

Unit 1 Number

1.1 Calculating with negative integers

1 a -4 b -6 c -6 d 15

2 a 6 b -3 c 3 d -5
e -7 f -9

3 a -3 b 27 c -3
d 3 e -44 f -8
g -44 h -44

4 a 7 b 9 c 10 d 6
e 14 f 10

5 a Solid
b 273 °C

6 a

Date in May	1	2	13	19	20	25	31
Deposit/Withdrawal (£)		+20	-37	+200	-12	+55	-25
Balance (£)	-128	-108	-145	+55	+43	+98	+73

b £201

7 a

Calculation	Answer		Calculation	Answer
3×4	12		4×-3	-12
3×3	9		3×-3	-9
3×2	6		2×-3	-6
3×1	3		1×-3	-3
3×0	0		0×-3	0
3×-1	-3		-1×-3	3
3×-2	-6		-2×-3	6
3×-3	-9		-3×-3	9

b positive $\times$ positive = **positive**
positive $\times$ negative = **negative**
negative $\times$ positive = **negative**
negative $\times$ negative = **positive**

8 a 8 b -24 c -36 d -45
e 9 f -120 g 36 h -60
i -5 j -10 k -24 l -40

9 a ii $-3 \times -4 = 12$ so $12 \div -3 = -4$
and $12 \div -4 = -3$
iii $-2 \times 5 = -10$ so $-10 \div -2 = 5$
and $-10 \div 5 = -2$

b positive $\div$ positive = **positive**
positive $\div$ negative = **negative**
negative $\div$ positive = **negative**
negative $\div$ negative = **positive**

- 10 a 4 b -5 c -3 d -4
 e -5 f 1 g 100 h -12
 i -8 j -0.4 k -6.2 l -4

- 11 a -18 b -4 c -4 d 15
 e 5 f -10

- 12 a -210 b 2205 c -420

- 13 a -15 b -68 c 14 d -18
 e 2

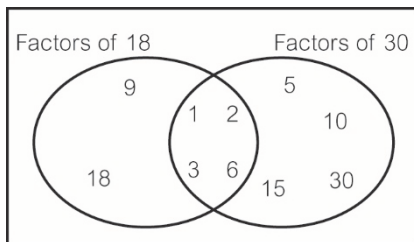
- 14 a 4 b 9 c 16 d 25
 e 36 f 49 g 64 h 100

- 15 a The answer is positive
 b No, as negative $\times$ negative = positive
 16 a 5, -5 b 8, -8 c 9, -9 d 1, -1
 e 11, -11 f 12, -12

1.2 Prime factor decomposition

- 1 48

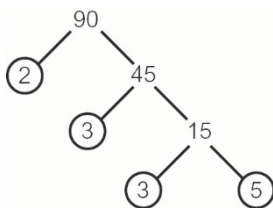
- 2 a



- b 6

- 3 a Multiples of 9: 9, 18, 27, 36, 45, 54, 63, 72
 Multiples of 12: 12, 24, 36, 48, 60, 72, 84, 96
 b 36

- 4 a

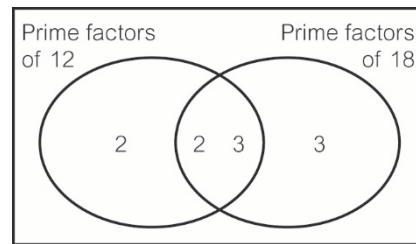


- b $90 = 2 \times 3 \times 3 \times 5 = 2 \times 3^2 \times 5$

- 5 a $32 = 2 \times 2 \times 2 \times 2 \times 2 = 2^5$
 b $75 = 3 \times 5 \times 5 = 3 \times 5^2$
 c $54 = 2 \times 3 \times 3 \times 3 = 2 \times 3^3$
 d $36 = 2 \times 2 \times 3 \times 3 = 2^2 \times 3^2$
 6 a i $225 = 3 \times 3 \times 5 \times 5 = 3^2 \times 5^2$
 ii $450 = 2 \times 3 \times 3 \times 5 \times 5 = 2 \times 3^2 \times 5^2$
 b i $140 = 2 \times 2 \times 5 \times 7 = 2^2 \times 5 \times 7$
 ii $420 = 2 \times 2 \times 3 \times 5 \times 7 = 2^2 \times 3 \times 5 \times 7$
 7 $20 = 2^2 \times 5$, $27 = 3^3$
 8 a 12 b 30 c 21 d 33

- 9 Possible answers are: $36 \times 2 = 72$ and $36 \times 3 = 108$, or 108 and $36 \times 4 = 144$, or 36 and $36 \times 5 = 180$ etc.

- 10 a



- b $36 = 2^2 \times 3^2$

- c $2 \times 2 \times 3 \times 3 = 2^2 \times 3^2 = 36$

- 11 $21 = 3 \times 7$, $45 = 3 \times 3 \times 5$;
 LCM = $3 \times 3 \times 5 \times 7 = 315$.

- 12 a 72 b 198 c 84 d 150

- 13 9 pm

1.3 Using indices

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

- 2 a 64 b 125 c 81 d 32

- 3 a 64
 b 243
 c 10 000 000
 d 625

- 4 $2^2 \times 2^3 = 2^{2+3} = 2^5$

- 5 a 3^6 b 4^4 c 5^6 d 7^6
 e 4^{14} f 3^{10} g 6^{13}

- 6 a Students' own answers: any three numbers that are different and add to 15, e.g. 2, 3 and 10.
 b Students' own answers: any two numbers that are the same and one that is different that add to 15, e.g. 2, 2 and 11.

- c 5

- 7 a i 4^2 ii 4^2

- b 2^3

- c 5

- 8 a 6^6 b 5^4 c 9 d 2^5
 e 4^6 f 12^4

- 9 a Students' own answers: any two powers of 3 where the difference in the powers is 2 and they are both greater than 20, e.g. $3^{25} \div 3^{23}$
 b Students' own answers: any two powers of 3 where the difference in the powers is 2 and they are both smaller than 20, e.g. $3^{19} \div 3^{17}$

- c $3^4 \div 3^2$

- 10 2^7 or 128

11 a 2^8 b 5^4 c 3^6 d 6^8

12 a 4^{12} b 7^{10} c 3^{18} d 8^{35}

13 a i 2^8 ii 3^8 iii p^8

b $p^a \times p^b = p^{a+b}$

c i 2^2 ii 3^2 iii p^2

d $p^a \div p^b = p^{a-b}$

e i $(2^5)^3 = 2^{15}$ ii $(3^5)^3 = 3^{15}$

iii $(p^5)^3 = p^{15}$

f $(p^a)^b = p^{a \times b}$

14 a i All answers are 1.

ii All answers are 1.

b i $\frac{9^5}{9^3} = 9^2$, $\frac{9^5}{9^4} = 9^1$, $\frac{9^5}{9^5} = 9^0$

ii $9^0 = 1$

iii Any number to the power of zero = 1

15 a 4^7 b 7^4 c 5^4

16 a 2^{12} b 4^6 c 3^5

1.4 Priority of operations

1 a 9 b 81 c 100 d 400

e 3 f 9 g 10 h 20

2 a 35 b 11 c 7 d 14

3 a She has subtracted 20 from 12 instead of subtracting 12 from 20

b 8

4 a 4 b 19 c 9 d 44

e 27 f 2 g 8 h 12

5 a 24 b -1 c -1 d 76

e 16 f 24 g 68 h yes

6 a $(3 + 4) \times 7 = 49$ b $(5 + 6)^2 - 9 = 112$

c $8 + 4 \times (5 - 3) = 16$

7 a 73 b 22 c 14

8 a 32 b 68 c 6752

9 a 53 b 1250 c 25

10 a $(7 - 5)^4 = 16$

$7 \times 5 - 1^4 = 34$

$2 \times (5 - 1)^3 = 128$

$(2 \times 5)^5 - 4^2 = 99\,984$

b Students write a calculation, involving index notation, with an answer 56.

11 $\frac{\sqrt{121}+5}{2^2}$, $\frac{7^2-3^2}{\sqrt[3]{8}}$, $\sqrt{49}+2^4$, $2^6-\sqrt[3]{125}$

1 Check up

Calculating with negative numbers

1 a 8 b -8 c 4 d -6

e -8 f -3 g -1 h 15

2 $-3 + -2$ and $-2 + -3 (= -5)$; $-3 - -2 (= -1)$; $-2 \div -3 (= 0.67)$; $-3 \div -2 (= 1.5)$; $-2 \times -3 (= 6)$

3 B and C

Prime factors

4 Students own version of factor tree and $72 = 2^3 \times 3^2$

5 $300 = 2^2 \times 3 \times 5^2$

6 a 45 b 160

Indices and priority of operations

7 a 3^7 b 5^3 c 6^{18} d 2^4

e 5^7 f 3^8 g 4^0

8 24

9 a 25 b 5 c 1

10 a 6^6 b 2^3 c 3^6

11 A $(2 \times 5)^2$ and C $2^2 \times 5^2$ – both equal 100

12 6

13 $a^x \times a^y = a^{x+y}$

$a^x \div a^y = a^{x-y}$

$(a^x)^y = a^{xy}$

14 a 19 b 11 c 76 d -31

e 44 f 180

15 $7 + 8 \times (3 - 2)$

1 Strengthen

Calculating with negative numbers

1 a -2 b 12 c 2 d -12

2 a 5 b 12 c 6 d -7

3 a -6 b -6 c 6 d 6

e 6 f 6 g -6 h -6

4 Any pair that multiply to give -10 (e.g. -1×10 , -10×1 , -2×5 , -5×2 etc.)

5 a 5 b 5 c -5 d -5

e -5 f 5 g -5 h 5

6 Any pair that divide to give -10 (e.g. $100 \div -10$, $-100 \div 10$, $-20 \div 2$, $20 \div -2$ etc.)

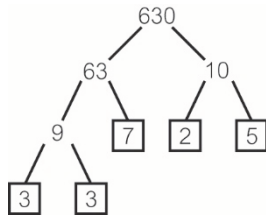
7 a 6 b 24 c -12 d -24

e 70 f -6

Prime factors

- 1 **b** $2^4 \times 3 \times 5^2$
c $2 \times 3^3 \times 5^5 \times 7$

2 **a**



b $630 = 2 \times 3^2 \times 5 \times 7$

- 3 **a** $92 = 2^2 \times 23$
b $160 = 2^5 \times 5$
c $156 = 2^2 \times 3 \times 13$
d $195 = 3 \times 5 \times 13$
e $441 = 3^2 \times 7^2$

- 4 **a** 4 **b** 9 **c** 12
 5 **a** 135 **b** 108 **c** 675

Indices and priority of operations

1

4^0	4^1	4^2	4^3	4^4
1	4	16	64	256

- 2 **a** $3^{2+5} = 3^7$ **b** $4^{3+1} = 4^4$
c $9^{6+3} = 9^9$ **d** 5^{11}
- 3 **a** $4^{6-3} = 4^3$ **b** $3^{5-1} = 3^4$
c 7^2 **d** 9^8
- 4 **a** 4^6 **b** 3^{10} **c** 6^8 **d** 8^{30}
- 5 $2^4 \times 2^3 = 2^{4+3}$ $2^x \times 2^y = 2^{x+y}$ $n^x \times n^y = n^{x+y}$
 $2^4 \div 2^3 = 2^{4-3}$ $2^x \div 2^y = 2^{x-y}$ $n^x \div n^y = n^{x-y}$
 $(2^4)^3 = 2^{4 \times 3}$ $(2^x)^y = 2^{xy}$ $(n^x)^y = n^{xy}$

6

2^0	2^1	2^2	2^3	2^4	2^5	2^6	2^7
1	2	4	8	16	32	64	128

- 7 **a** **i** 2^3 or 8 **ii** 24
b **i** 5^2 or 25 **ii** 100
- 8 **a** **i** 9 **ii** 49 **iii** 49
b **i** 16 **ii** 36 **iii** 4
- 9 **a** 8^7 **b** 3^4 **c** $6^0 = 1$ **d** 10^5
- 10 **a** $2^6 \times 2^2 \times 2^3 = 2^{11}$
b 3^9 **c** 3^5
- 11 **a** 14 **b** 14
- 12 **a** 8 **b** 8
- 13 **a** 6 **b** 5 **c** 8
- 14 **a** 13 **b** 56 **c** 6

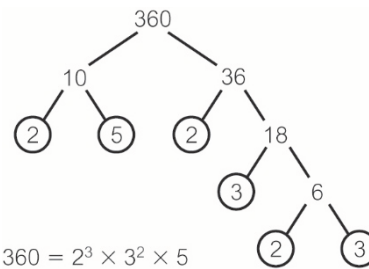
- 15 **a** 50 **b** 0 **c** 19
d 25 **e** 62 **f** 93

Enrichment

- 1 $7 \times 7^9 = 7^{10}$
 $7^8 \div 7^2 = 7^6$
 $(7^3)^5 = 7^{15}$
- 2 **a** 672 **b** 2:11:12 pm
c **i** 8 **ii** 7
d **i** 3200 m **ii** 2800 m

1 Extend

- 1 84, prime must be 3 to give number < 100
 2



$360 = 2^3 \times 3^2 \times 5$

- 3 **a** Yes $(-2)^2 \times (-2)^3 = (-2)^{2+3} = (-2)^5$
b Yes $(-3)^5 \div (-3)^2 = (-3)^{5-2} = (-3)^3$
c **i** $(-4)^{10}$
ii $(-7)^5$
- 4 2^3 cm
- 5 **a** **i** $165 = 3 \times 5 \times 11$
ii $180 = 2^2 \times 3^2 \times 5$
iii $210 = 2 \times 3 \times 5 \times 7$
b 15
c 13 860
- 6 **a** -15 **b** -68 **c** 14 **d** -18
e 2
- 7 **a** 1.05°C **b** 1.52°C (to 3 s.f.) **c** 18.5°C
- 8 $0.5(-12 - 32) = -22^\circ\text{C}$;
 calculator check: -24.528°C
- 9 **a** 0.0104 W/m^2 (3 s.f.)
b 0.00833 W/m^2 (3 s.f.)
- 10 **a** 4, -8, 16, -32, 64
b 24
c 2^6
- 11 **a** 8 **b** 4 **c** 12 **d** 5
e 7 **f** 12
- 12 **a** 5 **b** 10
- 13 **a** $3^3 \times 3^7 = 3^{10}$
b $7^9 \times 7^6 = 7^{15}$
c $5^4 \times 2^3 \times 5^6 \times 2^4 = 5^{10} \times 2^7$

Unit 2 Equations and formulae

2.1 Solving one-step equations

- 1 a 3 b 18 c 6
d 2 e 1 f 18
- 2 $x + 3$
- 3 $£5y$
- 4 a 6, 7, 8, 9
b 0, 5, 10, 15
- 5 a 8 b 20 c 20
- 6 a $x = 10$ b $x = 3$
c $x = 21$ d $x = -3$
- 7 a $x = 6$ b $n = 6$
c $m = 10$ d $p = 2.8$
- 8 a $z = 12$ b $x = 9$ c $y = 21$
d $c = 3.4$ e $a = 0.9$ f $k = 3$
g $x = -4$ h $y = -17$ i $n = -3$
j $p = 0$ k $x = -1$ l $x = -7$
- 9 a $x = 11$ b $m = 8$ c $t = 5$
d $m = 14$ e $R = 2$ f $d = 40$
- 10 a $C = x + 3$ b $£33.50$
- 11 a $3x = 180^\circ$ b $x = 60^\circ$
- 12 a $m = 30^\circ$
b Angles are 30° , 60° and 90°
- 13 a $a = 24^\circ$, $2a = 48^\circ$



- 14 2 hours 40 minutes
- 15 $£8$

2.2 Solving two-step equations

- 1 a $y = 14$ b $a = -8$ c $x = -3$
- 2 a $2x + 8$ b $3y - 6$ c $15 - 5z$
- 3 a 6, 10, 14 b 0, 2, 3
- 4 a $x = 5$ b $y = 10$
c $z = 6$ d $m = -20$
- 5 a $x = 4$ b $y = 7$ c $r = -6$
- 6 a $x = 4$ b $x = 4$ c $x = 2$
d $x = 6$ e $x = 12$ f $x = 8$
g $x = 8$ h $x = 5$ i $x = 3$
- 7 a $v = 11$ b $x = 4$ c $w = 80$
d $h = 3$ e $a = 4.5$ f $u = 5$
- 8 a $x = 4$ b $x = 10$ c $x = 20$
- 9 a $6n + 3 = 21$ b $n = 3$

- 10 a $\frac{n}{4} - 10 = 1$, $n = 44$
b $6(n + 7) = 54$, $n = 2$
c $2n + 12 = 42$, $n = 15$
d $\frac{n-3}{2} = 5$, $n = 13$

- 11 a $x = 40^\circ$, $2x = 80^\circ$
b $y = 25^\circ$, $y = 25^\circ$, $2y = 50^\circ$
- 12 a $z = 25^\circ$, $2z = 50^\circ$, $3z = 75^\circ$
b $a = 7.5^\circ$, $2a = 15^\circ$, $5a = 37.5^\circ$
c 55°
- 13 a $3x - 5 = 31$
b $£12$

2.3 More complex equations

- 1 a $n + 5$ b $2n + 10$ c $7(n + 4)$
- 2 a $x = 4$ b $x = 3$ c $x = -4$
- 3 a $x = 3$ b $x = 5$
c $y = 7$ d $m = -3$
e $x = 12$ f $x = 11$
g $x = 8$ h $m = 9$
i $r = 3$ j $t = 35$
- 4 a $2n + 4$, $5n - 20$
b $2n + 4 = 5n - 20$
c $n = 8$
- 5 Students' own answers
- 6 a $x = 6$ b $x = 6$ c $y = 3$
d $x = 8$ e $m = 2$ f $y = 3$
- 7 $2x + 15 = 4x - 45$, $x = 30$
Angles are both 75°
- 8 a y is larger, by 8
b s is larger, by 2

2.4 Working with formulae

- 1 a $a = 3$ b $x = 2.5$ c $y = -10$
d $m = 5$ e $x = 7.5$ f $y = 3.4$
- 2 a -6 b 1 c 13
d 0
- 3 a $b = 9$
b $a = 1$ $b = 9$, $a = 2$ $b = 8$, $a = 3$ $b = 7$, $a = 4$ $b = 6$, $a = 5$ $b = 5$, $a = 6$ $b = 4$, $a = 7$ $b = 3$, $a = 8$ $b = 2$, $a = 9$ $b = 1$
- 4 a Any pairs of numbers when n and m are multiples of 4.
b n and m must be multiples of 4.

5 a 300 cm b $C = 100M$

6 a $g = 1000K$ b $K = \frac{g}{1000}$

c $m = 1000L$ d $L = \frac{m}{1000}$

7 a $P = 5x$

b i $P = 60$ ii $P = 2$

c i $x = 4\frac{4}{5}$ ii $x = 1\frac{2}{5}$

8 a $T = 40m + 20$

b i $T = 140$ ii $T = 80$

c i $m = 2$ ii $m = 3.25$

2 Check up Solving equations

1 a $x = 19$ b $n = 11$ c $s = 15$
d $y = 4$ e $m = 0$ f $p = -4$

2 a $I = 2$ b $d = 21$

3 a $x = 4$ b $x = 5$ c $n = 6$
d $m = 2$ e $x = -3$ f $x = 3$

4 8 miles

5 a $x = 10$ b $x = 3$

6 $n = 3$

Writing equations and formulae

7 a $a = 90 - 67$ or $180 = 90 + 67 + a$
b $a = 23^\circ$

8 a 45°
b $x = 45^\circ$, $3x = 135^\circ$

9 $x = 57.5^\circ$, $2x = 115^\circ$, $x - 50 = 7.5^\circ$

10 $x = 7$ so length of side is 16 cm.

11 a $15C = £45$
b £6

12 a $3n + 4 = 2(n + 5)$
b $n = 6$

13 a $T = 20m + 8$
b 38 minutes
c 2.5 miles

14 $x = 1$, $y = 9$, $x = 2$, $y = 6$, $x = 3$, $y = 3$

2 Strengthen Solving equations

1 a $\square = 5$ b $\triangle = 6$

c $\diamond = 3$ d $\triangleleft = 18$

2 $x = 6$

3 a $x = 4$ b $m = 14$ c $n = 16$

d $x = 9$ e $y = 11$ f $s = 35$

4 a $x = 7$ b $y = 8$

c $p = 7$ d $q = 9$

e $s = -3$ f $n = 40$

g $h = 8$ h $y = 15$

i $m = -8$ j $n = -56$

5 a $m = 22$ b $x = 9$

c $A = 5$ d $x = 7$

e $x = 3$ f $a = 3$

g $P = 22$ h $d = 20$

6 a Yes

b i $x = 6$ ii $n = 2$

iii $x = 20$ iv $y = 30$

7 a $x = 5$ b $x = 3$ c $x = -2$

8 $v = 4$

9 a $x = 8$

b i $x = 3$ ii $x = 2$

10 a $4n + 8 = 5n + 5$

b $n = 3$

c $x = 9$

Writing equations and formulae

1 a $x + 95^\circ = 180^\circ$

b $x = 85^\circ$

2 $4n + 20^\circ = 180^\circ$, $n = 40^\circ$, $3n = 120^\circ$

3 Sides are 4 cm, 4 cm, 14 cm and 14 cm

4 Sides are 8 cm, 8 cm, 13 cm and 13 cm

5 a i 120 minutes

ii 180 minutes

b Number of minutes = number of hours $\times$ 60

c $m = 60h$

6 a i 65 ii 135

b $S = 10C + 15$

c 13

7 a $4x + 6$ b $P = 4x + 6$

c $x = 7$ cm so longest side = 14 cm

Enrichment

1 $x = 13$, $y = 7$

2 Extend

- 1 **a** $6x = 24, x = 4$ **b** $8y = 40, y = 5$
- 2 **a** $10x = 240, x = 24$, so each side is 24 cm
b $12x = 360, x = 30$, so each side is 30 cm
- 3 $n = 7$
- 4 **a** $x = -3$ **b** $m = 3$ **c** $t = -5$
d $n = -3$ **e** $d = 2$ **f** $e = -4$
- 5 **a** $m = 8$ **b** $u = 6$ **c** $n = 5$
d $w = 10$ **e** $y = -2$ **f** $t = 2$
- 6 **a** i $x = -r$ ii $x = \frac{2c}{3}$ iii $x = \sqrt{r}$
b i $x = -2$ ii $x = 2$ iii $x = \pm 5$
c Yes, because in both cases you have to find what x is equal to.
- 7 **a** $x = 6$ **b** $m = 2$
c $y = 5$ **d** $t = 4$
e $p = -4$ **f** $x = \pm 10$
g $x = \pm 6$
- 8 **a** $h = 13$ **b** $m = 13$
c $b = 8$ **d** $k = 4$
- 9 **a** $x + 87$
b $\frac{x+87}{5}$
c $\frac{x+87}{5} = 20$
d $x = 13$
- 10 $y = 15$
- 11 $6x = 36, x = 6$, so width = 6 cm and length = 12 cm
- 12 **a**
- A rectangle is shown with its longer sides labeled $3w$ and its shorter sides labeled w .
- b** length = 9 cm, width = 3 cm
- 13 $2(x + 2) = 5(x - 1), 20x + 3 = 9(x + 4), 3x + 2 = 2x + 5$
- 14 Angles are $40^\circ, 70^\circ$ and 70° .
- 15 **a** 50 cm **b** 150 cm^2
- 16 **a** $2n + 1$ **b** $2n + 1 = 315$
c $n = 157$ **d** 157, 158
- 17 261, 262
- 18 20, 21, 22

- 19 **a** $m + 25$
b $2m + 25$
c $2m + 25 = 57, m = 16$
d 16 years old
e 41 years old
- 20 70 and 42
- 21 Students' own answers
- 22 Adult £30, child £5
- 23 $h = 4 \text{ cm}$
- 24 $x = 15, y = -5$
- 25 **a** $a = 12, b = 4$ **b** 75
- 26 $x = 5, y = 30$
 $x = 20, y = 20$
 $x = 35, y = 10$
- 27 -2
- 28 $\frac{1}{3}$
- 29 $a = b$

2 Unit test

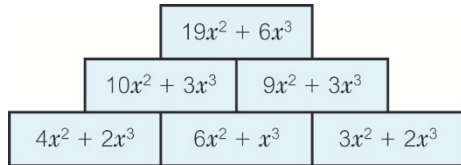
- 1 **a** $x = 23$ **b** $x = 9$ **c** $x = 14$
- 2 $x = 20^\circ$, so $2x = 40^\circ, 3x = 60^\circ, 4x = 80^\circ$
- 3 **a** $x = 7$ **b** $x = 12$
c $x = 9$ **d** $x = 3$
e $x = -8$
- 4 $x = 40^\circ, 2x + 10 = 90^\circ, 2x - 30 = 50^\circ$
- 5 $x = 7$
- 6 $v = 55$
- 7 **a** $m = 6$ **b** $n = 10$ **c** $x = 9$
- 8 $x = 12$
- 9 **a** $d = \frac{h}{24}$ **b** 20 days
- 10 Any pair of x and y values for which $2x - 4y = 12$, e.g. $x = 8, y = 1; x = 10, y = 2; x = 20, y = 7$
- 11 **a** 52 cm^2 **b** $c = 2 \text{ cm}$

