Workbook answers

Exercise 1.1

1 **a** −7 **b** 1 **c** −5 **d** 5

2 **a** −2 **b** −9 **c** 9 **d** 1

3

+	4	−5
2	6	−3
−6	−2	−11

4 **a** 15 **b** −25 **c** −15 **d** 17

5 **a** 25 **b** 5 **c** 11 **d** −23

6 **a** −7 **b** 6 **c** 4 **d** −10

7 **a** 9 **b** 5 **c** 2 **d** −3

8 **a** 4 **b** 17 **c** −20 **d** 6

9 **a** −80 **b** 200 **c** −800 **d** −90

10 −6

11 Two possible answers: −2 or 4.

12 **a** $-3+4=1$ **b** $-5+3=-2$

c $5+-2=3$

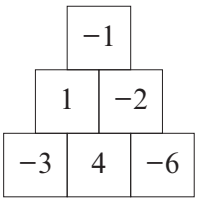
13

+	3	−4
2	5	−2
−2	1	−6

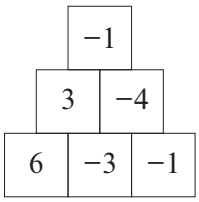
14

−	−4	6	2
3	7	−3	1
−3	1	−9	−5

15 **a**



b



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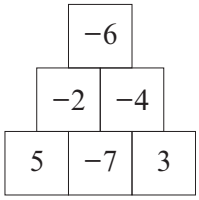


One method is to try different numbers in the bottom square. Try to get closer to −6 each time.

Exercise 1.2

1 **a** −30 **b** −36 **c** −55 **d** −49

2 **a** −12 **b** −4 **c** −5 **d** −7

3

×	4	7
−2	−8	−14
−6	−24	−42

4 **a** −12 **b** −30 **c** −28 **d** −30

5 **a** −3 **b** −7 **c** −2 **d** −6

6 **a** −8 **b** −3 **c** 13 **d** 5

7 **a** 9 **b** −4 **c** −36 **d** 32

8 **a** −12 **b** 21 **c** 8 **d** −3

9 **a** −1200 **b** −900 **c** −1200 **d** −200

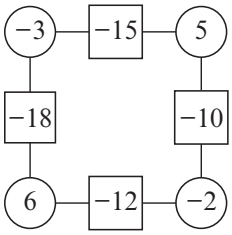
10 **a** −2 and 9; 3 and −6; −3 and 6; 1 and −18; −1 and 18

b There are two more, as listed in part **a**.

11

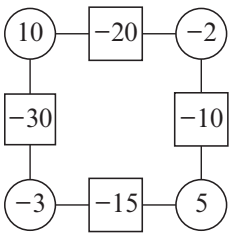
×	6	4
−5	−30	−20
−8	−48	−32

12 **a** **i**



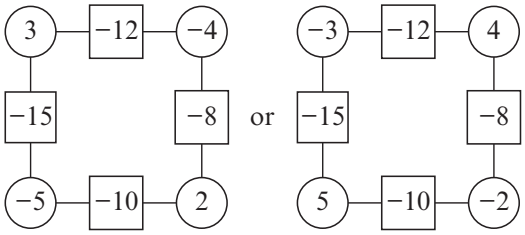
ii −55

b **i**



ii −75

13 a



b There are two solutions.

14 a $(3 + -5) \times 4$ or $(-5 + 3) \times 4$

b $(-4 + 7) \times 2 = 6$. The other possibilities are negative numbers.

15 a −1 and 20 have a sum of 19.

b −1 and 30 have a sum of 29.

c For any negative integer, the largest possible sum is the corresponding positive integer −1. For example: For −15, the largest sum is $15 - 1 = 14$.

Exercise 1.3

1 a 4, 8, 12, 16 **b** 7, 14, 21, 28

c 12, 24, 36, 48 **d** 30, 60, 90, 120

2 9

3 a 8, 16, 24, 32, 40, 48

b 5, 10, 15, 20, 25, 30, 35, 40, 45

c 40

4 a 6, 12, 18, 24, 30 **b** 6 **c** 6

5 a 12, 24, 36 **b** 12 **c** 12

6 a 30 **b** 20 **c** 10

7 The multiples of 3 are 3, 6, 9, 12, 15, . . . The multiples of 5 are 5, 10, 15, . . . So 15 is the lowest common multiple and the multiples of 15 are common multiples.

8 42

9 a i 14 **ii** 28 **iii** 42

b Multiply the two numbers.

c It works unless the other number is a multiple of 7. For example: it works for 7 and 8, or 7 and 9, or 7 and 10, but not for 7 and 14, or 7 and 21.

10 a i 90 **ii** Yes

b i 98 **ii** No; the LCM is 14.

c i 96 **ii** No; the LCM is 24.

11 30

12 72

13 a Because $96 \div 4 = 24$ and $96 \div 24 = 4$.

b No; the LCM is 24 because $24 = 6 \times 4$.

14 5 and 9

15 1 and 63; 7 and 9

Exercise 1.4

1 a 1, 3, 7, 21 **b** 1, 2, 4, 8, 16, 32

c 1, 2, 5, 10, 25, 50

d 1, 2, 3, 4, 6, 8, 9, 12, 18, 24, 36, 72

e 1, 43

2 a 1, 3, 17, 51 **b** 1, 2, 4, 13, 26, 52

c 1, 53 **d** 1, 2, 3, 6, 9, 18, 27, 54

e 1, 5, 11, 55

3 a 1, 2, 4 **b** 4

4 a 1, 3, 5, 15 **b** 15

5 a 3 **b** 9 **c** 18

6 a 9 **b** 25 **c** 8 **d** 1

7 a 7 **b** 5 **c** 14

8 a 8 **b** $\frac{4}{5}$

9 a 13 **b** $\frac{4}{7}$

10 5 and 30; 10 and 25; 15 and 20

11 a $8 = 4 \times 2$ and $12 = 4 \times 3$

b 8 is the HCF because $16 = 2 \times 8$.

c 8 and 20; 8 and 28; 12 and 16; 12 and 20; 12 and 28; 16 and 20; 16 and 28; 24 and 28

12 3 or 6 or 12 or 15 or 21 or 24 . . . Any multiple of 3 that is not a multiple of 9.

13 a i 1 **ii** 1 **iii** 1

b The HCF of two consecutive numbers is 1.

c The LCM of two consecutive numbers is the product of the numbers. For example: the LCM of 4 and 5 is 20.

Exercise 1.5

1 $28 \div 4 = 7$; 28 is divisible by 4 and so is 5328; $5 + 3 + 2 + 8 = 18$, which is divisible by 9.

2 **a** odd $= 9 + 7 = 16$; even $= 3 + 2 = 5$; $16 - 5 = 11$

b Yes, the sums are the same. This time odd $= 5$ and even $= 16$; $5 - 16 = -11$.

3 **a** The last two digits make the number 8, which is divisible by 4.

b No, the last three digits are not divisible by 8 because $108 \div 8 = 13$ r. 4.

4 The sum of the digits is $14 + *$. This is a multiple if 3 when it is 15, 18 or 21; $* = 1$ or 4 or 7.

5 1, 7 and 11

6 **a** **i** Any number with these digits that ends in 5.

ii Any number with these digits because the sum of the digits is always 12.

b **i** No, because the sum of the digits is 12.

ii Yes. For example: 1254 is a possible answer. The odd and even digit sums must be $1 + 5$ and $2 + 4$.

7 For example: $322 + 7 + 7 = 336$

8 It is divisible by 1. $520 = 8 \times 65$, so it is divisible by 2, 4, 8. It is also divisible by 3 and therefore also divisible by 6.
$2 + 5 + 2 + 0 = 9$, so it is divisible by 3 and 9.
The last digit is 0, so it is divisible by 5 and 10.
$2520 \div 7 = 360$, so it is divisible by 7.
Odd $= 0 + 5 = 5$ and even $= 2 + 2 = 4$, so it is not divisible by 11. This shows that 11 is the smallest integer that is not a factor.

9 The numbers with an even number of digits. For example: 99, 9999, 999 999, . . .

10 **a** It ends in 5, so it is divisible by 5.
$7 + 9 + 0 + 5 = 21$, so it is divisible by 3.
Hence, it is divisible by 15.

b The final digit must be 0 or 5. If it is 0, the other digit is 2, 5 or 8. If the final digit is 5, then the other digit is 0, 3, 6 or 9. These are the possible numbers: 20 805, 20 820, 20 835, 20 850, 20 865, 20 880, 20 895.

11 1 is a factor. Another factor is 3 because the digit sum is 21, which is a multiple of 3. A third factor is 11 because $9 + 7 = 16$, $2 + 3 = 5$ and $12 - 5 = 11$.

12 It is odd, so it is not divisible by 2, 4, 6, 8 or 10.
It ends in 9, so it is not divisible by 5.
The sum of the digits is 32, so 3 and 9 are not factors. Odd digit sum $= 15$ and even digit sum $= 17$, so 11 is not a factor. The only other possibility is 7, so that must be a factor.

13 **a** 1234 or 3456 or 5678 **b** 3456 or 6789

c 2345

d There are none because odd − even always equals 2.

Exercise 1.6

1 **a** 25 **b** 85 **c** 181

2 **a** 8 **b** 10 **c** 15 **d** 13

3 **a** 9 **b** 152 **c** 56

4 **a** 4 **b** 0 **c** −1

5 **a** 6 **b** 8 **c** 10 **d** 12

6 **a** $\sqrt{400} = 20$ **b** $\sqrt{625} = 25$

c $\sqrt{900} = 30$ **d** $\sqrt{1225} = 35$

7 **a** $\sqrt[3]{216} = 6$ **b** $\sqrt[3]{1000} = 10$

c $\sqrt[3]{1331} = 11$ **d** $\sqrt[3]{3375} = 15$

8 **a** 6 **b** 15 **c** 4

9 **a** $\sqrt{90}$ is between 9 and 10

b $\sqrt{135}$ is between 11 and 12

10 144

11 **a** 121, 144, 169 and 196

b 125

12 7

13 **a** 64 **b** $\sqrt[3]{64} = 4$ and $\sqrt{4} = 2$

14 361

15 2197

16 **a** $\sqrt{64} = 8$ and $\sqrt[3]{64} = 4$

b 729 because $\sqrt{729} = 27$ and $\sqrt[3]{729} = 9$.

c Learner's own answer.

Exercise 2.1

1 **a** 1

b 3

c c (or any other letter)

d 6

e a (or any other letter)

2 **a** 3

b 3, $3+2=5$

c b, $b+2$ (or any other letter)

3 A and iv, B and iii, C and ii, D and v, E and i

4 **a** $t+4$ **b** $t-2$

c $t+5$ **d** $t\div 2$ or $\frac{t}{2}$

5 **a** $s+2$ **b** $3s$

c $s-6$ **d** $\frac{s}{2}$

6 **a** $x+2$ **b** $t-15$

c $i+t$ **d** $2v$

7 **a** $6n$ **b** $\frac{n}{5}$ **c** $5n+1$

d $7n-2$ **e** $\frac{n}{10}+3$ **f** $25-3n$

8 **a** $a+c$ **b** $a+3c$

c $4a+c$ **d** $4a+5c$

9 a and vii; b and i; c and v; d and iii; e and ii; f and iv. Marcus is not correct, it should be 'Multiply x by 5, then subtract from 5.'

10 **a** $7d+6c$, where d is the number of drinks, c is the number of bags of potato chips.

b $6r$, where r is the value of a ring.

11 **a** $g+k$ **b** $t-h$

c $8x+y$ **d** $3ab$

12 **a** v added to 7 times u

b d subtracted from 8 times w

c 5 times x added to 3 times y

d $7p$ times q or 7 times p times q or $7q$ times p

13 **a** $8a+15+2b-3c$

b $8a+15-(2b-3c)$ or $8a+15-2b+3c$

14 **a** When $p=-12$ and $q=10$, $p+q=-12+10=-2$, but $pq=-12\times 10=-120$. This is not equal to -8.

b $p=2$ and $q=-4$

Exercise 2.2

1 **a** E **b** F **c** E

d F **e** F **f** E

2 **a** 7 **b** 8 **c** 9 **d** 10

3 **a** 4 **b** 5 **c** 6 **d** 7

4 A and iii; B and i; C and ii; D and v; E and iv

5 **b** true

c false when $p=2$, $9p=18$.

d true

e false when $x=12$, $\frac{x}{3}=4$.

6 **a** 16 **b** 117 **c** 20 **d** 25

e 60 **f** 7 **g** 13 **h** 9

i 12 **j** 18 **k** 0 **l** 11

7 **a** \$80 **b** \$144

8 **a** **i** Number of hours = number of days × 24

ii $h=24d$

b 96 hours

9 **a** **i** 20 **ii** 36

b 13

10 **a** **i** $\text{Hours}=\frac{\text{Minutes}}{60}$ **ii** $H=\frac{M}{60}$

b 6

11 **a** 3 hours **b** 3.5 hours

12 **a** **i** 750 newtons **ii** 103 440 newtons

b **i** 150 newtons **ii** 20 688 newtons

13 $x=4$

14 $a=3$ because $25\times 3=75$ (or $75\div 3=25$).

15 **a** $M=P\div h$ or $M=\frac{P}{h}$ **b** $M=14$

16 **a** 84 minutes or 1 hour 24 minutes

b 280 minutes or 4 hours 40 minutes

Exercise 2.3

1 A and iii; B and v; C and vi; D and ii; E and i; F and iv

2 **a** true **b** false, $6d$
c false, $10f$ **d** true
e false, $9h$ **f** true

3 A and ii; B and i; C and i; D and ii; E and ii

4 **a** false, $5b$ **b** true **c** false, $5f$
d true **e** true **f** false, $3v$

5 **a** ✓ $6p$ **b** ✗
c ✗ **d** ✓ $7u$

6 **a** $3x$ **b** $2z$
c $2x+y$ **d** $2z+x$
e $3x+2y$ **f** $2x+2y+z$

7 **a** $4a$ **b** $7b$ **c** $11c$
d $9d$ **e** $13e$ **f** $15f$
g $6g$ **h** h^2 **i** $8i$
j $6j$ **k** $4k$ **l** y^3

8 **a** top row $18x$, middle row $8x$
b middle row $8x$, bottom row (middle) $3x$ and (right) $5x$

9 **a** $7x+5y$ **b** $10z+6a$ **c** $7a+9b$
d $7x+7$ **e** $2d+2$ **f** $2f+9g$
g $30+11w$ **h** $4x+6y$ **i** $4a+b$
j $2w+20y$ **k** $200a+5g+30$

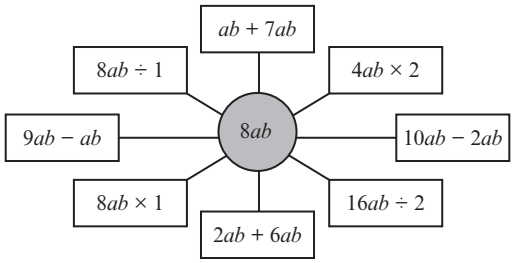
10 **a** $6ab+8xy$
b $6rd+11th$
c $11tv+4jk$
d $5ej+3hy$
e $3v+16rv$
f $3un$

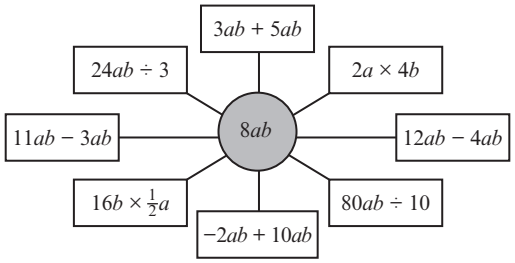
11 **a** Maddi has collected unlike terms. She should have done $2x+7x=9x$ and $8-4=4$, so answer is $9x+4$.
b Maddi hasn't collected together the letters rg, and she has incorrectly simplified $4t-t$. She should have done $5rg+2gr=7gr$ and $4t-t=3t$, so answer is $7gr+3t$.

