Answers

ESSENTIAL TOPICS – NUMBER

Chapter 1 Calculating

➤ Skills check – warming up (pages 2–3)

Adding and subtracting whole numbers

a 336 miles **b** 333 miles **c** 3 miles

Multiplying whole numbers

2604

Adding and subtracting decimals

a 10.69 **b** 13.66 **c** 7.56 **d** 1.41

Dividing whole numbers

a 25 **b** 65 remainder 10

Adding and subtracting negative numbers

a −17 **b** −11 **c** −13 **d** 25

e 80 **f** −40 **g** 0 **h** 1

Multiplying and dividing negative numbers

a −6 **b** 20 **c** −3 **d** 4

➤ Applying the knowledge (page 3)

① **a** Yes, 18 boxes cost £270

b 7 tiles left over

② **a**

Credits (+)	Debits (−)	Balance (£)
		150
50		200
	95	**105**

b

Credits (+)	Debits (−)	Balance (£)
		150
50		200
	95	105
	85	**20**
	40	**−20**
100		**80**
	150	**−70**
	25	**−95**
400		**305**

c £305

1.1 Order of operations

➤ Skills check – do I need to do this section? (page 4)

① **a** Correct answer is 14

b Graham worked out $(3 \times 2 + 9 - 3) \div 3$ simply calculating from left to right.

Susan worked out $3 \times 2 + (9 - 3) \div 3$

② $(5 + 1) \times 2 - 9$

➤ Learning exercise (pages 5–6)

① **a** 21 **b** 11

② **a** 42 **b** 66

③ **a** 7 **b** 23

④ **a** 14 **b** 4

⑤ **a** 99 **b** 57

⑥ **a** 72 **b** 45

⑦ **a** 4 **b** 12

⑧ **a** 8 **b** 14

⑨ **a** 36 **b** 144

⑩ **a** 40 **b** 16

⑪ **a** 24 **b** 4

⑫ **a** 7 **b** 0

⑬ **a** −6 **b** 5

⑭ **a** 42 **b** 0

⑮ 0

⑯ 8

⑰ **a** $(6 + 3) \times 2 = 18$

b $5 + (9 - 2) \times 2 = 19$

c $(8 + 3) \times 2 + 1 = 23$

d $(4 + 3) \times (3 + 2) = 35$

e $6 + 8 - (2 + 1) = 11$

f $13 - (5 + 4 - 2) = 6$

⑱ **a** 2 **b** 6.5

⑲ **a** 13 **b** 19

⑳ **a** 1 **b** 2.5

➤ Problem solving exercise (pages 6–7)

① **a** $(10 - 1) \div 3 + 6 = 9$

b $(3 + 7) \times (2 - 5) = -30$

c $2 \times (1 + 3)^2 = 32$

② **a** Hannah is correct: $4 \times 25 - 52 = 48$

b Michelle did $6 \times 2 + (3 \times 2)^2 = 48$

Finlay did $(4 \times 3)^2 \div 3 = 48$

③ **a** For example: $3 + 2 \times 4 = 11$

b 47 $(= 3 + 4 \times 11)$

④ **a** $6 \times (1 + 7) = 48$

b $9 \div (7 - 4) = 3$

⑤ **a** 5.114692654

b $5.36 + 62.87 \div 19.86 - 6.52$

➤ Do I know it now? (page 7)

① **a** 15 **b** 1 **c** 1

② **a** 25 **b** 4 **c** −5

③ **a** 6.25 **b** −20 **c** 0

④ **a** 4 **b** 4 **c** 11

⑤ **a** 2.5 **b** 0 **c** −2.5

➤ Can I apply it now? (page 7)

① **a** $(12 + 4) \div (5 - 1) = 4$

b $7 - 3 \times (4 - 2) = 1$

1.2 Multiplying decimals

➤ Skills check – do I need to do this section? (page 8)

① **a** 0.04 **b** 0.128 **c** 0.066

d 1.92 **e** 0.0016 **f** 0.08

② 7.8 m

➤ Learning exercise (pages 9–10)

① **a** 2.4 **b** 0.024 **c** 0.24

② **a** 4 **b** 0.4 **c** 0.4

③ **a** 1.2 **b** 1.2 **c** 0.12

④ **a** 10 **b** 0.1 **c** 0.01

⑤ **a** 10.07 **b** 1007 **c** 0.1007

⑥ **a** 0.42 **b** 0.2

⑦ **a** 3 **b** 0.006

⑧ **a** 0.09 **b** 0.0009

⑨ **a** £12.90 **b** £13.08

⑩ **a** −1.2 **b** −0.12 **c** −0.12

⑪ **a** −10.8 **b** 10.8 **c** 1.08

⑫ £78.10

⑬ £12.60

⑭ £138.06

⑮ **a** 327.5 calories

b 230.5 calories

⑯ £240.82

➤ Problem solving exercise (page 11)

① David (£136.50) earns more than Elaine (£133)

② Annual rail ticket (cheaper by £50)

③ £391.20

④ 2.61 m^2 (or 5.22 m^2, counting both sides)

➤ Do I know it now? (page 11)

① **a** 1.6 **b** 0.45 **c** 21

d 16 **e** 3.9 **f** 0.48

g 0.36 **h** 0.0016

② **a** 174.84 **b** 17.484 **c** 174.84
d 1.7484 **e** 0.017484 **f** 1748.4

➤ Can I apply it now? (page 12)

① **a** £7.96 **b** £17.10 **c** £9.20

1.3 Dividing decimals

➤ Skills check – do I need to do this section? (page 12)

① **a** 568 **b** 860 **c** 650
d 56 **e** 400 **f** 18

② No, 5 boxes are needed

➤ Learning exercise (pages 14–15)

① **a** 3.24 **b** 4.85 **c** 3.25
d 0.009 **e** 2.004 **f** 7.403 25

② **a** 1.5 **b** 150 **c** 0.15

③ **a** 7 **b** 6 **c** 19
d 0.25 **e** 0.35 **f** 35.62

④ **a** 370 **b** 84.4 **c** 14.1
d 0.9 **e** 1035 **f** 3560

⑤ 160 ÷ 20

⑥ 72 ÷ 9 = 8 0.72 ÷ 9 = 0.08 7.2 ÷ 9 = 0.8
720 ÷ 0.9 = 800 7.2 ÷ 0.09 = 80
0.72 ÷ 90 = 0.008

⑦ **a** −3.45 **b** −1.56 **c** −0.0025
d 6.25 **e** –0.0005 **f** 0.16

⑧ **a** 0.2 **b** 0.2 **c** 100
d 1 **e** 110 **f** 0.000 005

⑨ 1.25 kg

➤ Problem solving exercise (page 15)

① £48.20

② **a** 0.4 kg **b** 500

③ 150

④ **a** Small = 24/£; large = 25/£
b 28+ bags/£, so best value

➤ Do I know it now? (page 16)

① **a** 8 **b** 24 **c** 1700 **d** 1570

② **a** 80 **b** 9 **c** 0.15 **d** 0.0125

③ **a** 1 **b** 20 **c** 12.5 **d** 0.001

④ **a** −20 **b** −320 **c** −0.3 **d** 11

⑤ 500 stamps

➤ Can I apply it now? (page 16)

① **a** 0.0625 litres **b** 0.286 litres

Chapter 2 Using our number system

➤ Skills check – warming up (page 19)

Using whole numbers

940 > 409

> <

904 > 490

Understanding decimals

a 3 tens = 30
b 6 tenths = 0.6
c 9 hundreds = 900
d 9 thousandths = 0.009

Multiplying and dividing by powers of 10

× 1000	23 000	3 000 000	461 000	2 750 000	4 200 000
× 100	2300	300 000	46 100	275 000	420 000
Number	23	3000	461	2750	4200
÷ 10	2.3	300	46.1	275	420

Negative numbers

−6, −3, −1, 0, +1, +5

Applying the knowledge (page 20)

① **a** Timekeeper A
b Timekeeper C

② **a** No, the order reverses
b 4 and −2 *or* 2 and −4

2.1 Using the number system effectively

Skills check – do I need to do this section? (page 20)

① **a** 42 **b** 420 **c** 4200 **d** 5.7
e 63 **f** 80 **g** 46 **h** 39

Learning exercise (pages 22–23)

① **a** **i** 2 468 000 **ii** 246 800
iii 24 680 **iv** 2468
v 246.8 **vi** 24.68
vii 2.468
b more; less

② **a** **i** 6.5 **ii** 65
iii 650 **iv** 6500
v 65 000 **vi** 650 000
vii 6 500 000
b less; more

③ **a** 4 **b** 60 **c** 0.9
d 0.84 **e** 1250 **f** 9930
g 62 **h** 51.7

④ **a** 0.006 **b** 5 **c** 80
d 1.45 **e** 24 690 **f** 6130
g 3200 **h** 200 000

⑤ **a** 0.2259 **b** 0.638 **c** 0.008
d 0.0004 **e** 5840 **f** 700
g 24 900 **h** 81.5

⑥ **a** 60 **b** 1.3 **c** 4700
d 5290 **e** 0.08 **f** 7650
g 500 **h** 0.46

⑦ **a** 18 000 **b** 0.023 **c** 691
d 7.2 **e** 0.5 **f** 3200
g 0.001 64 **h** 58 990

⑧ **a** £8.60
b 8.60 × 10 = £86
c 8.60 × 0.1 = £0.86

⑨ 1, 4 and 5 are correct **2** 2 **3** 25
6 112 100 **7** 0.06 **8** 20.4

⑩ **a** 10 **b** 0.1 **c** 0.01
d 100 **e** 0.1 **f** 0.01

⑪ **a** 100 **b** 0.1 **c** 0.001
d 0.1 **e** 100 **f** 0.1

Do I know it now? (page 23)

① **a** 0.82 **b** 13 **c** 0.04
d 0.008 **e** 0.063 **f** 0.009
g 0.201 **h** 0.0007

② **a** 28 **b** 3000 **c** 80
d 200 **e** 6000 **f** 0.4
g 1 000 000 **h** 10

③ 10 000

2.2 Understanding standard form

Skills check – do I need to do this section? (page 24)

① **a** 1.36×10^3, 5.47×10^3, 2.3×10^4, 32 000, 40 thousand
b 0.000 03, 4×10^{-5}, 1.8×10^{-4}, 3.7×10^{-4}, 0.000 65

② **a** 2.34×10^1 **b** 2.34×10^7
c 2.34×10^{-2} **d** 2.34×10^2
e 2.34×10^{-6} **f** standard form
g 2.34×10^{-3} **h** 2.34×10^0

Learning exercise (pages 25–27)

① **a** **i** 5.12×10^3 **ii** 5.12×10^2
iii 5.12×10^1 **iv** 5.12×10^{-1}
v 5.12×10^{-3} **vi** 5.12×10^{-4}
b 5.12×10^0

② **a** 500 **b** 80 000
c 2600 **d** 190 000
e 8170 **f** 90 500
g 74 000 000 **h** 10 040

③ **a** 6×10^2 **b** 7×10^4
c 8.9×10^3 **d** 8.16×10^2
e 1.33×10^5 **f** 4×10^6
g 9.5×10^7 **h** 4×10^9

④ **a** 0.068 **b** 0.005 **c** 0.0299
d 0.0007 **e** 0.104 **f** 0.000 086
g 0.000 005 **h** 0.032 27

⑤ **a** 6.9×10^{-1} **b** 5.2×10^{-2}
c 1.14×10^{-2} **d** 7×10^{-4}
e 3.8×10^{-3} **f** 6×10^{-6}
g 9.55×10^{-1} **h** 9×10^{-5}

⑥ 1600 0.8×10^3 9×100^3

⑦ **a** 6×10^4 **b** 1.08×10^5
c 1.5×10^8 **d** 3×10^{-3}
e 2.6×10^{-6}

⑧ **a** 9000, nine thousand
b 2100, two thousand one hundred
c 680, six hundred and eighty
d 922, nine hundred and twenty-two
e 10 800, ten thousand eight hundred
f 70, seventy
g 0.7, seven tenths
h 0.03, three hundredths

⑨ **a** 6×10^3 **b** 7.4×10^1
c 8.1×10^2 **d** 2.015×10^3
e 4×10^{-1} **f** 3×10^{-2}
g 2.24×10^{-6} **h** 5.108×10^6
i 6.78×10^7 **j** 2.3×10^7
k 6×10^9 **l** 7.001×10^{-9}

⑩ 7.95×10^2, 7.09×10^3, 7100, 6.8×10^4, 9×10^4

⑪ 0.04, 3.9×10^{-2}, 3.82×10^{-2}, 2.2×10^{-3}, 2×10^{-3}

⑫ **a** < **b** < **c** =
d < **e** > **f** >

⑬ Venus, Mars, Mercury, Sun, Jupiter, Saturn, Uranus, Neptune

⑭ 5 (questions 3, 4, 6, 8 and 10)

➤ Do I know it now? (page 27)

① **a** 200 800 **b** 2 450 000
c 7 803 000 000 **d** 645 000 000
e 0.9 **f** 0.000 000 207
g 0.006 145 **h** 0.1007

② **a** 2.025×10^4 **b** 2.3×10^7
c 6.547×10^2 **d** $2.562\,487 \times 10^4$
e 3×10^{-1} **f** 7×10^{-2}
g 2.04×10^{-3} **h** 9.9×10^{-2}

③ **a** 7×10^9 **b** 8×10^{-3}

Chapter 3 Accuracy

➤ Skills check – warming up (page 29)

Rounding to the nearest 10 or 100

Number	Nearest 100	Nearest 10
371	400	**370**
402	**400**	400
6399	**6400**	**6400**
1045	**1000**	**1050**

Rounding larger numbers

Statement **d** is wrong. It should be 8 390 000.

Rounding decimals to the nearest integer

a 15 **b** 9 **c** 50
d 107 **e** 28

Rounding to a number of decimal places

a 34.3 **b** 14.5 **c** 1.6
d 1.65 **e** 0.14 **f** 1.0
g 0.50 **h** 1.00

➤ Applying the knowledge (page 30)

① By rounding: 4 cm + 8 cm + 4 cm + 11 cm = 27 cm – this is much less than Salome's answer.

② 0.08 has just one significant figure; 0.079 m^2

3.1 Significance

Skills check – do I need to do this section? (page 30)

① **a** 26 **b** 89.1 **c** 56.3
d 1770 **e** 0.028 **f** 7000
g 0.002 **h** 0.031

Learning exercise (pages 31–33)

① **a** 2 **b** 4 **c** 1
d 2 **e** 3 **f** 3
g 4 **h** 5

② **a** 30 **b** 50 **c** 400
d 900 **e** 7000 **f** 20 000
g 20 **h** 60 **i** 0.9
j 0.7 **k** 0.02 **l** 0.02

③ **a** 870 **b** 920 **c** 620
d 710 **e** 700 **f** 3300
g 5100 **h** 19 000 **i** 73 000
j 8000 **k** 0.64 **l** 0.60

④ **a** 400 000 **b** 380 000 **c** 384 000
d 384 000 **e** 384 030

⑤ **a** 8 **b** 8.0 **c** 8.00
d 8.000 **e** 8.0000

⑥ **a** 0.008 **b** 0.0081
c 0.008 11 **d** 0.008 106
e 0.008 1060

⑦ **a** 20 **b** 0.60 **c** 71 000
d 4 **e** 6.51 **f** 27.00

⑧ **a** 20 **b** 10
c 51 **d** 0.048
e 17 600 000 **f** 100
g 300 **h** 1.01
i 677

⑨ **a** true **b** true **c** true **d** false

⑩ **a** Ada and Cain, Ben and Dave
b Ada, Ben and Cain
c Ben and Cain

⑪ Ami. Dan has rounded down instead of up, Milly thinks that the zero is not significant and Bob has changed the size of the number.

⑫ **a** $C = 24\,\text{cm}$ **b** $C = 24.8\,\text{cm}$
c $C = 25.12\,\text{cm}$ **d** $C = 25.136\,\text{cm}$

Do I know it now? (page 33)

① **a** 1 **b** 0.01
c 1000 **d** 1 000 000

② **a** 6.4 **b** 20
c 0.0052 **d** 0.010

③ **a** 0.3068 **b** 515 300 **c** 2.0

3.2 Approximating

Skills check – do I need to do this section? (pages 33–34)

① **a** ≈ 5 **b** 5.34

② Tuesday 10–11 p.m.

Learning exercise (pages 35–36)

① **a** 90 **b** 800 **c** 1500
d 15 **e** 900 **f** 11 000

② **a** **iii** **b** **ii** **c** **iii**

③ **a**, **c** and **f**

④ No, she does not have enough money.

⑤ **a**, **d** and **f**

⑥ **a** 1000 **b** 70 **c** 3600
d 1600 **e** 1000 **f** 121

⑦ **a** **iii**, $500^2 = 250\,000$
b **iv**, $70 \times 7 = 490$
c **i**, $4^2 + 3^3 = 43$

⑧ £1000 ⑨ £360 ⑩ 50 mph

⑪ £2000 ⑫ 4 months

⑬ **a** wrong **b** right **c** wrong

⑭ **a** 100 times **b** 4 times **c** 400 times

➤ Problem solving exercise (pages 37–38)

① **a** Less; normal pay ≈ £210, overtime ≈ £50, Sunday ≈ £40

b Yes; ≈ £12 000 wages + ≈ £1500 holiday pay

② **a** 3600 seconds ÷ 900 batches = 4 seconds

b 9000 pots × 30 hours = 270 000 pots in a week

270 000 ÷ 100 pots/carton = 2700 cartons

③ **a** Yes, with about £4 to spare

b Yes, ≈ £1

④ Catch the 08:20 train from London – the 09:00 does not allow for any delay.

Catch the 18:12 train from Stoke – the 17:50 does not allow for any delay.

Leave home at about 8 a.m., arrive back at about 8 p.m. (12 hours).

➤ Do I know it now? (page 38)

① **a** ≈ 1000 **b** ≈ 20 **c** ≈ 1600

② **a** **i** **b** **iv**

③ **a** ≈ 280 **b** ≈ 4200 **c** ≈ 7000

④ ≈ £46.80

➤ Can I apply it now? (page 38)

① Volume of jar ≈ $3 \times 10^2 \times 35$

$= 105 \times 100\,\text{cm}^3$

Volume of 'man' = $1 \times 1 \times 2\,\text{cm}^3$

Number of men ≈ $\frac{^{50}\cancel{100} \times 100}{\cancel{2}_{1}} = 5000$

Chapter 4 Fractions

➤ Skills check – warming up (pages 41–42)

Understanding fractions

a £8 **b** 63 people

c 10 ounces **d** £4

Finding equivalent fractions

a $\frac{1}{2}$ **b** $\frac{3}{4}$ **c** $\frac{5}{6}$ **d** $\frac{2}{3}$

Multiplying fractions

a $\frac{15}{28}$ **b** $\frac{8}{55}$ **c** $\frac{20}{63}$

Adding and subtracting fractions

a $\frac{55}{63}$ **b** $\frac{1}{6}$ **c** $\frac{11}{20}$ **d** $\frac{1}{2}$

➤ Applying the knowledge (page 42)

① $\frac{5}{12}$ ② 120

4.1 Working with mixed numbers

➤ Skills check – do I need to do this section? (page 43)

① **a** $7\frac{1}{2}$ **b** $1\frac{8}{15}$ **c** $1\frac{5}{8}$ **d** $2\frac{1}{12}$

② 8 pizzas, 10 loaves of garlic bread, 5 lettuces, 23 tomatoes, 3 bottles of salad cream, 4 tubs of coleslaw

➤ Learning exercise (pages 45–47)

① **a** $\frac{4}{3}$ **b** $\frac{9}{4}$ **c** $\frac{7}{2}$ **d** $\frac{7}{5}$

e $\frac{11}{4}$ **f** $\frac{31}{6}$ **g** $\frac{20}{9}$ **h** $\frac{48}{7}$

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

e $3\frac{2}{5}$ **f** $3\frac{5}{6}$ **g** $8\frac{8}{9}$ **h** $12\frac{3}{4}$

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

d $4\frac{1}{2}$ **e** $2\frac{1}{10}$ **f** $4\frac{1}{2}$

④ **a** $4\frac{1}{6}$ **b** $4\frac{1}{4}$ **c** $3\frac{14}{15}$

d $7\frac{3}{10}$ **e** $5\frac{7}{12}$ **f** $6\frac{27}{40}$

⑤ **a** $\frac{11}{24}$ **b** $1\frac{4}{5}$ **c** $1\frac{17}{20}$

d $2\frac{19}{24}$ **e** $2\frac{5}{12}$ **f** $1\frac{29}{90}$

⑥ **a** $8\frac{2}{3}$ **b** $8\frac{4}{5}$ **c** $6\frac{3}{4}$

d $6\frac{3}{7}$ **e** 14 **f** $30\frac{3}{5}$

⑦ **a** $7\frac{7}{8}$ **b** $7\frac{2}{9}$ **c** $2\frac{1}{9}$

d $10\frac{2}{3}$ **e** $3\frac{5}{24}$ **f** $12\frac{3}{8}$

⑧ **a** $9\frac{7}{20}$ **b** $2\frac{17}{24}$ **c** $2\frac{1}{2}$

d $4\frac{1}{8}$ **e** $6\frac{5}{12}$ **f** $4\frac{9}{40}$

⑨ **a** $2\frac{2}{3}$ **b** 4 **c** $5\frac{1}{3}$

d $6\frac{2}{3}$ **e** 8 **f** $9\frac{1}{3}$

⑩ $5\frac{3}{8}$ km

⑪ **a** false **b** false; $1\frac{17}{60}$ km

c false; $1\frac{11}{12}$ pints **d** true

⑫ **a** $15\frac{23}{24}$ kg **b** $2\frac{7}{12}$ kg **c** $20\frac{73}{120}$ kg

⑬ **a** $2\frac{1}{4}$ **b** $6\frac{1}{4}$ **c** $1\frac{9}{16}$

d $3\frac{3}{8}$ **e** $10\frac{81}{125}$ **f** $7\frac{58}{81}$

⑭ **a** $1\frac{2}{5}$ **b** 8 **c** $1\frac{1}{12}$

⑮ $21\frac{11}{15}$ m

➤ Problem solving exercise (page 47)

① **a** 8 km **b** $4\frac{3}{4}$ km **c** $4\frac{5}{16}$ km

② No, he needs an additional $\frac{3}{20}$ litre

③ **a** $1\frac{5}{12}$ cups **b** Yes, $\frac{59}{90}$ left

➤ Do I know it now? (page 48)

① **a** $\frac{23}{5}$ **b** $\frac{20}{3}$ **c** $\frac{89}{9}$ **d** $\frac{51}{4}$

② **a** $4\frac{5}{8}$ **b** $5\frac{6}{7}$ **c** $13\frac{3}{5}$ **d** $6\frac{17}{20}$

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

d $2\frac{3}{4}$ **e** $1\frac{3}{4}$ **f** $1\frac{8}{15}$

④ **a** $4\frac{1}{2}$ **b** $5\frac{1}{16}$ **c** $10\frac{1}{8}$

d $11\frac{1}{4}$ **e** $11\frac{2}{5}$ **f** $4\frac{3}{8}$

➤ Can I apply it now? (page 48)

① $\frac{1}{12}$

4.2 Dividing fractions

➤ Skills check – do I need to do this section? (page 48)

① **a** 35 **b** $\frac{2}{7}$ **c** $17\frac{1}{2}$

d $3\frac{3}{4}$ **e** $1\frac{13}{27}$

② **a** 2 **b** $\frac{5}{4} = 1\frac{1}{4}$ **c** $\frac{3}{5}$

③ 5 days (He only has $\frac{13}{16}$ of an acre on the 6th day.)

➤ Learning exercise (pages 50–51)

① **a** 7 **b** $\frac{7}{5}$ **c** $\frac{1}{20}$ **d** $\frac{2}{3}$

e $\frac{8}{21}$ **f** $\frac{6}{29}$ **g** $\frac{8}{31}$ **h** $\frac{9}{56}$

② **a** $\frac{1}{10}$ **b** $\frac{1}{12}$ **c** $\frac{3}{20}$ **d** $\frac{1}{5}$

e $\frac{7}{54}$ **f** $\frac{9}{40}$ **g** $\frac{1}{40}$ **h** $\frac{1}{100}$

③ **a** 6 **b** 8 **c** 15 **d** 3

e $8\frac{1}{3}$ **f** 8 **g** 72 **h** 72

④ **a** $\frac{4}{9}$ **b** $\frac{5}{12}$ **c** $\frac{4}{9}$ **d** $\frac{8}{21}$

e $\frac{2}{3}$ **f** $\frac{15}{16}$ **g** $\frac{1}{4}$ **h** 4

⑤ **a** $\frac{5}{12}$ **b** $4\frac{2}{3}$ **c** $1\frac{1}{3}$ **d** $1\frac{13}{15}$
e $\frac{5}{7}$ **f** $1\frac{12}{13}$ **g** $3\frac{23}{27}$ **h** $\frac{15}{56}$

⑥ $\frac{7}{24}$ litre

⑦ $\frac{1}{6}$

⑧ **a** false; $\frac{1}{12} \neq 12$ **b** true; $12 = 12$
c true; $\frac{2}{15} \neq \frac{3}{10}$

⑨

×	$\frac{1}{4}$	$\frac{2}{3}$
$\frac{1}{5}$	$\frac{1}{20}$	$\frac{2}{15}$
$\frac{5}{6}$	$\frac{5}{24}$	$\frac{5}{9}$

⑩ **a** $4\frac{4}{5}$ m **b** $22\frac{1}{10}$ m

⑪ **a** $1\frac{71}{120}$ **b** $\frac{1}{8}$ **c** 3 **d** $1\frac{2}{5}$

⑫ 35 mph

⑬ 5 children

➤ Do I know it now? (page 52)

① **a** $\frac{1}{8}$ **b** $\frac{4}{3}$ **c** $\frac{3}{7}$ **d** $\frac{5}{9}$

② **a** $\frac{7}{16}$ **b** $\frac{1}{12}$ **c** 24 **d** $18\frac{2}{3}$

③ **a** $\frac{9}{13}$ **b** $\frac{4}{15}$ **c** $\frac{1}{3}$ **d** $2\frac{11}{32}$

④ 19 g/cm^3

Chapter 5 Percentages

➤ Skills check – warming up (pages 54–55)

Understanding and using percentages

a $\frac{16}{25}$ **b** 64%

Calculating percentages of quantities

a £60 **b** £150 **c** 22 km **d** 32.5 kg

Converting fractions and decimals to and from percentages

Fraction	Decimal	Percentage
$\frac{1}{2}$	**0.5**	**50%**
$\frac{3}{20}$	0.15	**15%**
$\frac{3}{4}$	**0.75**	75%
$\frac{1}{10}$	**0.1**	**10%**

➤ Applying the knowledge (page 55)

① £2245.83

② **a** $\frac{36}{50}$ (= 72%; $\frac{56}{80}$ = 70%)
b 55 (total marks available = 210; 70% = 147)

5.1 Applying percentage increases and decreases to amounts

➤ Skills check – do I need to do this section? (page 56)

① **a** £15 600 **b** £24 960 **c** £17 680

② £41 026.30

➤ Learning exercise (pages 59–60)

① **a** £7 **b** £77 **c** £63

② **a** £18 **b** £16.20 **c** £5.85

③ **a** £52 **b** £41.60 **c** £11.96

④ **a** reduction = £17, new price = £51
b reduction = £61, new price = £183
c reduction = £4.75, new price = £14.25

⑤ **a** 33 **b** 28 **c** 24
d 120 **e** 42 **f** 102
g 30 **h** 30 **i** 220

⑥ £61.95

⑦ **a** 60 bars
b 75 lollipops
c 200 chews

⑧ £8280

⑨ £190 550

⑩ £322.24

⑪ 1.38 litres

⑫ £115.20

⑬ **a** £722.40 **b** £1404.32
c £191.52 **d** £834.90

⑭ Sandra, by £1.13

➤ Problem solving exercise (page 60)

① **a** £20 000 **b** £15 000
c 25% of £20 000 is more than 25% of £16 000, so the final salary is less than the original.

② **a** Car C (C depreciated by £1565, A by £1575 and B by £1725.)
b £14 085

③ £150

➤ Do I know it now? (page 61)

① **a** £16 **b** £96 **c** £64

② **a** £24 (reduction £6)
b £79.20 (reduction £19.80)
c £44.40 (reduction £11.10)

③ **a** 126 g **b** 216 m
c 145.5 calories

④ £1152

➤ Can I apply it now? (page 61)

① **a** 5200 cm^3
b 260

5.2 Finding the percentage change from one amount to another

➤ Skills check – do I need to do this section? (pages 61–62)

① **a** 31.25% **b** 7.78%

② **a** 32% **b** 75%

➤ Learning exercise (pages 63–64)

① **a** 7% **b** 90% **c** 20%
d 4% **e** 15% **f** 14%
g 30% **h** 17% **i** 16%

② **a** £9, 75% **b** £7, 70%
c £12, 60% **d** £21, 60%

③ **a** £8, 80% **b** £3, 12%
c £16, 8% **d** £7, 10%
e £36, 30% **f** £1.04, 52%

④ **a** 60 ml **b** 8%

⑤ **a** 6 biscuits **b** 20%

⑥ 25%

⑦ 4%

⑧ 15%

⑨ 9.6%

⑩ 60%

⑪ (Sam 7.5%, Sally 6.5%); Sam's calf

⑫ (Mary 8.1%, Martin 7.0%); Mary's house

⑬ 50%

➤ Problem solving exercise (page 64)

① Wall insulation gives a saving of 15%; loft insulation gives a saving of 20%.

② 8%

➤ Do I know it now? (page 65)

① **a** 10% **b** 60%
c 75% **d** 80%

② **a** 25% **b** 24%
c 42% **d** 11.2%

③ **a** £4, 5% **b** 28p, 35%
c −£54, 45% loss **d** −£1.12, 56% loss

④ **a** 3%
b Car B (2% gain on Car A, 4.9% loss on Car B, 4.8% loss on Car C)

➤ Can I apply it now? (page 65)

① from 2009 to 2010

5.3 Reverse percentages

➤ Skills check – do I need to do this section? (page 66)

① **a** £280 **b** £16
c £110 **d** £11.60

② **a** **i** 36 923 000
ii 37 870 000
iii 33 367 000
b 2020

➤ Learning exercise (pages 67–68)

① £40

② £15

③ £30

④ **a** £115 **b** £23

⑤ **a** 70 cm **b** 128 m **c** 450 km
d 5 m **e** 850 km

⑥ **a** £230
b £173.91
c £226.09; no because 30% of £173.91 ≠ (15% of £173.91) + (15% of £200)

⑦ **a** £70 **b** £120 **c** £60 **d** £20

⑧ **a** £80 **b** £18 **c** £175 **d** £1250

⑨ 900 ml

⑩ 40 hours

⑪ £9400

⑫ £180 000

⑬ £44

⑭ 3640 miles

⑮ £140

➤ Problem solving exercise (page 69)

① £12.50 each

② £7200

➤ Do I know it now? (page 69)

① **a** £120 **b** £6

② **a** 140 cm on his 13th birthday
b He grew 7 cm.

③ **a** 240 **b** 36

➤ Can I apply it now? (page 69)

① £22

5.4 Repeated percentage increase/decrease

➤ Skills check – do I need to do this section? (page 70)

① £490.89

② £57 658

➤ Learning exercise (pages 71–73)

① **a** £7986
b 33.1%
c The increase is compound and is therefore being applied to an increasingly large amount.

② **a** £2560
b 48.8% decrease
c 2 more years

③

% change	Decimal multiplier
20% increase	1.2
60% decrease	0.4
12% increase	1.12
12% decrease	0.88
150% increase	1.5

④ **a** 300, 180, 162

b 19%

c 162

d They are the same calculation expressed as a percentage and a decimal multiplier.

⑤ **a** £30 **b** £530 **c** £31.80

⑥ **a** **i** £100

ii £1000

iii £52.50

b **i** £102.50

ii £1221.02

iii £54.36

⑦ **a** 40% **b** 16% **c** 6.4%

d 2.56% **e** 1.024%

⑧ **a** **i** £2400

ii £600

b **i** £2400 × 0.8 = £1920

ii 7 more years (9 years from purchase)

⑨ 358

⑩ **a** £92 220

b £97 753.20

c 2005

⑪ **a** compound interest £110.79; total investment £690.79

b compound interest £553.52; total investment £2203.52

c compound interest £44 146.10; total investment £68 146.10

⑫ 15 km and 12 km

➤ Problem solving exercise (pages 73–74)

① Yes, £4 485 000 in two years.

② The Friendly Bank gives £13 more interest.

③ The decrease was applied to a higher price so the reduced price was slightly higher than the original.

④ Andy (£1610.95) better than Tina (£1607.73).

⑤ No, it has increased by 23.2%.

➤ Do I know it now? (page 74)

① **a** Simple interest = £5280, compound interest = £5948.07

b Simple interest = £28 800, compound interest = £50 540.36

② **a** £6800 **b** £5508

➤ Can I apply it now? (page 74)

① No, after three months his weight will be 17.33 stones.

Chapter 6 Ratio and proportion

6.1 Sharing in a given ratio

➤ Skills check – do I need to do this section? (page 75)

① 20, 30, 50

② 2.1 kg, 2.4 kg, 2.7 kg

③ **a** Chat 5 hours 20 min, Reality 4 hours, Soap 2 hours 40 min

b Chat 160 min, Reality 120 min, Soap 80 min

➤ Learning exercise (pages 77–78)

① **a** 3 **b** £12 **c** £12

d £24 **e** £36

② **a** 9 **b** 5 **c** 10

d 35 **e** 45

③ **a** 6 **b** 80 ml **c** 80 ml

d 400 ml **e** 320 ml

④ **a** £24, £36 **b** £80, £16

c 60, 100 **d** 98 ml, 28 ml

⑤ **a** £54, £36 **b** £15, £105
c 125, 100 **d** 280 m, 120 m, 80 m

⑥ £56

⑦ 72

⑧ £180

⑨ 63 cm and 35 cm

➤ Problem solving exercise (page 78)

① **a** 30
b hockey 40°, tennis 120°, netball 200°

② **a** £60 **b** 2010

➤ Do I know it now? (page 79)

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

② **a** 60 g, 45 g
b 154, 176
c 22 g, 44 g, 220 g
d 35, 70, 140

➤ Can I apply it now? (page 79)

① $2\frac{1}{4}$ hours

6.2 Working with proportional quantities

➤ Skills check – do I need to do this section? (pages 79–80)

①

Ingredients	For 4	For 6
Mushrooms	240 g	360 g
Stock	300 ml	450 ml
Small onions	1	$1\frac{1}{2}$
Plain flour	30 g	45 g
Milk	400 ml	600 ml
Egg yolks	2	3

② Under her budget by 3.25 litres

➤ Learning exercise (pages 82–83)

① **a** 24p **b** 72p

② **a** 15p **b** £1.20

③ **a** £6 **b** £138

④ **a** **i** 35p **ii** 30p
iii Dan's Discounts
b **i** £1.30 **ii** 96p
iii Dan's Discounts
c **i** £3.72 **ii** £3.84
iii Bev's Bargains

⑤

Ingredient	Quantity for 5 people	Quantity for 1 person	Quantity for 8 people
Minced beef	900 g	180 g	1440 g
Stock	480 ml	96 ml	768 ml
Onion	2	$\frac{2}{5}$	$3\frac{1}{5}$
Tin of tomatoes	1	$\frac{1}{5}$	$1\frac{3}{5}$
Potatoes	700 g	140 g	1120 g
Worcestershire sauce	40 ml	8 ml	64 ml

⑥ £112

⑦ £6.80

⑧ **a** 6 kg for £14.70 (£2.45/kg *vs* £2.50/kg)
b 150 ml for £24 (16p/ml *vs* 18p/ml)
c 60 g for £12.06 (20.1p/g *vs* 20.5p/g)

⑨ No, he will charge £14.60.

➤ Problem solving exercise (pages 83–84)

① **a** £537.50 **b** 6 hours

② 13 (Brown sugar is the limiting ingredient.)

③ No, the small box costs 7.4p per chocolate, the medium box costs 6.8p per chocolate and the large box costs 6.9p per chocolate.

➤ Do I know it now? (page 84)

① **a** £2.34 **b** £21.06

② **a** 2 m for £8.10 because this is £4.05/m and 60 cm for £2.40 is £4.15/m.

b 600 g for £5.40 because this is £9/kg and 750 g for £7.20 is £9.60/kg.

c 2 litres for £22.12 because this is £11.06/l and 800 ml for £8.92 is £11.15/l.

➤ Can I apply it now? (page 84)

① 400 ml is the best value. (300 ml for £2.16 is 72p per 100 ml; 400 ml for £2.72 is 68p per 100 ml; 500 ml for £3.45 is 69p per 100 ml)

Chapter 7 Number properties

➤ Skills check – warming up (page 86)

Multiples

a 35, 40, 45, 50, 55, 60

b 28, 32, 36, 40, 44

c 36, 45, 54, 63, 72, 81

Factors, primes and powers

a 1, 2, 4, 8, 16

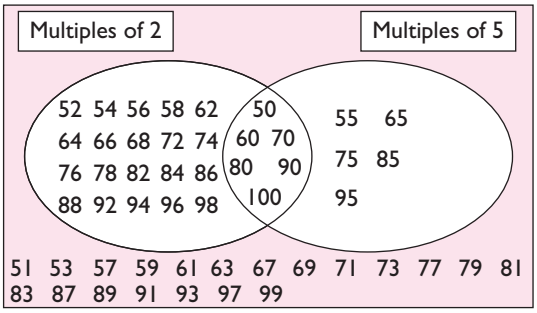
b **i** 1, 4 and 16

ii 2

iii 1 and 8

Divisibility tests

a



b They are multiples of 10.

➤ Applying the knowledge (page 87)

① **a** false **b** true **c** true

d true **e** false

② 4, 16 and 36 have all three properties.

a 1, 4, 9, 16, 25, 36

b 1, 2, 4, 6, 10, 12, 16, 18, 22, 28, 30, 36 (< 40)

c 4, 8, 12, 16, 20, 24, 28, 32, 36 (< 40)

7.1 Index notation

➤ Skills check – do I need to do this section? (page 87)

① **a** 4^{14} **b** 7^{7} **c** 13^{56}

➤ Learning exercise (page 89)

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

② **a** 5^3 **b** 2^6

c $2^2 \times 5^2$ **d** 7^5

e $11^3 \times 17^2$ **f** 3^8

g $2^5 \times 19$ **h** $5^3 \times 7^3$

③ **a** 125 **b** 1024 **c** 2401

d 1 **e** 729 **f** 7776

g 20.25 **h** 2 097 152 **i** 29

j 50 625 **k** 65 536 **l** 1296

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

e 2^8 **f** 2^2 **g** 2^2 **h** 2^8

⑤ **a** 3^8 **b** 3^3 **c** 3^5

d 3^6 **e** 3^6 **f** 3^6

g 3^9 **h** 3^4 **i** 3^5

⑥ **a** 5^6 **b** 5^8 **c** 5^{12}

d 5^{12} **e** 5^{36} **f** 5^{21}

g 5^{20} **h** 5^{18} **i** 5^{32}

⑦ 2^{10} and 4^5, 8^3 and 2^9, 9^3 and 3^6

⑧ **a** 28 **b** 500 **c** 337 **d** 216

⑨ **a** 12 **b** 120 **c** 64 **d** 990

e 7 **f** 17 **g** 72 **h** −1

⑩ **a** 2^7 **b** 2^4 **c** 2^8 **d** 2^{15}

e 2^{10} **f** 2^9 **g** 2^8 **h** 2^8

⑪ **a** 6 **b** 3 **c** 6 **d** 7

➤ Do I know it now? (page 90)

① **a** 17^3 **b** $2^2 \times 5^3$
c $3^4 \times 5^2$ **d** $2 \times 3^3 \times 11^2$

② **a** 2^{10} **b** 2^5 **c** 2^9 **d** 2^6

③ **a** 128 **b** 180 **c** 32 **d** 1

④ **a** 12 **b** 6 **c** 6 **d** 20

7.2 Prime factorisation

➤ Skills check – do I need to do this section? (page 90)

① **a** $2^3 \times 3 \times 13$
b LCM = 192 HCF = 4

② 8.30 p.m. (12 hours later)

➤ Learning exercise (pages 93–94)

① **a** 30 **b** 110 **c** 12 **d** 18
e 75 **f** 250 **g** 735 **h** 4725

② **a** $2^2 \times 3 \times 5$ **b** $2 \times 3^2 \times 7$
c $2^2 \times 5^2$ **d** 2×3^3
e $3^2 \times 5^2$ **f** $2 \times 7 \times 11$
g $3 \times 5 \times 7$ **h** $3^2 \times 5 \times 11$
i $2^2 \times 3 \times 5^2$ **j** $3^4 \times 5$
k $2^2 \times 5^3$ **l** $2^4 \times 3 \times 13$

③ **a** 1, 2, 3, 4, 6, 12 **b** 1, 2, 4, 5, 10, 20
c 1, 2 and 4 **d** 4

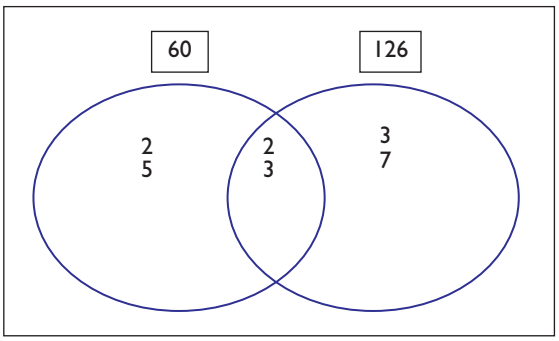
④ **a** 2 **b** 5 **c** 6 **d** 9
e 8 **f** 26 **g** 5 **h** 18
i 12 **j** 1 **k** 22 **l** 17

⑤ **a** 6, 12, 18, 24, 30, 36, 42, 48, 54, 60
b 8, 16, 24, 32, 40, 48, 56, 64, 72, 80
c 24 and 48 **d** 24

⑥ **a** 18 **b** 40 **c** 70 **d** 60
e 42 **f** 30 **g** 80 **h** 65
i 120 **j** 300 **k** 54 **l** 180

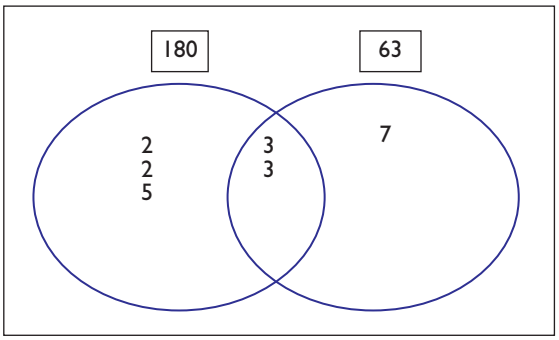
⑦ **a** $2 \times 3^{\mathbf{2}} \times 7^2$ **b** $2^{\mathbf{4}} \times 3 \times 5^2$
c $3 \times \mathbf{5}^3 \times 11$ **d** $\mathbf{2^6} \times 7 \times \mathbf{13}$

⑧ **a** $2^2 \times 3 \times 5$ **b** $2 \times 3^2 \times 7$
c



d 6 **e** 1260

⑨ **a** $2^2 \times 3^2 \times 5$ **b** $3^2 \times 7$
c



d 9 **e** 1260

➤ Problem solving exercise (page 94)

① Yes. She buys 6 boxes of samosas (£34.80), 9 boxes of sausage rolls (£22.50) and 8 boxes of cakes (£56.80) so total cost £114.10.

② 3 laps

③ 9 (at 6 km intervals)

➤ Do I know it now? (page 95)

① **a** 20 **b** 400
c 2310 **d** 23 100
e 2 310 000

② **a** $2 \times 3^2 \times 5$ **b** $3 \times 5 \times 11$
c $2 \times 5 \times 7 \times 11$ **d** $3^2 \times 7 \times 13$
e $2^3 \times 5^2 \times 7$ **f** $2 \times 5^3 \times 7$
g $2^4 \times 3^2 \times 11$ **h** $2^5 \times 7 \times 13$

③ **a** 54: 2×3^3; 60: $2^2 \times 3 \times 5$
b 6 **c** 540

➤ Can I apply it now? (page 95)

① 72 000 miles

ESSENTIAL TOPICS – ALGEBRA

Chapter 8 Starting algebra

➤ Skills check – warming up (pages 99–100)

Making and using word formulae

a Cost (in pence) = **25** × number of minutes

b £1.50

Using letters

a 1 **b** 8 **c** 0 **d** 5

Combining variables

a $8d$ **b** $-2m$

c $4g^2$ **d** $3r+11r^2$

e $5h - 5 - 2gh$ **f** $4bc + 4bc^2$

Working with formulae

a miles → ÷5 → ×8 → kilometres

b 120 km

c kilometres → ÷8 → ×5 → miles

d 75 miles

Setting up and solving simple equations

a $x = 6$

b $x = 4$

c $t = 5$

Using brackets

a i $3x + 6y$

ii $12 - 18r$

iii $12x^2 - 21x$

b i $a(6a+ b)$

ii $5a(3b + 2)$

iii $4d(4c - 3d)$

➤ Applying the knowledge (pages 100–101)

① Multiply b by 2 then subtract from a → $a - 2b$

Subtract c from a then multiply by b → $b(a - c)$

Add b to a then divide into c → $\frac{c}{a+b}$

Multiply a by b then divide by c → $\frac{ab}{c}$

Divide c by b then multiply by a → $\frac{c}{b} \times a$

Multiply a by c then divide into b → $\frac{b}{ac}$

Add b to a then divide by c → $\frac{a+b}{c}$

Multiply ab by c → abc

Subtract c from b then multiply by a → $a(b - c)$

No match

Multiply a by 4 then subtract c → $4a - c$

Divide a by c then subtract b → $\frac{a}{c} - b$

② Side length of square is $(10x + 15)$ cm;
side length of pentagon is $(8x + 12)$ cm;
$(10x + 15)$ cm – $(8x + 12)$ cm = $(2x + 3)$ cm.

8.1 Working with more complex equations

➤ Skills check – do I need to do this section? (page 101)

① **a** $x = 3$ **b** $x = 14$

② **a i** $4x + 2$ **ii** $2x + 4$

b $4x + 2 = 2x + 4$

c $x = 1$

③ 1 hour 20 minutes

➤ Learning exercise (pages 103–105)

① **a** $3x = 18$, $x = 6$

b $2x + 4 = 16$, $x = 6$

c $5x + 4 = 3x + 14$, $x = 5$

d $8x + 12 = 3x + 42$, $x = 6$

② **a** $s = 4.5$ **b** $x = 7$
c $h = 5$ **d** $y = 60$
e $m = -2$ **f** $g = -2.5$
g $p = 6$ **h** $p = 6$

③ **a** $a = -4$ **b** $f = 3$
c $x = 1$ **d** $y = -3$

④ **a** $a = -15$ **b** $b = -3$
c $c = \frac{1}{2}$ **d** $f = -\frac{1}{2}$

⑤ **a** $6a + 20 = 4a + 64$
b 22p

⑥ **a** She has not reversed the operations. The second line should read $11 - 5 = 6x + 4x$.
b $11 - 5 = 6x + 4x \rightarrow 6 = 10x \rightarrow x = 0.6$
c $11 - 4 \times 0.6 = 6 \times 0.6 + 5 \rightarrow$
$11 - 2.4 = 3.6 + 5 \rightarrow 8.6 = 8.6$ ✓

⑦ **a** Sally: $x = \frac{1.5}{0.5}$, $x = 3$ Tara: $5x = 15$, $x = 3$
b For example: Tara, because you are less likely to make mistakes with whole numbers.

⑧ **a** $a = 2.1$ **b** $b = 8$
c $c = 2.275$ **d** $d = 1.4$
e $x = 3$ **f** $x = 4.5$
g $x = 100$ **h** $x = 2$

⑨ **a** $3.5m + 4.25 = 2m + 11$
b $m = £4.50$ **c** £20

⑩ **a** $5n - 3 = 7 + 3n$ **b** 5

Problem solving exercise (pages 105–106)

① $150\,cm^2$

② **a** **i** $2h$ **ii** $h - 40$
b Harry £110, Ellie £220 and Tom £70

③ $6a + 108 = 180$, so $a = 12$. $(5a + 12)° = 72°$ and $(96 - 2a)° = 72°$, hence triangle is isosceles.

Do I know it now? (page 106)

① **a** $g = 15$ **b** $d = -6$
c $t = -0.5$ **d** $c = -1$

② **a** $d = 3$ **b** $e = 1.4$
c $g = -5.5$ **d** $h = 1$

③ **a** $x = 4$ **b** $x = 1$
c $x = 3$ **d** $x = 7$

Can I apply it now? (page 106)

① **a** £4.15 ($5p + 4.25 = 2p + 16.70$)
b £25.00

8.2 Solving equations with brackets

Skills check – do I need to do this section? (page 107)

① **a** $k = 4$ **b** $r = 1$ **c** $t = 10$
d $n = 1$ **e** $g = 5$ **f** $r = -\frac{2}{7}$

② 12 cm

Learning exercise (pages 108–110)

① **a** $x = 6$ **b** $x = 9$
c $x = 1.5$ **d** $x = 3$

② **a** $a = 4$ **b** $b = 8$
c $c = 8$ **d** $d = 11$

③ **a**

Instruction	Algebra
I think of a number, n.	n
I multiply it by 5.	$5n$
I add 6.	$5n + 6$
I multiply it by 3.	$3(5n + 6)$
The answer is 123.	$3(5n + 6) = 123$

b $n = 7$ ($5n + 6 = 41$, $5n = 35$)

④ **a** $x = 14$ **b** $x = 4$
c $x = 6$ **d** $x = 5$

⑤ **a** $x = -7$ **b** $x = 1.5$
c $x = 3$ **d** $x = 2$

⑥ **a** $x = 3$ **b** $x = 4$
c $x = 44$ **d** $x = -\frac{1}{4}$

⑦ **a** $8(x + 1) + 2(6x - 5)$
b $8(x + 1) + 2(6x - 5) = 28$, $x = 1.5$
c $40\,cm^2$

⑧ **a** $3(n-2)$

b $3(n-2) = 30 - n$

c 9

d $3 \times (9-2) = 30 - 9$; $3 \times 7 = 21$ ✓

⑨ **a**

	Age now	Age in 4 years
Peter	p	$p+4$
Dad	$42-p$	$46-p$

b $4(p+4) = 46 - p$

c $p = 6$

d Peter is 6 and his dad is 36.

e $6 + 36 = 42$. In 4 years' time, Peter will be 10 and his dad will be 40; $4 \times 10 = 40$.

⑩ **a** **i** $2x + 1$ **ii** $x + 2$

b $x = 1$

⑪ **a** **i** $3(4x+2)$ **ii** $2(3x+6)$

b $3(4x+2) = 2(3x+6)$

c $x = 1$

➤ Problem solving exercise (pages 110–111)

① £15

② **a** $3(n+12) = 60 - n$ **b** 6

③ Equates two sides and solves resulting equation. Substitutes answer in expression for third side. Shows the value is different. Sides not equal so can't be a square.

④ Equates a pair of opposite angles. Solves resulting equation. Substitutes answer in expressions for the other two angles. This is not a parallelogram, because the opposite angles are not equal.

➤ Do I know it now? (page 111)

① **a** $a = 4$ **b** $b = -1$

c $c = 9$ **d** $d = 1.25$

② **a** $x = 1$ **b** $x = 2$

c $x = \frac{5}{3}$ **d** $x = 3$

➤ Can I apply it now? (page 111)

① 1035 cm^2

Chapter 9 Sequences

➤ Skills check – warming up (page 113)

What is a sequence?

a 4 and 128 **b** 4 and 1 **c** 17 and 23

Defining sequences

a 3, 5, 7, 9 **b** 2, 5, 8, 11

c 1, 4, 9, 16 **d** 2, 5, 10, 17

➤ Applying the knowledge (page 113)

① **a** 72.5, 36.25, 18.125

b −3.75, 1.875, −0.9375

c −648, −972, −1458

② 10:50

9.1 Linear sequences

➤ Skills check – do I need to do this section? (page 114)

① **a** **i** 18, 20 and 24

ii 45, 40, 30 and 20

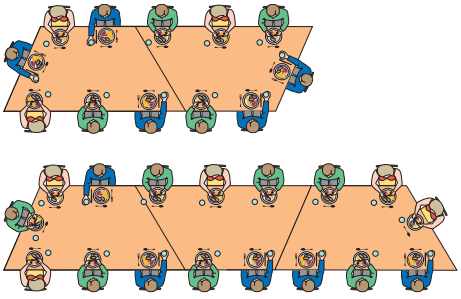
iii −18, −12 and −10

b **i** $2n + 14$

ii $-5n + 55$

iii $2n - 22$

② **a**



b

Number of tables	1	2	3	4	5
Number of seats	7	12	**17**	**22**	**27**

c **i** 32 **ii** 42

d $5n + 2$

e 102

Learning exercise (pages 116–118)

① **a** 3, 6, 9, 12, 15

b 6, 10, 14, 18, 22

c 27, 29, 31, 33, 35

② **a** **A** 38 and 46, **B** 81 and 78

b **A** 830, **B** −216

c **i** **8** × position + 22

ii −3 × position + **87**

③ **a** **i** 4, 7, 10, 13; 301

ii 4, +3

iii The difference between the terms, 3, is the multiple of n. The first term, 4, is the sum of the difference, 3, and the constant, 1.

b **i** 4, 10, 16, 22; 598

ii 4, +6

iii The difference between the terms, 6, is the multiple of n. The first term, 4, is the sum of the difference, –2, and the constant, 6.

c **i** 7, 11, 15, 19; 403

ii 7, +4

iii The difference between the terms, 4, is the multiple of n. The first term, 7, is the sum of the difference, 3, and the constant, 4.

