mph
- 8 15 mph
- 9 36 mph
- 10 42.8 mph

### Exercise 39.5 (page 440)

- 1 18 km/h
- 2 15 m/s
- 3 72 km/h
- 4 4 m/s
- 5 28.8 km/h
- 6 7 m/s
- 7 162 km/h
- 8 60 m/s
- 9 10.8 km/h
- 10 35 m/s

### Exercise 39.6 (page 441)

- 1 5.6 g/cm<sup>3</sup>
- 2 34.2 g
- 3 16 cm<sup>3</sup>
- 4 8.4 g/cm<sup>3</sup>
- 5 181.7 g
- 6 16.5 g/cm<sup>3</sup>
- 7 6 cm
- 8 2704 g
- 9 54 cm<sup>3</sup>
- 10 14 g/cm<sup>3</sup>

### Exercise 39.7 (page 442)

- 1 £1785
- 2 128 people/km<sup>2</sup>

- 3 £27.56/m<sup>2</sup>
- 4 56 250 000 people
- 5 2.5 kg
- 6 147 ml of concentrate
- 7 24.5 people/km<sup>2</sup>
- 8 £9.48 per book
- 9 3.4 m
- 10 180 000 km<sup>2</sup>

### Summary exercise 39 (page 443)

- 1 93 km/h
- 2 3 h 48 min
- 3 425 miles
- 4 02.28
- 5 48 mph
- 6 a 144 km/h  
b 2.5 m/s
- 7 a 105 miles  
b 12.54
- 8 3.2 cm
- 9 180 people/km<sup>2</sup>
- 10 330 000 km<sup>2</sup>

### Examination question (page 443)

- 1 a  $24 \div 2 = 12$  km/h (must include units)  
b Bicycle, with suitable reason given.

## Chapter 40 Bounds

### Exercise 40.1 (page 445)

- 1 47.5 kg, 48.5 kg
- 2 5.25 cm, 5.35 cm
- 3 4.275 ml, 4.285 ml
- 4 35 s, 45 s

- 5 4500 mm, 5500 mm
- 6 57.5 cm<sup>2</sup>, 58.5 cm<sup>2</sup>
- 7 395 ml, 405 ml
- 8 4950 mg, 5050 mg
- 9 58.5 ml, 59.5 ml
- 10 5.9995 km, 6.0005 km

### Exercise 40.2 (page 447)

- 1 a 21.8 cm  
b 30.3125 cm<sup>2</sup>
- 2 5.85 to 5.92 cm
- 3 a 29.8 cm  
b 73.9 cm<sup>2</sup>
- 4 13 125 to 39 375 cm<sup>3</sup>
- 5 50.9 to 56.4 mph
- 6 4.78 to 4.97 g/cm<sup>3</sup>
- 7 4.05 to 5.26 cm
- 8 a 9.32 cm  
b 20.6 cm<sup>2</sup>
- 9 a 6.75 cm  
b 1596 cm<sup>3</sup>
- 10 3.43 to 3.69 cm<sup>2</sup>

### Exercise 40.3 (page 449)

- 1 a i 128  
ii 1.42  
b i 3858.75  
ii 20
- 2 a i 23.681 525  
ii 0.59  
b i 9.73  
ii 1.12
- 3 a i 13.9  
ii 2.33  
b i 39.6325  
ii 3.09  
iii 5.3
- 4 a i 81 250  
ii 15.8  
iii 175

- b**
- i** 65
  - ii** 22500
  - iii** 1.26
  - iv** 0.462
- 5 a**
- i** 8.5
  - ii** 3.5775
  - iii** 1.8225
  - iv** 2.29
  - v** 1.4
  - vi** 6.8
  - vii** 0.243
- b**
- i** 7.1875
  - ii** 3.8
  - iii** 1.60
  - iv** 4.4
  - v** 0.472
  - vi** 10.9
  - vii** 2.30

### Summary exercise 40 (page 450)

- 1 56.5 cm, 57.5 cm; 415 mm, 425 mm; 4950 h, 5050 h; 8.455 m, 8.465 m; 5.75 litres, 5.85 litres; 5.1965 g, 5.1975 g
- 2 **a** 206.25 cm<sup>2</sup>  
**b** 178.25 cm<sup>2</sup>
- 3 **a** 10.5 to 13.5 cm  
**b** 4.375 to 7.875 cm<sup>2</sup>
- 4 5.20 to 6.43 cm
- 5 **a** 161.878 625 cm<sup>3</sup>  
**b** 171.735 cm<sup>2</sup>
- 6 **a** 1.48 h to 1.52 h  
**b** 1 h 28.8 min to 1 h 31.2 min
- 7 67.18625 to 67.79025 g
- 8 6.3640 and 6.6136 cm
- 9 **a** **i** 38.8575  
**ii** 61.6225  
**iii** 3  
**b** **i** 12.6  
**ii** 2.20  
**iii** 1.57

- 10 **a** **i** 7600  
**ii** 8 692 500  
**iii** 8 122 500  
**iv** 1600  
**v** 1.11
- b** **i** 12 237 500  
**ii** 5700  
**iii** 54.3  
**iv** 100  
**v** 0.604

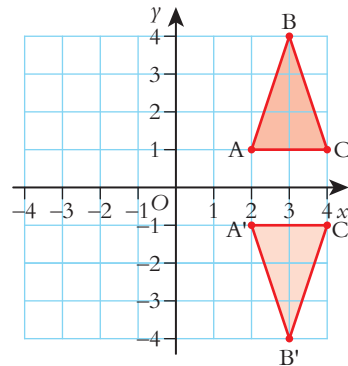
### Examination questions (page 451)

- 1  $12.05 \times 2.05 = 145.2 \text{ cm}^2$
- 2  $d = 23.05 + 25.55 + (18.65 \times 3) = 104.6$
- 3  $\tan^{-1}\left(\frac{79.5}{125}\right)$   
 $= 32.5^\circ$
- 4 least =  $9 \times 6.5 = 58.5 \text{ cm}$   
greatest =  $9 \times 7.5 = 67.5 \text{ cm}$

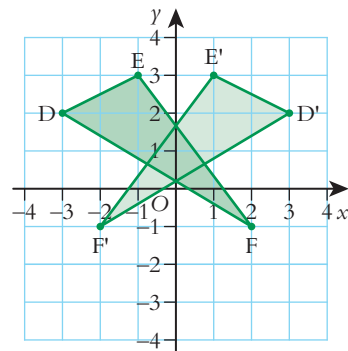
## Chapter 41 Transformations

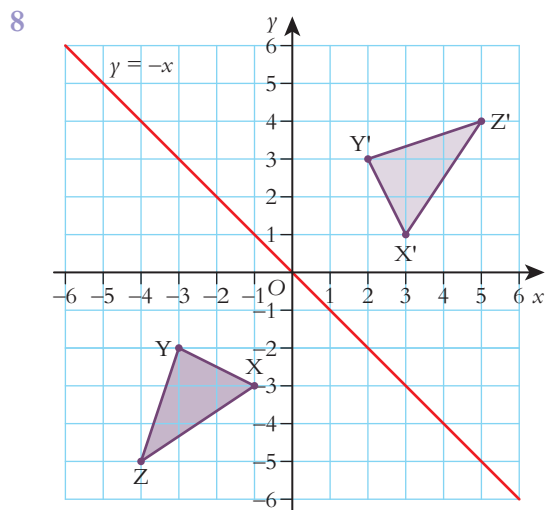
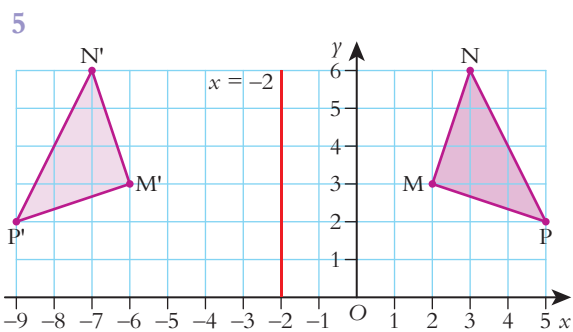
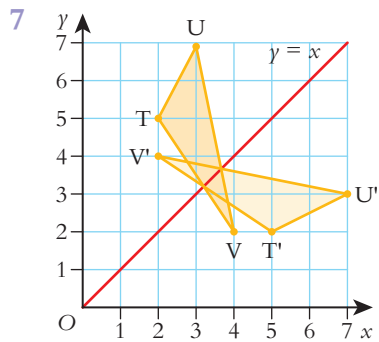
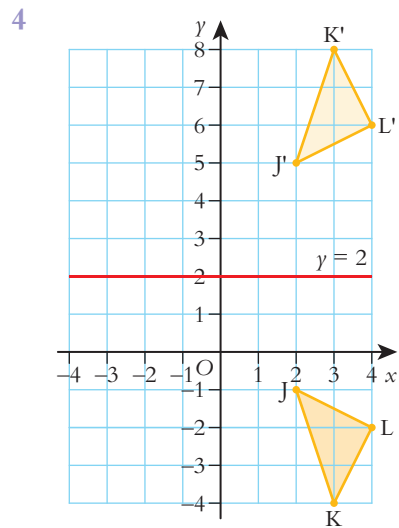
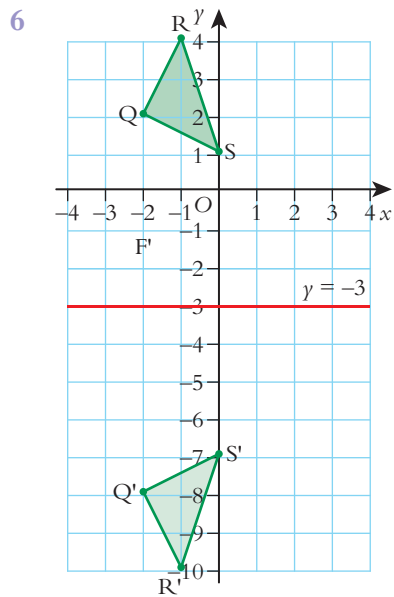
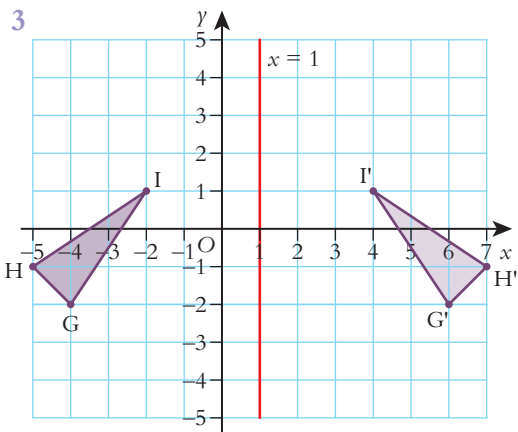
### Exercise 41.1 (page 453)

1

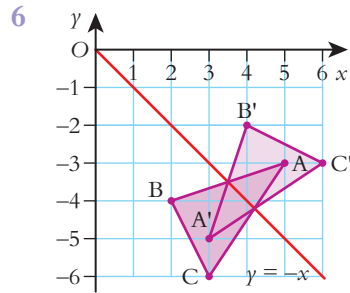
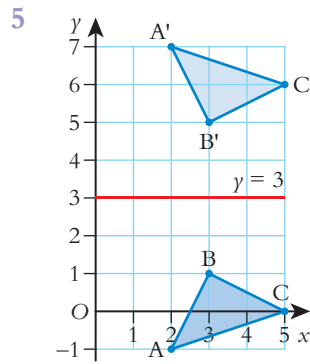
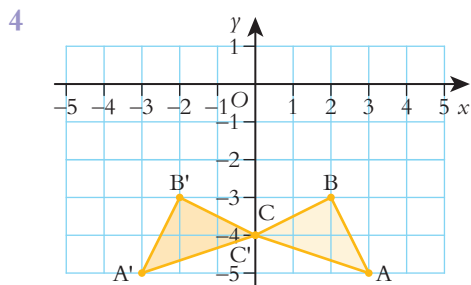
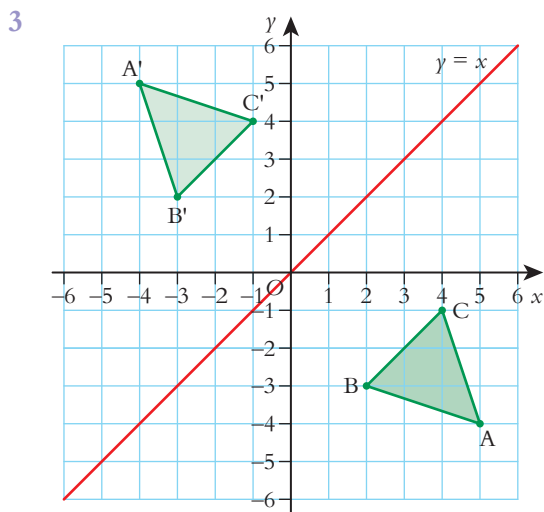
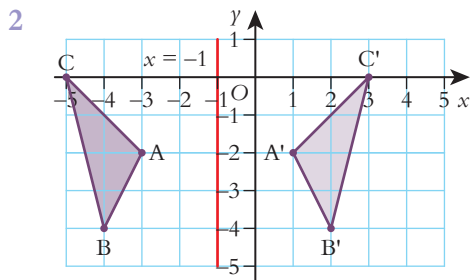
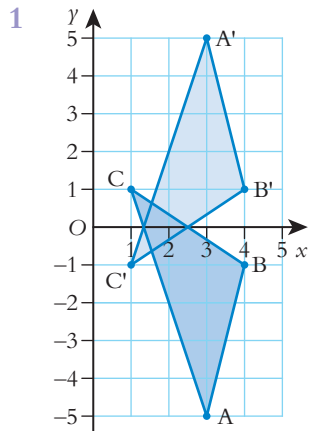


2





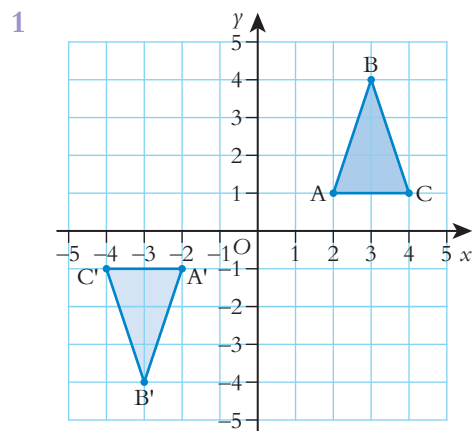
### Exercise 41.2 (page 454)



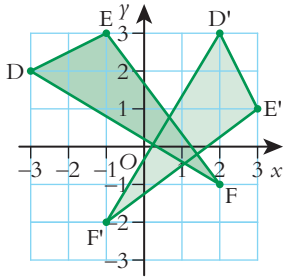
### Exercise 41.3 (page 455)

- 1 reflection in  $y = x$
- 2 reflection in  $x$ -axis ( $y = 0$ )
- 3 reflection in  $y = -1$
- 4 reflection in  $y = -x$

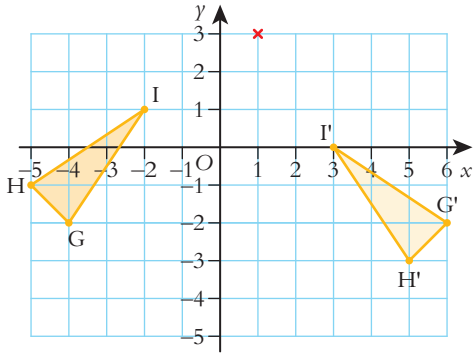
### Exercise 41.4 (page 456)