Unit 3 Working with powers

3.1 Simplifying expressions

- 1 a $8x$ b $10y + 11z$
c $2t + 3g$ d $9j - 7h$ e $2x^3 + x^2$

2



- 3 a $5x + 35$ b $-2a - 6$

- 4 a $10a^2$ b $24m^3$

- 5 a $3x$ b x^2 and $9x^2$
c $10x^2$

- 6 a $10x^2 + 11y^2$ b $6a^3 + 4b^2$

7 a, b

$$5q + 2p^2 - 3q^2 + 6p^2 + 4q + 10q^2 = 9q + 8p^2 + 7q^2$$

$$5q + 2p^2 - 3q^2 + 12q^2 - 3q - 5p^2 = 2q - 3p^2 + 9q^2$$

$$6p^2 + 4q + 10q^2 + 12q^2 - 3q - 5p^2 = q + p^2 + 22q^2$$

$$c \quad 6q + 3p^2 + 19q^2$$

- 8 a $7x + 7$ b $2m - 23$ c 12 d $12 - x$
e $8x + 6$ f $6x - 17$

- 9 a $8(x + 3)$ or $8x + 24$
b $5(x - 2)$ or $5x - 10$
c $3x + 34$

3.2 More simplifying

- 1 a 3^5 b 5^4 c 4^3 d 2^6
e x^2

- 2 a $4x^2$ b $20ab$ c $2t$

- 3 a i 2^9 ii 3^9 iii x^9
b When you multiply powers of the same variable together you add the powers.
c i 2^2 ii x^2
d When you divide powers of the same variable together you subtract the powers
e i 2^{15} ii 3^{15} iii x^{15}
f When you raise the power of a variable to another power you multiply the powers

- 4 a x^{16} b z^8 c v^8

- 5 a y^6 b n^9 c w^6

- 6 $3x^2 \times 5x^3 = 15x^5$
 $3x^2 \times 7x^5 = 21x^7$
 $3x^2 \times 2x^4 = 6x^6$
 $5x^3 \times 7x^5 = 35x^8$
 $5x^3 \times 2x^4 = 10x^7$
 $7x^5 \times 2x^4 = 14x^9$

- 7 a $3a^5$ b $5b^3$ c $5n^2$ d $6t$
e $12p^7$ f $10x^3$

- 8 Any two expressions that simplify to give $24x^5$
One expression must be a multiplication and the other a division, e.g. $2x \times 12x^4$, $48x^8 \div 2x^3$

9 a $\frac{5y^5 \cdot 9y^3}{3y^6} = 15y^2$

b $\frac{4y^2 \cdot 12y^7}{6y^5} = 8y^4$

- 10 a $16x^4$ b $4y^6$ c $27z^{12}$
d $\frac{x^6}{64}$ e $\frac{y^8}{49}$ f $\frac{z^{15}}{27}$

- 11 a Sometimes true – when $a = 2$ and $b = 2$
b Always true $x^a \div x^b \equiv x^{a-b}$
c Sometimes true – when $a = 2$ and $b = 2$
d Sometimes true – when $c = 0$ and $d = 0$
e Always true $(yc)^d \equiv (yd)^c$
f Always true $y^d \times y^c \equiv y^{c+d}$

3.3 Factorising expressions

- 1 a $2x + 6$
b $12x + 8$
c $18 - 9x$
d $20 - 35x$

- 2 a 9 b 4 c 7

- 3 a $1, 2$ b $1, 3$ c $1, 5$ d $1, 4$

- 4 a 8 b 12

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

- 6 a $3(x + 4)$
 b $5(p - 3)$
 c $11(2z - 1)$
 d $2(y - 10)$
 e $5(2 + m)$
 f $13(2 - n)$
 g $7(2 + s)$
 h $7(1 - 4t)$
- 7 a and iv
 b and vi
 c and ii
 d and v
 e and iii
 f and i
- 8 5 ways: $2(6x + 12b)$, $3(4x + 8b)$, $4(3x + 6b)$, $6(2x + 4b)$, $12(x + 2b)$
- 9 a $4(x + 2)$
 b $4(2y + 3)$
 c $14(m + 2)$
 d $6(2n - 1)$
 e $10(2 - s)$
 f $4(2 + 5t)$
 g $9(10y + 5)$
 h $33(2 + z)$
- 10 a $2(2m + n + 8)$
 b $5(3 + 2b + 11c)$
 c $p(q + 2 + 12)$
- 11 $70 + 10m$
- 12 $120 + 25n$

3.4 Expanding and factorising expressions

- 1 a $15ab$ b $6m^2$ c $-20n^2$ d $14a^5$
 e $-30p^5$
- 2 a $6x + 10$ b $12 - 8y$ c $y^2 + 3y$
 d $2x - 2$ e $30 + 3p$ f $10s - s^2$
- 3 a $x^2 + 5x$
 b $8y + y^2$
 c $2p^2 - 5p$
 d $12q - 6q^2$
- 4 The HCF is 4 not 2, so fully factorised it is $4(3x - 4)$
- 5 a i $x(3x + 2)$ ii $3x^2 + 2x$
 b i $2y(5 + 3y)$ ii $10y + 6y^2$
 c i $5z(3z - 7)$ ii $15z^2 - 35z$

- 6 a $x^3 + 4x^2$
 b $14x^6 - 6x^5$
 c $5x^4 + 10x^3 + 35x$
 d $x^4 - 5x^3 + 7x^2$
- 7 a $7a + 11b$
 b $14x^3 + 26x$
 c $18 - 6y + y^3 - 8y^2$
 d $5t^2 + 10t - 4t^5 + 8t^3$
- 8 $3x^2 + 6x$
- 9 $2y(3y - 1) + y(y - 1) + 2y(y + 3) = 9y^2 + 3y$
- 10 a x^2 b p c y^2 d $4z$
 e $5m^3$ f pq
- 11 a $3x(5x^2 - 1)$
 b $16x(2 + x)$
 c $3x(5 + 7x)$
 d $3x(x^2 + 2)$
 e $y^2(1 - 7y^2)$
 f $3y^3(y^2 + 5)$
 g $4y^3(3y - 1)$
- 12 a A as $B = C$
 b C as $A = B$
 c They are all different.
- 13 a i $4x^3 + x(3x^2 + 7x) = 4x^3 + 3x^3 + 7x^2$
 $= 7x^3 + 7x^2 = 7x^2(x + 1)$
 ii $2b(b^2 + 3b) - b(b^2 + 8b)$
 $= 2b^3 + 6b^2 - b^3 - 8b^2 = b^3 - 2b^2$
 $2b^2(b - 1) - b^3 = 2b^3 - 2b^2 - b^3 = b^3 - 2b^2$
 b $6y(y^3 - 3) - 2y(2y^3 - 11) \equiv 2y(y^3 + 3) - 2y$
- 14 Students' own answers

3.5 Substituting and solving

- 1 a 20 b 40 c 54 d 9
- 2 a $x = 5$ b $x = 3$ c $x = 6$ d $x = -17$
- 3 a $4x = x + 3$
 b $x = 1$
- 4 a 23 b 35 c 24 d 35
- 5 a A $5(3a + b)$ B $2(5a - 2b) + 2(4a + 3b)$
 b A $15a + 5b$ B $18a + 2b$
 c A 35 B 50
- 6 $x = 5$
- 7 a 63 b 28 c 34
- 8 a $s = 100$ m
 b $s = 76$ m
 c $s = 72$ m

- 9 a $8x^2 + 32x$
 b i 40 cm^2
 ii 96 cm^2
 iii 168 cm^2
 iv 360 cm^2
 v 1120 cm^2

10 a $x = 4$ b $y = 2$ c $z = 5$ d $x = 9$

11 a $x = 6$ b $y = 3$

- 12 a $x = 5$
 b Piece of card is 4 cm by 10 cm and the hole is 2 cm by 8 cm

3 Check up Simplifying and substituting into expressions

- 1 a $10x^2$
 b $11a^2 - 6b^2$
 c $11y + 5y^2$
 2 a $2x + 5 \equiv x + 7 + x - 2$
 b $2x + 1 = 4x - 3$

3 a 11 b 12 c 20 d 6

4 a 54 b 1

Index laws

- 5 a x^5 b y^{10} c z^6
 6 a $30x^6$ b $2b^2$ c $9p^8$ d $4p^3$
 e $\frac{n^6}{25}$

Expanding and factorising

- 7 a $x^3 + 2x^2$
 b $6x^3 - 12x^2$
 c $3x^4 + 2x^3 - x^2$
 8 a $11x + 5$
 b $-3x^2 - 4x$
 c $13x^3 + 22x$
 9 a $4(x + 5)$
 b $3(2x - 3)$
 c $7(2a - 3b)$
 10 a $6x(x + 3)$
 b $2y^3(4 - y)$
 c $8xy(2 - xy)$

Solving equations

- 11 $x = 4$
 12 $x = 7$

3 Strengthen Simplifying and substituting into expressions

1 a $5x^2$ b $5t^3$ c $9y^4$

2 $6y, -7y, 3y, -y$
 $5y^2, 2y^2, -y^2, 11y^2$
 $-12y^3, y^3, 4y^3$

- 3 a $12x + 5x^2$
 b $3a^2 + 2b^2$
 c $11p^3 - 10n^2$
 d $4v^3 + 3v + 4$

4 a 43 b 5 c 12 d 45

5 a 60 b 40 c 16 d 144

6 a 48 b 36 c 15 d 95

Index laws

- 1 a x^7 b y^7 c z^9
 2 a x^4 b y^3 c z^5
 3 a x^6 b y^8 c z^{15}

- 4 a $6x^4$ b $20y^7$
 c $18p^7$ d $72q^8$
 e $2a^4$ f $3b$
 g b^4 h $2b^6$

- 5 a $25x^6$ b $64m^{15}$ c $81n^{12}$
 d $\frac{x^6}{4}$ e $\frac{w^{12}}{36}$

Expanding and factorising

- 1 a $x^3 + 3x^2$
 b $y^3 - 5y^2$
 c $2x^4 - 8x^3$
 d $6y^4 + 12y^3$

- 2 a $8x + 11$
 b $6a + 10$
 c $2x^2 + 7x$
 d $11a - 2a^2$

- 3 a $3x + 2 \equiv x + 5 + 2x - 3$
 b $5x + 7 = 27$
 c $8p^2 \equiv 2p \times 4p$
 d $t + t + t + 8 + 3 \equiv 3t + 11$
 e $3x - 9 = 2x + 6$
 f $5(x + 3) \equiv 3x + 2x + 20 - 5$

- 4 a LHS and RHS both simplify to $14x^3 - 3x^2$
 b LHS and RHS both simplify to $y^3 - 12y^2$

5 a 3 b $3(x + 3)$

- 6 a $4x + 8 = 4(x + 2)$
 b $2x + 6 = 2(x + 3)$
 c $15x + 5 = 5(3x + 1)$
 d $18x - 12 = 6(3x - 2)$
 e $3x + 15 = 3(x + 5)$
 f $7x - 14 = 7(x - 2)$

Solving equations

- 1 a $x = 3$ b $x = 6$ c $x = 2$ d $x = 4$
 2 a 92 b $6x - 10$ c $102 - 6x$

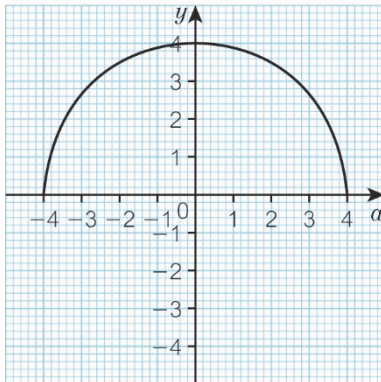
Enrichment

- 1 a Mean = $\frac{24x^2 - 8y^3 + 12z}{4} = 6x^2 - 2y^3 + 3z$
 b When $x = 2, y = 1$ and $z = 3$
 i 11, 72, -28, 69
 ii 31
 iii 31
 iv 100

2 a

x	-4	-3	-2	-1	0	1	2	3	4
y	0	2.65	3.46	3.87	4	3.87	3.46	2.65	0

b



c The shape is a parabola.

3 Extend

- 1 a $v = 5$ b $v = 7.5$ c $v = 18$
 2 a i $5(4p^2 + 3pq - 2q^2)$
 ii $8(3q^2 - pq - 4p^2)$
 b $14q^2 + 7pq - 12p^2$
 c i $52p^2 + 23pq - 34q^2$
 ii $34q^2 - 23pq - 52p^2$
 d One is the negative of the other.

- 3 a A $2(6a + 18)$, B $3(4a + 12)$ or $4(3a + 9)$ or $6(2a + 6)$, C $12(a + 3)$
 b i C
 ii Tallest rectangle, as the largest number has been factorised out as the width.
 c i, ii Students' own answers.
 d A $12a + 40$, B $8a + 30$ or $6a + 26$, $4a + 24$, C $2a + 30$
 e i A 2 by 30, B 3 by 20 or 4 by 15 or 6 by 10, C 12 by 5
 ii A 64, B 46 or 38 or 32, C 34
 4 a LHS = $15a^3 + 18a - 12a^3 = 3a^3 + 18a$, RHS = $3a^3 + 21a$
 b Make the 7 into a 6.
 5 a $5(ab + 2bc - 5ac)$
 b $24(2x^2y - 3y^2 + 5x)$
 c $13(5pt + 3ty - yx - 4xp)$
 6 a $4y(4y^2 + 5y + 6)$
 b $2x(6x + 3y - 1)$
 c $6xy(3x - xy + 5y)$
 d $6p^2q^3r^3(10r - 35pqr^2 + 9p^3q)$
 7 a $6xy - 12x^2 + 15x^2y = 3x(2y - 4x + 5xy)$
 b $6a^3b + 14a^2b - 12a^3b^2 = 2a^2b(3a + 7 - 6ab)$
 8 a 95 b 5 c 7 d 4
 e 12
 9 $12x^4 + 2x^3 + 5x^2 - 21x$
 10 a $5a + 6b - c^2 = -34$, $\sqrt{d} + h^2 = 31$, $\frac{g^2 + b^2}{2h} = -9$, $f - 2\sqrt{d} + i = -26$, $\frac{abc}{d} - e^2 = -62$,
 $\sqrt[3]{e} + a^2 + \frac{d}{b} = 2$
 b Any expression that has a value of 60. Students must use at least three of the letters from the table, and their expression must include a power or a root.
 11 Yes, $5xy^2$ will be negative and y^3 will be negative, but z^2 will be positive, so as long as z^2 is large enough, the expression will be positive, e.g. when $x = -2, y = -1$ and $z = -4$.
 12 a $-\frac{5}{16}$ b $\frac{9}{16}$
 13 a i $4x + 3$
 ii $180 - 2(4x + 3)$ or $174 - 8x$
 b $5(3x - 2) = 180 - 2(4x + 3)$ or $15x - 10 = 174 - 8x$
 c $x = 8$
 d ABC and ACB = 35° and BAC = 110°
 Total = 180°

14 a i $9x - 10$

ii $360 - 104 - 2(9x - 10)$ or $276 - 18x$

b $4(2x - 9) = 360 - 104 - 2(9x - 10)$ or
 $8x - 36 = 276 - 18x$

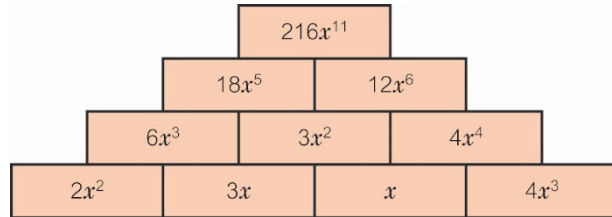
c $x = 12$

d $\text{CBA} = 104^\circ$, BAD and $\text{BCD} = 98^\circ$, $\text{ADC} = 60^\circ$
 Total = 360°

15 Adrian = 3, Jim = 5, Carl = 12, Rashid = 31

16 9 or -9

17



18 a w^{12} b z^7 c d^6 d $3s^8$

e $4b^{-1}$ or $\frac{4}{b}$

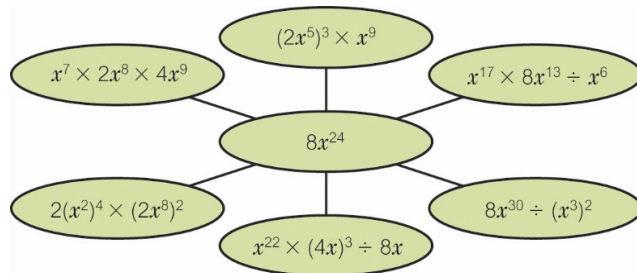
f n^{14}

19 a, b Students' answers for $\frac{\text{A term} \times \text{B term}}{\text{C term}}$

c $\frac{9y^5 \cdot 6y^3}{3y^7} = 18y$

d $\frac{12y^8 \times 8y^9}{2y^5} = 48y^{12}$

20



21 a $a^x \times a^y \times a^z = a^{x+y+z}$, $\frac{a^x}{(a^y)^z} = a^{x-yz}$,

$\frac{a^x \times a^y}{a^z} = a^{x+y-z}$, $\frac{a^x}{a^y \times a^z} = a^{x-y-z}$,

$a^x \times (a^y)^z = a^{x+yz}$, $\frac{(a^x)^y}{a^z} = a^{xy-z}$,

$(a^x)^y \times a^z = a^{xy+z}$

b $a^{xz-y} = \frac{(a^x)^z}{a^y}$

3 Unit test

1 a $5y^2$ b $5x + x^3$ c $7d^3 - 3 + 2d^2$

2 a x^{10} b y^{10} c z^{10}

d m^{15} e b^7

3 a $p^4 + 2p^2$

b $2m^3 - 8m^2$

c $6y^4 - 4y^3 + 14y^5$

d $24x + 12x^2 - 24x^3$

4 a $14p^2 + 13p$

b $5v^2 + 6uv - 4v$

5 a $2(x + 6)$

b $3(4x - 5)$

c $10(5 - 2x)$

6 a and c

7 LHS = $3y(5y^2 + 4y) + 2y^2(1 + 3y)$
 $= 15y^3 + 12y^2 + 2y^2 + 6y^3 = 21y^3 + 14y^2$
 $= 7y^2(3y + 2)$

8 a $7y(y + 4)$

b $3x(3 - 7x^2)$

c $4w(3w^2 + 5w - 8)$

9 40.2 m (3 s.f)

10 a 20 b 41

11 a 10 b 4 c 4 d 8

12 $x = 9$

13 a $x = 7$ b 56

14 a $21y^8$ b $5b^8$ c $4g^6$

d $\frac{q^9}{27}$ e x

Unit 4 2D shapes and 3D solids

4.1 Area of triangles, parallelograms and trapezia

- 1 a 20 cm^2 b 2100 mm^2
c 18 cm^2 or 1800 mm^2
- 2 a 5 cm b 4 cm c 2.5 cm
- 3 a 10 b 28 c 9
- 4 b Area of A = 24 cm^2 Area of B = 18 cm^2
c

Parallelogram	Base length (cm)	Perpendicular height (cm)	Area (cm^2)
A	6	4	24
B	3	6	18

- d Students' own answers. Base length multiplied by perpendicular height gives the area.
- e Area of a parallelogram
= base length $\times$ perpendicular height
- 5 a 21 cm^2 b 2666 mm^2
- 6 a 6 cm b 9.5 cm c 6.4 cm
- 7 a 16.5 cm^2 b 12 cm^2 or 1200 mm^2
c 2400 mm^2 or 24 cm^2
- 8 a 8 cm b 6 cm c 5 cm
- 9 6000 cm^2
- 10 Students' own answers
- 11 a b on the top of the diagram, a on the bottom of the diagram
b Parallelogram
c The length of the base of the parallelogram is $b + a$
d The area of the parallelogram is $h \times (a + b)$
e The area of one trapezium is $\frac{1}{2} (a + b)h$
- 12 a 22 cm^2 b 42.5 m^2 c 2100 cm^2
- 13 £250.25

4.2 Area of compound shapes

- 1 a 24 cm^2 b 12 cm^2 c 5 cm^2
- 2 a 52 cm^2 b 11 m^2 c 4.5 m^2
- 3 a Rectangle: base = 15 cm height = 12 cm
Triangle: base = 15 cm height 6 cm
b Rectangle: base = 14 mm height = 15 mm
Triangle: base = 11 mm height = 7 mm

- 4 Triangle A: base: $32 + 8 = 40$
height: $70 - 42 = 28$

$$\text{Area of triangle A: } \frac{1}{2} \times 40 \times 28 = 560 \text{ cm}^2$$

Rectangle B: base: 32 height: 42

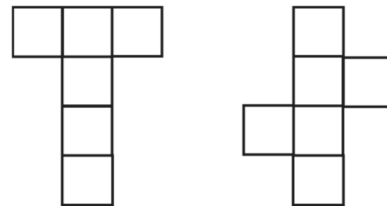
$$\text{Area of rectangle B: } 32 \times 42 = 1344 \text{ cm}^2$$

$$\text{Total area} = 560 + 1344 = 1904 \text{ cm}^2$$

- 5 a 225 cm^2 b 248.5 mm^2
- 6 a 74 mm^2 b 88 cm^2
- 7 a 2.1 m^2 b \$321.30
- 8 22.64 m^2
- 9 a 3 cm b 1 cm
- 10 a 20 cm^2 b 1600 mm^2 c 24 cm^2
- 11 Whole area = 140 cm^2
Area of shapes = 53 cm^2
Area of plastic = 87 cm^2
- 12 a i $x + 10$ ii $4x + 1$
b $x = 3 \text{ cm}$, Area = 13 cm^2
- 13 a 43 m^2
b i \$2 ii \$86

4.3 Properties of 3D solids

- 1 Cube, cuboid, triangular prism, tetrahedron (triangular-based pyramid), square-based pyramid, cylinder
- 2 a, b Nets A, D and F form cubes.
c Students' own answers, for example:



- 3 a–c Students' own answers. Correct nets of cuboids drawn, with dimensions labelled.
- 4 a Net B
b Net C
c Net A
- 5 a 2 cuboids
b 2 cuboids
c 2 triangular prisms
- 6 a CG b GH, AB, CD
c Any two of AD, EH, BC, FG, AE, DH, BF, CG
d EFGH e BF
f vertex g edge
- 7 Three different colours

4.4 Surface area

- 1 **a, b** Students' own answers. Correct nets of cuboids drawn, with dimensions labelled.
- 2 **a** 400 mm²
b 7.5 cm²
- 3 24 cm²
- 4 **a** 54 cm²
b 2400 mm² (or 24 cm²)
c 150 cm²
- 5 **a** n^2 cm²
b surface area = $6n^2$
c 96 cm²
- 6 **a** 34 cm²
b 78 cm²
- 7 **a** 62 cm²
b 7000 mm² (or 70 cm²)
c 59.5 cm²
- 8 **a** 16 cm²
b 4 cm
- 9 **a** wh
b wl
c hl
d $wh + wl + hl$
e $2(wh + wl + hl)$
- 10 No. Even though surface area of box < area of wrapping paper, a net of the box would not fit on the wrapping paper.
- 11 Yes. Surface area of outside of box = 13 400 cm²
- 12 10 800 cm²

4.5 Volume

- 1 **a** 120
b 72
c 32
- 2 **a** 12
b 10 (assuming that there are 2 hidden cubes, or 8 if there are not)
c 20
- 3 **a** 1, 8, 27
b 1, 8, 27
They are the same numbers.
- 4 512 cm³
- 5 **a** 9 cm²
b 3 cm
c 27 cm³

- 6 **a** A 30, B 18, C 36

b

Cuboid	Length	Width	Height	Length × width × height
A	5	3	2	30
B	3	2	3	18
C	4	3	3	36

- 7 **a** A 42 cm³
B 48 000 mm³ (or 48 cm³)
C 31.25 cm³
b **i** Yes. The volumes will be added together.
ii No. Some surfaces will be hidden or joined.
- 8 **a** 450 cm³
b 6.3 m/
c 7.346 litres
- 9 **a** 66 300 cm³
b 66.3 litres
c Yes
- 10 7 cm
- 11 24 cm³
- 12 **a** A 6 cm by 5 cm, B 6 cm by 7 cm, C 7 cm by 5 cm
b 210 cm³
c 214 cm²

4.6 STEM: Measures of area and volume

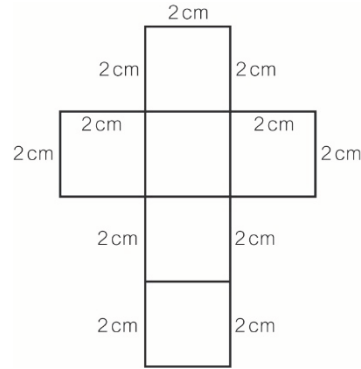
- 1 **a** 250
b 400
c 4.5
d 0.9045
- 2 **a** 10 000
b 100
c 3
- 3 **a** m²
b km²
c cm²
- 4 **a** Yes. 5.3 hectares = 53 000 m²
b 15 625
- 5 192 hectares
- 6 **a** 400 mm²
b 5800 cm²
c 0.017 km²
d 3 500 000 m²

- 7 a i 403.2 cm^2
 ii $40\,320 \text{ mm}^2$
 b $360 \text{ mm} \times 112 \text{ mm} = 40\,320 \text{ mm}^2$
- 8 a 96 (or 90, if the possible arrangement of the quadrats within a rectangular plot is considered)
 b $\frac{1}{8}$ or 12.5%
- 9 a 10 mm, 10 mm, 10 mm
 b i 1 cm^3 ii 1000 mm^3
 c i Multiply by 1000 ii Divide by 1000
 d 100 cm, 100 cm, 100 cm
 e i 1 m^3 ii $1\,000\,000 \text{ cm}^3$
 f i Multiply by 1 000 000
 ii Divide by 1 000 000
- 10 a 8000 mm^3
 b 0.095 cm^3
 c $73\,400\,000 \text{ cm}^3$
 d 0.25 m^3
- 11 No. $\frac{40}{8000} = 0.005 < \frac{5600}{1000000} = 0.0056$

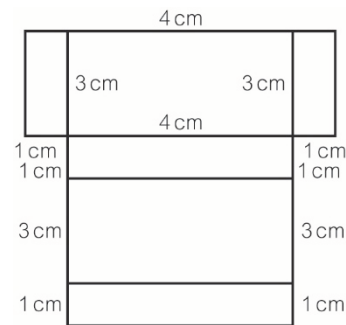
4.7 Plans and elevations

- 1 a i 4 triangles, 1 square
 ii Square-based pyramid
 b i 2 triangles, 3 rectangles
 ii Triangular prism
 c i 2 pentagons, 5 rectangles
 ii Pentagonal prism
 d i 6 triangles, 1 hexagon
 ii Hexagonal-based pyramid
- 2 a Cuboid
 b Triangular-based pyramid
 c Cylinder

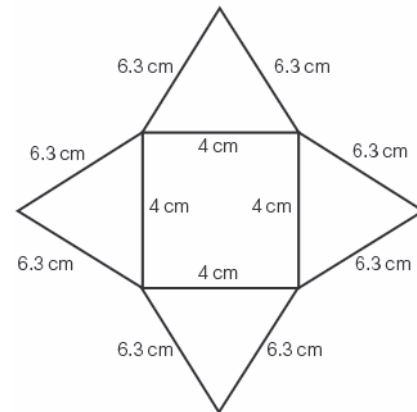
3 a



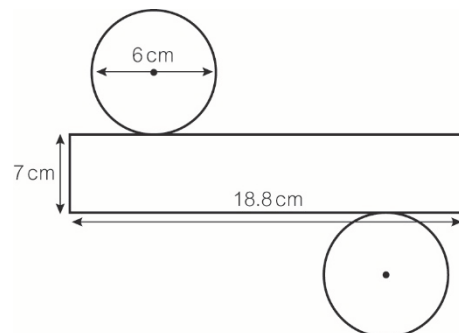
b



c

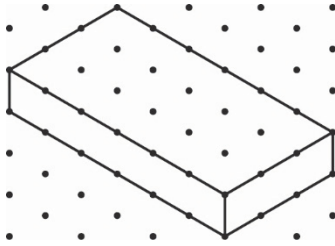


d

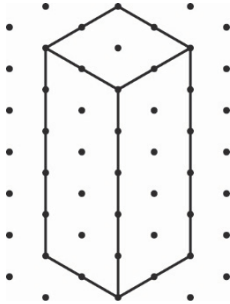


N.B. There are other valid ways of drawing these nets.