12 Second row: $9a+5b$
Third row: left $3a+4b$, right $4a+3b$
Fourth row from the left: $3b$, $3a+b$, $2a+2b$

13 **a** $\frac{a}{4}$ **b** $\frac{b}{2}$ **c** $\frac{22c}{7}$

14 **a** There are many different ways to complete this diagram. Two examples are:





b No, there are many different ways to fill in the diagram.

15 **a**

8	1	6
3	5	7
4	9	2

b

$a+b$	$b-a-c$	$b+c$
$b+c-a$	b	$a+b-c$
$b-c$	$a+b+c$	$b-a$

Exercise 2.4

1 **a**

×	10	3
5	50	15

$5\times13=50+15=65$

b

×	30	8
2	60	16

$2\times38=60+16=76$

c

×	20	1
7	140	7

$7 \times 21 = 140 + 7 = 147$

d

×	10	7
4	40	28

$4 \times 17 = 40 + 28 = 68$

2 **a** $3x$ **b** $4p$ **c** $9f$ **d** $5m$

3 **b**

×	x	4
3	$3x$	12

$3(x + 4) = 3x + 12$

c

×	m	1
5	$5m$	5

$5(m + 1) = 5m + 5$

d

×	n	2
4	$4n$	8

$4(n + 2) = 4n + 8$

4 **b**

×	x	-6
5	$5x$	-30

$5(x - 6) = 5x - 30$

c

×	y	-4
2	$2y$	-8

$2(y - 4) = 2y - 8$

d

×	k	-3
6	$6k$	-18

$6(k - 3) = 6k - 18$

5 **a** $3a + 6$ **b** $5b + 15$
c $3c + 6$ **d** $5d - 5$
e $4e - 36$ **f** $3f - 24$
g $8 + 4f$ **h** $56 + 8z$
i $27 + 9y$ **j** $16 - 4x$
k $7 - 7w$ **l** $14 - 7v$

6 **a** $10p + 5$ **b** $21q + 14$
c $18r + 27$ **d** $33s - 44a + 77$
e $4t - 10$ **f** $20u - 4$
g $6 + 12v$ **h** $48 + 32w - 24g$
i $60 + 70x$ **j** $15 - 25x$
k $20 - 15x$ **l** $25k - 40x - 30h$

7 **a** Paul didn't multiply the 3 by 5. Correct answer is $5a + 15$.

b Paul added the 3 and 5 instead of multiplying. Correct answer is $12b - 15$.

c Paul expanded the brackets correctly but then combined unlike terms. Correct answer is $12 - 4c$.

8 Odd one out is $2(10x + 8)$, as this expands to $20x + 16$. All the others expand to give $18x + 24$.

9 **a** $24x - 36y$ **b** $24 + 4x - 6y$

10 **a** $7x + 6$ **b** $12 + 4x$
c $11x + 7$ **d** $10x - 20$
e $11x + 23$ **f** $19x + 22$

11 Left-hand side expanded:
$8x + 28 + 18x - 15 = 26x + 13$

Right-hand side expanded: $26x + 13$

12 **a** $9(3x + 2) = 3(9x + 6)$
b $5(8 - 6z) = 10(4 - 3z)$

13 **a** $4(2x + 9) = 8x + 36$
b $5(3x - 7) = 15x - 35$
c $8(6y - 10) = 48y - 80$
d $7(2y + 6) = 14y + 42$

Exercise 2.5

1 **a** 2 **b** 5 **c** 8
d 3 **e** 7 **f** 7

2 **a** $x = 4$ **b** $x = 8$ **c** $x = 5$
d $x = 11$ **e** $x = 8$ **f** $x = 6$

3 **a** $x = 6$ **b** $x = 11$ **c** $x = 11$
d $x = 17$ **e** $x = 18$ **f** $x = 9$

4 **a** $y = 3$ **b** $y = 2$

5 **a** $x = 4$ **b** $x = 3$ **c** $x = 7$
d $x = 6$ **e** $x = 15$ **f** $x = 10$
g $x = 27$ **h** $x = 4$ **i** $x = 10$
j $x = 7$

6 **a** $x = 11$ **b** $x = 4$ **c** $x = 18$
d $x = 25$ **e** $x = 7$ **f** $x = 5$

7 **a** $x+5=21$, $x=16$

b $x-5=21$, $x=26$

8 **a** $x+14=20$, $x=6$

b $x-17=20$, $x=37$

c $5x=20$, $x=4$

9 **a** $a=7$

b $a=4$

c $b=3$

d $b=5$

10 **a** **i** $5x+4x=90°$

ii $9x=90°$

iii $x=\frac{90}{9}=10°$

iv Angles are 50° and 40°.

v $50+40=90°$

b **i** $6x+4x=180°$

ii $10x=180°$

iii $x=\frac{180}{10}=18°$

iv Angles are 108° and 72°.

v $108+72=180°$

c **i** $3x+4x+2x=180°$

ii $9x=180°$

iii $x=\frac{180}{9}=20°$

iv Angles are 60°, 80° and 40°.

v $60+80+40=180°$

d **i** $5x+4x+3x=180°$

ii $12x=180°$

iii $x=\frac{180}{12}=15°$.

iv Angles are 75°, 60° and 45°.

v $75+60+45=180°$

11 **a** $x=-18$ **b** $y=5$

c $z=-12$ **d** $w=-6$

12 $a=2$, $b=-12$, $c=3$, $d=-7$

$a\times b=-24$, $c+d=-4$

Zara is correct because −24 is less than −4.

13 **a** $w=-8$ **b** $x=-3$

c $y=-16$ **d** $z=6$

Exercise 2.6

1 **a** true **b** false

c false **d** true

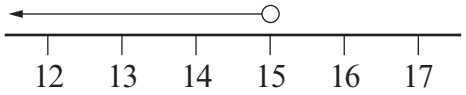
2 A and ii; B and iii; C and iv; D and i

3 **a** $x>2$ **b** $y>5$

c $m<15$ **d** $b<7$

4 A and iv; B and i; C and ii; D and iii

5 **a**



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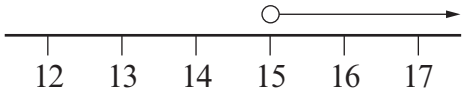
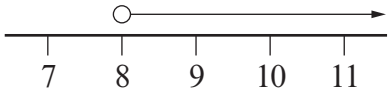


c $x>-2$

d $x<-2$

6 **a**



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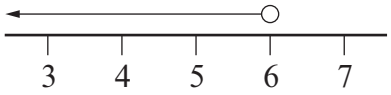
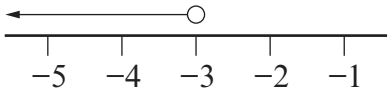
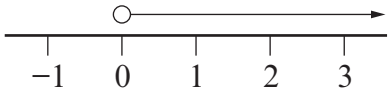


c



d



7 **a** $x<14$

b $x>32$

c $x>-8$

d $x<-1$

8 **a** C 6

b C −6

c A 11

d B −2

9 No; Zara's list should be −6, −7, −8, −9, . . .

10 **a** **i** 9 **ii** 9, 10, 11, 12, . . .

b **i** −2 **ii** −2, −1, 0, 1, 2, . . .

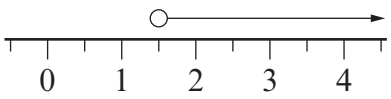
c **i** 5 **ii** 5, 6, 7, 8, 9, . . .

11 **a** **i** -2 **ii** $-2, -3, -4, -5, \ldots$

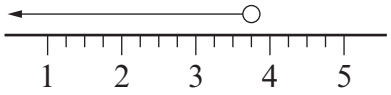
b **i** 15 **ii** 15, 14, 13, 12, . . .

c **i** 3 **ii** 3, 2, 1, 0, -1, . . .

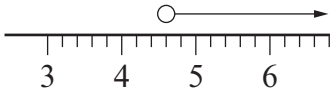
12 **a**



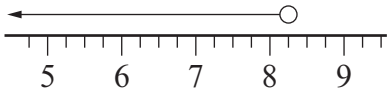
b



c



d



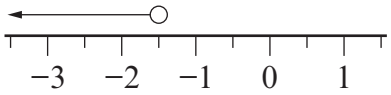
13 **a** $y > 0.5$ **b** $y < 11.2$

c $y < 3.8$ **d** $y > 26.25$

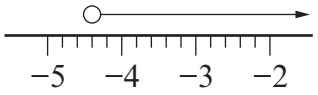
14 It should be $x > -3.5$. Arun has misread the number line.

15 **a** $w > -7.25$ **b** $w < -11.8$

16 **a**



b



Exercise 3.1

1 A and iii because $1000 = 10^3$.

B and v because $100 = 10^2$.

C and i because $100\,000 = 10^5$.

D and ii because $10\,000\,000 = 10^7$.

E and iv because $10\,000 = 10^4$.

2 **a** $6 \times 10^4 = 6 \times 10\,000 = 60\,000$

b $9 \times 10^4 = 9 \times 10\,000 = 90\,000$

c $3 \times 10^4 = 3 \times 10\,000 = 30\,000$

3 **a** $2 \times 10^5 = 2 \times 100\,000 = 200\,000$

b $7 \times 10^5 = 7 \times 100\,000 = 700\,000$

c $5 \times 10^5 = 5 \times 100\,000 = 500\,000$

4 **a** B **b** A **c** C

5 **a** 8 **b** 20 **c** 40

d 9 **e** 3 **f** 500

6 **a** A **b** C **c** B **d** C

7 **a** 5600 **b** 8 770 000 **c** 13 000 000

d 65 000 **e** 33 200 **f** 650 000

8 **a** 37 000 **b** 10^3 **c** 8.9 **d** 10^7

9 **a** 9 **b** 52 **c** 80

10

	$\div 10^2$	$\div 10^3$	$\div 10^4$	$\div 10^5$	$\div 10^6$
400 000	4000	400	40	4	0.4
56 000	560	56	5.6	0.56	0.056
3000	30	3	0.3	0.03	0.003
720	7.2	0.72	0.072	0.0072	0.00072

11 **a** B **b** A **c** C

12 No; it would be quicker for Arun to just multiply his starting number by 100 not 10.

13 **a** 28 000 mg = 28 g

b 750 mg = 0.75 g

c 2 000 000 mg = 2 kg

d 83 000 mg = 0.083 kg

e 53 000 000 000 mg = 53 t

f 2 500 000 mg = 0.0025 t

14 **a** number of g = number of mg $\div 10^3$

number of kg = number of mg $\div 10^6$

number of t = number of mg $\div 10^9$

b **i** 45 g = 45 000 mg

ii 7.6 kg = 7 600 000 mg

iii 0.0657 t = 65 700 000 mg

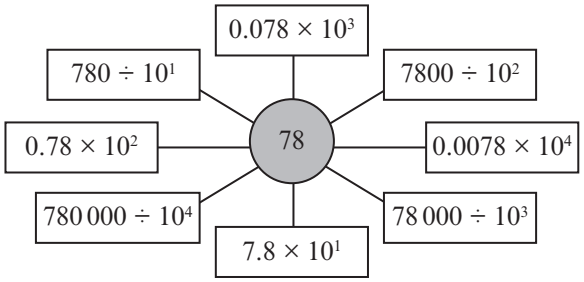
15 **a** Space station, weather satellite, Moon, Venus, Jupiter, Neptune.

You can tell from the power on the 10. The smaller the power, the closer it is to Earth.

b

Object	Distance from Earth (km)
space station	408
weather satellite	36 000
Moon	384 400
Venus	41 400 000
Jupiter	628 700 000
Neptune	4 350 000 000

16 There are many different answers for this diagram. One example is given.



17 **a** 41 000 **b** 9.24
c 25 **d** 20.7

Exercise 3.2

1 **a** 4.5 **b** 3.7 **c** 8.8
d 7.2 **e** 2.4 **f** 4.1

2 **a** B **b** B **c** A
d A **e** B

3 **a** 2.47 **b** 8.66 **c** 3.31
d 8.07 **e** 1.94 **f** 2.42

4 **a** B **b** A **c** A
d B **e** B

5 **a** 4.98 **b** 9.04 **c** 24.33
d 128.64 **e** 0.67 **f** 0.03

6 **a** 7.285 **b** 65.882
c 134.903 **d** 0.679
e 300.004 **f** 0.009

7 **a** 3.8826 **b** 61.8902
c 143.5623 **d** 200.0068
e 300.0006 **f** 18.2525

8 **a** B **b** A **c** A

9 0.00660 mm

10 **a** 1.73 **b** 11.1538
c 35.434

11 **a** 480 **b** 477
c 476.9 **d** 476.89
e 476.893 **f** 476.8926
g 476.89256 **h** 476.892564
i 476.8925637 **j** 476.89256370

12 **a** 0.63636. . . = 0.6364 (4 d.p.)
b 1.5714. . . = 1.571 (3 d.p.)
c 1.444. . . = 1.44 (2 d.p.)
d **i** Marcus = 8.285, Arun = 8.286
ii no
iii Arun's method. You need to find the number in the fourth decimal place so you know whether you need to round up or down the number in the third decimal place.

13 Any ten numbers in the interval 45.6375 ≤ number < 45.6385.

14 **a** 25.246 **b** 25.247
c No, because by rounding early, you lose accuracy.
d By rounding at the end of a calculation and not during a calculation, you know the answer will be accurate.

Exercise 4.1

1 12, 23, 45, 176, 204, 498

2 **a** **i** 215 **ii** 34, 59, 70, 152, 215, 251
b **i** 39 **ii** 39, 67, 88, 95, 101, 321
c **i** 10.9 **ii** 6, 8.2, 10.9, 14.5, 67, 100.7

3 **a**, **b** 18.1, 18.3, 18.5, 18.6, 18.9
c 9.2, 9.3, 9.5, 9.7, 9.8
d 3.21, 3.32, 3.42, 3.56

4 6.08, 6.1, 6.21, 6.5

5 **a** 4.02, 4.21, 4.5, 4.67
b 12.08, 12.3, 12.41, 12.9

6 **a** 3.5 **b** 214.92
c 34.56 **d** 336.9
e 0.22 **f** 5.41
g 25.67 **h** 0.013
i 0.009 **j** 0.049

7 **a** 9.58, 9.69, 9.72, 9.78, 9.79, 9.84
b Asafa Powell

8 **a** < **b** > **c** < **d** >
e > **f** < **g** > **h** >

9 **a** = **b** ≠ **c** ≠
d = **e** = **f** ≠

10 **a** 2.66, 4.41, 4.46, 4.49
b 0.52, 0.59, 0.71, 0.77
c 6.09, 6.9, 6.92, 6.97
d 5.199, 5.2, 5.212, 5.219
e 42.4, 42.42, 42.441, 42.449
f 9.04, 9.09, 9.7, 9.901, 9.99

11 **a** 0.081 m, 8.15 cm, 83 mm
b 6.7 kg, 0.00672 t, 6750 g
c 3455 mm, 346 cm, 0.00347 km, 3.48 m

12 **a** Any three numbers in the range 6.46 < number < 6.471.
b 10
c 6.461, 6.462, 6.463, 6.464, 6.465, 6.466, 6.467, 6.468, 6.469, 6.470

13 $2000 \div 1000$, 0.0208×100, 0.23×10, $2320 \div 1000$, 1.9×10, $2110 \div 100$

Exercise 4.2

1 **a** 97 **b** 81 **c** 132
d 439 **e** 598 **f** 363

2 **a** 5.5 **b** 9.1 **c** 15.2
d 76.2 **e** 82.8 **f** 9.33

3 **a** 11.8 **b** 13.1
c 18.2 **d** 3.79

4 **a** 36 **b** 28 **c** 815
d 5.3 **e** 3.6 **f** 2.18

5 **a** 1.4 **b** 3.6 **c** 7.62

6 **a** 7.8 **b** 17.8 **c** 15.2
d 5.4 **e** 11.2 **f** 7

7 **a** B **b** A

8 **a** 9.2 **b** 17.6 **c** 12.1
d 4.4 **e** 5.1 **f** 4.7

9 **a** 7.82 **b** 13.32 **c** 30.18
d 122.17 **e** 2.22 **f** 1.8
g 19.08 **h** 39.04 **i** 20.73

10 **a** May **b** 8.98 kg

11 **a** 6.26 **b** 6.44
c 27.817 **d** 14.339

12 **a** $4.10 **b** $0.90

13 **a** 6.55 m **b** 1.45 m

14 **a** −4.24 **b** −3.52 **c** −7.66
d −5.827 **e** −12.29 **f** 12.27

15 **a** $37.62 + 28.53 = 66.15$
b $84.56 - 28.59 = 55.97$

Exercise 4.3

1 **a** 8
b 60, 0.6
c 150, 15
d 350, 35, 3.5
e 1800, 180, 18, 1.8
f 4200, 420, 42, 4.2

2 Learner's own answers.

3 **b** $2 \times 8 = 16$, so $0.2 \times 8 = 1.6$.
c $4 \times 4 = 16$, so $0.4 \times 4 = 1.6$.
d $7 \times 9 = 63$, so $0.7 \times 9 = 6.3$.
e $5 \times 5 = 25$, so $0.5 \times 5 = 2.5$.