④ **a** $3n + 2$

b $2n + 2$

c $4n + 1$

⑤ **a** 9, 12, 15, 18, 21; 66

b 7, 9, 11, 13, 15; 45

c 4, 11, 18, 25, 32; 137

⑥ **a** **i** $4n + 7$ **ii** 407

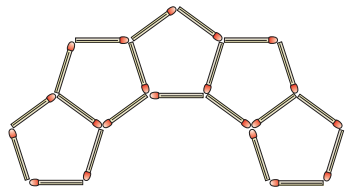
b **i** $10n - 8$ **ii** 992

c **i** $7n + 4$ **ii** 704

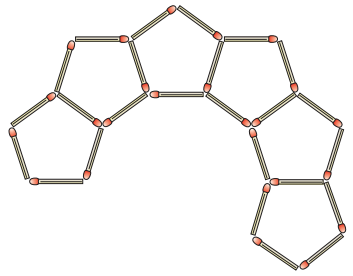
⑦ 3, 6, 9, 12 → $3n$; 7, 9, 11, 13 → $2n + 5$; 6, 11, 16, 21 → $5n + 1$

⑧ **a**

Pattern 5



Pattern 6



b

Number of pentagons	1	2	3	4	5	6
Number of matchsticks	5	**9**	**13**	**17**	**21**	**25**

c 29; the term-to-term rule is +4.

d $4n + 1$

e **i** 41 **ii** 81

f 25

⑨ **a** **i** 22

ii The term-to-term rule is +4.

b $4n + 2$ **c** 162 **d** 87th

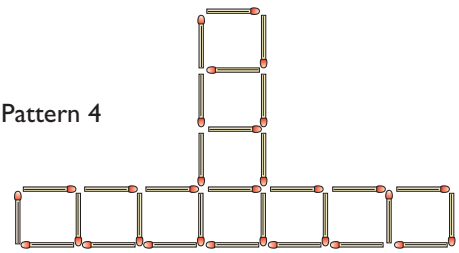
⑩ **a** **i** 27

ii The term-to-term rule is +6.

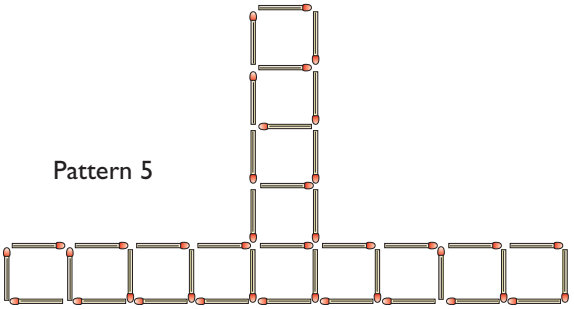
b $6n - 3$ **c** 237 **d** 45th

⑪ **a**

Pattern 4



Pattern 5



b

Pattern number	1	2	3	4	5	6
Number of matchsticks	4	**13**	**22**	**31**	**40**	**49**

c **i** 58

ii The term-to-term rule is +9.

d $9n - 5$

e **i** 85 **ii** 175

f Because all adjacent squares share one matchstick.

g 28 squares

➤ Problem solving exercise (page 118)

① **a** 18

b $4n + 2$

c $4n + 2 = 77$; $n = 18.75$, so least number of tables is 19. $4 \times 19 + 2 = 78$ chairs, so 1 empty chair.

② **a** 31, 28 **b** **ii** $43 - 3n$

c 2 is not in the sequence, because n must be a whole number and when $43 - 3n = 2$, $3n = 41$ and $n = 13.667$.

➤ Do I know it now? (page 119)

① **a** +8 **b** $8n + 1$

c 401 **d** 56th

② **a** **i** $-4n + 84$ **ii** −316

b **i** $-5n + 105$ **ii** −395

c **i** $-2n + 62$ **ii** −138

d **i** $6n + 74$ **ii** 674

③ **a** 13 in pattern 4 and 17 in pattern 5

b $d = 4n - 3$

c **i** 357 **ii** 477

d pattern 162

➤ Can I apply it now? (page 119)

① **a**

Sequence 1	**2**	4	8	**16**
Sequence 2	5	**9**	13	**17**
Sequence 3	12	**6**	**0**	−6
Sequence 4	**9**	6	**3**	0

b Sequence 1 Multiply by 2
Sequence 2 Add 4
Sequence 3 Subtract 6
Sequence 4 Subtract 3

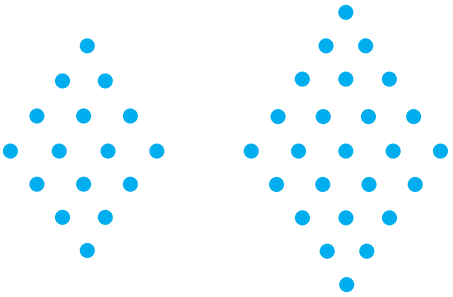
c Sequences 2, 3 and 4

d Sequence 2 $4n + 1$
Sequence 3 $-6n + 18$
Sequence 4 $-3n + 12$

9.2 Special sequences

➤ Skills check – do I need to do this section? (page 120)

① **a**



b

Pattern	1	2	3	4	5
Number of dots	1	4	**9**	**16**	**25**

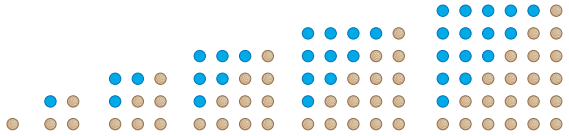
c n^2

② **a** Sequence A: 1, 3, 6, 10, 15, 21
Sequence B: 0, 1, 3, 6, 10, 15

b Sequence C: 1, 4, 9, 16, 25, 36

c Sequence C is the square numbers.

d



➤ Learning exercise (pages 122–124)

① **a** **i** 11, 14, 19, 26, 35

ii 0, 7, 26, 63, 124

iii 1, 3, 6, 10, 15

b the triangular numbers

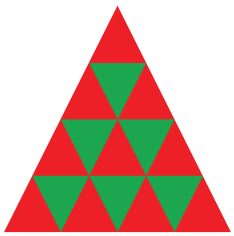
② **a** n^2 **b** $n^2 + 1$

c $n^2 - 1$ **d** $2n^2$

③ **a** $n^2 + 10$ **b** n^3

c $n^3 + 5$ **d** $2n^3$

④ **a**



b

Pattern number	1	2	3	4	5
Number of red triangles	1	3	**6**	**10**	**15**
Number of green triangles	0	1	**3**	**6**	**10**
Total number of triangles, T	1	**4**	**9**	**16**	**25**

c The number of red triangles and the number of green triangles are both sequences of triangular numbers. The total number of triangles is the sequence of square numbers.

d **i** 100 **ii** 55 **iii** 45

e $T = n^2$

⑤ **a** **i** 3 **ii** 5 **iii** 7

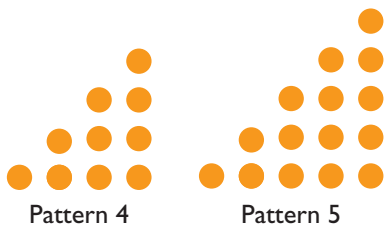
b 9 **c** 100 **d** n^2

e pattern 7 **f** 10 000

⑥ **a** 2, 6, 12, 20, 30

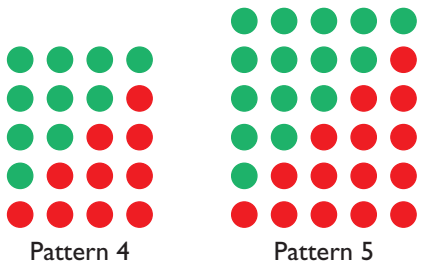
b **i** $\frac{1}{2}n(n+1)$ **ii** the triangular numbers

iii



iv 820

c **i**

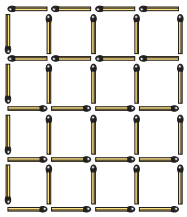


ii $n(n+1)$

iii $\frac{1}{2}n(n+1)$ red circles and $\frac{1}{2}n(n+1)$ green circles

iv The numbers of red and green circles are triangular numbers.

⑦ **a**



b

Pattern number	1	2	3	4	5
Number of matchsticks, M	4	12	24	40	60

c 144

d **i** 1, 3, 6, 10, 15

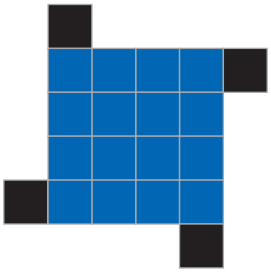
ii Number of matchsticks = 4 × triangular numbers

iii 840

iv $M = 2n(n+1)$

➤ Problem solving exercise (pages 124–125)

① **a**



b

Pattern number	1	2	3	4	5
Number of black tiles	4	4	**4**	**4**	**4**
Number of blue tiles	1	4	**9**	**16**	**25**
Total number of tiles, T	5	**8**	**13**	**20**	**29**

c 104 **d** pattern 15 **e** $T = n^2 + 4$

f **i** No, because each number in the sequence is 4 more than a square number and 400 is a square number.

ii pattern 19 **iii** 35 tiles

② **a** … 21, 34, 55, 89, 144

b 2, 3, 5, 13 and 89

c $8 = 2^3$, $144 = 2^4 \times 3^2$

➤ Do I know it now? (page 125)

① **a** 6, 9, 14, 21, 30 **b** 1, 7, 17, 31, 49

c 4, 11, 30, 67, 128 **d** 0, 2, 6, 12, 20

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

➤ Can I apply it now? (page 125)

① **a**

Pattern number	1	2	3	4	5
Number of blue squares	**1**	**4**	**9**	**16**	**25**
Number of red squares	**2**	**6**	**12**	**20**	**30**
Total number of squares	**3**	**10**	**21**	**36**	**55**

b n^2 **c** 110 **d** $n(n + 1)$

e Ben is correct: using estimation for values of $n(n + 1)$, $21 \times 22 = 462$ and $22 \times 23 = 506$

f $T = n^2 + n(n + 1) = 2n^2 + n = n(2n + 1)$
These are alternate triangular numbers.

Chapter 10 Functions and graphs

➤ Skills check – warming up (pages 127–128)

Real-life graphs

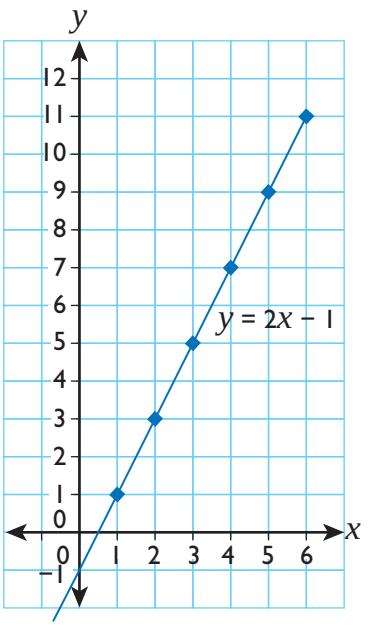
a i noon **ii** 30 minutes
b i 1 hour **ii** 20 miles
c 2:30 p.m. **d** 1 hour
e i 190 miles **ii** 63.33 mph

Plotting graphs of linear functions

a

x	1	2	3	4	5	6
$2x$	2	4	**6**	**8**	**10**	**12**
-1	-1	-1	-1	-1	-1	-1
$y = 2x - 1$	1	3	**5**	**7**	**9**	**11**

b



c at $y = -1$

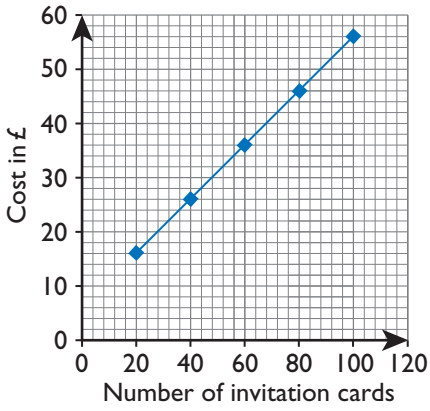
d Yes, because when $x = 7$, $y = (2 \times 7) - 1 = 13$.

➤ Applying the knowledge (page 128)

① **a** *Graph drawn from 20 to 70 mph*

b i 97–98 feet **ii** 250 feet

② **a**



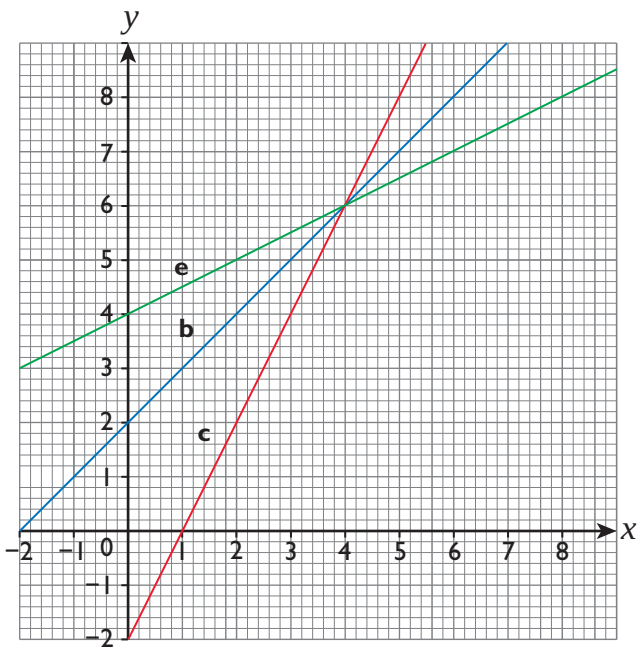
b i £33 **ii** 72 cards

10.1 The equation of a straight line

Skills check – do I need to do this section? (page 129)

① **a** $y + 3x = 0$ **b** $y = -3$
c $y + 3x = 0$, $y = 3 - x$ and $x + y = 5$
d $y = 3x + 5$
e $y = 2x - 3$ and $3y = 6x + 10$
f $y + 3x = 0$ **g** $y = 4x - 7$
h $x + y = 5$ and $y = 3x + 5$

② **a b c ei**



d (4, 6)
e ii It also passes through (4, 6).

Learning exercise (pages 132–134)

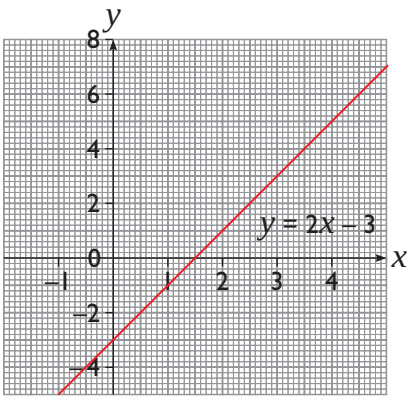
① **a i** (2, 1) **ii** (3, 1) **iii** (3, 5)
b i 4 **ii** 1
c 4

② **a** For example:
i (3, 0) and (6, 3) **ii** (2, 0) and (5, 6)
iii (0, 0) and (3, 6) **iv** (0, 2) and (4, 6)
b i 1 **ii** 2 **iii** 2 **iv** 1
c i **i** and **iv**; **ii** and **iii**
ii They are the same.

③ **a** 3; $y = 3x - 1$ **b** 1; $y = x + 1$
c 0; $y = 0$ **d** 4; $y = 4x + 2$
e -1; $y = -x + 2$ **f** -2; $y = -2x + 5$
g -3; $y = -3x - 3$ **h** -5; $y = -5x + 8$

④ **a** For example:
i (0, 0) and (2, 6)
ii (2, 0) and (3.2, 6)
iii (0, 6) and (6, 0)
iv (0, 3) and (6, 0)
b i 3 **ii** 5
iii -1 **iv** -0.5
c The gradient is negative.

⑤ **a** For example: (0, -3) and (2, 1)
b



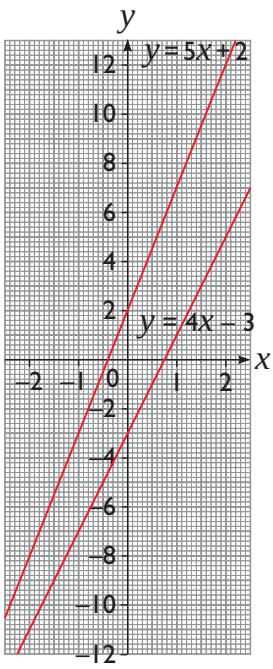
c i 2 **ii** -3
d i is the multiple of x, in this case 2.
ii is the constant, in this case -3.

⑥ **a**

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

x	-2	-1	0	1	2
$5x$	-10	**-5**	**0**	**5**	**10**
$+2$	$+2$	**$+2$**	**$+2$**	**$+2$**	**$+2$**
$y = 5x + 2$	-8	**-3**	**2**	**7**	**12**

b



c For $y = 5x + 2$, the gradient is 5.
For $y = 4x - 3$, the gradient is 4.

d For $y = 5x + 2$, the y-intercept is 2.
For $y = 4x - 3$, the y-intercept is -3.

e The answers can be found from the equations.

f gradient 8, y-intercept -5

⑦ **a**

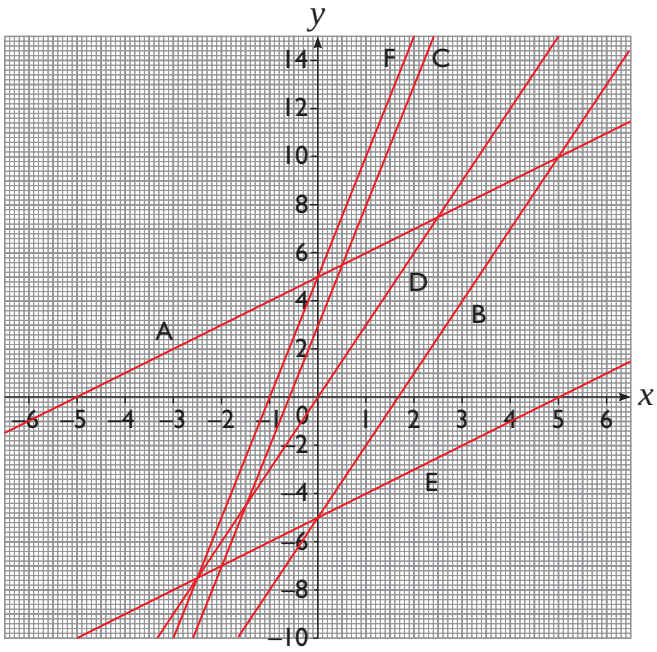
	A	B	C	D	E
i	For example: (0, 8) (4, 0)	For example: (4, 8) (1, 0)	For example: (0, 3) (5, 8)	For example: (0, 5) (5, 0)	For example: (0, 1) (8, 1)
ii	-2	2.666	1	-1	0
iii	8	$-\frac{8}{3}$	3	5	1

b **i** **B** **ii** **D** **iii** **A** **iv** **C** **v** **E**

⑧ **a** **C**

b **A** and **F** **c** **A** and **B** **d** **E** **e** **E**

⑨ **a**



b **A** and **E** **B** and **D** **C** and **F**

c **A** and **F** **B** and **E**

⑩ **a** $y = 3x$ **b** $y = 2x + 3$

c $y = 4x + 1$ **d** $y = x - 2$

⑪ **a** $C = 0.05m + 20$ **b** £80

c 1600 miles

➤ Problem solving exercise (page 135)

① **a** $C = 5d + 10$

b Cost of hiring is 5 pounds per day plus 10 pounds.

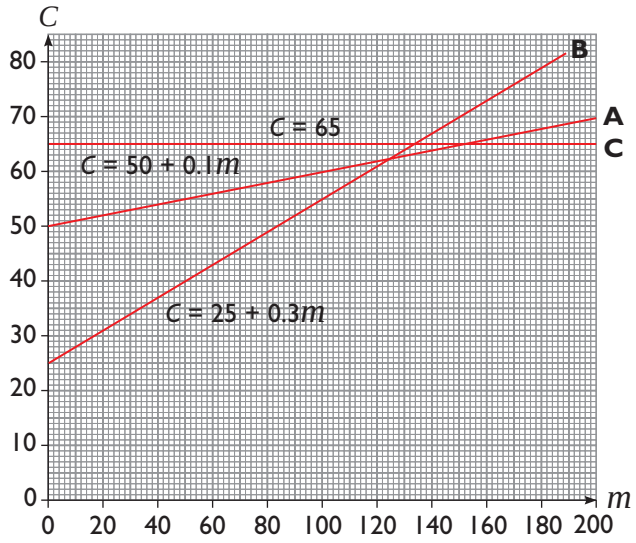
c **i** The gradient of the straight line represents the daily rate for hiring a hedge trimmer.

ii The intercept with the vertical axis represents the fixed or base cost of £10.

② **a** **B** and **E** **C** and **D** **b** **B** and **C**

③ **a** **B** $C = 25 + 0.3m$ **C** $C = 65$

b



c Company C

➤ Do I know it now? (page 136)

① **A** $y = 4x + 3$ **B** $y = 8x + 2$

C $y = 2x - 2$ **D** $y = -5x + 4$

E $y = -x - 5$ **F** $y = 6x - 3$

② **a** $x = -4$ **b** $y = 3x + 1$

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

➤ Can I apply it now? (page 136)

① **a** $C = 40 + 30h$

b **i** £40 **ii** £30 per hour

c 7 hours

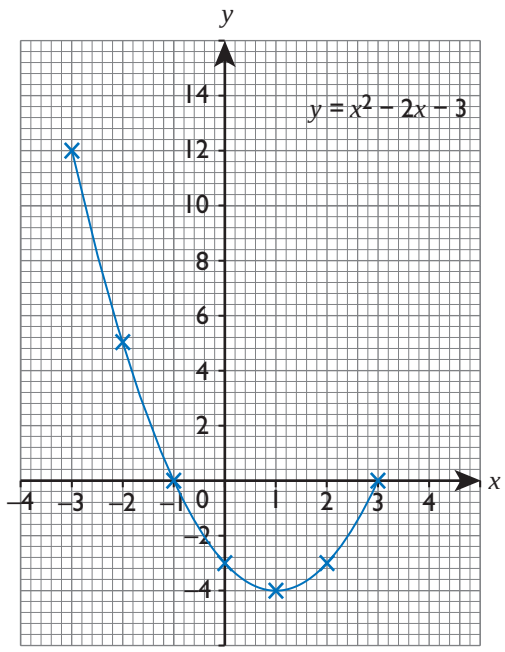
10.2 Plotting quadratic and cubic graphs

➤ Skills check – do I need to do this section? (page 137)

① **a**

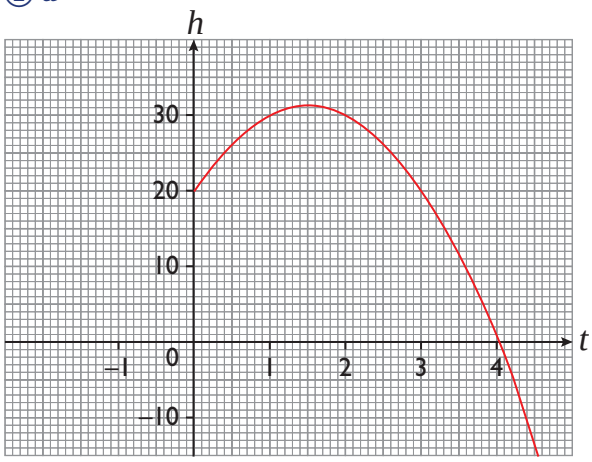
x	−3	−2	−1	0	1	2	3
x^2	9	4	**1**	**0**	**1**	**4**	**9**
$-2x$	6	4	**2**	**0**	**−2**	**−4**	**−6**
-3	−3	−3	**−3**	**−3**	**−3**	**−3**	**−3**
$y = x^2 - 2x - 3$	12	5	**0**	**−3**	**−4**	**−3**	**0**

b



c −4

② **a**



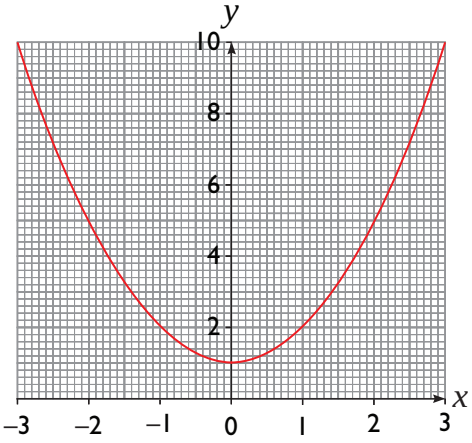
b 31.25 m

➤ Learning exercise (pages 140–143)

① **a**

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

b



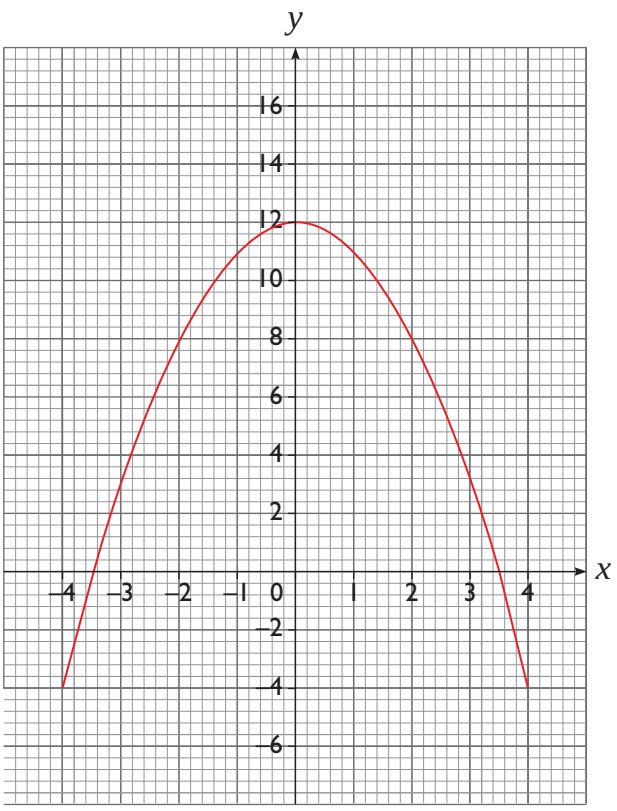
c $x = 0$ **d** (0, 1)

e −1.2 and +1.2

② **a**

x	−4	−3	−2	−1	0	1	2	3	4
12	12	**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**
$-x^2$	−16	**−9**	**−4**	**−1**	**0**	**−1**	**−4**	**−9**	**−16**
$y = 12 - x^2$	−4	**3**	**8**	**11**	**12**	**11**	**8**	**3**	**−4**

b

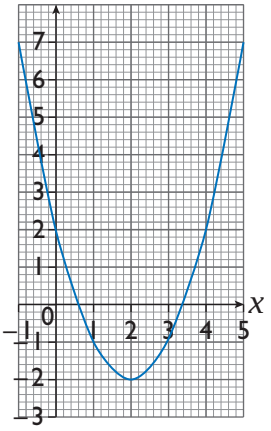


c $x = 0$ **d** (0, 12) **e** −3.5 and +3.5

③ **a**

x	−1	0	1	2	3	4	5
x^2	**1**	**0**	**1**	**4**	**9**	**16**	**25**
$-4x$	**4**	**0**	**−4**	**−8**	**−12**	**−16**	**−20**
+2	**2**	**2**	**2**	**2**	**2**	**2**	**2**
$y = x^2 - 4x + 2$	**7**	**2**	**−1**	**−2**	**−1**	**2**	**7**

b

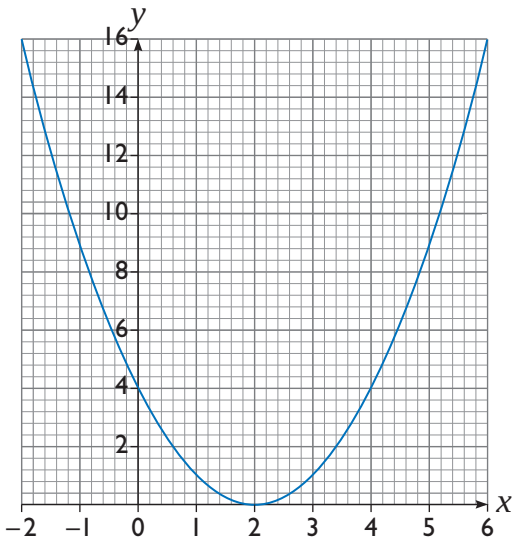


c $x = 2$ **d** (2, −2) **e** 1 and 3

④ **a**

x	−2	−1	0	1	2	3	4	5	6
$x - 2$	−4	**−3**	**−2**	**−1**	**0**	**1**	**2**	**3**	**4**
$y = (x - 2)^2$	16	**9**	**4**	**1**	**0**	**1**	**4**	**9**	**16**

b



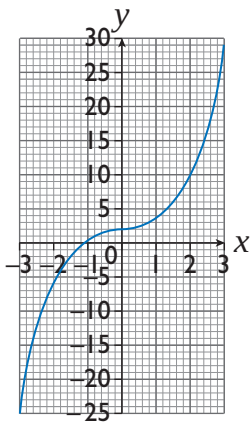
c $x = 2$ **d** (2, 0)

e 4.7 and −0.7

⑤ **a**

x	−3	−2	−1	0	1	2	3
x^3	−27	**−8**	**−1**	**0**	**1**	**8**	**27**
+2	2	**2**	**2**	**2**	**2**	**2**	**2**
$y = x^3 + 2$	−25	**−6**	**1**	**2**	**3**	**10**	**29**

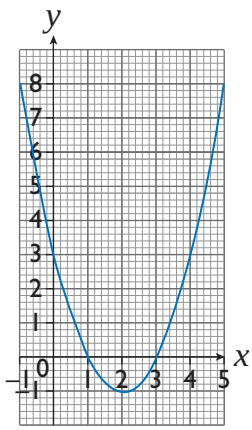
b



c (−1.2, 0) and (0, 2)

d rotational symmetry order 2 about (0, 2)

⑥ **a**

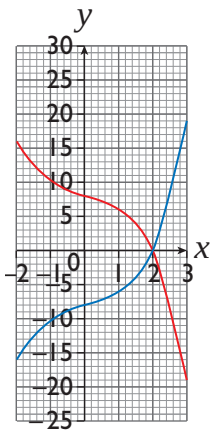


b $x = 1$ and $x = 3$

c −0.6 and 4.6

d Since the minimum point is (2, −1), there is no value of x where y is less than −1.

⑦ **a**



b $x = 2$

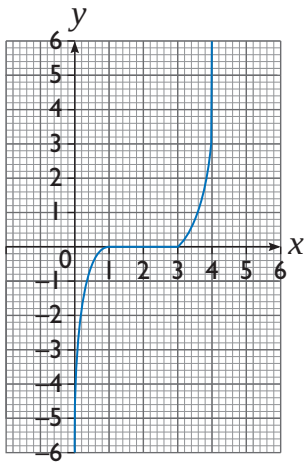
c for values of x greater than 2

d mirror images about the line $y = 0$

⑧ **a**

x	0	1	2	3	4
x^3	**0**	**1**	**8**	**27**	**64**
$-6x^2$	**0**	**−6**	**−24**	**−54**	**−96**
$+11x$	**0**	**11**	**22**	**33**	**44**
−6	**−6**	**−6**	**−6**	**−6**	**−6**
$y = x^3 - 6x^2 + 11x - 6$	**−6**	**0**	**0**	**0**	**6**

b

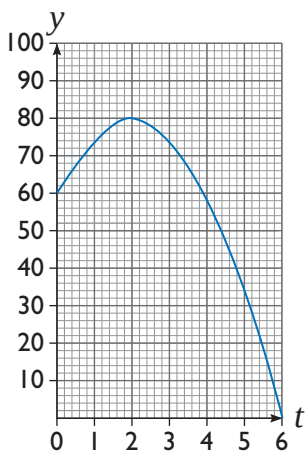


c $x = 1$, $x = 2$ and $x = 3$

d one value, $x = 3.2$

e $x = 3.8$

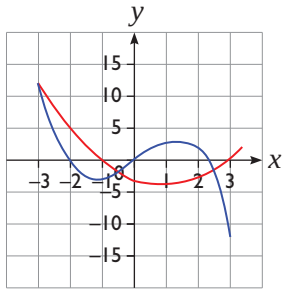
⑨ **a**



b 80 m

c 6 seconds

⑩ **a**

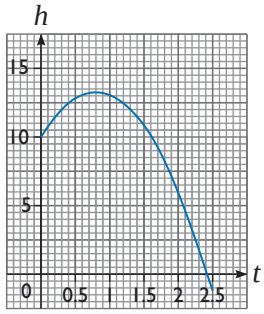


b $x = -3.0$ and $x = 2.3$

⑪ **a**

t	0	0.5	1	1.5	2	2.5
10	**10**	**10**	**10**	**10**	**10**	**10**
$+8t$	**0**	**4**	**8**	**12**	**16**	**20**
$-5t^2$	**0**	**−1.25**	**−5**	**−11.25**	**−20**	**−31.25**
$h = 10 + 8t - 5t^2$	**10**	**12.75**	**13**	**10.75**	**6**	**−1.25**

b



c 13.2 m **d** 1.6 seconds

e **i** when $t = 2.4$ seconds

ii No, the graph has no meaning after this time because the pebble is under water so its motion will not be modelled by the same equation.

➤ Problem solving exercise (pages 143–144)

① **a** $-4 < x < 1$ **b** $-1 < x < 4$

c $-2 < x < 2$ **d** (1.5, −6.25)

e (−1.5, 6.25)

② **a** $x < -2$ and $0 < x < 2$

b $x < -2$ and $0 < x < 2$

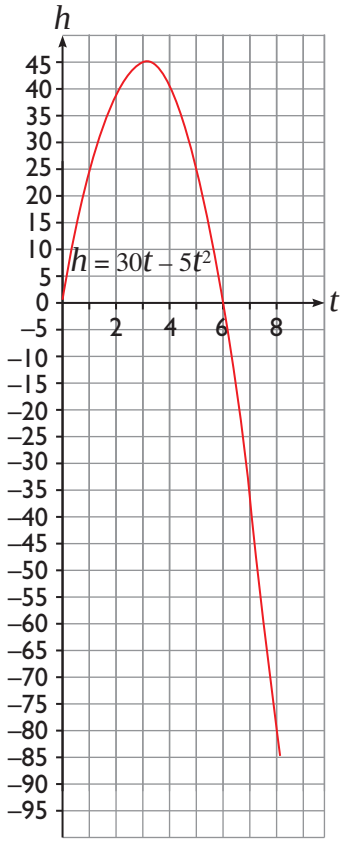
c $x < -2$ and $0 < x < 2$

d They are reflections of each other in the x axis.

e rotational symmetry order 2 about the origin

③ **a** *Values of* h *and* t *from the table substituted into the equation*
$h = 30t - 5t^2$

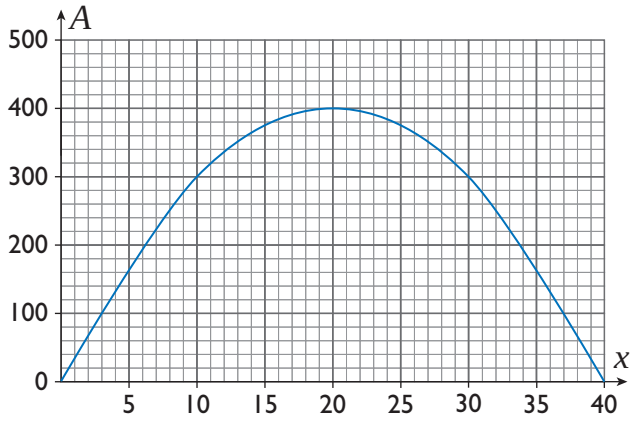
b



c 4 seconds **d** 80 m

④ **a** The length is x, so the width is $\frac{1}{2}(80 - 2x)$
$= (40 - x)$ so
$A = x(40 - x)$.

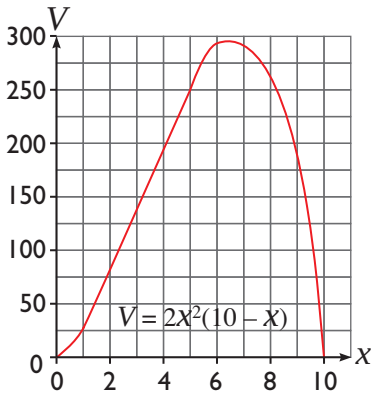
b



c 15 cm (*or* 25 cm)

d The maximum point of the curve occurs when $x = 20$. When $x = 20$, the width is also 20 and so the mat is square.

⑤ **a**



b 4.1 cm or 8.7 cm

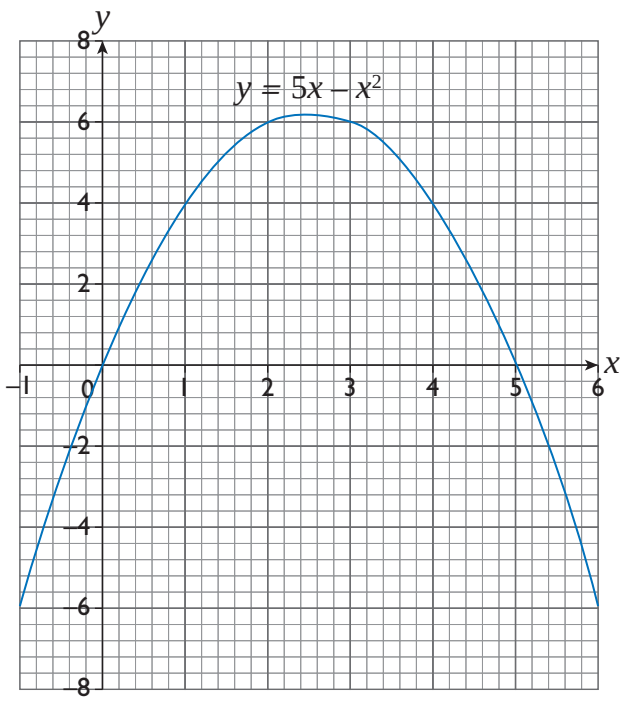
c approximately 1450 cm^3 (290 cm^3 × 5)

Do I know it now? (page 145)

① **a**

x	−1	0	1	2	3	4	5	6
$5x$	−5	**0**	**5**	**10**	**15**	**20**	**25**	**30**
$-x^2$	−1	**0**	**−1**	**−4**	**−9**	**−16**	**−25**	**−36**
$y = 5x - x^2$	−6	**0**	**4**	**6**	**6**	**4**	**0**	**−6**

b



c The graph is symmetrical about $x = 2.5$; its maximum point is (2.5, 6.25) and it crosses the x axis at (0, 0) and (5, 0).

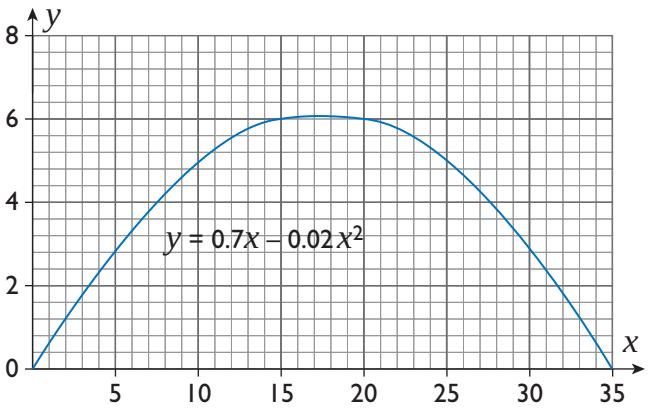
d $x = 0$ and $x = 5$

Can I apply it now? (page 145)

① **a**

x	0	10	15	20	25	35
$0.7x$	0	7	10.5	14	17.5	24.5
$-0.02x^2$	0	−2	−4.5	−8	−12.5	−24.5
$y = 0.7x - 0.02x^2$	0	5	6	6	5	0

b



c from between 5m and 30 m

Chapter 11 Algebraic methods

11.1 Linear equalities

➤ Skills check – do I need to do this section? (page 146)

① **a** $x < 5$
b $x \geqslant 6$
c $x \leqslant 11$
d $x > 60$
e $x > -2$
f $x > 7$

② **a** $p = 6w$
b $3 \leqslant w < 7$
c 18 and 72

➤ Learning exercise (pages 149–150)

① **a** $x > 5$ **b** $x \geqslant 5$
c $x \leqslant 5$ **d** $x \geqslant 5$
e $x < -5$ **f** $x \geqslant -5$
g $x \geqslant 5$ **h** $x \leqslant 5$

② **a** $x \geqslant -2$ **b** $x \leqslant 5$
c $-3 < x \leqslant 7$ **d** $-6 \leqslant x < 2$
e $-6 < x < -1$ **f** $-1 \leqslant x \leqslant 1$

③ **a** 2 ○——● 9
b 6 ●——○ 8
c −4 ○——● −1
d −2 ●——● 5

④ **a** $x < 3$ **b** $x > -3$
c $x < 5$ **d** $x \geqslant -6$
e $x > 4$ **f** $x < 9$

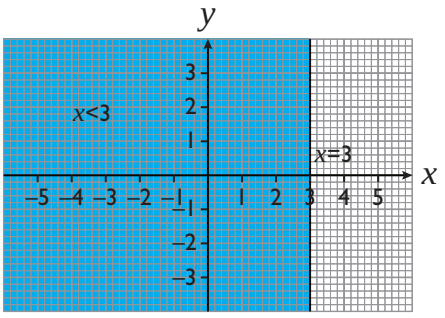
⑤ **a** 3, 4, 5 and 6 **b** −2
c 1, 2, 3 and 4
d −5, −4 , −3, −2, −1, 0 and 1

⑥ **a** $x \geqslant 4$ **b** $x < 1$
c $x < 25.5$ **d** $x \geqslant 12$

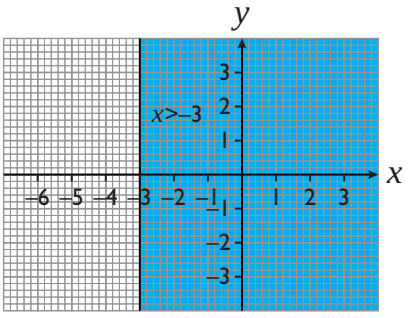
⑦ **a** $x < 3$ **b** $x > -3$
c $x < -3$ **d** $x > 3$

⑧ Wendy, because if you divide by a negative number you reverse the sign.

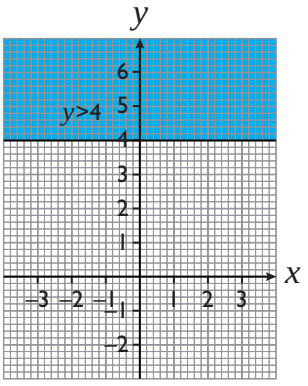
⑨ **a** **i**
ii



b **i**



ii



⑩ **a** $x < -5$ **b** $x > 7$ **c** $x \geqslant -1.5$
d $x \leqslant -1$ **e** $x > 4$ **f** $x > 6$

➤ Problem solving exercise (pages 150–151)

① **a** $2(n - 8) > 11$
b 14, 15, 16, 17, 18 and 19

② **a** $4x + 4 < 28$ (Sue x, Ben $2x$, Ceri $x + 4$)
b 3, 4 or 5
c Ben 6, 8 or 10; Ceri 7, 8 or 9

③ **a** $0.5m + 80 < 1m$

b $m > 160$

④ **a** **i** $x = 5$ **ii** $y = 1$ **iii** $y = 4$

b $y \leqslant x + 1$, $x \leqslant 5$, $y \geqslant 1$ and $y \leqslant 4$

➤ Do I know it now? (page 151)

① **a** $x < 4$ **b** $x > 11$

c $x \leqslant 2$ **d** $x \geqslant 2$

② **a** $x > 1$ **b** $x > -2$

c $x > 2$ **d** $x < 5$

➤ Can I apply it now? (page 152)

① **a** $4a - 5 < 35$ (Abbi a; Bobbi $2a$; Cathy $a - 5$)

b $a < 10$

c 18 years

11.2 Solving pairs of equations by substitution

➤ Skills check – do I need to do this section? (page 152)

① **a** $x = 5, y = 5$

b $a = 20, b = 4$

c $d = -2, e = 2$

② **a** $m + n = 21$; $m - n = 3$

b $m = 12$ and $n = 9$

c You can check by substituting the values for m and n into both equations.

d No; these are the only values that fulfil both equations.

➤ Learning exercise (pages 154–155)

① **a** $x = 6, y = 3$ **b** $x = 12, y = 4$

c $x = 3, y = 2$ **d** $x = -1, y = 2$

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

c $x = -2, y = -1$ **d** $x = 7, y = 5$

③ **a** $x = 3, y = 1$ **b** $x = -3, y = -3$

c $x = 4, y = 10$ **d** $x = 1, y = 9$

④ **a** $x = 8, y = 2$ **b** $x = -6, y = -2$

c $x = 4, y = 3$ **d** $x = 2, y = 4$

⑤ **a** $x = 2y, x + y = 15$ **b** $x = 10, y = 5$

⑥ $x + y = 6, x - y = 1$; $x = 3.5, y = 2.5$

⑦ **a** $h = 2p, 3h + 4p = 35$

b $h = £7, p = £3.50$

c £24.50

⑧ **a** $r = m + 2, 3r + 5m = 62$

b A rat (r) costs £9 and a mouse (m) costs £7.

⑨ $s = c + 7, 4s + 7c = 523$

A seat in the stalls costs £52 and a seat in the circle costs £45.

⑩ **a** $x + y = 42, 40y + 16x = 1080$

b 17 adults (y) and 25 children (x) went on the trip.

➤ Problem solving exercise (page 156)

① **a** $m + n = 27, m + 15 = n$ *or* $n + 15 = m$

b $m = 21$ and $n = 6$ *or* $n = 21$ and $m = 6$

② **a** $c = 5 + a$

b $15a + 10c = 550$

c 20 adults (a) and 25 children (c) went on the trip.

③ **a** $l - s = 100, 6l = 10s$

b $s = 150, l = 250$

c 1250 g *or* 1.25 kg

➤ Do I know it now? (page 156)

① **a** $x = 9, y = 3$

b $x = 4, y = 8$

c $x = -5, y = -2$

d $x = -3, y = -16$

② **a** $x = -4, y = -2$

b $x = 4, y = 8$

c $x = 4, y = -1$

d $x = 1, y = -1$

➤ Can I apply it now? (page 157)

① **a** $s = 3f$, $40f + 80s = 560$

b $f = 2$, $s = 6$ **c** 8 coaches

11.3 Solving simultaneous equations by elimination

➤ Skills check – do I need to do this section? (page 157)

① **a** $x = -3$ and $y = 4$ **b** $x = 2$ and $y = 5$

c $x = 3$ and $y = 5$ **d** $a = 4$ and $b = 2$

② $6m + 4p = 36$, $4m + 6p = 34$; mugs cost £4 each and plates cost £3 each.

➤ Learning exercise (pages 160–161)

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

c $x = -3, y = -1$ **d** $x = 2, y = -3$

e $x = -3, y = -2$ **f** $x = 1, y = 4$

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

c $x = 2, y = 6$ **d** $x = 1, y = -4$

e $x = 2, y = -2$ **f** $x = 5, y = -3$

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

c $x = 4, y = 5$ **d** $x = -3, y = 2$

e $x = 4, y = 3$ **f** $x = 6, y = -1$

④ **a** Because the coefficients of each pair of variables are different

b Multiply equation 2 by 2

c $x = 2, y = 3$

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

c $x = -3, y = 5$ **d** $x = 8, y = -1$

e $x = 1, y = -6$ **f** $x = -4, y = -5$

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

c $p = 5, q = -4$ **d** $x = 5, y = -1$

e $x = 3, y = -4$ **f** $m = 7, n = 4$

⑦ **a** $5s + 3p = 99$, $2s + 4p = 62$

b $s = 15, p = 8$ **c** 86 km

⑧ **a** $2a + 3c = 24$, $3a + 5c = 38$

b $a = 6, c = 4$; an adult ticket costs £6 and a child ticket costs £4.

➤ Problem solving exercise (pages 161–162)

① £5.75 ($4b + a = 150$, $2b + a = 100 \rightarrow b = 25$, $a = 50$)

② **a** $2w + 2l = 32$, $w + 2l = 26$

b $l = 10$ and $w = 6$

③ **a** $4m + 6s = 54$, $45m + 60s = 570$

b 6 mountain bikes and 5 sports bikes

④ **a** $10c + 40t = 7.30$, $5c + 50t = 7.25$

b $c = 0.25$, $t = 0.12$

c £4.25

➤ Do I know it now? (page 162)

① **a** $x = 2, y = -1$ **b** $x = 4, y = 2$

c $x = 3, y = -3$

② **a** $x = 12, y = 5$ **b** $x = 4, y = -3$

c $x = 5, y = -2$

③ **a** $x = 2, y = 0$ **b** $x = 5, y = 3$

c $x = 8, y = 3$

➤ Can I apply it now? (page 162)

① £99 ($4p + 3a = 75$, $3p + a = 45$; $p = £12$, $a = £9$)

ESSENTIAL TOPICS – GEOMETRY AND MEASURES

Chapter 13 Units and scales

➤ Skills check – warming up (pages 166–168)

Length

a AB = 4 cm, BC = 6 cm, CA = 5 cm

b XY = 20 mm, YZ = 30 mm, ZX = 25 mm

c The sides of triangle XYZ are half the length of the sides of triangle ABC.

Mass

a 1 kg **b** 6 kg **c** 25 kg
d 50 kg **e** 100 g **f** 450 g

Time

a 19:30 **b** 11:20 **c** 20:55
d 14:05 **e** 05:35

Volume

a **A** 2 litres **B** 120 ml
b Beaker B would be empty.

Interpreting scales

a 42 ml **b** 430 ml **c** 184 ml

The metric system

a 17 mm **b** 24 mm **c** 200 cm
d 48 cm **e** 4000 m **f** 1200 m

Metric-imperial conversions

a 18 kg, 39.6 pounds
b No, 25 cm = 10 inches

Bearings

a **i** 052° **ii** 052°
b They lie in a straight line.

➤ Applying the knowledge (page 168)

① French one; 4.2 kg ≈ 9 pounds 4 ounces

② 263° (260 → 265)

13.1 Scale drawing

➤ Skills check – do I need to do this section? (page 169)

① **a** 50 000 cm, 0.5 km
b 1.25 km
c 20 cm

② **a** *Accurate scale drawing*
b ≈ 6.25 m
c maximum height ≈ 5 m (to allow clearance)

➤ Learning exercise (pages 171–172)

① **a** 3.5 km
b 20.8 cm

② Write down the scale of these maps in the form $1 : n$.

a 1 : 20 000
b 1 : 2500
c 1 : 250 000
d 1 : 10 000 000

③

Places	Distance on map (cm)	Distance in real life (km)
Library to sports centre	**6**	1.2
School to park	2.5	**0.5**
Cinema to supermarket	7.5	**1.5**
Café to cinema	**10**	2
Bowling alley to river	**9**	1.8

④ *Accurate scale drawing*

⑤ Assuming width 7 cm by length 9 cm

Item	Plan measurement	True measurement
Length of patio	1.9 cm	3.8 m
Width of patio	4.7 cm	9.4 m
Length of lawn	9 cm	18 m
Length of vegetable patch	5.2 cm	10.4 m
Width of pond	1.4 cm	2.8 m
Length of pond	2.3 cm	4.6 m
Width of house	4.7 cm	9.4 m
Length of shed	1.9 cm	3.8 m
Width of shed	1.4 cm	2.8 m
Length of path	5.2 cm	10.4 m

⑥ 1 cm to 1.2 m is a possible answer.

➤ Problem solving exercise (page 173)

① **a** *Accurate scale drawing*
b 12 km
c 246°
d 066°

② **a** *Accurate scale drawing*

b ≈ 15 cm

③ **a** *Accurate scale drawing*

b No, it's 4.2 m above AB.

④ **a** *Accurate scale drawing*

b **i** 263°

ii 34 miles

➤ Do I know it now? (page 173)

① **a** 20 m **b** 8 cm

➤ Can I apply it now? (page 174)

① **a** *Accurate scale drawing*

b 2.6 m ± 0.1

13.2 Compound units

➤ Skills check – do I need to do this section? (page 174)

① **a** £9 per hour **b** 15p per minute

c £360

② **a** **i** 108 km **ii** 18 km

iii 4.5 km **iv** 1.5 km

b 675 mph

➤ Learning exercise (pages 176–177)

① **a** 450 km/h **b** 32 km/h **c** 40 km/h

② **a** 10 m/s **b** 36000 m/h **c** 36 km/h

③ **a** 40 km/h

b **i** 2 m/min **ii** 3.3 cm/s

c 0.22 m/s

④ Jamie is better paid. (Jamie: £8.50 per hour, Sarah: £7.80 per hour)

⑤ 126 mph

⑥ Jake's petrol is cheaper. (Jake: £1.38 per litre, Amy: £1.42 per litre)

⑦ 920 g

⑧ **a** 2.36 m/s **b** 67.5 mph

⑨ **a** 83 miles **b** 66.4 mph

⑩ 168

➤ Problem solving exercise (page 177)

① The UK speed limit is higher by 1.25 mph or 2 km/h.