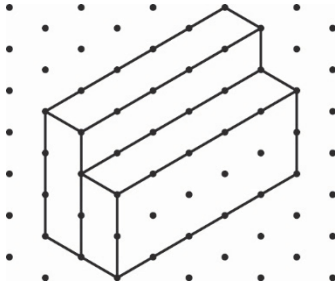
4 a



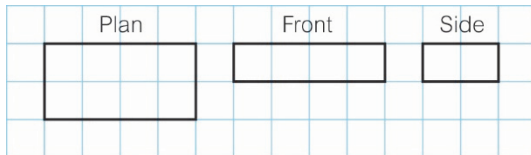
b



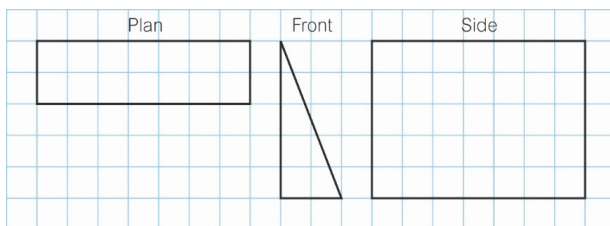
c



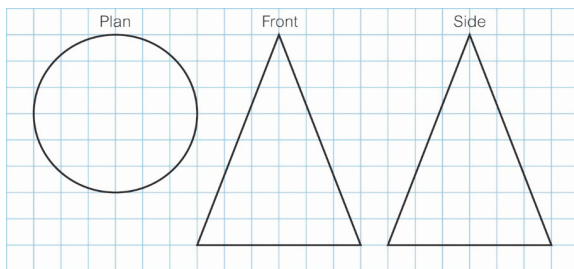
5 a



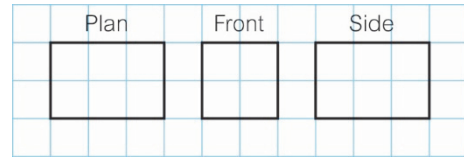
b



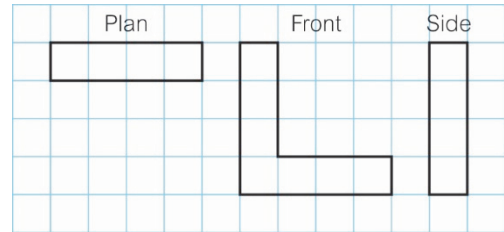
c



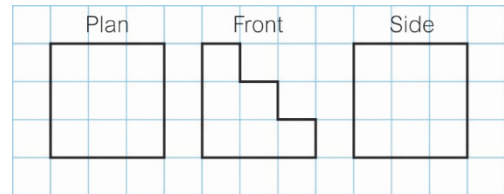
6 a



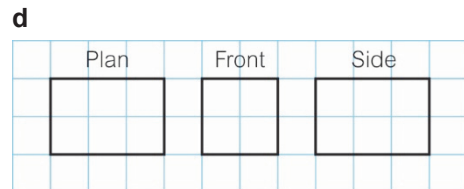
b



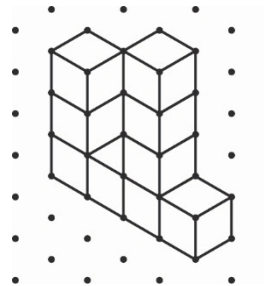
c



d



7



8 a Triangular-based pyramid.

b Square-based pyramid.

c Cone or cylinder or sphere.

d Cuboid or cylinder.

9 Students' own answers, for example, sketches of cylinder, cuboid, triangular prism, trapezoidal prism.

10 a i Square

ii 2 cuboids

b i Square

ii 2 cuboids

c i Rectangle

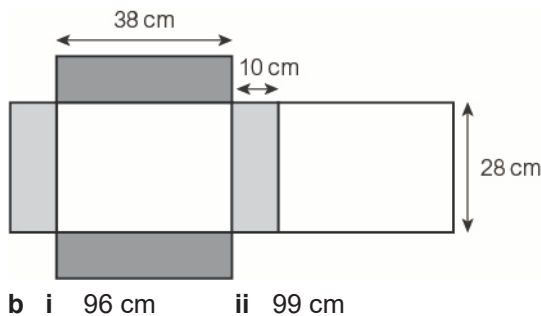
ii 2 triangular prisms

d i Triangle

ii Top left part makes a triangular-based pyramid.

4.8 Solving problems with 3D solids and measures

- 1 a 160 mm^2 b 216 cm^2
- 2 48 cm^3
- 3 No. She needs 160 ml of medicine but the bottle only contains 150 ml.
- 4 150 kg
- 5 a B 2.04
b A 5.25
c B 0.95
- 6 a length 5000 cm, width 2500 cm, depth 200 cm
b 2 500 000 litres
- 7 90 cm^3
- 8 3 cm
- 9 69.24 m^2
- 10 120
- 11 $165\,984 \text{ cm}^3$
- 12 a



- 13 900 cm^3

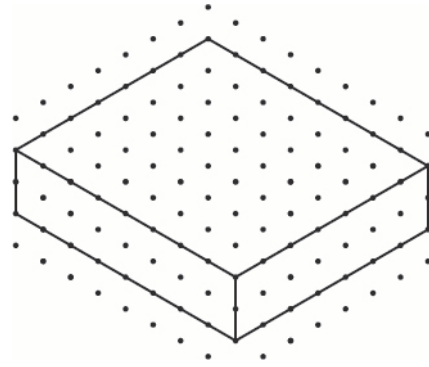
4 Check up Area of 2D shapes

- 1 750 mm^2 (or 7.5 cm^2)
- 2 a 10 cm^2 b 15 cm^2
- 3 144 mm^2

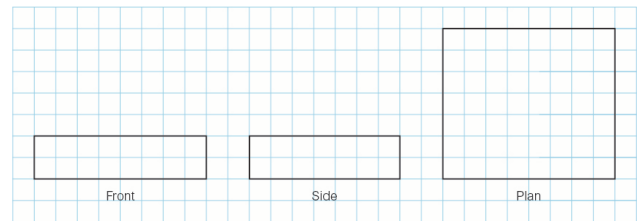
3D solids

- 4 40 cm^2
- 5 Students' own answers. A correct net of triangular prism given, with dimensions.
- 6 a 30 cm^3 b 216 cm^3
- 7 192 cm^3

8 a



b



Measures of area, volume and capacity

- 9 1800 mm^2
- 10 a 600 mm^2 b 90 mm^2 c 3.5 cm^2
d $30\,000 \text{ m}^2$ e $50\,200 \text{ m}^2$ f 0.259 m^2
- 11 a $18\,000 \text{ mm}^3$ b 0.265 cm^3
c $700\,000 \text{ cm}^3$ d 0.931 m^3
e $42\,000\,000 \text{ ml}$ f 3000 cm^3
- 12 a i 3750 m^3 ii $3\,750\,000\,000 \text{ cm}^3$
b 3 750 000 litres

4 Strengthen Area of 2D shapes

- 1 a 24 cm^2 , 12 cm^2
b 5 cm^2 , 2.5 cm^2
- 2 a A
i base length = 6 cm
ii perpendicular height = 2 cm
B
i base length = 4 cm
ii perpendicular height = 7 cm
C
i base length = 10 cm
ii perpendicular height = 4 cm
b A 6 cm^2
B 14 cm^2
C 20 cm^2
- 3 a 15 cm^2 b 21 cm^2
- 4 a–c Sketches of trapezia with perpendicular height labelled h , parallel sides labelled a and b

$$\begin{aligned} 5 \text{ Area} &= \frac{1}{2}(a+b)h \\ &= \frac{1}{2} \times (6+9) \times 4 \\ &= \frac{1}{2} \times 15 \times 4 \\ &= 30 \text{ cm}^2 \end{aligned}$$

6 a 16.5 cm² b 22 cm²

7 area of rectangle = length $\times$ width
 $= 9 \times 3$
 $= 27 \text{ cm}^2$

area of triangle = $\frac{1}{2} \times \text{base} \times \text{height}$
 $= \frac{1}{2} \times 9 \times 4$
 $= 18 \text{ cm}^2$
 total area = area of rectangle
 + area of triangle
 $= 27 + 18$
 $= 45 \text{ cm}^2$

8 a 42.5 cm² b 936 mm²

3D solids

1 None

2 a i Bottom ii Back
 iii Left-hand side

b

Face	Area
Top	$1 \times 5 = 5 \text{ cm}^2$
Bottom	$1 \times 5 = 5 \text{ cm}^2$
Front	$3 \times 5 = 15 \text{ cm}^2$
Back	$3 \times 5 = 15 \text{ cm}^2$
Right	$1 \times 3 = 3 \text{ cm}^2$
Left	$1 \times 3 = 3 \text{ cm}^2$
Total surface area	46 cm^2

3 72 cm²

4 a A $l = 1 \text{ cm}$, $w = 5 \text{ cm}$, $h = 2 \text{ cm}$
 B $l = 2 \text{ cm}$, $w = 4 \text{ cm}$, $h = 2 \text{ cm}$
 C $l = 3 \text{ cm}$, $w = 5 \text{ cm}$, $h = 2 \text{ cm}$

b A: 10 cm³, B: 16 cm³, C: 30 cm³

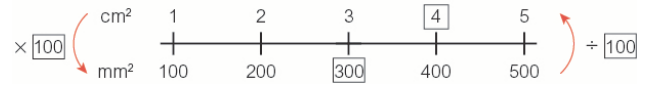
5 a 70 cm³ b 35 cm³ c 27 cm³

6 a 2325 cm² b 7425 cm³

Measures of area, volume and capacity

1 a A 1 cm², B 100 mm²

b



2 a 12 cm², 1200 mm²

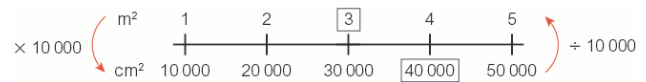
b 5 cm², 500 mm²

3 a 1600 mm², 16 cm²

b 1200 mm², 12 cm²

4 a A 1 m², B 10 000 cm²

b



5 a 2.05 m² = 2.05 $\times$ 10 000 = 20 500 cm²

b 0.07 m² = 700 cm²

c 0.86 m² = 8600 cm²

6 a i 6000 mm³ ii 12 mm³ iii 15.8 cm³

b i 40 000 cm³ ii 12 700 000 cm³

iii 1.4 m³

Enrichment

1 a 2 m³ b 100 cm $\times$ 400 cm $\times$ 50 cm
 c 2 000 000 cm³ d 50 bags e £125
 f £2000

4 Extend

1 a 1.44 cm² b 1.2 cm

2 a 24 cm² b 2 cm

3 2 cm

4 585 mm²

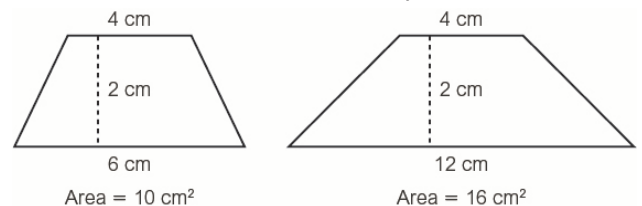
5 Dave is correct.

Area of this trapezium = 10.54 cm²

Area of trapezium with double height = 21.08 cm²

$10.54 \times 2 = 21.08$

6 Students' own answers, for example,



$2 \times 10 \neq 16$

7 2 cm or 20 mm

8 a 24x cm² b 4y cm²

9 a A 15 cm² B 15 cm² b 30 cm²

c Use the formula for the area of a trapezium.

10 a 49 cm^2 b 19 cm^2 c 64 cm^2

11 369 cm^2

12 a length 150 cm, width 70 cm, height 80 cm

b $630\,000 \text{ cm}^3$ c 630 litres

13 a No, it will only hold another 936 litres.

b 806 litres

c £565.81

14 163.2 cm^2

15 6016 mm^2

16 73 mm

17 175

18 22 hours and 40 minutes

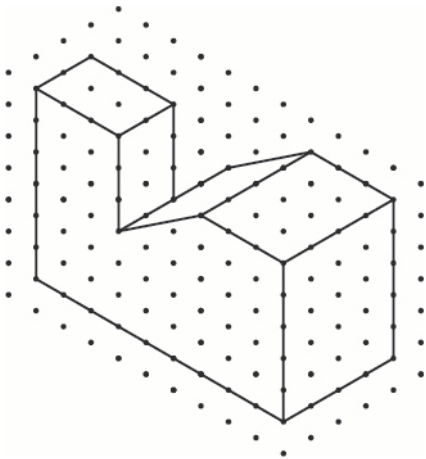
19 a 5 cm^3 b 22 cm^2

c i 2 high and 3 deep, or 3 high and 2 deep
(surface area 62 cm^2)

ii End to end (surface area 122 cm^2)

20 a 200 cm^3 b 168 cm^3 c 144 cm^3

21



22 Base cuboid

area front and back = $2 \times 9 \times 4 = 72 \text{ cm}^2$

area right and left ends = $2 \times 7 \times 4 = 56 \text{ cm}^2$

area bottom = $9 \times 7 = 63 \text{ cm}^2$

area top = $9 \times 7 - 6 \times 3 = 45 \text{ cm}^2$

Top cuboid

area front and back = $2 \times 6 \times 5 = 60 \text{ cm}^2$

area right and left ends = $2 \times 3 \times 5 = 30 \text{ cm}^2$

area top = $6 \times 3 = 18 \text{ cm}^2$

total surface area = 344 cm^2

23 a 140 cm^2 b 162 cm^2 c 294 cm^2

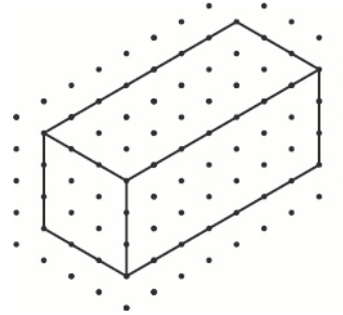
24 1.6 cm

4 Unit test

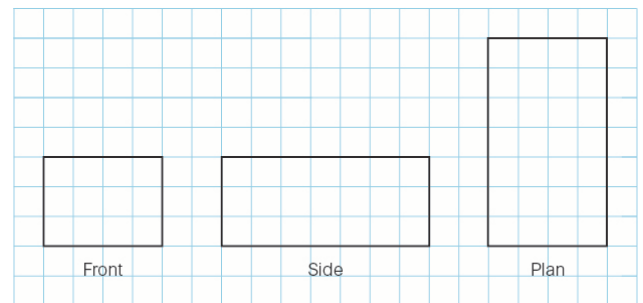
1 a 84 cm^3

b 122 cm^2

c



d



2 a 10 cm^2

b 14 cm^2

3 a 105 cm^2

b 230 mm^2

4 270 cm^2

5 a 48 cm^2

b 35 cm^2

6 a 60 cm^2

b 8 cm

7 324 cm^3

8 a $4\,300\,000 \text{ cm}^3$ b 8.5 cm^3 c 540 cm^3

9 519.86 cm^2

10 20 cm^2

11 15 mm

Unit 5 Graphs

5.1 Direct proportion

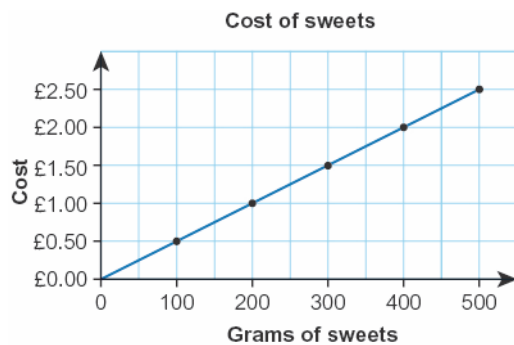
1 a 2040 Yen b £1.75 c £6

2 a 50p or £0.50 b £2.50

c

Grams of sweets	0	100	200	300	400	500
Cost (£)	0	0.50	1	1.50	2	2.50

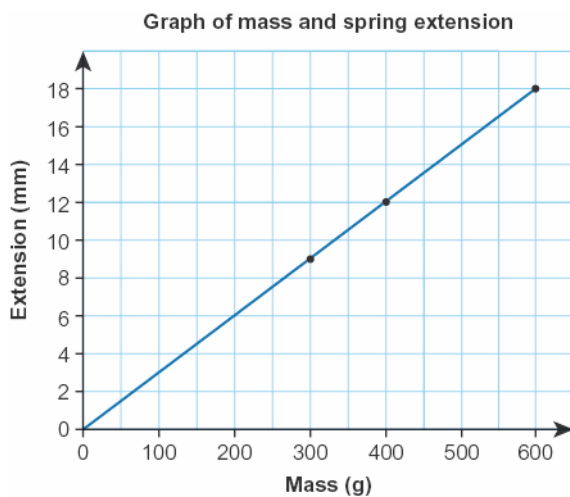
d



3 B and D

4 a Yes b ≈ 10 cm
c ≈ 7 inches d 6 inches
e ≈ 13.25 cm f ≈ 37.5 cm

5 a



b Yes c No

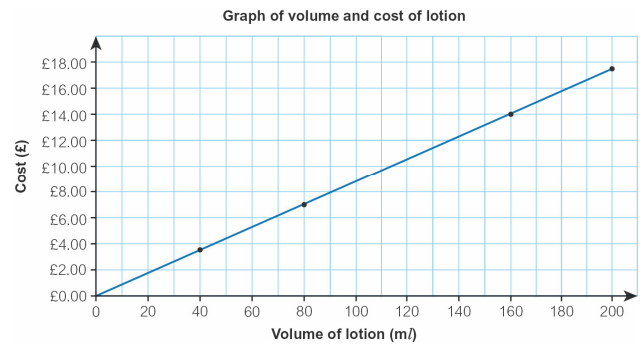
6 a i 86 °F ii 38 °C
b 32 °F c 212 °F

7 a £32 b £8 per hour
c 8 hours

8 a 1 b 3
c 4 d 2

9 a Yes b No
c No d Yes

10 a



b Yes

5.2 Interpreting graphs

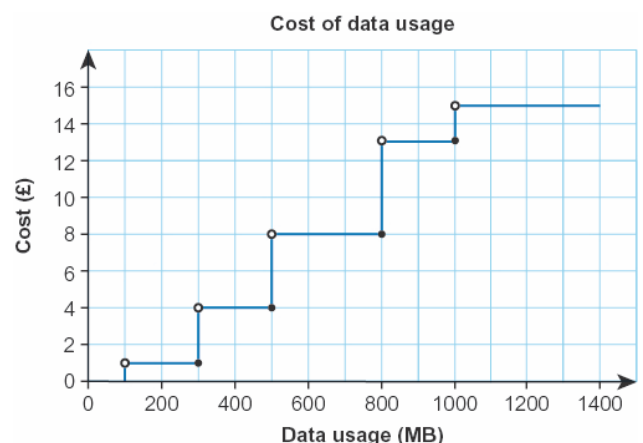
1 A (10, 3); B (35, 4.2); C (23, 3); D (8, 5);
E (46, 0.2)

2 a i £14 ii £10
b Unlimited – pay an infinite amount.
c £12
d 0 minutes
e 150 minutes
f Hana – B, Jeff – A, Matt – A

3 a The share price increased.
b \$11
c 1 September, 1 November
d 1 July, 1 October
e \$480
4 a £300 000 b £500 000
c 2004, 2008, 2009, 2011, 2012, 2013
d 2007
e i Income decreased.
ii Income increased.
f It is hard to predict as the graph goes up and down.

5 a £2 b £4 c 6–8 hours

6

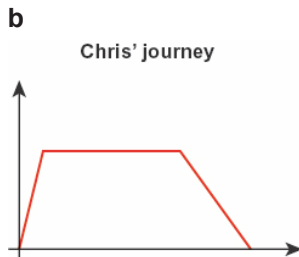


5.3 Distance–time graphs

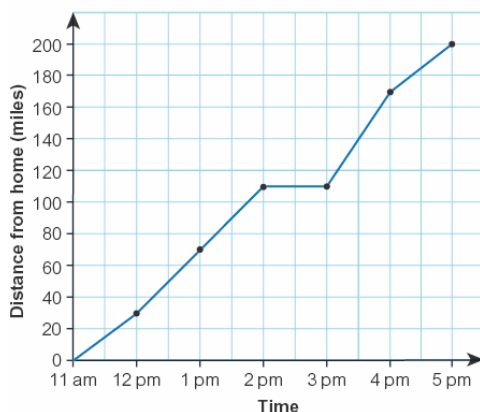
- 1 11.10 am
- 2 a 0.5 hours b 3 hours c 2.25 hours
- 3 a 800 m
b Stays the same/does not change
c 15 minutes d 10 minutes
e 10 minutes f 30 minutes
- 4



- 5 a 150 km b 2 hours
c i 0 km/h ii 50 km/h
iii 16.7 km/h (3 s.f.)
- 6 a Sania: The time to get to the friend's house is the same as the time to get home.
Karl: The time at the friend's house is not long enough.