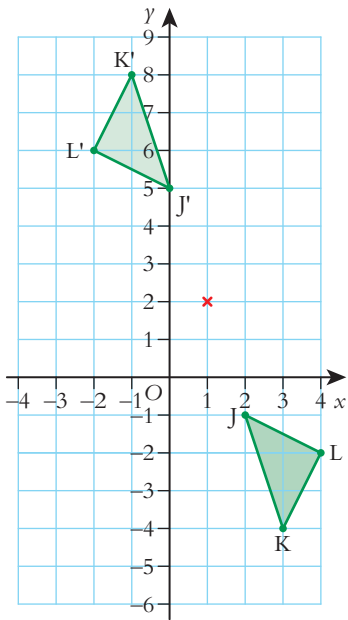
2



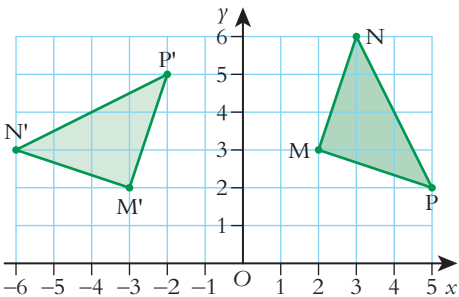
3



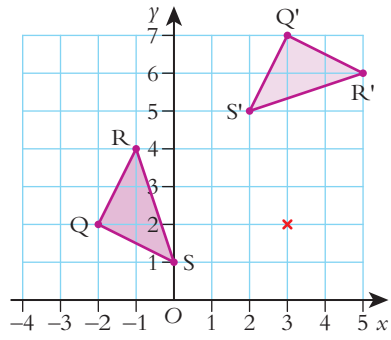
4



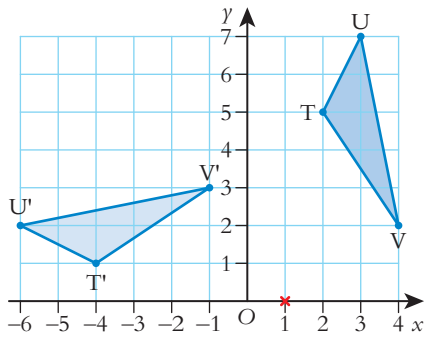
5



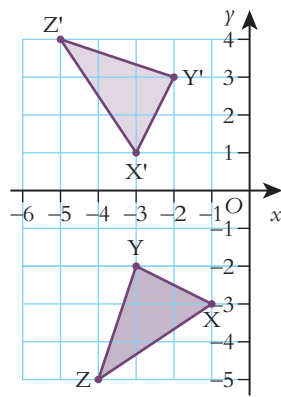
6



7

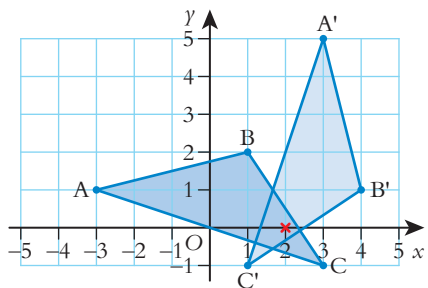


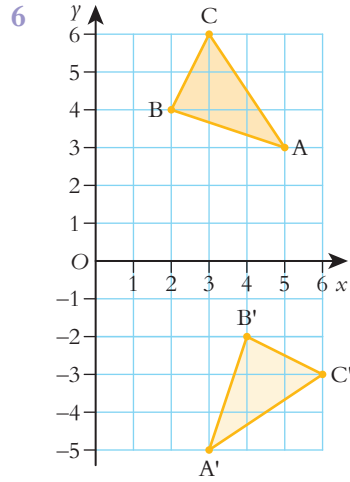
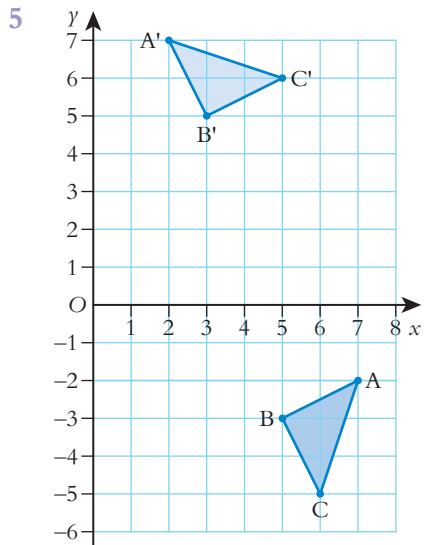
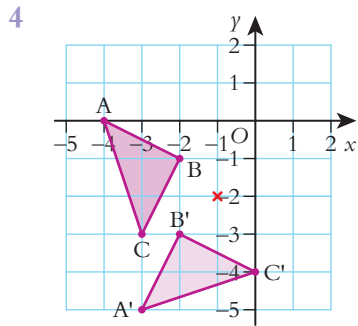
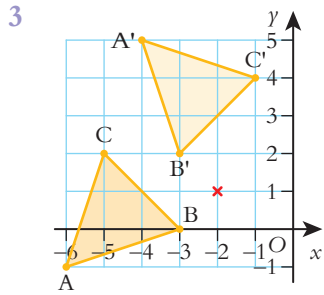
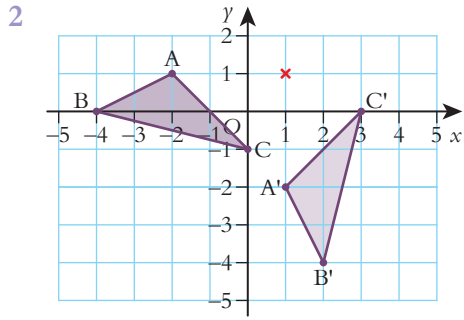
8



**Exercise 41.5 (page 457)**

1

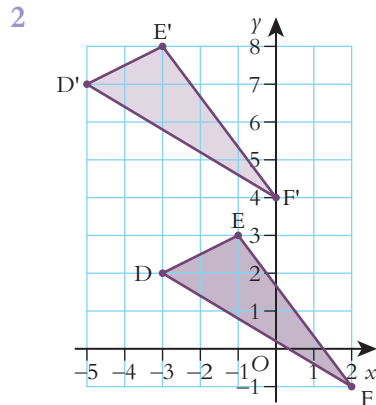
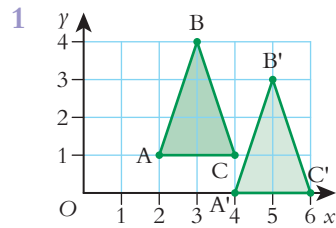


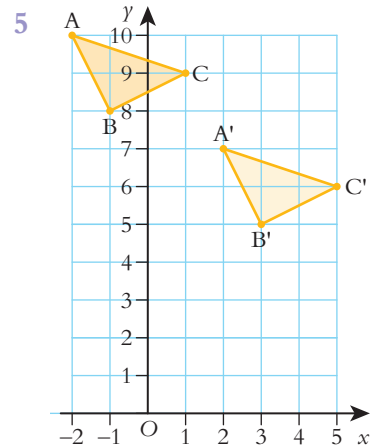
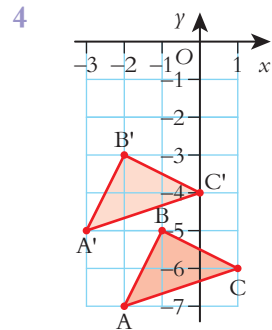
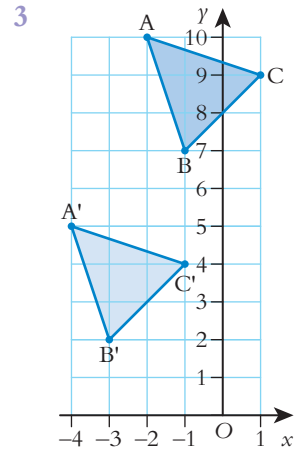
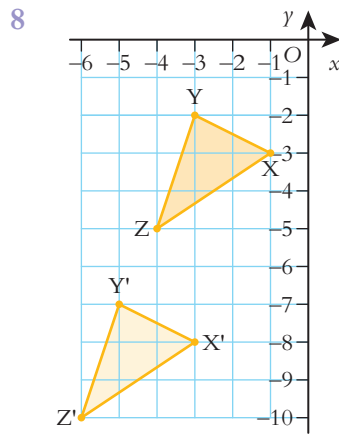
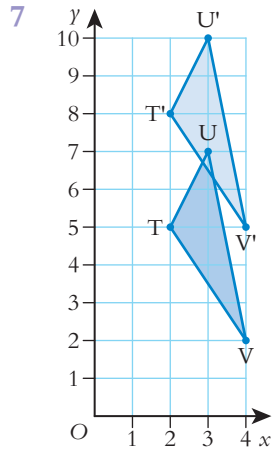
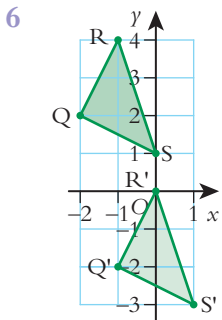
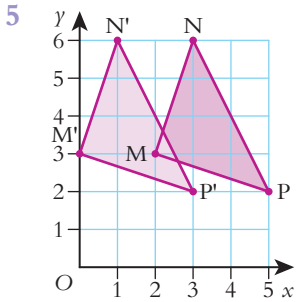
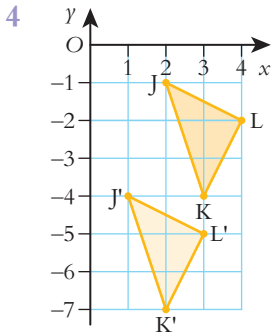
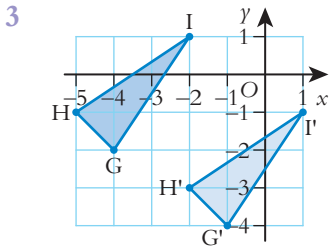


### Exercise 41.6 (page 458)

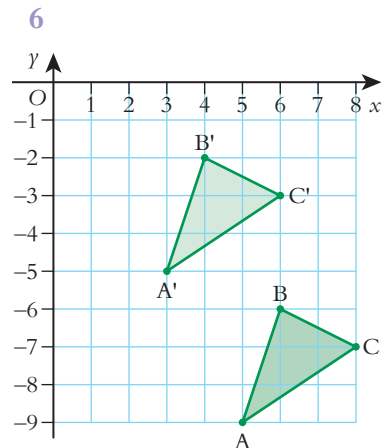
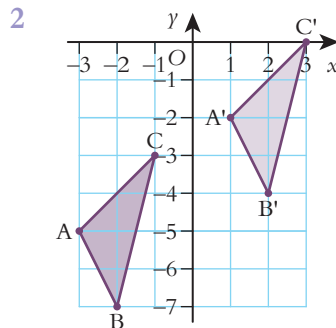
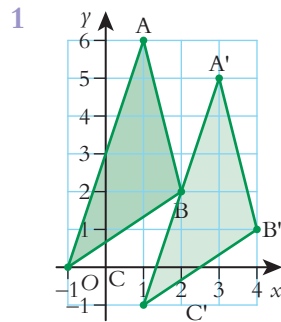
- 1  $90^\circ$  clockwise rotation about  $(0, 1)$
- 2  $90^\circ$  clockwise rotation about  $(1, 1)$
- 3  $90^\circ$  anti-clockwise rotation about  $O$
- 4  $90^\circ$  anti-clockwise rotation about  $(-1, -1)$

### Exercise 41.7 (page 459)





### Exercise 41.8 (page 460)

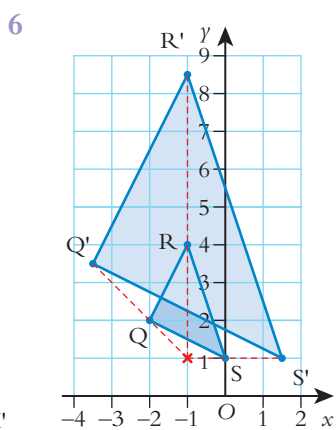
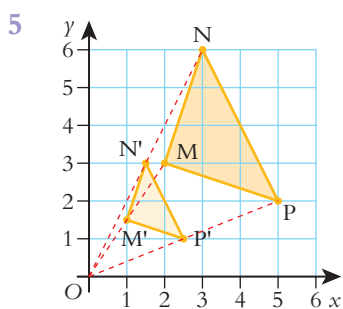
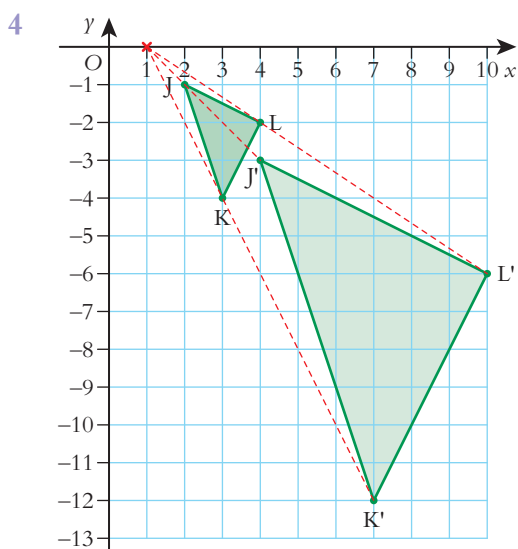
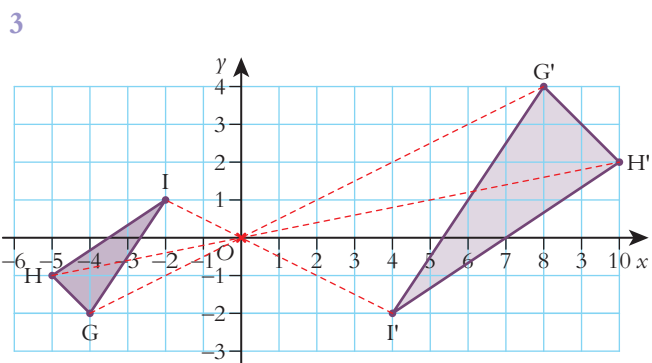
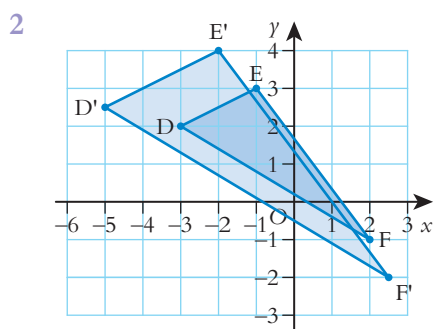
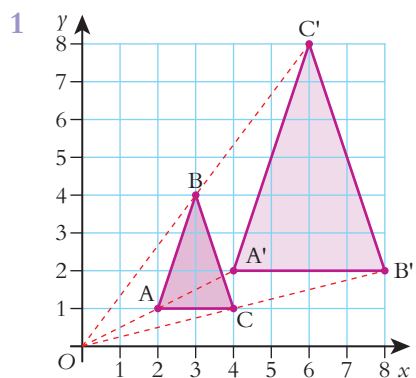




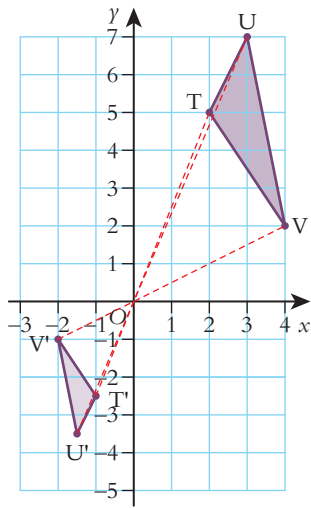
### Exercise 41.9 (page 460)

- 1 translation  $\begin{pmatrix} 4 \\ 3 \end{pmatrix}$
- 2 translation  $\begin{pmatrix} -1 \\ -2 \end{pmatrix}$
- 3 translation  $\begin{pmatrix} 3 \\ 0 \end{pmatrix}$
- 4 translation  $\begin{pmatrix} 0 \\ -2 \end{pmatrix}$

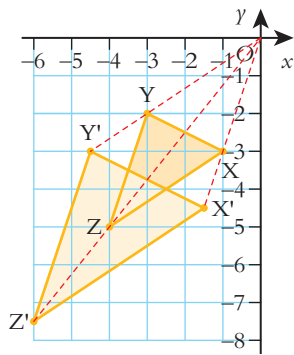
### Exercise 41.10 (page 462)



7

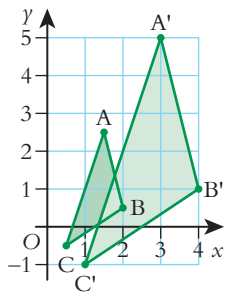


8

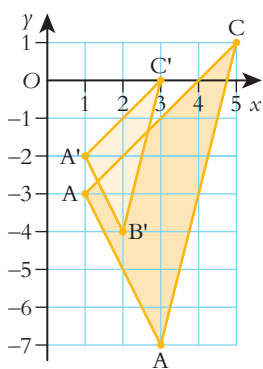


**Exercise 41.11 (page 463)**

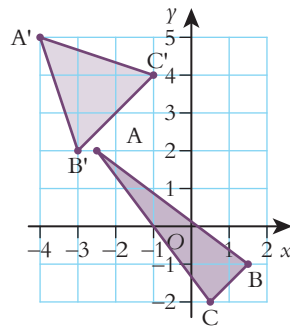
1



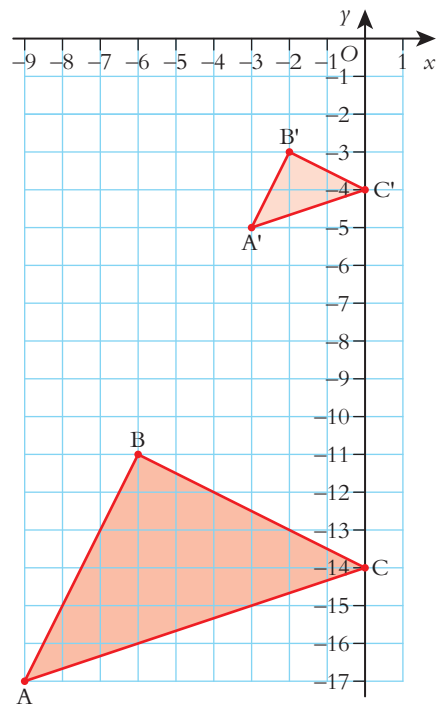
2



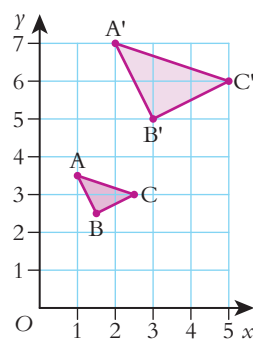
3



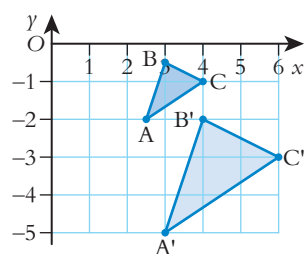
4



5



6

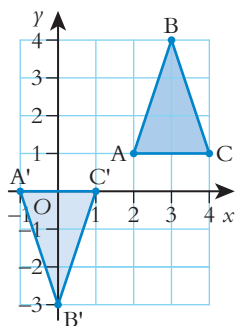


### Exercise 41.12 (page 464)

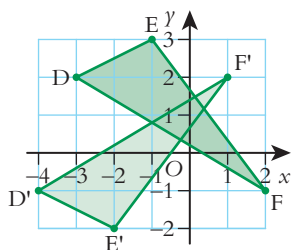
- 1 enlargement, centre O, scale factor  $2\frac{1}{2}$
- 2 enlargement, centre (1, 0), scale factor 2
- 3 enlargement, centre O, scale factor -2
- 4 enlargement, centre (-1, 2), scale factor  $\frac{1}{2}$
- 5 enlargement, centre (1, 3), scale factor 3
- 6 enlargement, centre O, scale factor  $1\frac{1}{2}$