4 2.5, 3, 3.5, 4, 4.5, 5

5 **a** 22.4 **b** 9 **c** 7.2
d 18.4 **e** 44.5 **f** 18.4

6 **a** 0.6 **b** 0.8 **c** 2.4
d 3 **e** 4.9 **f** 4.8

7 **a** 0.18 **b** 1.8
c 0.018 **d** 18

8 **a** 0.6 **b** 4 **c** 0.5
d 6 **e** 3.8 **f** 0.4, 2

9 1.5 g

10 **a** 6608

b **i** 660.8 **ii** 66.08 **iii** 6.608
iv 660.8 **v** 66.08 **vi** 6.608

11 **a** 163.2, $5 \times 30 = 150$

b 999.6, $2 \times 500 = 1000$

c 22.72, $0.3 \times 70 = 21$

d 361.95, $0.6 \times 600 = 360$

12 0.77 g

13 1415.25 kg

14 $1482.66

15 **a** 120.4 **b** 120.4

c 120.4 **d** 1.204

Exercise 4.4

1 **a** 21 **b** 2.1 **c** 0.21

d 14 **e** 1.4 **f** 0.14

2 **a** 2.1 **b** 2.3 **c** 1.3

d 2.8 **e** 0.7

3 **a** 231 **b** 23.1 **c** 2.31

d 352 **e** 35.2 **f** 3.52

4 **a** 4.13

b 3.11

c 1.21

d 3.11

e 9.01

5 **a** 1.232 **b** 3.172 **c** 1.122

6 **a** 1.176 **b** 1.279 **c** 1.117

d 1.788 **e** 1.369 **f** 0.256

7 **a** 2.314 **b** 1.321

c 5.569 **d** 0.122

8 $1.49

9 $1.26

10 **a** 3.226

b 7.451

11 **a**

1	2	3	4	5	6	7	8	9
18	36	54	72	90	108	126	144	162

b 13.456

c $13.456 \times 18 = 242.208$

12 **a**

1	2	3	4	5	6	7	8	9
25	50	75	100	125	150	175	200	225

b $32.32

c $\$32.32 \times 25 = \$808$

13 It is better for Shaun to pay for his own food rather than a share of the bill. His own food costs $13.60 and an equal share of the bill is $13.72. He will save $0.12.

14 **a** Learner's own answer.

b car A mean = 7.805 s, car B mean = 7.826 s

c Learner's own answer.

15 **a** 148

b 14.8

c 1.48

d 0.148

16 **a** 90 **b** 90

c 9 **d** 900

17 **a** 1.2

b 1.63

c 0.414

18
$$\begin{array}{r} 11.623 \\ 8\overline{)9^{1}2.^{4}9^{1}8^{2}4} \end{array}$$

Exercise 4.5

1 A and v; B and vii, C and i; D and ix; E and ii; F and viii; G and iv; H and vi; I and iii

2 **a** 2, 2, 30 **b** 3, 10, 3, 7, 3, 21

c 6, 10, 6, 10, 10, 6, 12, 6, 72

3 **a** 3, 3, 36 **b** 5, 100, 5, 9, 5, 45

c 4, 100, 4, 100, 100, 4, 7, 4, 28

4 **a** 10 **b** 25 **c** 8

d 24 **e** 26 **f** 11.5

5 **a** $23 - 2.3 = 20.7$

b $57 - 5.7 = 51.3$

6 **a** 27, 20, 7, 60, 21, 81

b 43, 40, 3, 280, 21, 301

7 **a** 252 **b** 200

c 357 **d** 210

8 **a**

Item	Amount
Ayida	0.4 × \$650 = \$260
Dayana	0.6 × \$650 = \$390

b 260 + 390 = 650

9 **a** 61.2

b 42.3

c 113.4

10 **a** 25.2

b 39

c 50.4

11 **a** 1.647 ÷ 3 = 0.549

b 10, 10, 8.925 ÷ 7 = 1.275

12 14.1 m

13 **a** 0.3816 ÷ 6 = 0.0636

b 100, 100, 6.765 ÷ 5 = 1.353

14 **a** **i** \$18.57

ii \$19

b Answer from part **a ii** is the most suitable amount because \$19 each will cover the bill plus a little extra, but \$18.57 × 40 = \$742.80, which isn't enough to cover the bill.

15 61.0 kg

Exercise 5.1

1 **a** 43° **b** 111°

2 **a** 195°

b 147°

c 115°

3 **a** 60° **b** 105°

4 XY is not a straight line because $54° + 124° \neq 180°$.

5 75°

6 $a = 80°$, $b = 65°$

7 62°, 118°, 118°

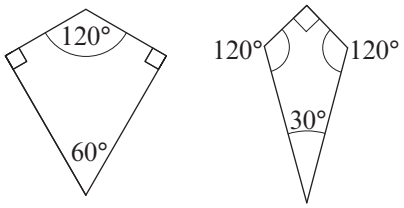
8 95° + 150° + 125° = 370° and because this is more than 360° the diagram is impossible.

9 $y = 360° - (60° + 60° + 90°) = 150°$

10 **a** The angles add up to 680°. This should be 2 × 360° = 720° if they are two quadrilaterals.

b The sum of the angles is 720°. One possible arrangement is 20°, 40°, 140°, 160° on one quadrilateral and 60°, 80°, 100°, 120° on the other quadrilateral. There are other possible arrangements.

11 There are two answers possible. They are shown in these diagrams:



Exercise 5.2

1 **a** perpendicular

b perpendicular

c parallel

2 $x = 38°$, $y = 142°$, $z = 38°$

3 $a = 99°$, $b = 81°$, $c = 99°$, $d = 99°$

4 $a = 69°$, $b = 57°$, $c = 54°$

5 $a = 67°$, $b = 64°$, $c = 113°$

6 $w = 75°$, $x = 105°$, $y = 80°$, $z = 25°$

7 $x = 60°$

8 Statement C is correct. You do not know the angle between EF and CD or the angle between AB and GH. The lines are parallel if these angles are 55°.

9 The angles opposite the four angles given are the four angles of a quadrilateral. The sum of these is 360°.

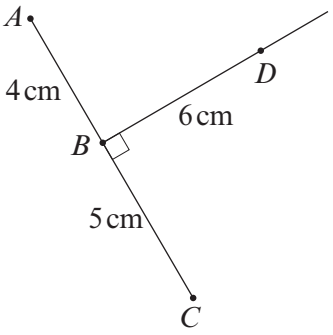
10 AB and CD are not parallel because the acute angle between CD and the transversal is 43°. AB and EF are parallel because the acute angle between EF and the transversal is 53°.

11 **a** The angles of the five-sided shape are the angles of a triangle and a quadrilateral. The sum is 180° + 360° = 540°

b It is true for any five-sided shape. Any five-sided shape can be divided into a quadrilateral and a triangle.

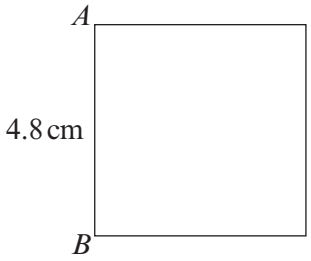
Exercise 5.3

1 **a–c**



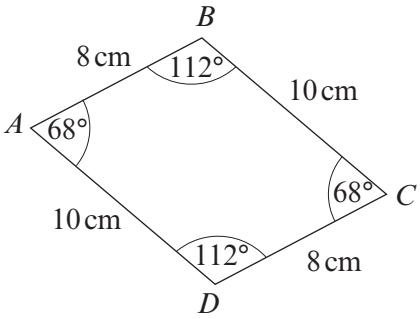
d 7.8 cm

2 **a, b**



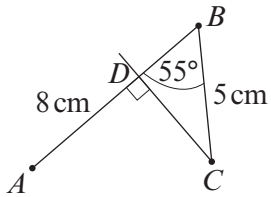
c 6.8 cm

3 **a**



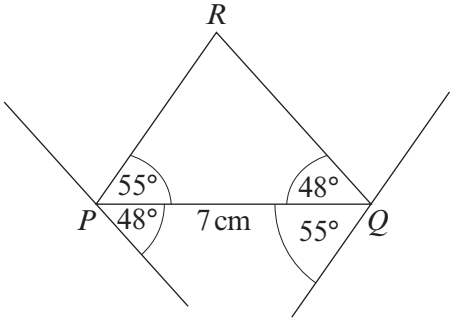
b 10.2 cm

4 **a, b**

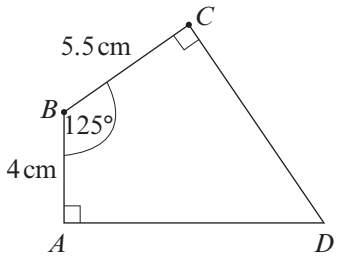


c 5.1 cm

5 **a–c**



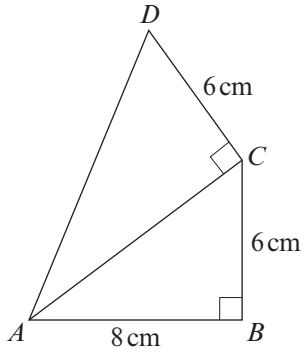
6 **a**



b 55°; use the fact that the sum of the angles is 360°.

c 8.7 cm

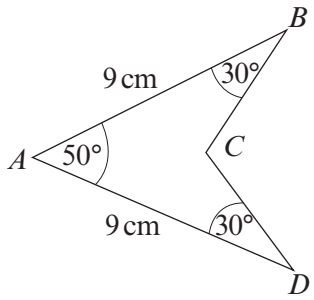
7 **a**



b 11.7 cm

c 68°, 90°, 143°, 59°; the sum should be 360°.

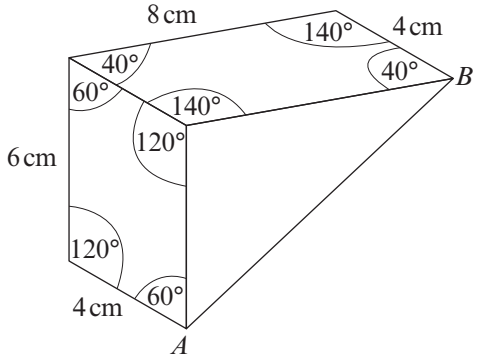
8 **a**



b 250° **c** 50° + 30° + 30° + 250° = 360°

d 5.5 cm

9 **a**



b 10.8 cm

Exercise 6.1

1 **a** discrete

b continuous

c categorical

2 For example:

a colour of walls, shape, type of furniture

b number of chairs, number of windows

c length of room, height of ceiling, temperature

3 **a** Question 1: Using a tick box or choosing a number is a better format. For example:

Did you enjoy your visit to the gym today?

Not at all ☐ *Not very much* ☐

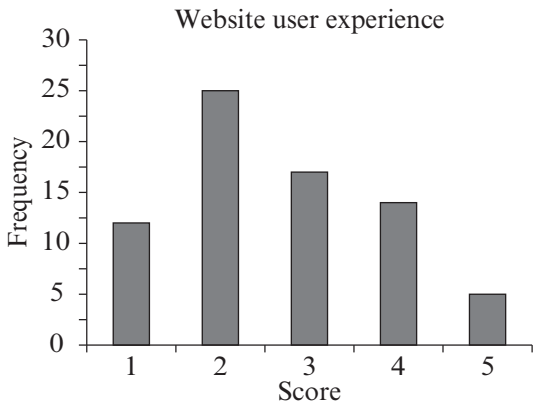
A little ☐ *A lot* ☐

b Question 2: It is better to give a list of equipment and to ask for a tick for each one used.

4 **a** It was reasonably easy.

b 73 people

c



d 2

e The prediction is not correct. For example: The mode is only 2, which means the website is not easy to use. Only 19 out of 75 users who answered the questionnaire gave a score of 4 or 5 to say that the website was easy or very easy to use. 37 out of 75 users said the website was not easy to use.

5 **a**

Mark	4	5	6	7	8	9	10
Frequency	4	8	6	3	11	5	3

b 8 **c** 7 **d** 6.9

e The prediction is not correct. For example: the mean is less than 8. The median is less than 8. Only 19 learners out of 40 got a mark of 8 or more.

6 **a** It is a good idea to group the data first, otherwise the bar chart will have over 30 bars.

b

45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84

c eight bars

d The group with the tallest bar.

e The first two columns will be shorter than the rest.

f The percentage in the first two bars.

7 **a** There are lots of ways a customer could answer this and it will be difficult to analyse the answers. For example:

How much did you enjoy shopping today?

Not at all 1 2 3 4 5 A great deal

b The question is too vague. Tick boxes would be better. For example:

On average, how often do you shop here?

Every week ☐

Between once a week and once a month ☐

Between once a month and once every 3 months ☐

Less than once every 3 months ☐

c This question is too personal. People are more likely to give an honest answer if you give an option of several age groups.

8 **a** For example: it gives a numerical answer; easy to use the data to draw conclusions; easy to answer.

b Learner's own answer.

c For example: people might have things to say that are not covered by the questions.

9 a No, because it does not give any details of the survey.

b For example: the number of people asked; details of the other brand; how the survey was carried out; did a range of people take part?

Exercise 6.2

1 a There will probably not be a mode. The median is the middle height when the boys are listed in order. To find the mean, add up the heights and divide the answer by 5.

b Five is too small for a sample size. The five boys chosen might not be a good representation of the whole population.

c 1000 would be a good representation, but such a big number would take a long time to find and survey.

2 a The data collected can be analysed easily.

b 100 people

c Learner's own chart. For example: a bar chart or a pie chart.

d Median is 4; mode is 3; mean is 4.07.

e No. For example: Learners could give an average or compare in some way the number of people giving high scores with those giving low scores.