- 7 a
- Michaela's journey



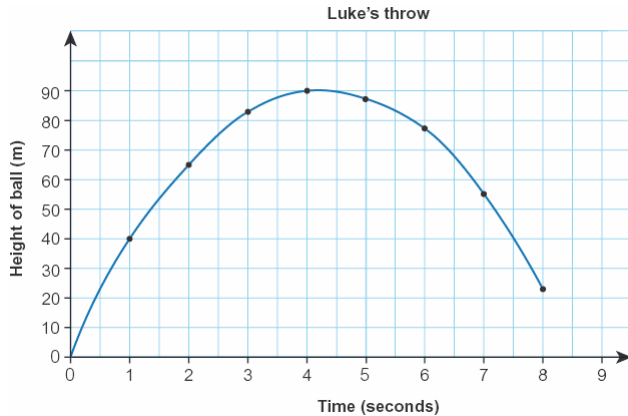
- b 2 pm–3 pm c 3 pm–4 pm
d i 36.7 mph ii 32.5 mph

- 8 a i 1.5 m/s ii 1.2 m/s
b Between 0 and 10 seconds
c 100 m d 1 m/s
- 9 a 600 km b 4.20 pm c 350 km
d Train A = 133.3 km/h; Train B = 171.4 km/h
- 10 a 42 km b 9.45 am
c A $2\frac{3}{4}$ h B $2\frac{1}{4}$ h C $3\frac{1}{4}$ h
d i Around 11.22 am ii 21.5 km

5.4 Rates of change

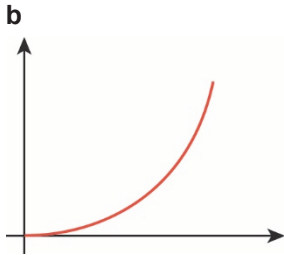
- 1 a $\approx$ £2550 b $\approx$ 8.3 years
c £2000 d $\approx$ £2100
- 2 a i C ii A iii B
b D The runner starts off quickly, stops for a while and then runs quickly to the finish.
E The runner starts off slowly, then runs quickly and then runs slowly again to the finish.
- 3 a A, B and F b E and H
c After 5 minutes (part C). The water level rises quickly.
d 8 minutes
e A – water fills up the bath quickly
B – water fills up the bath more slowly
C – person gets in
D – person sits in bath
E – some water let out of bath
F – water tops up the level of the bath
G – person gets out of the bath
H – the bath begins to empty
- 4 a $\approx$ £12 000 b 0–2 years
c After 3 years d No
- 5 a 1 b A – 1; B – 2
- 6 a Narrow part b Graph B

7 a



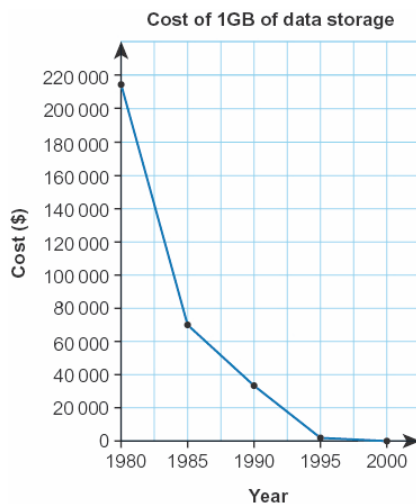
- b No – it is not a linear graph.
 c Because Luke's arm is 1 m above the ground when he throws the ball.
 d Approximately 1.4 seconds and 7.2 seconds
 e One is on the way up, the other is on the way down.
 f ≈ 8.6 seconds

8 a 2 A; 3 B; 4 C



5.5 Misleading graphs

- 1 a Saturday b 2
 c He received more.
 2 No title; no labels or key; percentages add up to more than 100; sectors are not in proportion.
 3 a It does not increase by the same number. You multiply by 10.
 b



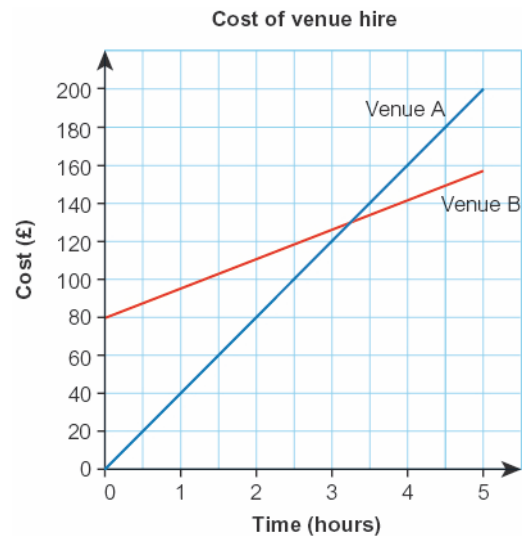
- c It decreased (rapidly).

- 4 a The first graph
 b The second graph
 c £750
 d 7.4%

5 Check up Direct proportion

- 1 a i 16 km ii 3 miles
 iii 1.6 km iv 50 miles
 b It is a straight-line graph that goes through (0, 0).

2 a

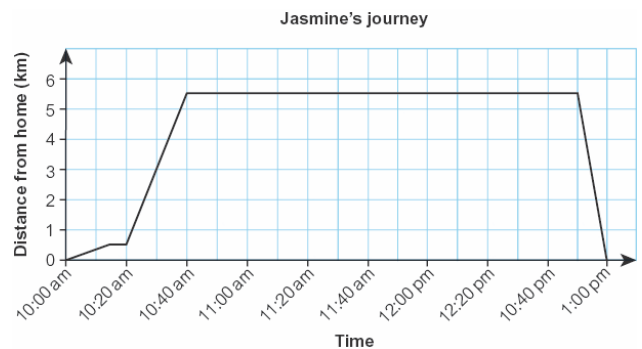


- b Venue A
 c Venue B
 d ≈ 3 hours 15 minutes
 e Venue B, £80

Distance–time graphs

- 3 a 45 km
 b 15 minutes
 c 1 hour 15 minutes
 d Between the pizza shop and his brother's house. This is the steepest part of the graph.

4



- 5 a 550 km b 3 times c 61.1 km/h

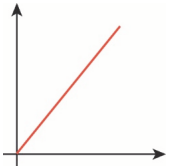
Real-life graphs

- 6 a i The number of visitors increased.
ii The number of visitors decreased.
b i ≈ 0.85 million
ii ≈ 0.65 million

7 Vase 1, Graph B; Vase 2 Graph A

5 Strengthen Direct proportion

1 a, b

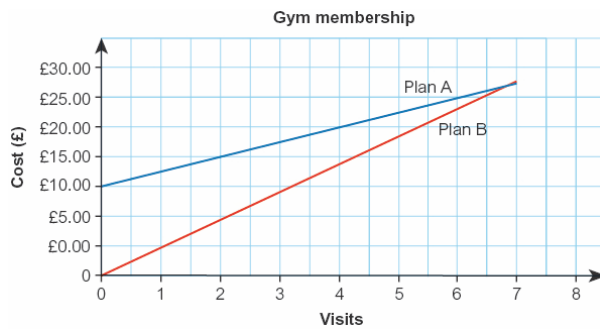


c Straight line through (0,0) (or the origin)

2 C and D

3 a £225 b £150 c 50 minutes

4 a–d

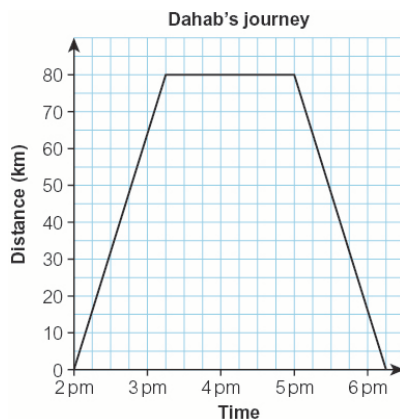


e Plan B b Plan A, £10
g 7

Distance–time graphs

- 1 a i C ii A iii B
b 10 minutes c 40 minutes
d 1 km e 9 km
f 9 km in 20 minutes; 9 km in 40 minutes
g On the way there
h Fastest

2 a–c



- 3 a 2 times b 5 miles c 240 miles
d 6 minutes e 6.5 hours f 36.9 mph

Real-life graphs

- 1 a 5
b i £116 000 ii £158 000
c £4000 d 2003 e 2007
- 2 a £50 b Approximately £280
c All the values in the table are approximate.

Age of bike (years)	0	1	2	3	4	5
Cost (£)	280	220	175	145	120	100

Age of bike (years)	6	7	8	9	10
Cost (£)	80	70	60	55	55

- d Between 0 and 1 years
e The line is the steepest
f No

- 3 a $\approx 52\%$ b $\approx 3\%$
c Between 1995 and 2000
d The percentage increased.
e 65%

- 4 a i Red line ii Blue line
b i $\approx 16^\circ\text{C}$ ii $\approx 8^\circ\text{C}$
c i July ii February
d July

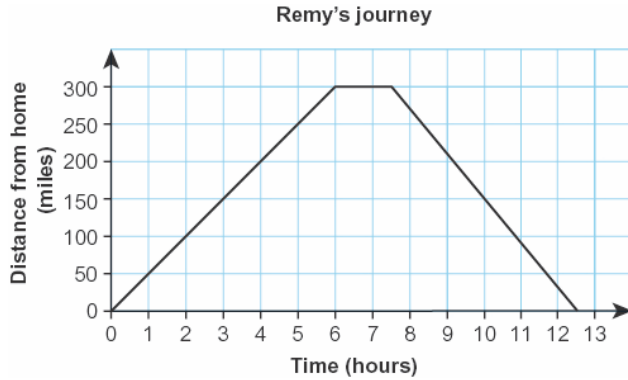
Enrichment

- 1 a ≈ 340 yuan
b ≈ 3740 yuan
c ≈ 480 Indian rupees
d ≈ 1700 Indian rupees
e ≈ 9500 Indian rupees
f $\approx £10$

5 Extend

- 1 a i August ii April
b i 9°C ii 11.5°C
c i ≈ 59 mm ii ≈ 122 mm
- 2 a 150 mph b 100 miles

3 a



b 48 mph

4 a 921.7 km/h

b 866.5 mm/day

c 26.2 m/s

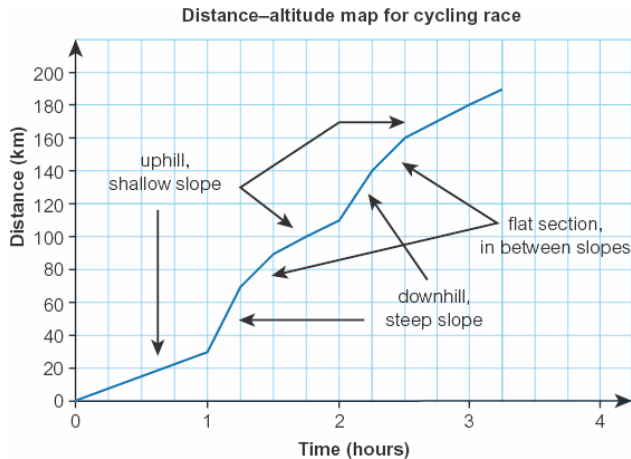
5 a 8.3 m/s b 0.0083 km/s

c 0.5 km/min d 30 km/h

6 a 190 km b 400 m

c The first one

d Students' own answer, for example:



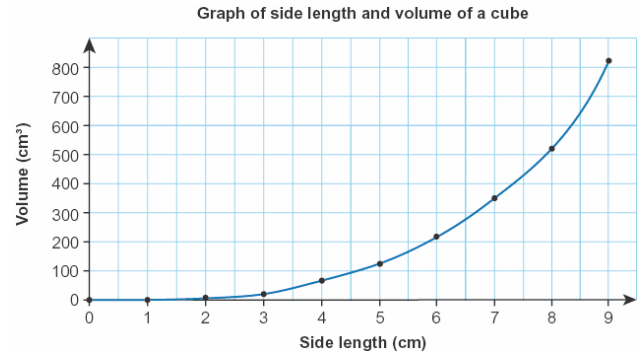
7 a i 19 °C ii 28 °C

b i 56 mm ii 65 mm

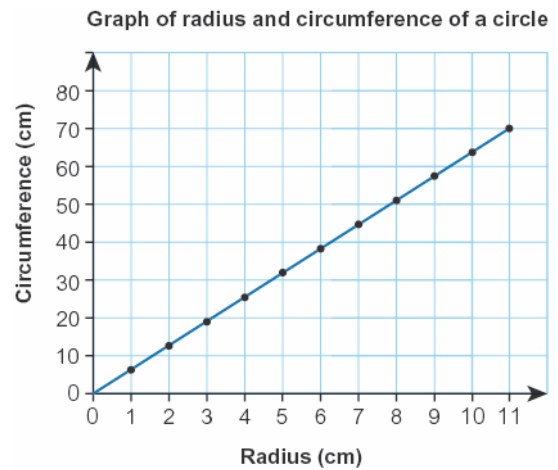
c Because the scales are very different.

d It is warmer but not always wetter in Florida.

8 a i



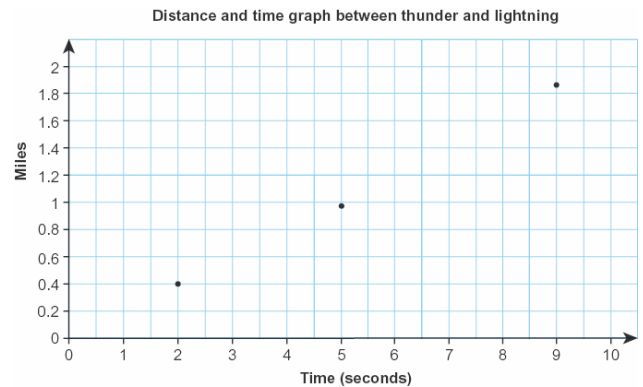
ii



b i No

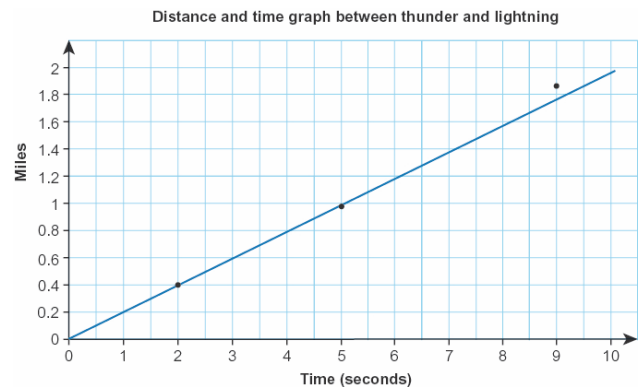
ii Yes

9 a



b No

c

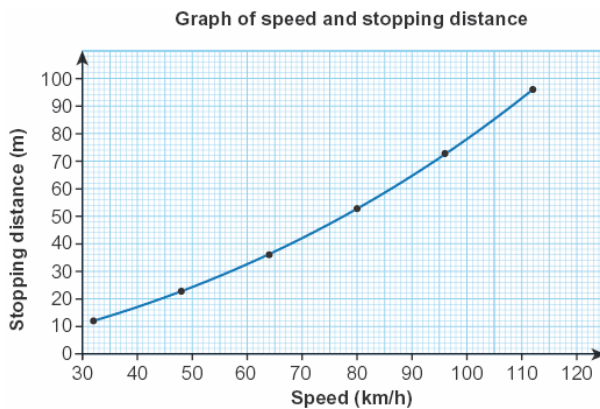


- 10 a i 30% ii 20%
- b The percentage of the population aged 0–14 decreased.
- c 40–64 and 65+
- d Older. The percentage of the population aged 40+ is increasing and the percentage aged 0–39 is decreasing.

- 11 a Decreases b $\approx 65 \text{ N/cm}^2$ c No
- d You cannot put a force on an area of 0 cm^2 .
- e i They will mark the floor because a lot of force goes through a small area (the heel).
- ii A sharp knife has a smaller area so the same force will generate a higher pressure.
- iii They put a large force through a small area – their toes.

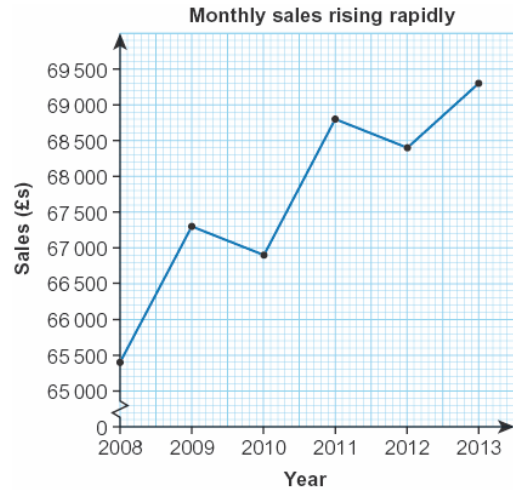
- 12 a 100 million websites.
- b Multiply by 10 every square.
- c 1992
- d i ≈ 200 million
- ii ≈ 120 million
- iii $\approx 300\,000$
- e Students' own answer, e.g. 'Left hand graph for (i) and (ii), right-hand graph for (iii).'
- f Approximately 1 000 000 000

13 a

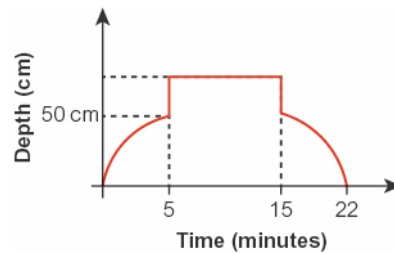


- b No
- c Yes
- d No, braking distance = (stopping distance) – (thinking distance)
- Because stopping distance is not in direct proportion, braking distance will not be in direct proportion.

14



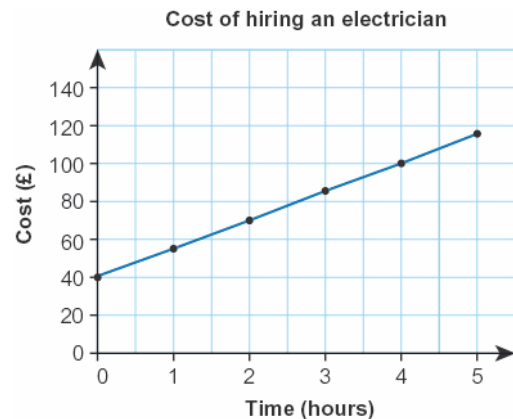
15



- 16 a 1 second
- b Just before and just after it hits the ground the first time.
- c 0 m/s
- d The maximum height would continue to decrease.

5 Unit test

- 1 a i 15.5. Accept 15.3–15.7
- ii 17.1. Accept 17.0–17.2
- b March and September
- c Lerwick d Lerwick
- 2 a 1 hour b First part c 45 km/h
- 3 A – iv B – i C – iii D – ii
- 4 a



- b £40 c £15 per hour
- d No, the graph does not go through the origin.

- 5 a** 158. Accept 157–159
b School A
c 2012
d i School A – increasing
ii School B – decreasing
- 6 a i** £25 **ii** £32
b 1.6 GB
- 7** A and C
- 8 a i** £30 000
ii £12 000
iii £2000
b Increasing

Unit 6 Fractions and decimals

6.1 Rounding decimals

- 1 a 4 b 5 c 5 d 6
 2 a 12 b 3 c 7 d 11
 e 37
 3 a 5.6 b 3.9 c 0.7 d 9.0
 e 10.0
 4 3.35, 3.36, 3.37, 3.38, 3.39, 3.40, 3.41, 3.42, 3.43, 3.44
 5 a 2.95 b 0.80 c 13.00 d 14.02
 6 a 0.71 b 0.82
 7 a 7 is the nearest whole number, but is not written to 2 decimal places.
 b 7.00

8 £1.10

9 a

Country	Population (numbers)	Population (numbers and words)
Italy	60 000 000	60 million
Canada	34 300000	34.3 million
Sri Lanka	20 400 000	20.4 million
Norway	5 100 000	5.1 million
Fiji	900 000	0.9 million

- b Sweden 9 700 000, 9.7 million
 Barbados 300 000, 0.3 million

10 2.646

- 11 a Athlete B
 b No
 c Yes. Both athletes have a time of 9.75 seconds.

12 A 4.286 and D 4.293

- 13 a 3.150–3.249 inclusive
 b 2.500–2.549 inclusive
 c 2.450–2.499 inclusive
 d 3.245–3.249 inclusive
 e 3.250–3.254 inclusive

14 a 2375 b 2400

6.2 Multiplying and dividing decimals

- 1 a 315 b 1484
 c 544 d 1005
 2 a $50 \times 1 = 50$
 b $5 \times 7 = 35$
 c $20 \times 0.5 = 10$
 d $130 \times 10 = 1300$
 3 a 0.22 b 0.452 c 3.6
 d 280 e 720 000 f 23 100
 4 a 8.14 b 10.5 c 22.382
 d 30.794 e 2.8608 f 33.128
 5 121.44
 6 a $3 \times 5 = 15$
 b 166 912
 c 16.6912
 7 a 12 663 m b 89.375 m
 8 a 144.4 b 60 c 210
 d 52 e 356 f 13.168
 g 152.9 h 0.2 i 103.6
 9 a 8.853 b 12.68676 c 45.67266
 d 67.38208 e 2.933775 f 168.72966
 10 a 145.152 cm^3 b 3.7 m

6.3 Converting fractions to decimals

- 1 a 2.5 b 0.4 c 0.5
 2 a $9x$ b $99x$
 3 a $\frac{5}{3}$ b $\frac{23}{99}$ c $\frac{326}{999}$
 4 a 0.125 b 0.375
 c 0.0833 (3 s.f.) d 0.417 (3 s.f.)
 5 a $0.\dot{6}$ b $0.\dot{1}\dot{7}$ c $0.\dot{5}4\dot{8}$
 6 a $0.1\dot{6}6\ 666\dots$ or $0.1\dot{6}$
 b $1.\dot{6}66\ 666\dots$ or $1.\dot{6}$
 7 a $0.\dot{0}\dot{9}, 0.\dot{1}\dot{8}$
 b $0.\dot{2}\dot{7}, 0.\dot{3}\dot{6}, 0.\dot{4}\dot{5}, 0.\dot{5}\dot{4}, 0.\dot{6}\dot{3}, 0.\dot{7}\dot{2}, 0.\dot{8}\dot{1}, 0.\dot{9}\dot{0}$
 8 92p

9

flour	117 g
butter	88 g
sugar	105 g
eggs	2
vanilla	29 ml

10 a $\frac{1}{9}$ b $\frac{2}{3}$

11 a $\frac{17}{99}$ b $\frac{277}{333}$ c $\frac{26}{111}$

12 a $\frac{1}{6}$ b $\frac{7}{30}$ c $\frac{41}{90}$

13 a $3\frac{4}{9}$ b $6\frac{14}{99}$ c $12\frac{35}{99}$

14 \$99 = £73

15 \$33 = £26

6.4 Multiplying fractions

1 a 75 kg b 20 cm c 21 m/

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

d $1\frac{3}{10}$ e $12\frac{1}{2}$ f $6\frac{1}{3}$

3 a 8 b 18 c 20

d 6 e 10 f 9

g 4 h 40

4 a $\frac{1}{4}$ b $\frac{1}{6}$ c $\frac{1}{8}$

d $\frac{3}{8}$ e $-\frac{1}{6}$ f $-\frac{5}{12}$

5 a Yes; $0.1 = \frac{1}{10}$, so $50 \times 0.1 = 50 \times \frac{1}{10}$.

b 10

c Purple

6 a $7\frac{1}{5}$ b $9\frac{3}{4}$ c $16\frac{2}{3}$

d $4\frac{2}{3}$

7 $26\frac{1}{4}$

8 a $\frac{3}{4}$ b $\frac{1}{6}$ c $\frac{1}{2}$

d $\frac{2}{7}$ e $\frac{1}{7}$ f $\frac{1}{6}$

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

b The writer gets £1000, the singer gets £250 and the guitarist gets £250.

10 a $\frac{7}{12}$ b $-\frac{1}{4}$ c $\frac{8}{81}$

d $-\frac{5}{27}$ e $\frac{3}{10}$ f $\frac{3}{32}$

11 a $\frac{7}{18} \text{ m}^2$ b $\frac{2}{9} \text{ m}^2$

6.5 Dividing by fractions

1 C

2 a $\frac{4}{15}$ b $\frac{5}{42}$

c $\frac{99}{176} = \left(\frac{9}{16}\right)$ d $\frac{45}{360} = \left(\frac{1}{8}\right)$

3 a $\frac{3}{2}$ b $\frac{1}{4}$ c $\frac{7}{1} (= 7)$

d $\frac{1}{8}$ e $\frac{1}{11}$

4 a $\frac{2}{3}$ b $\frac{3}{8}$ c $\frac{5}{26}$

d $\frac{13}{50}$

5 a 27 b 9

c $\frac{3}{10}$ d 5

e $\frac{49}{16} = \left(3\frac{1}{16}\right)$ f $\frac{55}{2} = \left(27\frac{1}{2}\right)$

6 a $\frac{8}{3} = 2\frac{2}{3}$ b $\frac{9}{13}$

c $\frac{112}{27} = 4\frac{4}{27}$ d $\frac{8}{3}$

7 67

8 312.5

6.6 Adding and subtracting fractions

1 a $\frac{5}{12}$ b $\frac{4}{7}$

2 48

3 a $\frac{5}{6}$ b $\frac{13}{15}$ c $\frac{11}{20}$

d $\frac{3}{10}$

4 a $\frac{2}{3}$ b $\frac{21}{40}$

5 a $\frac{3}{2} = 1\frac{1}{2}$ b $\frac{91}{90}$

c $\frac{27}{20} = 1\frac{7}{20}$ d $\frac{25}{18} = 1\frac{7}{18}$

6 a $\frac{28}{15} = 1\frac{13}{15}$ b $\frac{175}{24} = 7\frac{7}{24}$

c $\frac{149}{9} = 16\frac{5}{9}$ d $\frac{48}{5} = 9\frac{3}{5}$

7 a Any one of:

$\frac{7}{10} + \frac{27}{30} = 1\frac{3}{5}$ $\frac{7}{10} + \frac{5}{12} = 1\frac{7}{60}$

$\frac{7}{10} + \frac{11}{15} = 1\frac{13}{30}$ $\frac{27}{30} + \frac{5}{12} = 1\frac{19}{60}$

$\frac{27}{30} + \frac{11}{15} = 1\frac{19}{30}$ $\frac{5}{12} + \frac{11}{15} = 1\frac{3}{20}$

b $\frac{27}{30} + \frac{11}{15} = 1\frac{19}{30}$

c Any one of:

$\frac{27}{30} - \frac{7}{10} = \frac{1}{5}$ $\frac{27}{30} - \frac{5}{12} = \frac{29}{60}$

$\frac{27}{30} - \frac{11}{15} = \frac{1}{6}$ $\frac{7}{10} - \frac{5}{12} = \frac{17}{60}$

$\frac{11}{15} - \frac{7}{10} = \frac{1}{30}$ $\frac{11}{15} - \frac{5}{12} = \frac{19}{60}$

d $\frac{27}{30} - \frac{5}{12} = \frac{29}{60}$

8 a $1\frac{11}{12}$ b $1\frac{11}{20}$

c $\frac{3}{4}$ d $\frac{3}{10}$

9 a $\frac{2}{5}$

b 30, as the LCM of 15, 10 and 6 is 30, and a normal class size is around 30 students.