② **a** 156 miles **b** 52 mph

③ **a** 5.4 hectares

b 993.6 kg is required so 1000 kg is enough.

➤ Do I know it now? (page 177)

① **a** 65 km/h **b** 18.06 m/s

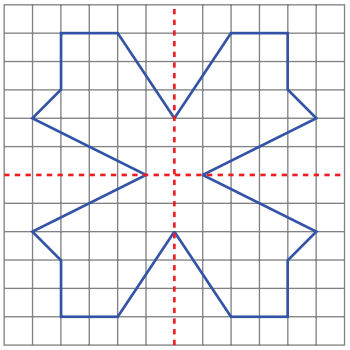
➤ Can I apply it now? (page 177)

① 3750 seconds

Chapter 14 Properties of shapes

➤ Skills check – warming up (pages 180–181)

Line symmetry



Angle facts

$q = 60°$, $r = 120°$ ($p = 60°$)

Rotational symmetry

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

Angles in triangles and quadrilaterals

a $d = 69°$ **b** $e = 76°$, $f = 104°$

c $p = 50°$ **d** $q = 133°$

Types of quadrilateral

a (4, 4) **b** (4, 3) **c** (3, 2)

➤ Applying the knowledge (page 182)

① 72°

② **a** square (ADGJ), rectangle (ACGI), trapezium (ACHJ), kite (ACGK)

b non-square rhombus, parallelogram

14.1 Angles in parallel lines

➤ Skills check – do I need to do this section? (pages 182–183)

① $a = 70°$, $b = 110°$, $c = 49°$, $d = 49°$, $e = 126°$, $f = 54°$, $g = 54°$, $h = 75°$, $i = 105°$, $j = 75°$, $k = 56°$, $l = 124°$, $m = 63°$, $n = 63°$, $o = 63°$

② 35°

➤ Learning exercise (pages 186–187)

① $a = 70°$, $b = 110°$, $c = 123°$, $d = 67°$, $e = 67°$

② $f = 107°$, $g = 107°$, $h = 107°$, $i = 136°$, $j = 136°$, $k = 44°$, $l = 136°$, $m = 95°$, $n = 85°$, $o = 95°$, $p = 85°$, $q = 55°$, $r = 125°$

③ Joe is right; the other angles are either 50° or 130°.

④ $f = 115°$ (corresponding), $g = 65°$ (allied), $h = 115°$ (vertically opposite), $i = 65°$ (allied)

⑤ **a** 72° **b** 18°

⑥ $a = 53°$, $b = 37°$, $c = 53°$, $d = 37°$

⑦ $a = 37°$ (alternate), $b = 64°$ (corresponding), $c = 40°$ (alternate), $d = 100°$ (corresponding), $e = 40°$ (angles in a triangle)

⑧ **a** $a = 82°$ (angles on a straight line), $b = 31°$ (vertically opposite), $c = 31°$ (corresponding), $d = 31°$ (vertically opposite), $e = 67°$ (corresponding), $f = 82°$ (vertically opposite *or* angles in a triangle)

b 180°

➤ Problem solving exercise (pages 187–188)

① 50°; $\angle ADE = 65°$ (allied), $\angle ADE = \angle AED$ (isosceles triangle), $\angle DAE = 50°$ (angles in a triangle).

② 8°; the other two angles in the small triangle with top angle marked x are 62° (alternate angles) and 110° (symmetry) respectively, therefore $x = 8°$ (angles in a triangle).

③ Jim is correct. Possible reasoning: extend one side of the square and use alternate and corresponding angles.

④ 107°; the angles of an equilateral triangle are each 60° so $x = (60 + 47)°$ (alternate angles).

⑤ 135°

➤ Do I know it now? (page 188)

① **a** $p = 85°$ (vertically opposite), $q = 95°$ (angles on a straight line, corresponding)

b $r = 103°$ (angles on a straight line, corresponding)

c $s = 100°$ (corresponding, vertically opposite), $t = 80°$ (angles on a straight line), $u = 80°$ (vertically opposite), $v = 100°$ (corresponding *or* vertically opposite)

② $a = 115°$, $b = c = 65°$

➤ Can I apply it now? (page 189)

① $\angle EDF = 40°$ (corresponding)
$\angle EFD = 70°$ (alternate)
$\angle DEF = 70°$ (angles in a triangle)
$\angle DEF = \angle EFD$

So triangle EDF is isosceles.

14.2 Angles in a polygon

➤ Skills check – do I need to do this section? (page 189)

① $y = 30°$, $z = 150°$

② 177°

③ 10 sides

④ 150°

➤ Learning exercise (pages 191–192)

① **a** 60° **b** 120°

② **a** 45° **b** 135°

③ $a = 90°$, $b = 65°$, $c = 110°$, $d = 75°$, $e = 45°$

④ **a** 36 sides
b 170°
c 6120°

⑤ **a** No, a regular pentagon has 5 equal sides and 5 equal angles but Seb's pentagon doesn't.
b 540°
c ∠EDC = 90°, ∠DCB = 90°, ∠ABC = 150°, ∠AED = 150°, ∠EAB = 60°

⑥ **a** 900° **b** 360° **c** 540° **d** 108°

⑦ **a** **i** 1080° **ii** 360° **iii** 720°
b An n sided polygon can be divided into n triangles. The total angle sum of the triangles is $n \times 180°$. The angles at the centre always sum to 360°, so the angle sum of the interior angles is $n \times 180° - 360°$.
c $n \times 180° - 360° = n \times 180° - 2 \times 180° = (n - 2) \times 180°$

⑧ **a** 360° **b** 12
c 150° **d** 1800°

⑨ **a** 60 sides **b** 13 sides **c** 6120°

⑩ **a** 6
b Yes, because the interior angle of a regular hexagon is 120° and 3 × 120° = 360°, so you can fit 3 hexagons around a point.
c No, because the interior angle of a regular pentagon is 108° which is not a factor of 360°.

⑪ **a** AB 4 sides, square; BC 6 sides, hexagon; AC 12 sides, dodecagon
b BC and AC 8 sides, octagons

➤ Problem solving exercise (pages 192–193)

① **a** 72°
b OA = OC (O is the centre), AB = BC (regular polygon)

② 72°

③ 12°

④ 120°

➤ Do I know it now? (page 193)

① **a** 40° **b** 100° **c** c 85°, d 75°

② **a** 72 sides
b No, 360° ÷ 7 does not give an integer value.

➤ Can I apply it now? (page 193)

① **a** Exterior angle is 360° ÷ 12 = 30°, Interior angle is 180° − 30°= 150°
b 120°
c Interior angle of regular hexagon = 180° − (360° ÷ 6) = 120° = ∠angle GBC = ∠FCB

Chapter 15 Measuring shapes

➤ Skills check – warming up (pages 196–197)

Understanding area

a The shape on the left has the larger area. (right shape 24, left shape 25)

b The shape on the right has the larger area. (right shape 18, left shape 15)

Finding area and perimeter

a perimeter 24.6 m, area 23 m^2

b perimeter 25.6 cm, area = 34.48 cm^2

Circumference

a 282.7 cm **b** 204.2 cm **c** 157.1 cm

➤ Applying the knowledge (page 197)

① 13 tins

② 31.8 cm

15.1 Area of circles

➤ Skills check – do I need to do this section? (page 198)

① **a** 113.1 cm^2 **b** 314.2 square feet
c 50.3 cm^2

② 17.87 m^2

Learning exercise (pages 200–201)

① **a** 28.3 cm² **b** 201.1 cm²
c 50.3 mm² **d** 113.1 m²
e 380.1 cm² **f** 346.4 mm²

② 3.3 cm

③ **a** 4.4 cm **b** 8.8 cm **c** 27.6 cm

④

	Radius	Diameter	Area	Circumference
a	7 cm	**14 cm**	**153.9 cm²**	44.0 cm
b	**8.5 cm**	17 cm	**227 cm²**	**53.4 cm**
c	**5.0 cm**	**10.1 cm**	80 cm²	**31.7 cm**
d	**8.9 cm**	**17.8 cm**	250 cm²	56.0 cm

⑤ **a** 380.1 cm² **b** 132.7 cm²
c 56.5 cm² **d** 63.6 cm²
e 14.7 m² **f** 503.9 cm²

⑥ 50.13 cm

⑦ 71.62 cm²

⑧ 27.52 cm

Problem solving exercise (pages 201–202)

① 76.4 m²

② 11.8 cm

③ 351.9 m²

④ **a** 14 627 cm² **b** £0.005/cm²

Do I know it now? (pages 202–203)

① **a** 78.5 cm² **b** 38.5 mm² **c** 18.1 km²

② **a** 4.1 cm **b** 8.1 cm

③ **a** 112.8 cm² **b** 195.4 cm²

Can I apply it now? (page 203)

① 12.6 m²

15.2 Pythagoras' theorem

Skills check – do I need to do this section? (page 204)

① **a** $a = 7.2$ cm **b** $b = 8.9$ cm

② 94.3 miles

Learning exercise (pages 206–208)

① **a** z, $z^2 = x^2 + y^2$ **b** m, $m^2 = n^2 + l^2$

② **a** $x^2 = 25 + 144$; $x^2 = 169$; $x = \sqrt{169}$ cm
The hypotenuse is 13 cm.

b $y^2 = 36 + 64$; $y^2 = 100$; $y = \sqrt{100}$ cm
The hypotenuse is 10 cm.

c $z^2 = 24^2 + 7^2$; $z^2 = 576 + 49$; $z^2 = 625$;
$z = \sqrt{625}$ cm
The hypotenuse is 25 cm.

③ **a** 7.2 cm **b** 8.6 cm **c** 1.4 cm

④ **a** $x^2 = 9$; $x = \sqrt{9}$; the base of the triangle is 3 cm.

b $y^2 + 225 = 289$; $y^2 = 289 - 225 = 64$;
$y = \sqrt{64}$; the base of the triangle is 8 m.

c $z^2 + 12^2 = 15^2$; $z^2 + 144 = 225$;
$z^2 = 225 - 144 = 81$; $z = \sqrt{81}$;
the base of the triangle is 9 cm.

⑤ **a** 9.2 cm **b** 6.7 cm **c** 6.2 cm

⑥ perimeter 140 cm; area 525 cm²

⑦ B is right-angled because it obeys Pythagoras' theorem: $7.2^2 + 9.6^2 = 12^2$.

⑧ 4 m

⑨ 19.2 m

⑩ 6.4 km

⑪ **a** 5 cm **b** 54 cm **c** 126 cm²

⑫ perimeter 20 m, area = 18 m²

⑬ 7.1 cm

Problem solving exercise (page 209)

① £1510

② £468

③ 26 km

④ AC is 95 m, so Beth runs 190 m. AB + BC + CD = 57 + 76 + 57 = 190 m, so Ali is at D.

➤ Do I know it now? (page 210)

① **a** 8 cm **b** 25 cm **c** 12 cm

② **a** 10.2 cm **b** 14.3 m **c** 10.0 cm

③ perimeter = 669.2 m, area = 19 200 m^2

➤ Can I apply it now? (page 210)

① 68.5 (21 + 15.6 + 31.9)

Chapter 16 Construction

➤ Skills check – warming up (page 212)

Construction with a ruler and protractor

a *Accurate diagram of* ABDC

b **i** 37° **ii** 5 cm **iii** 7.1 cm

16.1 Constructions with a pair of compasses

➤ Skills check – do I need to do this section? (page 212)

① **a** *Accurate drawing of triangle*

b isosceles triangle

c *Accurate bisection*

d BD = DC = 4 cm

e BD and DC are the same length.

② *Accurate construction of wall line*

➤ Learning exercise (pages 217–220)

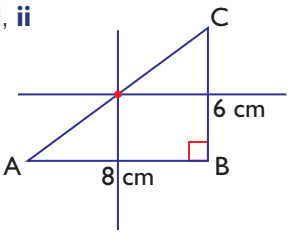
① **a** *Accurate triangle*; 60°, 60°, 60°

b *Accurate triangle*; 70°, 70°, 40°

c *Accurate triangle*; 60°, 38°, 82°

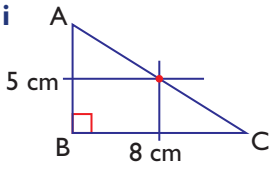
d *Accurate triangle*; 90°, 62°, 28°

② **a** **i**, **ii**



iii Bisectors meet at midpoint of AC.

b **i**



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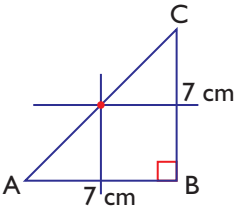

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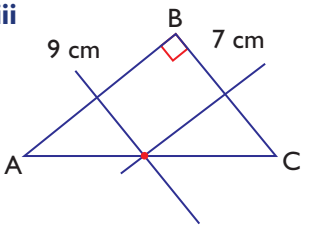
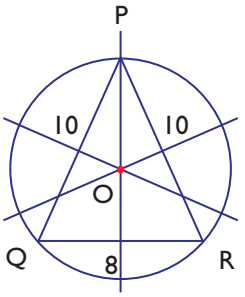


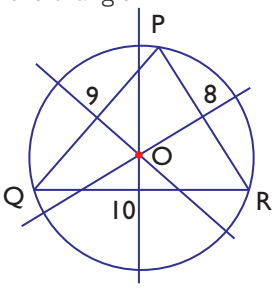
Yes, the bisectors of two sides of a triangle meet on the third side.

③ **a** **i**, **ii**, **iii**



iv The circle passes through all three points of the triangle.

b **i**



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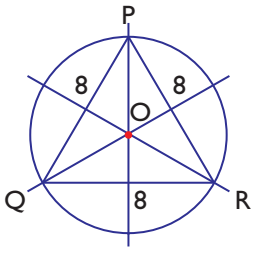

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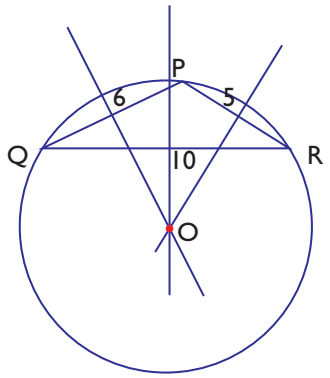

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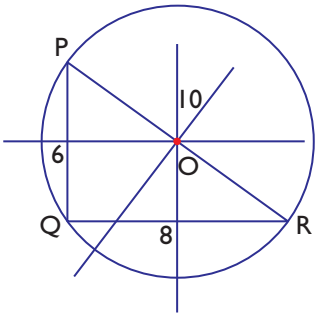
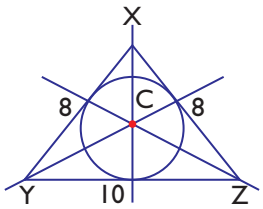


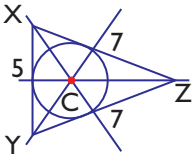
Yes, the circle passes through all three points of triangle each time.

④ **a** **i, ii, iii**



iv The circle touches all three sides of triangle.

b **i**



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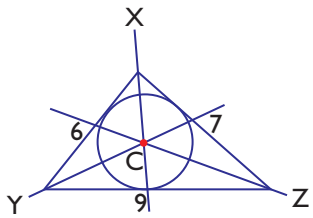

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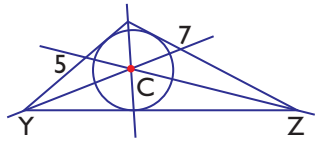

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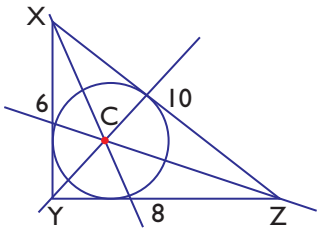


Yes, the circle touches all three sides of triangle each time.

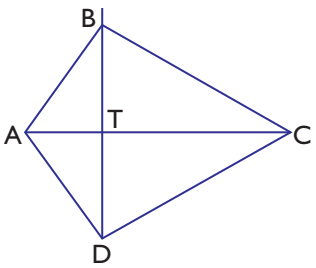
⑤ **a** BC = 6 cm; AD = 3.3 cm; so the area of triangle ABC = $\frac{1}{2} \times 6 \times 3.3\,\text{cm}^2 = 9.9\,\text{cm}^2$ (to 1 decimal place)

b **i** 27.8 cm^2 by calculation; 28.0 cm^2 or 27.5 cm^2 by drawing and measurement

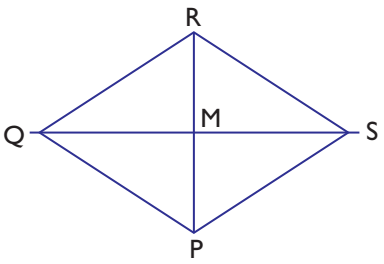
ii 15.0 cm^2

iii 16.2 cm^2 by calculation; 16.0 cm^2 or 16.5 cm^2 by drawing and measurement

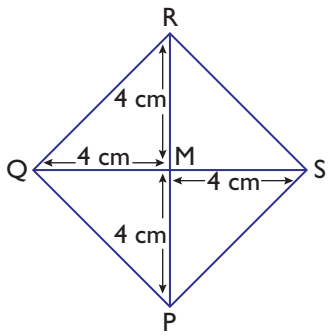
⑥ Kite with sides 8 cm and 5 cm



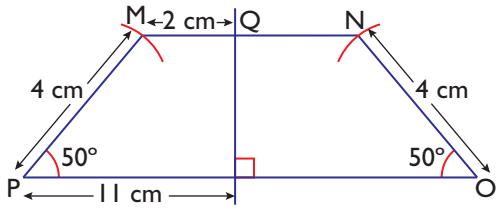
⑦ **a** Rhombus of side 7.2 cm



b Square of side 5.7 cm



⑧ **a b**

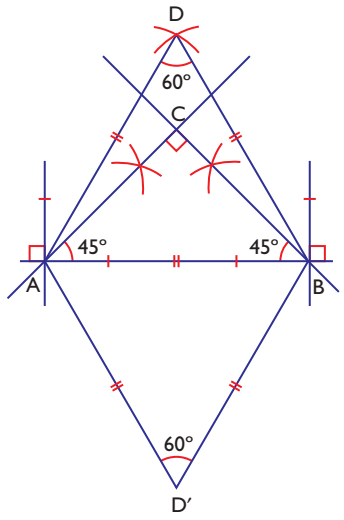


c 25.8 cm^2 by calculation; 26.2 cm^2 by drawing and measurement

➤ Problem solving exercise (pages 220–221)

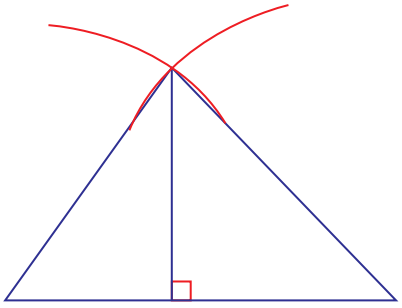
① **a i**

ii



b ACBD is an arrowhead with a reflex angle at ACB. ACBD′ is a kite with a 90° angle at ACB.

②

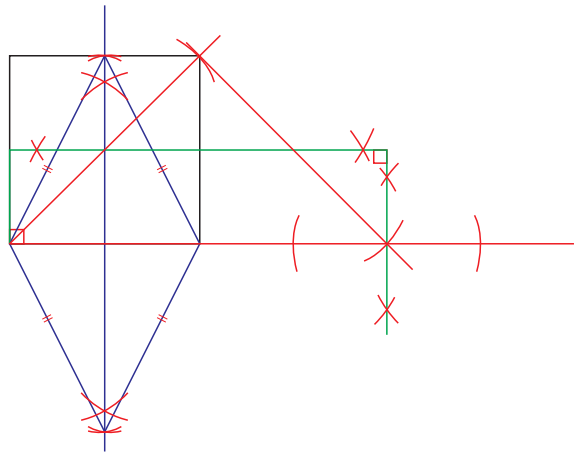


111 m^2

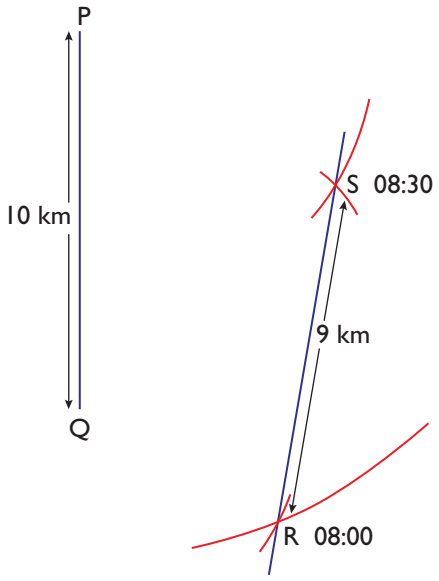
③ **a** *red triangle in diagram*

b *green rectangle in diagram*

c *blue rhombus in diagram*



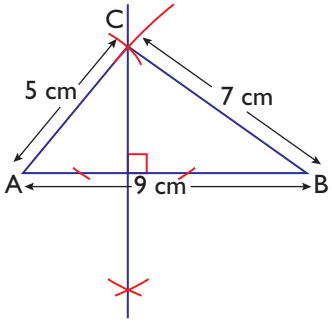
④ **a b**



c 9 km **d** 18 km/h

➤ Do I know it now? (page 221)

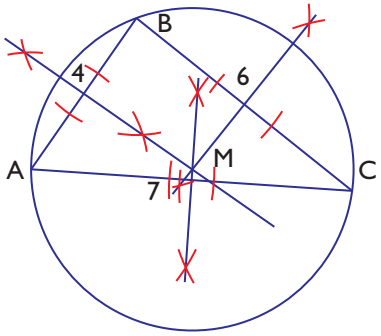
① **a c**



b ∠BAC 51°, ∠ABC 33°, ∠ACB 96°

d 17.4 cm^2 by calculation; 17.6 cm^2 (or 17.1 cm^2) by drawing and measurement

② **a b c d**



e 3.5 cm

➤ Can I apply it now? (page 221)

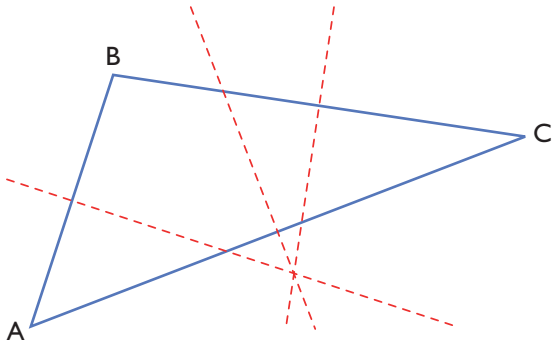
① **a** *Students' own drawings*

b 6.9 cm **c** 41.4 cm^2

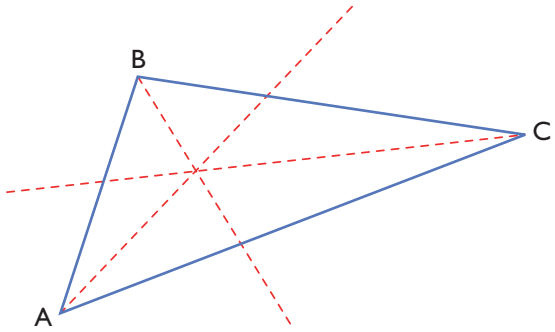
16.2 Loci

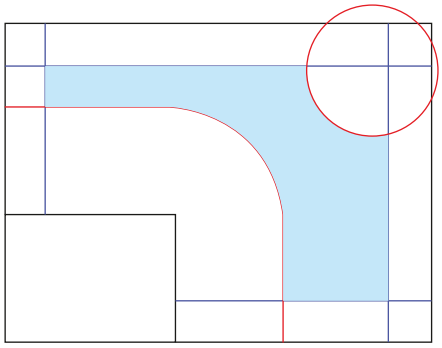
➤ Skills check – do I need to do this section? (page 222)

① **a** The point is where the three perpendicular bisectors meet.



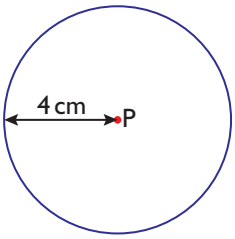
b The point is where the three angle bisectors meet.



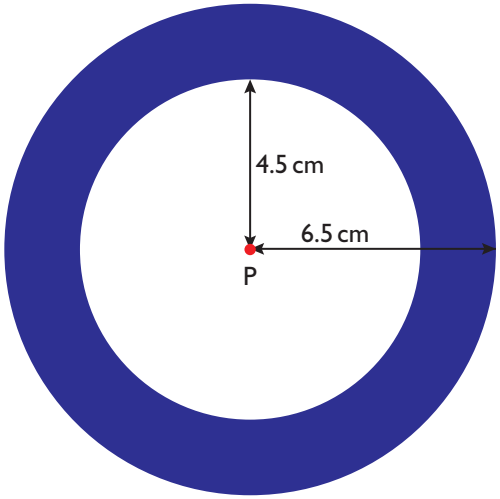
② 

➤ Learning exercise (pages 224–227)

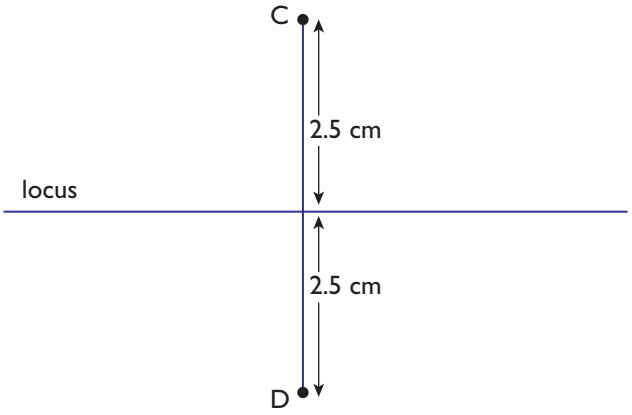
① **a** **b** circle



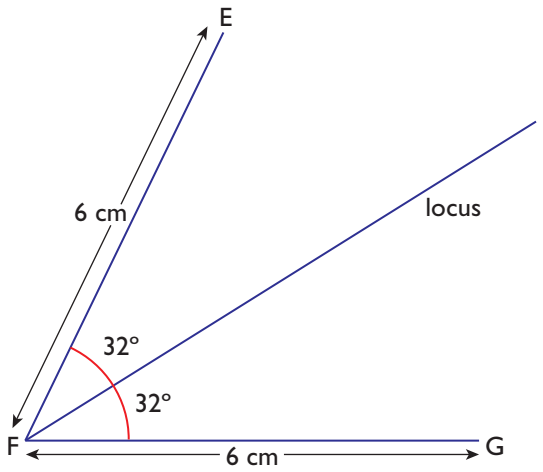
②



③ **a b**

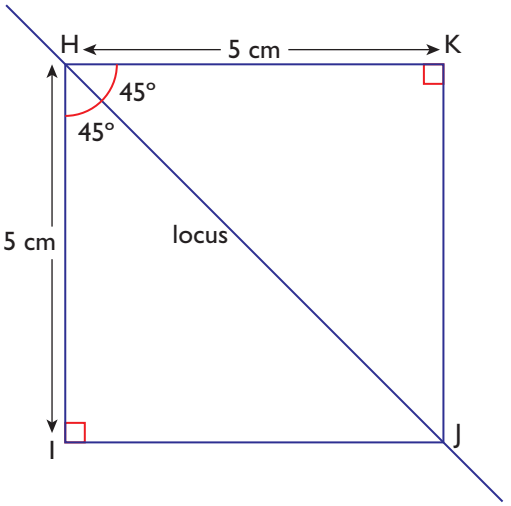


④ **a b**

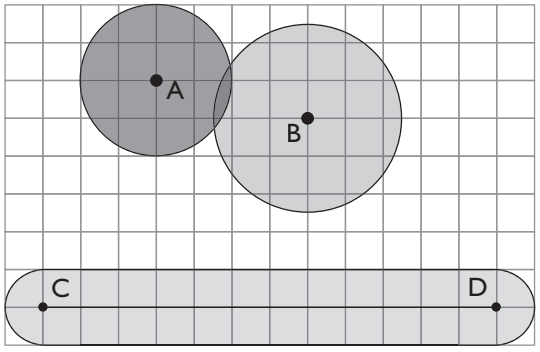


c Bisector of the angle EFG

⑤ **a b**

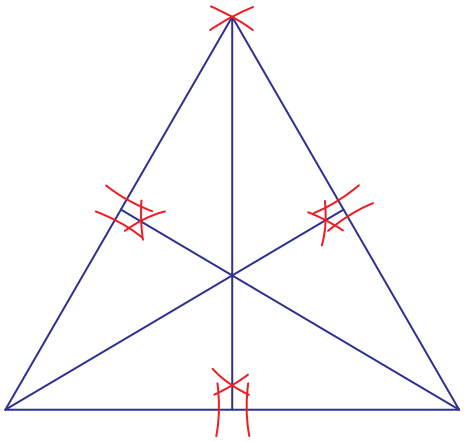


⑥ **a b**

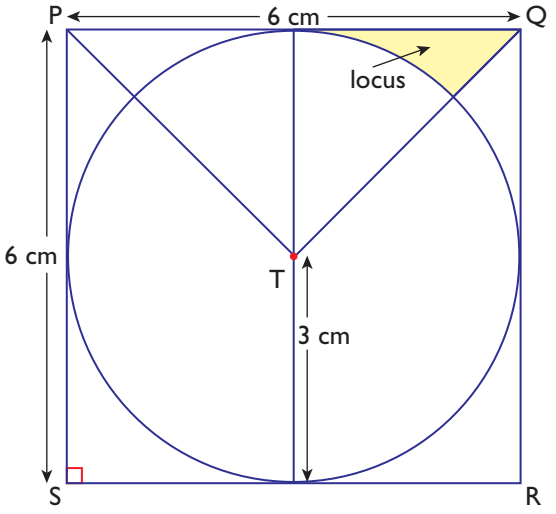


c No

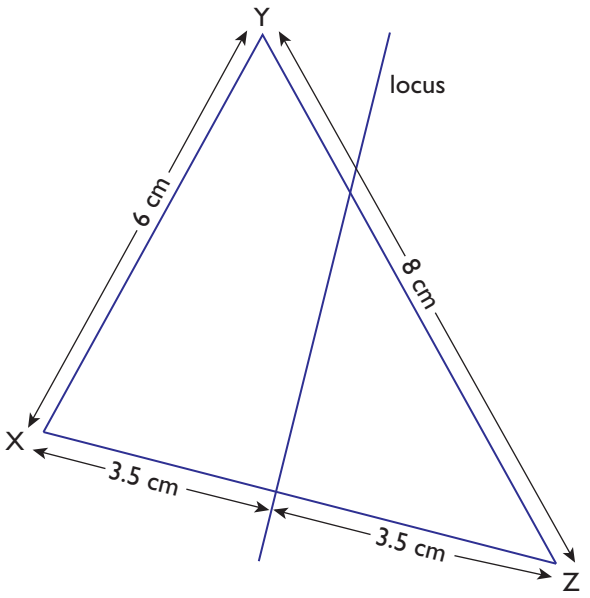
⑦



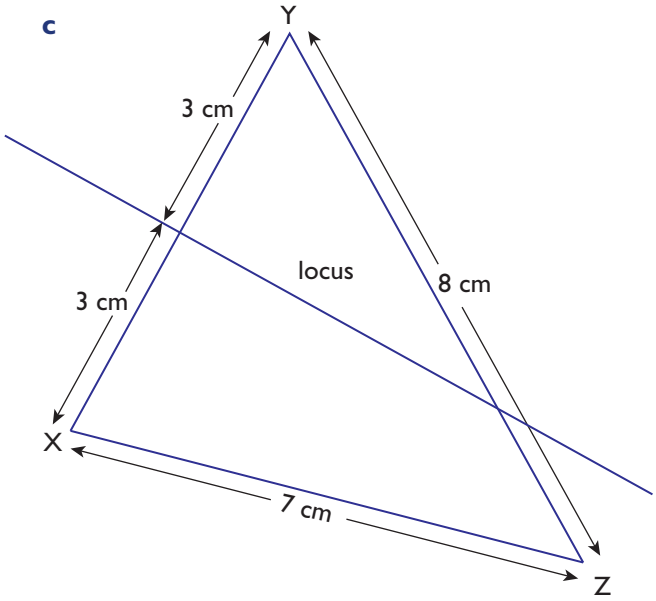
⑧ **a b**



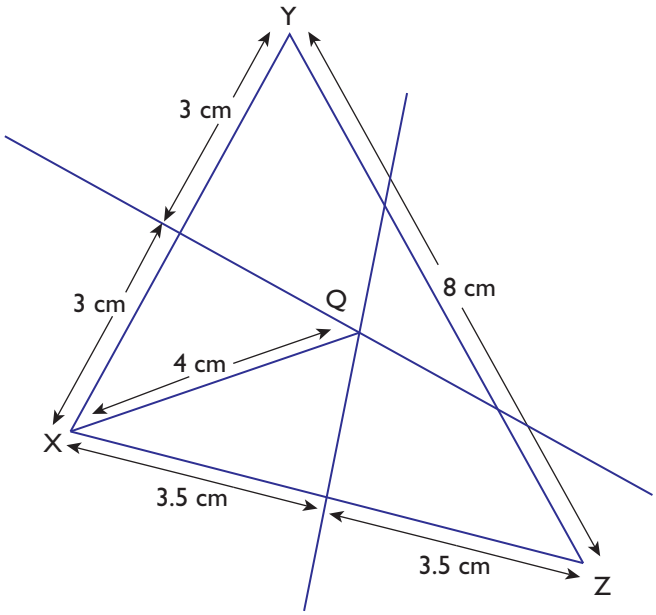
⑨ **a b**



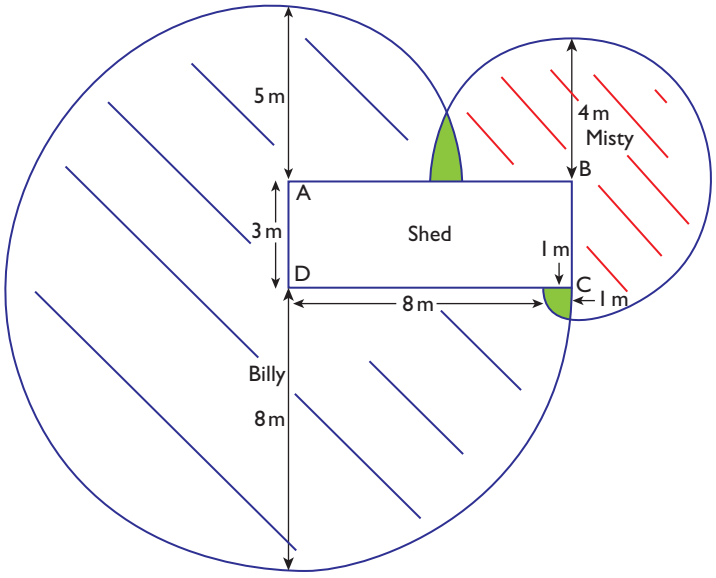
c



d QX = 4 cm

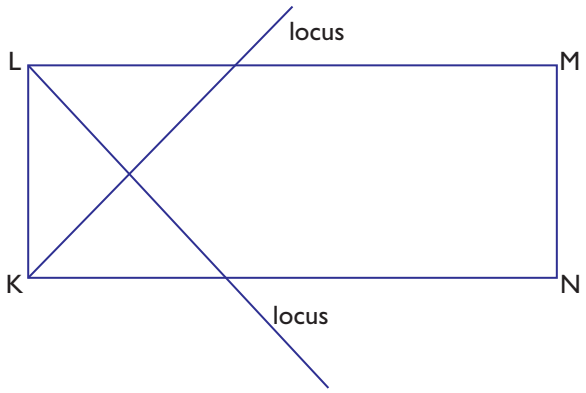


⑩ **a**



b **i** *red shading* **ii** *blue shading*
iii *green shading*

⑪ **a** **b**



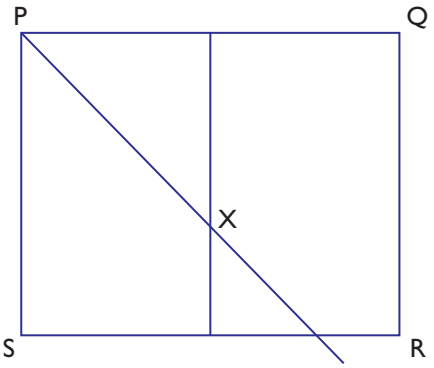
c I

d To find the point that is equal distance from three sides, you bisect two angles and the bisectors cross at that point. You cannot bisect three angles and find a point that three bisectors cross in a rectangle.

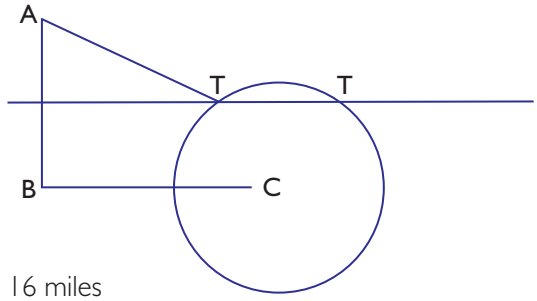
e It is a square.

➤ Problem solving exercise (pages 227–228)

① 58 m

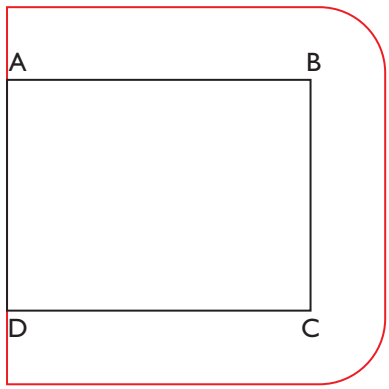


② **a**



b 16 miles

③ **a**

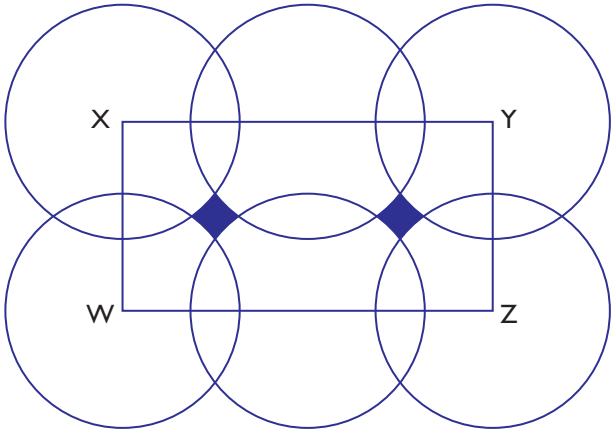


b 50.28 m^2

c The locus of the points that are 2 m from the house is the outside edge of the path.

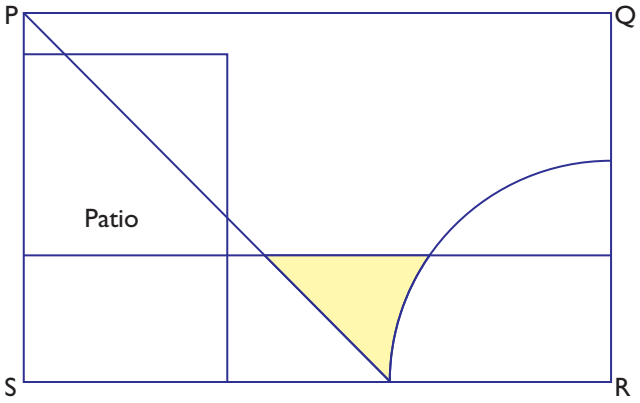
It misses the fourth side, AD.

④ **a b**

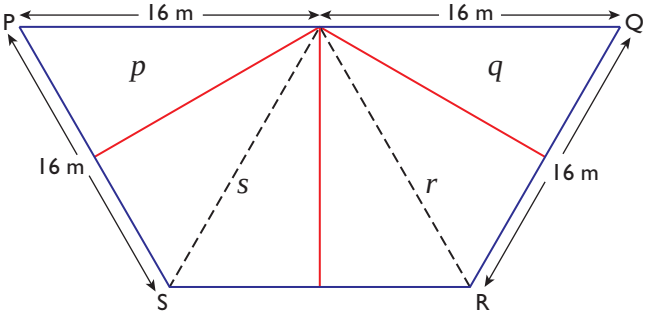


c Diagram to show, for example, the lights at W and at Z moved 10 m towards X and Y.

⑤ *The diagram shows an approximate location for the tree.*



⑥ **a b e**



c 42 m

d $p = 56\,\text{m}^2$, $q = 56\,\text{m}^2$, $r = 112\,\text{m}^2$, $s = 112\,\text{m}^2$

➤ Do I know it now? (page 229)

① **a** points equal distance from AB and AC

b points equal distance from P and Q

c points 2 squares away from the line XY

d points 5 squares away from point Q

② **a** points within the square and closer to BC than AD

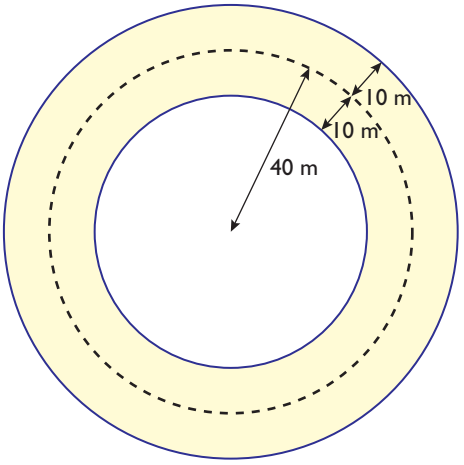
b points closer to the line OL than the line OM

c points within 2 squares of point O

d points more than 1.5 squares but less than 2.5 squares away from line UV

➤ Can I apply it now? (page 229)

① **a**



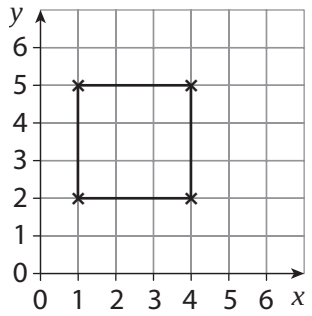
b 5027 m^2

Chapter 17 Transformations

➤ Skills check – warming up (pages 234–235)

Position and Cartesian co-ordinates

a



b (1, 5)

Cartesian co-ordinates in four quadrants

a 3rd quadrant **b** 4th quadrant

c 2nd quadrant **d** 1st quadrant

Translation

a **i** 5 left, 4 down

ii 4 right, 0 up or down

iii 1 left, 4 up

iv 1 right, 4 down

v 4 right, 1 up

vi 1 right, 4 up

b Triangle A

Reflection

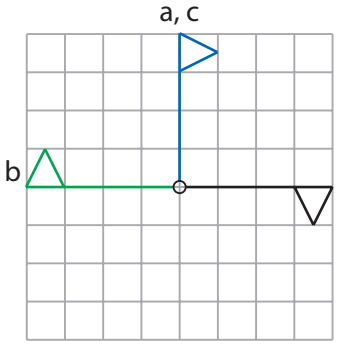
a $y = x$ **b** the x axis

c $y = -x$ **d** y axis

e You need to know the line which the shape has been reflected in.

Rotation

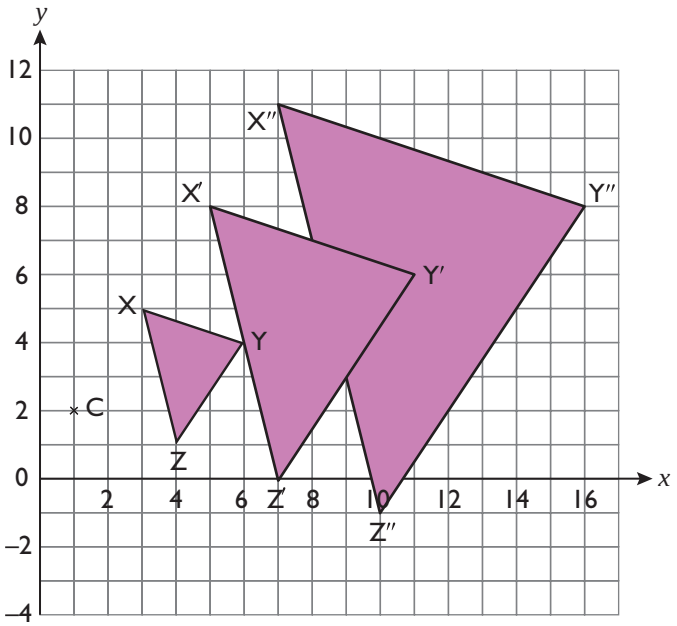
① **a b c**



② You need to know the centre and angle of rotation.

Enlargement

a b



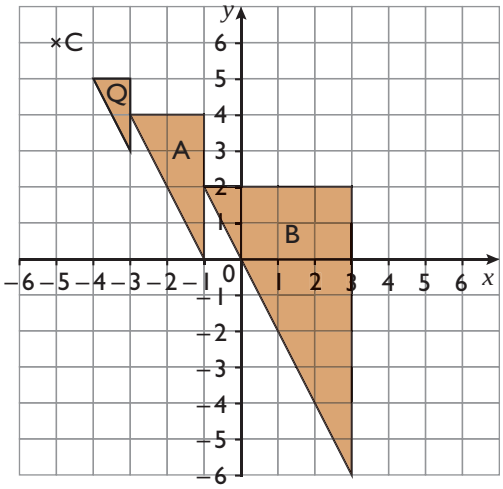
c an enlargement with scale factor $1\frac{1}{2}$, centre C

➤ Applying the knowledge (page 236)

① **a** $y = 10$ **b** $x = 0$

② **a** translation 4 to the right **b** translation 8 to the right

③ **a b**



c scale factor 2, centre (−5, 6)

d scale factor 0.5, centre (−5, 6)

17.1 Similarity

➤ Skills check – do I need to do this section? (page 237)

① **a** 2.5
b 0.5
c 9
d 3.8
e 5.4
f 5.5

② **a** Using the sum of the angles in a triangle is 180°, the triangles have equal angles and so are similar.
b 3

➤ Learning exercise (pages 239–242)

① Similar to P: A, F
Similar to Q: B, D
Similar to neither: C, E

② **a** $y = 7.5$ **b** $z = 9.6$
c $x = 3$ **d** similar

③ **a** $y = 12$ **b** $z = 16$
c $x = 5$ **d** similar
e Both are Pythagorean triples.

④ **a** 2
b $x = 10$
c $w = 8$
d They are the same.
e They are similar triangles.