3 a For example: There are different possible answers. It is cheap; it is easy to send; it can be sent to a large number of people.

b For example: It is easy to order online; people are usually happy with their shoes; the shoes are delivered quickly; the website is very helpful.

c It is a good way to choose a sample because of the reasons given in part **a**. However, it may be that the customers who choose to complete the questionnaire are not representative of all shoppers.

4 a, b A two-way table could look like this:

		Age (in years)					
		17	18	19	20	21	22
Number of subjects	1						
	2						
	3						
	4		10				
	5						

c There will be a very small number of students for each age. They will not be representative of the whole population.

5 a For example: Rosario could choose all the people using the library on one particular day. He could choose a particular number of people coming into the library each day for a week or more. He could take a sample from a list of registered users.

b 28

c Yes; more than half the people aged over 50 visited the library more than ten times. Only one person aged 21–35 visited the library more than ten times.

d The sample size is too small. 28 people are spread over nine categories. The results would be more convincing if they were from a larger sample.

6 a 50 or more employees would be a good sample size.

b For example: Choose the first employees using the restaurant on a particular day. Choose every tenth customer on one day. Choose a number of employees at random from several days. Choose names from a list of employees.

c For example: A questionnaire could be given to employees as they enter the restaurant. Questionnaires could be sent electronically. Employees could be interviewed individually to get more detailed replies.

7 a Group the data and draw a bar chart. Groups of ten would be suitable.

b You could use the chart to make a statement such as the modal age is 30–39 years. You should point out that you are assuming that the sample is a good representation of all 265 employees.

8 a They might not be a fair representation of the whole population of 150.

b For example: You could choose the same number from different classes. You could choose names at random, for example, by drawing names out of a hat.

c Learner's own answer.

d You should be able to use the answers to your question easily.

9 a The means are 3.5, 3.25, 2, 3, 4.5, 2.5, 3.75, 2.75, 3, 3.75.

b The means are 3, 3, 3.7, 3.1.

c There is less variation in the answers in part **b**, which has a larger sample size. The value is more likely to be closer to the population mean, which is the mean you get for a very large number of spins.

Exercise 7.1

1 a $27 \neq 29$ **b** $36 = 36$

c $0.60 = 0.6$ **d** $5.50 \neq 5.55$

2 a $\frac{2}{3} = \frac{2\times3}{3\times3} = \frac{6}{9}$

b $\frac{3}{5} = \frac{3\times2}{5\times2} = \frac{6}{10}$

c $\frac{1}{2} = \frac{1\times7}{2\times7} = \frac{7}{14}$

3 a $\frac{2}{3} \neq \frac{7}{9}$ **b** $\frac{3}{5} = \frac{6}{10}$ **c** $\frac{1}{2} \neq \frac{8}{14}$

4 a $\frac{7}{3} \rightarrow 7 \div 3 = 2 \text{ r}1 \rightarrow \frac{7}{3} = 2\frac{1}{3}$

b $\frac{15}{4} \rightarrow 15 \div 4 = 3 \text{ r}3 \rightarrow \frac{15}{4} = 3\frac{3}{4}$

c $\frac{9}{5} \rightarrow 9 \div 5 = 1 \text{ r}4 \rightarrow \frac{9}{5} = 1\frac{4}{5}$

d $\frac{7}{2} \rightarrow 7 \div 2 = 3 \text{ r}1 \rightarrow \frac{7}{2} = 3\frac{1}{2}$

5 a $\frac{7}{3} < 2\frac{2}{3}$ **b** $\frac{15}{4} > 3\frac{1}{4}$

c $\frac{9}{5} > 1\frac{3}{5}$ **d** $\frac{7}{2} < 4\frac{1}{2}$

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

c $\frac{7}{8} > \frac{5}{6}$ **d** $\frac{7}{11} < \frac{3}{4}$

7 a $\frac{1}{4} = \frac{2}{8}$

b $\frac{4}{5} \neq \frac{9}{10}$

c $\frac{2}{3} = \frac{10}{15}$

d $\frac{8}{20} \neq \frac{3}{5}$

e $\frac{20}{25} \neq \frac{3}{5}$

f $\frac{16}{24} = \frac{2}{3}$

8 a $\frac{21}{4} < 5\frac{3}{4}$ **b** $4\frac{2}{7} > \frac{27}{7}$

c $\frac{29}{3} > 9\frac{1}{3}$ **d** $5\frac{1}{8} < \frac{43}{8}$

9 a $\frac{17}{4} < 4\frac{1}{2}$ **b** $\frac{17}{6} > 2\frac{2}{3}$

c $2\frac{3}{5} > \frac{38}{15}$ **d** $7\frac{5}{6} < \frac{95}{12}$

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

b $\frac{16}{3}$

c $\frac{27}{5}$

11 a i $\frac{11}{8} = 1.375$

ii $\frac{9}{7} = 1.2857$

iii $\frac{15}{11} = 1.363$

b $\frac{9}{7}, \frac{15}{11}, \frac{11}{8}$

12 $\frac{17}{5}, \frac{31}{9}, \frac{47}{13}, \frac{11}{3}$

13 $\frac{5}{9}, \frac{3}{5}, \frac{80}{21}, \frac{23}{6}$

14 a, b First card: $\frac{133}{28} <$ fraction $< \frac{134}{28}$ or $\frac{266}{56} <$ fraction $< \frac{268}{56}$; e.g. $\frac{267}{56}$

Second card: $\frac{201}{42} <$ fraction $< \frac{203}{42}$; e.g. $\frac{202}{42} = \frac{101}{21}$

15 a i $\frac{8}{9}, \frac{9}{10}$

ii The fractions are getting bigger because as the denominator is increasing, so is the numerator and the fractions are getting closer to 1.

b i $\frac{128}{256}, \frac{256}{512}$

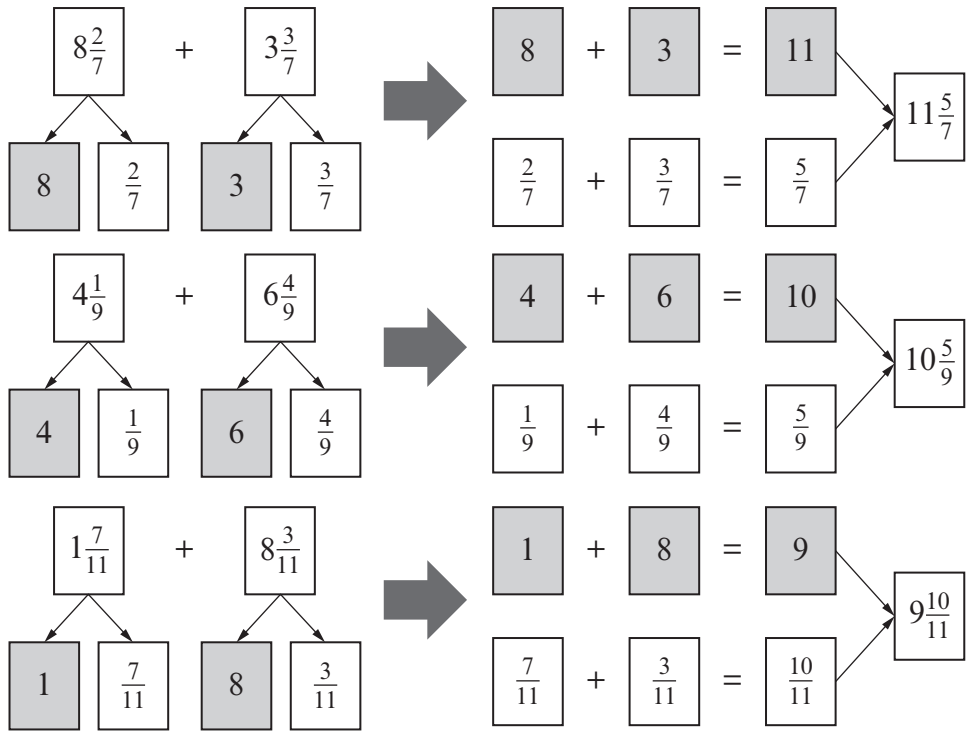
ii The fractions aren't getting bigger or smaller because they are all equivalent to $\frac{1}{2}$.

c i $\frac{8}{13}, \frac{9}{12}$

ii The fractions are getting bigger because the numerator is increasing as the denominator is decreasing.

Exercise 7.2

1 a

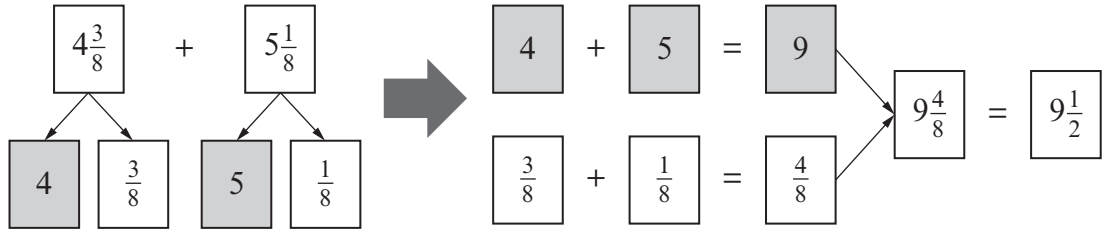


b

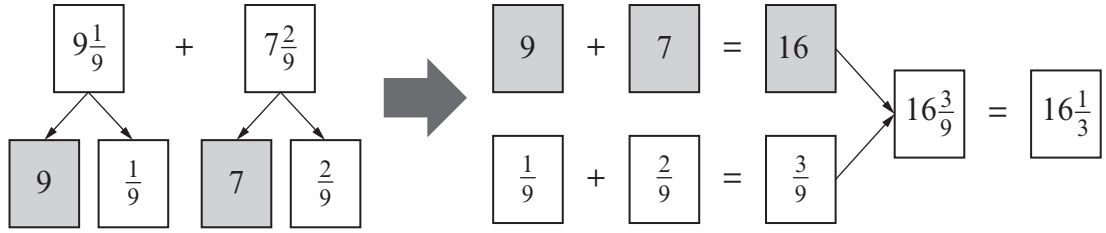
c

2 a $1\frac{2}{3}$ **b** $3\frac{1}{2}$ **c** $6\frac{3}{4}$ **d** $9\frac{1}{3}$

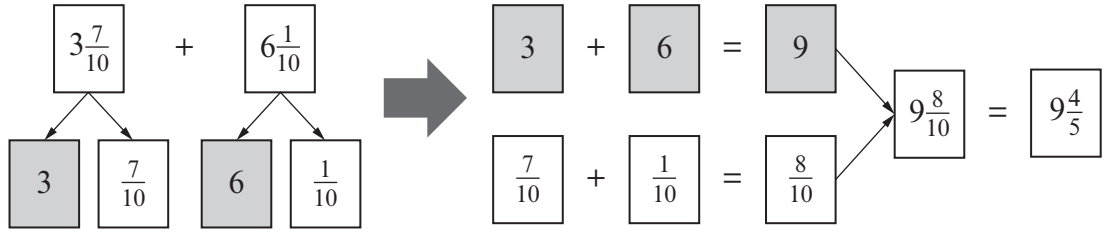
3 a



b



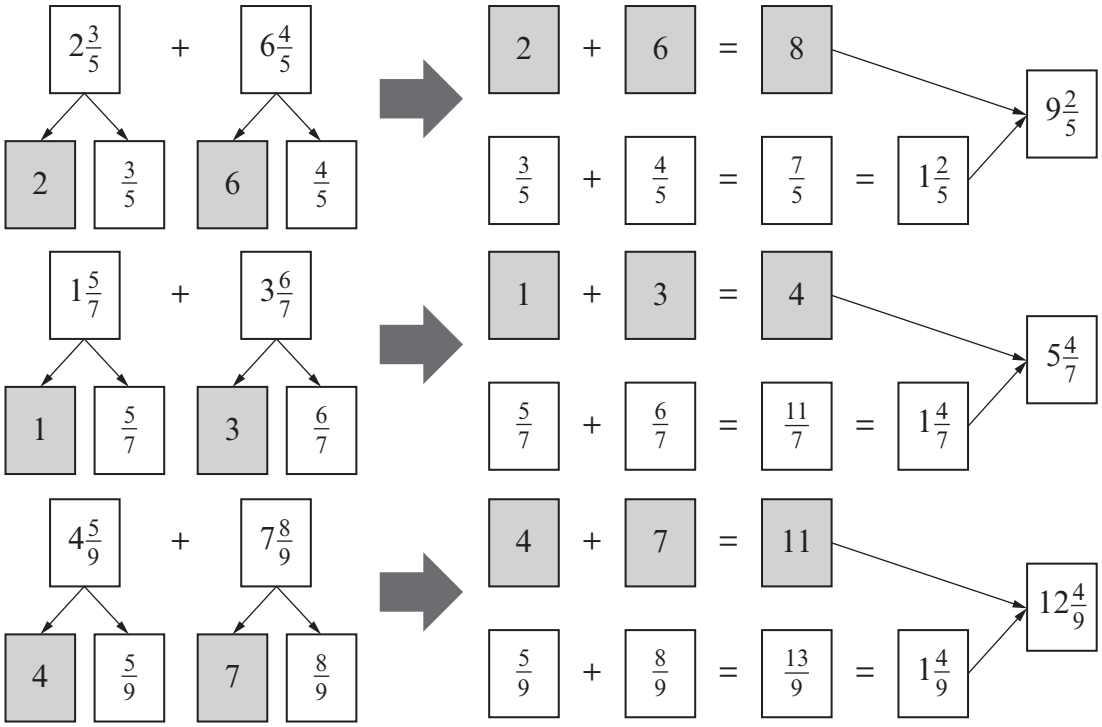
c



4 a i $1\frac{1}{3}$ **ii** $1\frac{1}{2}$ **iii** $1\frac{2}{5}$

b i $5\frac{1}{3}$ **ii** $9\frac{1}{2}$ **iii** $4\frac{2}{5}$

5 **a**



b

c

6 **a** $7\frac{4}{9}$ **b** $7\frac{2}{5}$ **c** $10\frac{1}{13}$ **d** $10\frac{1}{4}$

7 $16\frac{3}{7}$m

8 **a** $10\frac{3}{4}$ **b** $7\frac{7}{8}$ **c** $14\frac{2}{9}$ **d** $10\frac{1}{4}$

9 **a** $32\frac{3}{8}$km

b Yes, because $32\frac{1}{4} = 32\frac{2}{8}$ and $32\frac{3}{8} > 32\frac{2}{8}$.

10 $16\frac{3}{10}$km

11 $14\frac{13}{24}$ kg

12 **a** Step 2: $\frac{9}{13} = \frac{45}{65}$ not $\frac{35}{65}$ and $\frac{4}{5} = \frac{52}{65}$ not $\frac{54}{65}$.
Also $\frac{89}{65} = 1\frac{24}{65}$ not $1\frac{25}{65}$.

b $8\frac{32}{65}$

13 middle row: left $13\frac{7}{15}$, right $16\frac{5}{21}$;
top row: $29\frac{74}{105}$

14 **a** $7\frac{3}{4}x$ **b** $10\frac{1}{12}y + 6\frac{1}{2}x$

c $5\frac{1}{3}a + 8\frac{5}{24}b$

15 $151\frac{1}{20}$cm

16 Yes; perimeter triangle $= 13\frac{7}{36}$, quadrilateral $= 13\frac{4}{9} = 13\frac{16}{36}$ and $13\frac{16}{36} - 13\frac{7}{36} = \frac{1}{4}$cm.