6.7 Calculating with mixed numbers

1 a $1\frac{1}{6}$ b $\frac{7}{8}$ c $\frac{3}{20}$

d $\frac{1}{10}$ e $\frac{2}{3}$ f $2\frac{2}{3}$

2 a $\frac{1}{2}$ cm b 13 cm

3 a $\frac{11}{2}$ b $\frac{19}{8}$ c $\frac{55}{6}$

d $\frac{43}{4}$

4 a $5\frac{3}{4}$ b $6\frac{5}{6}$ c $7\frac{1}{2}$

d $8\frac{7}{15}$ e $8\frac{11}{72}$ f $1\frac{1}{4}$

g $6\frac{1}{40}$

5 a $6\frac{1}{4}$ hours b 21.30

6 a $\frac{11}{12}$ b $\frac{1}{10}$ c $3\frac{9}{10}$

d $-2\frac{1}{2}$ e $4\frac{1}{16}$ f $1\frac{2}{21}$

g $-3\frac{5}{12}$ h $-2\frac{2}{9}$

7 $9\frac{1}{21}$ miles

8 a $7\frac{1}{2}$ kg b $24\frac{3}{5}$ m c 16

d $6\frac{1}{4}$ e 5 f $11\frac{9}{10}$

9 25 seconds

10 $15\frac{5}{16}$ cm²

11 a $3\frac{1}{8}$ b $3\frac{2}{15}$ c $21\frac{1}{3}$

d $6\frac{7}{8}$ e $26\frac{1}{24}$ f $5\frac{19}{25}$

12 $\frac{5}{12}$ of a mile

13 $\frac{7}{8}$ of a pint

14 a $8\frac{4}{9}$ m b $7\frac{1}{3}$ m

6.8 Solving problems with fractions and decimals

- 1 a 9.46 b 81
- 2 a $\frac{3}{20}$ b $\frac{8}{7}$
- 3 a $\frac{5}{27}$ b $\frac{39}{44}$
- 4 a 13.9 is to 1 decimal place.
b 13.89
- 5 \$41.67
- 6 61.74 m³
- 7 250
- 8 0.7 $\dot{3}$
- 9 $\frac{232}{99}$
- 10 6
- 11 $\frac{1}{4} \times \frac{1}{3} = \frac{1}{12}$ so Denil is incorrect.
- 12 30
- 13 1050
- 14 1.25 l
- 15 214 500 000

6 Check up Rounding decimals

- 1 a 6.83 b 0.02 c 12.26
- 2 49p
- 3 0.29

Multiplying and dividing decimals

- 4 a 5.58 b 12.22
- 5 a 27.83 b 89

Converting fractions to decimals

- 6 a 0.222 222...
b 0.833 333...
- 7 a 0.142 857 142 857
b 0.068 181 818 181
- 8 a $\frac{7}{9}$ b $\frac{7163}{9900}$

Multiplying fractions

- 9 a $\frac{1}{4}$ b $\frac{1}{2}$ c $\frac{3}{4}$
- d $\frac{2}{11}$
- 10 a $2\frac{3}{20}$ m b $\frac{9}{32}$ m²
- 11 $\frac{1}{6}$

Dividing by fractions

- 12 a 12 b 25 c $8\frac{2}{5}$
- 13 a $\frac{1}{24}$ b $\frac{4}{27}$ c 10
- d $2\frac{21}{52}$ e $\frac{1}{2}$ f $\frac{2}{7}$
- 14 15

Adding and subtracting fractions

- 15 a $\frac{13}{20}$ b $\frac{1}{12}$ c $\frac{17}{18}$
- d $\frac{19}{30}$ e $\frac{1}{15}$ f $\frac{11}{24}$
- g $\frac{1}{2}$ h $\frac{29}{36}$
- 16 $\frac{1}{6} + \frac{1}{4} = \frac{2}{12} + \frac{3}{12} = \frac{5}{12}$
- 17 a $1\frac{19}{30}$ b $1\frac{7}{24}$ c $\frac{7}{30}$
- d $\frac{19}{40}$ e $\frac{59}{120}$ f $1\frac{27}{56}$
- g $1\frac{23}{40}$ h $1\frac{37}{72}$
- 18 $\frac{26}{63}$

Calculating with mixed numbers

- 19 a $\frac{171}{35} = 4\frac{31}{35}$ b $\frac{27}{176}$

Solving problems with fractions and decimals

20 28

21 $\frac{15}{32}$

6 Strengthen
Rounding decimals

1 9.34, 0.01

2 a 0.35 b 0.37 c 0.34

3 £0.79

4 a £0.83 b £11.67

Multiplying and dividing decimals

1 28.1634

2 4.1

Converting fractions to decimals

1 b and c

2 a 0.777 777 777 777

b 0.133 333 333 333

c 0.131 313 131 313

d 0.123 333 333 333

e 0.231 313 131 313

f 0.317 317 317 317

3 a $0.0\dot{6}$ b $0.\dot{1}4285\dot{7}$

4 a $0.1\dot{6}$ b $0.\dot{6}$ c $\frac{2}{3}$

d No, $\frac{3}{6} = \frac{1}{2} = 0.5$

5 $\frac{4}{9}$

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

7 a $\frac{23}{99}$ b $\frac{74}{99}$ c $\frac{9}{11}$

8 a $\frac{1}{6}$ b $\frac{61}{90}$ c $\frac{7}{15}$

Multiplying fractions

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

d $1\frac{7}{11}$ e $1\frac{3}{7}$ f $4\frac{1}{2}$

g 36

2 a $\frac{5 \times 3}{6 \times 5} = \frac{3 \times 5}{6 \times 5} = \frac{1}{2}$ b 1 c $\frac{1}{9}$

d $\frac{4}{5}$ e $\frac{2}{7}$

Dividing by fractions

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

d $\frac{1}{12}$ e 3 f 2

g 8 h $\frac{1}{6}$

2 a $\frac{3}{5} \times \frac{7}{2} = \frac{21}{10} = 2\frac{1}{10}$

b $\frac{8}{9} \times \frac{5}{1} = \frac{40}{9} = 4\frac{4}{9}$

c $\frac{3}{20}$ d $2\frac{4}{7}$ e $\frac{25}{51}$

Adding and subtracting fractions

1 a D, 1 b C, $\frac{2}{3}$ c A, 1

d E, $\frac{1}{2}$ e B, $\frac{3}{4}$

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

3 $\frac{5}{6}$

4 a $\frac{5}{9}$ b $\frac{7}{10}$ c $\frac{7}{8}$

d 1

5 a $\frac{3}{8}$ b $\frac{1}{10}$ c $\frac{1}{2}$

d $\frac{1}{9}$

6 a $\frac{6}{14} + \frac{7}{14} = \frac{13}{14}$ b $\frac{4}{12} + \frac{3}{12} = \frac{7}{12}$

c LCM is 30; $\frac{9}{30} + \frac{20}{30} = \frac{29}{30}$

7 a $\frac{19}{24}$ b $\frac{19}{60}$ c $-\frac{4}{33}$

Calculating with mixed numbers

- 1 a 4 b $4\frac{3}{5}$ c 8
- 2 a $4\frac{1}{12}$ b $6\frac{1}{2}$ c $4\frac{3}{70}$
- d $14\frac{7}{30}$ e $12\frac{1}{16}$
- 3 a $\frac{10}{2} - \frac{7}{2} = \frac{3}{2} = 1\frac{1}{2}$
- b $3\frac{1}{3}$ c $8\frac{1}{2}$ d $3\frac{7}{10}$
- e $\frac{3}{4}$ f $\frac{51}{70}$
- 4 a 3 hours 15 minutes
- b 1 hour 45 minutes or $1\frac{3}{4}$ hours

Solving problems with fractions and decimals

1 $\frac{5}{9}$

2 30 cm

Enrichment

1 $\frac{9}{20}$

2 a 15 hours b $\frac{1}{3}$ c $\frac{7}{24}$

- 3 a 12.5 cents
- b 37.5 cents
- c 310
- d $\$3\frac{3}{16}$

6 Extend

1 a

	Full calculator display	Rounded to 2 decimal places
$\sqrt{2}$	1.414 213 562	1.41
$\sqrt{3}$	1.732 050 808	1.73
$\sqrt{5}$	2.236 067 977	2.24
$\sqrt{6}$	2.449 489 743	2.45

b $\sqrt{4} = 2$, so it is an exact value.

2 a

Original number	Rounded to 1 d.p.	Rounded to nearest whole number
6.45–6.49	6.5	6
6.5–6.549	6.5	7

b Students can have different answers and be correct.

3 9.65, 9.66, 9.67, 9.68, 9.69, 9.70, 9.71, 9.72, 9.73, 9.74

4 a 3880.8 cm^3 b 1 : 8

5 819

6 $\frac{1}{14} = 0.071\ 428\ 571\dots$; $\frac{2}{14} = 0.142\ 857\ 142\dots$;
 $\frac{3}{14} = 0.214\ 285\ 714\dots$; $\frac{4}{14} = 0.285\ 714\ 285\dots$;
 $\frac{13}{14} = 0.928\ 571\ 428\dots$

The digits begin to follow the same cyclic sequence (...714285...).

7 a $\frac{223}{990}$ b $\frac{334}{495}$ c $\frac{247}{495}$

d $\frac{73}{300}$

8 $\frac{5}{7}$

9 a

Fraction	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{4}$	$\frac{1}{5}$	$\frac{1}{6}$	$\frac{1}{7}$
Decimal	0.5	$0.\dot{3}$	0.25	0.2	$0.1\dot{6}$	$0.\dot{1}4285\dot{7}$

Fraction	$\frac{1}{8}$	$\frac{1}{9}$	$\frac{1}{10}$	$\frac{1}{12}$	$\frac{1}{20}$
Decimal	0.125	$0.\dot{1}$	0.1	$0.08\dot{3}$	0.05

b 3, 6, 7, 9, 12

c 2, 4, 5, 8, 10, 20

d 2; 3; 4: 2×2 ; 5; 6: 2×3 ; 7; 8: $2 \times 2 \times 2$;
 9: 3×3 ; 10: 2×5 ; 12: $2 \times 2 \times 3$; 20: $2 \times 2 \times 5$

e Yes, Dan is correct.

10 a $\frac{1}{12}$ b $\frac{193}{430}$ c $\frac{4}{27}$ d $\frac{3}{20}$

11 $\frac{1}{18}$

12 a 10 cakes cut into sevenths gives 70 pieces, which is not enough for 75 people.

- b** 8
c 5

13 a

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

b Students' own answers

14 20

15 a $\frac{29}{75}$ **b** 2

16 a 1 **b** No; you cannot divide by 0.

17 a $\frac{1}{3}$ cm **b** $\frac{8}{27}$ cm³ **c** $\frac{1}{4}$ km

18 a

Fraction	Decimal
$\frac{1}{3}$	0.333...
$\frac{2}{4}$	0.5
$\frac{3}{5}$	0.6
$\frac{4}{6}$	0.666...
$\frac{5}{7}$	0.714...
and so on	

The size of the fraction is increasing; the denominator *increases* each time as a proportion of the numerator.

b

Fraction	Decimal
$\frac{6}{5}$	1.2
$\frac{7}{6}$	1.166...
$\frac{8}{7}$	1.142...
$\frac{9}{8}$	1.125
$\frac{10}{9}$	1.111...
and so on	

The size of the fraction is decreasing; the denominator decreases each time as a proportion of the numerator.

6 Unit test

1 a 89.37

b 23.12

c 0.37

2 a 2.456

b 0.024

c 156.235

3 a 9.72

b 217.26

4 a 90.3

b 6310

5 a $0.1\dot{6}$

b $0.\dot{2}\dot{3}$

c $0.\dot{1}3\dot{6}$

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

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

c $-\frac{7}{15}$

d $\frac{5}{12}$

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

b $1\frac{3}{5}$

c $-\frac{27}{28}$

d $1\frac{1}{24}$

8 a 0.555 555...

b 0.416 666...

c 0.466 666...

d 0.727 272...

9 $8\frac{15}{28}$

10 a $7\frac{11}{15}$

b $12\frac{5}{12}$

c $17\frac{11}{18}$

d $-2\frac{27}{40}$

11 a $\frac{1}{18}$

b $\frac{1}{12}$

c $\frac{2}{5}$

d $\frac{11}{48}$

12 a $\frac{3}{4}$

b $\frac{3}{4}$

c $5\frac{1}{60}$

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

13 a $\frac{8}{9}$

b $\frac{3}{11}$

c $\frac{13}{33}$

d $\frac{115}{333}$

14 a $\frac{1}{3}$ cm

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

15 a e.g. $\frac{1}{4} + \frac{1}{12}$

b e.g. $\frac{1}{6} + \frac{1}{30}$

Unit 7 Probability

7.1 Experimental probability

1 a

Colour	Tally	Frequency
Red		12
Blue		7
White		6

b 25

c $\frac{12}{25}$

2 a unlikely

b likely

c even chance

d unlikely

e likely

f impossible

3 a–b

Outcome	Frequency	Experimental probability
Symptom free	60	$\frac{60}{80} = \frac{3}{4}$
Some improvement	15	$\frac{15}{80} = \frac{3}{16}$
No improvement	5	$\frac{5}{80} = \frac{1}{16}$
Total frequency	80	

c The data supports the hospital's claim as 75% of the patients were symptom free after treatment.

4 a

Time (months)	Frequency	Experimental probability
5	7	$\frac{7}{100} = 7\%$
6	14	$\frac{14}{100} = 14\%$
7	35	$\frac{35}{100} = 35\%$
8	25	$\frac{25}{100} = 25\%$
9	15	$\frac{15}{100} = 15\%$
10	3	$\frac{3}{100} = 3\%$
11	1	$\frac{1}{100} = 1\%$
Total frequency	100	

b 19%

c Students' own answers, e.g. the skateboards were used on different types of surface.

5 a No

b Students' own answers, e.g. knowing that a large number of batteries had been tested.

6 a 38%

b 62%

7 a 41.5%

b No, because the data is for all the months of the year. The rainfall needs to be given for each month or for July only.

8 a i $\frac{17}{50}$ or 0.34 or 34%

ii $\frac{23}{50}$ or 0.46 or 46%

b Some people may have ordered both tinted lenses and two pairs of glasses.

9 a 80

b $\frac{65}{80} = \frac{13}{16}$

10 50%

7.2 Estimating probability

- 1 a 15
b 120
c 105
- 2 a 37%
b 45%
c 15.2%
- 3 a–c

Outcome	Frequency	Relative frequency
Great improvement	75	$\frac{75}{100}$
Slight improvement	20	$\frac{20}{100}$
Same or worse	5	$\frac{5}{100}$
Total frequency	100	

- d 285
- 4 a 325
b 405
- 5 a

Seats	Frequency	Relative frequency
2	30	$\frac{30}{80}$
3	10	$\frac{10}{80}$
4	25	$\frac{25}{80}$
5	5	$\frac{5}{80}$
6	10	$\frac{10}{80}$
Total frequency	80	

- b $\frac{30}{80}$ or $\frac{3}{8}$ or 0.375 or 37.5%
- c Incorrect. $P(\text{less than 4}) = \frac{40}{80} = 0.5$,
even chance
- d 75

6 a

Number of bananas	Frequency	Relative frequency
200–219	120	$\frac{120}{1000} = 12\%$
220–239	160	$\frac{160}{1000} = 16\%$
240–259	200	$\frac{200}{1000} = 20\%$
260–279	230	$\frac{230}{1000} = 23\%$
280–299	170	$\frac{170}{1000} = 17\%$
300–319	120	$\frac{120}{1000} = 12\%$
Total frequency	1000	

- b i $\frac{120}{1000}$ or 0.12 or 12%
ii $\frac{520}{1000}$ or 0.52 or 52%
- c 2600
- 7 280
- 8 a i $\frac{21}{50}$ or 0.42 or 42%
ii $\frac{14}{50}$ or 0.28 or 28%
- b 56
- 9 Sven, because of the larger sample.
- 10 a $\frac{11}{20}$ or 55%
b $\frac{45}{80}$ or 56.25%
c Odval's because the sample is larger.
d i $\frac{56}{100}$ or 0.56 or 56%
ii 112

7 Check up
Experimental probability

1 a

Time (hours)	Frequency	Experimental probability
7	5	$\frac{5}{40}$
8	9	$\frac{9}{40}$
9	16	$\frac{16}{40}$
10	7	$\frac{7}{40}$
11	3	$\frac{3}{40}$
Total frequency	40	

b i $\frac{26}{40}$

ii Rikka is not correct as the probability that the battery will last longer than 8 hours is greater than 50%.

c i Yes, as the data is recent.

ii No, as the data is older and the battery will be less able to hold charge over time.

2 a 500 000

b i $\frac{1}{2}$ ii $\frac{2}{5}$

3 $\frac{1}{10}$

Estimating probability

4 a $\frac{3}{16}$ b $\frac{41}{160}$ c $\frac{31}{40}$

5 a Adult $\frac{7}{20}$, Girl $\frac{9}{20}$, Boy $\frac{1}{5}$

b 0.45

c 60

6 a i $\frac{9}{40}$ ii $\frac{17}{30}$

b The estimate is accurate based on the data in the table.

7 Strengthen
Experimental probability

1 a, b, c

Colour	Tally	Frequency	Experimental probability
Blue		13	$\frac{13}{20}$
Yellow		5	$\frac{5}{20}$
Black		2	$\frac{1}{10}$
	Total frequency	20	

d Yellow. The experimental probability is higher.

2 a i

Cashier desk	Tally	Frequency	Experimental probability
1		14	$\frac{14}{100} = 14\%$
2	 	16	$\frac{16}{100} = 16\%$
3	 	25	$\frac{25}{100} = 25\%$
4	 	30	$\frac{30}{100} = 30\%$
5		15	$\frac{15}{100} = 15\%$
	Total frequency	100	

ii 4

b 25%

c The number of people visiting the Post Office next Monday may be different to Saturday.

3 a 50 b $\frac{1}{10}$

c No, the number of basking sharks seen in the winter may be different from the number seen in the summer.

4 Students' own answers

Estimating probability

1 a $\frac{1}{10}$ b 20

2 a $\frac{6}{20} = 0.3$

b 0.5, 0.2

c i 18

ii 30

iii 12

3 a $\frac{1}{5}$ b 40

4 23

5 125

Enrichment

1 Students' own answers

2 Students' own answers

7 Extend

1 a 45%

b 18

2 a Tom Sharp $\frac{25}{100}$ or 25%,
Sneaky Joe $\frac{7}{25}$ or $\frac{28}{100}$ or 28%

b Sneaky Joe, because 28% is greater than 25%.

c Tom Sharp's, because it is based on more throws.

d About 56

3 a i $\frac{12}{50}$ or 0.24 or 24%

ii $\frac{13}{50}$ or 0.26 or 26%

b $49.98 = 50$ days

c $\frac{49}{2500}$ or 0.0196

4 a $\frac{50}{800} = 0.0625 = 6.25\%$

b 14 500

c It is unlikely to be organic because only 10 out of 800 weigh 1.4 kg or more.

5

	Completely satisfied	Mostly satisfied	Dissatisfied	Total
20–39	80	40	40	160
40–59	60	28	12	100
60 or over	100	12	28	140
Total	240	80	80	400

6 a $\frac{19}{25}$ b 195 c cfu/100 ml
means 'colony forming units per 100 ml'

7 a i 0.73

ii 0.22

b i 5

ii 25 (rounding up for full packs of paper)

8 a i 50% or $\frac{1}{2}$

ii The estimate for the mean is \$24 629.63, which is \$25 000 to the nearest 1000. It is reasonable to assume that approximately half the people in the \$20 000 to \$30 000 group earn more than this, so $\frac{40}{81}$, 49% or 50% would be good estimates for the number earning more than the mean.

b The mean is estimated. The number for those earning more than the estimated mean is itself an estimate.

7 Unit test

1 a 20

b Curved surface $\frac{8}{20}$, flat surface $\frac{12}{20}$

c Yes. The ball landed on the flat surface more often than on the curved surface.

d Luke could carry out the experiment more times.

2 a

Action taken	Frequency	Experimental probability
Handed in at the nearest shop	25	$\frac{25}{60} = \frac{5}{12}$
Handed in at the police station	20	$\frac{20}{60} = \frac{1}{3}$
Stolen	15	$\frac{15}{60} = \frac{1}{4}$
Total frequency	60	

b $\frac{3}{4}$

3 $\frac{1}{8}$

4 20

5 a

Use	Frequency	Relative frequency
Discarded	50	$\frac{50}{1000} = \frac{1}{20}$
Food products	250	$\frac{250}{1000} = \frac{1}{4}$
Small	200	$\frac{200}{1000} = \frac{1}{5}$
Medium	300	$\frac{300}{1000} = \frac{3}{10}$
Large	200	$\frac{200}{1000} = \frac{1}{5}$
Total frequency	1000	

b $\frac{19}{20}$

c 1000

6 a 150

b 400

c $\frac{3}{8} = 0.375 = 37.5\%$

Unit 8 Percentages and ratios

8.1 Equivalent fractions, decimals and percentages

1 b $\frac{15}{100} = \frac{3}{20}$, 0.15 c $\frac{95}{100} = \frac{19}{20}$, 0.95 d $\frac{2}{100} = \frac{1}{50}$, 0.02 e $\frac{24}{100} = \frac{6}{25}$, 0.24

2

Mixed number	$1\frac{1}{2}$	$1\frac{7}{10}$	$1\frac{4}{5}$	$1\frac{1}{10}$
Decimal	1.5	1.7	1.8	1.1
Percentage	150%	170%	180%	110%

3 b $235\% = 2.35 = 2\frac{35}{100} = 2\frac{7}{20}$

c $385\% = 3.85 = 3\frac{17}{20}$

d $195\% = 1.95 = 1\frac{95}{100} = 1\frac{19}{20}$

4

Mixed number	$1\frac{1}{20}$	$1\frac{7}{20}$	$1\frac{17}{20}$	$2\frac{11}{20}$	$1\frac{9}{20}$
Decimal	1.05	1.35	1.85	2.55	1.45
Percentage	105%	135%	185%	255%	145%

5 b $2.16 = 2\frac{4}{25}$ c $1.42 = 1\frac{21}{50}$ d $4.94 = 4\frac{47}{50}$

6 b $0.475 = 47.5\%$ c $0.345 = 34.5\%$ d $0.375 = 37.5\%$

e $0.124 = 12.4\%$ f $0.034 = 3.4\%$ g $0.024 = 2.4\%$

7 b $0.125 = \frac{1}{8}$ c $0.425 = \frac{17}{40}$ d $0.095 = \frac{19}{200}$

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

9 a $\frac{2}{25}$ b i 0.08 ii 8%

10 a i $\frac{3}{50}$, 0.06, 6%

ii $\frac{261}{500}$, 0.522, 52.2%

iii $\frac{17}{250}$, 0.068, 6.8%

b Brand B c Brand A

11 Method B

8.2 Writing percentages

1 a 0.667 b 0.625 c 0.429

2 a 75% b 24% c 60% d 75%

- 3 a 30% of students use a smartphone.
 b 28% of people are vegetarian.
 c 37.5% of residents own their home.
 d 80% of items sold cost more than £35.
 e 13.3 % of students drink coffee.

4 a 27.5% b 17.5% c 25%

5 66%

6 a 25% b 10% c 75%

7 a £3 b £18

8 £25 500

9 £540

10 a £2.50 b £22.50

11 a £1020 b £1206

12 £232 800

13 £18.30

8.3 Percentage of amounts

1 a £15.40 b 264 g c 22p d 121 mm

2 a 42.5 ml b 37.4 kg c \$272 d £178.50

3 a £11.20 b 22.4 kg c 54 ml d 60 g

4 105 000 readers

5 £25

6 a £50 b £6 c £400 d £48

7 a £13.50 b £31.50 c £31.50

d The answers are the same. $100\% - 30\%$ is the same as 70% .

8 a £0.35 (or 35p) b £1.75 c £1.75

d The answers are the same. $100\% + 25\%$ is the same as 125% .

9 a £135 b 45 ml c 92 kg d 156 km

10 \$1976.25

11 a £10 b £30 c £430

12 £15 875

13 a £600 b 400 kg c 300 litres d 600 km e 50 cm

14 £9

15 £3.79 million (2 d.p.)