⑤ **a** not similar; the scale factor between the sides is different ($5 \times 2 = 10$ but $2 \times 2 \neq 5$)
b similar; both are regular pentagons
c not similar; SF is different for different sides
d not similar; SF is different for different sides
e not similar; angles are different
f similar; all angles are the same

⑥ B and C

⑦ 2.5 m

⑧ **a** 12 (including AXY)
b AEC and FBD; AVZ, FYU, BTX, YUC, XET and DVZ

⑨ **a** P and A, B and C **b** P and D

➤ Problem solving exercise (pages 242–243)

① 48 cm

② **a** $\angle C$ is common, $\angle CDE = \angle CAB$ (= 90°) and $\angle CED = \angle CBA$ (from corresponding angles)
b 1.4 m

③ 63 cm

④ 3.2 m

➤ Do I know it now? (pages 243–244)

① **a** 10 **b** 12.5 **c** 7.2

② **a** Unknown angle in T is 40° and unknown angle in V is 30°. The three angles are equal so V and T are similar.
b 4.5 cm **c** 5 cm

➤ Can I apply it now? (page 244)

① 3.36 m

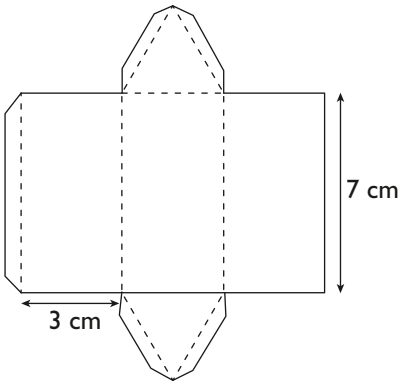
Chapter 18 Three-dimensional shapes

➤ Skills check – warming up (pages 248–249)

Properties of 3-D shapes

a isosceles triangular prism
b irregular prism
c cylinder
d hexagonal prism
e cuboid
f equilateral triangular prism

Understanding nets

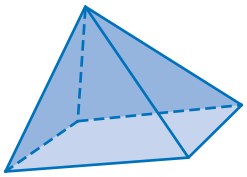


Volume and surface area of cuboids

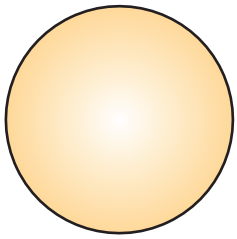
volume 24 m^3, surface area 52 m^2

2-D representations of 3-D shapes

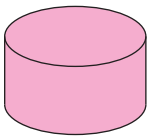
a



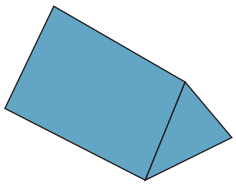
b



c

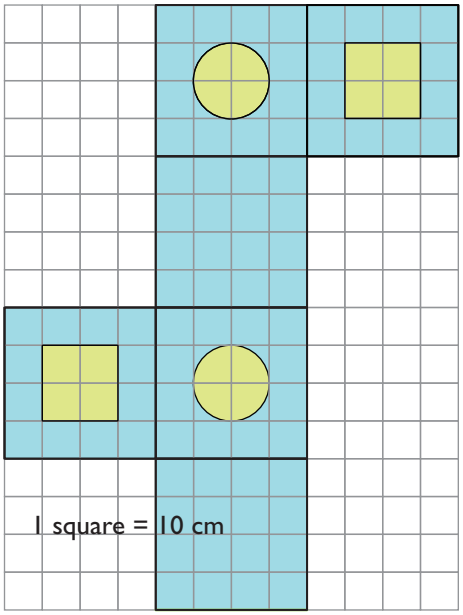


d



➤ Applying the knowledge (page 249)

① For example:



② 0.8 cm

18.1 Prisms

➤ Skills check – do I need to do this section? (page 250)

① **a** volume 16 cm^3, surface area 46 cm^2

b volume 36 cm^3, surface area 84 cm^2

② 3520 cm^3 (3 sf)

➤ Learning exercise (pages 252–255)

① **a** **i** 18 cm^2 **ii** 144 cm^3

b **i** 20 cm^2 **ii** 240 cm^3

c **i** 16 cm^2 **ii** 176 cm^3

② **a** **i** 7.1 cm^2 **ii** 71.0 cm^3

b **i** 50.3 cm^2 **ii** 352.1 cm^3

c **i** 78.5 cm^2 **ii** 628.0 cm^3

d **i** 153.9 cm^2 **ii** 923.4 cm^3

③ 54 cm^3

④ 8 cm

⑤ **a** 14 cm^2 **b** 20 cm

⑥ **a** **i** $50\,m^2$; $40\,m^2$; $30\,m^2$ **ii** $120\,m^2$

b **i** 12 m **ii** $120\,m^2$

c They are equal.

d **i** $6\,m^2$ **ii** the volume, $60\,m^3$

⑦ **a** $210\,cm^3$ **b** $168\,cm^3$

c $96\,cm^3$ **d** $62.8\,cm^3$

⑧ $3.5\,m^3$

⑨ **a** 62.8 cm **b** $1884\,cm^2$

c $314.2\,cm^2$ **d** $2512.4\,cm^2$

⑩ $370\,cm^3$

⑪ **a** Q **b** $301.6\,cm^3$

⑫ **a** $2.4\,m^3$ **b** $8.48\,m^2$

⑬ **a** Anna's **b** $0.033\,m^3$

⑭ **a** 5cm × 5cm × 15cm **b** $56\,cm^2$

c $350\,cm^2$ **d** $24\,cm^3$

e $375\,cm^3$ **f** 1 : 6.25

g 1 : 15.625

➤ Problem solving exercise (pages 255–256)

① **a** $29.52\,m^2$ **b** $12.96\,m^3$

② **a** $2.8\,m^2$ **b** $0.3\,m^3$ or $300\,000\,cm^3$

③ **a** $201\,cm^2$ **b** $1407\,cm^2$

c £1688.40

④ **a** **i** $900\,cm^2$

ii $180\,m^3$ or $180\,000\,000\,cm^3$

b $420\,m^3$

➤ Do I know it now? (page 257)

① **a** **i** $21\,cm^2$ **ii** $210\,cm^3$

b **i** $28\,cm^2$ **ii** $252\,cm^3$

② $46\,cm^2$

③ **a** **i** $113.1\,cm^2$ **ii** $1017.9\,cm^3$

iii $565.5\,cm^2$

b **i** $63.6\,cm^2$ **ii** $763.2\,cm^3$

iii $466.5\,cm^2$

④ $189\,cm^3$

➤ Can I apply it now? (page 257–258)

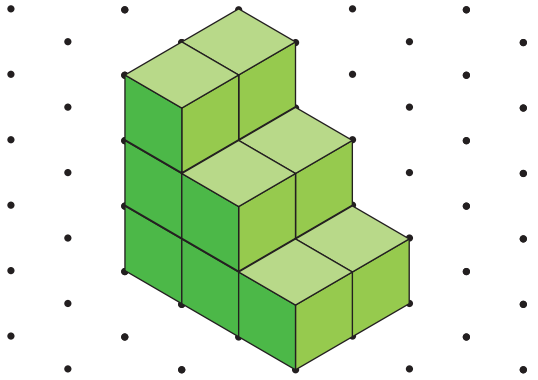
① **a** 1676 loads

b **i** $25133\,m^2$ **ii** $2482\,m^3$

18.2 Constructing plans and elevations

➤ Skills check – do I need to do this section? (page 258)

a



b **i** volume = $12\,cm^3$

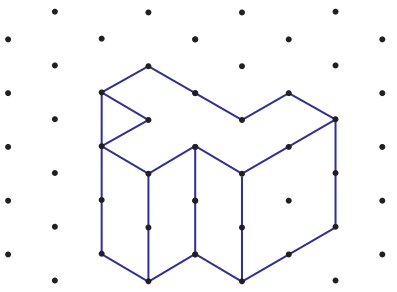
ii surface area = $36\,cm^2$

➤ Learning exercise (pages 259–263)

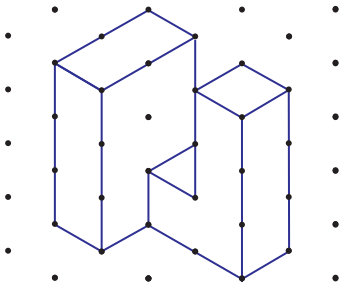
① **a** **iv** **b** **vi** **c** **v**

d **i** **e** **iii** **f** **ii**

② **a**



b



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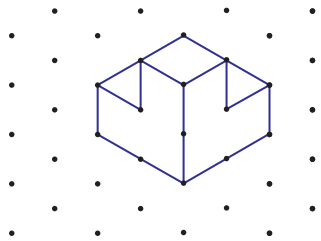

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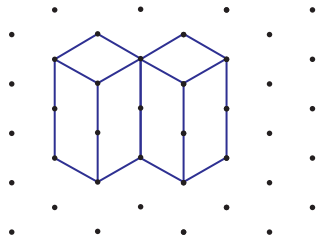


③

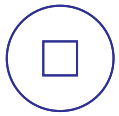
Shape	Front elevation	Side elevation	Plan
A	1	2	4
B	9	8	5
C	3	6	7

④ **a**

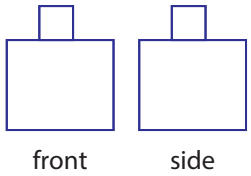
plan

front side

b

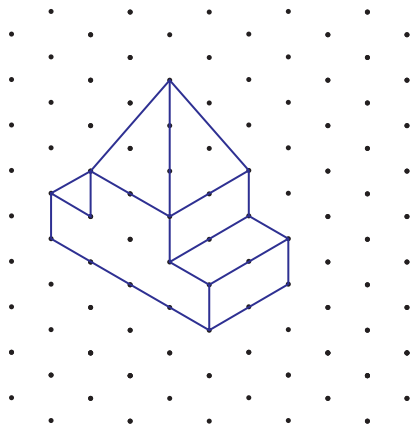


plan



front side

⑤ **a**



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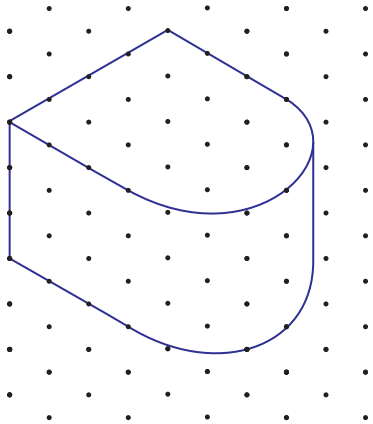
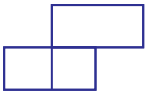
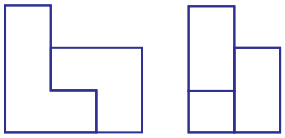


⑥ **a**

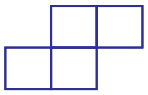


plan

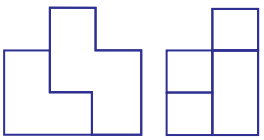


front side

b

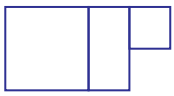


plan

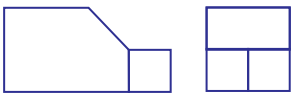


front side

⑦ **a**

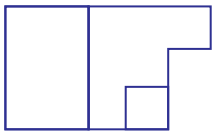


plan

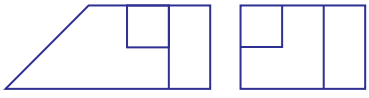


front side

b

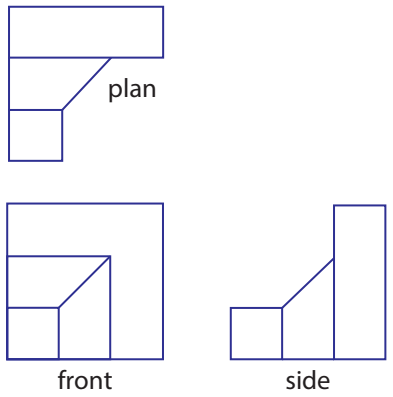


plan

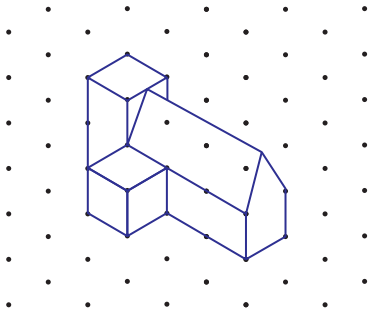


front side

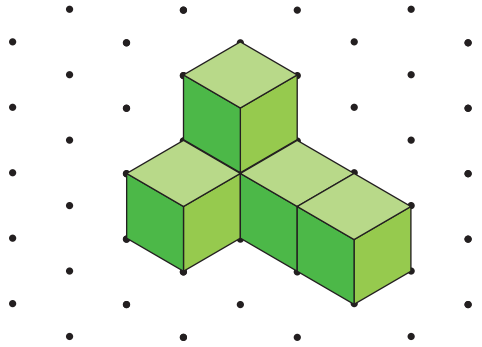
⑧



⑨



⑩ **a**



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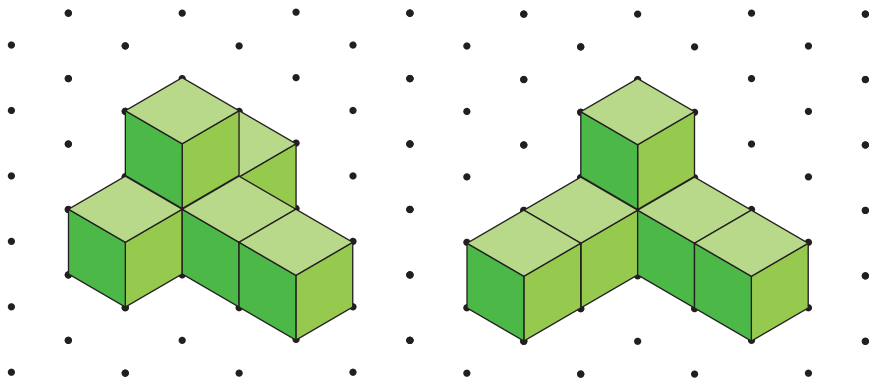
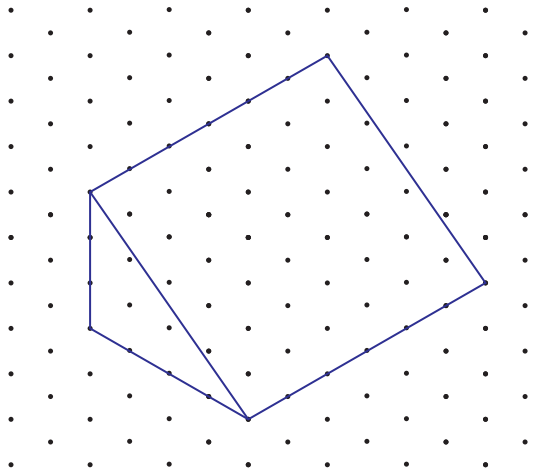
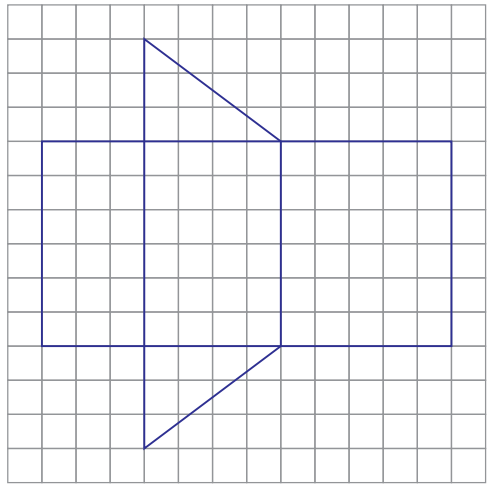


⑪ **a** triangular prism



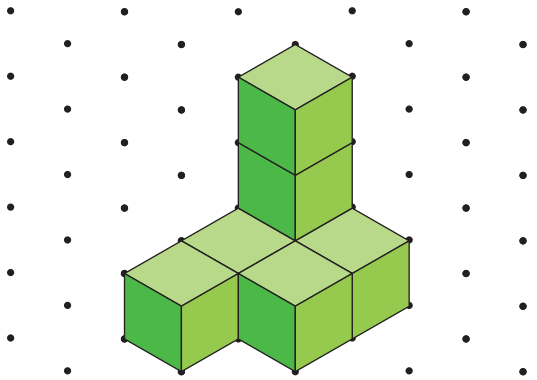
b 36 cm^3

c



d 84 cm^2

⑫ **a**



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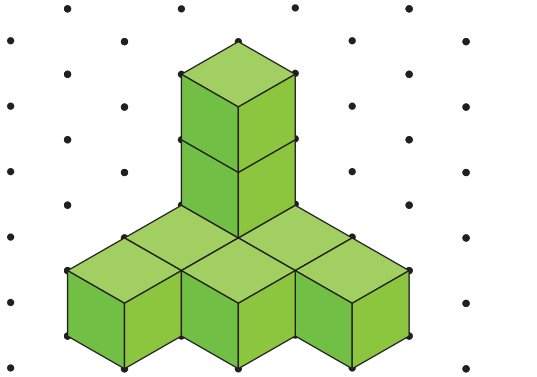
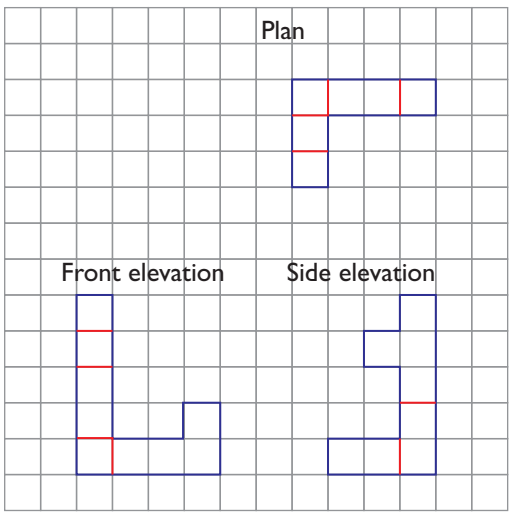


⑬ **a**



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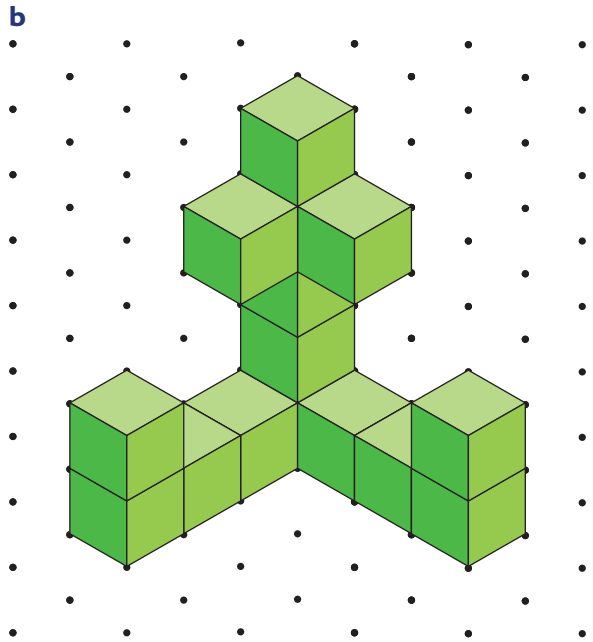
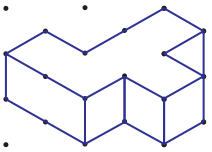
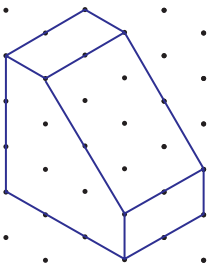


➤ Do I know it now? (page 263)

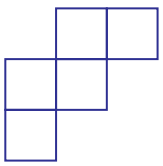
①

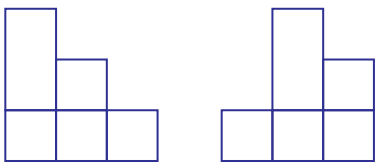


②



③





ESSENTIAL TOPICS – STATISTICS AND PROBABILITY

Chapter 20 Statistical measures

➤ Skills check – warming up (pages 265–266)

Mode, median and range

a mode = £16, median = £45

b £120

c the range

Using mean, median, mode and range

mean = 28 Nadir divided by 5 before finding the total.

mode = 23 Nadir wrote down the frequency instead of the actual data value.

median = 27 Nadir forgot to put the numbers in numerical order.

Using frequency tables

a **With Grow-well**

Number of tomatoes	Tally	Frequency
2	𝍸	3
3	𝍸	1
4	𝍸	3
5	𝍸	2
6	𝍸	2
7	𝍸	2
8	𝍸𝍸	4
9	𝍸	1
10	𝍸	2

Without Grow-well

Number of tomatoes	Tally	Frequency
3	𝍸𝍸	6
4	𝍸	1
5	𝍸𝍸	6
6	𝍸𝍸	6
7		
8		
9	𝍸	1

b **i** With Grow-well 5.9, without Grow-well 4.85

ii With Grow-well 6, without Grow-well 5

c Yes, both the mean and median suggest that on average an extra tomato is produced when Grow-well is used. From the data themselves, we can see there are more tomato plants with higher yields when Grow-well is used.

➤ Applying the knowledge (pages 266–267)

① **a** £229.76

b £216.15

c The median would be more useful as it eliminates those cars with extremely expensive bills.

d The range as it would tell the customer if there were any very expensive bills.

② **a** 63

b mean = 2.24, median = 2, mode = 0

c The median, because it represents that the majority of employees have a small number of absences.

20.1 Using grouped frequency tables

➤ Skills check – do I need to do this section? (pages 267–268)

① **a** 48.3 **b** $30 \leqslant q < 40$

c $40 \leqslant q < 50$ **d** 60

e 15

Learning exercise (pages 269–273)

①

Height, h (cm)	Frequency, f	Midpoint, m	$m \times f$
$150 \leqslant h < 156$	3	**153**	**459**
$156 \leqslant h < 162$	6	**159**	**954**
$162 \leqslant h < 168$	8	**165**	**1320**
$168 \leqslant h < 174$	3	**171**	**513**
$174 \leqslant h < 180$	2	**177**	**354**
Totals	**22**		**3600**

mean height $= 3600 \div 22 = 163.6$ cm

② **a**

Length of call, l (minutes)	Frequency, f	Midpoint, m	$m \times f$
$0 \leqslant l < 10$	**1**	**5**	**5**
$10 \leqslant l < 20$	**5**	**15**	**75**
$20 \leqslant l < 30$	**3**	**25**	**75**
$30 \leqslant l < 40$	**5**	**35**	**175**
$40 \leqslant l < 50$	**5**	**45**	**225**
$50 \leqslant l < 60$	**1**	**55**	**55**
Totals	**20**		**610**

b $30 \leqslant l < 40$

c $610 \div 20 = 30.5$

③ **a** **i** 19 and 185 seconds

ii 166 seconds

b 83.5 seconds

c

Time, t (seconds)	Frequency, f	Midpoint, m	$m \times f$
$0 \leqslant t < 40$	**3**	**20**	**60**
$40 \leqslant t < 80$	**8**	**60**	**480**
$80 \leqslant t < 120$	**9**	**100**	**900**
$120 \leqslant t < 160$	**1**	**140**	**140**
$160 \leqslant t < 200$	**3**	**180**	**540**
Totals	**24**		**2120**

d $80 \leqslant t < 120$

e $2120 \div 24 = 88.3$

f Their marks are between 63 and 103.

④ **a**

Speed, v (mph)	Frequency, f	Midpoint, m	$m \times f$
$0 \leqslant v < 10$	1	**5**	**5**
$10 \leqslant v < 20$	12	**15**	**180**
$20 \leqslant v < 30$	22	**25**	**550**
$30 \leqslant v < 40$	4	**35**	**140**
$40 \leqslant v < 50$	1	**45**	**45**
Totals	**40**		**920**

mean speed $920 \div 40 = 23$ mph

b 30 mph

c 40%

⑤ **a** $434 \div 45 = 9.64$ hours

b 1.61 hours

⑥ **a**

Time, t (minutes)	Frequency, f	Midpoint, m	$m \times f$
$0 \leqslant t < 10$	0	**5**	**0**
$10 \leqslant t < 20$	1	**15**	**15**
$20 \leqslant t < 30$	8	**25**	**200**
$30 \leqslant t < 40$	14	**35**	**490**
$40 \leqslant t < 50$	7	**45**	**315**
Totals	**30**		**1020**

mean time $= 1020 \div 30 = 34$ minutes

b It can be represented as 40 minutes.

c The second club were quicker on average but their runners were more spread out.

⑦ **a**

Waiting time (minutes), t	Frequency, f	Midpoint	$m \times f$
$0 \leqslant t < 5$	6	**2.5**	**15.0**
$5 \leqslant t < 10$	5	**7.5**	**37.5**
$10 \leqslant t < 15$	11	**12.5**	**137.5**
$15 \leqslant t < 20$		**17.5**	**0**
$20 \leqslant t < 25$	9	**22.5**	**202.5**
$25 \leqslant t < 30$	4	**27.5**	**110.0**
Totals	**35**		**502.5**

mean waiting time is $502.5 \div 35 = 14.4$ minutes

b 13 times

c For example: hold-up, accident or power failure.

The time was excluded because it is an outlier and does not represent a normal journey.

⑧ **a**

Distance (metres), d	Frequency, f	Midpoint, m	$m \times f$
$0 \leqslant d < 1$	1	**0.5**	**0.5**
$1 \leqslant d < 2$	5	**1.5**	**7.5**
$2 \leqslant d < 3$	12	**2.5**	**30**
$3 \leqslant d < 4$	9	**3.5**	**31.5**
$4 \leqslant d < 5$	8	**4.5**	**36**
Totals	**35**		**105.5**

mean distance jumped $= 105.5 \div 35 = 3.01$ m

b $(14 \times 3) - 35 = 7$ foul jumps

c Approximately 4 jumps which could come from 2, 3 or 4 jumpers.

⑨ B has a larger mean yield of 854.2 g compared with 812.5 g for A.

⑩

Score, s	Frequency, f	Midpoint, m	$m \times f$
$0 \leqslant s < 10$	11	**5**	**55**
$10 \leqslant s < 20$	6	**15**	**90**
$20 \leqslant s < 30$	12	**25**	**300**
$30 \leqslant s < 40$	10	**35**	**350**
$40 \leqslant s < 50$	9	**45**	**405**
Totals	**48**		**1200**

a 25 **b** 19

c The mean is estimated as the data are grouped. This means that the cut-off for interview is also an estimate and so in turn the number of applicants interviewed is an estimate.

⑪ **a**

Distance travelled, d km	Frequency, f	Midpoint, m	$m \times f$
$20 < d \leqslant 30$	6	25	**150**
$30 < d \leqslant 40$	**12**	**35**	420
$40 < d \leqslant 50$	20	45	900
$50 < d \leqslant 60$	**26**	**55**	**1430**
$60 < d \leqslant 70$	11	**65**	715
Totals	75		**3615**

b $40 < d \leqslant 50$ **c** 48.2 km

d 72.3 minutes

⑫ **a** 100 people **b** $170 < h \leqslant 180$

c Dr Smith is incorrect. You use the midpoints of the classes to calculate the range and so the range is 50 cm.

d 175.5 cm **e** 15–16%

⑬ **a** $30 < c \leqslant 40$ **b** $40 < c \leqslant 50$

c 53.7 **d** 61.1

e 22% ($c \geqslant 75$)

➤ Do I know it now? (page 274)

① **a** estimated mean 51.7

Score, s	Frequency, f	Midpoint, m	$m \times f$
$0 \leqslant s < 20$	6	**10**	**60**
$20 \leqslant s < 40$	8	**30**	**240**
$40 \leqslant s < 60$	15	**50**	**750**
$60 \leqslant s < 80$	14	**70**	**980**
$80 \leqslant s < 100$	5	**90**	**450**
Totals	**48**		**2480**

b 8 or 9 (= 3 or 4 from $60 \leqslant s < 80$ class)

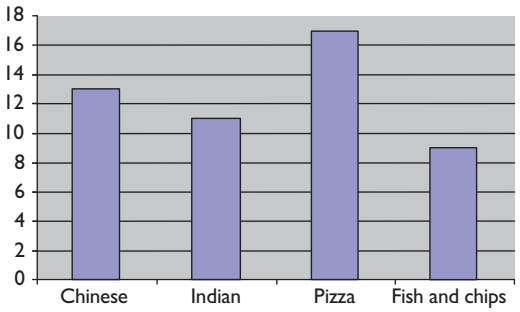
c They were less than 50.

Chapter 21 Statistical diagrams

➤ Skills check – warming up (pages 276–277)

Using tables and charts

a



b For example: Thai, Italian, French, burger

c Older people might be more traditional, e.g. more fish and chips, pizza.

d He could include age and gender to see trends more clearly.

Vertical line charts

a 17 °C **b** 30 °C

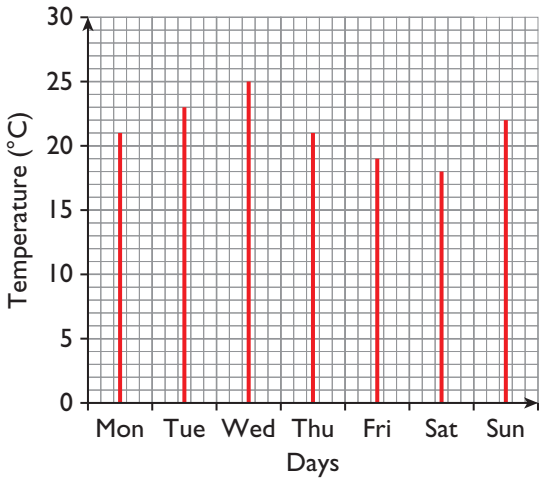
c 2 °C **d** Wednesday to Thursday

e i It continues to rise.
ii The vertical lines get taller.

Applying the knowledge (page 277)

① **a** October **b** 9 hours
c i 0 hours **ii** 24 hours
d 480 hours
e To be able to compare the two cities

② **a**



b For example: whilst the highest midday temperature is on Wednesday, the temperature could be higher at other times of the day that were not measured.

21.1 Pie charts

Skills check – do I need to do this section? (page 278)

① **a i** 40 **ii** 9°
b i 36 **ii** 10°
c *Check pie chart. Angles are:*

Boys: athletics 36°, football 171°, hockey 18°, swimming 90°, tennis 45°

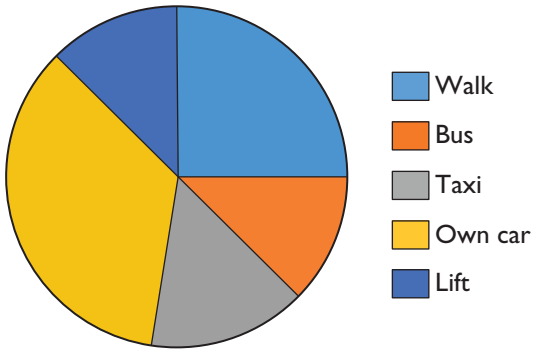
Girls: athletics 50°, football 30°, hockey 110°, swimming 90°, tennis 80°

d Boys' and girls' preferences for swimming and athletics are similar. Hockey is preferred much more by girls than boys. Football is preferred much more by boys than girls.

Learning exercise (pages 281–284)

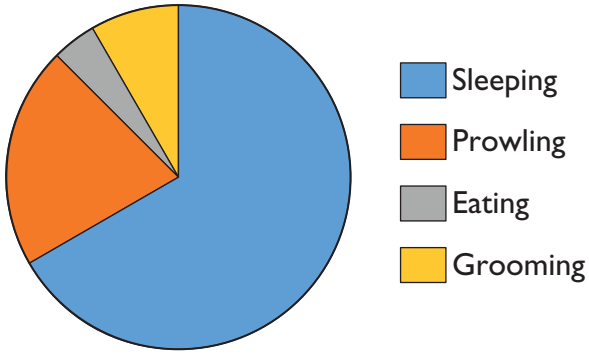
① **a** university **b** 90° **c** $\frac{1}{4}$
d gap year 42, university 70, apprenticeship 42, job 14

② **a** 9°
b



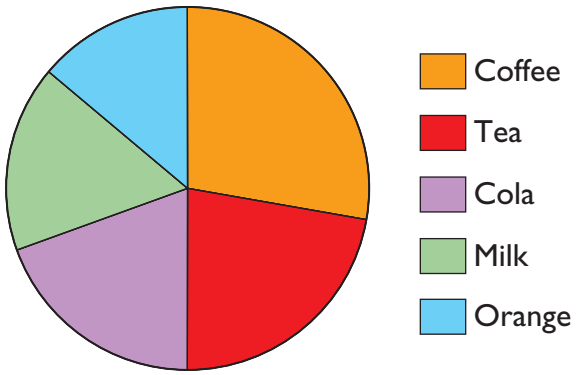
c 420

③ **a** 15°
b



c They must add another segment of 7.5°, increase prowling to 97.5° and decrease sleeping to 210°.

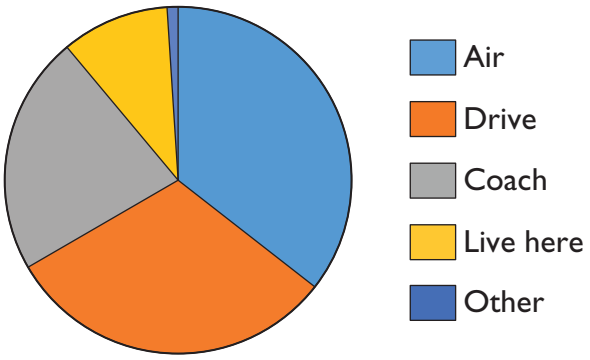
④ **a**



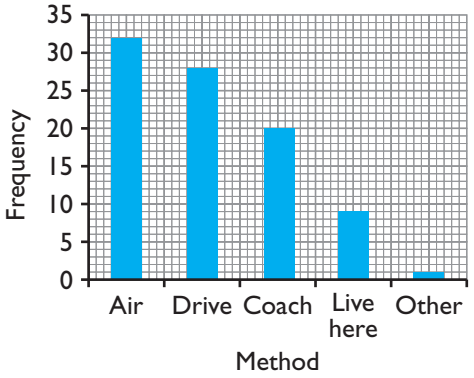
b *Student's own opinion with reason*

⑤ **a** 90 **b** 4°

c



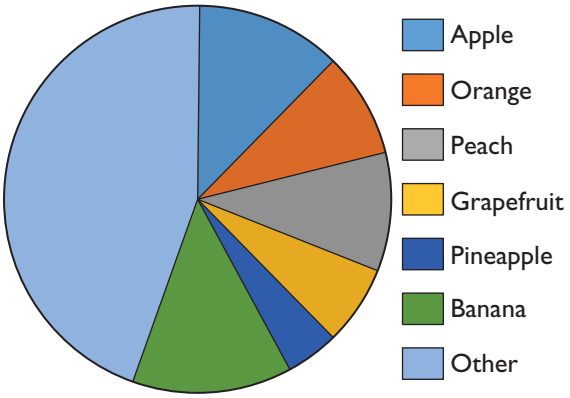
d



e The pie chart, because it shows fractions/ proportions more clearly

⑥ **a** 90 **b** 4°

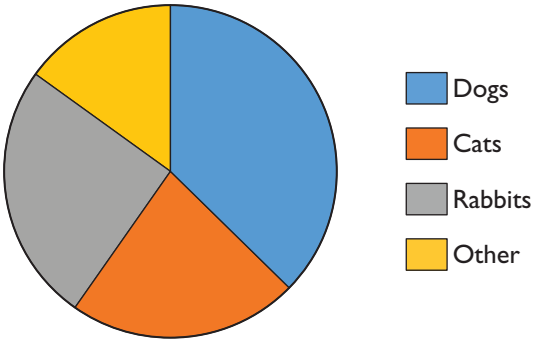
c



d *Other* is the largest category. The fruit seller should have listed more fruits to get more out of the data. There is little difference between the fruits and this is hard to see from the pie chart; a bar chart might have been clearer.

⑦ **a** dogs 135°, cats 80°, rabbits 90°, other 55°

b

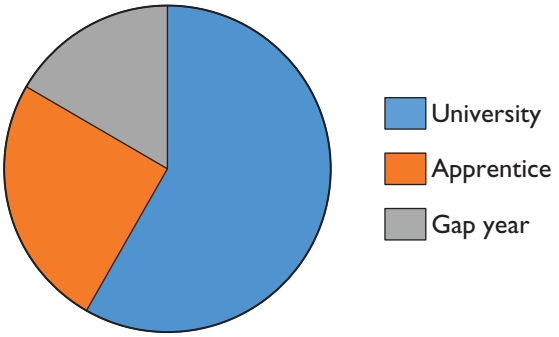


c No. There is no information about the absolute frequencies.

⑧ The Senior segment should be 210°. The Adult segment should be 50°.

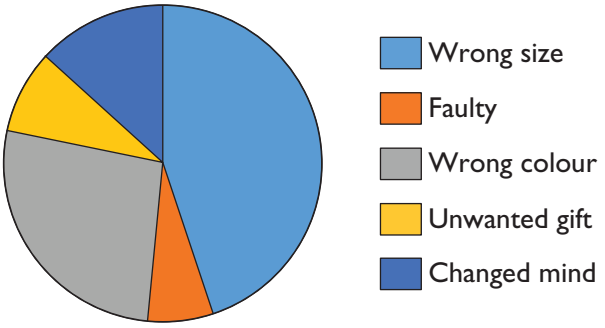
⑨ **a** $\frac{1}{6}$

b



c 240 students

⑩ **a**



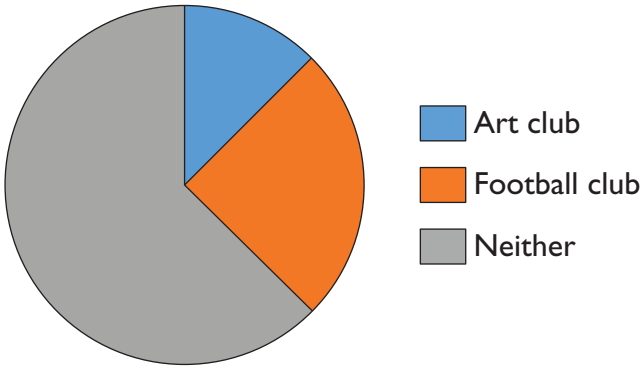
b 1000

➤ Do I know it now? (page 284)

① **a** **i** $\frac{5}{8}$

ii 225°

b



c 140 children

21.2 Displaying grouped data

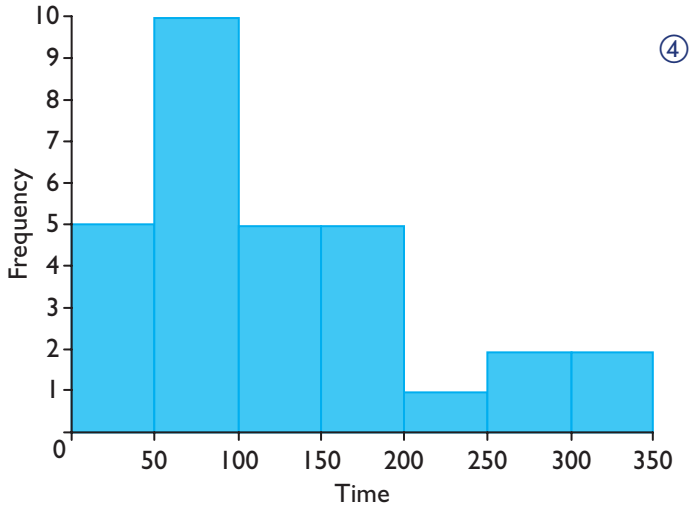
➤ Skills check – do I need to do this section? (pages 284–285)

① **a**

Time spent playing computer games, t minutes	Tally	Frequency
$0 \leqslant t < 50$	𝍸	**5**
$50 \leqslant t < 100$	𝍸 𝍸	**10**
$100 \leqslant t < 150$	𝍸	**5**
$150 \leqslant t < 200$	𝍸	**5**
$200 \leqslant t < 250$	I	**1**
$250 \leqslant t < 300$	II	**2**
$300 \leqslant t < 350$	II	**2**
	Total	**30**

b

Frequency diagram showing time spent playing computer games



c The pupils will not be at school, so they may spend more time playing computer games. This means that the frequencies in the higher groups are likely to increase.

➤ Learning exercise (pages 287–291)

① **a** **i** discrete
ii continuous
iii discrete

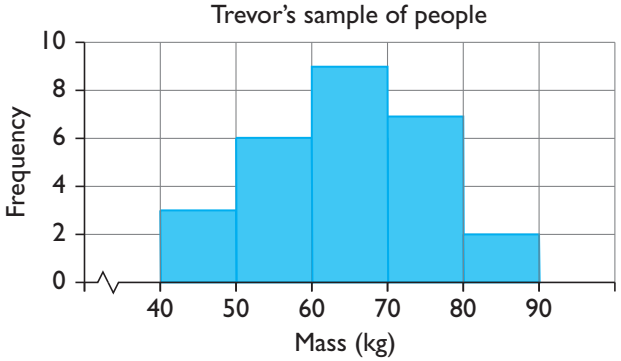
b **i** discrete
ii continuous
iii continuous
iv continuous

② **a** frequencies are 3, 6, 9, 7 and 2

b $60 \leqslant w < 70$

c

Frequency diagram showing the masses of Trevor's sample of people



d For example: the tally chart (or frequency diagram) because it shows the shape of the distribution

③ **a** frequencies are 1, 6, 5, 4, 4 and 1

b $30 \leqslant h < 40$

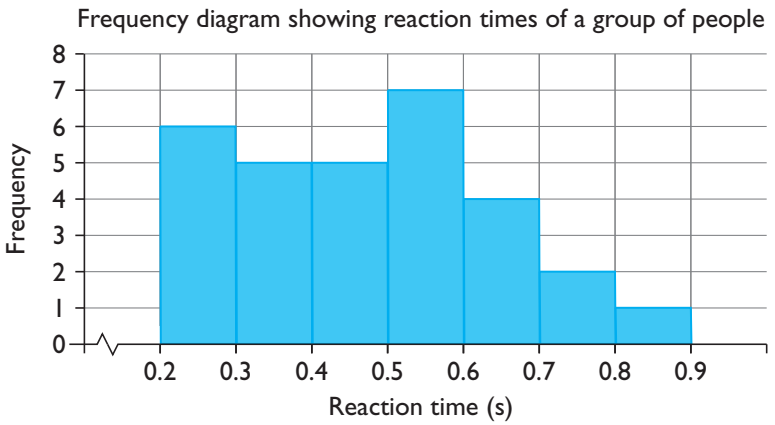
c on 7 days

d Between 20 and 80 people use the gym on any day.

④ **a**

Reaction time, n	Frequency
$0.20 \leqslant n < 0.30$	6
$0.30 \leqslant n < 0.40$	5
$0.40 \leqslant n < 0.50$	5
$0.50 \leqslant n < 0.60$	7
$0.60 \leqslant n < 0.70$	4
$0.70 \leqslant n < 0.80$	2
$0.80 \leqslant n < 0.90$	1

b



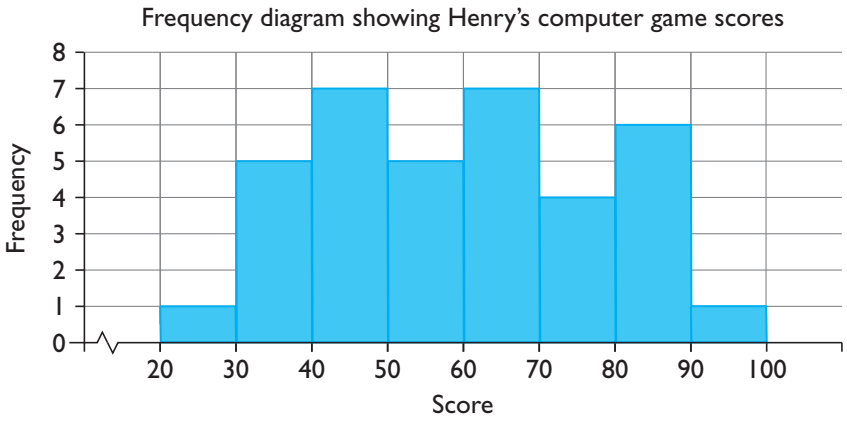
c 20%

d Fairly level until 0.5, with a modal class of $0.50 \leqslant n < 0.60$, then it falls away.

⑤ **a**

Score, n	Frequency
$20 \leqslant n < 30$	1
$30 \leqslant n < 40$	5
$40 \leqslant n < 50$	7
$50 \leqslant n < 60$	5
$60 \leqslant n < 70$	7
$70 \leqslant n < 80$	4
$80 \leqslant n < 90$	6
$90 \leqslant n < 100$	1

b



c You can order the actual scores in the original data to work out the median value: $\frac{58 + 60}{2} = 59$. The table only shows that the median value is between the two classes $50 \leqslant n < 60$ and $60 \leqslant n < 70$.

d Fairly even between 30 and 90 with only one score above and one below that. It is easier to use the grouped data.

⑥ **a** 21

b

Age, a	Frequency
$0 \leqslant a < 10$	4
$10 \leqslant a < 20$	10
$20 \leqslant a < 30$	15
$30 \leqslant a < 40$	19
$40 \leqslant a < 50$	16
$50 \leqslant a < 60$	5
$60 \leqslant a < 70$	2

c It includes mainly people of working age.

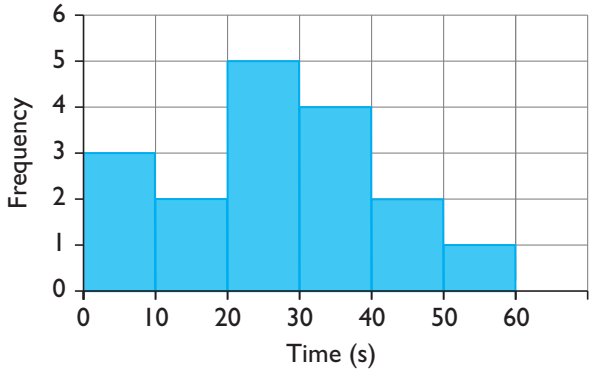
⑦ **a i ii**

Time, t (seconds)	Boys	Girls
$0 \leqslant t < 10$	3	0
$10 \leqslant t < 20$	2	2
$20 \leqslant t < 30$	5	3
$30 \leqslant t < 40$	4	4
$40 \leqslant t < 50$	2	4
$50 \leqslant t < 60$	1	2

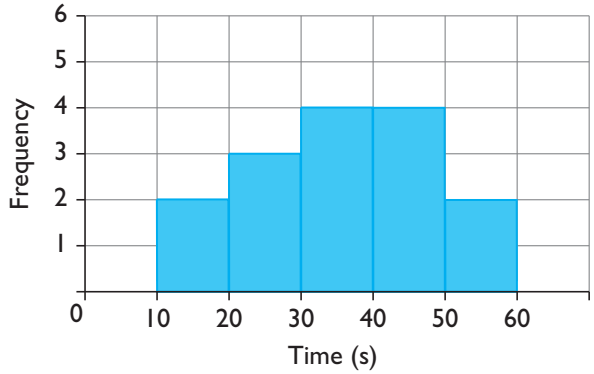
b Boys: Using the original data, the median is 25.

Girls: Using the original data, the median is 35.

c Frequency diagram showing how long boys held their breath for



Frequency diagram showing how long girls held their breath for



d The girls can stay underwater the longest; they have a higher mean (35.7 seconds *vs* boys 26.8 seconds).

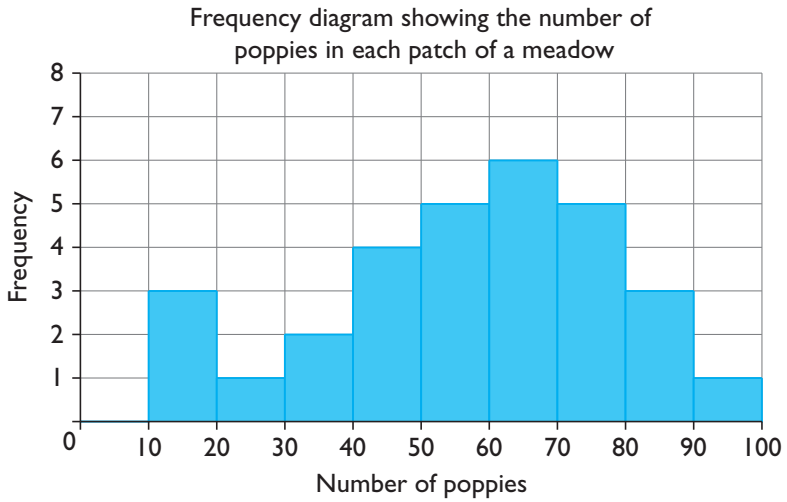
⑧ **a** **i** 150

ii She could choose to accept it because there might be one area of the field that is particularly densely populated. She could choose to reject it because it is so much higher than all the other values so therefore likely to be an error, or at least to distort the overall data pattern.

b

Number of poppies, p	Frequency
$0 \leqslant p < 10$	0
$10 \leqslant p < 20$	3
$20 \leqslant p < 30$	1
$30 \leqslant p < 40$	2
$40 \leqslant p < 50$	4
$50 \leqslant p < 60$	5
$60 \leqslant p < 70$	6
$70 \leqslant p < 80$	5
$80 \leqslant p < 90$	3
$90 \leqslant p < 100$	1

c



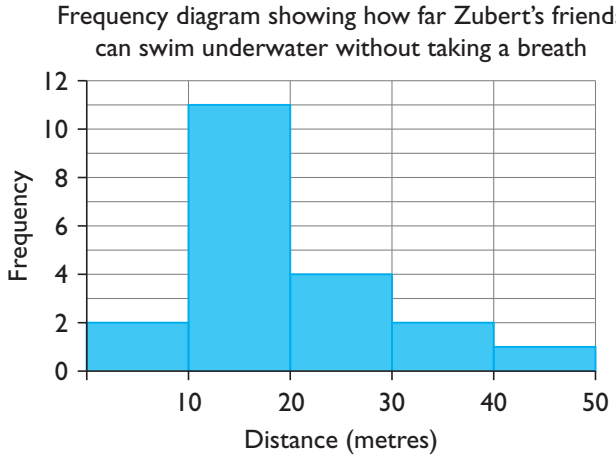
d **i** mode 15, median 61

ii The median is more representative.

Modal class is $60 \leqslant p < 70$ and also contains the median.

e 50%

⑨ **a**

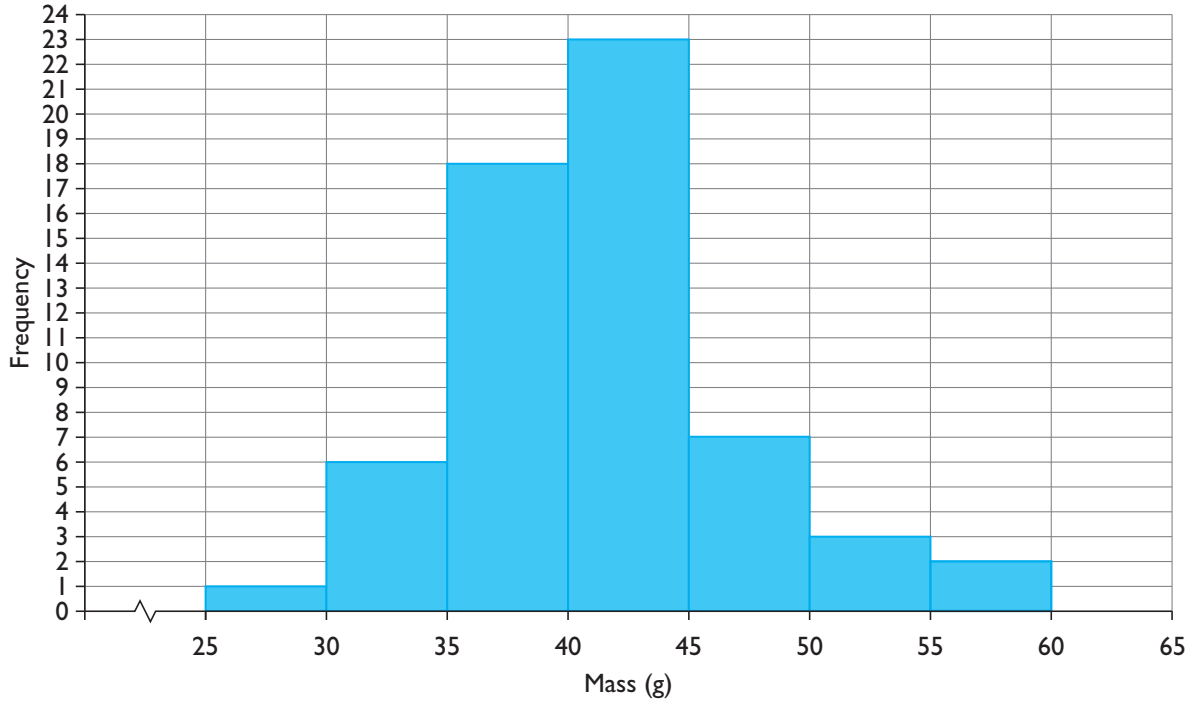


b Most of them can only swim less than 20 m and few of them can swim further. It is skewed towards the lower end (positively skewed).

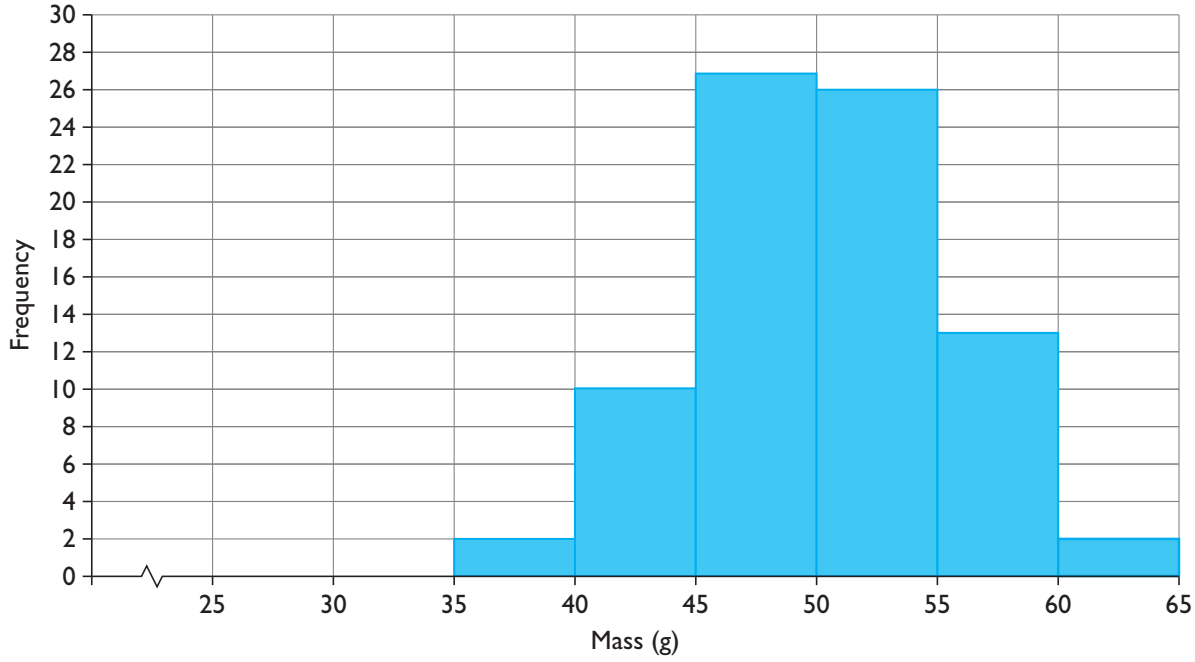
c 55%

d The better swimmers have increased the distance they can swim underwater slightly; the weaker swimmers have performed much the same as before.

⑩ **a** **Female chicks**



Male chicks



b Diagrams show that male chicks tend to be heavier than female chicks. The modal class for female chicks is $40 \leqslant m < 45$ compared with a modal class of $45 \leqslant m < 50$ for male chicks.

c **i** 20% **ii** 83% (males $\geqslant$ 45 mg, females $<$ 45 mg)

⑪ **a** Stephen has used the computer every day; Anna hasn't. Stephen's range is 69; Anna's is 115. The mean for each of them is 56 minutes.

b They don't really need a second computer as the maximum total time in one day is just over 3 hours, so there should be plenty of time to use the computer in the evening.

➤ Do I know it now? (page 291)

① **a** $0.5\,\text{kg} \leqslant n < 1.0\,\text{kg}$ **b** $1.5\,\text{kg} \leqslant n < 2.0\,\text{kg}$

c

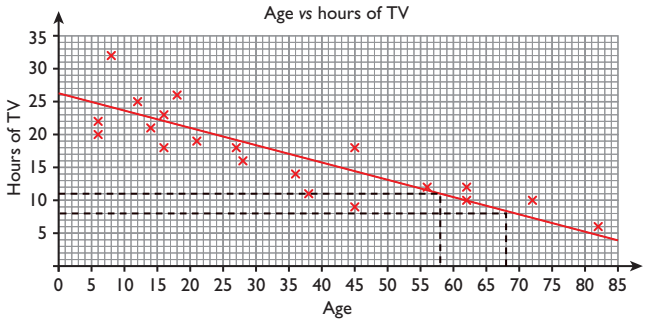
Weight, n (kg)	Frequency
$0 \leqslant n < 0.5$	3
$0.5 \leqslant n < 1.0$	5
$1.0 \leqslant n < 1.5$	7
$1.5 \leqslant n < 2.0$	10
$2.0 \leqslant n < 2.5$	9
$2.5 \leqslant n < 3.0$	6
$3.0 \leqslant n < 3.5$	4
$3.5 \leqslant n < 4.0$	4
$4.0 \leqslant n < 4.5$	1
$4.5 \leqslant n < 5.0$	1

d 50 cats

21.3 Scatter diagrams

➤ Skills check – do I need to do this section? (page 292)

① **a c**



b i There is a negative correlation.

ii Older people tend to watch less TV: middle-aged people may be too busy; aged people may be too tired.

d 11 hours

e 68 years

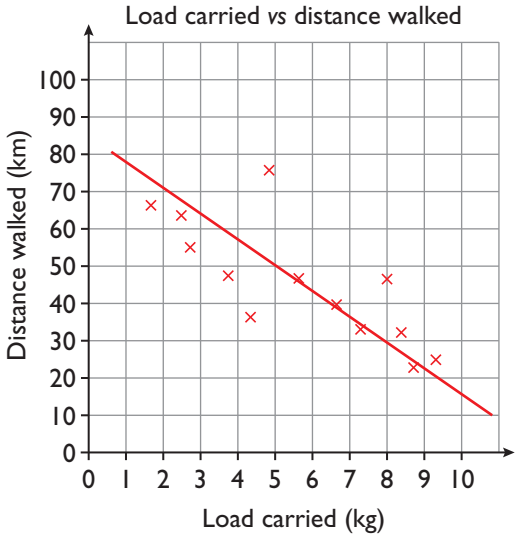
➤ Learning exercise (pages 294–297)

① **a** no correlation **b** negative correlation

c positive correlation **d** no correlation

② **a** negative correlation

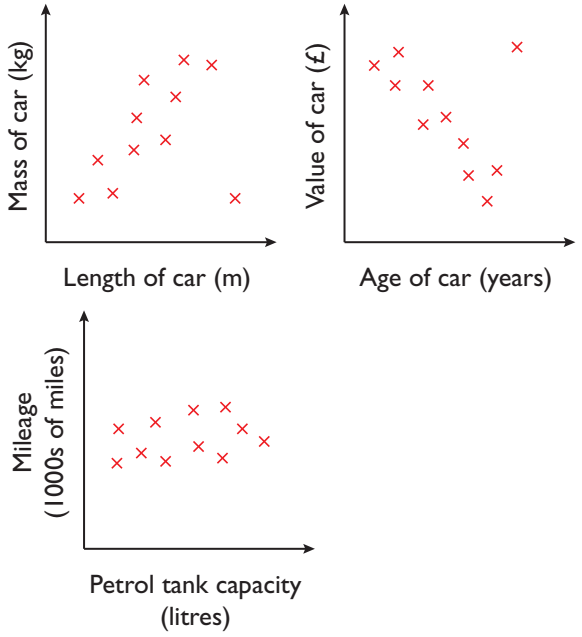
b



c 45 km **d** 2 kg

③ **a** 11

b For example:



c i positive correlation

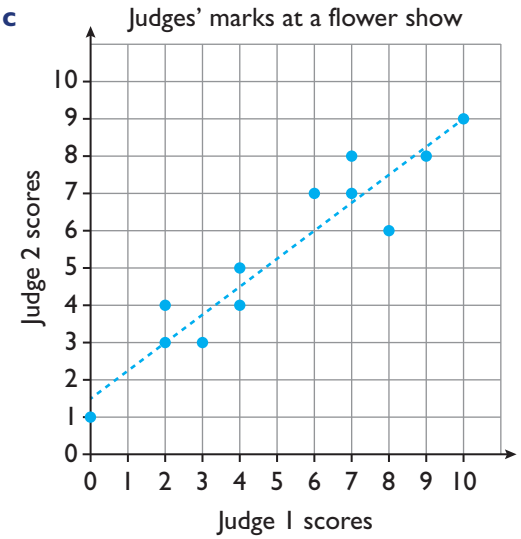
ii negative correlation

iii no correlation

d i a sports car

ii a valuable vintage car

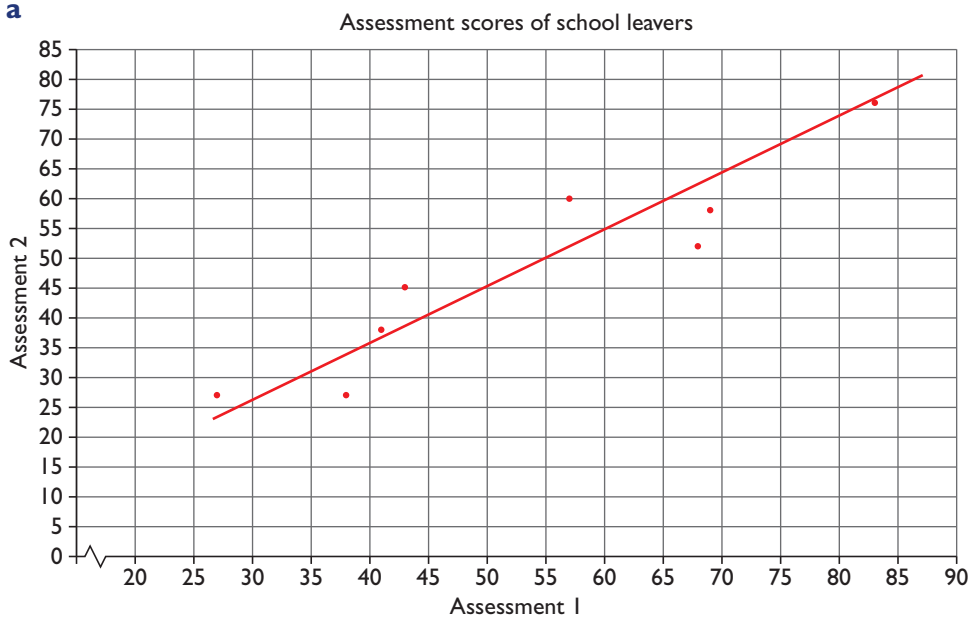
④ **a c**



b positive correlation (Both judges give similar scores for both candidates.)