Exercise 7.3

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

2 **a** $\frac{1}{10}$ **b** $\frac{1}{12}$ **c** $\frac{1}{14}$

d $\frac{1}{15}$ **e** $\frac{1}{18}$ **f** $\frac{1}{21}$

3 **a** true **b** false, $\frac{1}{20}$

c false, $\frac{1}{25}$ **d** true

4 **a** $\frac{3}{8}$ **b** $\frac{5}{12}$ **c** $\frac{3}{10}$

d $\frac{2}{15}$ **e** $\frac{5}{18}$ **f** $\frac{5}{21}$

5 **a** $\frac{2}{5}$ **b** $\frac{1}{2}$ **c** $\frac{6}{25}$ **d** $\frac{5}{21}$

6 **a** $\frac{1}{12}$ **b** $\frac{9}{16}$ **c** $\frac{5}{42}$

d $\frac{9}{20}$ **e** $\frac{6}{35}$ **f** $\frac{5}{12}$

7 **a** $\frac{2}{5}$ **b** $\frac{2}{5}$ **c** $\frac{3}{10}$

d $\frac{1}{2}$ **e** $\frac{7}{11}$ **f** $\frac{2}{5}$

8 $\frac{5}{44}\text{m}^2$

9 $\frac{4}{25}\text{m}^2$

10 **a** $\frac{3}{8}$ **b** $\frac{3}{5}$

c $\frac{1}{4}$ **d** $\frac{3}{8}$

11 **a** $\frac{3}{28}$

b $\frac{5}{28}$

c $\frac{5}{7}$

12 **a** $\frac{3}{7}$ **b** $\frac{2}{7}$

13 **a** Estimate $\frac{5}{7}$ is greater than $\frac{1}{2}$, but is less than 1

$\frac{1}{2}$ of $\frac{1}{10}$ is $\frac{1}{20}$ and $1\times\frac{1}{10}=\frac{1}{10}$.

So, the answer to $\frac{5}{7}\times\frac{1}{10}$ must be greater than $\frac{1}{20}$ but smaller than $\frac{1}{10}$.

Accurate $\frac{5}{7}\times\frac{1}{10}=\frac{5\times1}{7\times10}=\frac{5}{70}=\frac{1}{14}$

$\frac{1}{14}$ is greater than $\frac{1}{20}$ but is smaller than $\frac{1}{10}$. ✓

b Estimate $\frac{2}{5}$ is greater than zero, but is less than $\frac{1}{2}$.

$0\times\frac{1}{6}=0$ and $\frac{1}{2}$ of $\frac{1}{6}$ is $\frac{1}{12}$.

So, the answer to $\frac{2}{5}\times\frac{1}{6}$ must be greater than zero but is smaller than $\frac{1}{12}$.

Accurate $\frac{2}{5}\times\frac{1}{6}=\frac{2\times1}{5\times6}=\frac{2}{30}=\frac{1}{15}$

$\frac{1}{15}$ is greater than zero but is smaller than $\frac{1}{12}$. ✓

14 **a** Any one of the following:

$\frac{3}{5}\times\frac{9}{10}=\frac{27}{50}$, $\frac{3}{5}\times\frac{4}{7}=\frac{12}{35}$, $\frac{3}{5}\times\frac{7}{8}=\frac{21}{40}$, $\frac{9}{10}\times\frac{4}{7}=\frac{18}{35}$, $\frac{9}{10}\times\frac{7}{8}=\frac{63}{80}$, $\frac{4}{7}\times\frac{7}{8}=\frac{1}{2}$

b **i** $\frac{9}{10}\times\frac{7}{8}=\frac{63}{80}$ **ii** $\frac{3}{5}\times\frac{4}{7}=\frac{12}{35}$

c **i** Multiply together the two largest fractions.

ii Multiply together the two smallest fractions

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

d $\frac{1}{6}$ **e** $\frac{1}{7}$

f

Part	Question	Answer
i	$\frac{1}{2}\times\frac{2}{3}$	$\frac{1}{3}$
ii	$\frac{1}{2}\times\frac{2}{3}\times\frac{3}{4}$	$\frac{1}{4}$
iii	$\frac{1}{2}\times\frac{2}{3}\times\frac{3}{4}\times\frac{4}{5}$	$\frac{1}{5}$
iv	$\frac{1}{2}\times\frac{2}{3}\times\frac{3}{4}\times\frac{4}{5}\times\frac{5}{6}$	$\frac{1}{6}$
v	$\frac{1}{2}\times\frac{2}{3}\times\frac{3}{4}\times\frac{4}{5}\times\frac{5}{6}\times\frac{6}{7}$	$\frac{1}{7}$

g The answer always has a numerator of 1 and the denominator is the same as the final fraction in the list.

h **i** $\frac{1}{8}$ **ii** $\frac{1}{11}$

16 Three examples are: $\frac{1}{2}\times\frac{2}{5}$, $\frac{1}{3}\times\frac{3}{5}$, $\frac{1}{4}\times\frac{4}{5}$.

17 $\frac{3}{80}$

18 $2\frac{1}{4}\text{m}^2$

Exercise 7.4

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

2 **a** true **b** false, $\frac{8}{9}$ **c** true

3 **a** $\frac{5}{12}$ **b** $\frac{5}{8}$ **c** $\frac{15}{16}$ **d** $\frac{9}{22}$

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

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

6 **a** $\frac{3}{4}$ **b** $\frac{5}{12}$ **c** $\frac{6}{7}$

d $\frac{35}{54}$ **e** $\frac{18}{25}$ **f** $\frac{7}{30}$

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

d $1\frac{5}{9}$ **e** $4\frac{7}{12}$ **f** $2\frac{10}{21}$

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

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

9 **a** Nova has forgotten to turn her second fraction upside down.

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

10 $\frac{8}{9}$m

11 middle row: left $\frac{4}{7}$, right $\frac{3}{8}$; top row: $1\frac{11}{21}$

12 $\frac{9}{16}$

13 $\frac{3}{7}$m

14 **a**

Pattern	Working	Answer
$\frac{1}{2}\div\frac{2}{3}$	$\frac{1}{2}\div\frac{2}{3}=\frac{1}{2}\times\frac{3}{2}=\frac{3}{4}$	$\frac{3}{4}$
$\frac{2}{3}\div\frac{3}{4}$	$\frac{2}{3}\div\frac{3}{4}=\frac{2}{3}\times\frac{4}{3}=\frac{8}{9}$	$\frac{8}{9}$
$\frac{3}{4}\div\frac{4}{5}$	$\frac{3}{4}\div\frac{4}{5}=\frac{3}{4}\times\frac{5}{4}=\frac{15}{16}$	$\frac{15}{16}$
$\frac{4}{5}\div\frac{5}{6}$	$\frac{4}{5}\div\frac{5}{6}=\frac{4}{5}\times\frac{6}{5}=\frac{24}{25}$	$\frac{24}{25}$
$\frac{5}{6}\div\frac{6}{7}$	$\frac{5}{6}\div\frac{6}{7}=\frac{5}{6}\times\frac{7}{6}=\frac{35}{36}$	$\frac{35}{36}$

b bigger

c No; the numerator is always one less than the denominator, so it will never be 1 because the numerator will never be the same as the denominator.

15 $\frac{2}{3}$m

16 **a** $\frac{7}{88}$m **b** $\frac{16}{33}$m

Exercise 7.5

1 **a** **i** $6=2\times3$ **ii** $4=2\times2$

iii $10=2\times5$ **iv** $9=3\times3$

v $15=3\times5$ **vi** $14=2\times7$

b **i** $\frac{1}{6}=\frac{1}{2}\times\frac{1}{3}$ **ii** $\frac{1}{4}=\frac{1}{2}\times\frac{1}{2}$

iii $\frac{1}{10}=\frac{1}{2}\times\frac{1}{5}$ **iv** $\frac{1}{9}=\frac{1}{3}\times\frac{1}{3}$

v $\frac{1}{15}=\frac{1}{5}\times\frac{1}{3}$ **vi** $\frac{1}{14}=\frac{1}{2}\times\frac{1}{7}$

2 **a** 9 **b** 30 **c** 15

d 14 **e** 30

3 Learner's choice of calculation:

a A 32 or B 48 **b** A 28 or B 21

c A 30 or B 18 **d** A 42 or B 18

4 **a** 16 **b** 7

c 6 **d** 6

5 $\frac{1}{5}=\frac{2}{10}$, $\frac{2}{5}=\frac{4}{10}$, $\frac{3}{5}=\frac{6}{10}$, $\frac{4}{5}=\frac{8}{10}$

6 **a** 18 **b** 32 **c** 42 **d** 48

7 **a** 26 **b** 27 **c** 27 **d** 14

8 34

9 **a** Yes, Zara is correct.

b 37.5

10 **a** 54 **b** 128 **c** 132

11 656

12 **a** 105 **b** 225 **c** 105

13 **a** $\frac{7}{24}$ **b** $\frac{6}{11}$ **c** $\frac{8}{23}$

14 No, Seb has changed 14 to 7×7 instead of 7×2.

The solution should be:

$$\frac{7}{25}\times\frac{9}{14}=\frac{7\times9}{25\times14}=\frac{7\times9}{25\times7\times2}=\frac{9\times7}{25\times2\times7}=\frac{9\times7}{50\times7}=\frac{9}{50}\times\frac{7}{7}$$
$$=\frac{9}{50}\times1=\frac{9}{50}$$

15 **a** 240 **b** 500 **c** 560 **d** 870

16 **a** $1\frac{3}{10}$ **b** $\frac{11}{36}$ **c** $1\frac{2}{15}$

17 a $\frac{8}{9} \times 720 = 640$

b $\frac{11}{12} \times 840 = 770$

c $\frac{19}{20} \times 800 = 760$

18 a Learner's own answers.

b Another alternative method is to use $\frac{4}{5} = \frac{8}{10}$. Then work out $300 \times \frac{8}{10} = 240$, then $240 \times \frac{8}{10} = 192$.

c **i** 64 **ii** 72

d **i** 320 **ii** 120

Exercise 8.1

1 a C A

b N T

c C E

d N C

e C M

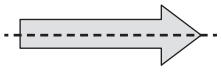
f N D

g N W

h N Y

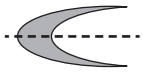
2 a

b

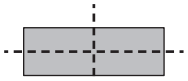


c

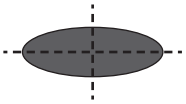
d



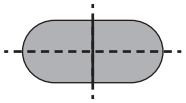
3 a



b



c



d

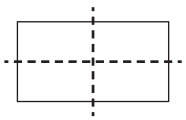
4 a 2 **b** 2 **c** 4

d 3 **e** 2 **f** 1

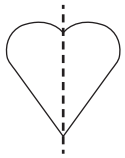
g 2 **h** 1 **i** 4

5 A and iii; B and i; C and iv; D and v; E and ii

6 a



b



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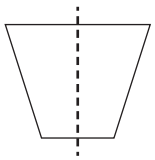

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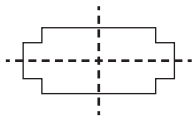

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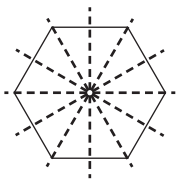

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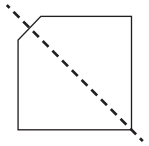

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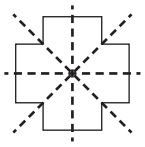

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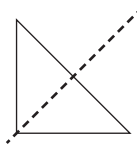

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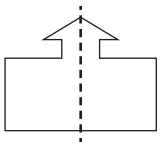

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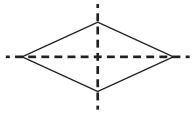

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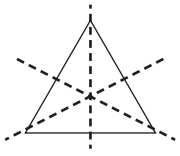
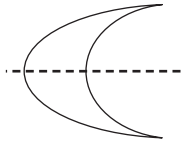


l



7 a 2 **b** 1 **c** 1 **d** 2

e 6 **f** 1 **g** 4 **h** 1

i 1 **j** 2 **k** 3 **l** 1

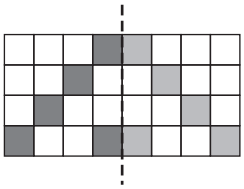
8 a 2 **b** 5 **c** 0 **d** 2

e 2 **f** 8 **g** 8 **h** 4

9 a 2 **b** 5 **c** 2 **d** 2

e 2 **f** 8 **g** 8 **h** 4

10 a **i**



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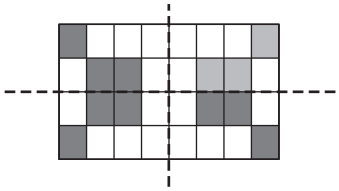
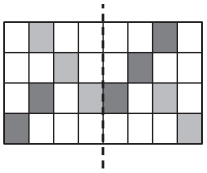
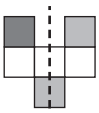
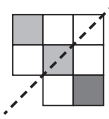
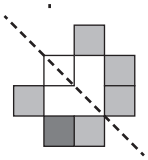
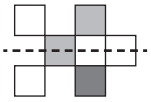


iii 

b i 1 ii 2 iii 1

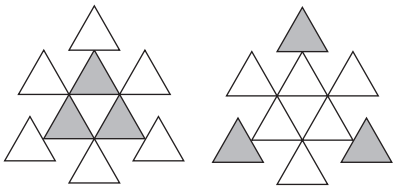
11 a, b i  ii 

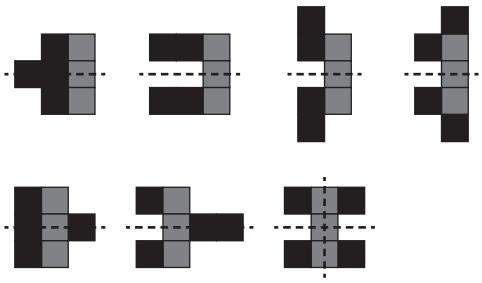
iii  iv 

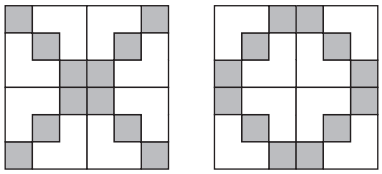
c i vertical ii diagonal

iii diagonal iv horizontal

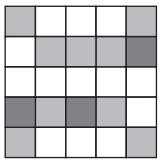
12 a, b For example:

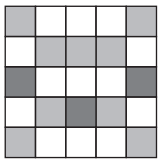


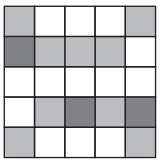
13 

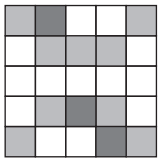
14 

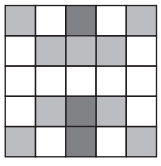
15 a Any three from:

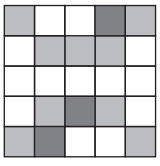
0 lines of symmetry 

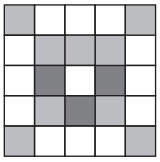
2 lines of symmetry 

0 lines of symmetry 

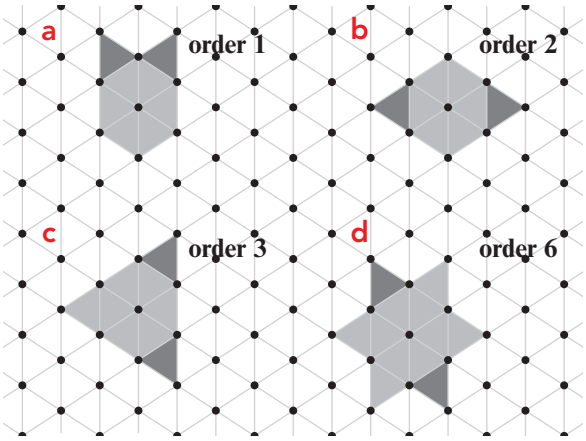
0 lines of symmetry 

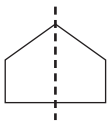
2 lines of symmetry 

0 lines of symmetry 

b It has 4 lines of symmetry. 