8.4 Compound interest

1 a \$55 b \$6 c \$132

2 a 1.05 b 1.1 c 1.01 d 1.035 e 1.002 f 2

3 a \$102 b \$510 c \$357

4 a \$3150 b \$3307.50

5

Bank	Interest rate	Start balance	End of year 1 balance	End of year 2 balance	End of year 3 balance	End of year 4 balance
Bank A	1.2%	\$5000	\$5060	\$5120.72	\$5182.17	\$5244.35
Bank B	1.3%	\$5000	\$5065	\$5130.85	\$5197.55	\$5265.11

6 5 years

7 \$28 679.04

8 a \$1530 b \$1689.24 c \$1902.36

9 \$58.43

10 a 100% b 167 772 160

8.5 Ratios

1 a $18 : 12 = 3 : 2$ b $24 : 18$ c $72 : 24 = 36 : 12 = 18 : 6$

2 a \$174, \$261 b 405 kg, 81 kg c 1.5 m, 2.5 m

3 a $1 : 2$ b $1 : 5$ c $3 : 1$ d $6 : 1$ e $1 : 12$ f $2 : 1$

4 a $1.8 : 1$ b $2.75 : 1$ c $1 : 1.94$ d $1 : 2.09$

5 $1 : 8$

6 a i $1.67 : 1$ ii $1.5 : 1$ iii $1.6 : 1$ iv $1.33 : 1$ v $1.85 : 1$ vi $2.4 : 1$

b Cinema widescreen

7 a Jasmine $0.75 : 1$; Taran: $0.714 : 1$ b Jasmine

8 a $80 : 57$ b $175 : 128$ c $51 : 34$ d $572 : 103$

9

Front cog teeth	53	53	53	53	53
Gear	1	2	3	4	5
Rear cog teeth	32	25	19	14	11
Ratio of front teeth to rear teeth	$53 : 32$	$53 : 25$	$53 : 19$	$53 : 14$	$53 : 11$
Unit ratio	$1.66 : 1$	$2.12 : 1$	$2.79 : 1$	$3.79 : 1$	$4.82 : 1$
Number of rear wheel turns per turn of the pedals	1.66	2.12	2.79	3.79	4.82

8.6 Working with ratios

1 a $2 : 1$ b $4 : 1$ c $3 : 5$ d $2 : 9$ e $1 : 7$ f $2 : 3$

2 a £8 and £12 b £16 and £20 c 15 m and 9 m

3 a \$24, \$36, \$48

b \$54, \$162, \$270

c \$85, \$170, \$255

d \$22, \$44, \$66, \$110

e 78 m, 117 m, 234 m

f 87.75 kg, 175.5 kg, 204.75 kg

g 49.25 km, 98.5 km, 197 km, 246.25 km

h \$182.12, \$303.53, \$546.35

4 240 g sugar, 300 g flour, 360 g butter

5 \$6000, \$10 000, \$8000

6 a $1 : 4 : 10$ b $1 : 10 : 55$ c $1 : 20 : 80$ d $4 : 1 : 10$

7 a 6.65 g copper, 0.245 g tin, 0.105 g zinc

b $\frac{7}{200}$

8

Quantity	Blue	Green	Yellow
1 litre	0.625 l	0.35 l	0.025 l
1.5 litres	0.9375 l	0.525 l	0.0375 l
2.5 litres	1.5625 l	0.875 l	0.0625 l

9 a $\frac{20}{103}$ (or 19.4%)

b Ironman, because it has the highest proportion (79.66%) of cycling.

8 Check up Fractions, decimals and percentages

1

Fraction	$1\frac{1}{25}$	$1\frac{14}{25}$	$1\frac{2}{25}$	$2\frac{1}{20}$	$2\frac{3}{20}$	$2\frac{9}{25}$	$4\frac{9}{20}$	$5\frac{3}{25}$
Decimal	1.04	1.56	1.08	2.05	2.15	2.36	4.45	5.12
Percentage	104%	156%	108%	205%	215%	236%	445%	512%

2 2.9, 2.6, 246%, $2\frac{9}{25}$, $2\frac{7}{20}$, 209%

3

Fraction	Decimal	Percentage
$\frac{9}{40}$	0.225	22.5%
$\frac{27}{200}$	0.135	13.5%
$\frac{31}{200}$	0.155	15.5%

Using percentages

4 98%

5 \$25.50

6 a \$19.50 b \$78 c \$728

7 \$740

8 \$520.93

9 \$13 858.97

Ratio

10 a 4 : 1 b 8 : 5

11 a 2.6 kg and 3.9 kg

b 82 litres, 164 litres and 205 litres

c \$111.11, \$333.33 and \$555.56

12 a 1.4 : 1 b 1 : 3.6

8 Strengthen
Fractions, decimals and percentages

1

Fraction	0	$\frac{1}{10}$	$\frac{1}{5}$	$\frac{3}{10}$	$\frac{2}{5}$	$\frac{1}{2}$	$\frac{3}{5}$	$\frac{7}{10}$	$\frac{4}{5}$	$\frac{9}{10}$	1
Decimal	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Percentage	0	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

- 2 **a** 2.8, 280% **b** 1.3, 130%
c 5.75, 575% **d** 7.2, 720%

- 3 **a** $3\frac{7}{10}$, 370% **b** $9\frac{1}{2}$, 950% **c** $4\frac{1}{10}$, 4.1 **d** $9\frac{2}{5}$, 9.4

- 4 **a** $\frac{16}{25}$ **b** $\frac{41}{50}$ **c** $8\frac{11}{25}$ **d** $\frac{29}{40}$ **e** $\frac{121}{250}$

- 5 **a** 60% of students like sport.
b 52% of members of a tennis club are girls.
c 64% of members of a football club are boys.
d 20% of students have a cat.

- 6 Saturday; 82.8% were chocolate cakes.

- 7 Maths; 76.67%

- 8 **a** 48% **b** 30% **c** 15% **d** 25% **e** 26%

Using percentages

- 1 **a** \$3.60 **b** \$21.60

- 2 **a** \$55.20 **b** \$66 **c** \$92 **d** \$70

- 3 **a** \$80.75 **b** \$81 **c** \$14 **d** \$61.20

- 4 **a** $0.4 \times \$150 = \60
b $0.65 \times 550 \text{ g} = 357.5 \text{ g}$
c $0.08 \times 560 \text{ ml} = 44.8 \text{ ml}$
d $1.2 \times 68 \text{ litres} = 81.6 \text{ litres}$

- 5 **a** \$1.20 **b** \$120

- 6 **a** 6 g **b** 600 g

- 7 18%

- 8 \$30

- 9 **a** \$625 **b** \$750 **c** \$750

- 10 $800 \times 1.03 = \$824$ end year 1

$$824 \times 1.03 = \$848.72 \text{ end year 2}$$

$$848.72 \times 1.03 = \$874.18 \text{ end year 3}$$

- 11 \$102.66

Ratio

- 1 5.1 m and 3.4 m

- 2 6.3 m, 4.725 m and 1.575 m

- 3 Saturday: receptionists \$16.50, porters \$33, cleaners \$41.25
Sunday: receptionists \$50.72, porters \$101.44, cleaners \$126.80

- 4 **a** 13 : 6 **b** 17 : 6 **c** 12 : 5 **d** 9 : 11

- 5 a 27.2% b 17.92 g

Enrichment

- 1 a i, ii \$2.50
 b i, ii 16 kg
 c i, ii 262.5 m
 $x\% \text{ of } y = y\% \text{ of } x$

- 2 31.64%

8 Extend

- 1 Janan is not correct because 48 minutes is not 0.48 hours; it is 0.8 hours.

2

Year	Value at start of year	Percentage change	Value at end of year
1st	\$5000	20% increase	\$6000
2nd	\$6000	8% increase	\$6480
3rd	\$6480	12% decrease	\$5702.40
4th	\$5702.40	10% increase	\$6272.64
5th	\$6272.64	3% decrease	\$6084.46

- b i \$1084.46 ii 21.7% (1 d.p.)

- 3 Supermarket C gives the best offer.
 Supermarket A: 1 biscuit costs 12 cents.
 Supermarket B: 1 biscuit costs 12.5 cents.
 Supermarket C: 1 biscuit costs 11.25 cents.

- 4 0.7%, 1.1%, 1.4%, $\frac{1}{68}$, $\frac{3}{85}$, 4.1%, $\frac{1}{20}$, $\frac{4}{2}$

- 5 a $\frac{71}{125}$ b 56.8%

6

Staff	Pay rise	Original salary
Shop floor staff	2.4%	\$17 600
Shop floor managers	2.8%	\$23 450

7 a

Department	Percentage reduction	Original staff number
Telemarketing	7.1%	254
Sales	20.6%	564
Administration	12.9%	248
Accounts	9.8%	512

- b 13.7%

- 8 16 m/

- 9 a 3880.8 cm³ b 1 : 8

- 10 \$1507.66

- 11 2.75%

- 12 Any values that give the area of the blue triangle as 80 cm², e.g. base = 10 cm, height = 16 cm, area = $0.5 \times 10 \times 16 = 80 \text{ cm}^2$

- 13 a 60 b 62

14 63 872

15 a 400, 120, 36, 10.8 b 80, 96, 115.2, 138.24

16 6.5 m

17 \$5587.87

18 a i 227 cm ii 207 cm

b No, because the increase is compounded.

19 a \$9274.19 b 8 years

8 Unit test

1

Fraction	$\frac{3}{4}$	$\frac{9}{10}$	$\frac{1}{4}$	$2\frac{3}{4}$	$1\frac{3}{10}$	$1\frac{3}{5}$
Decimal	0.75	0.9	0.25	2.75	1.3	1.6
Percentage	75%	90%	25%	275%	130%	160%

2 a i Group A $\frac{18}{25}$; Group B $\frac{37}{50}$; Group C $\frac{71}{100}$ ii Group A 72%; Group B 74%; Group C 71%

b Group B c Group C

3 a 35% b 40% c 25%

4 \$176

5 \$23 760

6 a 62 kg b 240 m

7 a 5 : 7 b 1 : 5

8 80 m/ and 208 m/.

9 800 m/, 640 ml and 60 m/.

10 a i $\frac{3}{4}$ ii $\frac{1}{5}$ iii $\frac{1}{20}$ b 15 : 4 : 1

11 \$2367

12 \$5081.18

Unit 9 Shapes and angles

General comment: Reasons given for evaluation of angles are not comprehensive; in many cases, alternative solutions are valid. Accept all valid reasons.

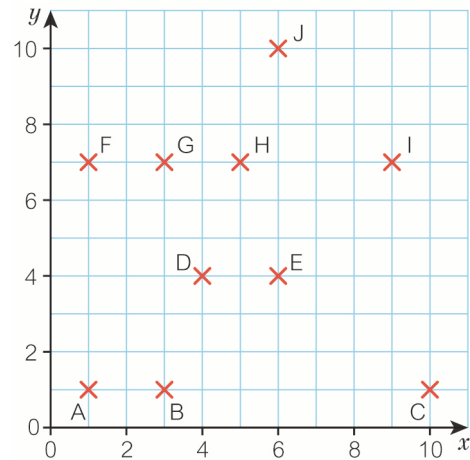
9.1 Quadrilaterals

1

Quadrilateral	Square	Rectangle	Parallelogram	Rhombus	Kite	Trapezium	Isosceles trapezium
Number of lines of symmetry	4	2	0	2	1	0	1
Order of rotational symmetry	4	2	2	2	1	1	1

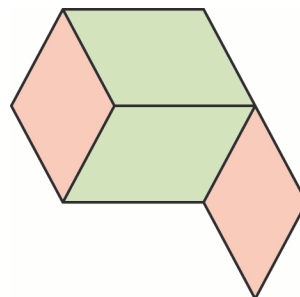
- 2 a 120° b 37°
- 3 a Parallelogram b Isosceles trapezium
c Kite d Rectangle
- 4 a Several answers, for example, all angles are 90° or two pairs of parallel sides.
b Several answers, for example, kite has no parallel sides.
c Several answers, for example, diagonals intersect at 90° .
- 5 a Several answers, for example, rectangle does not have all equal sides.
b Several answers, for example, rhombus has all sides equal in length, parallelogram has only opposite sides equal.
c Several answers, for example, rectangle has right angles, parallelogram does not.
d Several answers, for example, square has four right angles.

6



- a ABGF
b There are many possibilities, e.g. ADEC or BDEC or FDEI or FDEH.
c ADEB or DEGF or DEHG or ABHG
d EIJG
e EIJH or EIJF
- 7 a = 65° (angles at a right angle add up to 90°)
b = 25° (angles in a triangle add up to 180°)
c = 65° (angles at a right angle add up to 90° or alternate angles)
- 8 a a = b = 140° (angles in a quadrilateral add to 360° and opposite angles of a rhombus are equal)
c = 40° (opposite angles of a rhombus are equal)
d = e = 70° (angles in a quadrilateral add to 360° and opposite angles of a parallelogram are equal)
f = 110° (opposite angles of a parallelogram are equal)

b

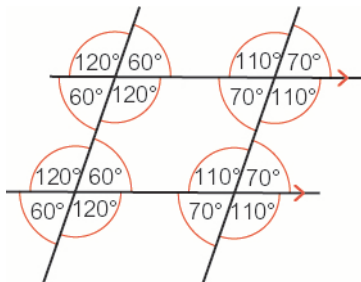


- 9 a = 65° (angles in quadrilateral add to 360° , so $2a = 360 - 90 - 90 - 50 = 130^\circ$)
b = 25° (angles in a triangle add to 180° , so $b = 180 - 90 - 65$)
c = 65° (b + c = 90°)

10 270°

9.2 Angles and parallel lines

- 1 a 50° b $s = 55^\circ, t = 55^\circ, u = 125^\circ$
c 96°
- 2 a 135° b 50° c 102°
- 3 $x = 25^\circ, y = 155^\circ, z = 155^\circ$
- 4 x and v, y and u
- 5 a Angle r and angle p are alternate angles.
b Angle t and angle q are alternate angles.
c Angle t is the same size as angle q .
d Angle r is the same size as angle p .
- 6 a 80° (alternate angles are equal)
b $b = 112^\circ$ (alternate angles are equal)
 $c = 68^\circ$ (angles on a straight line add up to 180°)
c $x = 38^\circ$ (alternate angles are equal)
 $y = 65^\circ$ (alternate angles are equal)
 $z = 77^\circ$ (angles on a straight line add up to 180°)
d $p = 125^\circ$ (alternate angles)
 $q = 55^\circ$ (angles on a straight line add up to 180°)
 $r = 55^\circ$ (angles on a straight line add up to 180°)
 $s = 125^\circ$ (opposite angles of a parallelogram are equal)
- 7 $a = 75^\circ$ and $b = 105^\circ, c = 105^\circ$ (alternate angles are equal)
- 8 a-c



- 9 a $a = 115^\circ$ (corresponding angles)
b $b = 95^\circ$ (corresponding angles)
 $c = 85^\circ$ (angles on a straight line)
c $d = 85^\circ$ (corresponding angles)
 $e = 85^\circ$ (vertically opposite angles)
d $f = 112^\circ$ (alternate angles)
 $g = 112^\circ$ (corresponding angles)
 $h = 68^\circ$ (angles on a straight line)
 $i = 112^\circ$ (vertically opposite angles)

- 10 a $w = 42^\circ$ (alternate angles)
 $x = 42^\circ$ (vertically opposite angles)
 $y = 75^\circ$ (corresponding angles)
b $a = 132^\circ$ (angles on a straight line)
 $b = 48^\circ$ (corresponding angles)
 $c = 120^\circ$ (corresponding angles)
 $d = 60^\circ$ (angles on a straight line)
c $p = 42^\circ$ (alternate angles)
 $q = 76^\circ$ ($118 - 42$, corresponding angles)
 $r = 118^\circ$ (vertically opposite angles)
 $s = 118^\circ$ (corresponding angles)
- 11 If WX and YZ were parallel, the angles labelled 120° and 125° would need to be equal and the angles labelled 55° and 60° would also need to be equal, because they would be pairs of corresponding angles. As these are not equal, the lines cannot be parallel.

9.3 Angles in polygons

- 1 a $x = 45^\circ$ b $x = 150^\circ$ c $x = 84^\circ$
- 2 a i 5 ii 5
b Students' own answers
c Number of lines of symmetry = order of rotational symmetry
- 3 a $a = 120^\circ$ b $b = 120^\circ$
- 4 15
- 5 a 120° b 140°
- 6 a 108° b 72°
c 5 d 360°
- 7 a 120° b 60°
c 6 d 360°
- 8 a Students' own diagrams
b Students' own answers
c The exterior angles of any polygon add up to 360° .
e Exterior angle = $360^\circ \div \text{number of sides}$
f $\frac{360^\circ}{n}$
- 9 a 360° b 40° c 140°
- 10 a 165° b $360 \div 15 = 24$
- 11 a 12° b 168°
- 12 a $a = 360 - 90 - 60 - 60 = 150^\circ$
b $b = 360 - 90 - 120 = 150^\circ$
c $c = 360 - 144 - 108 = 108^\circ$
d $d = 360 - 150 - 90 = 120^\circ$,
 $e = 360 - 150 - 120 = 90^\circ$
- 13 $720^\circ - 90^\circ - 90^\circ = 540^\circ$
 $x = 540^\circ \div 4 = 135^\circ$ (two lines of symmetry)

9 Check up Quadrilaterals

- 1 **a** Square **b** Rhombus
c Isosceles trapezium
- 2 $a = 44^\circ$ (alternate angles are equal), $b = 32^\circ$
(alternate angles are equal), $c = 104^\circ$ (angles in a triangle sum to 180°)
- 3 **a** $a = 78^\circ$ (adjacent angles in parallel sides of a trapezium add up to 180°)
 $b = 102^\circ$ (angles are equal in isosceles trapezium when between equal sides)
b $c = 6$ cm (two sides are equal in an isosceles trapezium)

Angles and parallel lines

- 4 **a** $x = 70^\circ$ (alternate angles are equal)
b $x = 125^\circ$ (alternate angles are equal and angles on a straight line add to 180°)
c $x = 142^\circ$ (corresponding angles are equal)
d $x = 95^\circ$ (corresponding angles are equal and angles on a straight line add to 180°)
- 5 **a** $p = 82^\circ$ (corresponding angles)
 $q = 82^\circ$ (vertically opposite angles)
b $r = 78^\circ$ (alternate angles)
 $s = 78^\circ$ (vertically opposite angles)
c $a = 40^\circ$ (alternate angles)
 $b = 40^\circ$ (vertically opposite angles)
 $c = 75^\circ$ (corresponding angles)
d $x = 60^\circ$ (angles on a straight line add to 180°)
 $y = 60^\circ$ (alternate angles)
 $z = 125^\circ$ (alternate angles and angles on a straight line add to 180°)
e $a = 110^\circ$ (corresponding angles)
 $b = 110^\circ$ (vertically opposite angles)
 $c = 30^\circ$ (angles on a straight line add to 180°)
 $d = 150^\circ$ (alternate angles)

Angles in polygons

- 6 1080°
- 7 **a** 720° **b** 135°
- 8 **a** $360 \div 10 = 36^\circ$ **b** 144°
- 9 18

9 Strengthen Quadrilaterals

- 1 **a** Rhombus **b** Rectangle
c Isosceles trapezium
- 2 All sides equal, two pairs of parallel sides, all angles 90° , diagonals intersect at 90° .

- 3 **a** The sum of the angles in any quadrilateral is 360° .
b **i** $a = 145^\circ$ **ii** $b = 72^\circ$ $c = 108^\circ$
iii $d = 55^\circ$ **iv** $e = 95^\circ$
- 4 **a** $a = 42^\circ$ **b** $b = 138^\circ$ **c** $c = 42^\circ$
d $d = 96^\circ$
- 5 **a** $x = 35^\circ$ **b** $y = 55^\circ$ **c** $z = 110^\circ$
- 6 $\angle BCA = 48^\circ$ (angles in a triangle add to 180°)
 $\angle ECD = 42^\circ$ (alternate angles)
 $\angle CDE = 37^\circ$ (angles in a right angle add to 90°)
 $\angle CED = 180 - 42 - 37 = 101^\circ$ (angles in a triangle add to 180°)

Angles and parallel lines

- 1 **a** a and b are vertically opposite angles.
b a and d are alternate angles.
c a and c are corresponding angles.
d b and d are corresponding angles.
e c and d are vertically opposite angles.
- 2 **a** $x = 125^\circ$ (alternate angles)
b $y = 40^\circ$ (alternate angles)
c $z = 95^\circ$ (alternate angles)
- 3 **a** $e = 115^\circ$ (corresponding angles)
b $f = 34^\circ$ (corresponding angles)
c $g = 100^\circ$ (corresponding angles)
- 4 **a** $m = 35^\circ$, $n = 75^\circ$
b $p = 50^\circ$, $q = 60^\circ$
- 5 $a = 130^\circ$, $b = 20^\circ$, $c = 30^\circ$

Angles in polygons

- 1 **a, b, c** Pentagon, 5 sides, 5 interior angles and 5 exterior angles.
Hexagon, 6 sides, 6 interior angles and 6 exterior angles.
Octagon, 8 sides, 8 interior angles and 8 exterior angles.
- d** Number of sides = number of interior angles = number of exterior angles.

2

Polygon	Angle sum
Pentagon	540°
Hexagon	720°
Heptagon	900°
Octagon	1080°

- 3 **a** $a = 130^\circ$ **b** $b = 130^\circ$ **c** $c = 150^\circ$
- 4 The exterior angles don't add up to 360° (they add up to 370°).

5 a 12 b 12

Enrichment

- 1 a–c Students' own diagrams and observations
d Co-interior angles add up to 180° .

9 Extend

- 1 $\angle CDE = 135^\circ$
2 $z = 125^\circ$
3 a $b = 15$ $a = 45 - 15 = 30^\circ$
b $c = 45 - 15 = 30^\circ$

c

Number of rhombuses	1	2	3	4	5
Total angle	45°	75°	105°	135°	165°

- d Next term is last term + 30°
e 12 rhombuses
4 a $3 \times 180^\circ = 540^\circ$
b $y = 30^\circ$
c $45^\circ, 120^\circ, 95^\circ, 30^\circ, 250^\circ$
d $45 + 120 + 95 + 30 + 250 = 540$
5 $x = 230^\circ$
6 $12 - 2 = 10, 10 \times 180^\circ = 1800^\circ$
7 $p = 85^\circ$ (corresponding angles)
 $q = 55^\circ$ (angles in a triangle add to 180°)
 $r = 40^\circ$ (alternate angles)
 $s = 40^\circ$ (vertically opposite angles)
8 $a = x$ (corresponding angles)
 $b = 180^\circ - x$
 $a + b = x + 180^\circ - x = 180^\circ$
9 a $a = 130^\circ$ b $b = 60^\circ$ c $c = 80^\circ$
10 a 39° (angles in a triangle add to 180°)
b No, because $80^\circ + 96^\circ = 176^\circ$
(or $100^\circ + 84^\circ = 184^\circ$) so they are not co-interior angles.
11 a Parallel b Isosceles trapezium
c i 75° ii 30°
12 a $g = 120^\circ$ (interior angle of a regular hexagon)
 $h = 60^\circ$ (line symmetry or co-interior angles)
b $p = 108^\circ$ (interior angle of a regular pentagon)
 $q = 36^\circ$ (isosceles triangle)
c $x = 135^\circ$ (interior angle of a regular octagon)
 $y = 45^\circ$ (line symmetry and angle sum of a quadrilateral)
 $z = 135^\circ - 45^\circ = 90^\circ$
13 a 3.6° b 176.4°
14 a $a = 144^\circ$ b $b = 240^\circ$ c $c = 90^\circ$ d $d = 30^\circ$

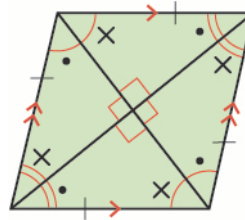
15 $b = 230^\circ$

- 16 $x + y + 90 + 90 = 360$ (angles in a quadrilateral)
 $x + y = 180$
 $x = 120^\circ, y = 60^\circ$ (angle x is double angle y)

- 17 Callie is correct. 1500 is not a multiple of 180.
A 10-sided polygon has total interior angles of $8 \times 180 = 1440^\circ$.
An 11-sided polygon has total interior angles of $9 \times 180 = 1620^\circ$.

9 Unit test

1 a



- b Diagonals intersect at 90° , marked as right angles.
2 a Square, rhombus
b Square, rhombus, kite
c Square, rectangle, rhombus, parallelogram
3 Kite
4 a $a = 40^\circ$ (alternate angles)
 $b = 50^\circ$ (opposite angles of a parallelogram)
 $c = 90^\circ$ (angles in a triangle add to 180°)
 $d = 90^\circ$ (alternate angles)
5 $w = 140^\circ$
6 a i The angles in a triangle add up to 180° .
ii The angles in a quadrilateral add up to 360° .
iii The angles in a pentagon add up to 540° .
iv The angles in a hexagon add up to 720° .
b $m = 60^\circ$
7 a $a = 85^\circ$ (alternate angles)
b $b = 76^\circ$ (corresponding angles)
c $c = 37^\circ$ (corresponding angles)
8 a $x = 80^\circ$ b 540°
9 Students' own answers, for example:

10 a 24° b 156°
11 30
12 a 45 b $x = 86^\circ$ c 172°

Unit 10 Charts and diagrams

10.1 Using tables

- 1 a 32 b 25
c 2 d 4
- 2 1.55
- 3 a 5 b 6 c 3.45
- 4 Mean is $3070 \div 97 = 31.65$, or 31 rounded down to a whole number
Mode is 32.
So the label is accurate if they are using the mode; but strictly speaking if they are using the mean, they should say 31.