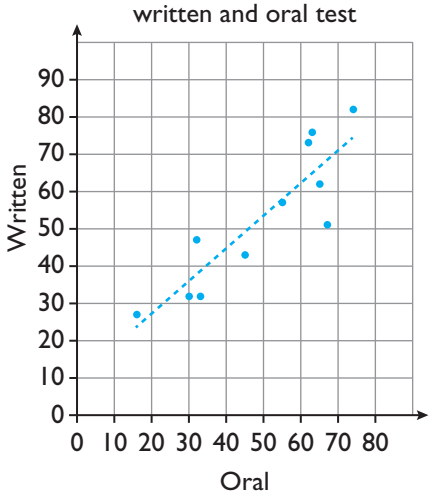
d 5

⑤ **a**



b 45

⑥ **a d**



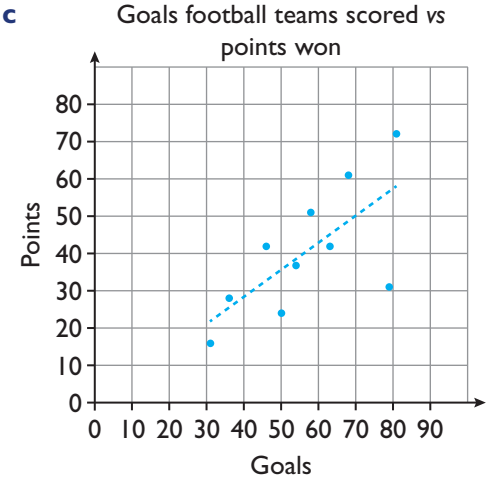
b positive correlation

c i 4

ii 4 points lie to the right of the line $y = x$ (i.e. Oral > Written).

e i 57 **ii** 45

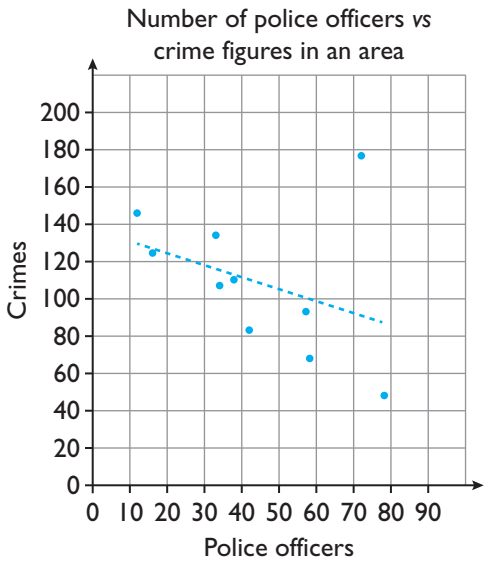
⑦ **a c**



b positive correlation

d i 43 **ii** 64

⑧ **a d**

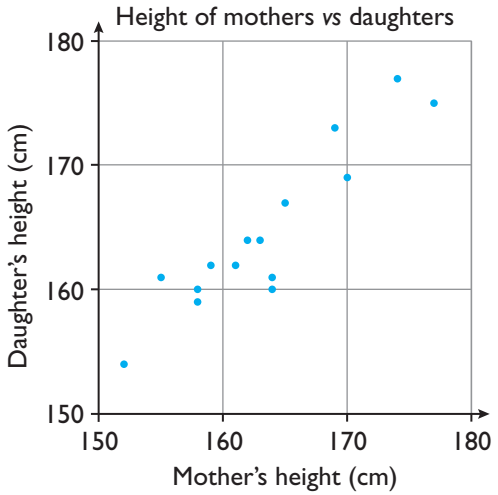


b (72, 177)

c negative correlation (The more police officers, the fewer crimes.)

e 105

⑨ **a**

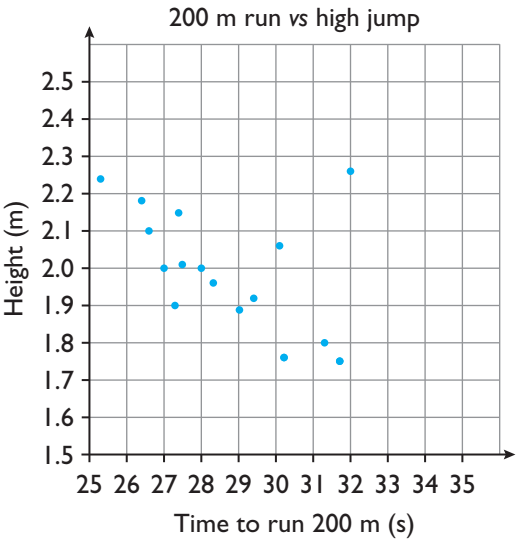


b positive correlation (Taller mothers have taller daughters.)

c i The median height of the group of mothers is 163 cm. The median is the 8th data point you come to when you look from left to right. This data point has 7 data points to the left and 7 to the right.

ii No, her daughter is 164 cm and the median height of the daughters is 162 cm.

⑩ **a**



b There is a negative correlation. The coach seems to be right: the faster they are at running, the higher they can jump.

c 28.15 s

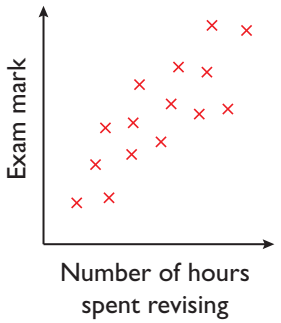
d i 2 m

ii No. There are 16 data items so the middle one is between the 8th and the 9th.

e 6

⑪ **a** There is low negative correction correlation, so there is some evidence to support the statement that there is a relationship between the number of hours spent watching television and the exam mark.

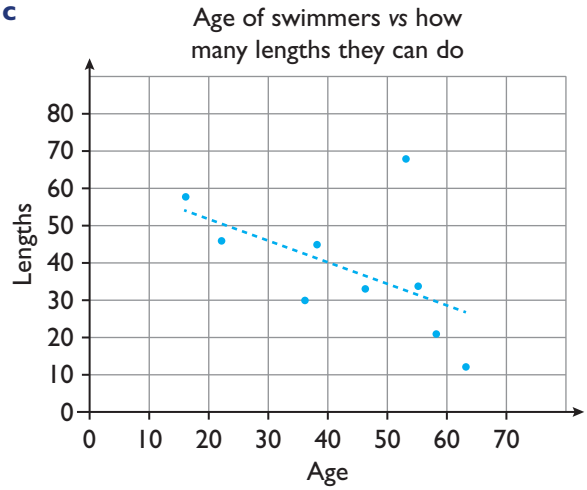
b i



ii Yes, Mrs Jones is right because as number of hours spent watching TV increases, so the exam mark decreases and a low exam mark corresponds with fewer hours spent revising. Students who watch more TV have less time to spend revising.

➤ Do I know it now? (page 297)

① **a c**



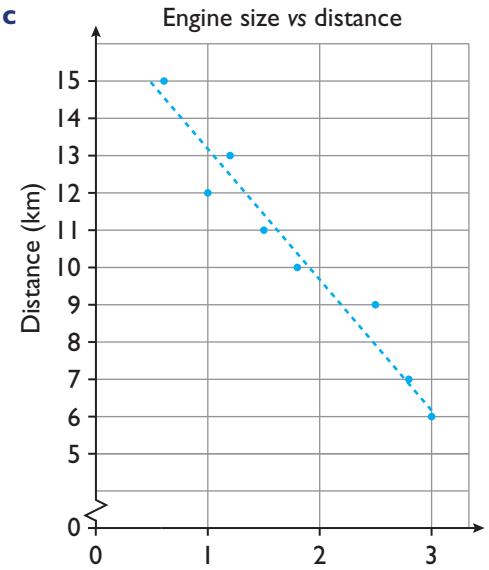
b The older they are, the fewer lengths they can swim. (negative correlation)

d i 35 lengths **ii** 40 years

21.4 Use and limits of lines of best fit

➤ Skills check – do I need to do this section? (page 298)

① **a c**



b The graph shows negative correlation, meaning that the larger the engine size, the less distance it can cover on 1 litre of diesel.

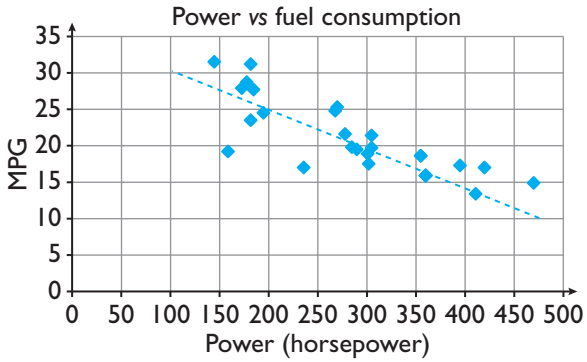
d 11.7 km

➤ Learning exercise (pages 300–303)

① **a** fuel consumption: least 13.4, most 31.5

power: least 145, most 470

b c



d i The more power a car has, the worse its fuel economy.

ii approximately 420 horsepower

iii approximately 13 mpg

e For example: No; this value would be off the graph (and might also be too extreme a value to lie on the same line).

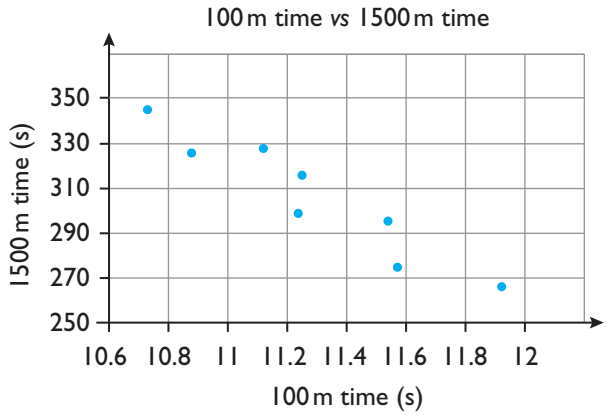
② D, B, C, A

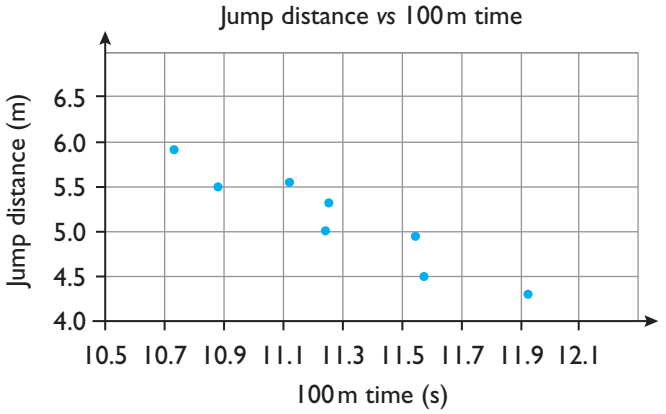
D is best as it has roughly half of the points on either side of the line of best fit. Then comes B; it seems to split the data fairly evenly, but has been forced through the origin. Next comes C as it doesn't split the data evenly. A is the worst; it has been formed by joining two points and does not have half the data points on either side of the line.

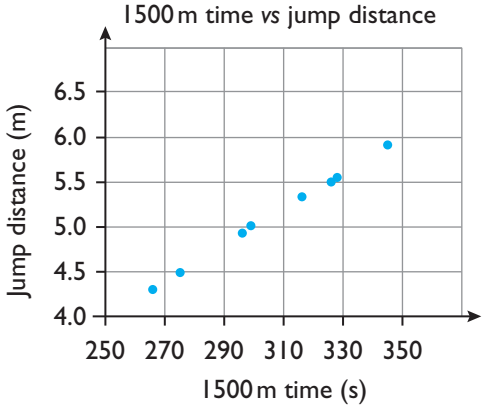
③ **a** 100 m and 1500 m shows negative correlation; the faster an athlete can run 100 m, the slower they can run 1500 m.

100 m and long jump shows negative correlation; the longer it takes an athlete to run 100 m, the shorter the distance they can jump.

1500 m and long jump shows positive correlation; the longer it takes an athlete to run 1500 m, the further they can jump.







b People who tend to run the 100 m faster are better at long jump. 1500 m runners aren't very good at 100 m or long jump.

c increase the sample size / test more athletes

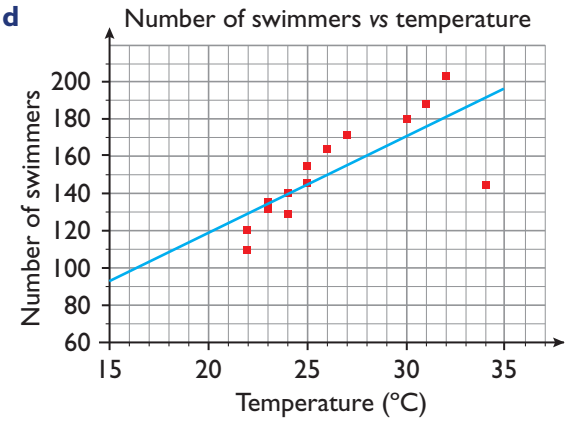
d **i** The line of best fit suggests this, but it is extrapolating from the data and so the trend may not continue; there could be a physical limit.

ii This goes against the correlation of the data and so is untrue.

④ **a** positive correlation

b Correlation doesn't prove causation so both may be wrong. It is more likely that doing well at maths makes you good at science, since science is dependent on maths in a way that maths is not dependent on science.

⑤ **a d**



b positive correlation

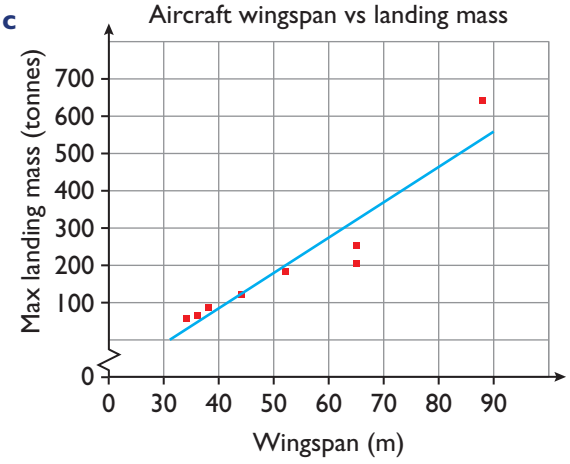
c (34, 144) is an outlier. It could be because some people felt it was too hot to go to the beach or because it was a week day and lots of people were at work and school.

e **i** 93 swimmers

ii The estimate may not be very accurate as it is beyond the range of the data. It is likely that very few people will swim once the temperature drops below a certain level.

f The graph shows correlation which is not the same as causality. Both the numbers of swimmers and the ice creams sold depend on a 3rd variable – the temperature.

⑥ **a c**

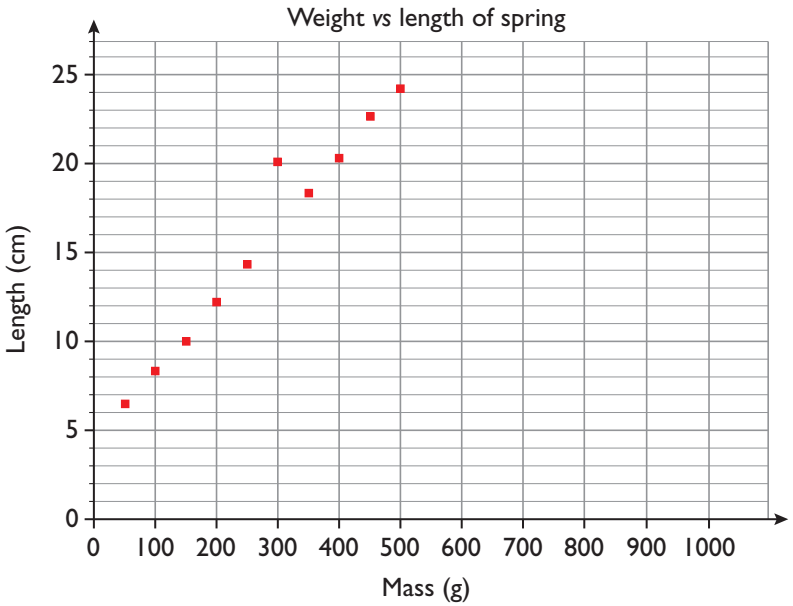


b There is evidence to suggest there is positive correlation because when the values in one set increase, the values in the other set also increase.

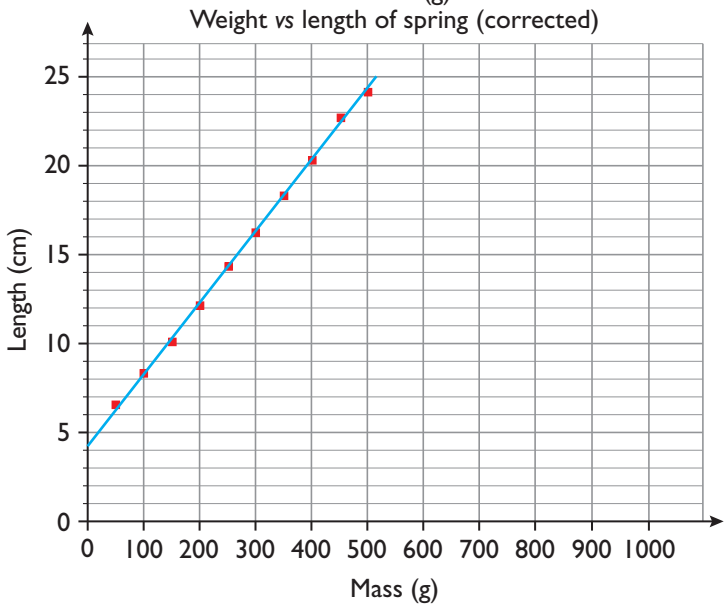
d approximately 250 tonnes

e No because it is too far outside the range of values plotted to extrapolate.

⑦ **a**



b c



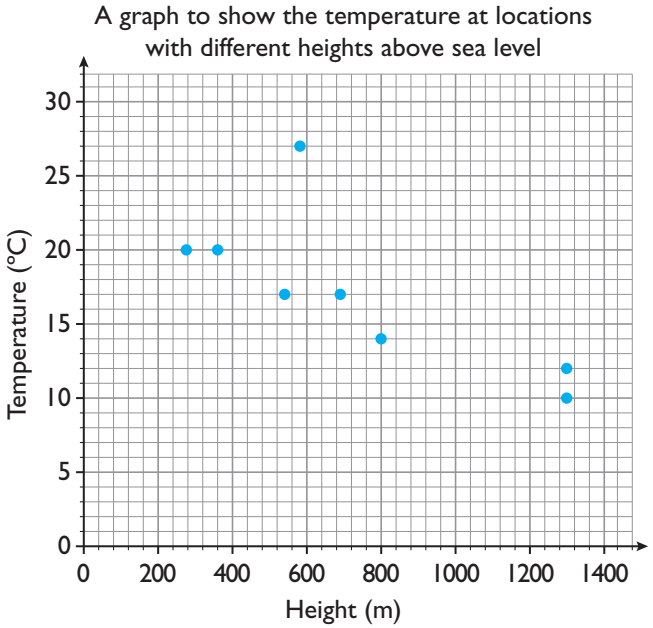
d 11.5 cm

e The estimate would be unreliable as 1 kg is beyond the range of the data. The spring may well break when a mass of 1 kg is hung from it.

f 4.2 cm

➤ Do I know it now? (page 303)

① **a** The graph shows negative correlation.



b (580 m, 27 °C) might be an outlier. It could be that the weather was particularly warm there or that it was recorded in a location which is generally hotter than the other areas.

c 19 °C

d −150 m

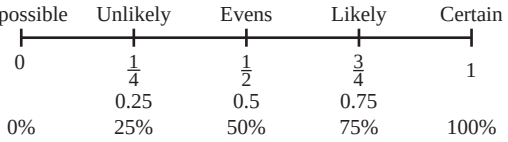
e The answer to part **c** is probably quite reliable since it is interpolated within the data range. The answer to part **d** is less reliable since it is extrapolating significantly from our data range. The answer seems quite improbable which gives us reason to doubt its reliability.

Chapter 22 Probability

➤ Skills check – warming up (pages 305–306)

Introduction to probability

a b



c **i** unlikely **ii** likely

iii impossible **iv** certain

v likely (can vary from person to person)

vi certain

Single event probability

a 8 **b** $\frac{9}{40}$ **c** 40

d 48 black and 27 white

➤ Applying the knowledge (page 306)

① **a** 0.3 **b** 9 **c** 0.65

② *spinners drawn with sectors as shown*: 3 red, 2 yellow, 2 blue and 1 green; 4 red, 2 green, 1 blue and 1 yellow; 5 red, 1 green, 1 blue and 1 yellow

22.1 Combined events

➤ Skills check – do I need to do this section? (page 307)

① **a**

Second spin

First spin +	1	2	3
1	**2**	3	**4**
2	**3**	**4**	5
3	**4**	**5**	**6**

b **i** 4 **ii** 2 and 6

c **i** $\frac{2}{9}$ **ii** $\frac{3}{9}$ *or* $\frac{1}{3}$

iii $\frac{3}{9}$ *or* $\frac{1}{3}$ **iv** $\frac{5}{9}$

② **a** HHH, HHT, HTH, HTT, THH, THT, TTH, TTT

b $\frac{2}{8}$ *or* $\frac{1}{4}$ **c** $\frac{6}{8}$ *or* $\frac{3}{4}$

d For example: James wins if he gets 2 or more heads; Kate wins if she gets 2 or more tails.

➤ Learning exercise (pages 310–312)

① **a** PB, PC, PL, MB, MC, ML, RB, RC, RL, SB, SC, SL

b 12; multiply the number of starters by the number of main courses (4 × 3)

c $\frac{1}{12}$

② **a**

Red die

Blue die ×	1	2	3	4	5	6
1	1	2	3	4	5	6
2	2	4	6	8	10	12
3	3	6	9	12	15	18
4	4	8	12	16	20	24
5	5	10	15	20	25	30
6	6	12	18	24	30	36

b **i** $\frac{1}{18}$ **ii** $\frac{1}{36}$ **iii** 0 **iv** 1

c no

d multiples of 10

③ **a**

Green spinner

Blue spinner +	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10

b i $\frac{1}{6}$ **ii** 0 **iii** $\frac{1}{8}$

c i 6 and 7

ii 11, 13, 14, 15, 16, 17, 18 and 19

iii 8

④ **a** $\frac{21}{64}$ **b** $\frac{31}{64}$ **c** $\frac{7}{64}$

d $\frac{43}{64}$ **e** $\frac{33}{64}$ **f** $\frac{19}{64}$

⑤ **a** $\frac{1}{2}$ **b** $\frac{3}{10}$ **c** $\frac{3}{20}$

⑥ **a** GB, GG, GC, RB, RG, RC, BB, BG, BC, CB, CG, CC

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

⑦ **a**

Bag 1

Bag 2	R	R	B	B	B
R	RR	RR	BR	BR	BR
R	RR	RR	BR	BR	BR
R	RR	RR	BR	BR	BR
R	RR	RR	BR	BR	BR
B	RB	RB	BB	BB	BB
B	RB	RB	BB	BB	BB

b i $\frac{8}{15}$ **ii** $\frac{4}{15}$ **iii** $\frac{1}{5}$

➤ Problem solving exercise (pages 313–314)

① **a i** 0.885 **ii** 0.0125 **iii** 0.07

b This is probably unfair as most employees who were late travelled by bus, so it is likely that the bus was late that day which is not the employees' fault. Also, nearly 90% of employees were on time.

② **a**

	Cube	Cuboid	Cylinder	Total
Red	14	40	**17**	71
Green	21	**27**	12	60
Blue	**23**	33	**13**	69
Total	**58**	100	42	**200**

b i 0.5 **ii** 0.355 **iii** 0.115

c i 0.27 **ii** 0.45

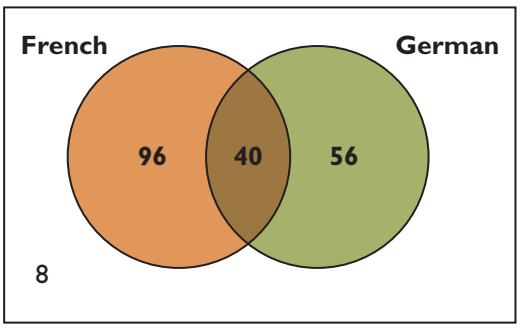
③ **a**

Isobel's spinner	Peter's spinner
1	1
1	2
1	3
2	1
2	2
2	3
3	1
3	2
3	3

b $\frac{4}{9}$

c For example: They win if their spinner shows the higher number and draw if both spinners show the same number: P(win) = $\frac{1}{3}$, P(draw) = $\frac{1}{3}$, P(lose) = $\frac{1}{3}$.

④ **a**



b i 0.68 **ii** 0.2 **iii** 0.28

⑤ **a i** 0.328 **ii** 0.172 **iii** 0.688

b i 1651 **ii** 55 kg

➤ Do I know it now? (page 314)

① **a**

Blue die \ Green die	1	3	3	4	6	6
2	3	5	5	6	8	8
3	4	6	6	7	9	9
4	5	7	7	8	10	10
4	5	7	7	8	10	10
5	6	8	8	9	11	11
5	6	8	8	9	11	11

b i $\frac{1}{18}$ **ii** $\frac{5}{36}$ **iii** $\frac{1}{9}$

iv $\frac{5}{6}$ **v** $\frac{7}{36}$

➤ Can I apply it now? (page 314)

① **a** $\frac{1}{10}\left(=\frac{3}{30}\right)$ **b** $\frac{1}{15}\left(=\frac{2}{30}\right)$ **c** $\frac{1}{3}\left(=\frac{2}{6}\right)$

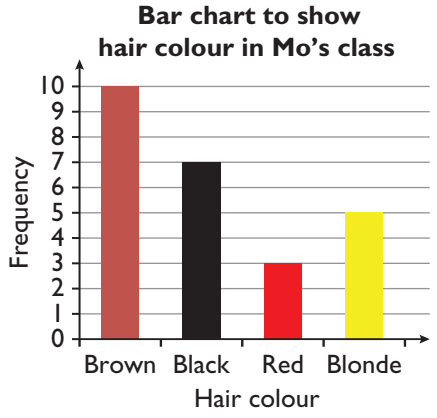
d $\frac{1}{6}$ **e** $\frac{2}{5}\left(=\frac{12}{30}\right)$

Essential Topics Test Paper 1

➤ (pages 315–317)

① £10 + £4 + £7 + £36 + £30 + £30 = £117; much less than £150.05 [3]

② **a**



[4]

b i The mode will represent the data best because it is non-numerical. [1]

ii brown [1]

③ 18° ($2x + 3x + 90° = 180°$ (angles on a straight line); $5x + 90° = 180°$; $5x = 90°$; $x = 90° \div 5$) [3]

④ £420 [4]

⑤ Yes, 11 boxes required at a cost of £440. [4]

⑥ 0.25 (0.2 + 0.15 + 0.4 = 0.75; 1 − 0.75 = 0.25) [2]

⑦ **a** $2(n + 5) + 3n = 50$ [1]

b $n = 8$ ($2n + 10 + 3n = 50$; $5n = 40$), so the cost of an adult ticket is 8 + 5 = £13. [2]

⑧ **a** (1200 + 4m) pence *or equivalent in pounds* [2]

b 400 minutes (64 − 4 × 12 = £16 for calls; 1600 ÷ 4) [2]

⑨ 23.04 tonnes (12 000 ÷ 5 × 8 = 19 200 km/car; 19 200 × 8 = 153 600 km/fleet; 153 600 × 150 ÷ 1000 = 23 040 kg = 23.04 tonnes) [4]

⑩ **a** reflection in the line $y = 3$ [2]

b translation $\begin{pmatrix} 0 \\ -5 \end{pmatrix}$ [2]

⑪ 81.4 cm^2 (square has side length 8 cm and perimeter 32 cm; $32 = \pi d$ so $d = 10.186\ldots$ and $r = 5.09$; area of circle = $\pi r^2 = \pi \times 5.09^2$) [6]

⑫ −3, 2 and 7 *or* −3, 7 and 17 *or* −13, −3 and 7 *or* −3, −8 and −13 *or* −3, −13 and −23 *or* 3, 8 and 13 *or* 3, 13 and 23 *or* 3, −2 and −7 *or* −7, 3 and 13 *or* −17, −7 and 3 [5]

⑬ Italy (£490 = €612.50 or €603 = £482.40) [2]

Essential Topics Test Paper 2

➤ (pages 318–320)

① Mary is incorrect. She has selected the middle (5th) value without arranging the numbers in numerical order (1, 2, 2, 3, 4, 4, 6, 7, 8). The median value is 4. [2]

② **a**

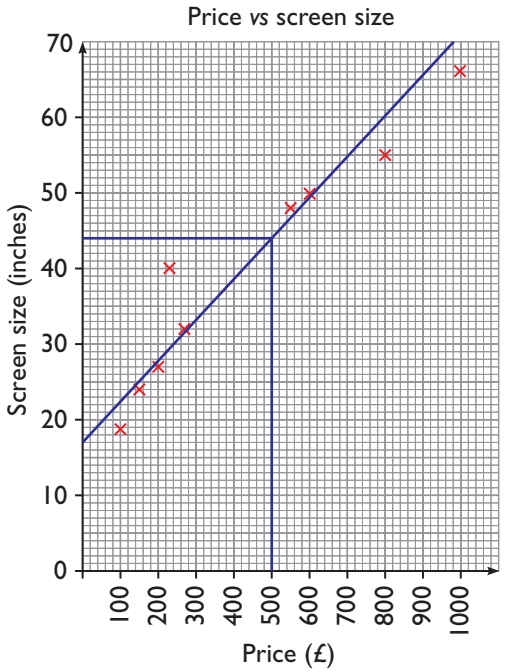
Item	Cost price in £	Selling price in £	Profit or loss
Clock	25.80	46.00	Profit of £20.20
Tea set	32.70	65.40	**Profit of £32.70**
Silver watch	56.00	**43.80**	Loss of £12.20
Painting	**115.20**	124.00	Profit of £8.80
Coffee table	93.50	56.00	**Loss of £37.50**
Mason jug	8.60	23.90	**Profit of £15.30**

[5]

b Profit of £27.30 [2]

③ **a** 24 °C [1] **b** 3 °C [1] **c** 7 °C [1]

④ **a**



[4]

b positive correlation [1]

c £500 [1]

⑤ Yes, the correct monthly payment is £79.50. [3]

⑥ **a** $5 + 5 = 8 + 2$ [1]

b pentagonal prism [1]

c octagonal pyramid [1]

⑦ 72° (180° − 90° = 90°; 90° ÷ 5 = 18°; angle ABE = 4 × 18°) [3]

⑧ **a** $\frac{22}{30}$ [1]

b Humanities, A&C, English, Science, Languages, Maths, D&T [4]

⑨ £4 [3]

⑩ Rounding to 1 s.f., 0.5 × 0.1 = 0.05, so clear place-value error. [2]

⑪ 3 ($4x - 5 + 11 = 6x$; $2x = 6$; $x = 3$) [3]

⑫ Angles of an equilateral triangle are 60° each. For the first two expressions, the value of x is 10° but $x = 10.25°$ for the third expression. [3]

⑬ **a**

+	−3	−2	−1	1	2	3
−3	−6	−5	−4	−2	−1	0
−2	−5	−4	−3	−1	0	1
−1	−4	−3	−2	0	1	2
1	−2	−1	0	2	3	4
2	−1	0	1	3	4	5
3	0	1	2	4	5	6

[4]

b i $\frac{6}{36} = \frac{1}{6}$ [1] **ii** $\frac{3}{36} = \frac{1}{12}$ [1] **iii** $\frac{2}{36} = \frac{1}{18}$ [1]

Essential Topics Test Paper 3

➤ (pages 321–323)

① **a** 18 [1] **b** 96 [1] **c** 7 [1]

② **a** $x + 10$ [1] **b** $x - 5$ [1] **c** $4x$ [1]

d $5x + 30$ [$2x + 3(x + 10)$] [2]

③ 23.5 cm (area of triangle = 12 × 5 ÷ 2 = 30 cm^2; 8 × width = 30 cm, so width = 3.75 cm; perimeter = 8 + 8 + 3.75 + 3.75) [4]

④ **a** 27.7 minutes [3]

b $20 < t \leqslant 30$ [1]

c $20 < t \leqslant 30$ [1]

⑤ £14 (saving on jacket: 0.2 × 40 = £8; 0.25 × 12 = £3, so saving on 2 hats is £6) [4]

⑥ **a** 090° [1] **b** 135° [1] **c** 225° [1]

⑦ Enlarged length = 5 × 3 = 15 inches; enlarged width = 2 × 3 = 6 inches; area = 15 × 6 = 90 inches [3]

⑧ 11.6% (March = $\frac{15}{31} \times 100\% = 48.4\%$; April = $\frac{18}{30} \times 100\% = 60\%$) [5]

⑨ **a** $6x + 14$ [$2(2x + 3) + 2(x + 4)$] [2]

b $6x + 14 = 44 \rightarrow x = 5$, so length = 13 cm and width = 9 cm; area = $13 \times 9 = 117\,\text{cm}^2$ [3]

⑩ The 3rd term is the same.

Either $3n + 4 = 5n - 2 \rightarrow 2n = 6 \rightarrow n = 3$ *or* by working out terms $3n + 4$: 7, 10, (13), 16, … and $5n - 2$: 3, 8, (13), 18 … [2]

⑪ translation $\begin{pmatrix} 3 \\ 5 \end{pmatrix}$ [3]

⑫ $\frac{2}{5}$ ($3 + 2 = 5$ options) [2]

⑬ $\frac{1}{5}$ (Either £54 ÷ 3 = £18, $\frac{18}{90} = \frac{1}{5}$ *or* $\frac{3}{5}$ of $\frac{1}{3}$ $= \frac{3}{5} \times \frac{1}{3} = \frac{1}{5}$) [3]

⑭ approximately 3.40 p.m. [3]

PROBLEM SOLVING

Problem Solving Chapter 1 Getting started

➤ Practice problems (pages 329–330)

①

It would be hard to check a guess, so making a guess won't be useful.

A diagram, such as a bar model, may help.

I will start with what I can work out.

I can work out the number of Economy class seats:

$6 \times 31 = 186$

Now I can work out the cost of the Economy class seats:

$186 \times £199 = £37014$

I know the number of Business class seats, so I can work out this cost:

$36 \times £399 = £14364$

Now I can work out the total cost of all the tickets sold:

$£14364 + £37014 =$ **£51 378**

②

Guessing isn't helpful for best buy questions as you have to do all the working anyway.

A diagram, such as a bar model, may help.

I will start with what I can work out.

I can work out any number of £ in €:

$£48 = 48 \times €1.20$

$= €57.60$

I can see what the answer is!

€57.60 is more than €54, so **the sunglasses are cheaper in Portugal**.

③

Guessing is not going to help as you have to do the working to check the guess anyway.

A diagram, such as a bar model, may help.

I will start with what I can work out.

I can work out the deposit, 30% of £180:

30% = 0.3, so the deposit is $0.3 \times £180 = £54$

I can work out the total cost of the instalments:

$12 \times £13 = £156$

Now I can work out the total cost of the laptop:

$£156 + £54 = £210$

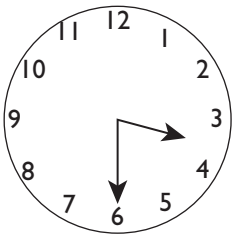
I can see what the answer is now!

She pays **£30 more**.

④

It would be hard to check a guess, so making a guess won't be useful.

Drawing a diagram would help as the question is about movement and shapes:



I know there are 360° in a whole turn.

I can work out the angle between two numbers on the clock.

The angle between two adjacent numbers is $360° \div 12 = 30°$

Now I can work out the angle between 4 and 6…

$2 \times 30° = 60°$

…and the half hour bit:

The hour hand is halfway between 3 and 4 so that is another 15°.

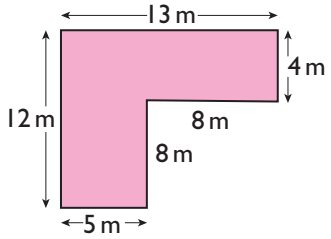
Now I can work out the answer.

$60° + 15° = \mathbf{75°}$

⑤

Guessing is not going to help as you have to do the working to check the guess anyway.

There is a diagram already, and I can add the missing lengths to it:



I can work out the distance round the room:

$12 + 13 + 4 + 8 + 8 + 5 = 50\,\text{m}$

Now look back at the question. It says there are two doors, each 1 m wide.

I can work out the length of skirting board needed:

$50\,\text{m} - 2\,\text{m} = 48\,\text{m}$

Look back at the question again. It says that each skirting board is 4 m long.

I can work out the number of skirting board planks needed:

$48 \div 4 = 12$

Look back at the question:

The skirting board comes in packs of four.

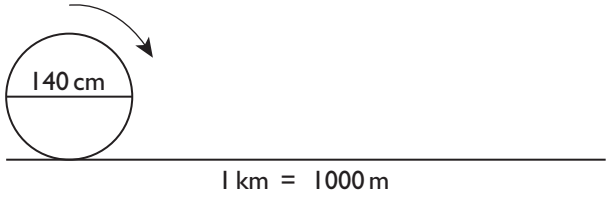
I can work out the number of packs needed:

$12 \div 4 = \mathbf{3\ packs}$

⑥

Guessing is not going to help as you have to do the working to check the guess anyway.

Drawing a diagram might help as the question is about a shape:



I can work out the circumference of the wheel:

$\text{circumference} = 140 \times \pi$
$= 439.822\,97\,\text{cm}$
$= 4.398\,229\,7\,\text{m}$

The wheel rolls round on its circumference.

I can work out how many circumferences fit into 1 km.

$1000 \div 4.398\,229\,7$
$= 227.3642$

So the number of complete turns is **227**.

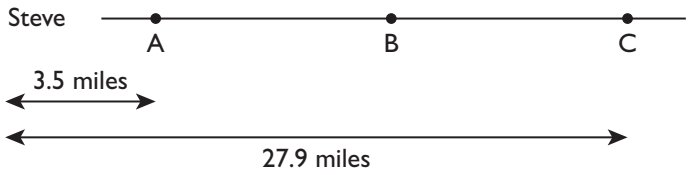
Problem Solving Chapter 2 Making a plan

➤ Practice problems (pages 339–340)

①

Guessing is not going to help as you have to do the working to check the guess anyway.

There is a diagram already, but I can add to it:



I can work out the distance from A to C:

$27.9 - 3.5 = 24.4$ miles

Now I can work out how far B is from A:

$\frac{1}{2}$ of $24.4 = 12.2$ miles

Now I can see what to do.

I need to work out the distance to B and compare it with 16 miles:

Distance to B is $3.5 + 12.2$ miles = **15.7 miles**

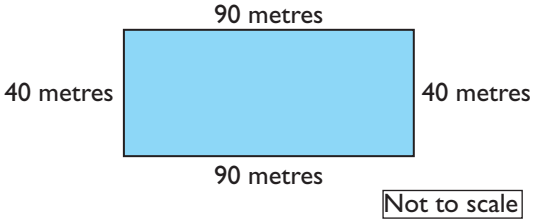
$15.7 < 16$ miles

He has enough petrol to reach service station B, but it is risky!

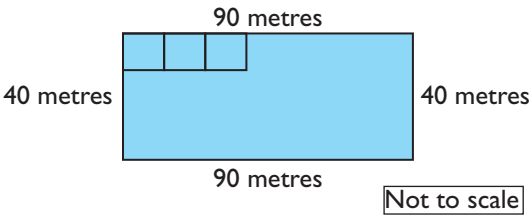
②

I could guess but I cannot see how I would check the guess.

There is a diagram already, but I could add on some other measurements:



I can begin to fill in the spaces for the goats:



I can work out the total area required for 28 goats:

$28 \times 125\,m^2 = 3500\,m^2$

I can work out the area of the field:

$40\,m \times 90\,m = 3600\,m^2$

Now I can answer the question:

$3500 < 3600$ so **the field is big enough for the 28 goats**.

$3600 - 3500 = 100$, $100 < 125$ so **there is no room for another goat**.

③

Guessing is not going to help as you have to do the working to check the guess anyway.

I could draw a diagram if I knew who was taller, but I don't.

I can work out Sam's height in inches…

$5 \times 12 + 3 = 63$ inches

… and convert this to centimetres:

$63 \times 2.54 = 160.02$ cm

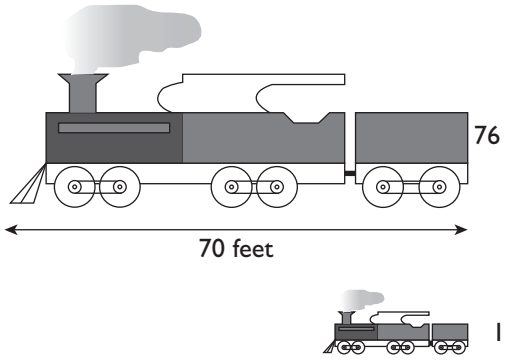
Look back at the question. It asks who is taller and by how much. I can answer that.

$163 > 160.02$, so **Penny is taller** by
$163 - 160.02 =$ **2.98 cm**.

④

Guessing is not going to help as you have to do the working to check the guess anyway.

I can draw a diagram:



I can change the length of the real Mallard to inches…

$70 \times 12 = 840$ inches

…and then convert this to centimetres:

$840 \times 2.54 = 2133.6$ cm

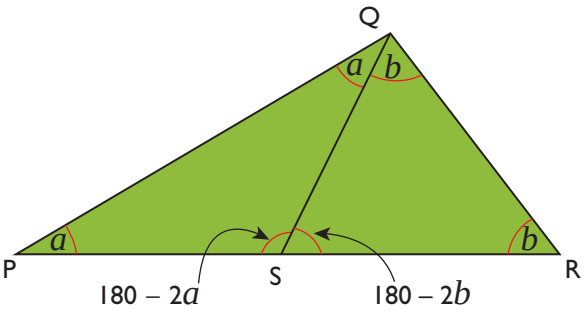
To find the length of the model, I need to divide 2133.6 cm by 76:

$2133.6 \div 76 = 28.073\,68$ cm
$=$ **28.1 cm**

⑤

Guessing won't work, because I already have the answer.

There is a diagram, but I can add some more to it:



I can't work out the values of the angles, but I can write expressions for them:

$180 - 2a$

$180 - 2b$

The angles make a straight line, so I can write an equation…

$180 - 2a + 180 - 2b = 180$

… and simplify it:

$180 - 2a - 2b = 0$

$2a + 2b = 180$

$a + b = 90$

Look back at the question.

angle PQR $= a + b = 90$, so it's a **right angle**.

⑥

I could make a guess. I'll double each side of the picture:

6 by 4 doubles to 12 by 8

This isn't big enough.

I need half as much again to get to 15 cm:

12 by 8 then 3 more and 2 more gives 15 cm by 10 cm

Now I can answer the question.

The picture fits one way (15 cm), but not the other.
No, it doesn't fit exactly.

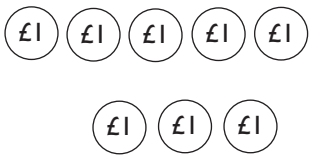
Problem Solving Chapter 3 Carrying out the plan

➤ Practice problems (pages 344–345)

①

I don't think a guess will be useful here.

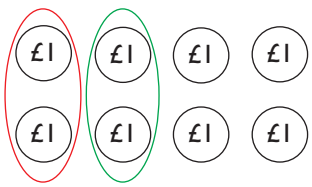
I could draw the coins:



I have £8 altogether. I can arrange the coins better:

a quarter for magazines:

a third of the rest for make-up:



I can work out how much is left each week after she buys sweets:

£4.00 − 50p = £3.50

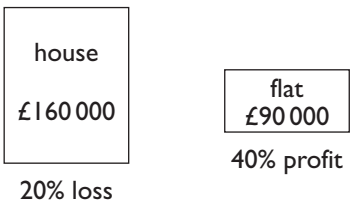
I can see how to answer the question now:

12 × £3.50 = **£42**

②

Guessing is not going to help as you have to do the working to check the guess anyway.

I can draw a diagram:



I can work out the loss on the house:

0.2 × 160 000 = £32 000

I can work out the profit on the flat:

0.4 × 90 000 = £36 000

I can work out the overall profit or loss:

36 000 − 32 000 = £4000 **profit**

I can work out the total outlay:

£160 000 + £90 000 = £250 000

I can work out 2% of £250 000:

1% of £250 000 = £2500
2% of £250 000 = £5000

I can work out the answer:

£5000 > £4000, so he made **less than 2% profit**.

③

I don't think guessing will help with this question.

There is a diagram already and I can't mark on anything else as I don't know enough about the angles.

I can add up the angles:

$90 + 2x + 10 + x - 20 + x = 80 + 4x$

I know that the angles in a quadrilateral add up to 360, so I can write an equation…

$80 + 4x = 360$

… and solve it:

$4x = 280$

$x = 70$

Look back at the question. It asks for the largest interior angle. I think that must be $2x + 10$:

$2x + 10 = 150°$

Just checking the others, $x - 20 = 50$ and $x = 70$, so the largest angle is **150°**.

④

I could make a guess:

I guess 100 seconds.

I can check my guess:

In 100 seconds, there will be 2000 litres. This is 2 cubic metres.

I need to know the volume of water in the pool when it is 150 cm deep to find out if I am close:

volume of water = 5 m × 10 m × 1.5 m

= 75 m^3

100 seconds is too small. 75 cubic metres is 37.5 lots of 2 cubic metres. I can use this to work out the answer:

37.5 lots of 2 cubic metres will take 37.5 lots of 100 seconds.

37.5 × 100 = 3750 seconds

3750 ÷ 60 minutes = 62.5 minutes

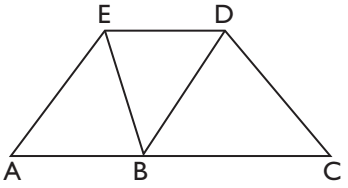
= **1 hour, 2.5 minutes**

⑤

Guessing won't help here, but a diagram seems like a good idea.

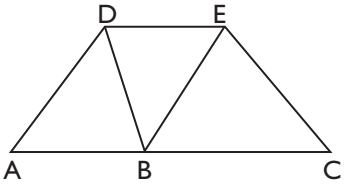
Start with the straight line:

Now where do D and E go? Let's try this:



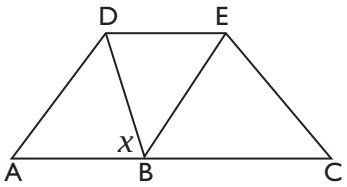
This doesn't work. EBD is about half the size of DBA, not twice the size.

I'll have another try:

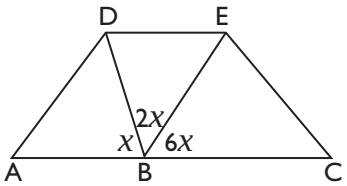


That's better, now I need to write in the angles.

Angle DBA is the smallest angle, so I will label this x.



Now I can label the other angles:



What can I do now? I can add the angles:

$x + 2x + 6x = 9x$

$9x = 180°$

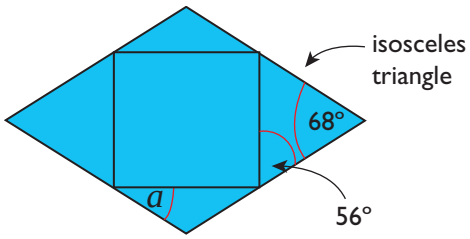
$x = 20°$

Angle EBC = **120°**

⑥

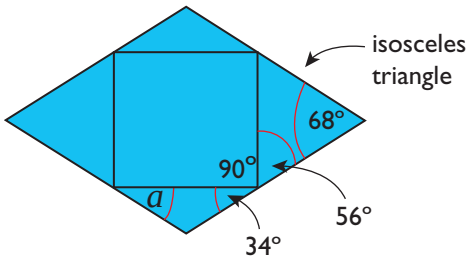
Guessing doesn't help with angle questions.

I could try adding to the diagram:



$180° - 68° = 112°$

$112° \div 2 = 56°$



$180° - 56° - 90° = 34°$

This angle of 34° is in another isosceles triangle, so a = **34°**

Problem Solving Chapter 4 Reviewing the solution

Answers are in the text of Problem Solving Chapter 5.

Problem Solving Chapter 5 Bringing it all together

➤ Practice problems (pages 356–357)

①

I don't think guessing will work.

What can I work out?

Pens

5 packs of 5 costs 5 × £1.20 = £6 +

3 more to make 28 pens = £6.90

Pencils

9 packs of 3 costs 9 × 50p = £4.50 +

1 more to make 28 pencils = £4.70

Erasers

3 packs of 10 costs 3 × £1 = £3

Total

£6.90 + £4.70 + £3 = £14.60

£14.60 < £15 so **she has enough**.

②

Guessing won't help as I would need to work it out to check the guess!

A diagram might be helpful, but I will work out what I can first.

I can change the flour in the recipe from ounces (oz) to grams…

$\frac{1}{2}$ oz = 14g

… and work out how much flour is needed for 12 soufflés:

12 × 14 g = 168 g

168 g > 150 g, so **not enough flour**.

I can change the milk in the recipe to litres…

$\frac{1}{4}$ pint = $\frac{1}{4}$ × 568 ml = 142 ml

… and work out if there is enough milk for 12 soufflés:

12 × 142 ml = 1704 ml = 1.704 litres

1.704 litres < 2 litres, so she has **enough milk**.

③

I will make a guess first.

Ric is 10 years old, Steph is 16 years old, Tom is 48 years old.

This adds up to 74 years. I will make a higher guess.

Ric is 12 years old, Steph is 18 years old, Tom is 54 years old.

This adds up to 84 years, so **Tom is 54 years old**.

④

I don't think guessing will help here and there is already a diagram.

I can work out the width of each block…

The block of fencing is 50 cm wide.

…and the number of blocks required for the 8 m path:

800 ÷ 50 = 16 blocks

I can see how to work out the answer now:

16 blocks require 4 × 16 planks = 64 planks

7 packs of planks are needed for 64 planks.
(6 × 10 = 60 planks)

7 × £6.99 = **£48.93**

⑤

Guessing is not particularly useful with angles.

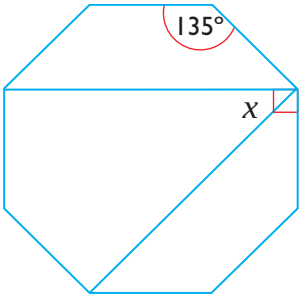
There is already a diagram, but I can add to it:

The exterior angles of a regular polygon always add up to 360°.