16 For example:



17 a For example: 

b For example: 

Exercise 8.2

1 a chord

b tangent

c tangent

d chord

2 Alun has labelled the chord as the tangent and he has labelled the tangent as the chord.

3 Ffion's tangent doesn't touch the circle, it crosses it. Her chord doesn't go all the way across the circle. She has drawn a radius not a chord.

4 Learner's own diagram.

5 Learner's own diagram.

6 A tangent to a circle and the radius of a circle always meet at 90°.

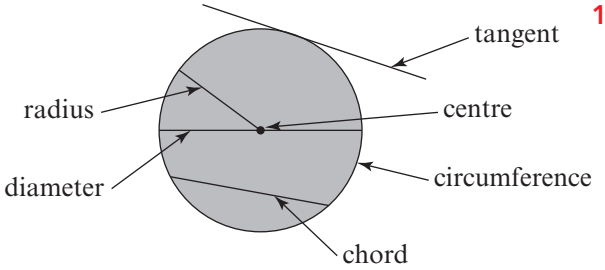
7 **A** is a pentagon and has 5 sides.

B is a hexagon and has 6 sides.

C is an octagon and has 8 sides.

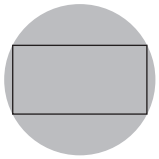
D is a decagon and has 10 sides.

8

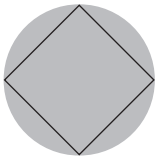


9 For example:

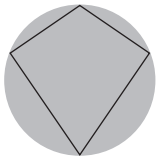
a



b

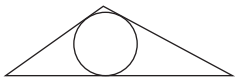


c



10 For example:

a



For the example given in part **a**:

b My triangle is called a scalene triangle.

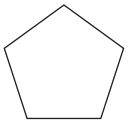
My triangle has 0 sides the same length.

My triangle has 0 angles the same size.

My triangle has 0 lines of symmetry.

My triangle has order 1 rotational symmetry.

11 a



b A regular pentagon has: five sides the same length; five angles the same size; five lines of symmetry; rotational symmetry of order 5.

12 12, 12, 12, 12

13 a The line CD is a radius of the circle.

b 90°

c 58°

14 No; there are six sides, each is 5 cm. So the perimeter is $6 \times 5 = 30$ cm.

15 12 mm

16 a $x = 60°$, $y = 60°$, $z = 120°$

b

Name of regular polygon	Number of triangles	x	y	z
pentagon	5	72°	54°	108°
hexagon	6	60°	60°	120°
octagon	8	45°	67.5°	135°
nonagon	9	40°	70°	140°
decagon	10	36°	72°	144°

c $z = 2 \times y$ $x + z = 180°$

Exercise 8.3

1 a C **b** B **c** A **d** C

2 B, D, G, H

3 The two squares are not congruent because they are not the same size. Although they are both squares, one has a side length of 3 cm and the other is 5 cm. To be congruent they must have the same side length.

4 a 3 cm **b** 5 cm

5 a 8 cm **b** 5 cm

6 C and F

7 a 7 cm **b** 2 cm

8 a i 10 cm **ii** 6 cm **iii** 8 cm

b 62°

c i 28° **ii** 62°

d i Side KM corresponds to side DF.

ii Side KL corresponds to side DE.

iii Side LM corresponds to side EF.

iv $\angle KLM$ corresponds to $\angle DEF$.

v $\angle KML$ corresponds to $\angle DFE$.

vi $\angle LKM$ corresponds to $\angle EDF$.

9 a i 10.3 m **ii** 5.1 m **iii** 12 m

b i 96° **ii** 25° **iii** 59°

10 a i WX **ii** XY

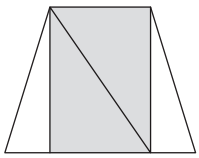
iii PQ **iv** PS

b i $\angle XYZ$ **ii** $\angle WXY$

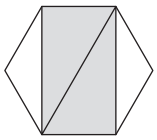
iii $\angle PSR$ **iv** $\angle QPS$

11 For example:

b



c



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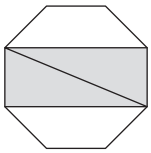

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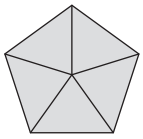


12 **a** 12 cm **b** 17 cm

c **i** 30° **ii** 42°

d 108°

13 125°

14 **a** $Q(3, 4)$, $S(3, -1)$ **b** $Q(2, -3)$, $S(2, 2)$

Exercise 8.4

1 Faces are the flat sides of a solid shape.

Edges are the lines where two faces meet.

Vertices are the corners of a solid shape.

2 6, 8, 12, 90°

3 4, 4, 6, 60°

4 **a** cone, cylinder

b sphere, cone, cylinder

c sphere, cylinder

5 I have a total of six faces.

One of my faces is a pentagon and the other five faces are congruent triangles.

I have ten edges and six vertices.

6 a and D and ii; b and A and iii; c and B and iv; d and C and i

7 A cylinder has two circular faces and one curved surface. It has no vertices and two edges.

8 **a** No; it is an equilateral triangular prism.

b The fact that the two triangular faces are equilateral triangles.

9 **a** K **b** H **c** K

d G **e** I **f** J

10 **a** cube

b triangular prism

c sphere

d tetrahedron

11

top view

front view

side view

12 **a**

Original shape	Number of sides	Shape of base of pyramid	Number of faces	Number of vertices	Number of edges
triangle	3	triangular	4	4	6
square	4	square	5	5	8
pentagon	5	pentagonal	6	6	10
hexagon	6	hexagonal	7	7	12
heptagon	7	heptagonal	8	8	14
octagon	8	octagonal	9	9	16

b Yes; regardless of how many sides the base has, there are that many triangular faces to the pyramid plus the base itself, giving the total number of faces.

Number of faces of pyramid = number of sides of original shape + 1

c Number of vertices of pyramid = number of sides of original shape + 1

d Number of edges of pyramid = number of sides of original shape × 2

e The number of edges of a pyramid is always a multiple of 2.

13 a nine faces, 16 edges, nine vertices

b

Shape	Number of faces	Number of edges	Number of vertices
cube	6	12	8
pyramid	5	8	5
new shape	9	16	9

c 11 faces, 20 edges, 11 vertices

d

Shape	Number of faces	Number of edges	Number of vertices
pentagonal prism	7	15	10
pentagonal pyramid	6	10	6
new shape	11	20	11

e i Where the two shapes join, the two faces that go together are now inside the shape, so are no longer counted as faces.

ii Number of edges on new shape = edges on prism + $\frac{1}{2}$ × edges on pyramid

Where you join the pyramid to the prism, the two sets of edges now become one, so the base edges of the pyramid can be ignored. This leaves only the side edges of the pyramid to be added to the edges of the prism.

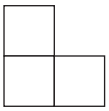
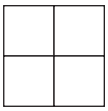
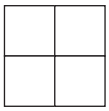
iii Number of vertices on new shape = vertices on prism + 1

Where you join the pyramid to the prism, the two sets of vertices now become one, so the base vertices of the pyramid can be ignored. This leaves only the top vertex of the pyramid to be added to the vertices of the prism.

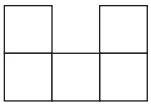
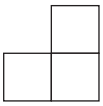
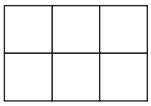
f

Shape	Number of faces	Number of edges	Number of vertices
hexagonal prism	8	18	12
hexagonal pyramid	7	12	7
new shape	8 + 7 − 2 = 13	18 + $\frac{1}{2}$ × 12 = 24	12 + 1 = 13

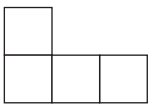
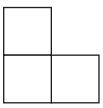
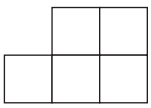
14 a

front view  side view  top view 

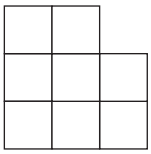
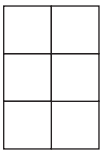
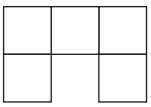
b

front view  side view  top view 

c

front view  side view  top view 

d

front view  side view  top view 

Exercise 9.1

1 a 25, 30; add 5 **b** 9, 11; add 2

c 22, 26; add 4 **d** 52, 60; add 8

e 6, 5; subtract 1 **f** 4, 1; subtract 3

g 12, 10; subtract 2 **h** 30, 25; subtract 5

2 a 5, 8, 11, 14, 17 **b** 2, 8, 14, 20, 26

c 12, 22, 32, 42, 52 **d** 0, 7, 14, 21, 28

e 12, 10, 8, 6, 4 **f** 25, 20, 15, 10, 5

g 13, 12, 11, 10, 9 **h** 100, 80, 60, 40, 20

3 **a** 22 and 34 **b** 41 and 35

4 **a** **i** Add 2 **ii** 20, 22 **iii** 30

b **i** Add 3 **ii** 17, 20 **iii** 32

c **i** Subtract 4 **ii** 30, 26

iii 10

5 **a** 4, 7, 10 **b** 30, 25, 20

c 4, 8, 16 **d** 80, 40, 20

6 **a** 12, 18 **b** 24, 31, 45

c 39, 33, 15 **d** 23, 20, 11, 8, 5

7 **a** finite

b infinite

c finite

8 **a** 5, 13, 29

b 7, 9, 15

c 30, 14, 6

9 **a** \$112

b \$124, \$136, \$148

10 No, the term after 6 is 17, but $6 + 3 = 9$ and $6 \times 2 = 12$.

11 There are many different answers. For example:

a ① Add 2 would give 1, 3, 5, 7, . . .

② Multiply by 4 and subtract 1 would give 1, 3, 11, 43, . . .

③ Multiply by 3 would give 1, 3, 9, 27, . . .

b ① Add 3 would give 3, 6, 9, 12, . . .

② Multiply by 3 and subtract 3 would give 3, 6, 15, 42, . . .

③ Multiply by 2 would give 3, 6, 12, 24, . . .

c ① Add 7 would give 1, 8, 15, 22, . . .

② Multiply by 2 and add 6 would give 1, 8, 22, 50, . . .

③ Multiply by 8 would give 1, 8, 64, 512, . . .

d ① Add 6 would give 5, 11, 17, 23, . . .

② Multiply by 3 and subtract 4 would give 5, 11, 29, 83, . . .

③ Multiply by 2 and add 1 would give 5, 11, 23, 47, . . .

12 3

13 5

14 Multiply by 3 then subtract 2.

15 There are many different answers. For example:

4, 8, 12, 16, . . .; add 4.

4, 6, 8, 10, 12, 14, . . .; add 2.

4, 5, 6, 7, 8, 9, 10, 11, 12, 13, . . .; add 1.

4, 6, 12, 30, . . .; multiply by 3 then subtract 6.

16 **a** subtract 3; −8, −11

b add 6; −26, −20

c multiply by 2 then add 1; −17, −33

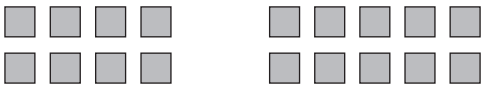
d divide by 2 then subtract 1; −5, −3.5

Exercise 9.2

1 **a** **i** 2 **ii** 4 **iii** 6

b Zara is correct. The term-to-term rule is 'Add 2'.

c pattern 4 pattern 5



d

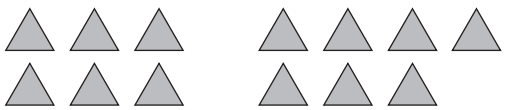
Pattern number	1	2	3	4	5
Number of squares	2	4	6	8	10

e 2, 4, 6, 8, 10, . . .

2 **a** **i** 3 **ii** 4 **iii** 5

b Add 1

c pattern 4 pattern 5

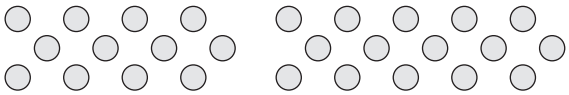


d

Pattern number	1	2	3	4	5
Number of triangles	3	4	5	6	7

e 3, 4, 5, 6, 7, . . .

3 a

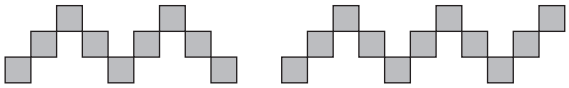


b 3, 6, 9, 12, 15

c Add 3

d Three extra dots are added.

4 a



b

Pattern number	1	2	3	4	5
Number of squares	3	5	7	9	11

c Add 2

d i 13 **ii** 17

5 a

b

Pattern number	1	2	3	4	5
Number of blocks	5	7	9	11	13

c Add 2

d i 15 **ii** 21

6 a

Pattern number	1	2	3	4	5
Number of dots	3	7	11	15	19

b i 39 **ii** 71

7 a

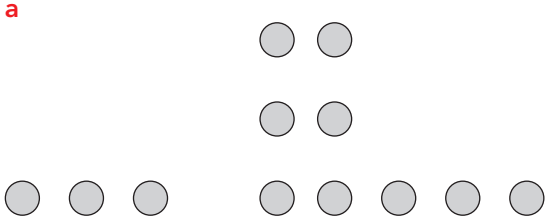
Pattern number	1	2	3	4	5
Number of hexagons	3	6	9	12	15

b Yes because 51 is a multiple of 3. Pattern 17 will have 51 hexagons.

c 92 is not a multiple of 3.

d The number of hexagons used in this sequence of patterns is always a multiple of 3.

8 a



b 18

9 Sofia; $1 \times 3 + 2 = 5$, $2 \times 3 + 2 = 8$, $3 \times 3 + 2 = 11$ and $4 \times 3 + 2 = 14$.

10 Learner's own patterns that have the following sequences:

a 4, 6, 8, . . .

b 1, 4, 7, . . .

c 3, 8, 13, . . .

11 a

Pattern number	1	2	3	4	5
Number of grey triangles	3	7	11	15	19
Number of white triangles	1	3	5	7	9
Total number of triangles	4	10	16	22	28

b i Add 4 **ii** Add 2 **iii** Add 6

Add 4 + Add 2 = Add 6 or i + ii = iii.

c 39

d 23

e 124

12 a

Pattern number	1	2	3	4	5
Number of grey octagons	6	12	18	24	30
Number of white squares	2	6	10	14	18
Total number of shapes	8	18	28	38	48

b i Add 6 **ii** Add 4 **iii** Add 10

Add 6 + Add 4 = Add 10 or i + ii = iii.

c 72

d 78

e 498

Exercise 9.3

1 a 2, 4, 6, 8, 10, . . .

Position number	1	2	3	4	5
× 2	× 2	× 2	× 2	× 2	× 2
Term	2	4	6	8	10

Term = 2 × position number, so *n*th term rule is: *n*th term = 2*n*.

b 3, 6, 9, 12, 15, . . .

Position number	1	2	3	4	5
× 3	× 3	× 3	× 3	× 3	× 3
Term	3	6	9	12	15

Term = 3 × position number, so *n*th term rule is: *n*th term = 3*n*.

c 4, 8, 12, 16, 20, . . .

Position number	1	2	3	4	5
× 4	× 4	× 4	× 4	× 4	× 4
Term	4	8	12	16	20

Term = 4 × position number, so *n*th term rule is: *n*th term = 4*n*.

2 a 2, 3, 4, 5, 6, . . .

Position number	1	2	3	4	5
+ 1	+ 1	+ 1	+ 1	+ 1	+ 1
Term	2	3	4	5	6

Term = position number + 1, so *n*th term rule is: *n*th term = *n* + 1.

b 3, 4, 5, 6, 7, . . .