- 5 a 42 b 24
c 96 d $\frac{24}{96} = \frac{1}{4}$

6 a

	Beginners	Intermediate	Advanced	Total
Men	33	36	21	90
Women	32	40	38	110
Total	65	76	59	200

- b 21
c 57
d Advanced
e 19%
- 7 a i Sandwiches
ii Cakes
b Fish and chips
c He should cut salads as they make the lowest profit on Saturdays.

8 a $2 \leq l < 4$

b

Length, l cm	Tally	Frequency
$0 \leq l < 2$		0
$2 \leq l < 4$		4
$4 \leq l < 6$		7
$6 \leq l < 8$		5

- c $4 \leq l < 6$
- 9 Students' own answers; must have between 3 and 5 classes of equal spread.

10.2 Stem and leaf diagrams

- 1 No; the median will be the 5.5th value (halfway between the 5th and 6th).
- 2 a i 9 ii 18
b i 5th ii 9.5th
c i 8 ii 10.5

3 a

5	2, 3, 6
6	1, 4, 5, 8
7	0, 3, 7, 7, 8, 9
8	4, 5, 5, 6, 7
9	0, 1, 2

Key: 5 | 2 means 52 visitors

- b i 21 ii 13 iii 76%
- 4 a 155 cm and 165 cm
b $174 - 146 = 28$ cm c 162.5 cm
- 5 Before special offer, median = £2.95 and mean = £2.73
After special offer, median = £3.30 and mean = £3.04
So no, it has not increased the average spend by £1.
- 6 a Most of the composition scores are between 30 and 39.
b i Median = 33.5 Range = 26
ii Median = 44.5 Range = 29
c e.g. The median score for transcription is higher than the median score for composition. The range for composition is lower than the range for transcription.

10.3 Pie charts

- 1 a 30 b 8 c 2
d 40 e 90 f 32.5

2 a, b Students' correctly drawn angles

3 a Violin. It has the highest proportion.

- b i $\frac{1}{4}$ ii $\frac{1}{8}$

c

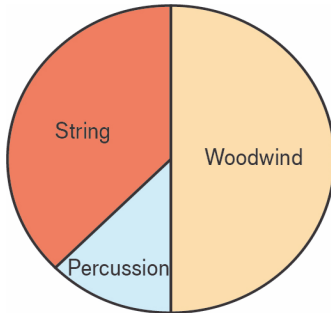
Instrument	Frequency
Violin	16
Flute	4
Cello	8
Drum	4

4 a 24

b One musician is $360^\circ \div 24 = 15^\circ$

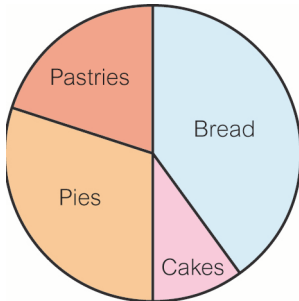
c Woodwind: 180° String: 135°
Percussion: 45°

d



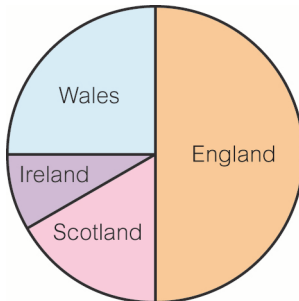
5 a i 144° ii 108° iii 36°

b



6 a 2° b 30° ; 60° ; 90° ; 180°

c



7 a £40 000 b £100 000

c Even though the band earned a greater proportion from CDs in 2004, the total income from CDs was greater in 2014 – £100 000 compared with £80 000.

d

	Concerts	CDs	Downloads
2004	£40 000	£80 000	0
2014	£200 000	£100 000	£100 000

10.4 Comparing data

- 1 a i Business A = £8659, Business B = £9258.25
ii Business A = £9641, Business B = £1874
b e.g. Business A has a lower mean than Business B.
Business A has a much greater range of quarterly profits, whereas Business B's profits are more even throughout the year.
c Business A; its profits are much higher in April to September than in the colder months.

2 a Blue

b i Week 4 and 12 (175 marks)

ii Week 7 (5 marks)

c No, she is not correct; some losing scores are higher than winning ones, e.g. week 7 losing is higher than week 3 winning.

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

b Between 6 and $6\frac{1}{2}$ (77.5th value)

c Order most of $6\frac{1}{2}$; use the mode

4 a Alex

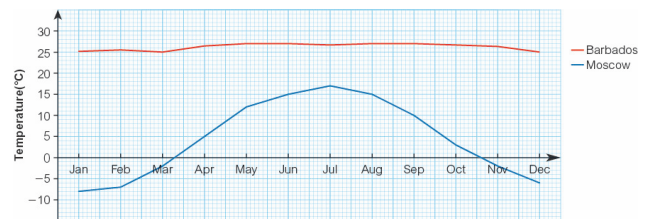
b Alex = 4.66 m, Dan = 5.09 m

c Alex = 5.23 m, Dan = 5.10 m

d Median

e 2.78 m. It did not affect the median because the median comes only from the middle value(s), and the 3rd jump was not one of these; it was the lowest value, but exactly how low makes no difference to the median.

5 a



b Students' own answers, comparing temperature ranges and values

6 a i Loxley Dental surgery
ii Deerfield Dental surgery

b i Deerfield Dental surgery
ii Loxley Dental surgery

7 a £75 000

b i £28 175 ii £21 350

c 6

d 4

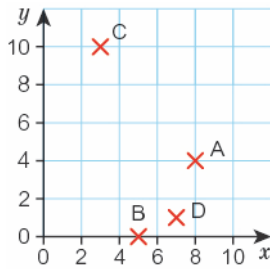
e Median

f i Mean ii Median

10.5 Scatter graphs and correlation

1 A (0, 2), B (4, 4), C (6, 8), D (10, 3)

2



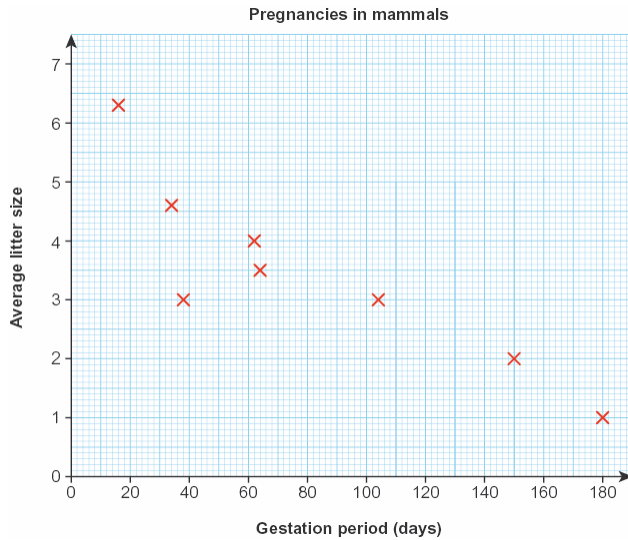
3 a (Strong) positive correlation

b 8 m

c 25 cm and 32 cm

d (41, 16); because the point lies well away from all the other points on the graph.

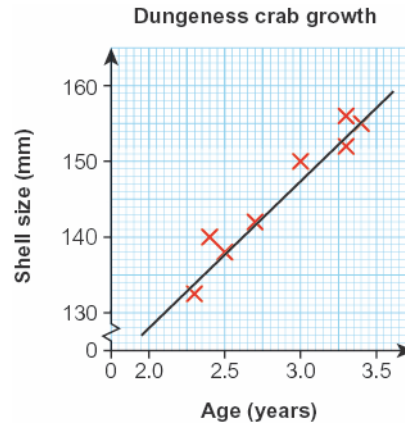
4 a



b (Weak) negative correlation

c Mammals with **longer** gestation periods tend to have **fewer** offspring in each litter.
OR
Mammals with **shorter** gestation periods tend to have **more** offspring in each litter.

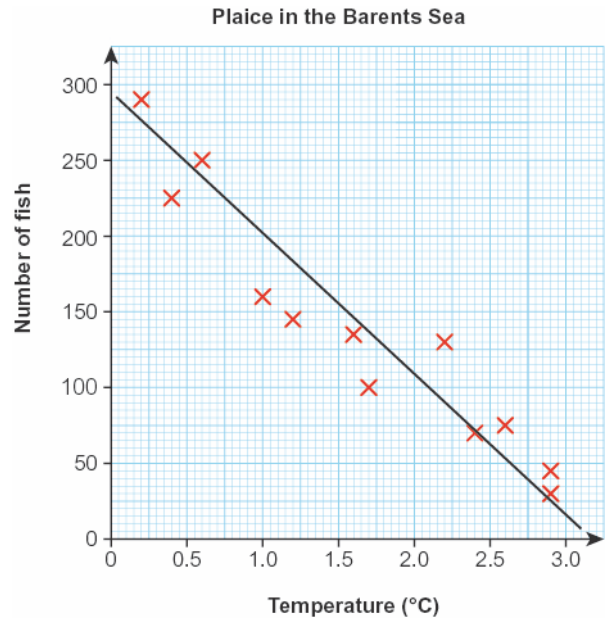
5 a, c



b Positive correlation

d Students' own answers from their line of best fit. Between 2.6 and 3 years. (Read off 146 mm from y-axis and corresponding x-value.)

6 a, c



b Negative correlation

d Students' own answers from their line of best fit. Between 90 and 110 fish. (Read off 2.1°C from x-axis and corresponding y-value.)

e The population of plaice in the Barents Sea could decrease if the temperature of the sea rises.

10 Check up Using tables

1 a 2 b 4 c 1.83

2 a 55 b 30

c

	Under 18	18–40	Over 40	Total
Male	10	30	55	95
Female	30	38	37	105
Total	40	68	92	200

d 92 e 20%

3 a 41 b $40 \leq m < 50$

c $60 - 0 = 60$ g

d No; the frequency of the $30 \leq m < 40$ class will increase to 14, but the frequency of the $40 \leq m < 50$ class will increase to 16, so the modal class will still be $40 \leq m < 50$.

4 a Alpha 1.7 km, Catling 4 km

b Alpha students travel the shortest distance, using the mean to compare.

c Alpha 2.2 km, Catling 9.4 km

d Catling College

e Probably Alpha, because in cities students don't need to travel so far to their nearest school as there are more schools closer together.

Presenting and comparing data

5 a 26 b 52 c 59

d 53 e 4

6 a Karen b $\frac{1}{2}$ c \$20

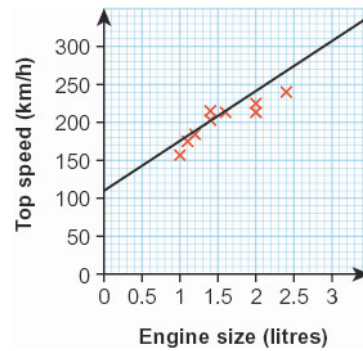
d $\frac{1}{3}$ e \$10

f

	Music	Clothes	Food
Dana	\$20	\$10	\$10
Karen	\$10	\$10	\$10

Scatter graphs

7 a, c



b The larger the engine size, the **higher** the top speed.

The graph shows **positive** correlation

d 220 km/h

10 Strengthen Using tables

1 a 13 b 12

c, f

	Flute	Violin	Trumpet	Total
Girls	13	10	6	29
Boys	12	8	4	24
Total	25	18	10	53

d 6 girls play the trumpet.

e 18 students play the violin.

g 4 h 53

2 a

	Male	Female	Total
Rabbit	4	6	10
Cat	5	8	13
Parrot	6	7	13
Total	15	21	36

b 13 c 36 d $\frac{13}{36}$

e $\frac{6}{36} = \frac{1}{6}$

f Yes; there were 13 cats and 13 parrots.

- 3 a 3 b 5 c 24
d 2 children e 4

f

Number of children	Frequency	Total number of children
0	3	$0 \times 3 = 0$
1	6	$1 \times 6 = 6$
2	10	$2 \times 10 = 20$
3	4	$3 \times 4 = 12$
4	1	$4 \times 1 = 4$
	Total number of families 24	Total number of children 42

- g 1.75
4 6 km, 6.5 km, 9 km, 5 km
5 a Masses that are greater than or equal to 10 kg, but less than 12 kg

b

Mass, m (kg)	Tally	Frequency
$10 \leq m < 12$		3
$12 \leq m < 14$		1
$14 \leq m < 16$		4
$16 \leq m < 18$		2

- c $14 \leq m < 16$ kg.

Presenting and comparing data

- 1 a i Median 7, range 9.
ii Median 7, range 2.
b The median marks for Aya and Jad are the same.
c The range of Aya's marks is greater than the range of Jad's marks, so Jad's marks are more consistent.
d Jad; because his marks show that he has a fairly good understanding of all the different topics.

2 a

1	8, 9
2	1, 2, 5, 8, 9
3	0, 1, 3, 5, 8, 9, 9
4	1, 7, 8, 9
5	0, 5

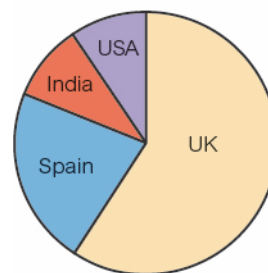
Key

1 | 8 means 18 mm

- b i 9 ii 20%
3 a Age 40 b 5 c 22
d Age 51 e 25 f 13
g 51
4 a 2°
b 2° for 1 person; 200° for 100 people
c 90° , 40° , 30°

d

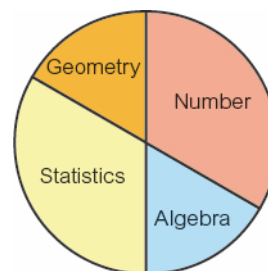
Holiday destinations



- 5 a Number
b

	Number	Algebra	Statistics	Geometry
Boys	40	20	10	10
Girls	20	10	20	10

c

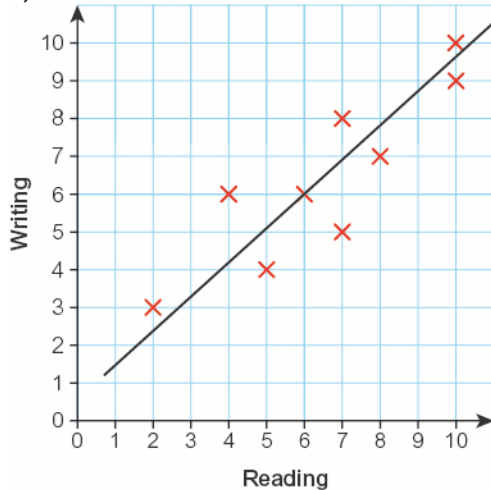


- d Nadia is wrong, 10 boys and 10 girls like Geometry, but there are more boys so the angle for Geometry is smaller in the Boys pie chart.

Scatter graphs

- 1 a 0.6 kg b 8 weeks
c As the age of the bear cub increases, the mass increases.
- 2 a Positive correlation
b Negative correlation
c Positive correlation
d No correlation
e Negative correlation

3 a, c



- b There is **positive** correlation between the students' reading and writing results.
- d i Students' own answers from line of best fit. Between 3 and 4.
ii Students' own answers from line of best fit. Between 7 and 9.

Enrichment

1 a–d Students' own answers

10 Extend

- 1 a i Mean: Men 47.87; Boys 53.42
ii Median: Men 47.86; Boys 53.46
iii Range: Men 0.92; Boys 0.75
- b Men are faster on average as their average time is less than the boys' average time, but the boys' times are more consistent as the range is lower.

2 a

	$11 < t \leq 12$	$12 < t \leq 13$	$13 < t \leq 14$	Total
Male	3	2	2	7
Female	2	5	1	8
Total	5	7	3	15

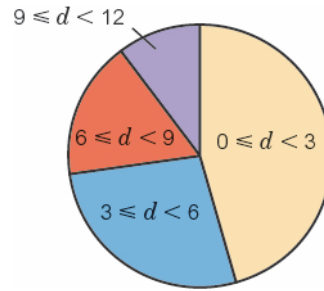
b 8

c 2

d 7

3 Real Madrid

4 a



- b i The modal distance travelled to the shops is $0 \leq d < 3$ km.
ii Fewer than half the shoppers had travelled less than 3 km.
iii Just over 25% of shoppers had travelled more than 6 km.

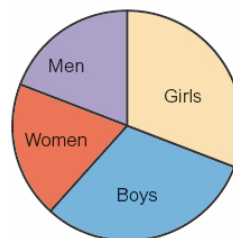
5 a

	Beginner	Intermediate	Advanced	Total
Girls	6	20	12	38
Boys	10	14	10	34
Women	2	10	13	25
Men	3	6	14	23
Total	21	50	49	120

b 120

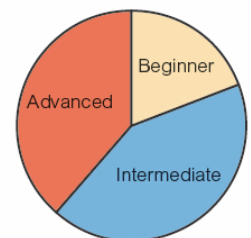
c i

Members of a hockey club



ii

Levels of players at a hockey club



- 6 a Before: median = 26, range = 36;
After: median = 37, range = 38
- b The median result was 11 points higher after the film. The range increased very slightly showing that there was a slight increase in the difference between the lowest and highest scores.
- 7 a Positive correlation
b As the temperature increases, the length of the bar increases.
- c i Answers near to 10.02 m
ii Answers near to 10.07 m
- d 0.05 m

8 a

1	25, 37, 96
2	00, 56, 94
3	16, 27, 58, 67, 76, 82
4	12, 20, 46, 64, 88, 96
5	17, 34, 62, 78, 84
6	27

Key: 1|25 means 125 pages

b 24

c 25%

d

Number of pages, p	Frequency
$100 \leq p < 200$	3
$200 \leq p < 300$	3
$300 \leq p < 400$	6
$400 \leq p < 500$	6
$500 \leq p < 600$	5
$600 \leq p < 700$	1

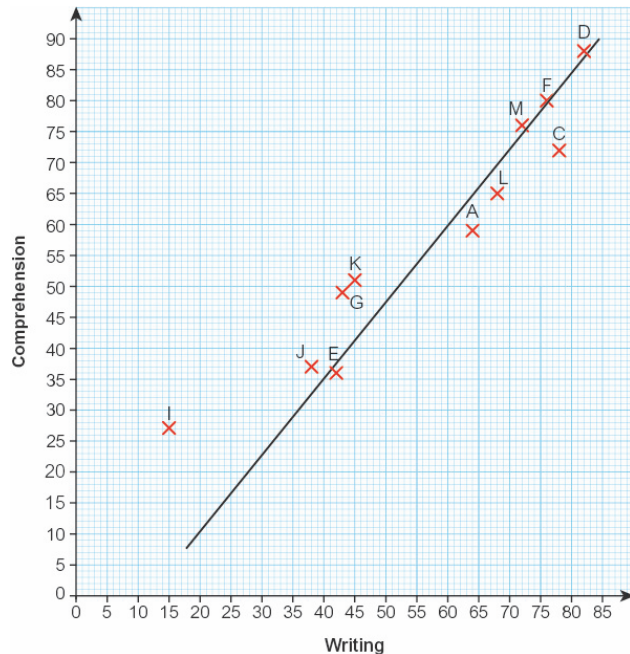
e i 397

ii 394.25

iii 502

iv $300 \leq p < 400$ and $400 \leq p < 500$ pages

9 a, b

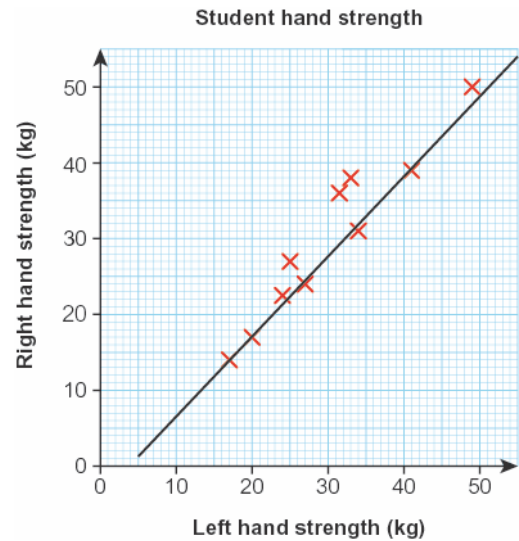


c Positive correlation. Students with higher writing marks tend to get higher comprehension marks.

d i About 58

ii About 80

10 a



b Students' own answers. Between 33 kg and 36 kg

10 Unit test

1 a 36

b 9

c 6

2 a 5 items

b 2 items

c 2.3 (1 d.p.)

3 a Students' own answers, for example:

The Smith family have a higher mean and median, so they spend more on average. The Smith family also have a higher range, so the amount they spend each week varies more, whereas the Jones family have a smaller range, so their spending is more consistent.

b They are unlikely to spend exactly the same amount twice.

4



5 a 55°C b 20°C

c The pan without the lid reached room temperature after 40 minutes. The pan with the lid took 20 minutes longer and reached room temperature after 60 minutes.

d 15°C

6

Mass, m (g)	Tally	Frequency
$45 \leq m < 50$		2
$50 \leq m < 55$		0
$55 \leq m < 60$		5
$60 \leq m < 65$		3

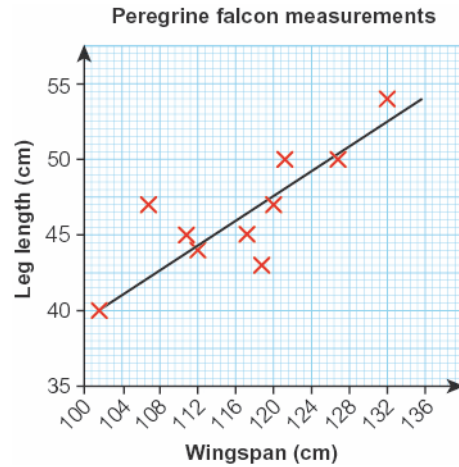
7 a

	Tennis	Hockey	Badminton	Total
Females	20	32	15	67
Males	24	26	20	70
Total	44	58	35	137

b 44 c 58

8 a 3.8 seconds b 12.9 seconds

9 a, c



b Positive correlation

- d i Students' own answers. Between 46 cm and 50 cm
ii Students' own answers. Between 110 cm and 115 cm