### Exercise 41.13 (page 465)

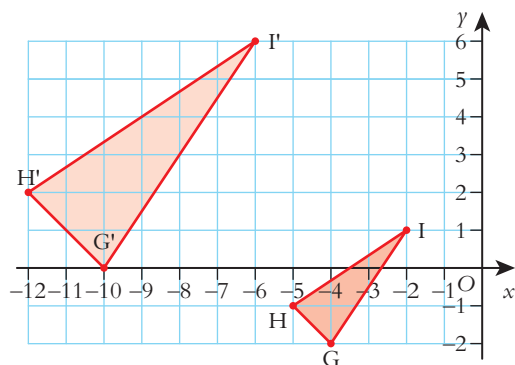
1



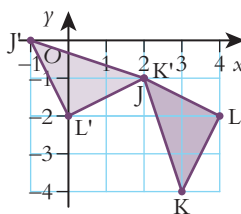
2



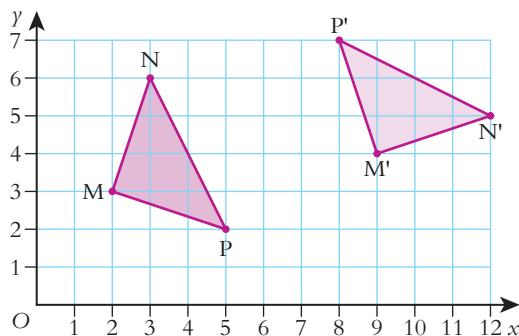
3



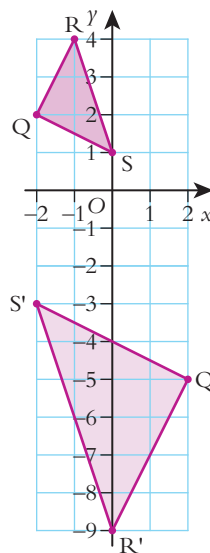
4



5



6

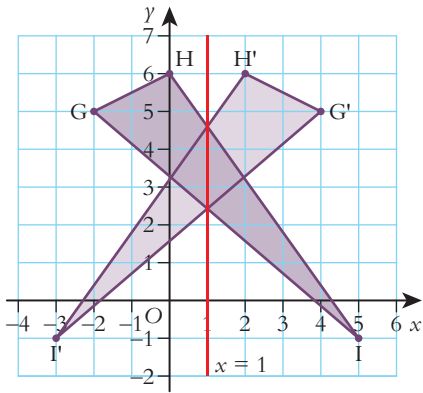


### Exercise 41.14 (page 467)

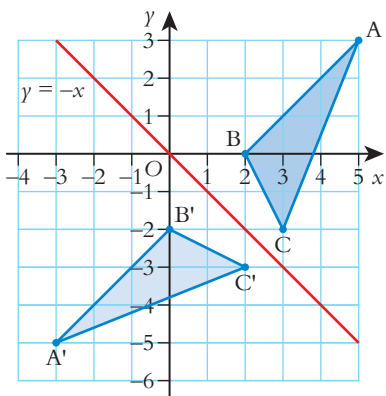
- 1 enlargement, centre (1, 2), scale factor  $\frac{1}{2}$
- 2 translation  $\begin{pmatrix} 1 \\ -3 \end{pmatrix}$
- 3  $180^\circ$  rotation about (-1, 1)
- 4 reflection in  $x = -2$
- 5  $90^\circ$  anti-clockwise rotation about (-2, 1)
- 6 reflection in  $y = x$

## Summary exercise 41 (page 467)

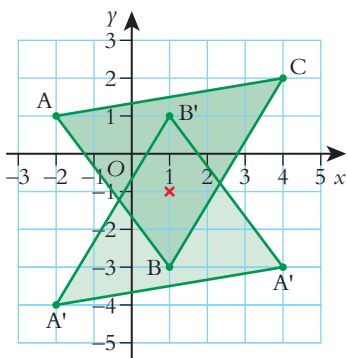
1



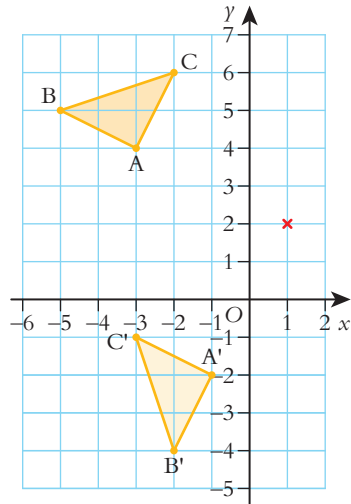
2



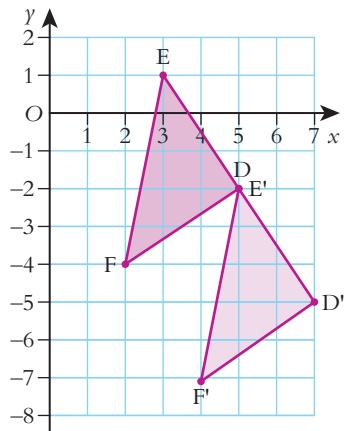
3



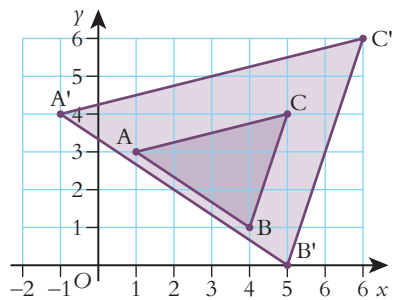
4



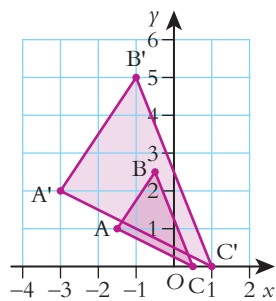
5



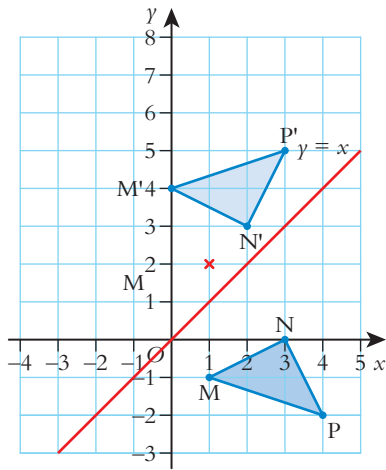
6



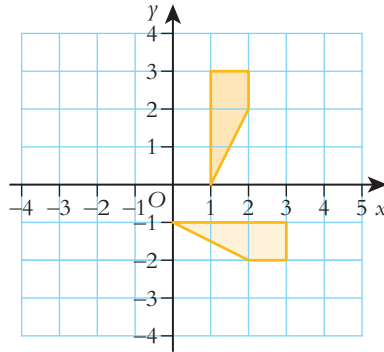
7



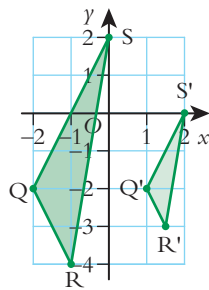
8



- 1 a See diagram; correct reflection.
  - b See diagram; correct enlargement.
  - c  $180^\circ$  rotation about centre  $(0, 0)$
- 2 See diagram; shape drawn correctly.

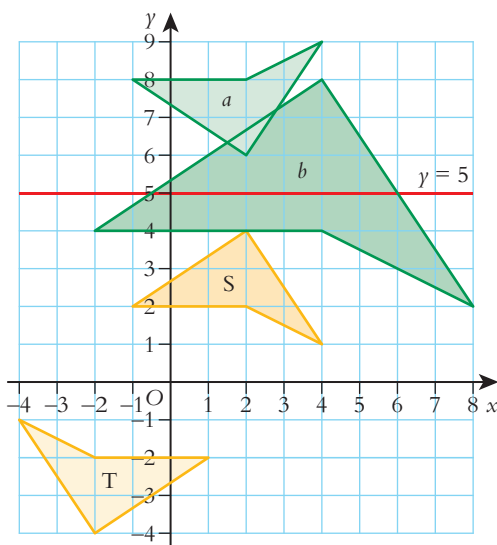


9



- 10 a  $90^\circ$  clockwise rotation about  $(1, -1)$
- b enlargement, centre  $(1, 0)$ , scale factor 2
- c reflection in  $x = 1$
- d translation  $\begin{pmatrix} -2 \\ -5 \end{pmatrix}$

### Examination questions (page 469)



## Chapter 42 Questionnaires

### Exercise 42.1 (page 473)

- 1–6 Suitable suggestions.

### Exercise 42.2 (page 475)

- 1–10 Suitable suggestions.

### Exercise 42.3 (page 477)

- 1 a not balanced
- 2 a wrongly defined
- 3 a not closed
- 4 a gaps
- 5 a gaps
- 6 a wrongly defined
- 7 a not balanced
- 8 a gaps
- 9 a not closed
- 10 a wrongly defined

### Exercise 42.4 (page 478)

- 1–10 Suitable suggestions.

## Exercise 42.5 (page 479)

1–10 Suitable suggestions.

### Summary exercise 42 (page 479)

1,2 Suitable recording sheets.

3 a biased

4 a wrongly defined

5 a not closed

6 a gaps

7–10 Suitable answers.

### Examination questions (page 480)

1 a i, ii

Suitable suggestions.

b Suitable question and response section.

## Chapter 43 Statistical diagrams

### Exercise 43.1 (page 483)

1

Number of brothers or sisters	Frequency
0	13
1	16
2	13
3	9
4	6
5	3

2

Number of goals scored	Frequency
0	4
1	17
2	26
3	28
4	15
5	3
6	2
7	3
8	2

3

Breadths of objects (cm)	Frequency
1–5	3
6–10	8
11–15	12
16–20	11
21–25	11
26–30	5

4

Mass of objects, $M$ (kg)	Frequency
$5 < M \leq 7$	8
$7 < M \leq 9$	13
$9 < M \leq 11$	11
$11 < M \leq 13$	14
$13 < M \leq 15$	10
$15 < M \leq 17$	2
$17 < M \leq 19$	2

5

Heights $h$ (cm)	Frequency
1–5	10
6–10	9
11–15	11
16–20	16
21–25	14

6

Capacity $V$ (cm <sup>3</sup> )	Frequency
12–19	12
20–27	8
28–35	10
36–42	12
43–50	6

### Exercise 43.2 (page 486)

1 a

Time (hours)	Frequency
2	135
3	225
4	190
5	90
6	110
7	40
8	10

b range = 6

c mode = 3

d 31.25%

e 27:22

2 a

Points	Frequency
15	12
30	46
45	42
60	74
75	28
90	42
105	6

b range = 90

c mode = 60

d  $\frac{2}{5}$

e 14 played the game again

3 a

Volume, $V$	Frequency
$0 < V \leq 6$	1200
$6 < V \leq 12$	1900
$12 < V \leq 18$	600
$18 < V \leq 24$	1650

b The limits of the modal class are 6 and 12.

c  $\frac{45}{107}$

d 57.9%

e 12:37

4 a

Area, $A$	Frequency
$0 < A \leq 5$	28
$5 < A \leq 10$	56
$10 < A \leq 15$	18
$15 < A \leq 20$	96
$20 < A \leq 25$	74
$25 < A \leq 30$	36

b The limits of the modal class are 15 and 20.

c 198

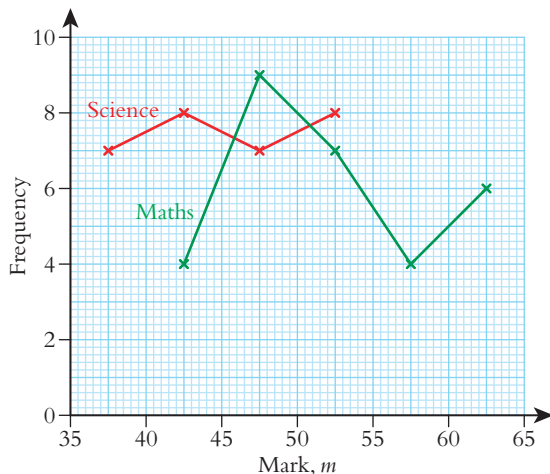
d  $\frac{24}{77}$

e  $\frac{61}{77}$

### Exercise 43.3 (page 489)

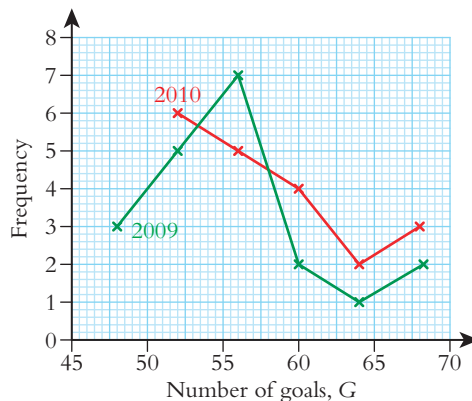
Note that for questions 1 to 4 part b there may be alternative answers to those given here.

1 a



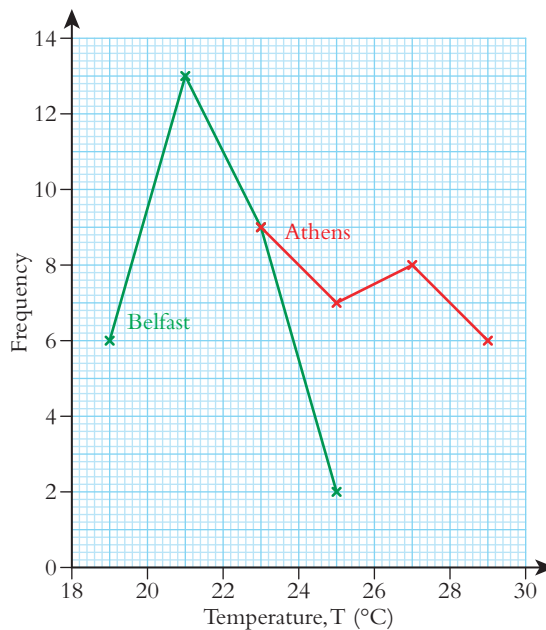
b The maths results are generally better than the science results / the maths results are more spread out than the science results.

2 a



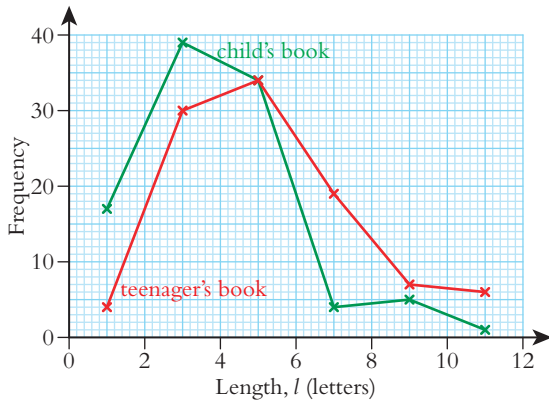
b There is more variation in the number of goal scored in 2009 than 2010.

3 a



b Athens is generally warmer than Belfast / there is more variation in the temperature in Belfast.

4 a



b The length of the words in the child's book is generally shorter than those in the teenager's book.