Position number	1	2	3	4	5
+ 2	+ 2	+ 2	+ 2	+ 2	+ 2
Term	3	4	5	6	7

Term = position number + 2, so *n*th term rule is: *n*th term = *n* + 2.

c 7, 8, 9, 10, 11, . . .

Position number	1	2	3	4	5
+ 6	+ 6	+ 6	+ 6	+ 6	+ 6
Term	7	8	9	10	11

Term = position number + 6, so *n*th term rule is: *n*th term = *n* + 6.

3 a *n*th term = 5*n* When *n* = 1, 5 × 1 = 5.

When *n* = 2, 5 × 2 = 10.

When *n* = 3, 5 × 3 = 15.

When *n* = 4, 5 × 4 = 20.

First four terms of sequence are 5, 10, 15, 20.

b *n*th term = *n* + 3 When *n* = 1, 1 + 3 = 4.

When *n* = 2, 2 + 3 = 5.

When *n* = 3, 3 + 3 = 6.

When *n* = 4, 4 + 3 = 7.

First four terms of sequence are 4, 5, 6, 7.

4 a 40 **b** 80

c 14 **d** 18

5 a 9*n* **b** 10*n* **c** 12*n* **d** 30*n*

6 a i 90 **ii** 180

b i 100 **ii** 200

c i 120 **ii** 240

d i 300 **ii** 600

7 a *n* + 7 **b** *n* + 10

c *n* + 13 **d** *n* + 19

8 a i 19 **ii** 32

b i 22 **ii** 35

c i 25 **ii** 38

d i 31 **ii** 44

9 Yes, when $n = 1$, $1 - 7 = -6$. When $n = 2$, $2 - 7 = -5$. When $n = 3$, $3 - 7 = -4$, etc.

10 **a** $-7, -6, -5, -4, -3$

b 25, 26, 27, 28, 29

c 50, 100, 150, 200, 250

d $-9, -8, -7, -6, -5$

11

*n*th term rule	5th term in sequence	10th term in sequence	20th term in sequence
*n*th term = $n + 30$	35	40	50
*n*th term = $n - 12$	−7	−2	8
*n*th term = $5n$	25	50	100
*n*th term = $n + 14$	19	24	34
*n*th term = $n - 20$	−15	−10	0
*n*th term = $40n$	200	400	800

12 A and iii; B and iv; C and ii; D and v; E and i

13 **a** **i** $-4, -3, -2, -1, 0$ **ii** 4, 3, 2, 1, 0

b **i** $-10, -9, -8, -7, -6$ **ii** 10, 9, 8, 7, 6

c Parts i and ii have the same numbers except that one set is positive and one set is negative.

When *n*th term = n − 'a number' and *n*th term = 'a number' − n, where 'a number' is the same number, one set of numbers will be the negative of the other set of numbers.

14 **a** C; when $n = 26$, $2 - n = -24$. When $n = 22$, $2 - n = -20$. When $n = 14$, $2 - n = -12$.

When $n = 12$, $2 - n = -10$. When $n = 9$, $2 - n = -7$. When $n = 2$, $2 - n = 0$.

When $n = 1$, $2 - n = 1$.

b −20. In A, when $n = 5$, $-4n = -20$. In B, when $n = 2$, $n - 22 = -20$.

In C, when $n = 22$, $2 - n = -20$. In D, when $n = 4$, $-5n = -20$.

c −12. In A, when $n = 3$, $-4n = -12$. In B, when $n = 10$, $n - 22 = -12$. In C, when $n = 14$, $2 - n = -12$.

−10. In B, when $n = 12$, $n - 22 = -10$. In C, when $n = 12$, $2 - n = -10$. In D, when $n = 2$, $-5n = -10$.

d D because there are only two multiples of 5 in the list. There are three multiples of 4, so it is not A. C has all the numbers in the list and B has five of the numbers in the list.

Exercise 9.4

1 **a** 6 **b** 5 **c** 0, 2

d 10, 40 **e** 6, 9, 21

2 **a** 1 **b** 3 **c** 8, 11

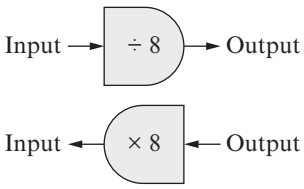
d 6, 20 **e** 3, 7, 23

3 **a** input: 9; output: 8, 12

b input: 14; output: 3, 13

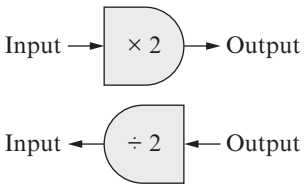
c input: 7, 20; output: 50

4 **a**



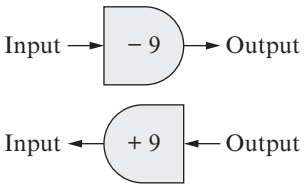
Input	24	64	80
Output	3	8	10

b



Input	8	13	30
Output	16	26	60

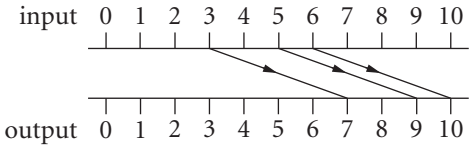
c



Input	10	23	34
Output	1	14	25

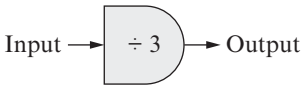
5 **a** + 3 **b** ÷ 3 **c** × 7

6



7

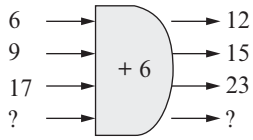
Input	3	6	9
Output	1	2	3



8 ÷ 4 or −15

Learner's own justification.
Example: $20 \div 4 = 5$ and $20 - 15 = 5$

9 **a**



b It is not possible to work out all the numbers. Learner's own answers. Example: You can have any pair of numbers as long as the output is 6 more than the input. For example, 20 and 26, 35 and 41, etc.

Exercise 10.1

1 **a, b** $10\% = \frac{1}{10}$, $20\% = \frac{1}{5}$, $30\% = \frac{3}{10}$, $40\% = \frac{2}{5}$, $50\% = \frac{1}{2}$, $60\% = \frac{3}{5}$, $70\% = \frac{7}{10}$, $80\% = \frac{4}{5}$, $90\% = \frac{9}{10}$

2 **a** $\frac{18}{25}$ **b** $\frac{73}{100}$ **c** $\frac{37}{50}$

d $\frac{3}{4}$ **e** $\frac{19}{25}$

3 For example: 6% = 0.06 and 60% = 0.6.

4 $\frac{17}{25}$, 70%, 0.71, $\frac{3}{4}$, $\frac{38}{50}$, 77%, 0.8

5 **a** 60% **b** 30% **c** 26%

d 92% **e** 66%

6 **a** 35% **b** 42 cm²

7 **a** **i** \$72 **ii** \$168

iii \$12 **iv** \$228

b \$240 − \$12 = \$228

8 **a** 50% = \$3; 25% = \$1.50; 10% = \$0.60; 20% = \$1.20

b Learner's own answers.

9 Learner's own answers.

10 **a** $2 \times 8.12\,\text{m} = 16.24\,\text{m}$

b Half of $8.12\,\text{m} = 4.06\,\text{m}$

c $3 \times 8.12\,\text{m} = 24.36\,\text{m}$

11 **a** $20\% = \frac{1}{5}$ and $\frac{1}{5}$ of 50 is 10; $50\% = \frac{1}{2}$ and $\frac{1}{2}$ of 20 is 10; both have the same answer.

b 70% of 30 is $\frac{7}{10} \times 30$ and 30% of 70 is $\frac{3}{10} \times 70$; both have the same answer.

12

Fraction	$\frac{3}{5}$	$\frac{3}{10}$	$\frac{3}{20}$	$\frac{3}{40}$	$\frac{3}{80}$
Percentage	60%	30%	15%	7.5%	3.75%

Exercise 10.2

1 **a** $\frac{1}{1000}$ **b** $\frac{1}{500}$ **c** $\frac{3}{1000}$

d $\frac{1}{250}$ **e** $\frac{1}{200}$

2 **a** \$36 **b** \$3.60 **c** \$0.36

3 **a** 2.4

b **i** 1.20 **ii** 0.24 **iii** 0.48

4 **a** $\frac{1}{40}$ **b** $\frac{3}{40}$ **c** $\frac{1}{8}$ **d** $\frac{7}{40}$

5 **a** 20% **b** 56% **c** 92.5%

6 **a** possible

b Impossible; it cannot go down by more than 100%.

c possible

7 **a** 1.3 and 130% **b** 1.8 and 180%

c 1.07 and 107% **d** 1.05 and 105%

e 2.12 and 212%

8

Percentage	20%	40%	65%	130%	175%	190%
Fraction	$\frac{1}{5}$	$\frac{2}{5}$	$\frac{13}{20}$	$1\frac{3}{10}$	$1\frac{3}{4}$	$1\frac{9}{10}$
Decimal	0.2	0.4	0.65	1.3	1.75	1.9

9 **a** $1\frac{1}{10}$ **b** $1\frac{4}{5}$ **c** $1\frac{7}{20}$ **d** $2\frac{3}{20}$

10

Percentage	45%	60%	75%	90%	105%	120%	135%
Fraction	$\frac{9}{20}$	$\frac{3}{5}$	$\frac{3}{4}$	$\frac{9}{10}$	$1\frac{1}{20}$	$1\frac{1}{5}$	$1\frac{7}{20}$

11 **a** 65% **b** 35%

12 **a** 133 cm **b** 161 cm

13 **a** $\frac{3}{8}$ **b** \$550 **c** \$750

14 Learner's own answers.

15 25% of \$144; 200% of \$18; 150% of \$24; 80% of \$45; 20% of \$180; 50% of \$72

16 **a** 300% **b** 200%

Exercise 11.1

1 **a** 27 **b** 9.5

c 22 **d** $y = x - 3$

2 **a** 44 cm **b** 25 cm **c** $l = 4w$

3 **a** \$21 **b** \$$(b + 12)$

c $t = b + 12$

4 **a** Learner's own answer.

b $y = 0.5x$

5 **a**

Zara (min)	10	15	23	7	31
Marcus (min)	20	25	33	17	41

b $y = x + 10$

6 **a** 22.5 cm

b

Small plate (x cm)	15	16	17	18	20	21
Large plate (y cm)	22.5	24	25.5	27	30	31.5

c $y = 1.5x$

7 **a** 35 cm

b 24 cm

c B and C are both correct.

8 **a** **i** 10 cm

ii 30 cm

b **i** 13 cm

ii 39 cm

c $l = 2w$ **d** $p = 6w$

9 **a** Learner's own table.

b \$11.95

c B and D are both correct.

10 **a** \$170 **b** $c = 17n$

c \$612 **d** 58

11 **a** 135 crowns

b $c = 13.5d$, where c is the number of crowns and d is the number of dollars.

12 **a** 25 g **b** $y = 2.5n$

c $z = 10n$

13 **a** **i** \$60 **ii** \$30 **iii** \$3

b $c = 3x$

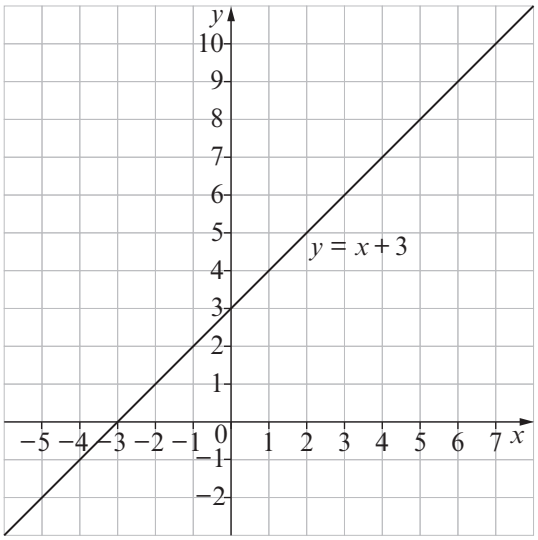
c \$100.50

Exercise 11.2

1 **a**

x	−4	−2	0	2	4	6
$x+3$	−1	1	3	5	7	9

b



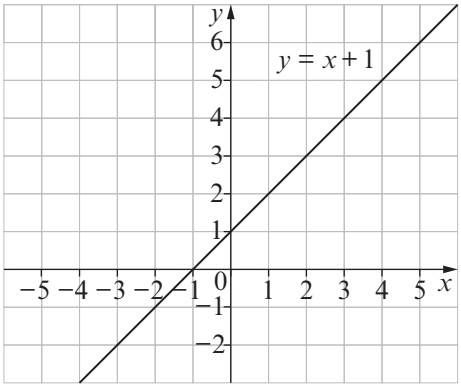
c **i** (3, 6) **ii** (8, 11)

iii (−3, 0) **iv** (−9, −6)

2 **a**

x	−3	−2	−1	0	1	2	3	4
$x+1$	−2	−1	0	1	2	3	4	5

b

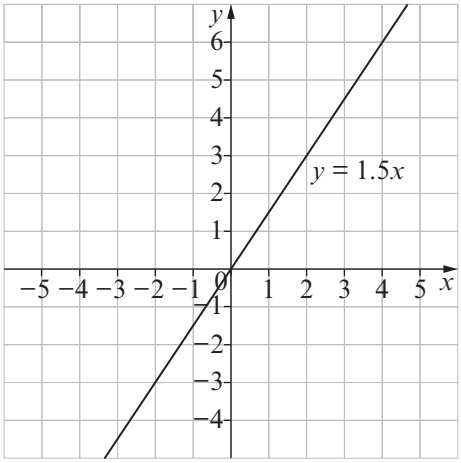


c (6, 7), (−10, −9) and (−0.5, 0.5)

3 **a**

x	−4	−2	0	2	4
$1.5x$	−6	−3	0	3	6

b

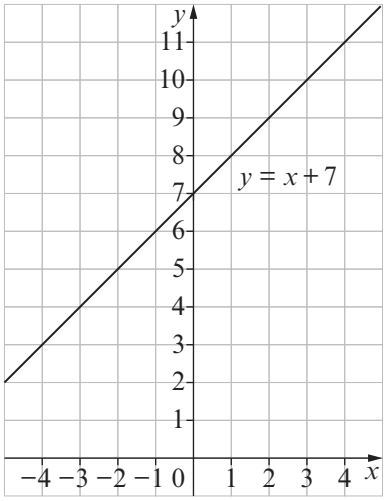


c 12 **d** −10

4 **a** For example (learner's will have their own values):

x	−4	−2	0	2	4
$y=x+7$	3	5	7	9	11

b



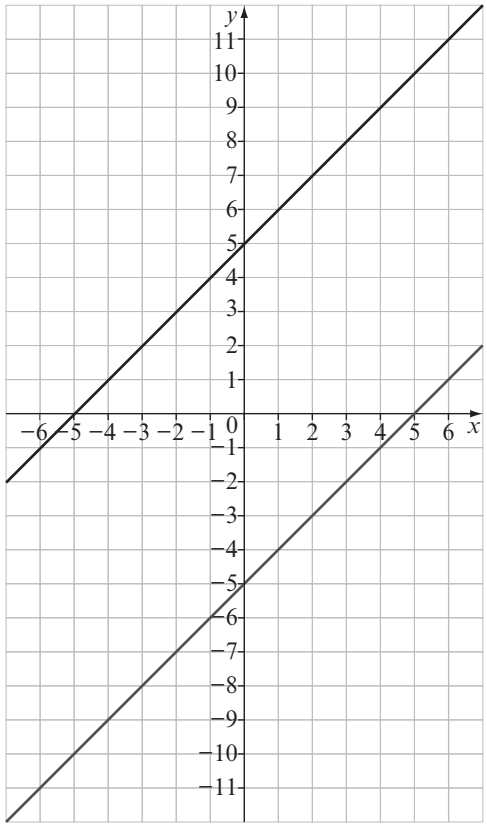
c (−7, 0)

d (−14, −7)