Unit 11 Straight-line graphs

11.1 Plotting linear graphs

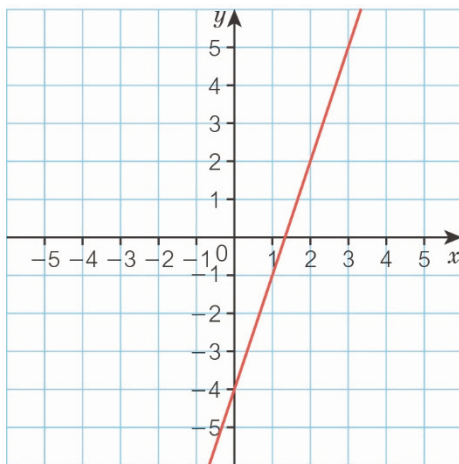
1 a $y = 5$ b $y = -3$ c $y = -9$

- 2 A $y = 3$
 B $x = 2$
 C $y = -2$
 D $x = -1.5$
 E $y = x$
 F $y = -x$

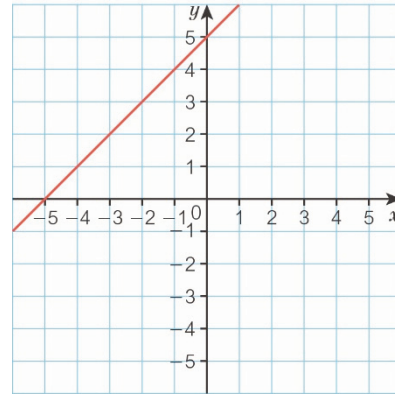
3 a

x	-2	-1	0	1	2
y	-10	-7	-4	-1	2

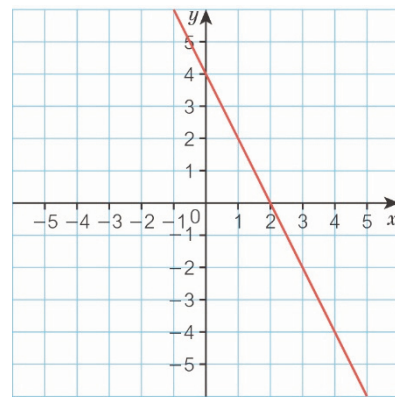
b $y = 3x - 4$



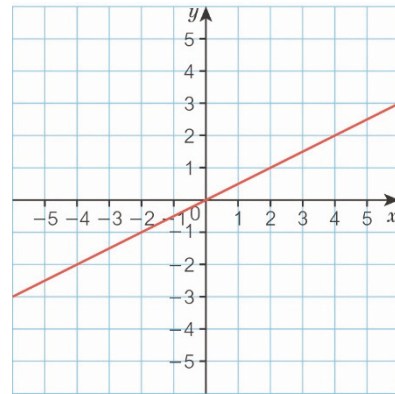
4 a $y = 5 + x$



b $y = 4 - 2x$



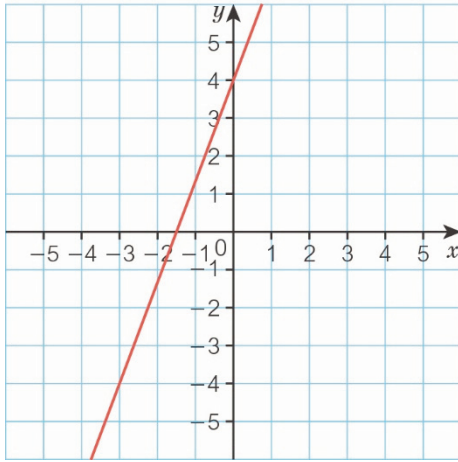
c $y = \frac{1}{2}x$



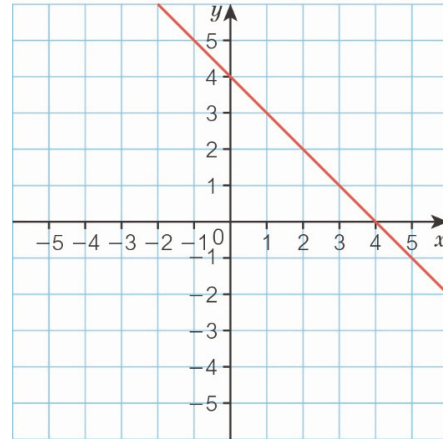
5 a $y = 4$

b $x = -\frac{12}{8} = -\frac{3}{2} = -1.5$

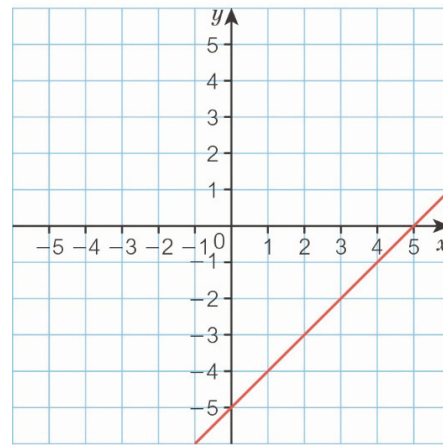
c $(0, 4), (-\frac{3}{2}, 0)$



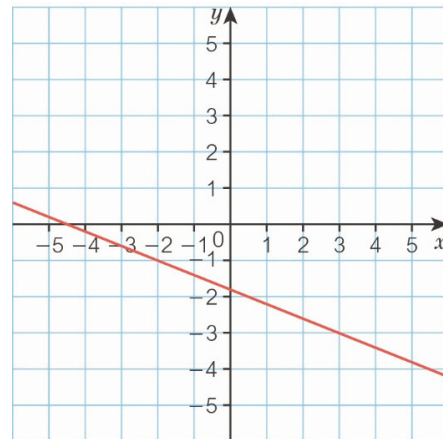
6 a $x + y = 4$



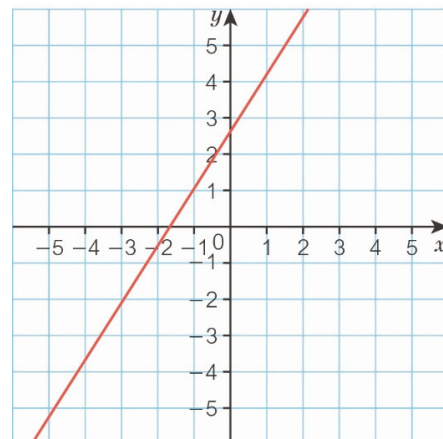
b $x - y = 5$



c $2x + 5y + 9 = 0$



d $7y - 11x = 18$



- 7 a (0, -4) b (0, 1) c (0, -3)
 d (0, 1) e (0, -4) f (0, -5)
 g (0, 0) h (0, 0) i (0, 1)
 j (0, -4)

- 8 A $y = -2x + 4$ B $y = 3x - 1$
 C $y = -x$ D $y = 3x + 1$
 E $y = -4x + 2$ F $y = -\frac{1}{2}x - 2$

- 9 Any of the form $y = mx + 5$

10 a



- b £1750

11.2 The gradient

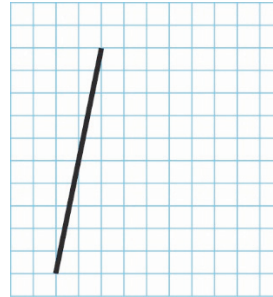
- 1 a (0, 4)
 b (0, 1)
 c (0, -5)
 d (0, -2)

2 B

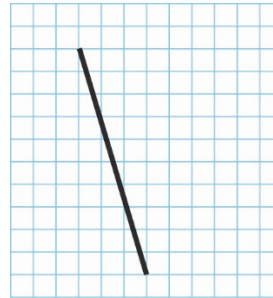
- 3 A 2 B $\frac{1}{2}$
 C -2 D -3
 E 1 F 2

4 3

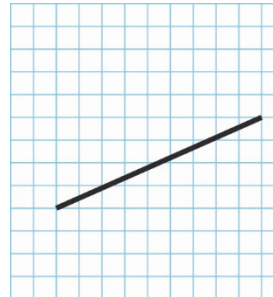
5 a



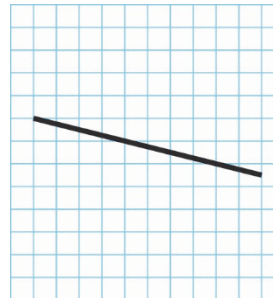
b



c



d



- 6 a 0.5 or $\frac{1}{2}$

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

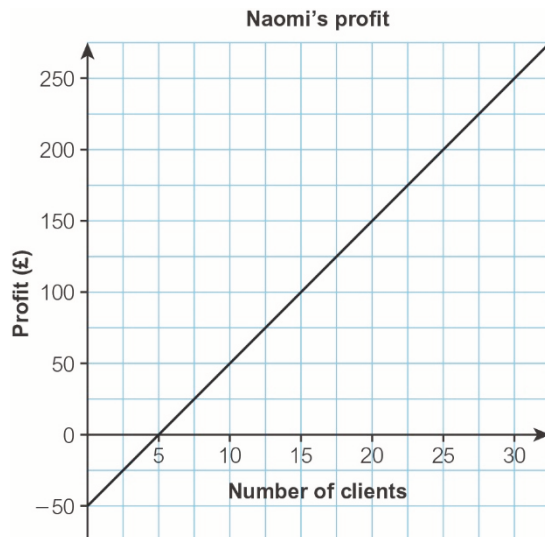
7

Equation of line	Gradient	y-intercept
$y = 2x - 5$	2	(0, -5)
$y = x + 1$	1	(0, 1)
$y = 3x + 4$	3	(0, 4)
$y = -x + 2$	-1	(0, 2)
$y = -2x - 7$	-2	(0, -7)
$y = \frac{1}{3}x + 1$	$\frac{1}{3}$	(0, 1)

Students' own graphs, with appropriate axes

- 8 a (0, 10)
b £10
c 0.5
d £0.50

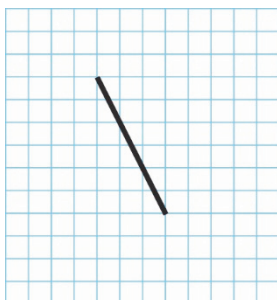
9 a



- b i -£50
ii The cost of hiring the room.
c £10

11.3 $y = mx + c$

1



- 2 a i 3
ii -12
iii -6
b i 4
ii 1
iii 2

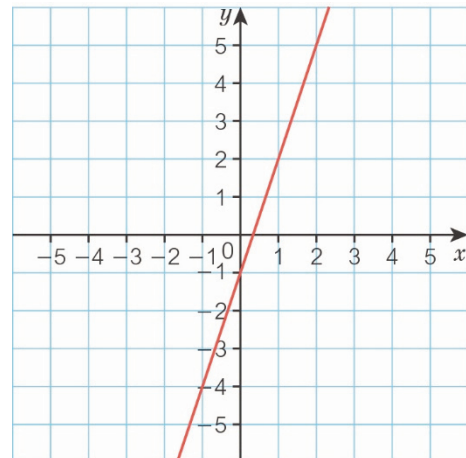
- 3 a Gradient 2; y-intercept (0, -5)
b Gradient 3; y-intercept (0, 0)
c Gradient $-\frac{1}{2}$; y-intercept (0, 4)
d Gradient -1; y-intercept (0, 0)

- 4 a 2
b (0, 2)
c $y = 2x + 2$

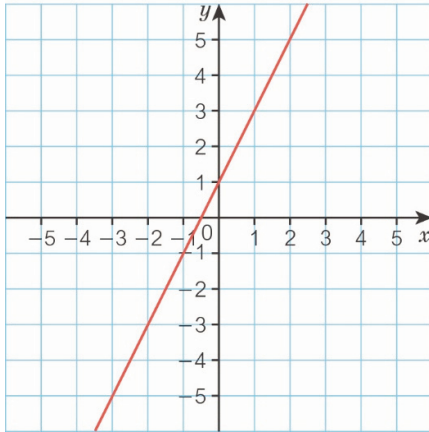
- 5 A $y = 2x + 1$ B $y = \frac{1}{2}x - 1$
C $y = -2x + 3$ D $y = x - 3$
E $y = 3x$ F $y = -2x$

6 C, A, B

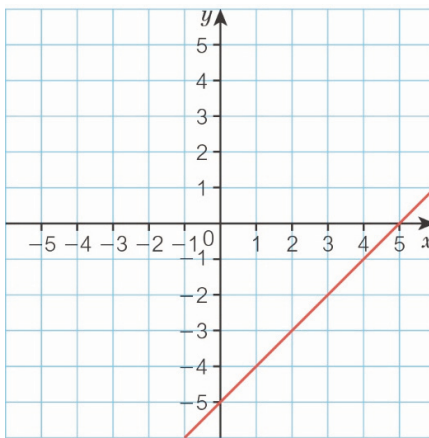
- 7 a (0, -1)
b 3
c $y = 3x - 1$



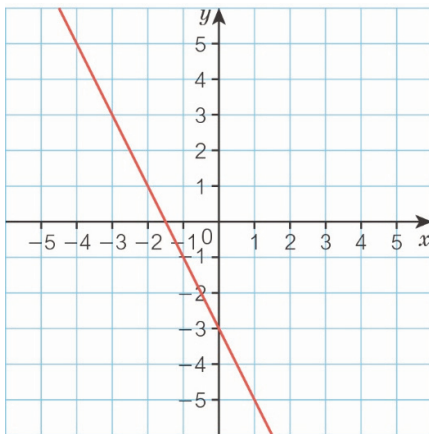
8 a $y = 2x + 1$



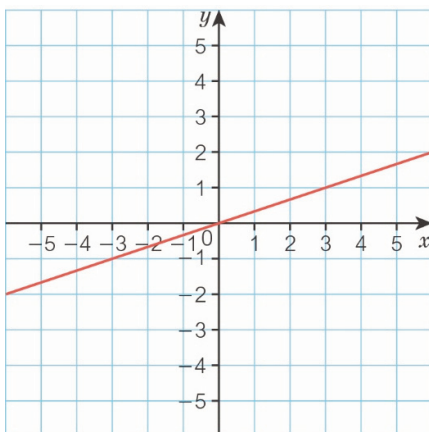
b $y = x - 5$



c $y = -2x - 3$



d $y = \frac{1}{3}x$



9 A, D

10 a £500

b £300

c $y = 300x + 500$

11 a (3, 11)

b No. When $x = 1$, $y = 2 \cdot 1 + 5 = 7$, not 9

12 a C

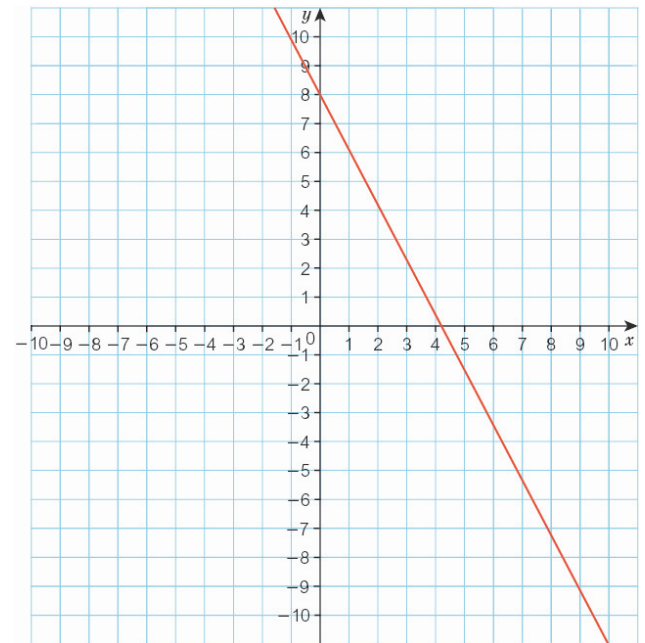
b A, C, G

c None

d A, D, F

11 Check up Straight-line graphs

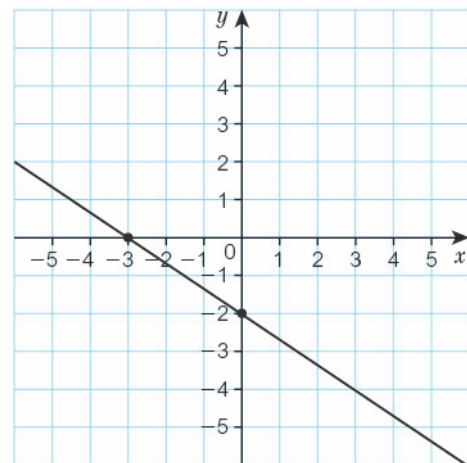
1 $2x + y = 8$



2 a -2

b -3

c $2x + 3y + 6 = 0$



3 A: $y = 2x + 3$; B: $y = 5 - x$; C: $y = 2x - 1$,

D: $y = \frac{1}{2}x$; E: $y = -2x - 3$;

- 4 Students' own answers, e.g. $y = x - 2$,
 $y = 2x - 2$, $y = 3x - 2$, etc.

5 B

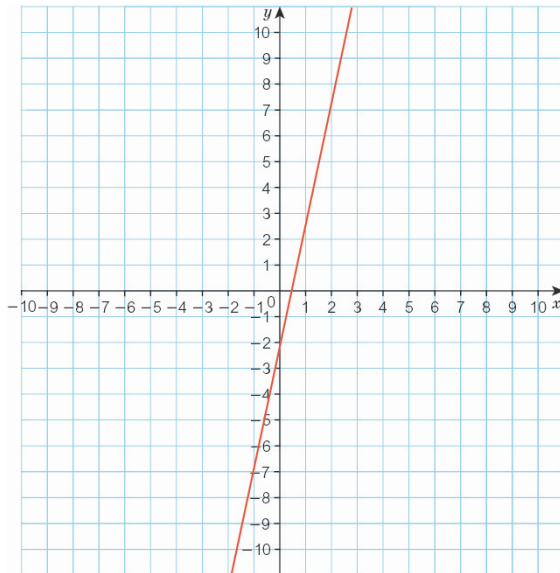
Gradients

6 2

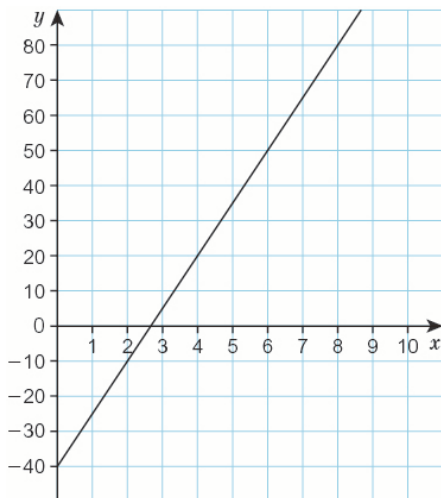
7

Equation	Gradient	y-intercept
$y = 5x - 2$	5	(0, -2)
$y = x + 1$	1	(0, 1)
$y = \frac{1}{3}x$	$\frac{1}{3}$	(0, 0)
$y = 5 - 3x$	-3	(0, 5)

8



9 a



- b The cost of hiring the hall
 c The number of dollars each students pays per class
 d 3

Finding the equation of a line

10 a y-intercept (0, -4); gradient 2

b y-intercept (0, 0); gradient $\frac{1}{2}$

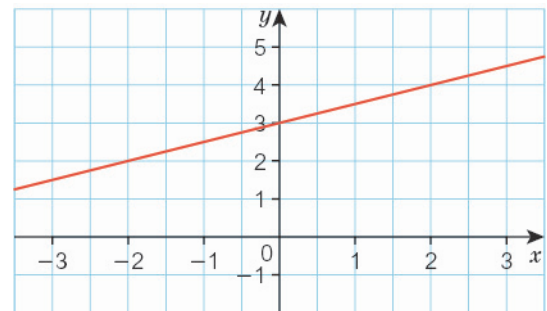
11 $y = 3x - 2$

11 Strengthen Straight-line graphs

1 a

x	-3	-2	-1	0	1	2	3
$\frac{1}{2}x$	-1.5	-1	-0.5	0	0.5	1	1.5
+ 3	1.5	2	2.5	3	3.5	4	4.5
y	1.5	2	2.5	3	3.5	4	4.5

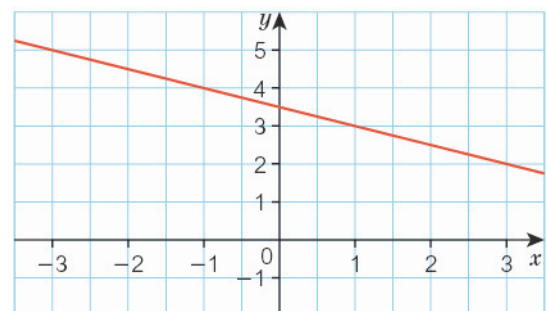
b $y = \frac{1}{2}x + 3$



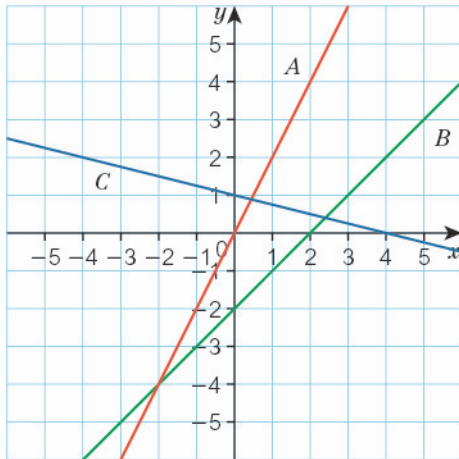
2 a

x	-3	-2	-1	0	1	2	3
$-x + 7$	10	9	8	7	6	5	4
2y	10	9	8	7	6	5	4
y	5	4.5	4	3.5	3	2.5	2

b $x + 2y = 7$



3 a



b $(-2, -4)$

4 a 1 b $(2, 3)$ c 4
d $(5, 9)$

5 a No b $(0, 5)$ and $(4, 9)$

Gradients

1 a Positive b 2
c B 3 C 1 D 5

2 a Negative b -4
c F -2 G -1

3 A 3 B 1
C -4 D -2

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

5 a C
b The gradient of $y = x$ is 1.
c A gradient 1; B gradient 2; C gradient 3

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

7 a-c Will vary according to point chosen.
d 4

Finding the equation of a line

1 a $(0, -7)$ b $(0, -5)$ c $(0, 1)$
d $(0, 7)$ e $(0, -2)$ f $(0, 0)$

2

Equation	Gradient	y-intercept
a $y = 3x + 1$	3	$(0, 1)$
b $y = 2x$	2	$(0, 0)$
c $y = x + 5$	1	$(0, 5)$
d $y = 2x - 3$	2	$(0, -3)$
e $y = 5x - 7$	5	$(0, -7)$
f $y = -2x + 4$	-2	$(0, 4)$
g $y = -5x - 2$	-5	$(0, -2)$
h $y = -x + 7$	-1	$(0, 7)$

3 a 2 b $(0, 4)$ c $y = 2x + 4$

4 A $y = 4x + 1$ B $y = 2x - 2$
C $y = x + 3$ D $y = \frac{1}{2}x - 1$

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

Enrichment

1 Students' own answers
2 C is the odd one out because it has a gradient of 3 whereas all the others have gradient 2.

11 Extend

1 A $\frac{1}{3}$ B 2 C $-\frac{1}{2}$
D $\frac{3}{4}$ E $-\frac{2}{3}$

2 a -2 b $y = -2x - 3$

3 a $y = 3x + c$ b $4 = 3(-2) + c$
c $c = 10$ d $y = 3x + 10$

4 $y = -2x + 5$

5 a 2 b 3 c -2
d 1

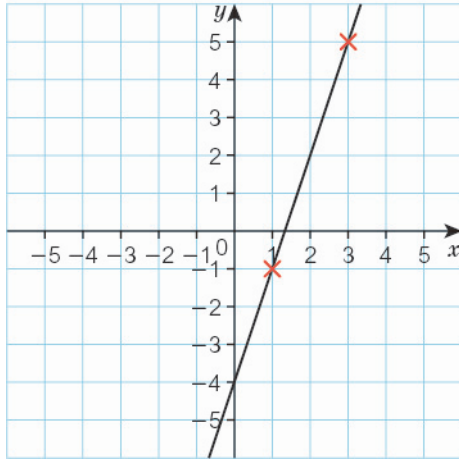
6 $y = 3x + 6$

7 6

8 $y = 3x + 9$

9 a 1 b -1 c 3
d 7 e 9 f 4

10 a, b

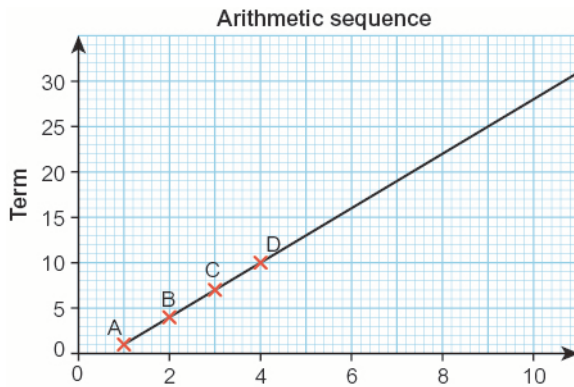


c $y = 3x - 4$

11 a 3000 rupees b £120 c 100

- d The gradient represents how many rupees you get for every £1.
e There is a £20 charge by the bank.

12 a



- b $y = 3x - 2$
c $3n - 2$. It is the same as the equation of the line.
d 58
e No. If you substitute $y = 23$ into the equation of the graph it does not give you a whole number value of x .

13 a $y = 2x + 1$ b 21 cm

14 a Yes b $\frac{1}{30}$ c $y = \frac{1}{30}x$

d The gradient is $\frac{1}{30}$

15 b, c and d

16 a Red and green (A and B), yellow and blue (C and D).

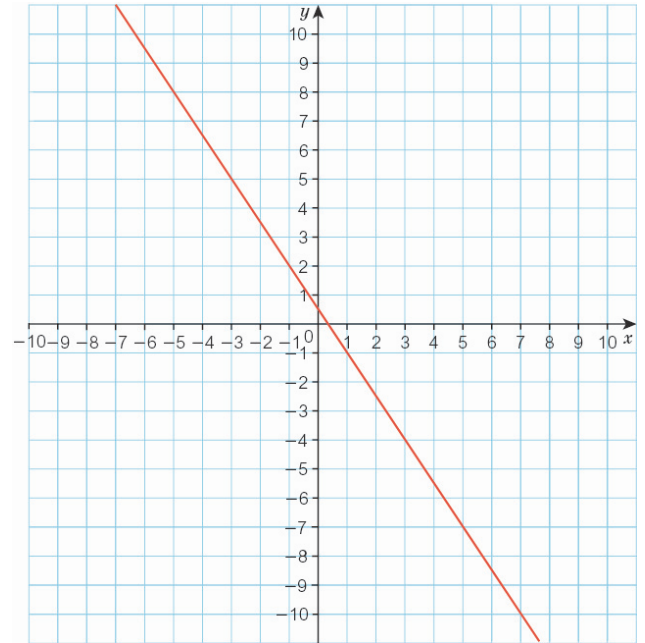
b Yellow line $y = 2x + 5$; green line $y = -\frac{1}{2}x + 4$;
red line $y = -\frac{1}{2}x - 1$; blue line $y = 2x - 3$

Enrichment

17 Students' own answers

11 Unit test

1 $3x + 2y = 1$



2 a B and D b B c A and C

d A $y = 2x + 4$ B $y = 3x$
C $y = 2x - 1$ D $y = x$

3 a A 2 B $\frac{1}{3}$
C $-\frac{1}{2}$ D $\frac{2}{3}$

b A $y = 2x - 3$ B $y = \frac{1}{3}x + 4$
C $y = -\frac{1}{2}x + 1$ D $y = \frac{2}{3}x$

4 $y = 3x$

5 a (0, -5) b -2

6 $y = 4x - 3$

7 Substitute $x = 6$ into $y = 2x - 14$, $y = 12 - 14$, $y = -2$. No, the point does not lie on the line.

8 A $y = -4x + 2$ B $y = \frac{1}{4}x - 2$
C $y = -x + 3$ D $y = 4x + 2$