5

Mass, $M$ (kg)	$2 < M \leq 4$	$4 < M \leq 6$	$6 < M \leq 8$	$8 < M \leq 10$	$10 < M \leq 12$
cubes	2	6	8	4	
spheres			3	12	5

6

Volume, $V$ (cm <sup>3</sup> )	$5 < V \leq 10$	$10 < V \leq 15$	$15 < V \leq 20$	$20 < V \leq 25$	$25 < V \leq 30$
copper	180	730	490		
silver		110	370	680	240

### Exercise 43.4 (page 491)

1

$$\begin{array}{l} 3 \\ 4 \\ 5 \end{array} \left| \begin{array}{cccccc} 1 & 2 & 2 & 3 & 5 \\ 2 & 4 & 5 & 6 & 6 & 7 \\ 0 & 1 & 4 & 4 & 5 \end{array} \right.$$

Key:  $3 \mid 1 = 31^\circ\text{F}$

2

$$\begin{array}{l} 2 \\ 3 \\ 4 \\ 5 \end{array} \left| \begin{array}{cccccc} 1 & 3 & 5 & 6 & 6 \\ 0 & 4 & 6 & 7 & 8 \\ 2 & 5 & 6 & 7 \\ 1 & 4 & 4 & 9 & 9 & 9 \end{array} \right.$$

Key:  $2 \mid 1 = 2.1 \text{ cm}$

3

$$\begin{array}{l} 2 \\ 3 \\ 4 \\ 5 \end{array} \left| \begin{array}{cccccc} 2 & 3 & 5 & 5 & 6 & 7 \\ 4 & 4 & 5 & 6 & 7 & 8 & 9 \\ 1 & 2 & 3 & 5 & 6 \\ 1 & 1 & 4 & 6 & 8 & 9 \end{array} \right.$$

Key:  $2 \mid 2 = 2.2 \text{ km}$



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

Key: 3 | 1 = 31 litres

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

Key: 1 | 4 = 41 marks (girls)

4 | 1 = 41 marks (boys)

6			height					length							
			4	2	2	1		4	1	3	5	6	7		
			6	5	4	3	1		5	2	4	6	7	8	
			7	7	6	5	4	2		6	1	3	5	8	
			9	9	8	7	3		7	1	1	4	6	7	9

Key: 1 | 4 = 4.1 cm (height)

4 | 1 = 4.1 cm (length)

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

Key: 0 | 5 = £50 (amount spent by women)

5 | 1 = £51 (amount spent by men)

8			flat objects					round objects										
			8	7	5	4	3	1		2	1	3	5	6				
			9	6	4	2	1	1		3	1	2	4	5	6			
			5	4	3	3	2	1		4	1	3	5	7				
								3	1		5	1	1	2	7	8	8	9

Key: 1 | 2 = 2.1 kg (flat objects)

2 | 1 = 2.1 kg (round objects)

## Exercise 43.5 (page 493)

- range = 38 mm
  - mode = 35 mm
  - median = 33 mm
- range = 34 marks
  - mode = 53 marks
  - median = 59 marks
- range = 23 litres
  - mode = 93 litres
  - median = 86.5 litres
- range = 36 kg
  - mode = 24 kg
  - median = 31 kg
- boys:
  - range = 46
  - mode = 74
  - median = 74
 girls:
  - range = 45
  - mode = 72
  - median = 74
- lengths:
  - range = 3.6 cm
  - mode = 5.1 cm
  - median = 5.1 cm
 widths:
  - range = 3.6 cm
  - mode = 3.1 cm
  - median = 5.1 cm
- mass:
  - range = 35 g
  - mode = 64 g
  - median = 64 g
 volume:
  - range = 38 cm<sup>3</sup>
  - mode = 42 cm<sup>3</sup>
  - median = 61 cm<sup>3</sup>
- female:
  - range = £34
  - mode = £62
  - median = £61
 male:
  - range = £36
  - mode = £50
  - median = £62

### Exercise 43.6 (page 495)

- 1 negative correlation
- 2 zero correlation
- 3 positive correlation
- 4 zero correlation
- 5 negative correlation
- 6 positive correlation

### Exercise 43.7 (page 497)

- 1 **b** positive correlation  
**c** as the distance increases, the time taken to travel increases
- 2 **b** positive correlation  
**c** as the number of books ordered increases, the cost increases
- 3 **b** negative correlation  
**c** as the density increases, the volume decreases
- 4 **b** negative correlation  
**c** as the Literacy mark goes up, the Numeracy marks falls
- 5 **b** positive correlation  
**c** the larger the number in the group, the greater the amount of money collected
- 6 **b** negative correlation  
**c** as the age of the car increases, its value falls

### Exercise 43.8 (page 500)

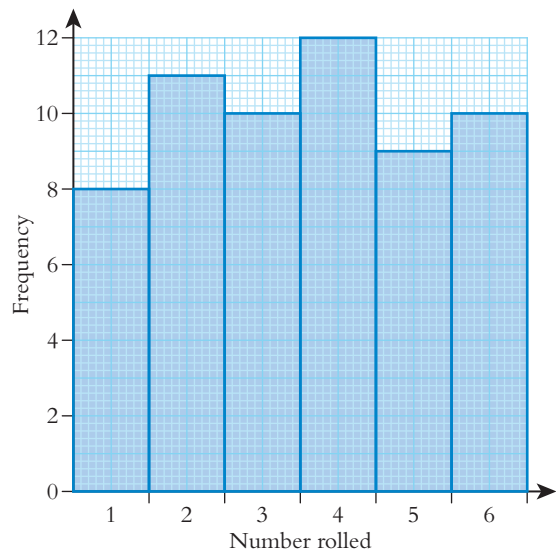
- 1 43
- 2 7
- 3 448
- 4 2.5
- 5 950
- 6 21.21

### Summary exercise 43 (page 501)

1 a

Number rolled	Frequency
1	8
2	11
3	10
4	12
5	9
6	10

b



2 a

Points scored	Frequency
50	108
100	164
150	96
200	68
250	88
300	32
350	44

- b** range = 100 points
- c** mode = 150 points
- d** 600 players
- e** 91 616 points
- f** 41:17

3 a

Heights, $h$ (cm)	Frequency
$0 < h \leq 16$	900
$16 < h \leq 32$	1450
$32 < h \leq 48$	650
$48 < h \leq 64$	1900
$64 < h \leq 80$	1550
$80 < h \leq 96$	1250
$96 < h \leq 112$	1700
$112 < h \leq 128$	950

b the limits of the modal class are 48 and 64

c 3450 heights

d  $\frac{47}{207}$

e 25.6%

4

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

Key: 3 | 4 = 3.4 cm

5 a

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

Key: 1 | 2 = 21 (girls)

2 | 3 = 23 (boys)

b For example, there is not very much difference between the girls' and boys' results – the range of the sets of data is the same and the median values only differ by 1 mark.

6 a i range = 3.6 g

ii mode = 2.5 g

iii median = 2.85 g

b i range = 3.3 g

ii mode = 2.6 g

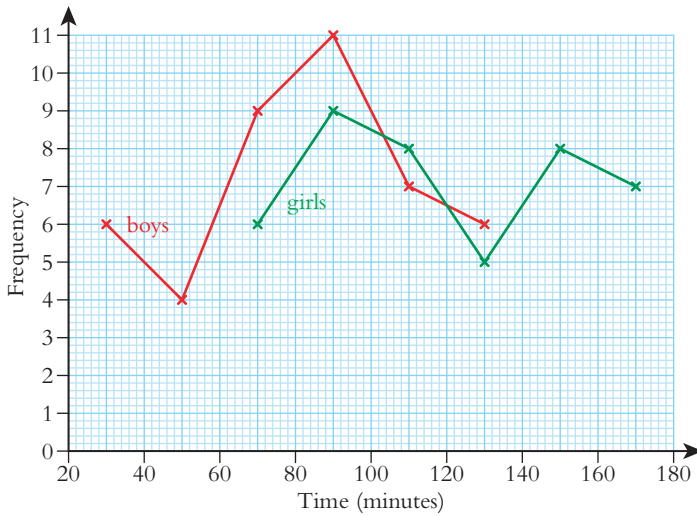
iii median = 2.6 g

7 b positive correlation

c the higher the temperature, the more bottles of water sold

8 45

9 a



b For example, the girls spent longer talking on their mobile phones than the boys.

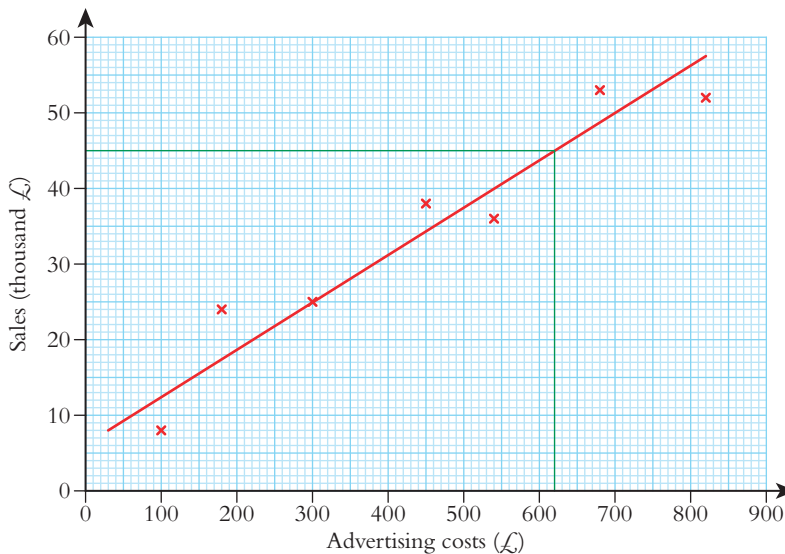
10 a

Mark, $M$	$55 < M \leq 60$	$60 < M \leq 65$	$65 < M \leq 70$	$70 < M \leq 75$	$75 < M \leq 80$
English	38	54	46	12	
History		48	62	18	22

b For example, the history marks were generally better than the English marks.

### Examination questions (page 504)

1 a See graph; all 7 points correct

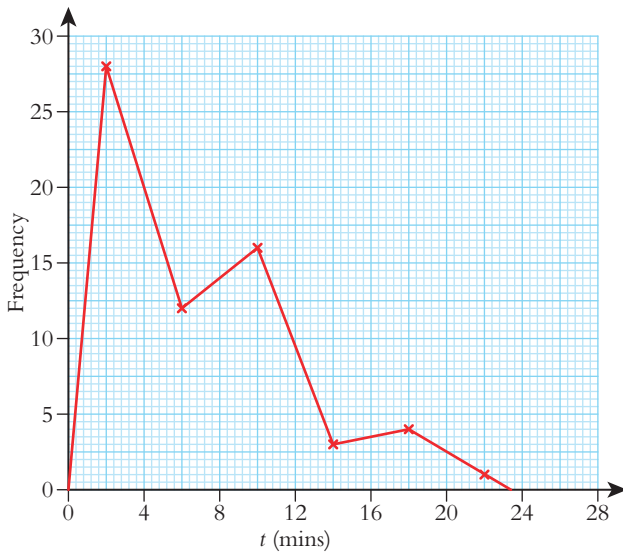


b Line of best fit

c Estimating cost for £45 000 from student's graph (£620)

d Positive

- 2 See graph, points correct and joined by straight lines.



3

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

## Chapter 44 Statistical averages and spread

### Exercise 44.1 (page 508)

- 1 **a** range = 5  
**b** mode = 10  
**c** median = 9  
**d** mean = 9.4
- 2 **a** range = 25  
**b** mode = 10  
**c** median = 15  
**d** mean = 17
- 3 **a** range = 20  
**b** mode = 16  
**c** median = 8  
**d** mean = 10.08
- 4 **a** range = 2.5  
**b** mode = 1.5  
**c** median = 1.75  
**d** mean = 1.95

- 5 **a** range = 15  
**b** mode = 12  
**c** median = 9  
**d** mean = 6.825

- 6 **a** range = 1  
**b** mode = 1.2  
**c** median = 1.4  
**d** mean = 1.46

- 7 **a** range = 30  
**b** mode = 30  
**c** median = 18  
**d** mean = 15.9

- 8 **a** range = 50  
**b** mode = 30  
**c** median = 45  
**d** mean = 45

- 9 **a** range = 42  
**b** mode = 7  
**c** median = 14  
**d** mean = 16.45

- 10 **a** range = 1.2  
**b** mode = 6.2  
**c** median = 6.4  
**d** mean = 6.52

### Exercise 44.2 (page 510)

- 1 **a** **i** modal class  $16 < l \leq 20$   
**ii** median class  $12 < l \leq 16$   
**b** mean = 11.6 mm
- 2 **a** **i** modal class  $32 < h \leq 40$   
**ii** median class  $16 < h \leq 24$   
**b** mean = 20.6 cm
- 3 **a** **i** modal class  $10 < P \leq 15$   
**ii** median class  $15 < P \leq 20$   
**b** mean = £20
- 4 **a** **i** modal class  $12 < M \leq 13$   
**ii** median class  $13 < M \leq 14$   
**b** mean = 13.2 mg
- 5 **a** **i** modal class  $0 < A \leq 25$   
**ii** median class  $25 < A \leq 50$   
**b** mean = 43.5 cm<sup>2</sup>
- 6 **a** **i** modal class  $0 < D \leq 6$   
**ii** median class  $12 < D \leq 18$   
**b** mean = \$13.5

- 7 a **i** modal class  
 $38 < V \leq 52$   
**ii** median class  
 $38 < V \leq 52$   
**b** mean =  $41.5 \text{ cm}^3$
- 8 a **i** modal class 31–40  
**ii** median class 21–30  
**b** mean = 24.375 years
- 9 a **i** modal class 16–20  
**ii** median class 11–15  
**b** mean = 12.75 mm
- 10 a **i** modal class 1–3  
**ii** median class 7–9  
**b** mean = 7.16 absences

### Exercise 44.3 (page 512)

- 1  $n = 4$   
 2  $n = 4$   
 3  $n = 5$   
 4  $n = 8$   
 5  $n = 21$   
 6  $n = 9$   
 7  $n = 2$   
 8  $n = 9$

### Exercise 44.4 (page 513)

- 1 7.76 m  
 2 £6.96  
 3 5.204 litres  
 4 32.2 years  
 5 8.176 kg  
 6 £28  
 7 7.2 cm  
 8 58 marks

### Exercise 44.5 (page 515)

- 1 boys:  
 range 4,  
 mode 31,  
 median 32,  
 mean 31.95
- 2 men:  
 range 2,  
 mode 7,  
 median 6,  
 mean 6.25
- women:  
 range 3,  
 mode 4,  
 median 8,  
 mean 7.8
- 3 boys:  
 range 5,  
 mode 0,  
 median 0,  
 mean 1.16
- girls:  
 range 3,  
 mode 0,  
 median 0,  
 mean 0.52
- 4 boys:  
 range 4,  
 mode 17,  
 median 17,  
 mean 16.6
- girls:  
 range 2,  
 mode 16,  
 median 16,  
 mean 16.04
- 5 British:  
 range 5,  
 mode 5,  
 median 4,  
 mean 3.65
- Foreign:  
 range 4,  
 mode 2,  
 median 3,  
 mean 2.86
- 6 bus:  
 range 4,  
 mode 3,  
 median 2,  
 mean 1.9

- train:  
 range 3,  
 mode 2,  
 median 2,  
 mean 1.7

### Exercise 44.6 (page 516)

- 1 mode  
 2 mean  
 3 median  
 4 mode  
 5 mean  
 6 mode  
 7 mean  
 8 mean  
 9 mode  
 10 median

### Summary exercise 44 (page 517)

- 1 a range = 4  
 b mode = 4.5  
 c median = 3.5  
 d mean = 3.65
- 2 a **i** modal class  
 $5 < x \leq 10$   
**ii** median class  
 $10 < x \leq 15$   
 b 11.5
- 3  $n = 5$   
 4  $n = 13$   
 5 £234.90  
 6 £425
- 7 Belfast:  
 range 3 mm,  
 mode 2 mm,  
 median 1.5 mm,  
 mean 1.433... mm
- Bonn:  
 range 5 mm,  
 mode 2 mm,  
 median 2 mm,  
 mean 2.333... mm

- 8 a mode  
b
- 9 a median  
b
- 10 a mean  
b

### Examination questions (page 519)

1

Midpoint (x)	Frequency (f)	Product (fx)
4	2	8
12	13	156
20	17	340
28	25	700
36	3	108
	sum ( $\sum f$ ) = 60	sum ( $\sum fx$ ) = 1312

$$\text{Mean} = \frac{1312}{60} = \pounds 21.87$$

- 2 a  $5 < H \leq 7$

b

Midpoint (x)	Frequency (f)	Product (fx)
6	30	180
8	25	200
10	14	140
12	9	108
14	5	70
	sum ( $\sum f$ ) = 83	sum ( $\sum fx$ ) = 698