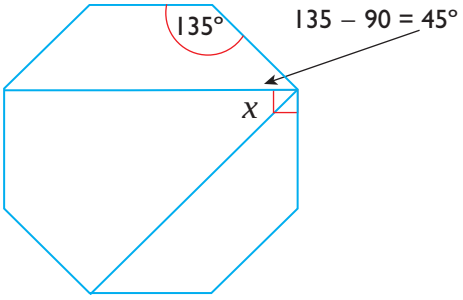
Each exterior angle of the octagon is
360 ÷ 8 = 45°

The exterior angle and its corresponding interior angle always add up to 180°.

Each interior angle is 180 − 45 = 135°



Now I can work out the next part:



x = 135 − 45 − 45

= **45°**

⑥

Guessing is not going to help as you have to do the working to check the guess anyway.

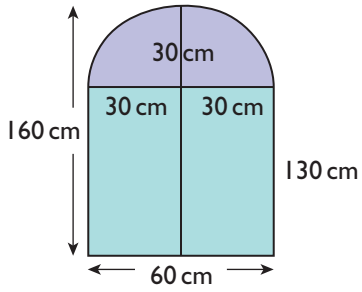
There is a diagram already, but I can add to it.

I can work out the shorter straight parts:

$60 \div 2 = 30\,\text{cm}$

I can work out the shorter vertical straight parts:

$160 - 30 = 130\,\text{cm}$



I can work out the total of the straight sections:

$130 + 130 + 130 + 30 + 30 + 30 + 60 = 540\,\text{cm}$

I can see that the curved section is a semicircle with radius 30 cm, so I can work out this length:

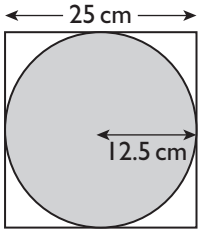
$= \frac{1}{2} \times 2 \times \pi \times 30 = 94.248\,\text{cm}$

The total length is $94.248 + 540 =$ **634 cm**

⑦

Guessing is not going to help as you have to do the working to check the guess anyway.

There is a diagram already, but I could add to it:



I can see the radius is 12.5 cm.

I can work out the area of the circle:

$\pi \times 12.5^2 = 490.873\ldots\,\text{cm}^2$

I can also work out the area of the square:

$25 \times 25 = 625\,\text{cm}^2$

Now I can work out the area of material that is wasted:

$625 - 490.873\ldots = 134.126\ldots\,\text{cm}^2$

There are 800 discs made in an hour so the total amount thrown away is:

$134.126\ldots \times 800 = 107300.918\ldots\,\text{cm}^2$

$= \mathbf{10.73\,m^2}$

NEXT STEPS – NUMBER

Chapter 2 Using our number system

2.3 Calculating with standard form

➤ Learning exercise (pages 359–361)

① **a** 7.8×10^5 **b** 1.7×10^{-2}
c 8.7×10^3 **d** 8.4×10^3
e 4×10^{-3} **f** 3.1×10^{-2}

② **a** 1.18×10^6 **b** 7.66×10^5
c 5.32×10^6 **d** 2.6×10^5
e 6.74×10^6 **f** -3.88×10^6

③ **a** 6×10^{12} **b** 8×10^8
c 1×10^8 **d** 9×10^2
e 1×10^{-1} **f** 6.3×10^{-9}

④ **a** 3×10^2
b 2×10^1 (2×10 is also acceptable)
c 3×10^4 **d** 1.5×10^4
e 5×10^1 **f** 2.5×10^{-3}

⑤ **a** 5.99×10^5 to 6.01×10^4
b 6.01×10^{-3} to 5.99×10^{-2}
c 7.11×10^2 to 7.09×10^3
d 7.09×10^{-6} to 7.11×10^{-7}

⑥ If the numbers multiplied together give a result greater than 10, then you will need to divide the result by 10 and add an additional 1 to the index.

⑦ **a** 3.208×10^{-2} **b** 3.2×10^2
c 1.28×10^2 **d** 8.01×10^2

⑧ 9×10^{15}

⑨ **a** Jupiter, Saturn, Earth, Mercury
b 3.17×10^2
c 5.76×10^3
d 1.82×10^1

⑩ **a** 2.33×10^{18}
b 1.07×10^1
c 3.33×10^{13}

⑪ $H_2 = 2 \times 1.67 \times 10^{-27} = 0.334 \times 10^{-26}$
$H_2O = (0.334 + 2.67) \times 10^{-26} = 3.00 \times 10^{-26}$ kg

➤ Problem solving exercise (page 361)

① yes (total mass 5.424×10^5 kg)

② **a** $1 : 6.25 \times 10^{12}$ **b** 13.6 cm

③ **a** 1×10^{-4} m **b** 1.783×10^{-2} kg

④ 327.06 m (330 − 2.94)

➤ Do I know it now? (page 362)

① **a** 9.29×10^4
b **i** 84 800 **ii** 8400 **iii** 300
c $84\,800 + 8400 - 300 = 92\,900 = 9.29 \times 10^4$

② **a** 9×10^{12} **b** 3.2×10^{-7}
c 5.3×10^6 **d** 2×10^{-3}
e 1.52×10^2 **f** 3.8×10^3

➤ Can I apply it now? (page 362)

① **a** 18 seconds
b The thunderstorm is 1 km away. The time taken for the light to travel this distance is assumed to be zero.

Chapter 3 Accuracy

3.3 Limits of accuracy

➤ Learning exercise (pages 364–365)

① **a** 79.5 cm, 80.5 cm **b** 75 cm, 85 cm
c 299.5 g, 300.5 g **d** 250 g, 350 g

② **a** 4999.5 m, 5000.5 m **b** 4995 m, 5005 m
c 4950 m, 5050 m **d** 4500 m, 5500 m

③ **a** 595 m, 605 m **b** 597.5 m, 602.5 m
c 550 m, 650 m **d** 575 m, 625 m

④ $5.5 \leqslant m < 6.5$

⑤ $8.5 \leqslant l < 9.5$

⑥ **a** 2.5 m, 3.5 m **b** 55 m, 65 m
c 0.35 mg, 0.45 mg **d** 0.065 km, 0.075 km

⑦ **a** 23.5 ml, 24.5 ml **b** 355 g, 365 g
c 0.825 kg, 0.835 kg **d** 0.0185 m, 0.0195 m

⑧

	Number	Lower limit	Upper limit
a	4	3.5	4.5
b	70	65	75
c	600	595	605
d	0.3	0.25	0.35
e	0.06	0.055	0.065
f	80 km	75 km	85 km
g	68 mg	67.5 mg	68.5 mg
h	0.032	0.0315	0.0325

⑨ $1475 \text{ ml} \leqslant V < 1525 \text{ ml}$

⑩ 52.5 km

⑪ $182.25 \text{ cm}^2 \leqslant A < 210.25 \text{ cm}^2$

⑫ No, the minimum in one bag is 245 g. If all three bags are at the lower limit, she will only have 735 g.

⑬ **a** $225 \text{ m} \leqslant p < 255 \text{ m}$
b $2812.5 \text{ m}^2 \leqslant A < 3612.5 \text{ m}^2$

⑭ C; it is to the nearest 10 and all the others are to the nearest 5.

⑮ **a** $n = 680 \pm 5$
b $675 \leqslant n < 685$
c 685, 675 **d** 10

➤ Problem solving exercise (pages 365–366)

① no, only 8 per page

② **a** If each person's mass is given to the nearest kilogram, their total mass could be 652 kg.
b 80 kg

③ 48

➤ Do I know it now? (page 366)

① **a** 39.5 ml, 40.5 ml **b** 35 ml, 45 ml
c 650 kg, 750 kg **d** 695 kg, 705 kg

② **a** 649.5 m, 650.5 m **b** 645 m, 655 m
c 625 m, 675 m **d** 647.5 m, 652.5 m

③ $315 \text{ g} \leqslant m < 325 \text{ g}$

④ **a** 850 cm, 950 cm **b** 1500 km, 2500 km
c 0.15 g, 0.25 g **d** 0.0045 m, 0.0055 m

⑤ **a** 7050 m, 7150 m **b** 48.5 cm, 49.5 cm
c 515 mm, 525 mm **d** 0.002 75 km, 0.002 85 km

➤ Can I apply it now? (page 366)

① No. If each side is at the upper limit of 20.5 cm, the perimeter is 82 cm and the ribbon would be too short.

Chapter 6 Ratio and proportion

6.3 The constant of proportionality

➤ Learning exercise (pages 369–371)

① **a**

x	1	**3**	2.5	**1.5**
y	**4**	12	**10**	6

b $k = 4$
c **i** proportional
ii constant, proportionality

② **a** $m = kn$ **b** $y = kx$ **c** $A = kB$
d $P = kQ$ **e** $T = kd$ **f** $C = kd$

③ **a** **i** 20 **ii** 30
iii 50 **iv** 5
b $k = 5$ **c** $y = 5x$

④ **a** **i** 24 **ii** 36
iii 3 **iv** 1
b $k = 3$ **c** $D = 3w$

⑤ **a** $V = kn$ **b** $k = 0.5$ **c** 1

⑥ **a** $y = 10x$ **b** 50 **c** 1.2

⑦ **a** $C = 2.5d$ **b** 15 **c** 10

⑧ **a** $P = 27$ when $L = 7$
b $A = 4B$
c $M = 8$ when $N = 4$

⑨ **a** true **b** true **c** false

⑩ 6

⑪ Yes. If you multiply both sides of Bobby's formula by 2, you arrive at Blaise's formula: $x = 0.5y \rightarrow 2x = y \rightarrow y = 2x$.

⑫

x	8	12	**36**
V	10	**15**	45

⑬ Error is when $n = 14$, $T = 60$. When $n = 14$, T should equal 63.

⑭ Yes, h and t are proportional. When you divide each value for h by its value for t, you get a constant of 1.5, $h = 1.5t$.

➤ Problem solving exercise (page 371)

① **a** $p = 250n$ **b** 14

② **a** moving at a constant speed

b 20 **c** 25 km

③ 2500

➤ Do I know it now? (page 372)

① **a** **i** 70 **ii** 105 **iii** 140

b $k = 7$ **c** $t = 7d$

② **a** $y = 6x$ **b** $y = 42$ **c** $x = 5$

③

s	**70**	210	35	**560**	**7**
t	1	**3**	$\frac{1}{2}$	8	$\frac{1}{10}$

➤ Can I apply it now? (page 372)

① $L = \frac{A}{15}$; £34

6.4 Working with inversely proportional quantities

➤ Learning exercise (pages 374–376)

① **a** $y = kx$ **b** $y = \frac{k}{m}$ **c** $T = kd$

d $M = \frac{k}{t}$ **e** $W = \frac{k}{x}$ **f** $C = kd$

② **a** $A = kd$ and $\frac{w}{r} = k$

b $M = \frac{k}{n}$ and $Ct = k$

③ **a** $y = \frac{k}{x}$ **b** $k = 10$

c **i** $y = 2$ **ii** $y = 1$

④ **a** $C = \frac{k}{d}$ **b** $k = 25$

c **i** $C = 6.25$ **ii** $C = 100$

iii $C = 0.25$ **iv** $C = 2500$

d **i** $d = 1$ **ii** $d = 625$

iii $d = 250$ **iv** $d = 2.5$

⑤ **a** $M = \frac{24}{t}$ **b** $M = 2.4$ **c** $t = 4$

⑥ **a** $E = \frac{36}{h}$ **b** $E = 3$ **c** $h = 0.24$

⑦ **a** true **b** false **c** false

d true **e** true

⑧ **a** $y = \frac{36}{x}$ **b** $y = 9$

c Yes, when $x = 6$, $y = 6$.

⑨ **a** $I = \frac{12}{R}$

b $I = 2$

c $R = 120$

⑩ **a**

m	6	**24**	16
n	8	2	**3**

b $m = \frac{48}{n}$

c m is inversely proportional to n.

⑪ $C = 400$ and $m = 0.6$

⑫ Levi is correct, $h = 0.4d$.

⑬ $y = 2$

➤ Problem solving exercise (pages 376–377)

① **a** For example:

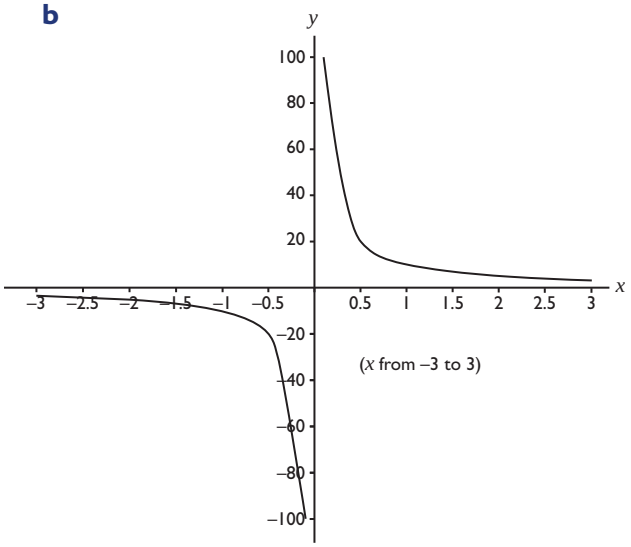
l	1	2	4	5	10	20	25	50	100
w	100	50	25	20	10	5	4	2	1

b 40 m

② **a**

x	1	2	2.5	4	5	10
y	10	**5**	**4**	**2.5**	**2**	**1**

b



c **i** 20

ii 100

d The graph is a curve and gets closer and closer to each axis, but does not ever actually touch the axes. *(These are called asymptotes.)*

e yes

➤ Do I know it now? (page 377)

① **a** $E = \frac{k}{T}$ **b** $k = 10$

c $E = 5$ **d** $T = 0.5$

② **a** $v = \frac{240}{t}$ **b** $v = 80$

c $t = 4.8$

➤ Can I apply it now? (page 377)

① **a** $t = \frac{300}{v}$

b **i** 150 hours **ii** 900 hours

c 1.5 km/h

Chapter 7 Number properties

7.3 Rules of indices

➤ Learning exercise (pages 379–380)

① **a**

Index form	In full	Ordinary number
2^5	$2 \times 2 \times 2 \times 2 \times 2$	32
2^4	$2 \times 2 \times 2 \times 2$	16
2^3	**$2 \times 2 \times 2$**	**8**
2^2	**2×2**	**4**
2^1	**2**	**2**
2^0	**1**	1
2^{-1}	$\frac{1}{2}$	$\frac{1}{2}$
2^{-2}	$\frac{1}{2 \times 2}$	$\frac{\mathbf{1}}{\mathbf{4}}$
2^{-3}	$\frac{1}{2 \times 2 \times 2}$	$\frac{\mathbf{1}}{\mathbf{8}}$

b **i** 128

ii $\frac{1}{2^4} = \frac{1}{16} = 0.0625$

② **a**

Index form	In full	Ordinary number	In words
10^3	$10 \times 10 \times 10$	1000	One thousand
10^2	**10×10**	**100**	**One hundred**
10^1	**10**	**10**	**Ten**
10^0	**1**	1	**One**
10^{-1}	$\frac{1}{10}$	$\frac{1}{10}$	**One tenth**
10^{-2}	$\frac{1}{10 \times 10}$	$\frac{\mathbf{1}}{\mathbf{100}}$	**One hundredth**
10^{-3}	$\frac{\mathbf{1}}{\mathbf{10 \times 10 \times 10}}$	$\frac{\mathbf{1}}{\mathbf{1000}}$	One thousandth

b 1 000 000, one million

c 0.000 001, one millionth

③ **a** 2^6, 64 **b** 3^6, 729

c 5^3, 125 **d** 5^3, 125

④ **a** **i** $3^6 \div 3^4 = 3^2$

Check: $729 \div 81 = 9$, $3^2 = 9$

ii $5^4 \div 5^3 = 5^1$

Check: $625 \div 125 = 5$, $5^1 = 5$

iii $10^5 \div 10^2 = 10^3$

Check: $100\,000 \div 100 = 1000$, $10^3 = 1000$

b $a^m \div a^n = a^{(m-n)}$

⑤ **a** 2^3, 8 **b** 3^1, 3

c 10^3, 1000 **d** 5^3, 125

⑥ **a** **i** $(2^4)^3 = (2 \times 2 \times 2 \times 2) \times (2 \times 2 \times 2 \times 2) \times (2 \times 2 \times 2 \times 2)$

$= 2^{12}$

Check: $16 \times 16 \times 16 = 4096$, $2^{12} = 4096$

ii $(3^2)^5 = (3 \times 3) \times (3 \times 3) \times (3 \times 3) \times (3 \times 3) \times (3 \times 3)$

$= 3^{10}$

Check: $9 \times 9 \times 9 \times 9 \times 9 = 59\,049$, $3^{10} = 59\,049$

iii $(10^3)^2 = (10 \times 10 \times 10) \times (10 \times 10 \times 10)$

$= 10^6$

Check: $1000 \times 1000 = 1\,000\,000$, $10^6 = 1\,000\,000$

b $(a^m)^n = a^{(mn)}$

⑦ **a** 2^{10}, 1024 **b** 2^{10}, 1024

c 10^{12}, 1 000 000 000 000 (one million million or one trillion)

d 10^{12}, 1 000 000 000 000 (one million million or one trillion)

⑧ **a** 3^{13} **b** 2^{12} **c** 10^6 **d** 5^6

⑨ **a** 6^9 **b** 6^9 **c** 6^{22} **d** 6^9

⑩ **a** 3^5 **b** 3^5 **c** 3^5 **d** 3^5

➤ Do I know it now? (page 380)

① **a** 5^1 **b** 5^1 **c** 5^1

② **a** 10^{-2} **b** 10^{-1} **c** 10^{-2}

③ **a** 2^2 **b** 7^1 **c** 10^0

④ For example: $23^2 \times 23^{-2} = 23^{2-2} = 23^0$, and $23^2 \times 23^{-2} = 1$

NEXT STEPS – ALGEBRA

Chapter 8 Starting algebra

8.3 Simplifying harder expressions

➤ Learning exercise (pages 382–383)

① **a** f^2 **b** g^4 **c** d^6 **d** a^{24}

② **a** $x \times x \times x \times x \times x = x^5$

b $x \times x \times x \times x \times x = x^5$

c $\frac{x \times x \times x}{x \times x} = x$

d $\frac{x \times x}{x \times x \times x} = x^{-1}$

e $x \times x \times x \times x \times x \times x = x^6$

f $x \times x \times x \times x \times x \times x = x^6$

③ **a** $20a^5$ **b** $2b$

c $6c^{14}$ **d** $30d^8$

e $\frac{1}{2}e$ **f** $8f^5g^8$

g $24m^4p^5$ **h** $2s^3$

④ **a** $3a^2$ **b** $4c^6$

c $5d^8$ **d** $3f^5$

⑤ **a** **i**

×	x	4
x	x^2	$4x$
2	$2x$	8

ii $x^2 + 6x + 8$

b **i**

×	x	5
x	x^2	$5x$
3	$3x$	15

$x^2 + 8x + 15$

ii

×	x	-4
x	x^2	$-4x$
6	$6x$	-24

$x^2 + 2x - 24$

iii

×	x	-7
x	x^2	$-7x$
-5	$-5x$	35

$x^2 - 12x + 35$

⑥ $n^{12} \div n^4 = n^8$; $n^6 \div n^3 = n^3$; $n^4 \times n^2 = n^6$; $n^3 \div n = n^2$; $n^3 \times n^2 = n^5$; $(n^5)^2 = n^{10}$

⑦ **a** $x^2 + 11x + 18$ **b** $x^2 + 2x - 15$

c $x^2 - 3x - 4$ **d** $x^2 - 7x + 10$

⑧ **a** Tim is correct. Harry has not multiplied each term in one bracket by each term in the other bracket.

b **i** $a^2 + 6a + 9$

ii $b^2 + 12b + 36$

iii $c^2 - 8c + 16$

⑨ **a** $x^2 + 15x + 50$

b top row x^2, $10x$; bottom row $5x$, 50

c They are equal – the small rectangles represent the stages of expanding the $(x + 5)(x + 10)$ bracket.

⑩ **a** **i** $4x^2 + 8x$ **ii** $2x^2 + 4x$

b Black area $= 2 \times \frac{1}{2} \times (2x + 4) \times x$

$= 2x^2 + 4x$, so both colours have same area.

➤ Problem solving exercise (page 384)

① $w(w + 20) = w^2 + 20w$

② $a^2 + 8a$

③ $\frac{3}{2}b^2 + 12b$

④ **a** $n = 8$ **b** $n = 6$ **c** $n = 3$

➤ Do I know it now? (page 384)

① **a** a^{14} **b** b^6 **c** $c^0 = 1$ **d** d^{18}

② **a** $12a^7$ **b** $4b^5$ **c** 1 **d** $5g^8$

③ **a** $a^2 + 11a + 30$ **b** $b^2 + 4b - 21$

c $c^2 - 10c + 25$ **d** $d^2 - 8d + 15$

➤ Can I apply it now? (page 384)

① **a** $x^2 + 8x - 48$

b top left: $x^2 - 4x$; top right: $12x - 48$; bottom: $4x$

c $x^2 + 12x - 48$

8.4 Using complex formulae

➤ Learning exercise (pages 387–388)

① **a** 12 **b** 45 **c** 40 **d** 3

② **a** 24 **b** 45 **c** 24 **d** 9

③ **a** $x = y + 8$ **b** $x = \frac{y}{3}$

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

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

c $b = \frac{a}{6}$ **d** $t = \frac{p}{m}$

⑤ **a** 24 **b** 106 **c** 49 **d** 54

⑥ **a** **i** 27 **ii** 32 **iii** 26

b $w = \frac{p - d}{3}$

c 5 matches

⑦ **a** **i** £13 **ii** £14 **iii** £21

b $m = \frac{c - 2p}{1.5}$

c 3 miles

⑧ **a** $C = 35h + 18$

b **i** £88 **ii** £228 **iii** £368

c $h = \frac{c - 18}{35}$

d **i** 4 hours

ii 12 hours

iii 27 hours

⑨ **a** **i** 452.389 cm^2

ii 1809.557 m^2

iii 2010619.3 km^2

b 514718540.4 km^2

c $r = \sqrt{\frac{S}{4\pi}}$

d 2.00 cm

⑩ **a** **i** 0 °C **ii** 35 °C

iii 100 °C **iv** −40 °C

b $F = \frac{9C}{5} + 32$

c **i** 32 **ii** 95

iii 572 **iv** −40

⑪ **a** $x = \frac{y + 6}{5}$ **b** $x = \frac{y}{5} + 6\frac{y}{5} + 6$

c $p = \frac{T}{4m}$ **d** $p = \frac{T - m^2}{4r}$

⑫ **a** £165

b $h = \frac{c - 15}{30}$

c 1 hour 15 minutes

⑬ **a** £104 **b** $d = \frac{c - 20}{12}$

c 15 days

⑭ **a** $m = dv$ **b** 252 g

⑮ **a** $h = \frac{v}{\pi r^2}$ **b** 10.4 cm

➤ Do I know it now? (page 389)

① **a** $e = d - f$ **b** $t = \frac{s - b}{a}$

c $g = fh$ **d** $w = \frac{v + 3}{4}$

e $r = \frac{C}{2\pi}$ **f** $r = \sqrt{\frac{A}{\pi}}$

g $r = \frac{100P}{Mt}$ **h** $t = \sqrt{\frac{S}{3}}$

② **a** **i** 10 **ii** 0

iii −20 **iv** 30

b $a = \frac{v - u}{t}$

c 3 m/s^2

8.5 Identities

➤ Learning exercise (pages 391–392)

① **a** a term **b** the coefficient

c an expression **d** a term, an expression

e an equation **f** a formula

g an identity

② $2n$; when you multiply any (whole) number by 2 you get an even number.

③ $0 = x^2 - 6x + 5$ is the equation because it can be solved to find x.

$(x - 5)(x - 1) = x^2 - 6x + 5$ is the identity because it is always true.

④ **a** $x + 5 + 3x - 6 = x + 3x + 5 - 6 = 4x - 1$

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

c $4(x - 3) + 3(x + 7) = 4x - 12 + 3x + 21$
$= 7x + 9$

⑤ **a** $2n \rightarrow$ an even number

b $n^2 \rightarrow$ a square number

c $7n \rightarrow$ a multiple of 7

d $2n - 1 \rightarrow$ an odd number

e $4n - n \rightarrow$ a multiple of 3

⑥ 1, 9, 15 and 99

⑦ *Examples will vary.*

a sometimes odd **b** always odd

c sometimes odd **d** always odd

e never odd

⑧ **a** **i** some values of x **ii** all values of x

iii no values of x **iv** all values of x

v no values of x **vi** all values of x

b **ii, iv and vi** These are true for all values of x.

⑨ **a** both simplify to $3x - 16$

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

c both simplify to $-6x^2 + 13x + 5$

⑩ **a** $n + n + 1 = 2n + 1$ which is always odd.

b $n + n + 1 + n + 2 + n + 3 + n + 4 +$
$= 5n + 10 = 5(n + 2)$ which is always a multiple of 5.

c $n + n + 1 + n + 2 + n + 3 = 4n + 6 =$
$2(n + 3)$ which is always a multiple of 2.

⑪ **a** n, $2n$, $2n + 5$

b 8, 16 and 21

⑫ **a** **i** 2; 4; 3 and 5; $4 \rightarrow 3^2 + 4^2 = 5^2$

ii 6; 36; 35 and 37; $12 \rightarrow 12^2 + 35^2 = 37^2$

iii 10; 100; 99 and 101; $20 \rightarrow 20^2 + 99^2 = 101^2$

iv 1000; 1 000 000; 999 999 and 1 000 001;
$2000 \rightarrow 2000^2 + 999\,999^2 = 1\,000\,001^2$

b $2n$; $4n^2$; $4n^2 - 1$ and $4n^2 + 1$; $4n \rightarrow$
$(4n)^2 + (4n^2 - 1)^2$
$= 16n^2 + 16n^4 - 4n^2 - 4n^2 + 1$
$= 16n^4 + 8n^2 + 1$
$= (4n^2 + 1)^2$ as required

➤ Do I know it now? (page 392)

① **a** **i** equation

ii identity

iii identity

iv identity

b **i** $x = 4$

ii $2x + 14 + 3x + 6 = 5x + 20$

iii $x^2 - 8x - 1 = (x - 2)(x - 6) - 13 = x^2 - 8x + 12 - 13$

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

② **a** false, negative values of n will make left side less than right side

b true, definition of identity

c true, the last digit squared for any number is never 2, therefore no square number ever ends in 2

d true, it's an identity

Chapter 9 Sequences

9.3 Quadratic sequences

➤ Learning exercise (pages 395–397)

① **a** **ii** **b** **iii** **c** **iv** **d** **i**

② **a** 16, n^2 **b** 17, $n^2 + 1$

c 18, $2n^2$ **d** 35, $2n^2 + 3$

③ **a** **iii** **b** **v** **c** **i**

d **ii** **e** **iv**

④ **a** **i**, **iii** and **v**

b **i** $n^2 + 4$ **iii** $3n^2$ **v** $2n^2 + 3$

⑤ **a** *drawing of a 5 × 5 square*

b

Pattern	1	2	3	4	5
Number of tiles	4	9	16	25	36

c pattern 9

d $(n + 1)^2$

e **i** 50

ii 2551

iii $(n + 1)^2 - n$ or $n^2 + n + 1$

⑥ **a** 64 **b** n^2 **c** pattern 10

⑦ **a** 15 **b** 231 **c** 15 **d** 5050

e **i** No, because the 17th stack needs 153 tins and the 18th stack needs 171 tins; or because 169 is a square number and $n^2 \neq \frac{1}{2}n(n + 1)$.

ii 78 and 91

⑧ **a** **i** 6 **ii** 12 **iii** 8

b 26

c

Cube size	2	3	4	5	10	n
1 sticker	0	6	24	54	384	$6(n - 2)^2$
2 stickers	0	12	24	36	96	$12(n - 2)$
3 stickers	8	8	8	8	8	8
Total number of stickered cubes	8	26	56	98	488	$6(n - 2)^2 + 12(n - 2) + 8 = 6n^2 - 12n + 8$

➤ Problem solving exercise (page 397)

① **a** 42 **b** $n(n + 1)$

c $2(n + 1)$ **d** 50

② 33 and 24

③ **a** 35 **b** $n - 3$

c $\frac{n(n - 3)}{2}$ **d** 16

➤ Do I know it now? (page 397)

① **a** 70, $10n + 10$

b 48, $3n^2$

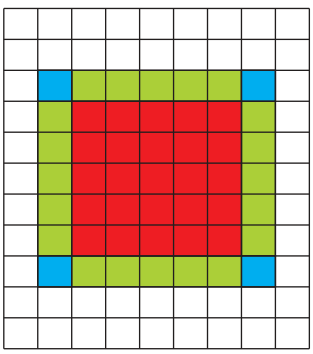
c 81, $105 - 6n$

d 177, $11n^2 + 1$

②

Term	$n^2 + 5$	1st difference	2nd difference
1	6		
2	9	3	
3	14	5	2
4	21	7	2
5	30	9	2

③ **a**



b

Pattern number	1	2	3	4	5
Number of green squares	4	8	12	16	20
Number of blue squares	4	4	4	4	4
Number of red squares	1	4	9	16	25
Total number of squares, S	9	16	25	36	49

c **i** 40 **ii** 4
iii 100 **iv** 144

d **i** $4n$ **ii** 4 **iii** n^2

e $S = n^2 + 4n + 4$ *or* $S = (n + 2)^2$

Can I apply it now? (page 398)

① **a** *You might have decided to put your results in a table like this for your investigation.*

Number of levels	1	2	3	4	5
Cards used	2	7	15	26	40

b **i** 5612 cards

ii No, the height would be about 5 metres.

9.4 Geometric progressions

Learning exercise (pages 400–401)

① **a** no **b** yes **c** no **d** yes

② **a** 3, 9, 27, 81 **b** powers of three

③ **a** $r = 4$ **b** $r = 3$
c $r = 0.5$ **d** $r = 0.1$

④ **a** 1250, 6250 **b** 0.005, 0.0005
c 40.5, 60.75 **d** 0.0096, 0.00192

⑤ **a** $r = 3$ **b** 2 **c** 162

⑥ **a** **i** 1.5, 1.5 **ii** yes
b **i** 0.8, 0.83 **ii** no
c **i** 1.25, 1.25 **ii** yes

⑦ **a** 6 **b** 2 **c** 31.25

⑧ **a** 3, 9, 27 **b** 21, 41, 61

⑨ **a** £5100 **b** £5202
c £5306.04 **d** 1.02

Problem solving exercise (pages 401–402)

① **a** **i** £9000 **ii** £8100 **iii** £7290
b multiply by 0.9
c 12 years

② **a** £169 (£100 × 1.3^2)
b £2329.81 (£100 × 1.3^{12})
c 92 months (£100 × 1.3^{92} = £3 039 403 870 834.45)

Do I know it now? (page 402)

① **a** **i** 2 **ii** 48, 96
b **i** 0.25 **ii** 0.25, 0.0625

② **a** 48, 1536 **b** 1, 0.04

Can I apply it now? (page 402)

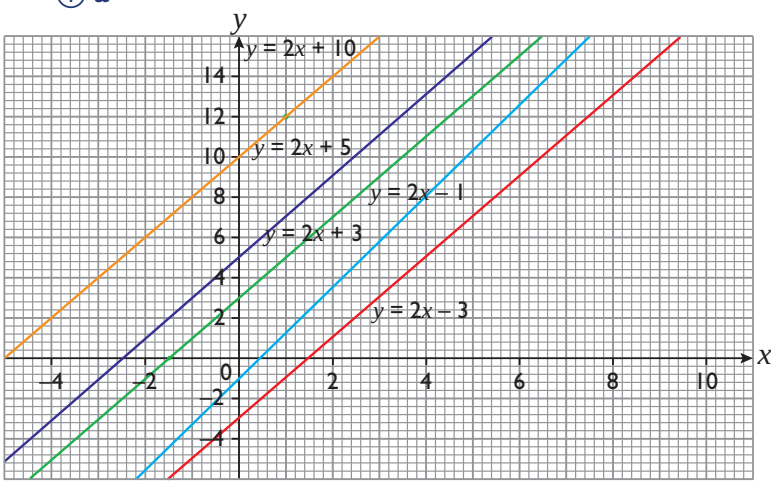
① 12 days

Chapter 10 Functions and graphs

10.3 Finding equations of straight lines

Learning exercise (pages 405–408)

① **a**



b **i** 3 **ii** 10 **iii** −1
iv −3 **v** 5

c **i** $y = 2x + 3$ **ii** $y = 2x + 10$
iii $y = 2x - 1$ **iv** $y = 2x - 3$
v $y = 2x + 5$

② **a** 3

b Substituting values for x and y into the equation gives $11 = 6 + k$.

c $k = 5$; $y = 3x + 5$

d (0, 5)

③ **a** $y = 3x - 2$ **b** $y = 7x - 9$

c $y = 2x - 19$ **d** $y = \frac{1}{2}x + 1$

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

④ **a** $\frac{9-1}{4-2} = 4$ **b** $y = 4x - 7$

c $9 = 4(4) - 7$

⑤ **a** **i** 1.5, $y = 1.5x - 0.5$
ii 1, $y = x + 2$
iii 1.5, $y = 1.5x - 0.5$
iv $\frac{4}{7}$, $y = \frac{4}{7}x + 4\frac{1}{7}$
v $-\frac{2}{3}$, $y = -\frac{2}{3}x + 10\frac{1}{3}$

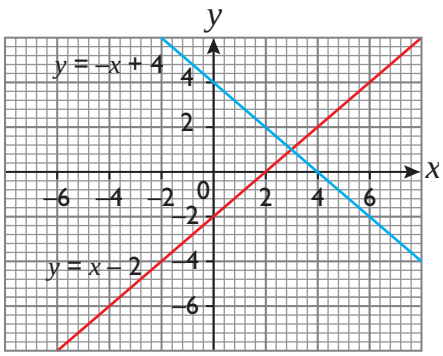
b **i** $1 = 1.5 - 0.5$, $7 = 1.5 \times 5 - 0.5$
ii $3 = 1 + 2$, $7 = 5 + 2$
iii $4 = 1.5 \times 3 - 0.5$, $7 = 1.5 \times 5 - 0.5$
iv $3 = -\frac{8}{7} + 4\frac{1}{7}$, $7 = \frac{20}{7} + 4\frac{1}{7}$
v $9 = \frac{-4}{3} + 10\frac{1}{3}$, $7 = \frac{-10}{3} + 10\frac{1}{3}$

⑥

	Gradient is 3	**Gradient is −7**
***y*-intercept is 6**	$y = 3x + 6$	$y = -7x + 6$
***y*-intercept is −5**	$y = 3x - 5$	$y = -7x - 5$

⑦ **a** **l** $y = -x + 4$, **m** $y = x - 2$

b



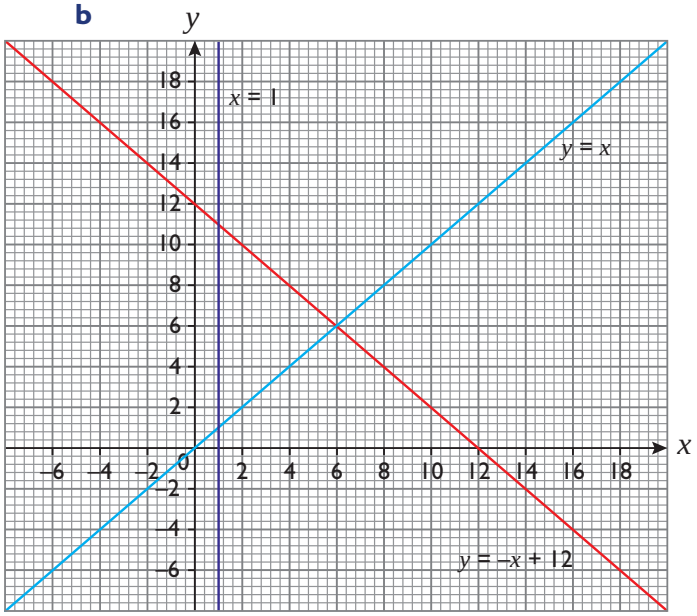
⑧ **a** **i** $y = x + 1$ **ii** $y = x + 2$
iii $y = x + 4$ **iv** $y = x + 4$
v $y = x + 2$ **vi** $y = x + 1$

b **i** is same as **vi**, **ii** is the same as **v**, **iii** is the same as **iv**

⑨ It is always true. If $a > b$, point B always has a greater y value, but lower x value than point A and the line between them has a negative gradient.
If $b > a$, the reverse applies, but the line between them still has a negative gradient.

⑩ **a** $y = x$; $y = -x + 12$; $x = 1$

b

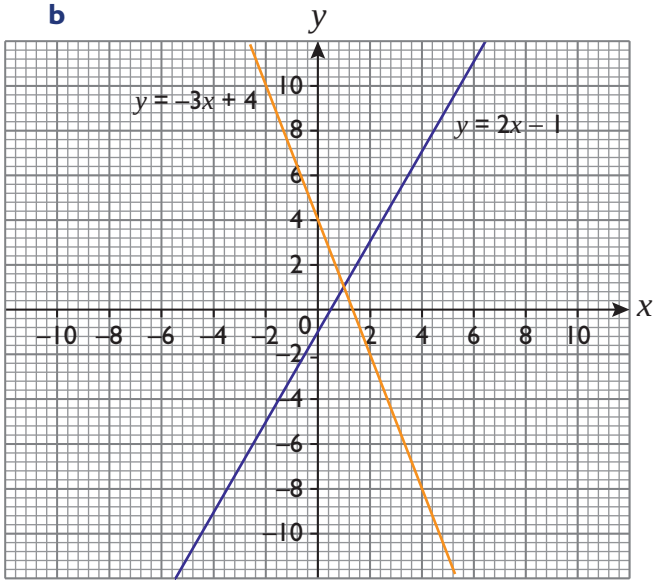


c isosceles and right-angled at (6,6)

d 25 square units

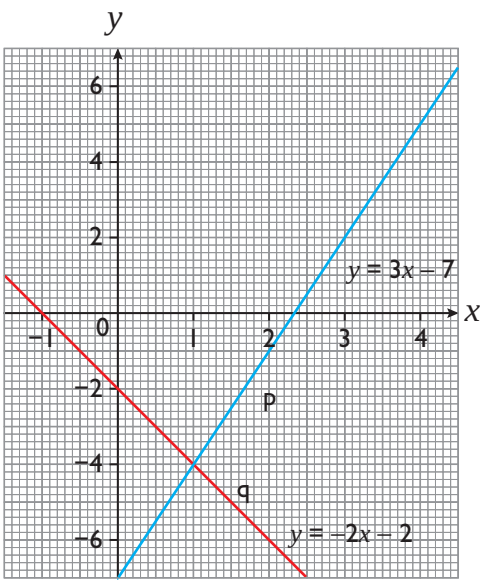
⑪ **a** **l** $y = 2x - 1$; **m** $y = -3x + 4$

b



c (1, 1)

⑫ **a**



b **p** $y = 3x - 7$; **q** $y = -2x - 2$

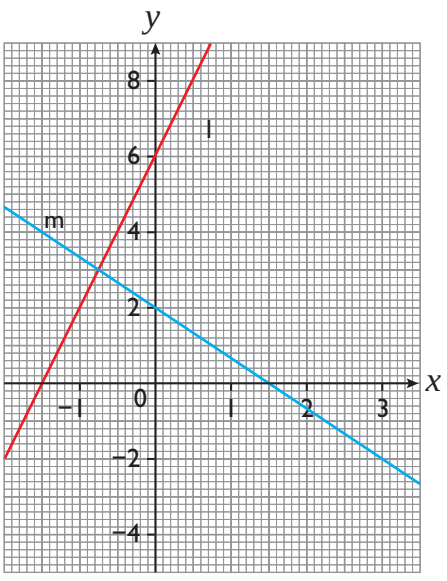
c $(1, -4)$ **d** $-4 = -4(1)$

⑬ **a** **r** $y = x + 5$; **s** $x + y = 1$

b $(-2, 3)$

c $x + x + 5 = 1$, $2x = -4$, $x = -2$, and $-2 + y = 1$, $y = 3$; the co-ordinates of the point of intersection.

⑭ **a**



b **l** $y = 4x + 6$; **m** $4x + 3y = 6$

c $(-0.75, 3)$

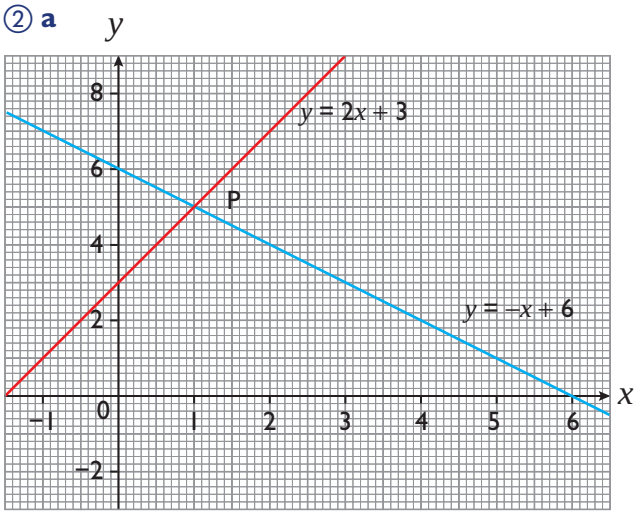
d $4x + 3(4x + 6) = 4x + 12x + 18 = 6$, $16x = -12$, $x = -0.75$; $y = 4(-0.75) + 6 = 3$

➤ Do I know it now? (pages 408)

① **a** $y = 2x + 5$ **b** $y = -x + 7$

c $y = 3x - 1$

② **a**



b $(1, 5)$

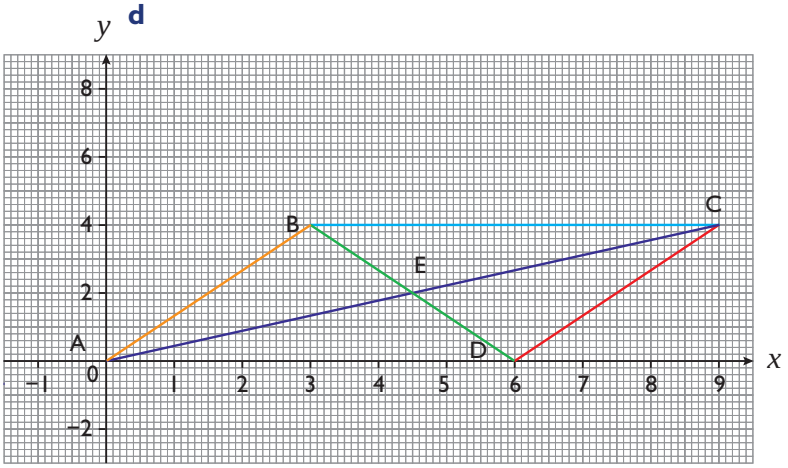
c *Derive the equation of the line as* $y = -2x + 7$ *and insert coordinates P to prove.*

③ **a** Gradient of both AB and CD is $\frac{4}{3}$, therefore they are parallel. Gradient of AD and BC is 0, therefore they are parallel. Gradient AC is $\frac{4}{9}$ and gradient BD is $-\frac{4}{3}$ so the diagonals are not perpendicular and therefore ABCD is not a rhombus.

b AC $y = \frac{4}{9}x$; BD $y = -\frac{4}{3}x + 8$

c *Substitute the coordinates into both equations.*

d



10.4 Quadratic functions

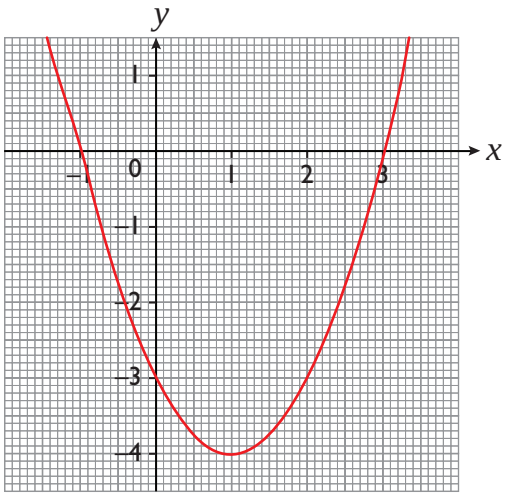
Learning exercise (pages 411–412)

① **a** (0, 12) **b** (2, 0), (6, 0)

c $x = 2$ and $x = 6$ **d** $x = 4$

e (4, −4)

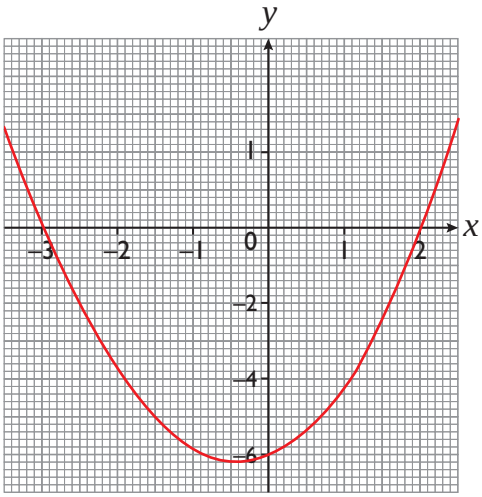
② **a**



b $x = -1$ and $x = 3$

c $x = 1$

③ **a**



b $x = -3$ and $x = 2$

c $x = -\frac{1}{2}$

④ **a** (0, 4) **b** (−4, 0), (1, 0)

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

e **i** (−1.5, 6.25)

ii $-(-1.5)^2 - 3(-1.5) + 4$
$= -2.25 + 4.5 + 4 = 6.25$

⑤ **a** **i** (−2, 0), (0, 6), (3, 0)

ii $x = -2$ and $x = 3$

iii $x = \frac{1}{2}$

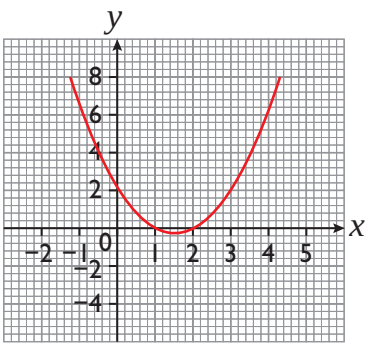
b $(\frac{1}{2}, -6\frac{1}{3})$ (y-co-ordinate may vary)

c the equation of the function

⑥ **a**

x	−1	0	1	2	3	4
x^2	1	0	1	4	9	16
$-3x$	3	0	−3	−6	−9	−12
$+2$	2	2	2	2	2	2
$y = x^2 - 3x + 2$	6	2	0	0	2	6

b



c (0, 2), (1, 0), (2, 0)

d $p = 1, q = 2$ (or vice versa)

e $(x - 1)(x - 2) = 2x^2 - 3x + 2$; it is the same as the original function.

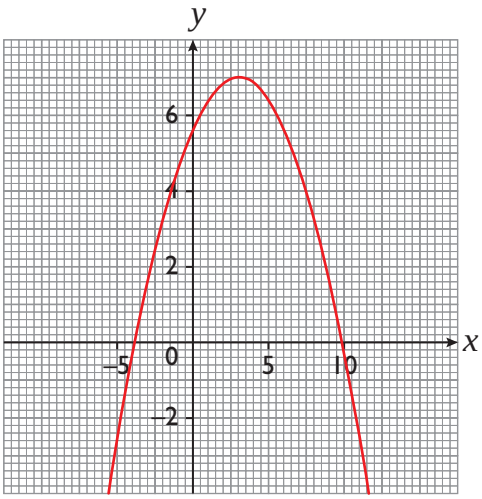
⑦ **a** (0, −2), (−1, 0), (2, 0)

b $p = -1, q = 2$ (or vice versa)

c $(x + 1)(x - 2) = x^2 - x - 2$; it is the same as the original function.

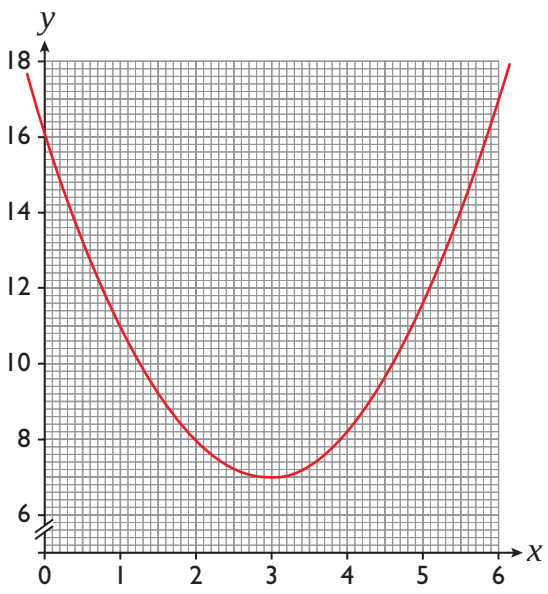
d $(\frac{1}{2}, -2\frac{1}{4})$, minimum

⑧ **a**



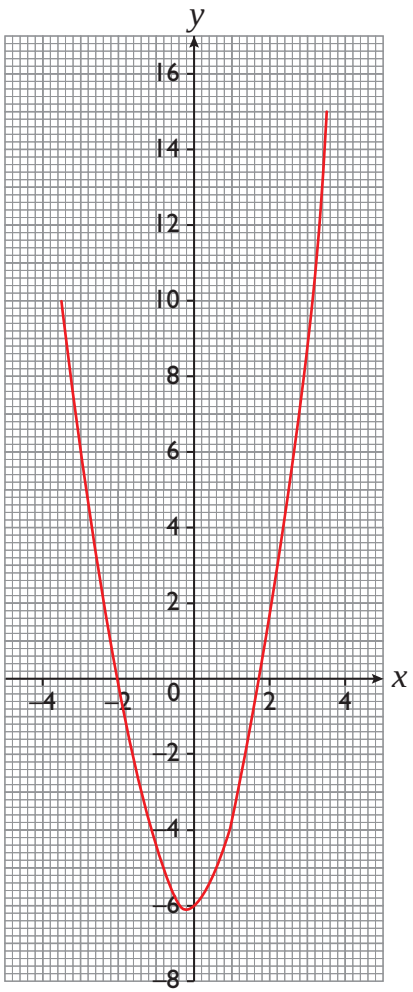
b (10, 0)

c



d No, the line through the turning point, perpendicular to the x axis, is a line of symmetry so the curve would cut the x axis either not at all or in two places, one on either side of the point where the symmetry line cut it.

⑨ a



b approx. (−0.25, −6.1)

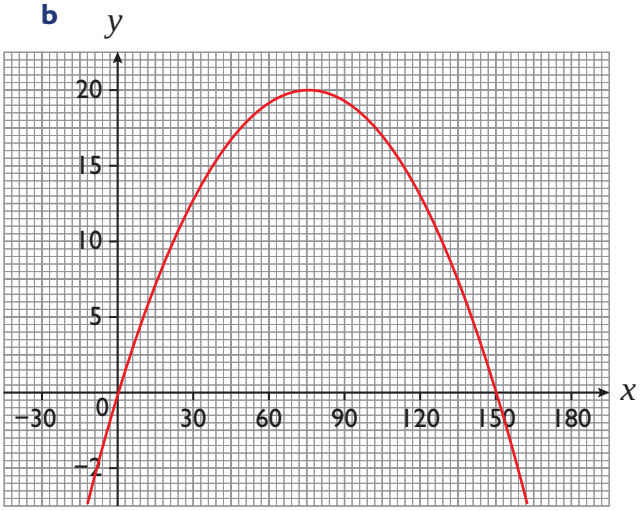
c approx. −2 and 1.5

➤ Problem solving exercise (pages 412–413)

① a

x	0	30	60	90	120	150
y	0	12	18	18	12	0

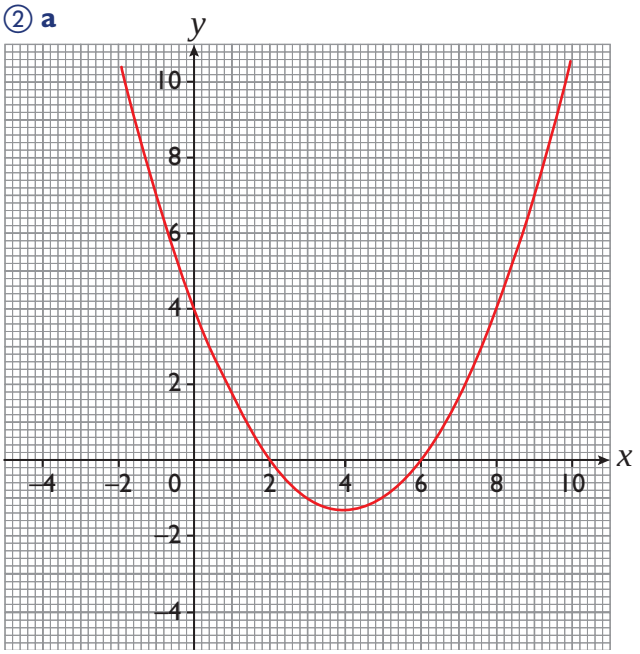
b



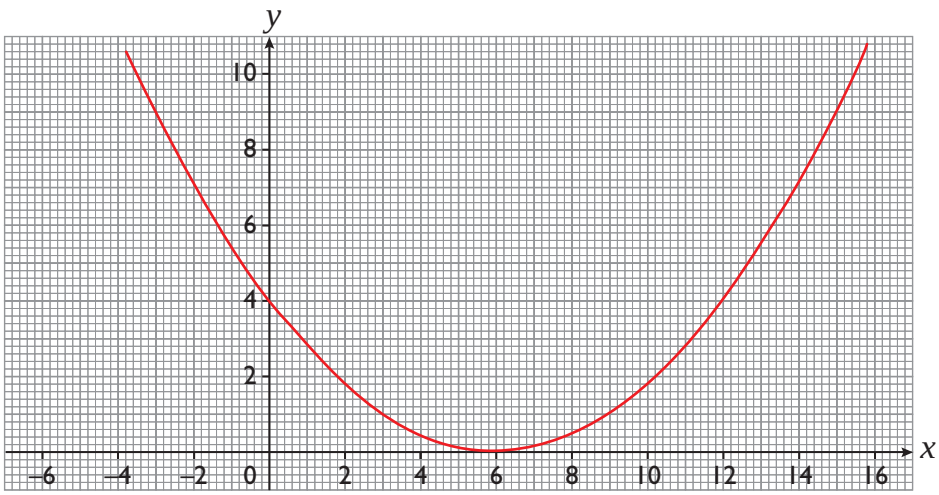
c 150 m

d c. 20 m

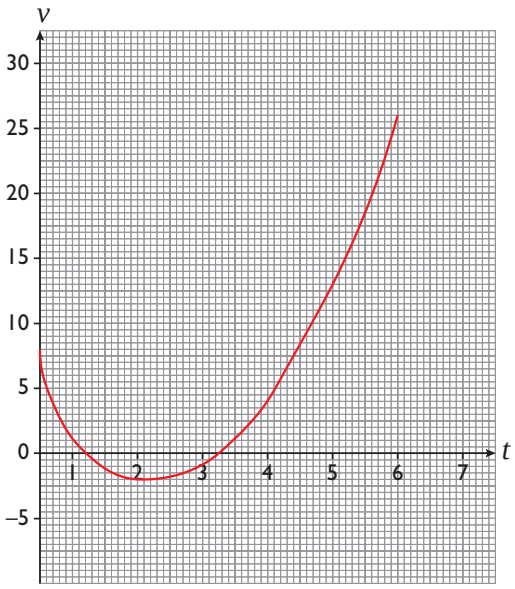
② a



b



③ **a**



b **i** (2.5, −2.25)

ii An object dropped from a height and bouncing back up.