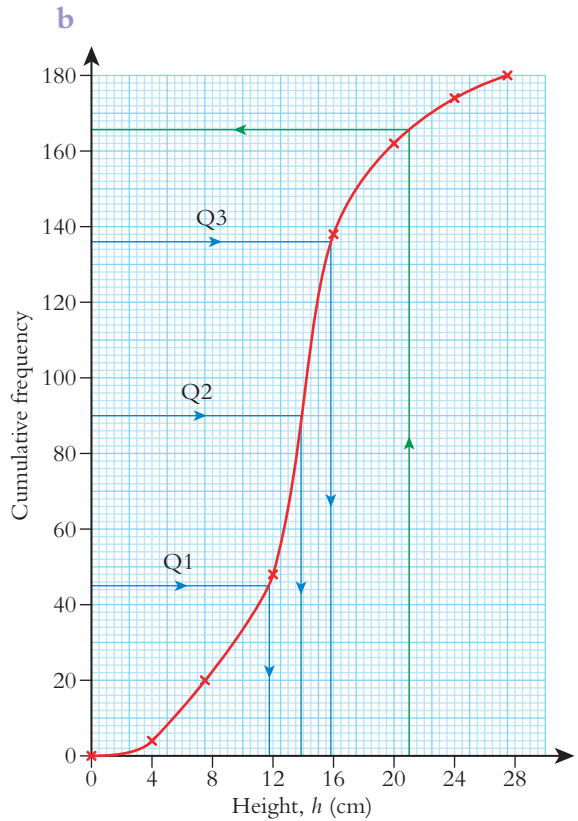
$$\text{Mean} = \frac{698}{83} = \pounds 8.41$$

## Chapter 45 Cumulative frequency curves and box plots

### Exercise 45.1 (page 523)

1 a

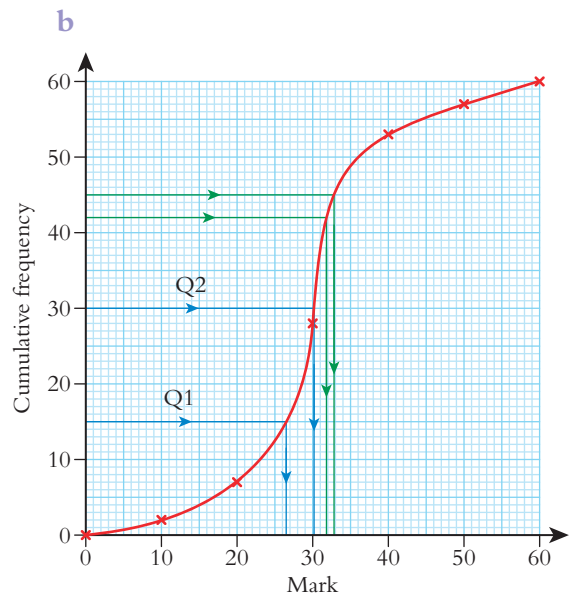
Height $\leq h$ (cm)	0	4	8	12	16	20	24	28
Cumulative frequency	0	4	20	48	138	162	174	180



- c i 142.5 cm  
ii 4 cm  
d 165

2 a

Mark ( $\leq$ )	0	10	20	30	40	50	60
Cumulative frequency	0	2	7	28	53	57	60

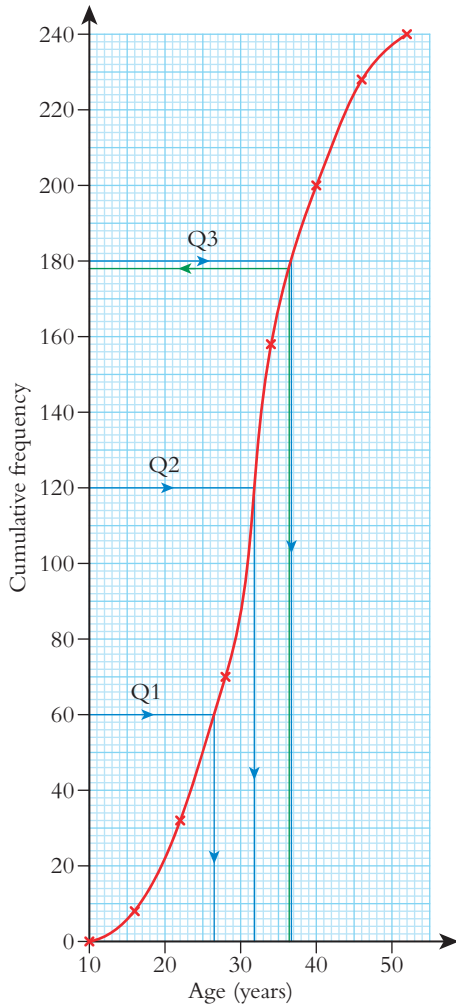


- c i 31
- ii 12
- d 35

3 a

Age ( $\leq$ ) (years)	10	16	22	28	34	40	46	52
Cumulative frequency	0	8	32	70	158	200	228	240

b

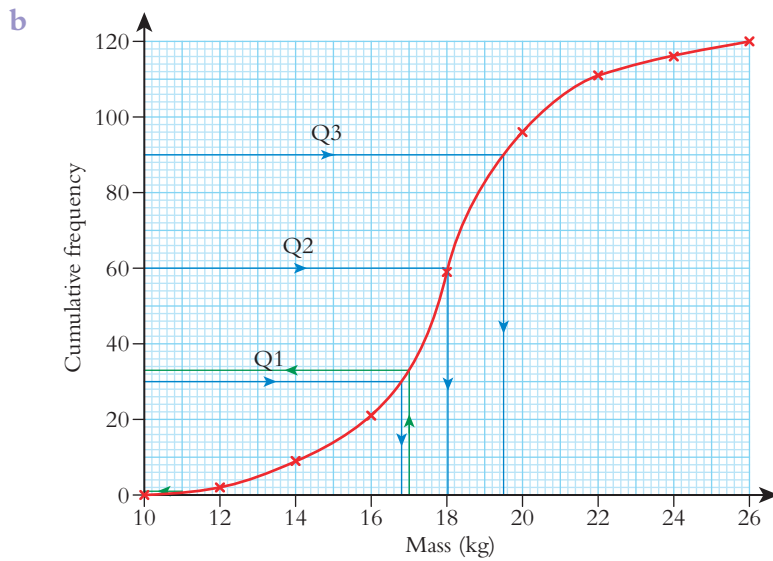


- c i 32.5 years
- ii 9.5 years
- d 26%

4 a

Mass $\leq M$ (kg)	10	12	14	16	18	20	22	24	26
Cumulative frequency	0	2	9	21	59	96	111	116	120





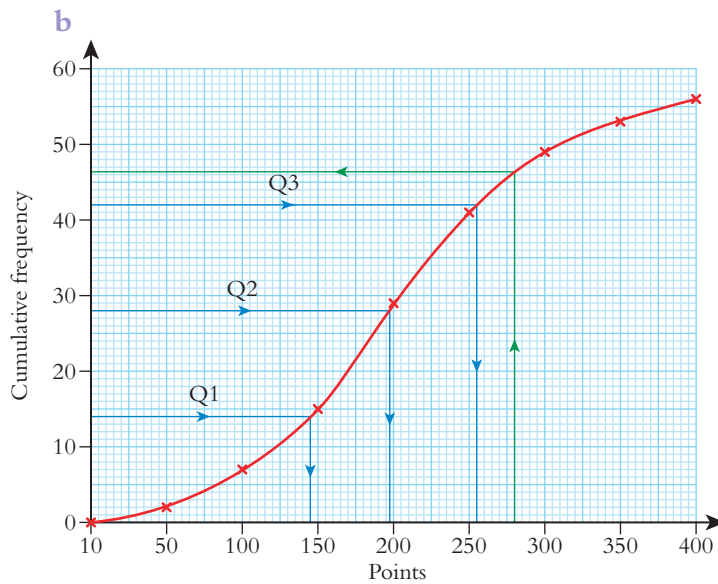
**c i** 18 kg

**ii** 2.6 kg

**d** 32

**5 a**

<b>Points (<math>\leq</math>)</b>	0	50	100	150	200	250	300	350	400
<b>Cumulative frequency</b>	0	2	7	15	29	41	49	53	56



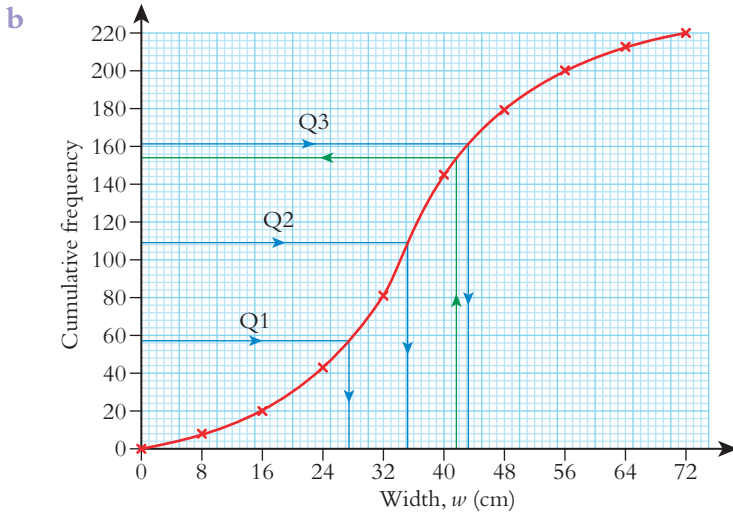
**c i** 198 points

**ii** 108 points

**d** 10

**6 a**

<b>Width <math>\leq w</math> (cm)</b>	0	8	16	24	32	40	48	56	64	72
<b>Cumulative frequency</b>	0	8	20	43	81	145	179	204	214	220



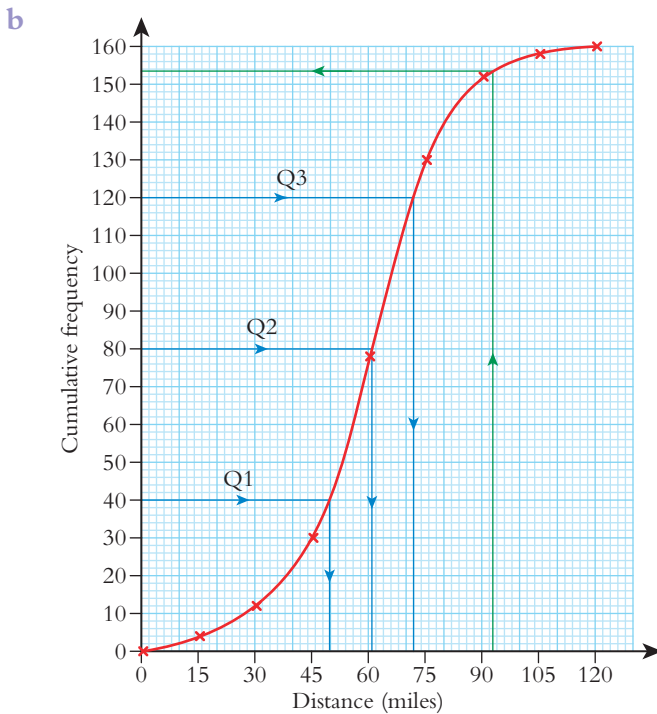
**c i** 35.5 cm

**ii** 17.5 cm

**d** 49

**7 a**

<b>Miles (<math>\leq</math>)</b>	0.5	15.5	30.5	45.5	60.5	75.5	90.5	105.5	120.5
<b>Cumulative frequency</b>	0	4	12	30	78	130	152	158	160



**c i** 61.5 miles

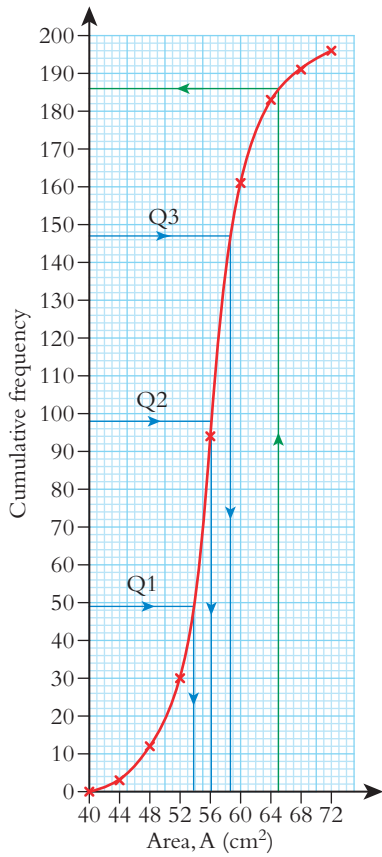
**ii** 22 miles

**d** 4%

**8 a**

<b>Area <math>\leq A</math> (cm<sup>2</sup>)</b>	40	44	48	52	56	60	64	68	72
<b>Cumulative frequency</b>	0	3	12	30	94	161	183	191	196

b

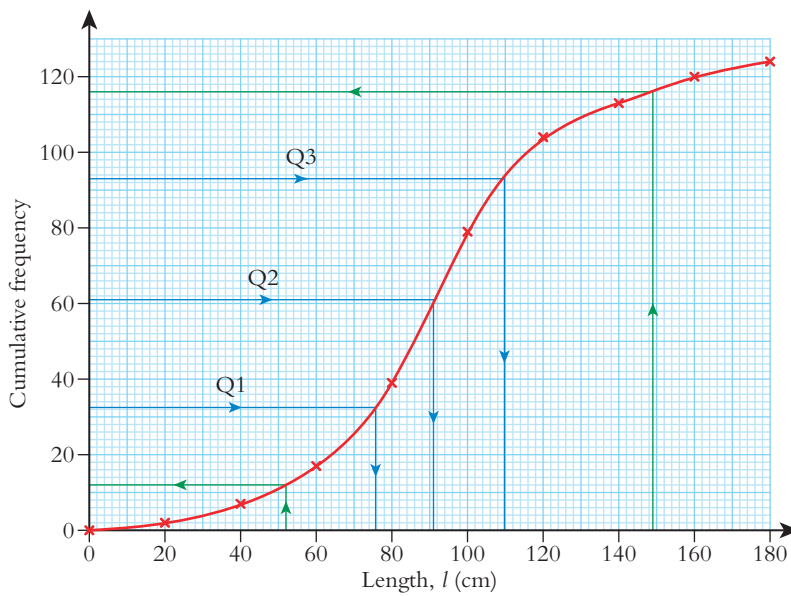


- c i 56.25 cm<sup>2</sup>
- ii 4.75 cm<sup>2</sup>
- d 11

9 a

<b>Length <math>\leq l</math> (cm)</b>	0	20	40	60	80	100	120	140	160	180
<b>Cumulative frequency</b>	0	2	7	17	39	79	104	113	120	124

b

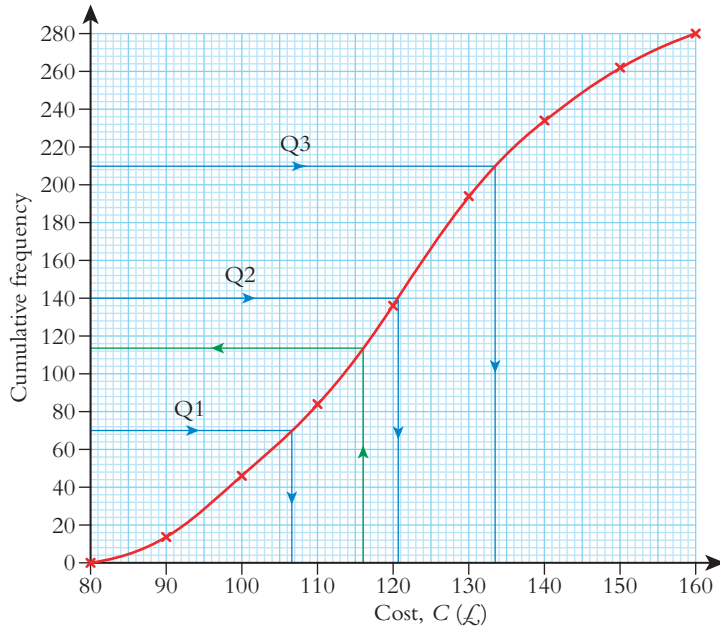


- c i 91 cm
- ii 37 cm
- d 103

10 a

<b>Cost <math>\leq C</math> (£)</b>	80	90	100	110	120	130	140	150	160
<b>Cumulative frequency</b>	0	14	46	84	136	194	234	262	280

b



- c i £121
- ii £27
- d 166

### Exercise 45.2 (page 527)

1 a

Volume, $V$ (litres)	Frequency
$0 < V \leq 16$	4
$16 < V \leq 32$	8
$32 < V \leq 48$	24
$48 < V \leq 64$	36
$60 < V \leq 80$	28
$72 < V \leq 96$	12
$84 < V \leq 112$	8

- b median 58 litres, IQR 28 litres

2 a

Height, $h$ (cm)	Frequency
$130 < h \leq 135$	40
$135 < h \leq 140$	80
$140 < h \leq 145$	170
$145 < h \leq 150$	190
$150 < h \leq 155$	100
$155 < h \leq 160$	60

b median 145.5 cm, IQR 8.5 cm

3 a

Number	Frequency
1–20	10
21–40	25
41–60	50
61–80	40
81–100	30
101–120	5

b median 58 downloads, IQR 36 downloads

4 a

Costs (£)	Frequency
Over 200 and up to and including 240	2
Over 240 and up to and including 280	5
Over 280 and up to and including 320	14
Over 320 and up to and including 360	20
Over 360 and up to and including 400	12
Over 400 and up to and including 440	6
Over 440 and up to and including 480	1

b median £338, IQR £64

5 a

Age (years)	Frequency
5–6	50
7–8	200
9–10	600
11–12	250
13–14	100

b median 9.2 years, IQR 2 years

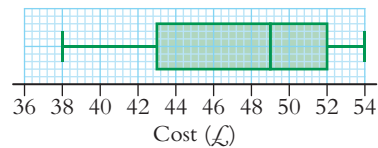
6 a

Mass, $M$ g	Frequency
$10 < M \leq 14$	10
$14 < M \leq 18$	25
$18 < M \leq 22$	35
$22 < M \leq 26$	60
$26 < M \leq 30$	40
$30 < M \leq 34$	35
$34 < M \leq 38$	5

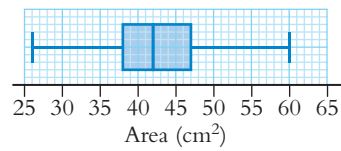
b median 24.5 kg, IQR 8.5 kg

### Exercise 45.3 (page 529)

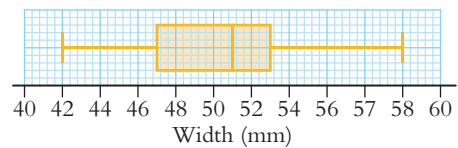
1



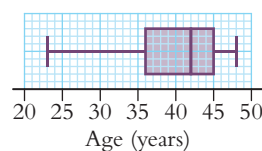
2



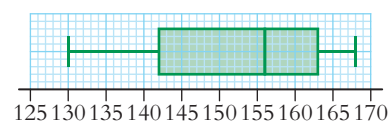
3



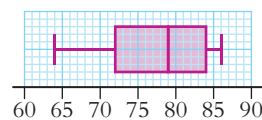
4



5



6



### Exercise 45.4 (page 530)

Note that alternative answers are possible for questions **1 to 6**.