④ **i** a → B, b → C, c → A, d → E, e → D

ii **A** $x^2 - 4x + 3$

B $x^2 - 1$

C $x^2 - 2x$

D $x^2 - 8x + 15$

E $x^2 - 6x + 8$

Coefficients of x are in a sequence 0, –2, –4, –6, –8

Do I know it now? (page 413)

① **a** (0, 4), (−2, 0), (2, 0)

b $p = -2$, $q = 2$ (or vice versa)

c $x^2 - 4$; it is minus the original function.

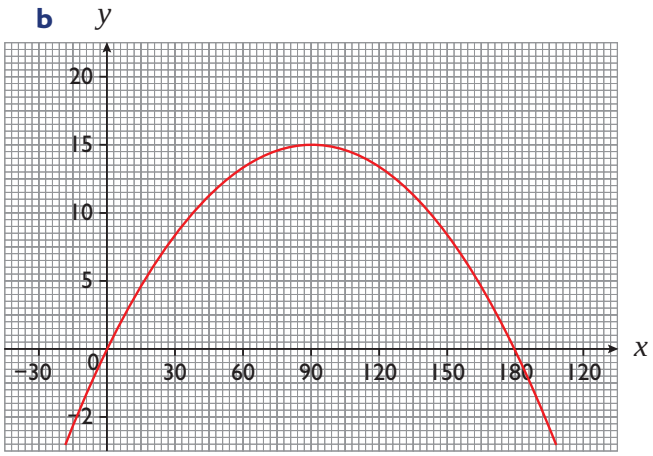
d (0, 4); maximum

Can I apply it now? (page 414)

① **a**

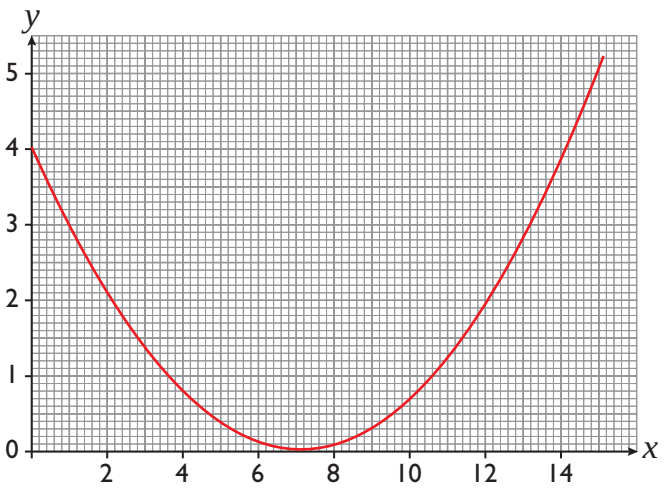
x	0	30	60	90	120	150	180
y	0	$8\frac{1}{3}$	$13\frac{1}{3}$	15	$13\frac{1}{3}$	$8\frac{1}{3}$	0

b



c 180 m **d** 15 m

② **a**



b (7, 0)

c −3 and 7

10.5 Polynomial and reciprocal functions

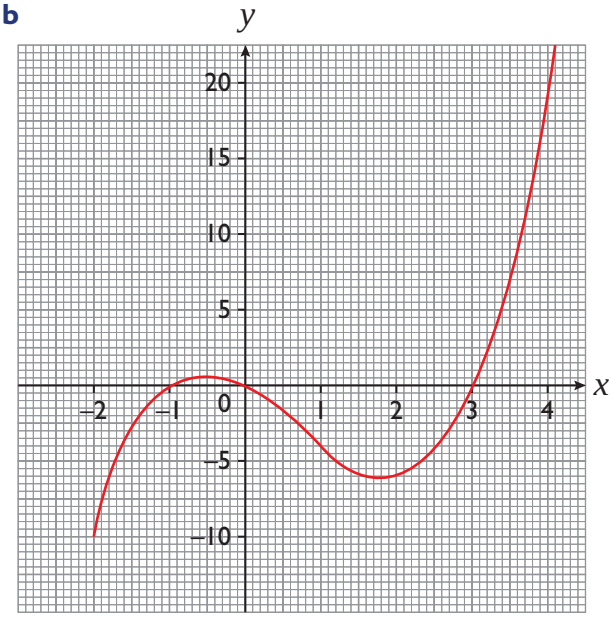
➤ Learning exercise (pages 417–418)

① A → xv, B → i, C → viii, D → xiv,
E → iii, F → vi, G → x, H → xii,
I → ii, J → ix, K → xiii, L → v,
M → iv, N → xi, O → vii

② **a**

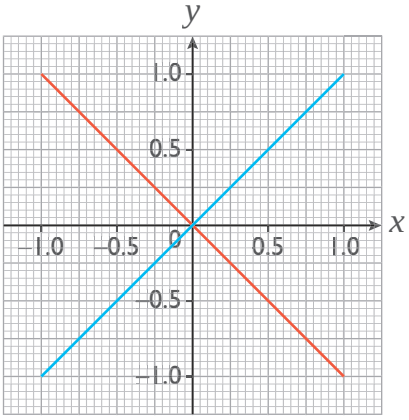
x	−2	−1	0	1	2	3	4
y	−10	0	0	−4	−6	0	20

b

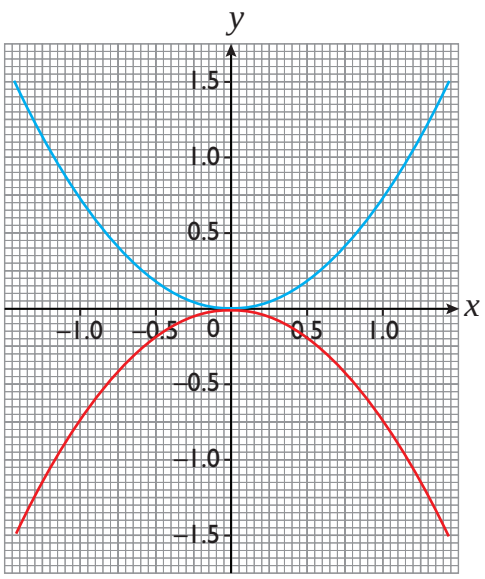


③ all of them

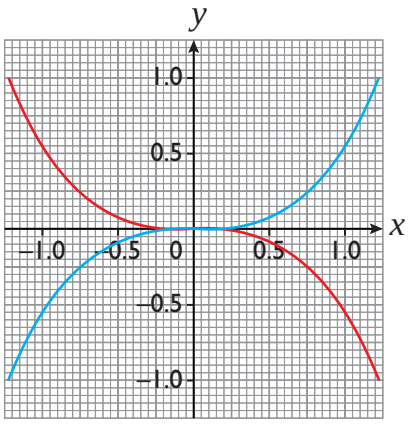
④ **a** **i**



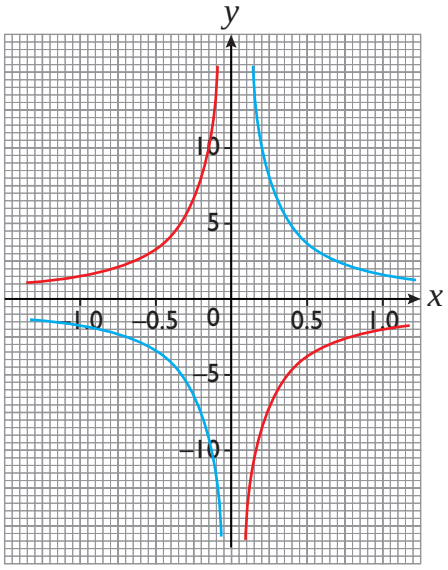
ii



iii



iv



b For example:

Same: all show line symmetry in both axes when both graphs are drawn.

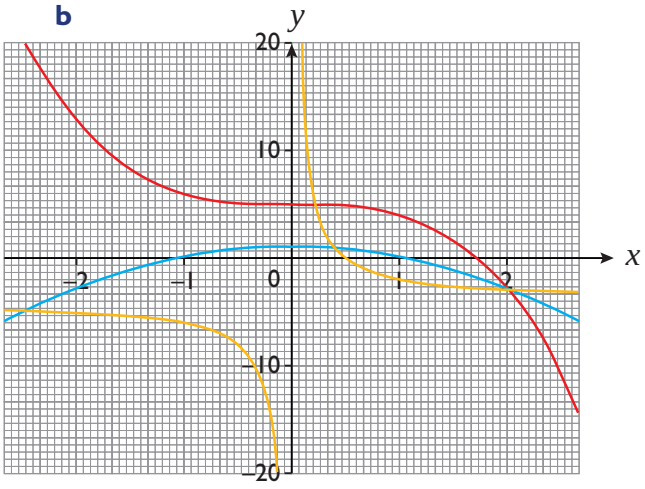
Different: **i** and **iii** intersect at one point;
ii meet at one point;
iv do not meet at all.

Problem solving exercise (page 419)

① **a** **iv** **b** **ii** **c** **i** **d** **iii**

② **a** 1, 5, 4

b



c $y = 1 - x^2$

③ **a** $x < -2$ and $0 < x < 2$

b $x < -2$ and $0 < x < 2$

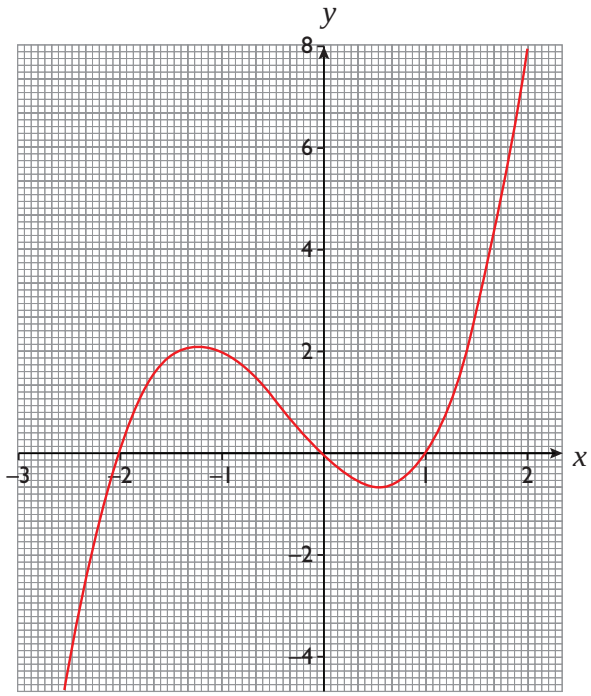
c $x < -2$ and $0 < x < 2$

d reflection in line $y = 0$

e rotational symmetry of order 2 about the origin

Do I know it now? (page 420)

① $x = -2$, $x = 0$ or $x = 1$

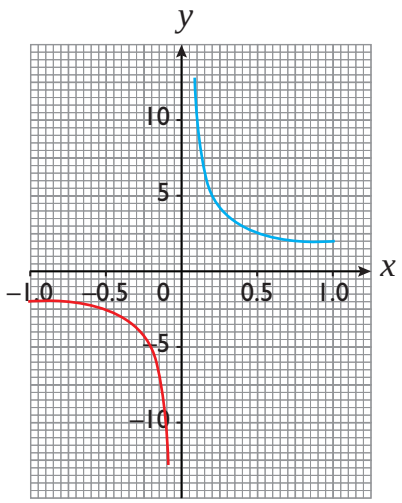


② **a**

x	−5	−4	−3	−2	−1	−0.5	−0.2	0.2	0.5	1	2	3	4	5
$\frac{1}{x}$	−0.2	−0.25	−0.33	−0.5	−1	−2	−5	5	2	1	0.5	0.33	0.25	0.2
y	−5.2	−4.25	−3.33	−2.5	−2	−2.5	−5.2	5.2	2.5	2	2.5	3.33	4.25	5.2

b $\frac{1}{0}$ isn't defined.

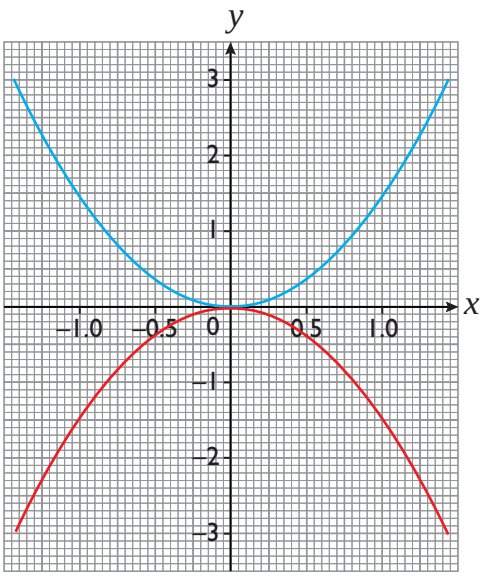
c



d approximately 0.4

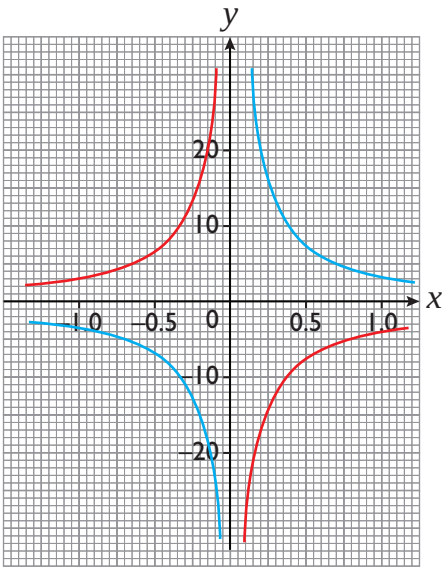
➤ Can I apply it now? (page 420)

① **a b**



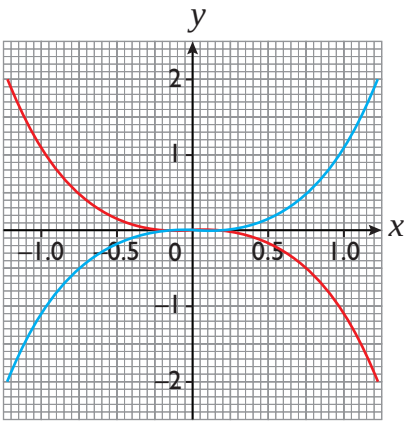
c reflection in $y = 0$

d i



rotational symmetry order 2 about the origin

ii



reflection in $y = 1$

Chapter 11 Algebraic methods

11.4 Using graphs to solve simultaneous equations

➤ Learning exercise (pages 422–424)

① **a** (3, 1)

b $x = 3, y = 1$

c $3 + 1 = 4, 1 = 3 - 2$

② **a** (1, 1)

b i $x = 1, y = 1$

ii $16x - 12 = 3x + 1, x = 1, y = 1$

③ **a** **m** is $y = x$, **e** is $3y = 4x - 1$

b (1, 1)

c i $x = 1, y = 1$

ii $3x = 4x - 1$ or $3y = 4y - 1$; $x = 1, y = 1$

④ **a** **m** is $y = \frac{1}{3}x + 1\frac{2}{3}$

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

b (1, 2)

c $3y = x + 5$ and $x + 2y = 5$

d *proof by substitution*

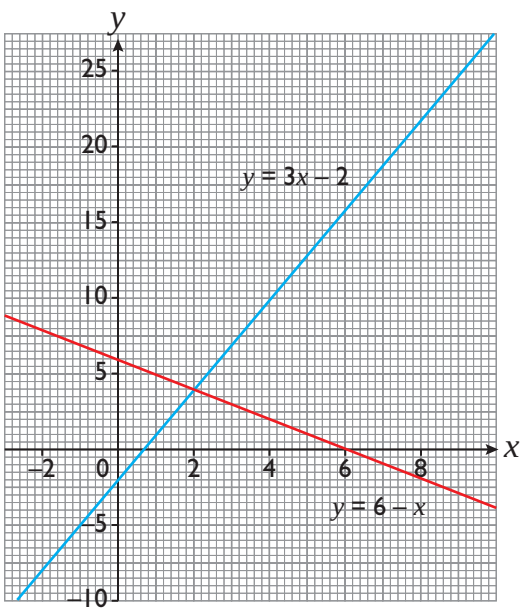
⑤ **a**

x	0	1	2	3
$3x$	0	**3**	**6**	**9**
-2	−2	**−2**	**−2**	**−2**
$y = 3x - 2$	−2	**1**	**4**	**7**

b

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

c

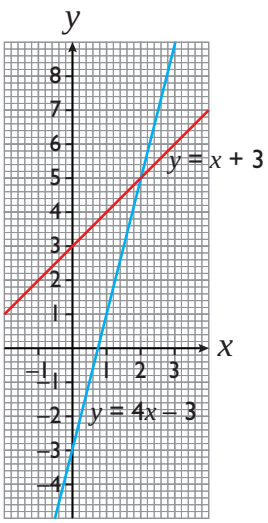


d (2, 4)

e $3(2) - 2 = 6 - 2$

⑥ **a** $x + 3 = 4x - 3$; $x = 2$, $y = 5$

b c

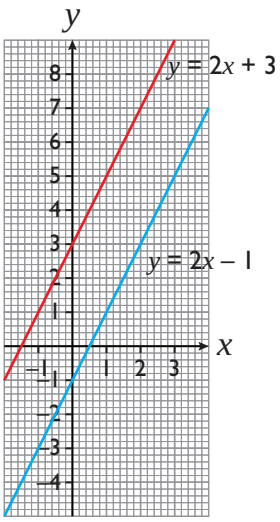


d $5 = 8 - 3$, $5 = 2 + 3$

⑦ **a** There is no solution; $2x + 3$ can never be equal to $2x - 1$.

b The coefficients of x and y are the same.

c

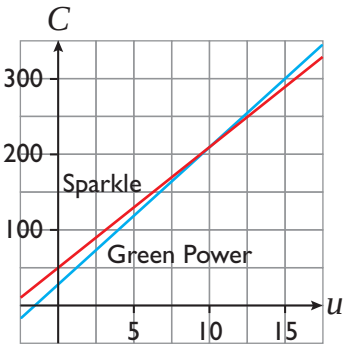


d The lines are parallel so there is no solution; they will never intersect.

⑧ **a** **i** $C = 30 + 18u$

ii $C = 50 + 16u$

b



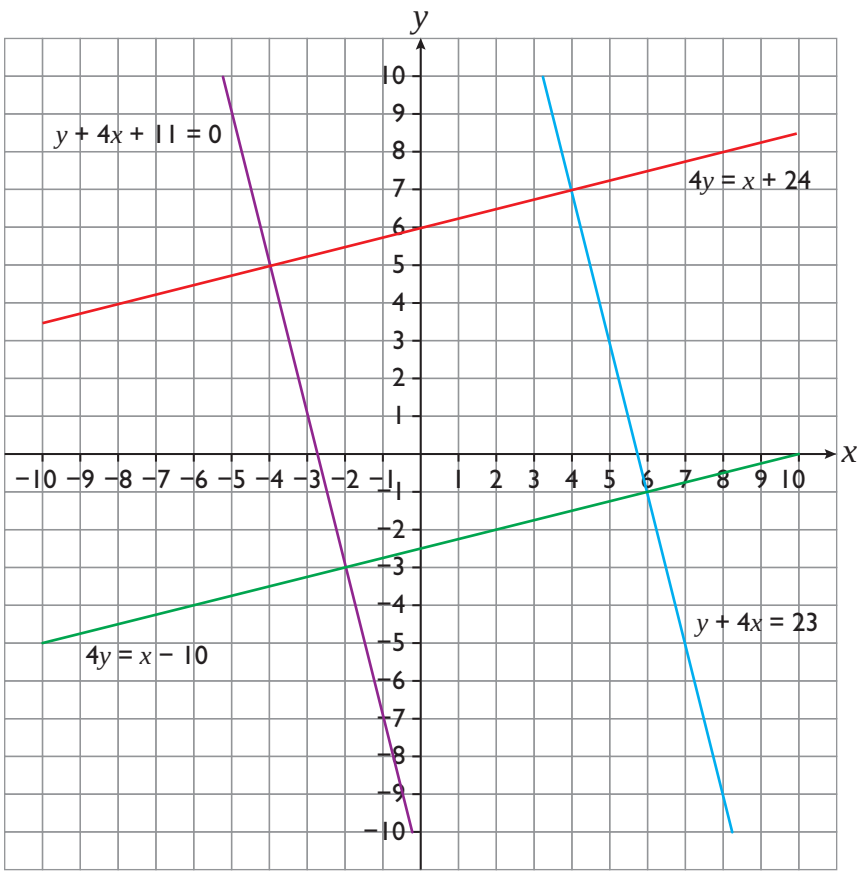
c **i** 10

ii £2.10

iii *Students' own check*

d Sparkle (lower cost for more than 10 units)

⑨ **a**



b (−4, 5), (4, 7), (6, −1) and (−2, −3)

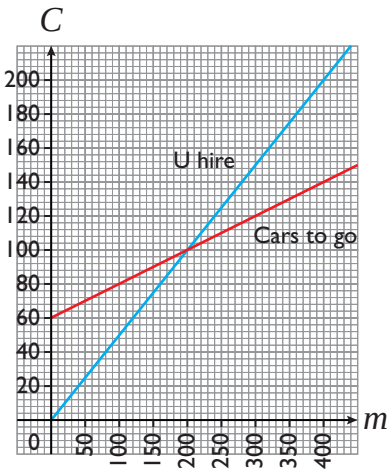
c *Students' own check*

d square

➤ Problem solving exercise (pages 424–425)

① **a** $C = 0.5m$, $C = 0.2m + 60$

b



c Cars 2 go

② **a**

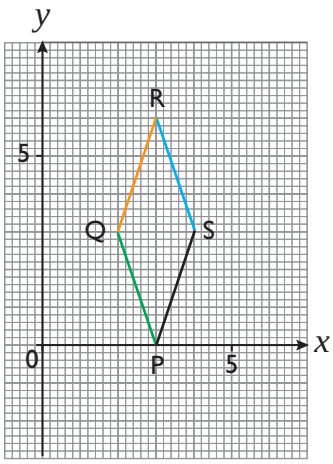
x	0	1	2	3	4	5
3x	0	3	6	9	12	15
−3	−3	−3	−3	−3	−3	−3
y = 3x − 3	−3	0	3	6	9	12

x	0	1	2	3	4	5
3x	0	3	6	9	12	15
−9	−9	−9	−9	−9	−9	−9
y = 3x − 9	−9	−6	−3	0	3	6

x	0	1	2	3	4	5
−3x	0	−3	−6	−9	−12	−15
+15	+15	+15	+15	+15	+15	+15
y = −3x + 15	15	12	9	6	3	0

x	0	1	2	3	4	5
−3x	0	−3	−6	−9	−12	−15
+9	+9	+9	+9	+9	+9	+9
y = −3x + 9	9	6	3	0	−3	−6

b

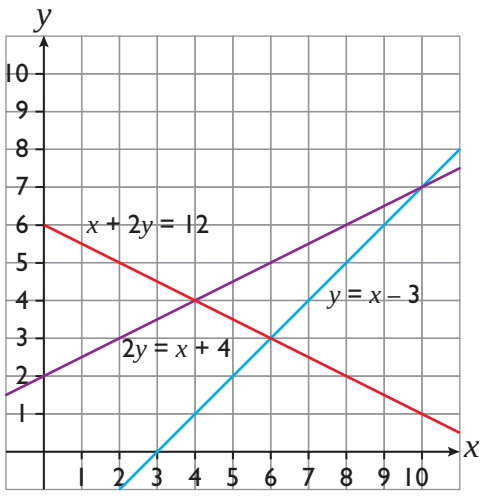


c P (3, 0), Q (2, 3), R (3, 6), S (4, 3)

d *Students check their answer*

e rhombus

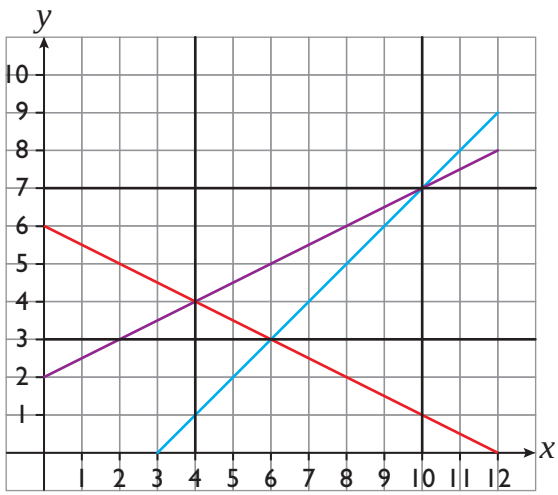
③ **a**



b **i** (4, 4), (6, 3), (10, 7)

ii **A** $x = 4$ and $y = 4$; **B** $x = 6$ and $y = 3$; **C** $x = 10$ and $y = 7$

c **i**



ii $x = 4$, $x = 10$, $y = 3$, $y = 7$

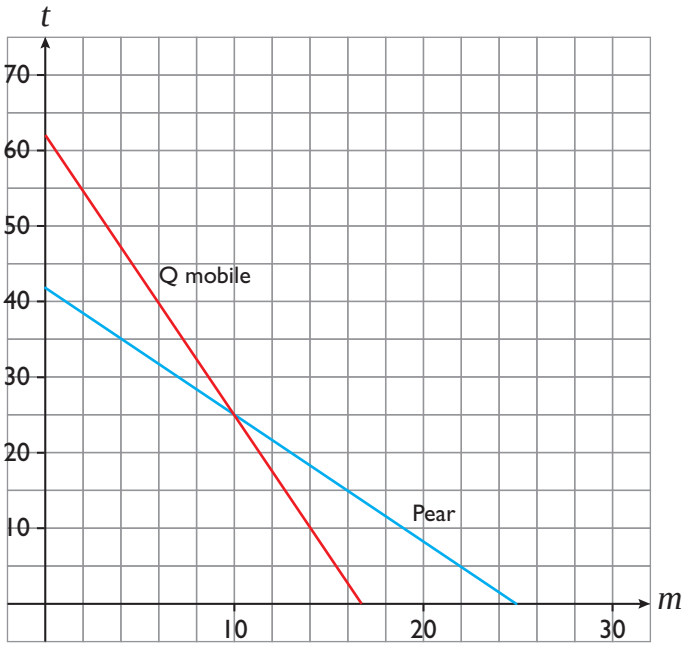
iii 24 square units

d 6 square units

④ **a** **i** $30m + 8t = 500$

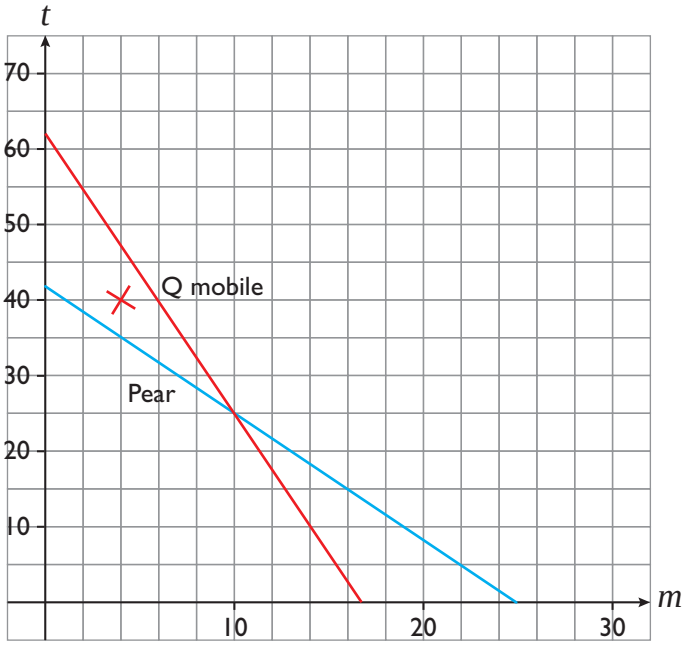
ii $20m + 12t = 500$

b



c 10 minutes of calls, 25 texts

d **i**

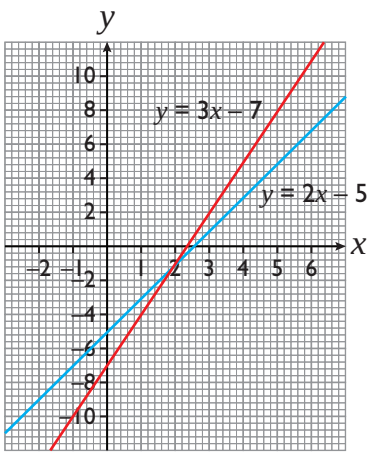


ii Daisy, 60p

iii Chloe, 60p

Do I know it now? (page 426)

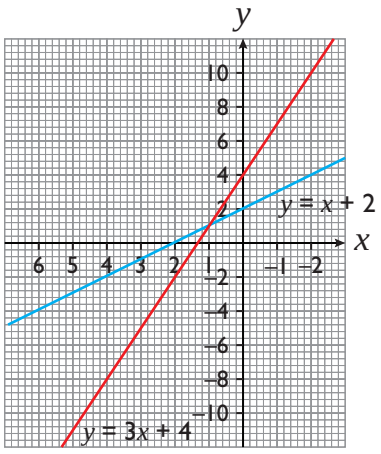
① **a**



$x = 2, y = -1$

b $-1 = 4 - 5; -1 = 6 - 7$

② **a**



$x = -1, y = 1$

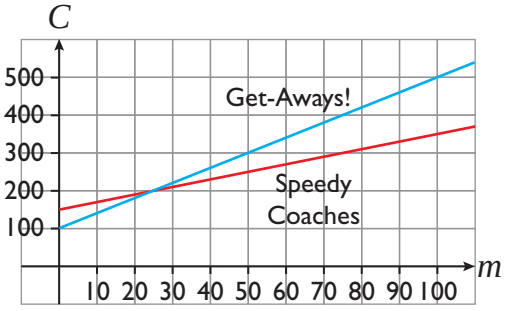
b $1 = -3 + 4; 1 = -1 + 2$

c *Students check their answer*

Can I apply it now? (page 426)

① **a** **i** $C = 150 + 2m$ **ii** $C = 100 + 4m$

b



c **i** 25 miles **ii** £200

iii *Students' own check*

d **i** Speedy Coaches **ii** £110

Chapter 12 Working with quadratics

12.1 Factorising quadratics

Learning exercise (pages 429–430)

① **a** $x^2 + 3x$ **b** $x^2 - x$

c $x^2 - 25$ **d** $x^2 + x - 6$

e $x^2 - 3x - 40$ **f** $x^2 - 5x + 4$

g $x^2 - 4$

② **a** 4 and 2 **b** 4 and −2

c −4 and 2 **d** −4 and −2

e 8 and 1 **f** 8 and −1

g −8 and 1 **h** −8 and −1

③ **a** $2(a + 5) + 7(a + 5) = \mathbf{9}(a + 5)$

b $12(b - 6) - 3(b - 6) = \mathbf{9}(b - 6)$

c $8(c + 2) + (c + 2) = \mathbf{9}(c + 2)$

d $-2(d - 7) + (d - 7) = \mathbf{-1}(d - 7)$

④ **a** $x(x + 5) + 7(x + 5) = (\mathbf{x + 7})(x + 5)$

b $x(x - 6) - 3(x - 6) = (\mathbf{x - 3})(x - 6)$

c $x(x + 2) + (x + 2) = (\mathbf{x + 1})(x + 2)$

d $-x(x - 7) + (x - 7) = (\mathbf{-x + 1})(x - 7)$

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

c $(x + 4)(x + 4)$ **d** $(x + 7)(x - 3)$

e $(x + 2)(x - 3)$ **f** $(x + 16)(x + 1)$

g $(x + 1)(x - 16)$ **h** $(x - 10)(x + 2)$

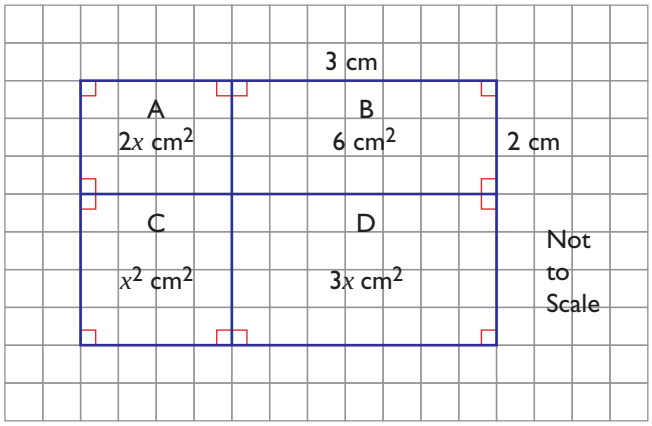
⑥ **a** $x(x + 8)$ **b** $(x - 10)(x + 10)$

c $x(x - 16)$ **d** $(x - 4)(x + 4)$

e $(x + 1)(x + 6)$ **f** $(x - 1)(x + 1)$

g $(x - 12)(x + 12)$ **h** $(x - 5)(x + 5)$

⑦ **a**



b $(x + 3)$ cm and $(x + 2)$ cm

c $(x + 3)(x + 2)$ cm

d $(x + 3)(x + 2) = x^2 + 3x + 2x + 6$

⑧ **a**

$2x$ cm²	8 cm²
x^2 cm²	$4x$ cm²

b Sides are $x + 2$ and $x + 4$

Perimeter is $2[(x + 2) + (x + 4)] = 2(2x + 6)$
$= (4x + 12)$ cm

Area $= x^2 + 2x + 4x + 8 = (x^2 + 6x + 8)$ cm²

c $(x + 2)(x + 4)$

d $(x + 2)(x + 4) = x^2 + 2x + 4x + 8$

⑨ **a** **i** $x^2 + 10x + 21$ **ii** $x^2 + 9x + 14$

b $x + 7$

c Subtract the answer to **ii** from the answer to **i**.

➤ Do I know it now? (page 431)

① **a** $(x - 4)(x - 2)$ **b** $(x - 3)(x + 4)$

c $(x - 4)(x + 3)$ **d** $(x - 2)(x + 5)$

e $(x - 5)(x + 2)$ **f** $(x - 4)(x - 4)$

g $(x - 7)(x + 7)$ **h** $(x - 3)(x + 3)$

② $x^2 + 8x + 7 - (x^2 + 8x + 12) + x^2 - 4$
$= x^2 - 9 = (x + 3)(x - 3)$

12.2 Solving equations by factorising

➤ Learning exercise (pages 433–434)

① **a** $x = -4$ or $x = -1$ **b** $x = -7$ or $x = 3$

c $x = 1$ **d** $x = -2$ or $x = -1$

② **a** $(x - 3)(x - 4)$; $x = 3$ or $x = 4$

b $(x + 1)(x - 2)$; $x = -1$ or $x = 2$

c $(x - 3)(x + 5)$; $x = 3$ or $x = -5$

d $(x + 5)(x + 1)$; $x = -5$ or $x = -1$

e $(x + 2)(x - 2)$; $x = -2$ or $x = 2$

f $x(x - 7)$; $x = 0$ or $x = 7$

g $(x + 4)(x - 3)$; $x = -4$ or $x = 3$

h $(x + 3)(x - 3)$; $x = -3$ or $x = 3$

③ **a** $x^2 + 4x + 3 = 0$; $(x + 3)(x + 1) = 0$;
$x = -1$ or $x = -3$

b $x^2 + 2x - 8 = 0$; $(x + 4)(x - 2) = 0$;
$x = 2$ or $x = -4$

c $x^2 + x = 0$; $x(x + 1) = 0$; $x = 0$ or $x = -1$

d $x^2 - 3x - 4 = 0$; $(x - 4)(x + 1) = 0$; $x = 4$ or $x = -1$

e $x^2 - 49 = 0$; $(x + 7)(x - 7) = 0$; $x = -7$ or $x = 7$

④ **a** $(x + 8)(x - 8) = 0$; $x = -8$ or $x = 8$

b $x^2 - 9x - 36 = 0$; $(x - 12)(x + 3) = 0$;
$x = -3$ or $x = 12$

c $x = 2$ or $x = -8$

d $(x + 2)(x - 1) = 0$; $x = -2$ or $x = 1$

e $x(x - 9) = 0$; $x = 0$ or $x = 9$

⑤ **a** $x^2 - 8x + 15 = 0$ **b** $x^2 + 8x + 15 = 0$

c $x^2 + 2x - 48 = 0$ **d** $x^2 - 1 = 0$

e $x^2 + x - 90 = 0$ **f** $x^2 + 6x = 0$

⑥ **a** $x(x + 4)$

b $x(x + 4) = 45$; $x^2 + 4x - 45 = 0$

c $(x + 9)(x - 5) = 0$; $x = -9$ or $x = 5$

d Taking positive value for x, 5 cm and 9 cm

⑦ **a** $x(x - 2) = 48$; $x^2 - 2x - 48 = 0$, $x = 8$ or $x = -6$

b Taking positive value for x, 8 cm by 6 cm

⑧ $\frac{1}{2}x(x + 6) = 8$; $x^2 + 6x - 16 = 0$; $x = 2$ or $x = -8$. Taking positive value for x, 2 cm base and 8 cm height.

⑨ $\frac{1}{2}x(x - 2 + x + 6) = 35$; $x^2 + 2x - 35 = 0$;
$x = 5$ and $x = -7$. Taking positive value for x, 11 cm base, 3 cm for the parallel side and 5 cm height.

Problem solving exercise (page 434)

① $(x + 6)(x - 5) = 26$; $x^2 + x - 30 = 26$; $x^2 + x - 56 = 0$; $(x + 8)(x - 7)$. Taking positive value for x, $x = 7$ so length is 13 cm and width is 2 cm.

② Andy could be thinking of 3 or 7. [$(x - 5)^2 = 4$, $x - 5 = \pm 2$]

Do I know it now? (page 434)

① **a** $x = -2$ or $x = -3$

b $x = 2$ or $x = 4$

c $x = 2$ or $x = -1$

d $x = 4$ or $x = -7$

e $x = -1$ or $x = -4$

f $x = 2$ or $x = -2$

g $x = 5$ or $x = -3$

h $x = \sqrt{10}$ or $x = -\sqrt{10}$

Can I apply it now? (page 434)

① $x^2 - 3x - 54 = 0$; $x = 9$ and $x = -6$. Taking positive value for x, the rectangle is 9 cm by 6 cm.

NEXT STEPS – GEOMETRY AND MEASURES

Chapter 13 Units and scales

13.3 Working with compound units

Learning exercise (pages 437–438)

① **a** 1.5 litres of lemonade for 65p

b 12 for 75p

c 3 kg of grass seed for £4.20

d 1.5 kg for £4.65

② **a** 3.57 m/s **b** 12.86 km/h

③ **a** 2.11 g/cm^3 **b** 2111.1 kg/m^3

④ 24 000 N/m^2

⑤ **a** $\frac{n}{t}$ m/s **b** $\frac{3.6n}{t}$ km/h

⑥ **a** 10.5 g/cm^3 **b** 84 kg

⑦ **a** It's travelling at a constant speed.

b 6 m/s^2 **c** acceleration

⑧ No, it will take her 4 hours 41 minutes.

⑨ £1.17

⑩ No, change in speed is acceleration. The second car is accelerating and the first car is at constant speed.

⑪ $1000f$ N/cm^2

⑫ $\frac{1000m}{v}$ kg/m^3

⑬ V m/s $= 3600V$ metres per hour $= 3.6V$ kilometres per hour $= 2.25V$ mph

Problem solving exercise (pages 438–439)

① **a** 10

b 4.67 calories/minute

c 3120

② 1.8 litre bottle (0.45 litre / £ compared with 0.43 litre / £)

③ **a** 900 kg/m^3 **b** $\frac{y}{x}$ kg/m^3

④ £171.31

⑤ Yes, his BMI is 21.

Do I know it now? (pages 439–440)

① 1:30 p.m.

② 54.5 kg/m^3

③ **a** £75

b 27p

Can I apply it now? (page 440)

① No. Volume $= 8 \times 4 \times 1.6 = 51.2$ cm^3
Mass $= 51.2 \times 19.32$ g $= 989.184$ kg, just under 1 kg.

Chapter 14 Properties of shapes

14.3 Congruent triangles and proof

➤ Learning exercise (pages 443–446)

① **a** Vertically opposite angles

b Base angles in an isosceles triangle

c Corresponding angles

d Opposite angles of a parallelogram

② **a** equal sides of isosceles triangle

b opposites sides of rectangle

c radii of a circle

d opposite sides of a parallelogram

e sides of an equilateral triangle

③ **a** p and r, s and q

b s and p, p and q, q and r, r and s

c $p + q + r + s = \mathbf{360°}$ (angles round a **point**)

④ **a** u and r (alternate angles); s and p (alternate angles); q and t (opposite angles of a parallelogram *or* triangles are similar by AAA)

b uts (angles in a triangle,) pqr (angles in a triangle); puq, srt (adjacent angles of a parallelogram)

⑤ **a** congruent, SSS

b not congruent

c congruent, ASA

d congruent, SAS

e not congruent

f congruent, RHS

g congruent, AAA

h not congruent

⑥ In triangles ABP and ACP: AB = AC (Isosceles triangle); ∠BAP = ∠CAP (given); AP is common. Triangles ABP and ACP are congruent (SAS); PB = PC (corresponding sides of congruent triangles).

⑦ **a** AC = CE (both given as 8 cm); ∠ACB = ∠ECD (vertically opposite angles); ∠BAC = ∠CED (alternate angles). So triangles ABC and CDE are congruent (ASA).

b AB and DE are the same length because they are parallel and the triangles are congruent.

⑧ **a** In triangles DAB and DCB: AB = CB (a rhombus has equal sides); AD = CD (a rhombus has equal sides); BD is common to both triangles. So triangles DAB and DCB are congruent (SSS).

b They are equal because DAB and DCB are congruent.

⑨ **a** OA = OB (radii); ON is common to both triangles; ∠ONA = ∠ONB = 90°. So triangles OAN and OBN are congruent (RHS).

b Point N is in the middle of the line AB as ON bisects AB at 90°, and AN and NB are equal.

⑩ **a** The angle must be the one between the equal sides.

b The sides are not in corresponding positions.

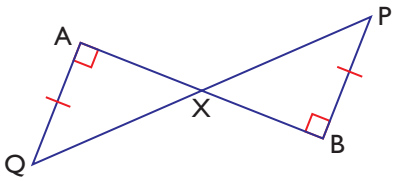
c The hypotenuse on the left is equal to one of the shorter sides on the right.

d AAA does not prove congruence. One triangle could be bigger than the other.

⑪ AD = BC (given); ∠DAB = ∠ABC (given); AB is common. Triangles DAB and CBA are congruent (SAS), hence BD = AC (corresponding sides of congruent triangles).

⑫ Let PQ cut AB at X.

AQ = BP (given); ∠QAX = ∠PBX = 90° (given); ∠AXQ = ∠BXP (vertically opposite angles) so triangles AQX and BPX are congruent (ASA). Therefore PX = XQ (corresponding sides of congruent triangles).



⑬ AD = BD (given); MD = ND (given); ∠AMD = ∠BND = 90° (given). So triangles AMD and BND are congruent (RHS). Hence ∠CAB = ∠CBA (corresponding sides of congruent triangles), so ABC is isosceles.

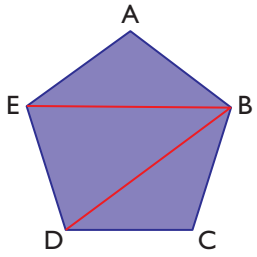
⑭ ∠BAC = ∠DAC (∠BAD bisected); ∠BCA = ∠DCA (∠BCD bisected); AC is common. Hence triangles ABC and ADC are congruent (ASA). AB = AD and BC = CD (corresponding angles of congruent triangles) therefore ABCD is a kite.

Problem solving exercise (page 446)

① **a** They are the same length.

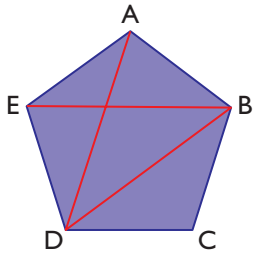
b They are the same size.

c

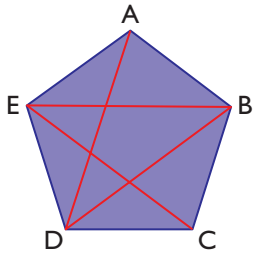


Statements	Reason
AB = BC AE = CD ∠EAB = ∠DCB	All sides of a regular pentagon are equal. All sides of a regular pentagon are equal. All interior angles of a regular pentagon are equal.
BAE = BCD	SAS
BE = BD	CPCT (corresponding parts of congruent triangles)

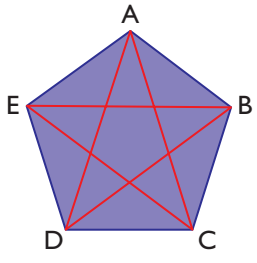
d Draw in line AD: AED = BCD (SAS), therefore AD = BD (CPCT)



Draw in line EC: EDC = EAB (SAS), therefore EC = EB (CPCT)



Draw in line AC: ABC = AED (SAS), therefore AC = AD (CPCT)



Do I know it now? (pages 446–447)

① **a** Similar, RHS

b Congruent, ASA

c Congruent, SSS

d Congruent, ASA

e Congruent, RHS

f Congruent, SAS

② **a** ∠DAE = ∠EBC = 90° (rectangle properties); AD = BC (rectangle properties); ED = EC (given, isosceles triangle); ADE and BCE are congruent (RHS).

b Point E is in the centre of line AB as AE = EB due to the triangles ADE and BCE being congruent.

Can I apply it now? (page 447)

① Draw and label the parallelogram. Draw the diagonals. Prove triangles AOB and DOC are congruent using AAS (combinations of alternate/vertically opposite angles, and opposite sides of a parallelogram are equal). Therefore lines AO and OC are equal and DO and OB are equal meaning O is at the centre of the lines and the lines bisect each other.

14.4 Proof using similar and congruent triangles

Learning exercise (pages 450–452)

① A, H congruent (ASA *or* SAS, with angles in a triangle)

B, F similar (corresponding sides in same ratio, corresponding angle equal)

C, J congruent (ASA)

D, E congruent (SAS)

G, K congruent (Pythagoras, RHS)

I, L similar (corresponding sides in same ratio, corresponding angle equal)

② In triangles FAB, BCD and DEF: FA = BC = DE (sides of regular hexagon); AB = CD = EF (sides of regular hexagon); ∠FAB = ∠BCD = ∠DEF (angles of regular hexagon). Therefore FAB, BCD and DEF are congruent (SAS). Hence FB = BD = DF (corresponding sides of congruent triangles). So BDF is equilateral.

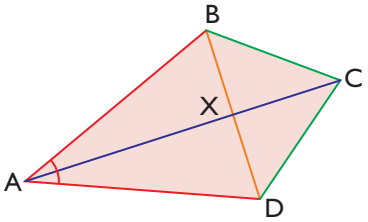
③ **a** a rectangle

b In triangles ABD and BCA: AD = BC (opposite sides of rectangle); ∠DAB = ∠CBA = 90° (angles of a rectangle); AB is common. Triangles ADB and BCA are congruent (RHS).

c Triangles ADB and BCA are therefore also congruent by RHS. AC = BD (corresponding sides of congruent triangles).

d A rectangle is a parallelogram with four right angles.

④ **a** In triangles ABC and ADC: AB = AD (equal sides of kite); BC = DC (equal sides of kite); AC is a common side to both triangles, so triangles ABC and ADC are congruent (SSS).



b In triangles ABX and ADX: AB = AD (equal sides of kite); ∠BAX = ∠DAX (corresponding angles of congruent triangles ABC and ADC); AX is a common side to both triangles, so triangles ABX and ADX are congruent (SAS).

c Triangles ABX and ADX are congruent (SAS), so BX = DX, meaning X is mid-point of BD.

d The longer diagonal of a kite bisects the shorter diagonal at right angles.

⑤ **a** In triangles ABC and DEC: ∠ACB = ∠DCE (vertically opposite); ∠ABC = ∠EDC (alternate). Therefore the triangles are similar (AA).

b 2

c $\frac{2}{3}$

⑥ In triangles AXY and ABC: ∠XAY = ∠BAC (common); ∠AXY = ∠ABC (corresponding angles on parallel lines). Triangles AXY and ABC are similar (AA), so $\frac{AY}{AC} = \frac{AX}{AB} = \frac{XY}{BC} = \frac{1}{2}$, so Y is the midpoint of AC and XY = $\frac{1}{2}$BC.

⑦ **a** DB = BC (given); BA = BE (sides of equilateral triangle); ∠DAB = ∠BEC = 90° (given). Triangles DAB and CEB are congruent (RHS).

b Since triangles DAB and CEB are congruent (RHS), ∠ABD = ∠BCE, so ∠ABD + ∠ABE = ∠DBE = ∠CBE + ∠ABE = ∠CBA, hence result.

c Yes, providing AB = BE.

⑧ **a** ∠BAC = ∠GFC (alternate angles), ∠ACB = ∠FCG (opposite angles), so the triangles are similar (AA).

b 5 : 3

⑨ **a** ∠OBP = ∠DBA; ∠OPB = ∠DAB (corresponding angles). Triangles are similar (AA).

b Any of: BQO and BCD, APO and ABC, CQO and CBA

c OB = $\frac{1}{2}$DB (AC bisects DB at O) and triangles OPB and DAB are similar, so PB = $\frac{1}{2}$AB (or P is the midpoint of AB).

d PB = $\frac{1}{2}$AB and triangles PBQ and ABC are similar, so PQ = $\frac{1}{2}$AC.

⑩ **a** SQ = SR (given); ∠SUQ = 90° (alternate angles); ∠SUR = 90° (angles on a straight line); SU is common. Therefore triangles are congruent (RHS).

b 2 : 1

c ∠TUR = 90° (corresponding angles); ∠TRU = ∠PRQ (shared angle). TUR and PQR are similar (AA).

d PQR and TUR are similar and QR = 2UR as above, so all sides are in the ratio 2 : 1. Therefore PQ = 2TU.

➤ Do I know it now? (page 452)

① **a** In triangles ABX, CDX: AX = XC (AC is bisected at X); BX = XD (BD is bisected at X); ∠AXB = ∠CXD (vertically opposite angles). Triangles ABX and CDX are congruent (SAS). AB = CD (corresponding sides of congruent triangles); ∠BAX = ∠DCX (corresponding angles of congruent triangles).

b ABCD is a parallelogram. ∠BAX = ∠DCX as above, so AB is parallel to CD (alternate angles equal); ∠DAX = ∠BCX (corresponding angles of congruent triangles) therefore AD is parallel to BC (alternate angles equal). Two pairs of parallel sides means parallelogram.