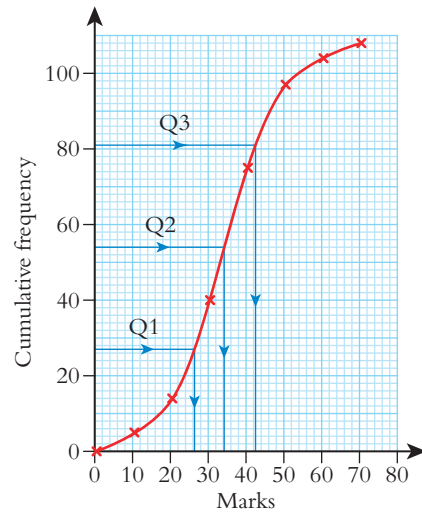
- The Year 12 marks are more spread out (a bigger range).  
Year 8 students have generally done better (higher minimum mark, median and quartiles).
- The number of hours spent revising by girls is more spread out (a bigger range).  
The middle 50% of the girls' hours are more spread out (a bigger box).
- Teenagers own more CDs than adults (min, median, quartiles and max values all higher).  
The number of CDs owned by teenagers is more spread out (a bigger range).
- The number of mistakes made by women is more spread out (a bigger range).  
In general women make fewer mistakes (lower median and quartile values).
- The middle 50% of the men's wages are more spread out (a bigger box).  
The range of wages is the same for women and men but lower min and max values for women.
- The middle 50% of the science and maths marks cover the same range.  
More students have done better in maths (higher quartile and median values).

### Exercise 45.5 (page 532)

1 a

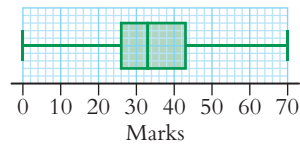
Mark (<)	Cumulative frequency
0.5	0
10.5	5
20.5	14
30.5	40
40.5	75
50.5	97
60.5	104
70.5	108

b



- c
- 33
  - 26
  - 43

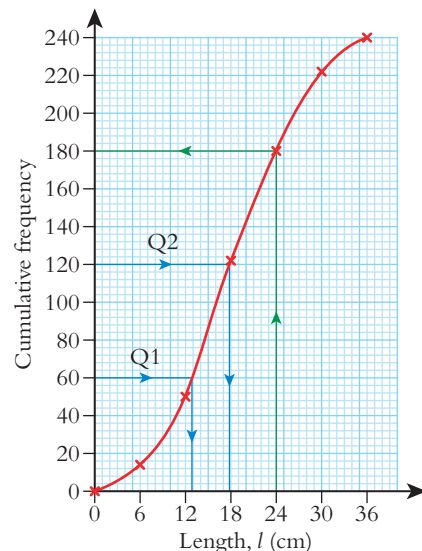
d



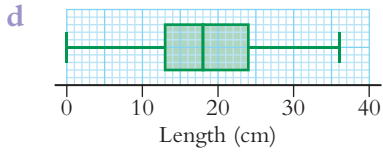
2 a

Length $\leq l$ (cm)	Cumulative frequency
0	0
6	14
12	50
18	122
24	180
30	222
36	240

b



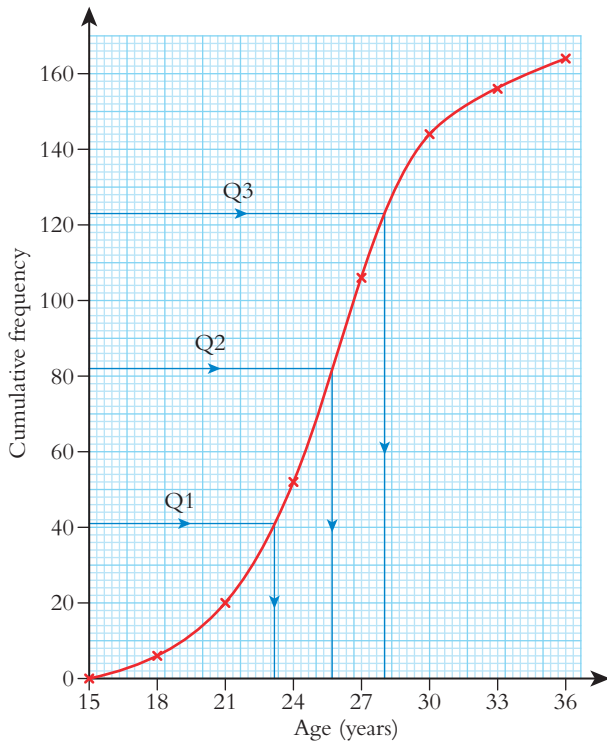
- c i 18  
ii 13  
iii 24



3 a

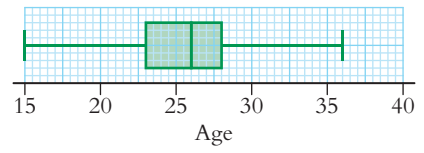
Age ( $\leq$ )	Cumulative frequency
15	0
18	6
21	20
24	52
27	106
30	144
33	156
36	164

b



- c i 26  
ii 23  
iii 36

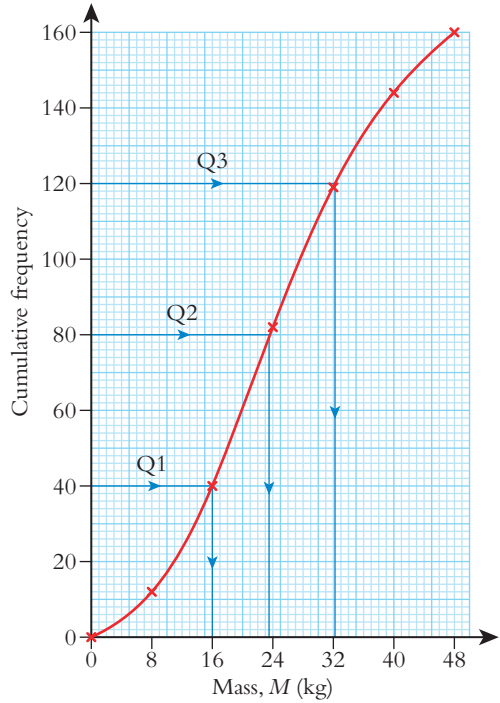
d



4 a

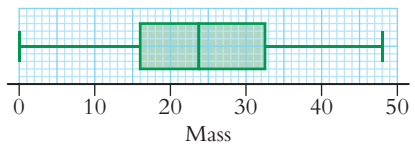
Mass $\leq M$ g	Cumulative frequency
0	0
8	12
16	40
24	82
32	119
40	144
48	160

b



- c i 23.75  
ii 16  
iii 32.5

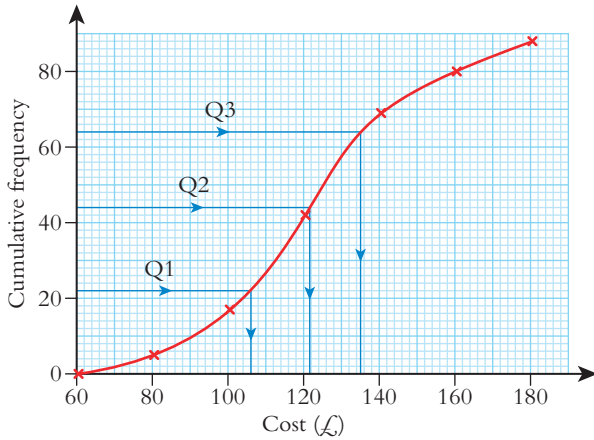
d



5 a

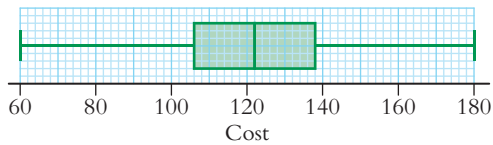
Cost (<) (£)	Cumulative frequency
60.50	0
80.50	5
100.50	17
120.50	42
140.50	69
160.50	80
180.50	88

b



- c
- i £122
  - ii £106
  - iii £138

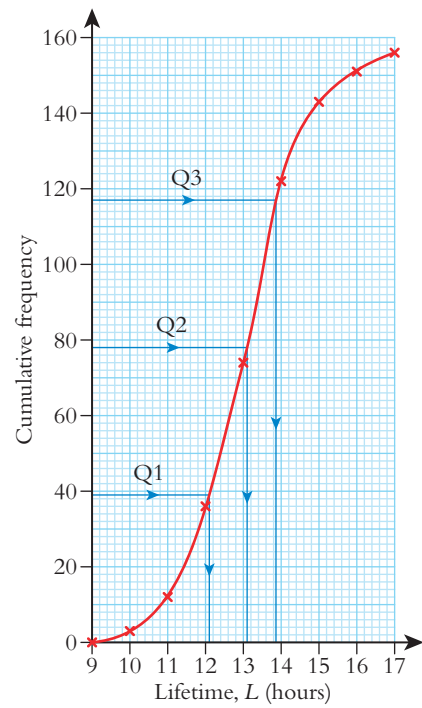
d



6 a

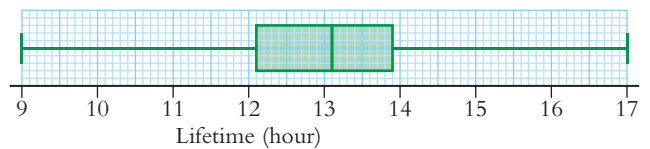
Lifetime $\leq L$ (hours)	Cumulative frequency
9	0
10	3
11	12
12	36
13	74
14	122
15	143
16	151
17	156

b



- c
- i 13.1 hours
  - ii 12.1 hours
  - iii 13.9 hours

d

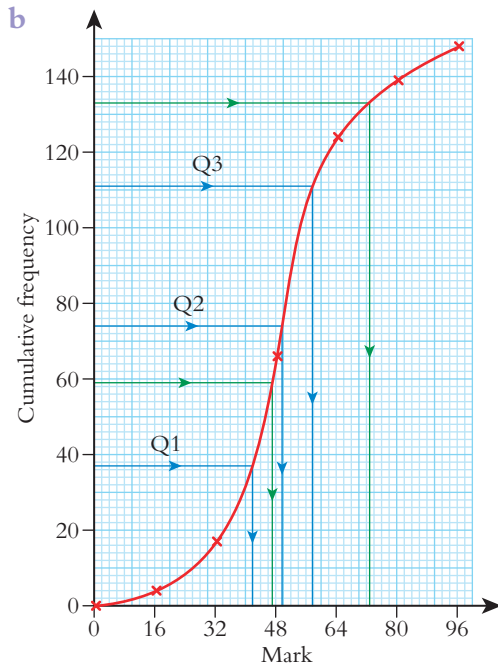




## Summary exercise 45 (page 533)

1 a

Mark (<)	0.5	16.5	32.5	48.5	64.5	80.5	96.5
Cumulative frequency	0	4	17	66	124	139	148

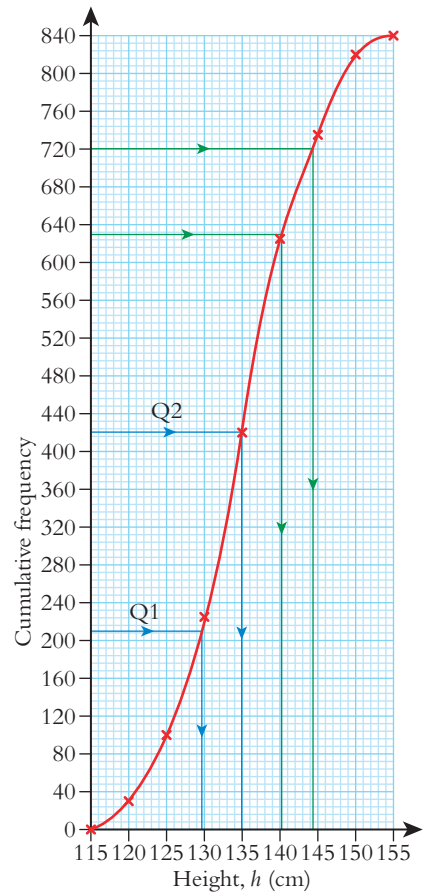


- c i 50  
 ii 17.5  
 d 47  
 e 73

2 a

Height $\leq h$ (cm)	115	120	125	130	135	140	145	150	155
Cumulative frequency	0	30	100	225	420	625	735	820	840

b

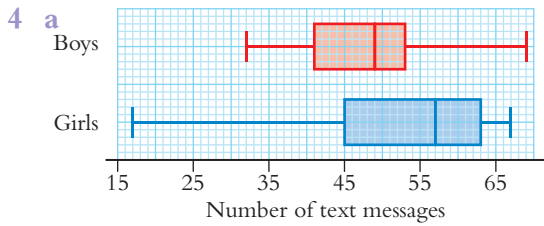


- c i 135  
 ii 10.75  
 d 14%

3 a

Length, $l$ (cm)	Frequency
$0 < l \leq 40$	4
$40 < l \leq 80$	14
$80 < l \leq 120$	22
$120 < l \leq 160$	40
$160 < l \leq 200$	24
$200 < l \leq 240$	18
$240 < l \leq 280$	6

- b median 145 cm, IQR 75 cm  
 c 100  
 d 75 cm

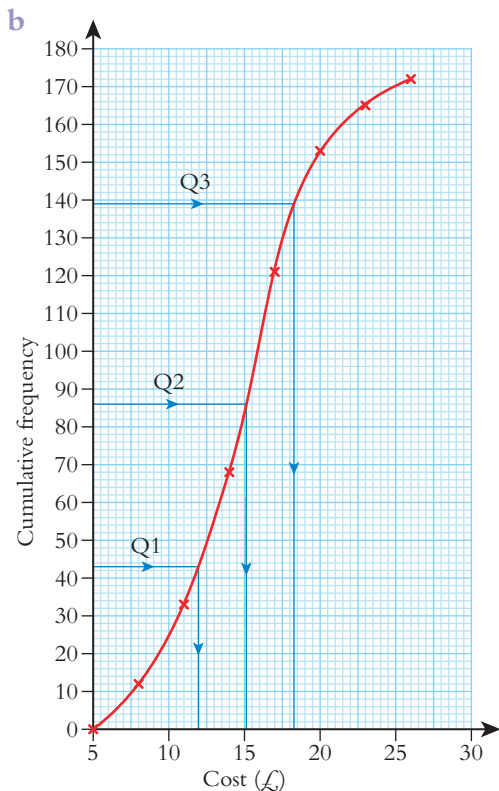


b For example, the number of text message sent by girls is more spread out, i.e. a wider range.

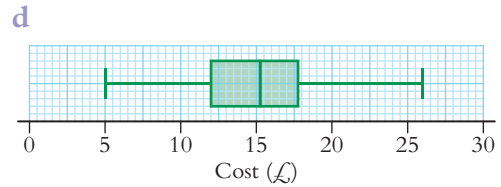
5 For example, the times taken to go to school are more spread out (a bigger range); the middle 50% of the 'to school' times are more spread out (a bigger box).

6 a

Cost $\leq C$ (£)	Cumulative frequency
5	0
8	12
11	33
14	68
17	121
20	153
23	165
26	172

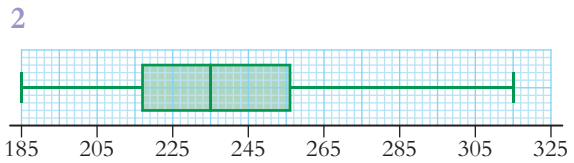


- c
- i £15.25
  - ii £12
  - iii £17.75



## Examination questions (page 535)

- 1
- a 44%
  - b  $58 - 30 = 28\%$
  - c 73%

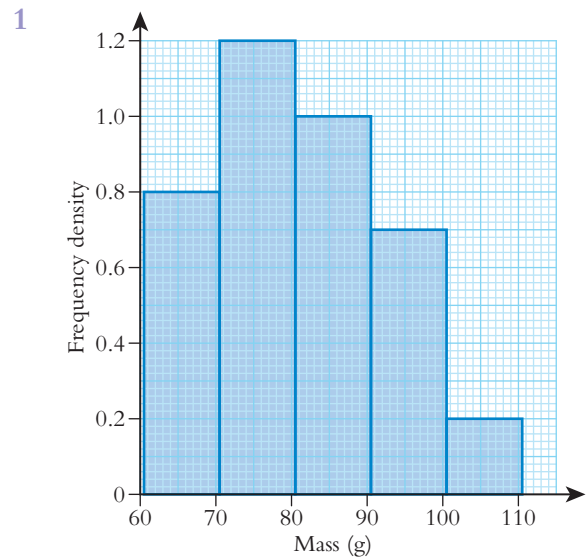


median, quartiles and range shown

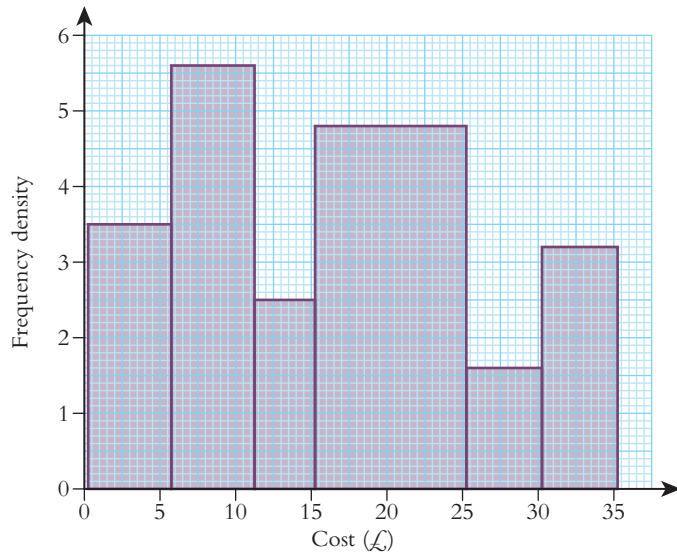
- 3 It is in the upper quartile.

## Chapter 46 Histograms and sampling

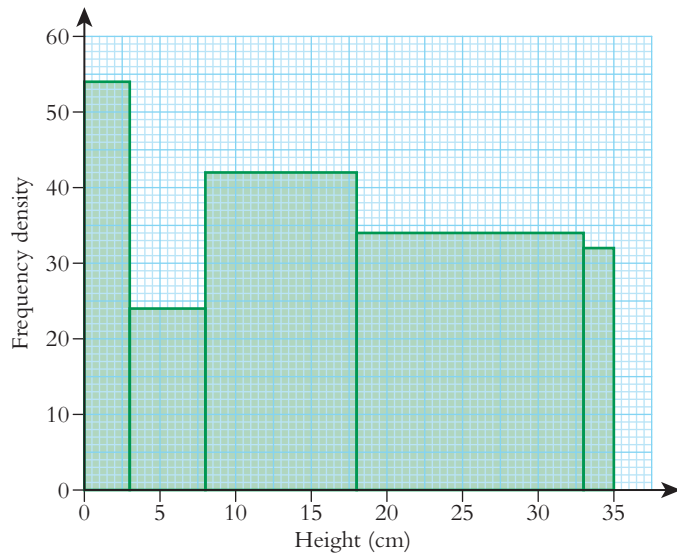
### Exercise 46.1 (page 539)



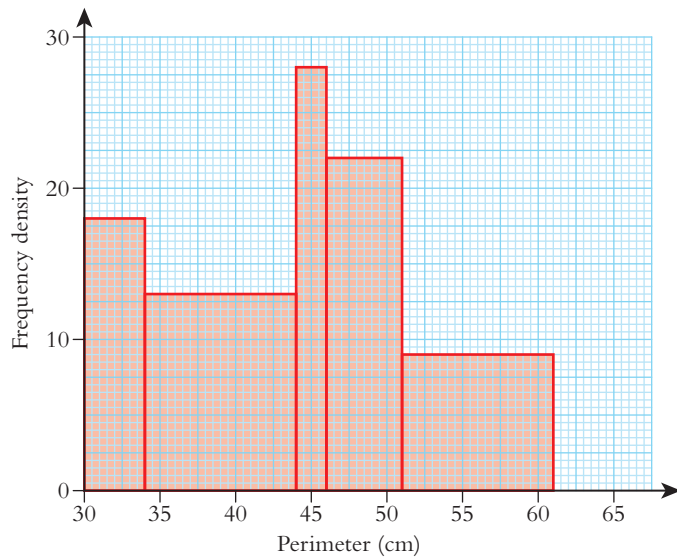
2



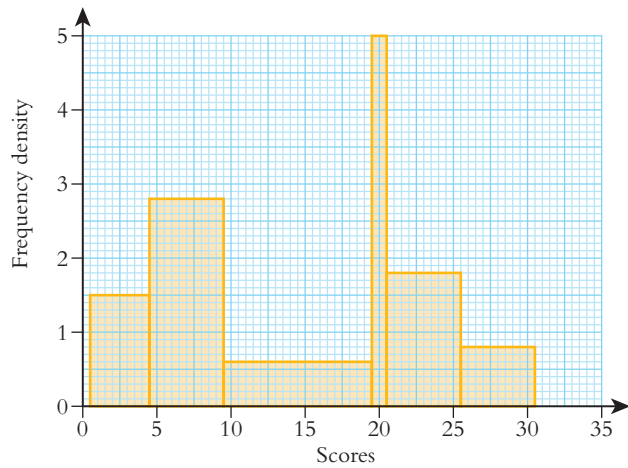
3



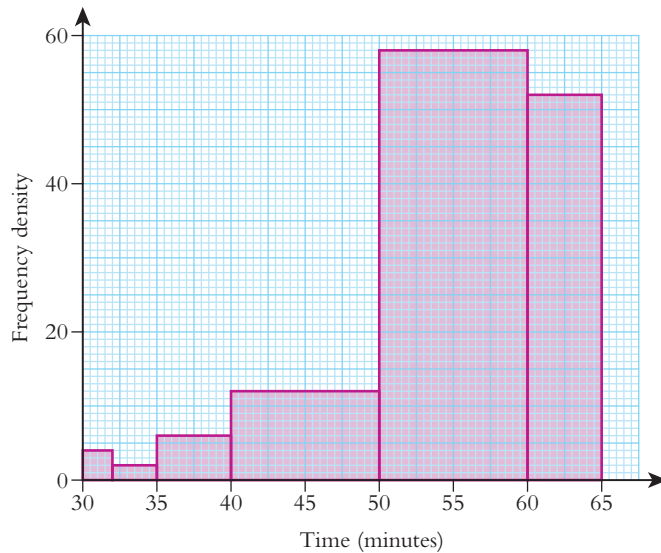
4



5



6



### Exercise 46.2 (page 541)

1

Cost, $C$ (£)	Frequency
1-6	21
7-11	28
12-15	10
16-25	48
26-30	8
31-35	16

2

Height, $h$ (cm)	Frequency
$0 < h \leq 3$	162
$3 < h \leq 8$	120
$8 < h \leq 18$	440
$18 < h \leq 33$	510
$33 < h \leq 35$	88

3

Price, $P$ (£)	Frequency
1–4	6
5–9	14
10–19	6
20–21	5
22–25	8
26–30	4

4

Time, $t$ (minutes)	Frequency
$30 < t \leq 32$	8
$32 < t \leq 35$	6
$35 < t \leq 40$	30
$40 < t \leq 50$	120
$50 < t \leq 60$	580
$60 < t \leq 65$	260

### Exercise 46.3 (page 543)

- random
  - no, doesn't include people who don't use the train, perhaps because they find it unreliable
- random
  - possibly, but sample size is small and it is unclear what range of subjects is covered
- systematic
  - yes
- random
  - yes
- random
  - no, depends who those 100 people are and how they are selected
- random
  - no, needs to be done at different times
- Biased because boys are not asked.
- Biased because only people who go to church are asked.
- Biased because no young people are asked.
- Biased because only students in the Additional Maths class are asked.

### Exercise 46.4 (page 545)

- red 4, yellow 12, blue 18, green 16
- Ford 9, Renault 15, Volkswagen 18, Skoda 6
- 24 males
- Spain 6, Italy 18, France 22, Portugal 4
- chicken 10, turkey 16, beef 14, vegetarian 8
- football 16, rugby 20, netball 8, hockey 12
- 14 from full or half board
- tennis 9, motor racing 12, ice hockey 24, hurling 18
- train 6, car 10, walk 12, bus 16
- 3

### Exercise 46.5 (page 547)

- 97 red
  - 194 blue
  - 388 green
- 194 men
  - 582 boys
  - 679 girls
- The Times* 436
  - The Mirror* 545
- Mini 363
  - Fiesta 484
  - Audi 605
- gym 146
  - badminton 438

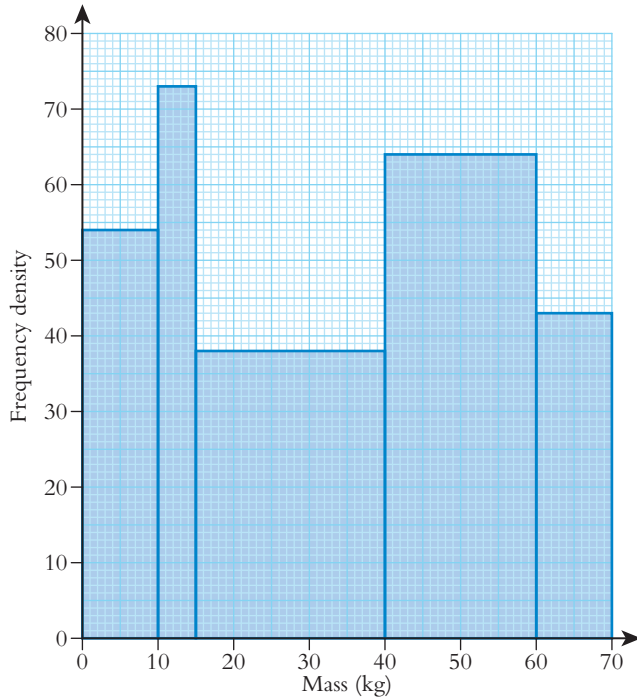
- Irish 119
  - French 595
- 162 walk
  - 243 come by train
  - 486 drive
- 492 visit friends
  - 984 stay at home
- 134 men
  - 469 boys
  - 536 girls
- Australia 87
  - America 348
  - Egypt 435

### Exercise 46.6 (page 548)

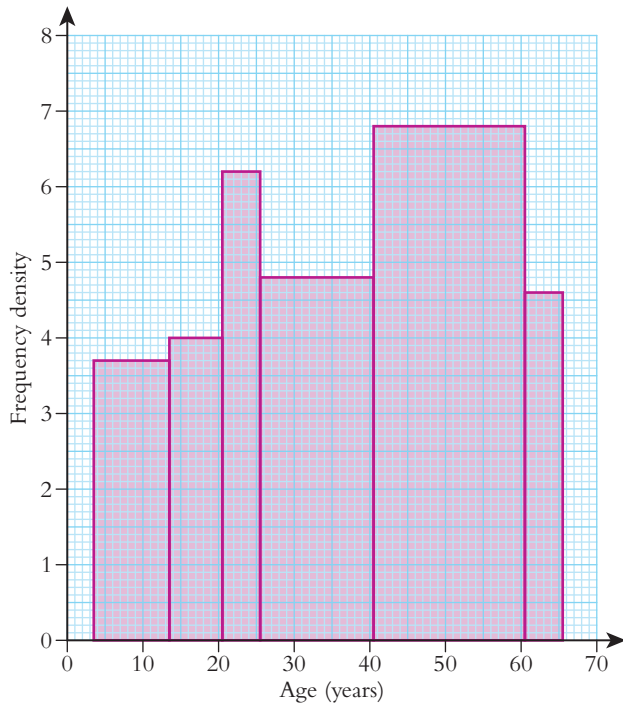
- 3 men
  - 12 children
- 10 motor bikes
  - 25 cars
- 8 cubes
  - 28 cylinders
- 28 in Years 8 and 9
  - 21 in Years 10 and 11
- 12 marbles
  - 16 counters
  - 20 beads
- 12 carp
  - 6 perch
  - 15 pike
- 15 Linfield, 40 Cliftonville, 35 Glenavon
- 8 men
  - 20 children

## Summary exercise 46 (page 549)

1



2



3

Cost (£)	Frequency
Over 0 and up to and including 50	120
Over 50 and up to and including 80	54
Over 80 and up to and including 140	126
Over 140 and up to and including 190	60
Over 190 and up to and including 210	16

- 4 Any example of random sample
- 5 a systematic  
b yes
- 6 Doesn't include students of different ages and different examinations
- 7 8 from  $h < 1.45$ , 12 from  $1.45 \leq h < 1.70$ , 14 from  $h \geq 1.70$
- 8 6
- 9 a 158 juice  
b 395 tea  
c 474 coffee
- 10 21 chicken, 35 tuna, 28 beef

### Examination questions (page 551)

- 1 a  $26 \div 10 = 2.6$   
 $5.6 \times 5 = 28$   
 $4.8 \times 5 = 24$   
 $0.6 \times 20 = 12$   
Total = 90
- b  $\frac{16}{64} \times 24 = 6$  students
- 2 It is biased to long-distance drivers.  
Some of the motorists will be driving company cars.
- 3 a All names in a bag is one example.  
b Ratio of boys to girls in the school and year groups of students, or other valid factors.