Chapter 15 Measuring shapes

15.3 Arcs and sectors

➤ Learning exercise (pages 455–458)

① **a** 7.8 cm **b** 18.8 cm
c 19.2 cm **d** 33.0 cm

② **a** 942.5 cm^2 **b** 42.4 cm^2
c 91.4 cm^2 **d** 149.0 cm^2

③ **a** **i** 2.6 cm **ii** 9.8 cm^2
b **i** 11.0 cm **ii** 23.1 cm^2
c **i** 1.1 m **ii** 0.6 m^2
d **i** 2.4 mm **ii** 3.5 mm^2

④ **a** 251° **b** 60° **c** 70°

⑤ **a** 9.6 m **b** 5.8 m^2

⑥ small arcs are each $\frac{60}{360} \times 12\pi = 2\pi$; large arc is $\frac{60}{360} \times 18\pi = 3\pi$; total perimeter $= 2 \times 2\pi + 3\pi + 18 = 7\pi + 18$ cm

⑦ 7.5 cm

⑧ 9.234π cm^2

⑨ 112.5°

⑩ 234.4 cm^2

⑪ 114.6°

➤ Problem solving exercise (page 458)

① **a** 22.85 m **b** 18.85 m^2

② 114.6

➤ Do I know it now? (page 459)

① **a** 6.6 cm **b** 13.2 cm
c 19.8 cm **d** 4.4 cm

②

a	**b**
i 12.19 cm	**i** 8.38 cm^2
ii 26.85 cm	**ii** 37.70 cm^2
iii 14.28 cm	**iii** 3.43 cm^2
iv 28.57 cm	**iv** 6.87 cm^2

③ perimeter 13.33 πm; area 533.33 πm^2

➤ Can I apply it now? (page 459)

① **a** 52.6 m
b Yes, the volume enclosed is 100.5 m^3.

Chapter 17 Transformations

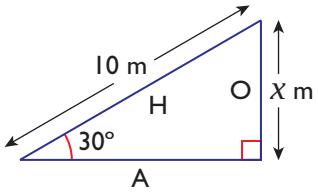
17.2 Trigonometry

➤ Learning exercise (pages 462–464)

① **a** **i** a **ii** b **iii** c
b **i** h **ii** i **iii** g

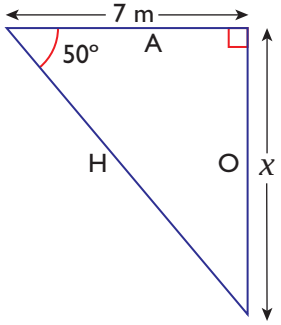
② **a** $\frac{5}{12}$ **b** $\frac{12}{13}$ **c** $\frac{5}{13}$

③ **a** **i** and **ii**



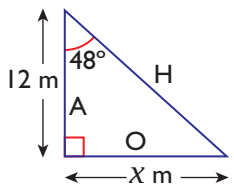
iii $\sin 30° = \frac{x}{10}$ **iv** $x = 5\,\text{m}$

b **i** and **ii**



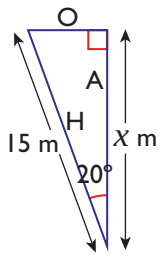
iii $\tan 50° = \frac{x}{7}$ **iv** $x = 8.3\,\text{m}$

c **i** and **ii**



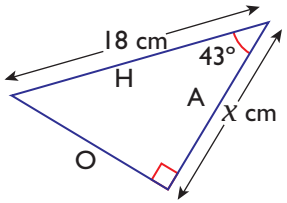
iii $\tan 48° = \frac{x}{12}$ **iv** $x = 13.3\,\text{m}$

d **i** and **ii**



iii $\cos 20° = \frac{x}{15}$ **iv** $x = 14.1\,\text{m}$

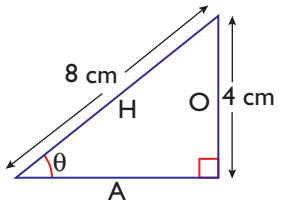
e **i** and **ii**



iii $\cos 43° = \frac{x}{18}$ **iv** $x = 13.2\,\text{cm}$

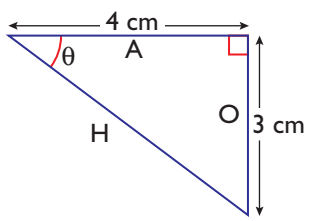
④ **a** 30° **b** 45° **c** 60°
d 40° **e** 72° **f** 82°
g 53° **h** 48° **i** 61°

⑤ **a** **i** and **ii**



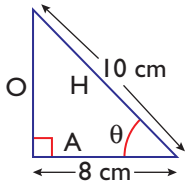
iii $\sin\theta = \frac{4}{8}$ **iv** $\theta = 30°$

b **i** and **ii**



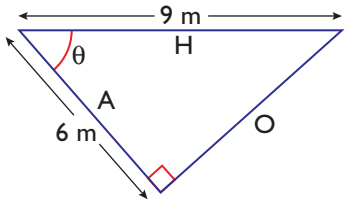
iii $\tan\theta = \frac{3}{4}$ **iv** $\theta = 36.9°$

c **i** and **ii**



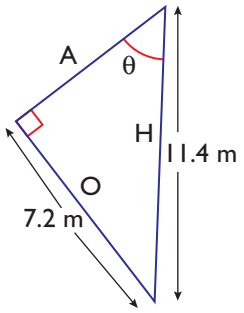
iii $\cos\theta = \frac{8}{10}$ **iv** $\theta = 36.9°$

d **i** and **ii**



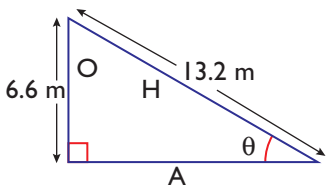
iii $\cos\theta = \frac{6}{9}$ **iv** $\theta = 48.2°$

e **i** and **ii**



iii $\sin\theta = \frac{7.2}{11.4}$ **iv** $\theta = 39.2°$

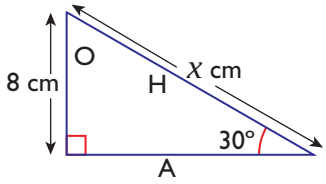
f **i** and **ii**



iii $\sin\theta = \frac{6.6}{13.2}$ **iv** $\theta = 30°$

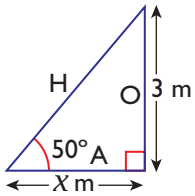
v triangles b and c

⑥ **a** **i** and **ii**



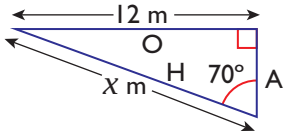
iii $\sin 30° = \frac{8}{x}$ **iv** $x = 16.0\,\text{cm}$

b **i** and **ii**



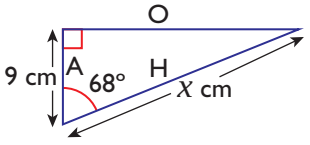
iii $\tan 50° = \frac{3}{x}$ **iv** $x = 2.5\,\text{m}$

c **i** and **ii**



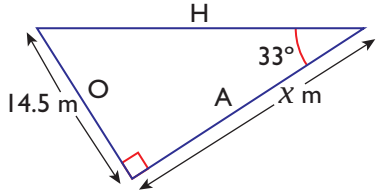
iii $\sin 70° = \frac{12}{x}$ **iv** $x = 12.8\,\text{m}$

d **i** and **ii**



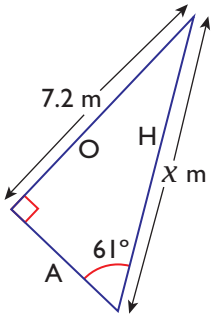
iii $\cos 68° = \frac{9}{x}$ **iv** $x = 24.0\,\text{cm}$

e **i** and **ii**



iii $\tan 33° = \frac{14.5}{x}$ **iv** $x = 22.3\,\text{m}$

f **i** and **ii**



iii $\sin 61° = \frac{7.2}{x}$ **iv** $x = 8.2\,\text{m}$

⑦ **a** 11.0 m (1 dp)

b 44.0 m^2 (1 dp)

c 31.4 m (1 dp)

⑧ perimeter 53.3 m (1 dp), area 109.8 m^2 (1 dp)

⑨ 27.3 m (including the diagonal)

⑩ 15.5 m (1 dp)

⑪ 158.5 m (1 dp)

⑫ **a** **i** 71.1° **ii** 12 cm

b 12 cm by $x^2 + 35^2 = 37^2$

c yes

⑬ 2800.3 m

➤ Problem solving exercise (page 465)

① 0.350 m

② **a** 19.8 m **b** 20.2 m

➤ Do I know it now? (pages 465–466)

① **a** **i** hypotenuse 8 cm, opposite x, adjacent unlabelled

ii sin, $x = 4\,\text{cm}$

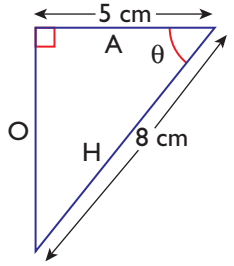
b **i** hypotenuse unlabelled, opposite x, adjacent 9 cm

ii tan, $x = 19.3\,\text{cm}$

c **i** hypotenuse 20 m, opposite unlabelled, adjacent x

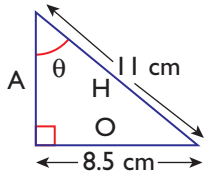
ii cos, $x = 12.3\,\text{m}$

② **a** **i** and **ii**



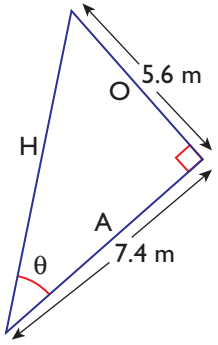
iii $\cos\theta = \frac{5}{8}$ **iv** $\theta = 51.3°$

b **i** and **ii**



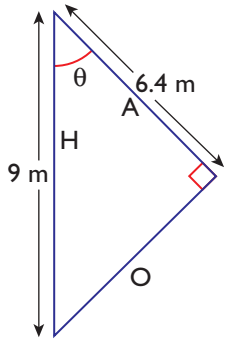
iii $\sin\theta = \frac{8.5}{11}$ **iv** $\theta = 50.6°$

c **i** and **ii**



iii $\tan\theta = \frac{5.6}{7.4}$ **iv** $\theta = 37.1°$

d **i** and **ii**



iii $\cos\theta = \frac{6.4}{9}$ **iv** $\theta = 44.7°$

③ **a** 5.5 cm **b** 10.4 m **c** 7.8 m

④ **a** 10.3 cm **b** 10.6 m **c** 8.3 m

➤ Can I apply it now? (page 466)

① 8.77 m

17.3 Trigonometry for special angles

➤ Learning exercise (pages 468–469)

① **a** 6 cm **b** $6\sqrt{3}$ cm

② **a** 10 cm **b** $10\sqrt{3}$ cm

③ **a** $7\sqrt{2}$ cm **b** $7\sqrt{2}$ cm **c** 49 cm^2

④ **a** 7 cm **b** 14 cm

⑤ **a** $5\sqrt{3}$ cm **b** 15 cm

⑥ $13\sqrt{2}$ cm

⑦ $64\sqrt{3}$ cm^2

⑧ $\frac{17\sqrt{6}}{2}$ cm

➤ Do I know it now? (page 469)

① **a** AB = $6\sqrt{2}$ cm, BC = $6\sqrt{2}$ cm

b 36 cm^2 **c** $2\sqrt{6}$ cm

d $6\sqrt{12}$ cm^2 **e** $6(\sqrt{12} + 6)$ cm^2

17.4 Finding centres of rotation

➤ Learning exercise (pages 471–474)

① **a** When triangle A is rotated **90°** clockwise about (**2**, **7**), it moves to position B.

b When triangle B is rotated 90° **anticlockwise** about (4, 8), it moves to position **C**.

c When triangle C is rotated 90° **anticlockwise** about (**7**, **7**), it moves to position E.

d When triangle **E** is rotated 90° clockwise about (9, 5), it moves to position **D**.

② **a** (1, 4), 90° clockwise

b (−0.5, 5), 180° **c** (−3, 2.5), 180°

d (1.5, 2), 180° **e** (4, −1), 180°

f (−0.5, −3.5), 180° **g** (1.5, 0.5), 90° clockwise

③ **a** **i** (0, 2) **ii** (−1, 1) **iii** (−2, 0)

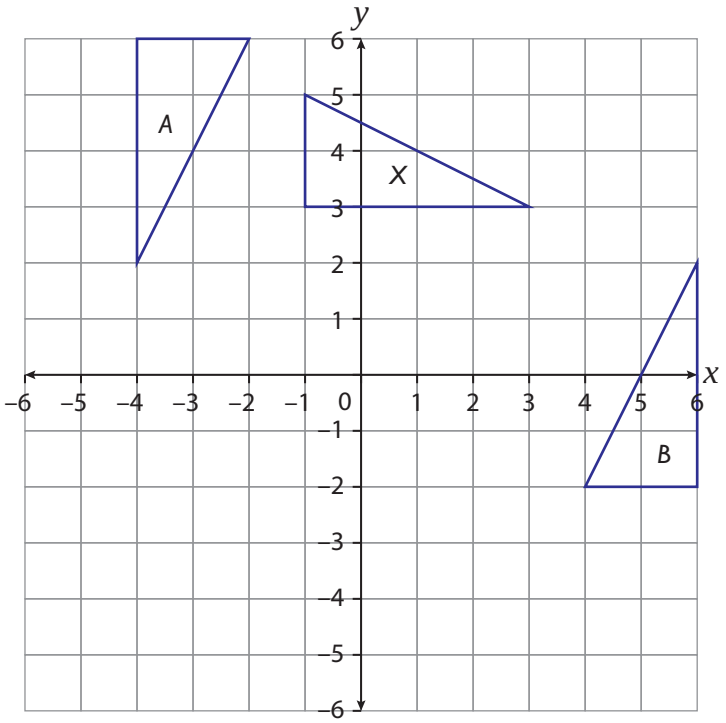
b They lie on a straight line.

④ **a** Q **b** T **c** P **d** S **e** R

⑤ **a** 90° clockwise rotation about (−3, 4)

b 90° anticlockwise rotation about (−3, 4)

⑥ **a b**



c 180° rotation about (1, 2)

⑦ **a** 90° clockwise about (4, 6)

b 180° about (5, 7)

c 90° anticlockwise about (7, 5)

d 180° about (4, 5)

⑧ **a** **i** translation $\begin{pmatrix} 7 \\ -8 \end{pmatrix}$

ii rotation 180° about (3.5, −4)

iii reflection in the y axis

iv reflection in x axis

v rotation 90° clockwise about (0, 3)

vi 90° clockwise about (−3, 0)

vii rotation 180° about (3.5, −4)

viii translation $\begin{pmatrix} -7 \\ 8 \end{pmatrix}$

b B and D

➤ Do I know it now? (pages 474–475)

① **a** 90° clockwise about (−1, −1)

b 90° anticlockwise about (−1, −1)

c 90° clockwise about (4, 2)

d 180° about (3, −2)

② **a** a rotation of 90° anticlockwise about the origin

b a rotation of 90° anticlockwise about (−2, 4)

c a rotation of 180° about (1, 3)

Chapter 18 Three-dimensional shapes

18.3 Surface area and volume of 3-D shapes

➤ Learning exercise (pages 477–478)

① 605 cm^3

② **a** 1018 cm^3 **b** 679 cm^2

③ **a** 8181 cm^3 **b** 1963 cm^2

④ 7 cm

⑤ **a** 348π cm^3 **b** 180π cm^2

⑥ **a** 1847 cm^2 **b** 5747 cm^3

⑦ 14 cm

⑧ **a** 435.6π cm^2 **b** 1064.8π cm^3

⑨ **a** 405π cm^3 **b** $189\pi + 108$ cm^2

➤ Problem solving exercise (pages 478–479)

① 1830π cm^3

② 763 m^3

③ **a** 47 909 cm^3 **b** 6912 cm^2

➤ Do I know it now? (page 479)

① **a** 4712 cm^3

b 1885 cm^2

➤ Can I apply it now? (page 479)

① 1511 cm^2

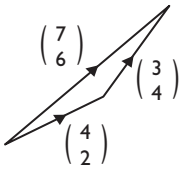
Chapter 19 Vectors

19.1 Vectors

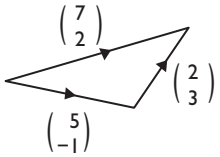
Learning exercise (pages 483–484)

① **a** **vi** **b** **ii** **c** **viii** **d** **iii**
e **vii** **f** **i** **g** **v** **h** **iv**

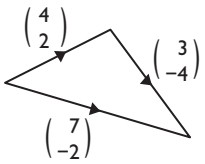
② **a**



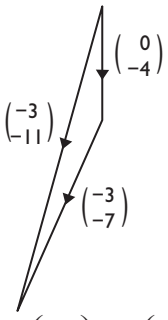
b



c



d



Vector additions: **a** $\begin{pmatrix}7\\6\end{pmatrix}$, **b** $\begin{pmatrix}7\\2\end{pmatrix}$, **c** $\begin{pmatrix}7\\-2\end{pmatrix}$, **d** $\begin{pmatrix}-3\\-11\end{pmatrix}$

③ **a** $\begin{pmatrix}1\\2\end{pmatrix}$ **b** $\begin{pmatrix}1\\-4\end{pmatrix}$
c $\begin{pmatrix}3\\-8\end{pmatrix}$ **d** $\begin{pmatrix}3\\2\end{pmatrix}$

④ **a** $\begin{pmatrix}6\\9\end{pmatrix}$ **b** $\begin{pmatrix}12\\-4\end{pmatrix}$
c $\begin{pmatrix}2\\-9\end{pmatrix}$ **d** $\begin{pmatrix}-8\\9\end{pmatrix}$

⑤ **a** **g**
b **c** and **f**
c **h**

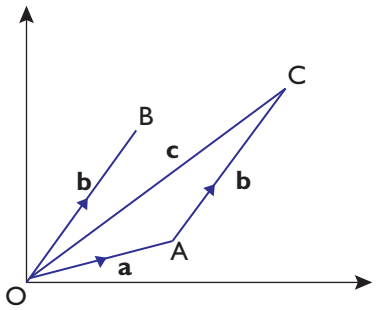
⑥ **a** **i** $\begin{pmatrix}4\\6\end{pmatrix}$ **ii** $\begin{pmatrix}3\\8\end{pmatrix}$ **iii** $\begin{pmatrix}7\\1\end{pmatrix}$
iv $\begin{pmatrix}6\\-5\end{pmatrix}$ **v** $\begin{pmatrix}18\\1\end{pmatrix}$ **vi** $\begin{pmatrix}2\\11\end{pmatrix}$

b $3\mathbf{a}-\mathbf{b}=3\begin{pmatrix}2\\3\end{pmatrix}-\begin{pmatrix}4\\-1\end{pmatrix}=\begin{pmatrix}6\\9\end{pmatrix}-\begin{pmatrix}4\\-1\end{pmatrix}=$
$\begin{pmatrix}2\\10\end{pmatrix}=2\begin{pmatrix}1\\5\end{pmatrix}=2\mathbf{c}$

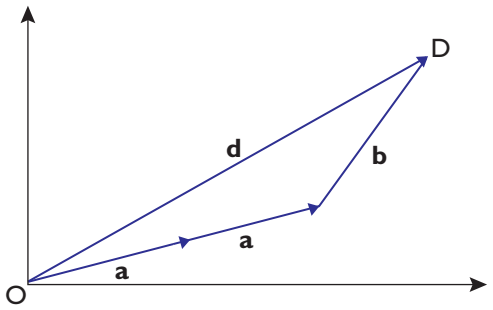
⑦ $\begin{pmatrix}-3\\2\end{pmatrix}$

⑧ **a** $a=-1, b=-8$
b $c=1, d=-5$
c $e=2, f=3$
d $g=-2, h=-3$

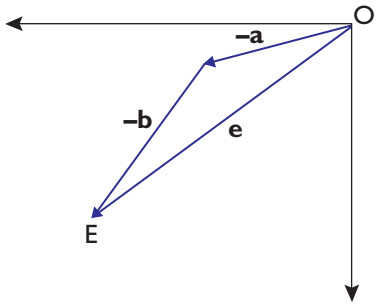
⑨ **i**



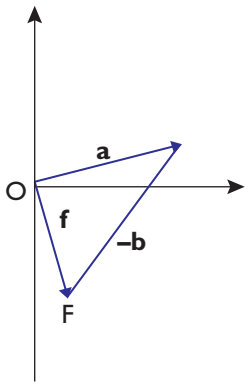
ii



iii



iv



⑩ **a** $\mathbf{p}+\mathbf{q}=\begin{pmatrix}2\\0\end{pmatrix}$, $\mathbf{p}-\mathbf{q}=\begin{pmatrix}0\\2\end{pmatrix}$

b **i** $3\mathbf{p}+3\mathbf{q}$

ii $3.5\mathbf{p}-0.5\mathbf{q}$

iii $-3.5\mathbf{p}+0.5\mathbf{q}$

⑪ **a** **i** $\mathbf{p}-2\mathbf{q}$; $2\mathbf{p}-4\mathbf{q}$; $3\mathbf{p}-6\mathbf{q}$, etc.

ii $2\mathbf{p}+\mathbf{q}$; $4\mathbf{p}+2\mathbf{q}$; $6\mathbf{p}+3\mathbf{q}$, etc.

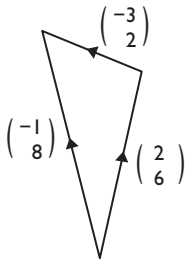
b $11\mathbf{p}-2\mathbf{q}$

⑫ **a** $\mathbf{p}+\mathbf{q}=\begin{pmatrix}3\\0\end{pmatrix}$, $2\mathbf{q}-\mathbf{p}=\begin{pmatrix}0\\3\end{pmatrix}$

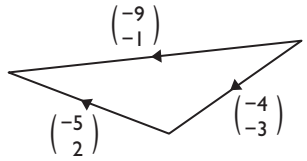
b $n=-1$, $m=5\left(5\mathbf{q}-\mathbf{p}=\begin{pmatrix}3\\6\end{pmatrix}\right)$

➤ Do I know it now? (page 485)

① **a**



b



Vector additions: **a** $\begin{pmatrix}-1\\8\end{pmatrix}$, **b** $\begin{pmatrix}-9\\-1\end{pmatrix}$

② **a** $\begin{pmatrix}-2\\6\end{pmatrix}$ **b** $\begin{pmatrix}0\\-5\end{pmatrix}$

c $\begin{pmatrix}-6\\8\end{pmatrix}$ **d** $\begin{pmatrix}-6\\5\end{pmatrix}$

NEXT STEPS – STATISTICS AND PROBABILITY

Chapter 22 Probability

22.2 Estimating probability

➤ Learning exercise (pages 488–491)

① **a** $\frac{216}{591}=\frac{72}{197}$

b 315 *Daily Posts*, 142 *Gazettes*, 365 *The News*, 178 *The Tribune*

② **a** **i** $\frac{67}{385}$ **ii** $\frac{215}{385}=\frac{43}{77}$ **iii** $\frac{103}{385}$

b Yes, the probability of the fault being to do with the power supply is over half.

c 870 motherboards, 2792 power supplies and 1338 hard drives

③ **a**

Number of throws	20	50	100	400	1000	2000	5000
Number of heads	12	27	46	211	486	982	2516
Relative frequency	0.6	0.54	0.46	0.5275	0.486	0.491	0.5032

b Yes, because the larger the sample, the closer the relative frequency gets to 0.5, the probability expected from an unbiased coin.

④ **a** Lorry ≈ 0.35; Van ≈ 0.055; Bus ≈ 0.024; Car ≈ 0.57

b 5

c It may be accurate due to the large sample size used to estimate the probabilities. However, the sample data came from just one junction rather than from across the whole city so it might be misrepresentative of the rest of the city.

⑤ **a** **i** $\frac{12}{40}=\frac{3}{10}$ **ii** $\frac{18}{40}=\frac{9}{20}$

iii $\frac{10}{40}=\frac{1}{4}$

b **i** 4 red, 5 blue and 3 green

ii She can make it more reliable by picking out more balls (increasing her sample size).

⑥ **a** **i** $\frac{1}{2}$ **ii** $\frac{14}{20}$ **iii** $\frac{6}{20}$

b The probability that a moth is dark is much higher at site A. At site A a moth is more likely to be dark; at site B a moth is more likely to be light.

⑦ **a** None of them: Sara is probably the closest, but if it's a fair die you would expect to roll a six one time in six rather than one time in three.

b **i** We can't tell for definite from only 20 throws since the sample size is too small.

ii Less likely; 15 times in 120 is closer to 1 in 6.

iii Throwing more times to increase his sample size

⑧ **a** **i** $\frac{3}{35}$ **ii** $\frac{4}{30} = \frac{2}{15}$ **iii** $\frac{6}{58} = \frac{3}{29}$

b **i** Katie's

ii It's a sentence that uses every letter in the alphabet.

c Take the average over more sentences.

d **i** 12

ii There are 12 Es in a standard *Scrabble* set.

⑨ **a** **i** $\frac{240}{275} = \frac{48}{55}$ **ii** $\frac{9}{275}$ **iii** $\frac{259}{275}$

b 545

⑩ **a**

Lands on	1	2	3	4
Relative frequency	0.3	0.35	0.15	0.2

b The one with 100 throws because it is the larger sample size.

c 300

⑪ **a** **i** 60 **b** 90 **c** 0.6

ii 38

⑫ For every 8 tickets they sell, they make £1.60 but are likely to lose £1.00 of that, meaning every 8 tickets makes on average £0.60. So to make £120, they would need to sell 1600 tickets.

➤ Do I know it now? (page 492)

① **a** **i** 0.1 **ii** 0.075 **iii** 0.025

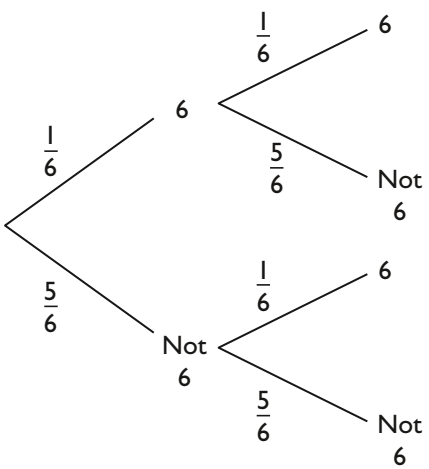
b 3

c It probably won't be that accurate because it is a larger sample in a different surgery, with unknown variables affecting its results.

22.3 The multiplication rule

➤ Learning exercise (pages 495–497)

① **a**



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

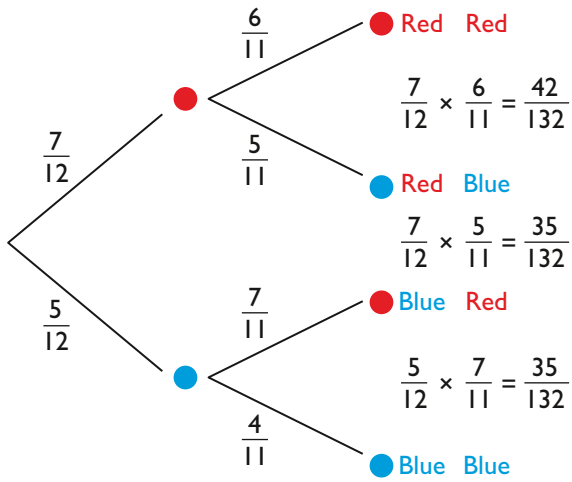
iii $\frac{11}{36}$ **iv** $\frac{10}{36} = \frac{5}{18}$

② **a** $\frac{4}{52} = \frac{1}{13}$ **b** $\frac{4}{51}$

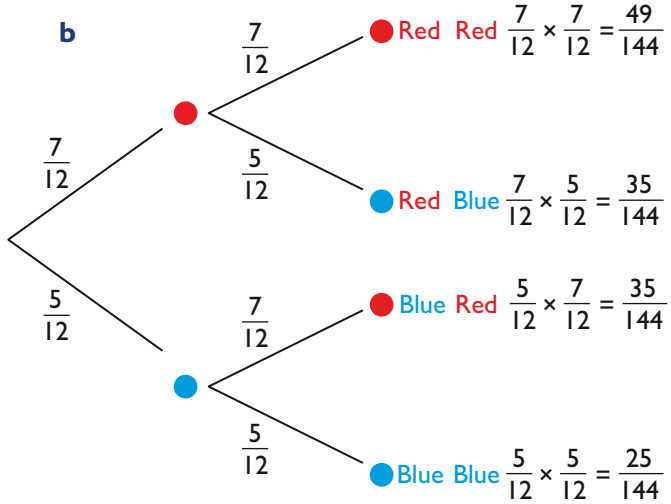
c $\frac{4}{50} = \frac{2}{25}$ **d** $\frac{3}{49}$

③ **a** $\frac{1}{12}$ **b** $\frac{5}{12}$ **c** $\frac{1}{12}$ **d** $\frac{5}{12}$

④ **a**



b

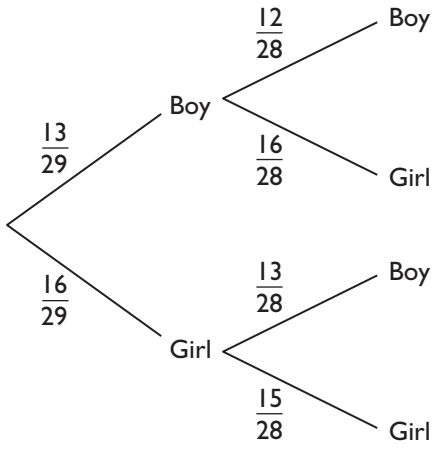


⑤ **a** $\frac{4}{9}$

b There are 3 red and 5 yellow counters left in the bag.

c **i** $\frac{3}{8}$ **ii** $\frac{2}{7}$ **iii** $\frac{5}{7}$

⑥ **a**



b **i** $\frac{240}{812}$ **ii** $\frac{156}{812}$

iii $\frac{572}{812}$ **iv** $\frac{416}{812}$

⑦ **a** independent **b** independent

c dependent

⑧ **a** **i** $\frac{1}{8}$ **ii** $\frac{1}{6}$

b **i** $\frac{1}{8}$ **ii** $\frac{1}{6}$

c $\frac{1}{8}$ **d** independent

➤ Problem solving exercise (pages 497–499)

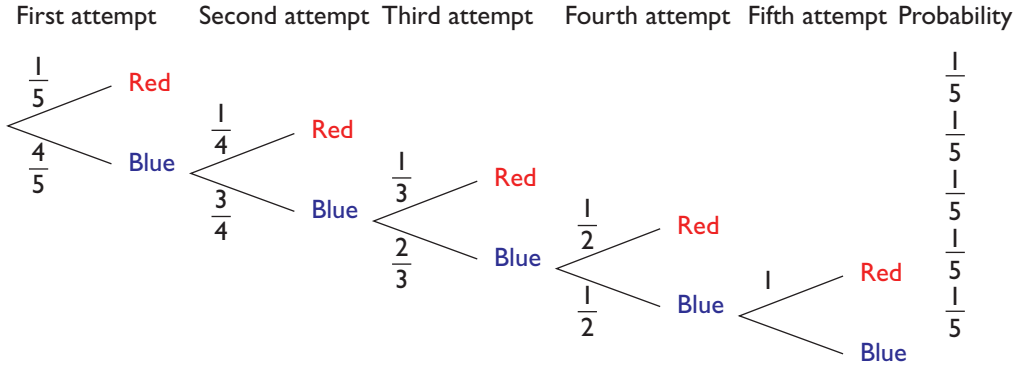
① **a** $1 - 0.05 = 0.95$

b $1 - 0.4 = 0.6$

c $0.4 \times 0.05 = 0.02$

d $1 - (0.95 \times 0.6) = 0.43$

⑦ **a**



b **i** Each of the outcomes is equally likely; probability $= \frac{1}{5}$.

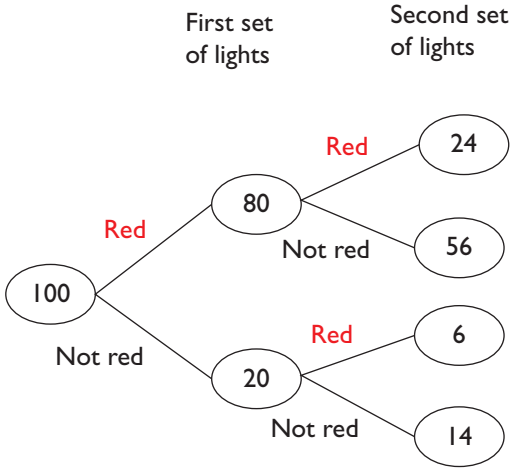
ii There are no other options in outcomes since they add to 1.

② It is not impossible (each time James tossed the coin it had a $\frac{1}{2}$ chance of landing on heads), but very unlikely in practice, with an unbiased coin.

③ **a** $\frac{4}{15}$ **b** $\frac{2}{15}$ **c** $\frac{1}{3}$

④ **a** $\frac{1}{182}$ $\left(\frac{1}{14} \times \frac{1}{13}\right)$ **b** $\frac{1}{48}$

⑤ **a**



b Yes, 6 is what you would expect from $0.8 \times 0.3 \times 25$, so this suggests that the lights are indeed independent events.

c 15 or 16 times

⑥ **a** $\frac{7}{15}$

b 7, assuming he doesn't put the socks back into the drawer. If he pulled out 6 blue socks in a row, then all the socks remaining are red.

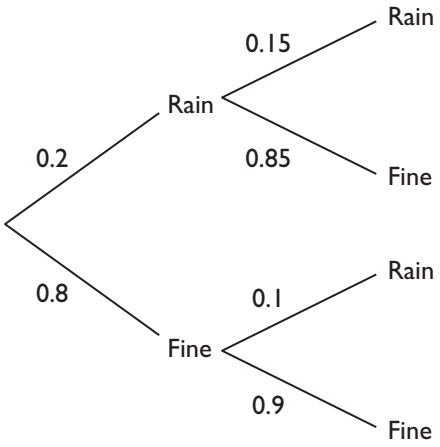
c **i** Instead of the probabilities changing as counters are removed they will stay the same at $\frac{1}{5}$ for a red and $\frac{4}{5}$ for a blue.

ii 0.67 [1 – P (all 5 blue) $= 1 - \left(\frac{4}{5}\right)^5$]

Do I know it now? (page 499)

① **a** $\frac{2}{21}$ **b** $\frac{9}{21}$ **c** $\frac{10}{21}$ **d** $\frac{19}{21}$

② **a**



b $1 - (0.2 \times 0.15) = 0.97$

Can I apply it now? (page 499)

① **a** $\frac{31}{220}$ or 0.14

b Yes; It is expected that Naela's train will be late 30% of the time when it's raining, but it might not have been late at all!

22.4 The addition rule

Learning exercise (pages 502–504)

① **a** $\frac{3}{15}$ **b** $\frac{2}{15}$ **c** $\frac{1}{3}$

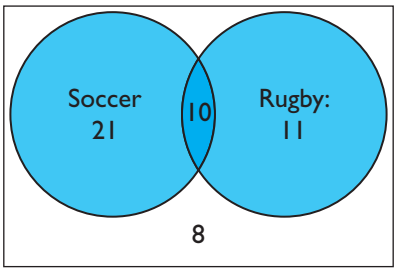
② **a** $\frac{1}{60}$ **b** $\frac{7}{300}$ **c** $\frac{1}{25}$

③ **a** $\frac{57}{600} = \frac{19}{200}$ **b** $\frac{72}{600} = \frac{3}{25}$

c $\frac{129}{600} = \frac{43}{200}$ **d** $1 - \frac{43}{200} = \frac{157}{200}$

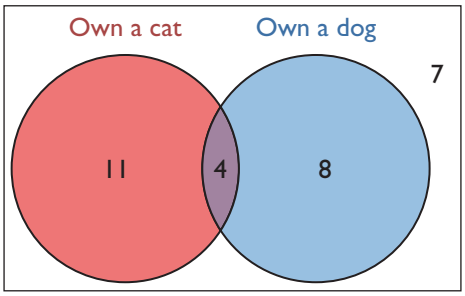
④ **a** $\frac{1}{3}$ **b** $\frac{1}{3}$ **c** $\frac{2}{3}$

⑤ **a**



b $\frac{11}{50}$

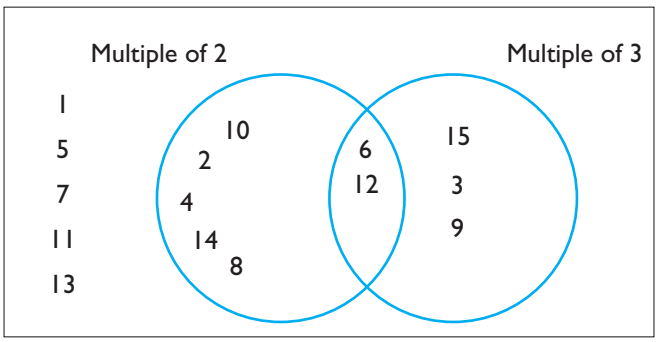
⑥ **a**



b **i** $\frac{12}{30} = \frac{2}{5}$ **ii** $\frac{4}{30} = \frac{2}{15}$

iii $\frac{23}{30}$ **iv** $\frac{7}{30}$

⑦ **a**



b **i** $\frac{7}{15}$ **ii** $\frac{1}{3}$ **iii** $\frac{2}{15}$

iv $\frac{2}{3}$ **v** $\frac{1}{3}$

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

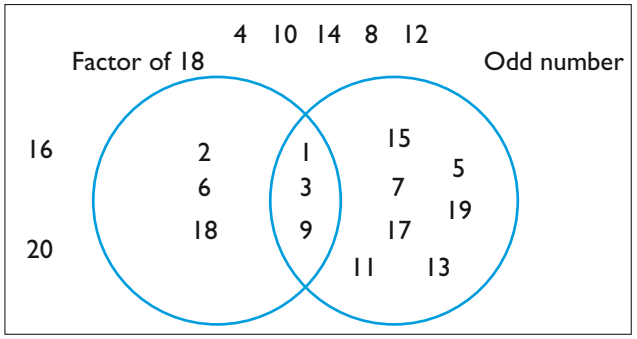
d $\frac{8}{52} = \frac{2}{13}$ **e** $\frac{44}{52} = \frac{11}{13}$

⑨ **a** wears glasses total 7, does not wear glasses total 22

b **i** $\frac{12}{29}$ **ii** $\frac{15}{29}$ **iii** $\frac{13}{29}$

iv $\frac{10}{29}$ **v** 0

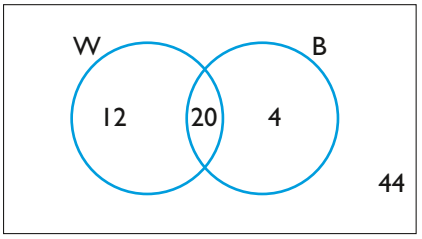
⑩ **a**



b **i** $\frac{1}{2}$ **ii** $\frac{6}{20} = \frac{3}{10}$ **iii** $\frac{3}{20}$

iv $\frac{13}{20}$ **v** $\frac{7}{20}$

⑪ **a**



b **i** $\frac{20}{80} = \frac{1}{4}$

ii because it is based on a sample and not on all the dogs of the breed

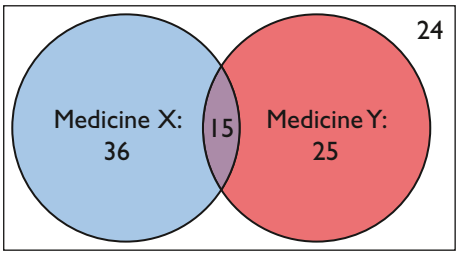
c **i** P(W or B) = P(W) + P(B) − P(W and B) =

$\frac{32}{80} + \frac{24}{80} - \frac{20}{80} = \frac{36}{80} = \frac{9}{20}$

ii $\frac{36}{80} = \frac{9}{20}$ (12 + 20 + 4 = 36)

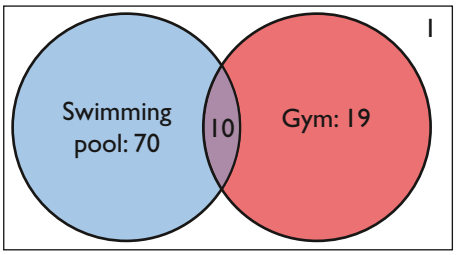
➤ Problem solving exercise (pages 504–505)

① **a**



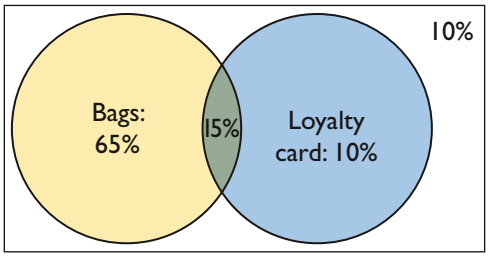
b P(neither medicine) = $\frac{24}{100}$

② **a**



b $\frac{29}{100}$ **c** $\frac{89}{100}$

③ **a**

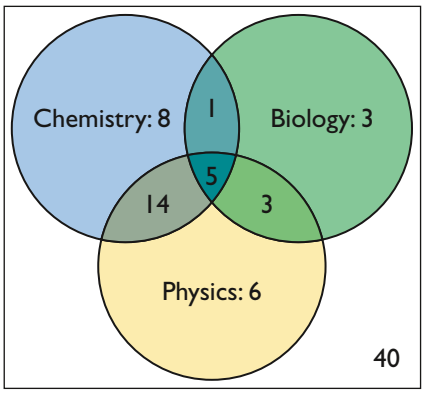


b **i** 0.1 **ii** 0.65

iii 0.9 **iv** 0.1

④ **a** $\frac{5}{12}$ **b** $\frac{3}{4}$

⑤ **a b**



c $\frac{23}{80}$

d Neither; this is 40 students in each case, so both are equally likely.

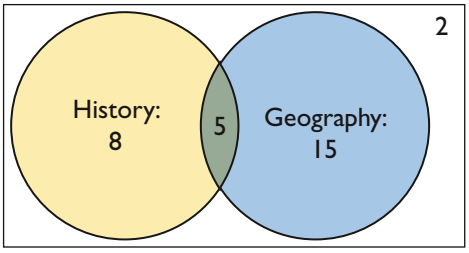
➤ Do I know it now? (page 505)

① **a** **i** $\frac{1}{2}$ **ii** $\frac{1}{2}$ **iii** $\frac{5}{6}$

b The events 'even' and '3 or less' are not mutually exclusive as '2' is both even and less than 3.

➤ Can I apply it now? (page 505)

① **a**



b $\frac{23}{30}$

Next Steps Test Paper 1

➤ (pages 506–508)

① **a** $-8 \times -4 = 32$ [1]

b 104 $(32 - -72)$ [2]

② *Pie chart showing A* 54°, A 135°, B 108°, C 45° and D 18°* [3]

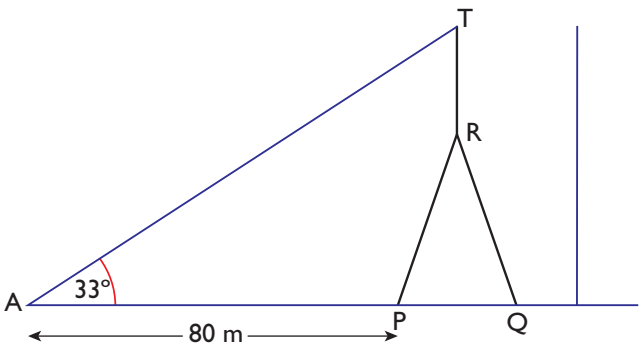
③ 5 [$5(n + 10) = 80 - n$; $5n + 50 = 80 - n$; $6n = 30$] [3]

④ 24 kg ($30 \times 5 = 150$; $29 \times 6 = 174$; $174 - 150$) [2]

⑤ 28° (180° − 96° = 84°; 84° ÷ 2 = 42°; 42° ÷ 3 = 14°; 2 × 14°) [3]

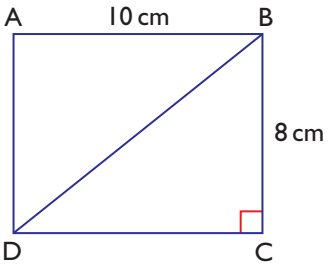
⑥ 20 cm (area = $\frac{x+2}{2} \times 4 = (x + 2) \times 2 =$ $2x + 4 = 20$; $x = 8$; sides 8 cm, 5 cm, 2 cm and 5 cm) [4]

⑦ 62 m



[3]

⑧ ∠DBC = 51.3° (BC = $(36 - 2 \times 10) \div 2 =$ 8 cm; $\tan DBC = \frac{10}{8} = 1.25$, $\angle DBC = \tan^{-1} 1.25$)



[4]

⑨ $\frac{8}{45}$ [3]

⑩ 12 melons (@ 90p each) and 4 pineapples [3]

⑪ area $= (x + 5)(x - 5) = x^2 + 5x - 5x - 25 = x^2 - 25$ [2]

⑫ $\frac{4(10x+15)}{4} - \frac{5(8x+12)}{5} = 10x + 15 - (8x + 12) = 2x + 3$ [3]

⑬ **a** 2 732 000 [3] **b** 2002 [3]

⑭ **a** $B = £27.20 \left(\frac{(8 \times 80 + 2 \times 40)}{100} + 20 = 7.20 + 20\right)$ [2]

b $t = 110 \left(27 = \frac{8 \times 60 + 2t}{100} + 20; 27 - 20 = \frac{480 + 2t}{100}; 700 - 480 = 2t; 2t = 220\right)$ [3]

⑮ **a** $n = 7$ [1] **b** $n = 6$ [1] **c** $n = 6$ [1]

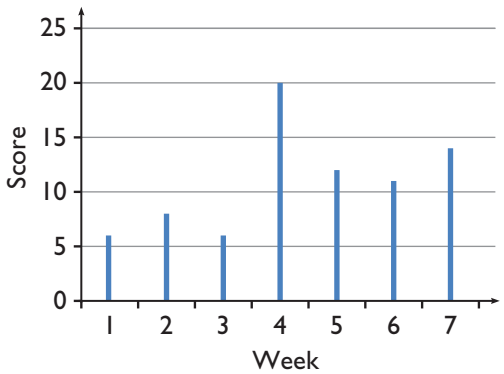
Next Steps Test Paper 2

➤ (pages 509–511)

① **a** Anwar did not work out 4 × 2 first; the correct answer is 5. [2]

b Bronwin did not square the 2 first; the correct answer is 19. [2]

② **a**



[3]

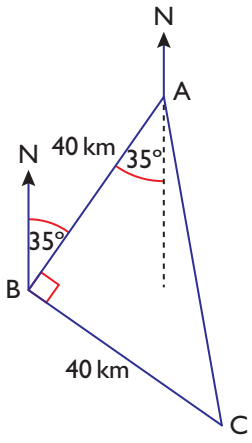
b Sandra may have revised really well for the test. Sandra might have found that week's topic really easy. [1]

c No, the difficulty of tests and the topics will vary so there is no clear trend. [1]

③ 600 cm^2 (area of octagon $= 4 \times \frac{5 \times 5}{2} + 4 \times 5 \times 10 + 10 \times 10 = 350$ cm^2; number of octagons $= \frac{60}{20} \times \frac{80}{20} = 12$; total area of octagons $= 12 \times 350 = 4200$ cm^2; area of card left over $= 60 \times 80 - 4200$) [4]

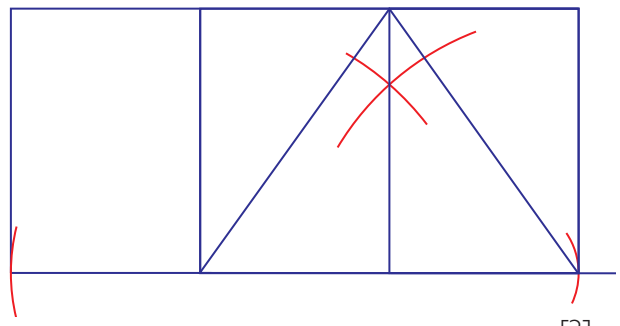
④ **a** $180° + 35° = 215°$ [1]

b 170° ($\angle$CBA $= 125° - 35° = 90°$; triangle CBA is isosceles so $\angle$BAC $= 45°$; bearing $= 180° - (45° - 35°)$)



[3]

⑤

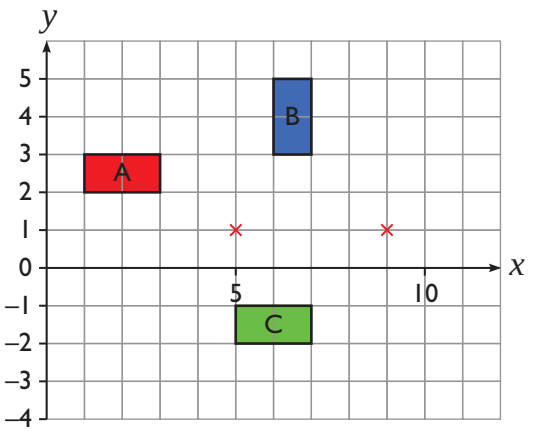


[3]

⑥ 2 or 6 [$(x - 4)^2 = 4$; $x^2 - 8x + 16 = 4$; $x^2 - 8x + 12 = 0$] [3]

⑦ *hexagon of side 4 cm and angles 135°, 90°, 135°, 135°, 90°, 135°* [3]

⑧ Translation by $\begin{pmatrix} 4 \\ -4 \end{pmatrix}$



[4]

⑨ $180° - 40° = 140°$; $140° \div 2 = 70°$. If Sam is correct then exterior angle is 70°, but $360° \div 70° = 5\frac{1}{7}$ which is impossible as the number of sides must be a whole number. So Sam is wrong. [3]

⑩ motorcycle (54 km/h) and sports car (50.4 km/h) 50 km/h = 13.9 m/s [3]

⑪ 26.3p [4]

⑫ 162 km/h ($v = u + at$; $v = 25 + 2.5 \times 8$; $v = 45$ m/s; $v = 45 \times 3600 = 162\,000$ m/h; $v = 162\,000 \div 1000$) [3]

⑬ $\frac{5}{9}$ [3]

⑭ Area of large square is $(4x - 3 + x + 5)^2 = (5x + 2)^2 = 25x^2 + 20x + 4$

Area of 4 triangles is $4 \times \frac{1}{2}(4x - 3)(x + 5) = 2(4x^2 + 17x - 15) = 8x^2 + 34x - 30$

Area of shaded square is $25x^2 + 20x + 4 - (8x^2 + 34x - 30) = 17x^2 - 14x + 34$. Correct result. [4]

Next Steps Test Paper 3

➤ (pages 512–514)

① £1.60 [3]

② approximately (3×10^7) km^2 [3]

③ **a** less, 27.78% [2] **b** the new size [1]

④ **a** $33\frac{1}{3}$ seconds $\left(\frac{1}{108} \times 3600\right)$ [2]

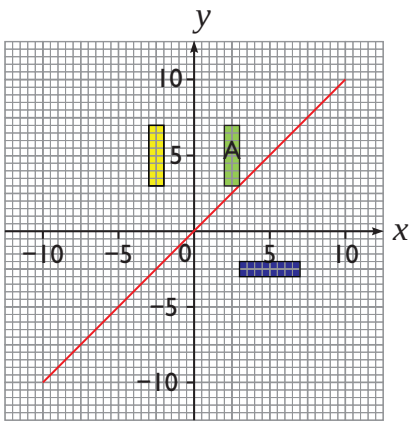
b 63 miles $\left(108 \times \frac{35}{60}\right)$ [2]

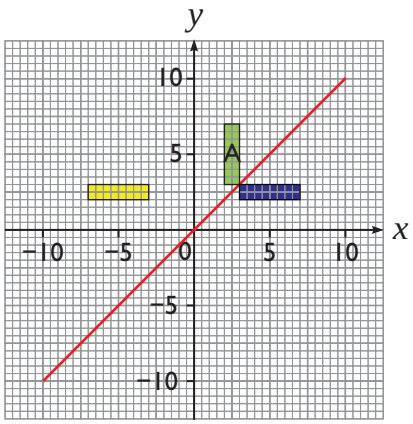
⑤ 21.5 cm^2 (area of square $= 10 \times 10 = 100\,\text{cm}^2$;

area of 1 circle $= \pi \times \left(\frac{10}{4}\right)^2 = 6.25\pi$;

area of 4 circles $= 4 \times 6.25\pi = 25\pi$;
area of shaded region $= 100 - 25\pi$) [4]

⑥





[4]

⑦ City bank (total investment after 4 years = £12 986.16, more than local bank (£12 948.98)). [4]

⑧ **a** 212 °F $\left(\frac{9 \times 100 + 160}{5} = \frac{1060}{5}\right)$ [2]

b $-40\left(x = \frac{9x + 160}{5}; 5x = 9x + 160; 4x = -160\right)$ [2]

⑨ **a** Seb 10 laps, Nikki 9 laps [2]

b 7 times [2]

⑩ **a** $8.94 \times 250 = 2235\,\text{g}$ [1]

b 8.42 g/cm^3 (total mass $= 2235 + 7.13 \times 100 = 2235 + 713 = 2948\,\text{g}$; total volume $= 250 + 100 = 350\,\text{cm}^3$; density $= 2948 \div 350$) [3]

c The volumes can be added together. [1]

⑪ Shows value of x is different for whichever three equations are solved. All three angles are not equal so polygon is not regular. [3]

⑫ $36^2 - 25^2 = (36 + 25)(36 - 25) = 61 \times 11 = 671\,\text{cm}^2$ [3]

⑬ $(x + 5)$ cm $[x^2 + 9x + 20 = (x + 4)(x + 5)]$ [2]

⑭ **a** $\frac{3}{7}$ [1] **b** $\frac{1}{7}$ [1] **c** $\frac{1}{4}$ [2]