## Chapter 47 Probability

### Exercise 47.1 (page 554)

- 1 a  $\frac{9}{25}$   
b  $\frac{16}{25}$   
c 115

- 2 a P 0.24, Q 0.17, R 0.19, S 0.2, T 0.2  
b 44 times
- 3 a 40 withdrawals 0.675  
80 withdrawals 0.6375  
120 withdrawals 0.633  
160 withdrawals 0.63125  
200 withdrawals 0.645  
b 0.645, as this is from the most results  
c 39 blues and 21 greens
- 4 a red 0.573, amber 0.183, green 0.244  
b 82 more red lights than green
- 5 a

Number of questions	Total number wrong	Relative frequency to 3 significant figures if necessary
10	4	0.4
20	8	0.4
30	11	0.367
40	15	0.375
50	18	0.36
60	20	0.333
70	22	0.314

- b 0.314, because it is from the most results  
c 47 wrong
- 6 a 1, 0.147; 3, 0.172; 5, 0.122; 7, 0.325; 9, 0.233  
b i 23 or 24 times  
ii 37 times

### Exercise 47.2 (page 557)

- 1 0.31  
2  $\frac{1}{24}$   
3  $\frac{1}{8}$

- 4 0.27  
5  $\frac{21}{40}$   
6 0.16  
7  $\frac{23}{25}$   
8  $\frac{3}{20}$   
9 0.36

### Exercise 47.3 (page 559)

- 1 a  $\frac{13}{16}$   
b  $\frac{1}{2}$
- 2 0.45
- 3 a  $\frac{1}{10}$   
b  $\frac{13}{40}$   
c  $\frac{19}{40}$   
d  $\frac{1}{5}$   
e  $\frac{21}{40}$
- 4 a 0.46  
b 0.68  
c 0.16  
d 0.19
- 5 a  $\frac{5}{9}$   
b  $\frac{7}{9}$   
c  $\frac{1}{6}$   
d  $\frac{5}{36}$
- 6 a 0.42  
b 0.77  
c 0.11  
d 0.07  
e i 0.1  
ii 0.3

- 7 a  $\frac{17}{30}$   
b  $\frac{3}{5}$   
c  $\frac{3}{20}$

**d i**  $\frac{17}{180}$

**ii**  $\frac{17}{90}$

**8 a** 0.37

**b** 0.86

**c** 0.126

**d** 0.329

**e** 0.441

**9 a i**  $\frac{13}{16}$

**ii**  $\frac{9}{16}$

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

**10 a** 0.54

**b** 0.135

**c** 0.055

**d** 0.595

**e** 0.865

### Exercise 47.4 (page 564)

**1 a**  $\frac{6}{25}$

**b**  $\frac{12}{25}$

**c**  $\frac{4}{25}$

**d**  $\frac{21}{25}$

**2 a**  $\frac{5}{21}$

**b**  $\frac{10}{21}$

**c**  $\frac{3}{7}$

**d**  $\frac{2}{21}$

**e**  $\frac{19}{21}$

**3 a**  $\frac{4}{39}$

**b**  $\frac{17}{39}$

**c**  $\frac{6}{13}$

**4 a**  $\frac{1}{36}$

**b**  $\frac{1}{6}$

**c**  $\frac{1}{4}$

**d**  $\frac{8}{9}$

**5 a** 0.6

**b** 0.24

**c** 0.48

**d** 0.36

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

**b**  $\frac{1}{6}$

**c**  $\frac{1}{9}$

**d**  $\frac{1}{36}$

**e**  $\frac{4}{9}$

**f**  $\frac{11}{36}$

**7 a**  $\frac{6}{49}$

**b**  $\frac{1}{49}$

**c**  $\frac{3}{49}$

**d**  $\frac{9}{245}$

**e**  $\frac{87}{245}$

**f**  $\frac{18}{35}$

**8 a**  $\frac{3}{200}$

**b**  $\frac{9}{100}$

**c**  $\frac{3}{25}$

**d**  $\frac{121}{400}$

**e**  $\frac{1}{25}$

**f**  $\frac{399}{400}$

**9 a**  $\frac{64}{295}$

**b**  $\frac{11}{295}$

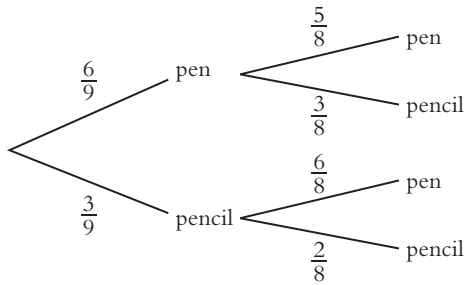
**c**  $\frac{221}{295}$

**d**  $\frac{249}{295}$



**Exercise 47.5 (page 567)**

**1 a**

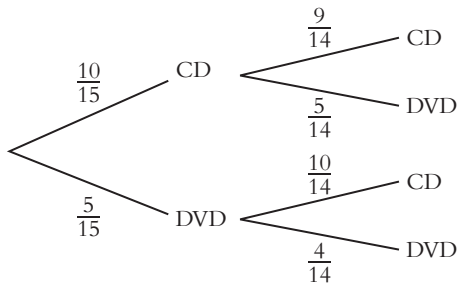


**b**  $\frac{5}{12}$

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

**d**  $\frac{1}{12}$

**2 a**

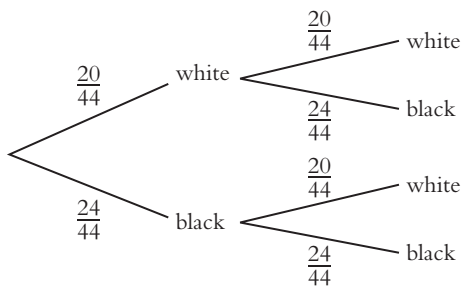


**b**  $\frac{3}{7}$

**c**  $\frac{10}{21}$

**d**  $\frac{2}{21}$

**3 a**

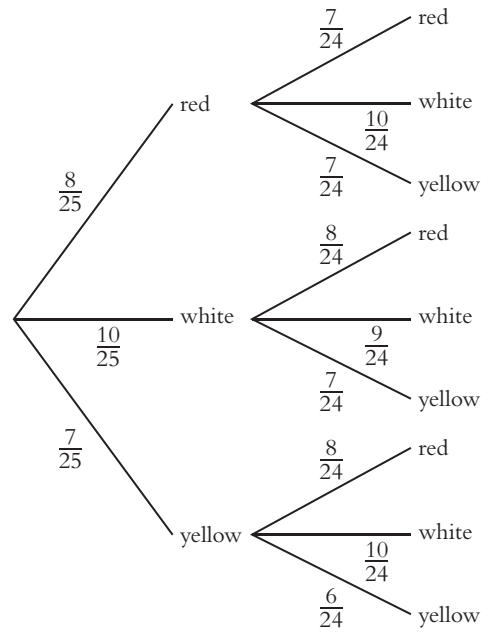


**b**  $\frac{36}{121}$

**c**  $\frac{25}{121}$

**d**  $\frac{60}{121}$

**4 a**



**b**  $\frac{14}{75}$

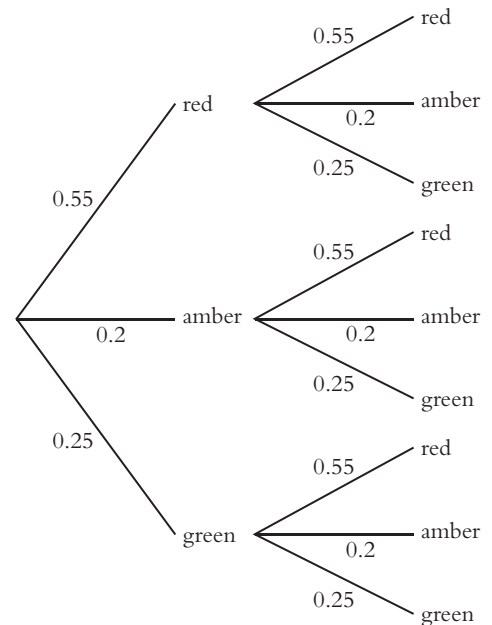
**c**  $\frac{3}{20}$

**d**  $\frac{34}{75}$

**e**  $\frac{49}{100}$

**5 a** 0.25

**b**



**c** 0.3025

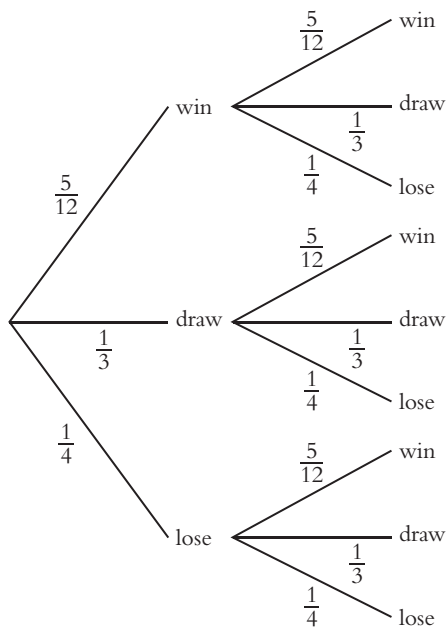
**d** 0.5625

**e** 0.32

**f** 0.7975

6 a  $\frac{1}{4}$

b



c  $\frac{1}{16}$

d  $\frac{35}{72}$

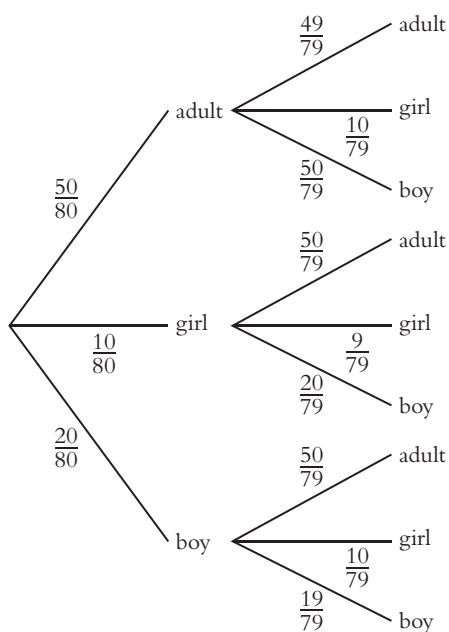
e  $\frac{5}{9}$

7 a  $\frac{50}{80}$

b  $\frac{10}{80}$

c  $\frac{20}{80}$

d

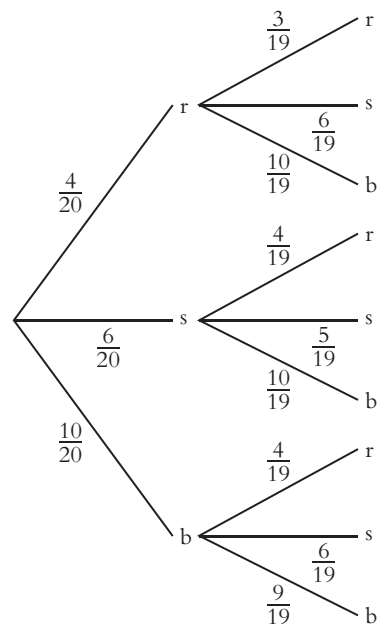


e  $\frac{245}{632}$

f  $\frac{87}{632}$

g  $\frac{297}{316}$

8 a



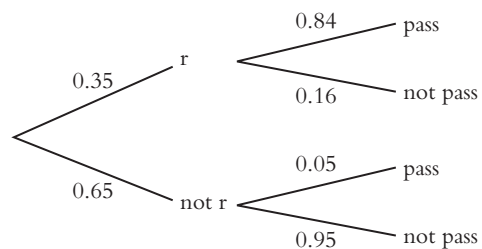
b  $\frac{6}{19}$

c  $\frac{3}{95}$

d  $\frac{91}{190}$

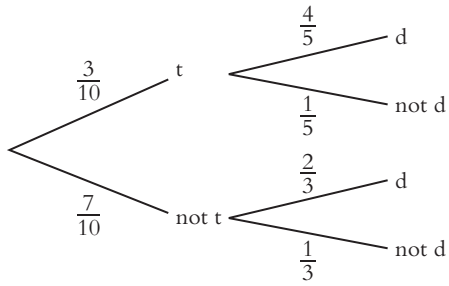
### Exercise 47.6 (page 569)

1 a



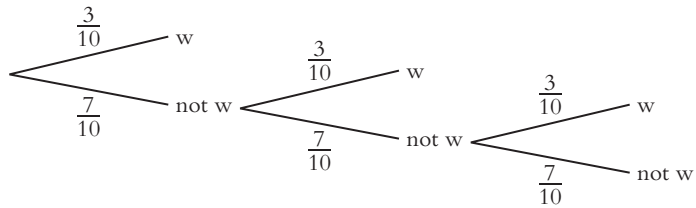
b 0.3265

2 a



b  $\frac{53}{75}$

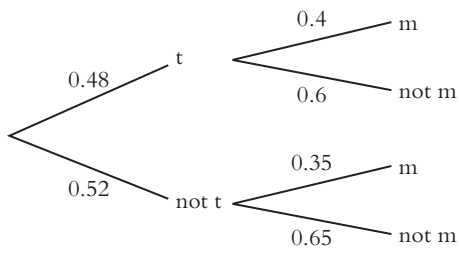
3 a



b  $\frac{21}{100}$

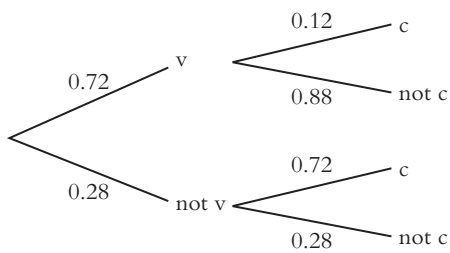
c  $\frac{343}{1000}$

4 a



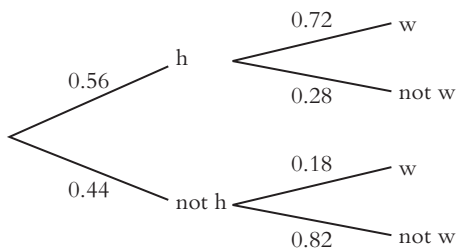
b 0.374

5 a

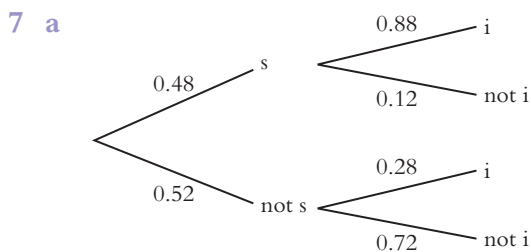


b 0.288

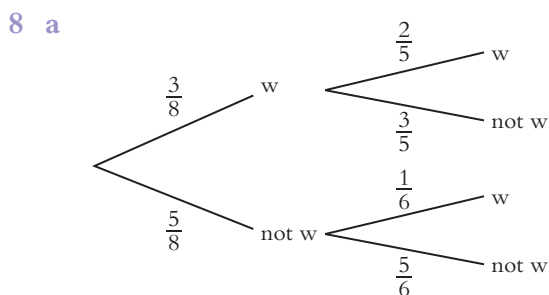
6 a



b 0.4824



b 0.568



b  $\frac{179}{240}$

### Summary exercise 47 (page 571)

1 a Frank 0.358, Gillian 0.337, Harry 0.309, Aishling 0.430

b 0.367

c 0.367, because it has the most results

d 349

2  $\frac{1}{18}$

3 a  $\frac{13}{80}$

b  $\frac{9}{20}$

c  $\frac{23}{30}$

4 a 0.41

b 0.85

c 99 sausage meals

5 a  $\frac{4}{25}$

b  $\frac{44}{105}$

c  $\frac{3}{7}$

6 a  $\frac{1}{7}$

b  $\frac{96}{625}$

c  $\frac{16}{125}$

d  $\frac{144}{625}$

e  $\frac{16}{25}$

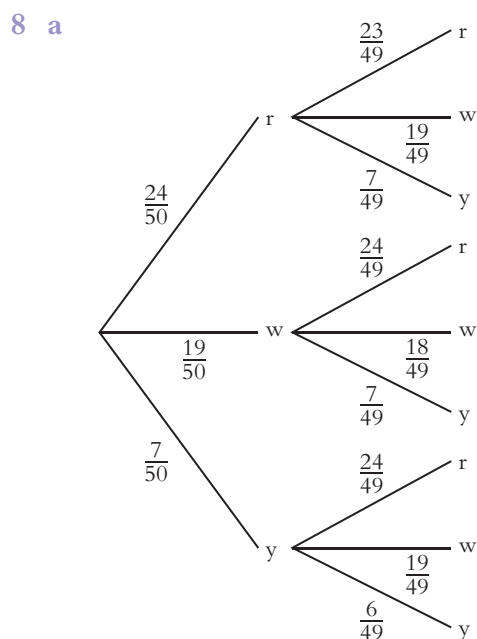
f  $\frac{336}{625}$

7 a  $\frac{14}{275}$

b  $\frac{7}{330}$

c  $\frac{713}{825}$

d  $\frac{163}{275}$

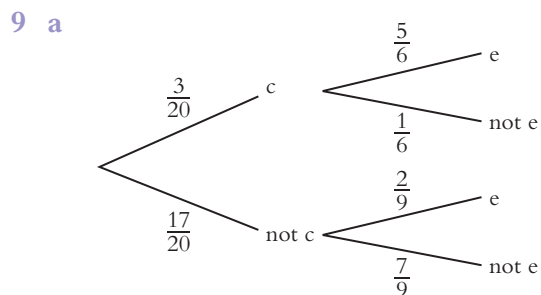


b  $\frac{24}{175}$

c  $\frac{3}{175}$

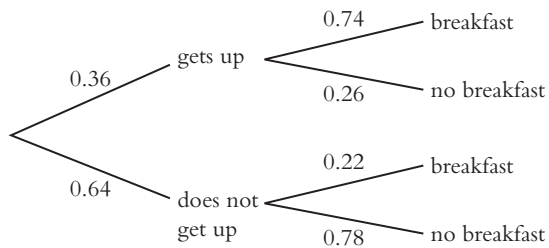
d  $\frac{13}{49}$

e  $\frac{46}{175}$



b  $\frac{113}{360}$

10 a



b 0.4072

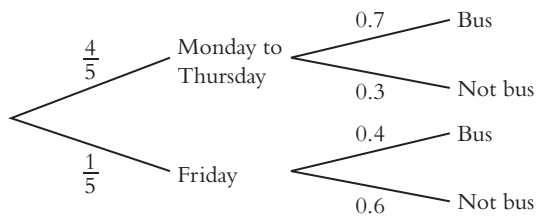
### Examination questions (page 573)

1 a  $1 - 0.9 = 0.1$

b 0.5

c 0.5

2 a



b  $0.8 \times 0.7 + 0.2 \times 0.4 = 0.56 + 0.08 = 0.64$

c  $0.2 \times 0.3 = 0.06$

3 a  $\frac{3}{16} \times 80 = 15$

b i  $\frac{8}{16} \times \frac{7}{15} = \frac{7}{30}$

ii  $\frac{8}{16} \times \frac{8}{15} + \frac{3}{16} \times \frac{13}{15} + \frac{5}{16} \times \frac{11}{15} = \frac{158}{240}$