5 **a**

x	−6	−3	0	3	6
$x-5$	−11	−8	−5	−2	1

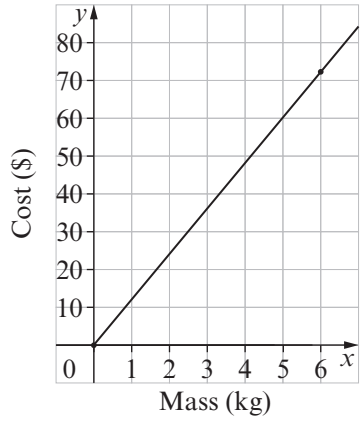
b, c



6 a

Mass (kg)	1	2	3	4	5	6
Cost ($)	12	24	36	48	60	72

b



The learner's graph might have different scales on the axes.

c $y = 12x$

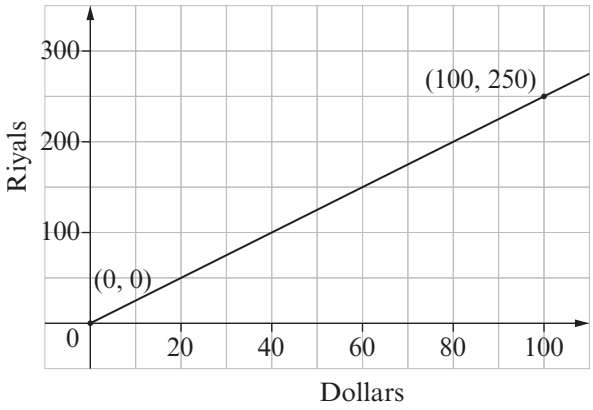
d i \$30 **ii** \$108

7 a

Miles (m)	10	20	30	40	50
Kilometres (k)	16	32	48	64	80

b 25 **c** 1.6 **d** $k = 1.6m$

8 a



The learner's scale might be different.

b 100

c

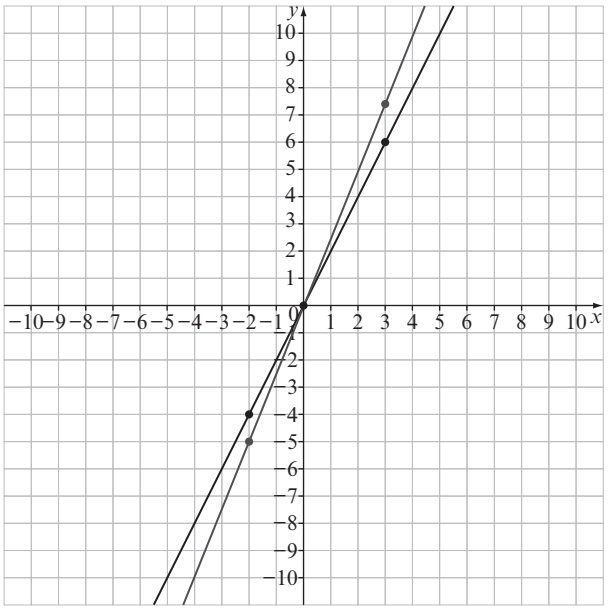
Dollars (d)	20	40	60	80	100
Riyals (r)	50	100	150	200	250

d $r = 2.5d$

9 a A straight line through (0, 20), making an angle of 45° with the coordinate axes.

b $(-a, 0)$ and $(0, a)$ **c** $k = 5 - 12 = -7$

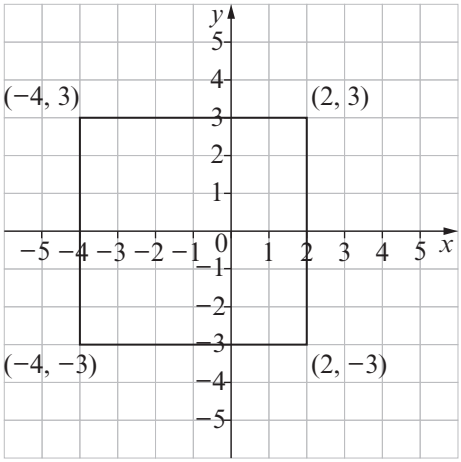
10 a, c



b $y = 2x$ **d** $y = 2.5x$

Exercise 11.3

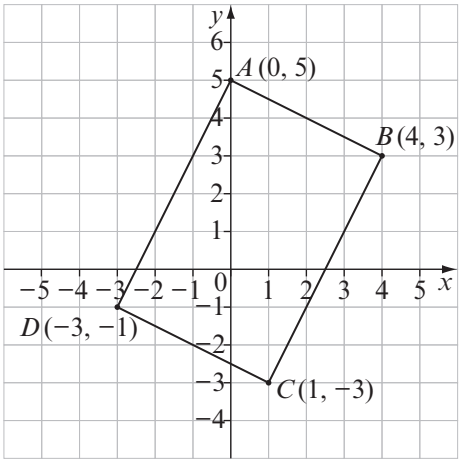
1 a



b (−4, 3) **c** (−1, 0)

d $x = -4$, $y = 3$, $y = -3$

2 a D is (−3, −1).



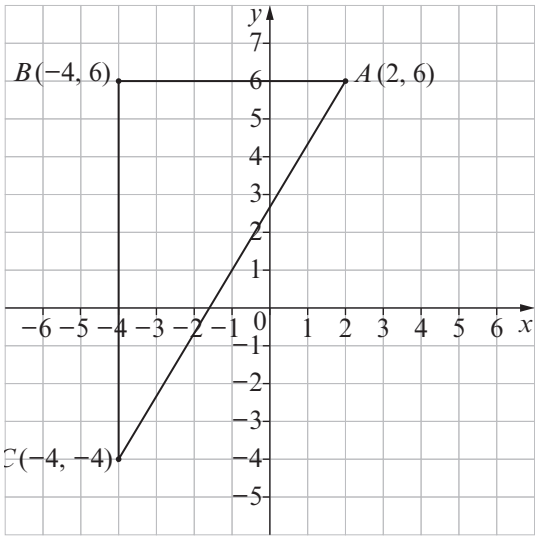
b (2.5, 0) **c** (0.5, 1)

d $y = -3$ **e** $x = 1$

3 a B **b** D **c** C

d A **e** D

4 a



b $y = 6$ **c** $x = -4$

d $x = -1$ **e** $y = 1$

5 a (−3, 2) **b** $y = 2$

6 (−2.8, 5.3), (−2.8, −0.7), (−4.5, 5.3), (−4.5, −0.7)

7 18 and 7

8 a $y = 6$ **b** $y = 3$

9 (4, 2) or (4, 17) or (4, −13)

10 (−2, 6), (6, 6), (−2, −2)

11 a parallelogram

b (0, 1), (0, 4), (−4, 0), (−4, −3)

12 $y = 0.5x$, $y = x - 6$, $y = 0$

Exercise 11.4

1 a 2 km **b** 30 minutes

c

Time (min)	5	10	15	20	25
Distance (km)	1	2	3	4	5

d Erica runs at a constant speed.

e 12 km

f 3.5 hours or 3 hours 30 minutes

2 a 160 pages **b** 2.5 hours

c 40 pages per hour **d** 6 hours

e positive

3 a 2 km **b** 3.5 km

c The graph is a straight line.

d negative

e

Time (min)	0	5	10	15	20
Distance from home (km)	3.5	3	2.5	2	1.5

f 35 minutes

4 **a** \$4.60 **b** 5 minutes

c A connection charge of \$3 and then \$0.2 for each minute.

d A call for 20 minutes costs
$\$3 + 20 \times \$0.2 = \$3 + \$4 = \$7$.

5 **a** 100%

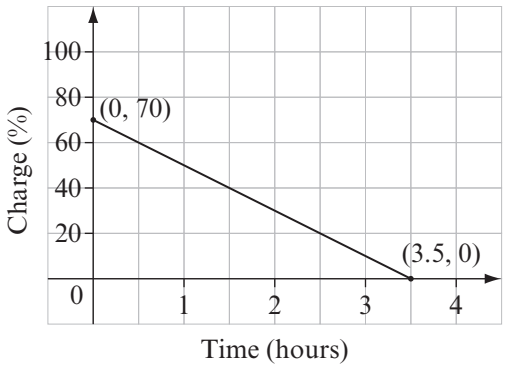
b

Time (h)	0	1	2	3	4
Charge (%)	100	80	60	40	20

c after 5 hours

d 20 percentage points per hour

e

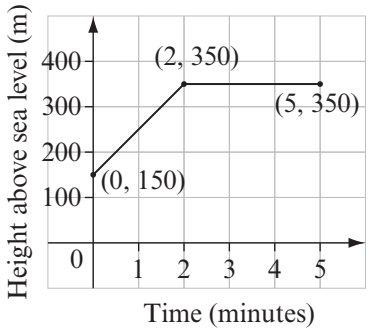


In this case, the charge is 0% after 3.5 hours.

6 **a** 150 m **b** 4 min

c 50 m/min

d



It reaches the top in 2 minutes.

7 **a** The temperature is decreasing at a constant rate.

b 90° C **c** 70° C **d** 4° C

e It will take 15 minutes, assuming the temperature continues to decrease at the same rate.

8 **a** 0.6 m **b** 24 min

c Increases by 0.1 m.

d It would start at the same place and be twice as steep.

e True; the increase from 0.6 m to 3 m is 2.4 m. The increase is now 0.2 m per minute. At 0.2 m per minute this takes $2.4 \div 0.2 = 12$ minutes.

9 **a** The car slows down from 70 km/h to 20 km/h over a period of 20 seconds. It speeds up in the next 10 seconds to a speed of 40 km/h. It travels at a constant speed of 40 km/h for the next 40 seconds.

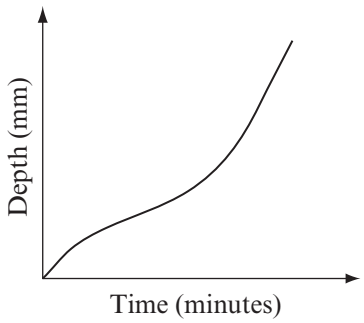
b After about 10 seconds, where the graph is steepest.

c **i** from 20 second until 30 seconds

ii for the first 20 seconds

iii at 20 seconds and then from 30 seconds to 70 seconds

10 The graph should look something like this:



Exercise 12.1

1 **a** 1 **b** 2 **c** 1 : 2 **d** 2 : 1

2 There are two black squares and eight white squares.

The ratio of black squares : white squares is 2 : 8, which simplifies to 1 : 4.

3 There are two black squares and ten white squares.

The ratio of black squares : white squares is 2 : 10, which simplifies to 1 : 5.

4 There are six black squares and nine white squares.

The ratio of black squares : white squares is 6 : 9, which simplifies to 2 : 3.

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

6 **a** B **b** C **c** C **d** A

7 **a** 1 : 2 **b** 1 : 10

c 1 : 3 **d** 1 km : 7 km

e 1 L : 4 L **f** 1 m : 5 m

g 6 : 1 **h** 6 : 1

i 20 : 1 **j** 3 kg : 1 kg

k 5 t : 1 t **l** 8 cm : 1 cm

8 **a** 2 : 9 **b** 2 : 15 **c** 8 : 9

d 2 h : 5 h **e** 4 m : 9 m

f 4° C : 15° C **g** 5 : 4 **h** 8 : 3

i 11 : 2 **j** 8 days : 5 days

k 8 mL : 5 mL **l** 7 mm : 2 mm

9 8 : 5

10 **a** Greg has the ratio the wrong way around.

b 'The ratio of white flour to porridge oats is 5 : 2.' Or 'The ratio of porridge oats to white flour is 2 : 5.'

11 50 : 6

12 Azul, mango juice : water = 9 : 12

Belen, mango juice : water = 8 : 12

So Azul's drink has the higher proportion of mango juice.

13 **a** 7 : 5 **b** 11 : 7

c Bulawayo because Harare is 49 : 35, Bulawayo is 55 : 35 and 55 > 49.

d Harare because Harare is 28 : 21, Bulawayo is 24 : 21 and 28 > 24.

14 **b** 4 : 5 **c** 6 : 13 **d** 2 : 9

15 **a** 3 : 2 : 4 **b** 2 : 3 : 4

c 5 : 2 : 8 **d** 5 : 8 : 4

16 6 : 3 : 7

17 9 : 13 : 6

Exercise 12.2

1 Tudza 3, Pepi 9

2 Sassi 6, Mimi 9

3 Total number of parts is 1 + 2 = 3.

Value of one part is \$48 ÷ 3 = \$16.

Nigel gets 1 × \$16 = \$16. Pamela gets 2 × \$16 = \$32.

4 Total number of parts is 1 + 4 = 5.

Value of one part is \$45 ÷ 5 = \$9.

Ben gets 4 × \$9 = \$36. Kir gets 1 × \$9 = \$9.

5 Total number of parts is 2 + 3 = 5.

Value of one part is \$60 ÷ 5 = \$12.

Danai gets 2 × \$12 = \$24. Maita gets 3 × \$12 = \$36.

6 **a** \$6, \$18 **b** \$9, \$36

c \$7, \$42 **d** \$24, \$8

e \$30, \$6 **f** \$28, \$4

7 **a** \$22, \$33 **b** \$21, \$28

c \$24, \$40 **d** \$20, \$8

e \$28, \$20 **f** \$22, \$6

8 **a** 20 **b** $\frac{4}{7}$

9 **a** 600 litres

b **i** $\frac{7}{9}$ **ii** $\frac{2}{9}$

10 **a** 1 : 2 **b** \$28 000

11 carp : pike = 120 : 16 = 15 : 2; 34 000 ÷ 17 = 2000; 2 × 2000 = 4000 pike

12 **a** Learner's own answer.

b Age is better for Estela. Age: Estela gets 15. Dolls: Estela gets 14.

13 No, Arun has \$4.95, which is less than \$5.

14 $1152

15 $679.40

Exercise 12.3

1 two shirts cost $2 \times 30 = \$60$; three shirts cost $3 \times 30 = \$90$; four shirts cost $4 \times 30 = \$120$; ten shirts cost $10 \times 30 = \$300$

2 two chairs weigh $2 \times 8 = 16$ kg; three chairs weigh $3 \times 8 = 24$ kg; five chairs weigh $5 \times 8 = 40$ kg; eight chairs weigh $8 \times 8 = 64$ kg

3 one drink costs $3 \div 2 = \$1.50$; seven drinks cost $7 \times 1.50 = \$10.50$

4 one grape weighs $60\text{ g} \div 5 = 12\text{ g}$; four grapes weigh $4 \times 12 = 48$ g

5 **a** 9 **b** 156

6 Mass of one potato: $500 \div 4 = 125$ g; mass of seven potatoes: $7 \times 125\text{ g} = 875$ g

7 **a** 180 g **b** 1260 g or 1.26 kg

8 $31.50

9 240 g

10 **a** $28 **b** $84

11 **a** €83 **b** €415

12 Eduardo worked it out for six people, not ten. The recipe needs 700 g of potato for ten people.

13 No, it should be $360. The carpenter has worked out the total price with ten extra pieces, not eight.

14 Offer 1: 28.33. . . cents per bag; Offer 2: 25 cents per bag; Offer 3: 26.6 cents per bag Offer 2 is the best value for money as it is the cheapest per bag.

15 $0.40 per kg

16 320 kg

Exercise 13.1

1 **a**, **b** Learner's own answers.

2 **a** unlikely **b** likely **c** certain

3 **a** A **b** G **c** D

4 a and v; b and vi; c and iii; d and vii; e and i

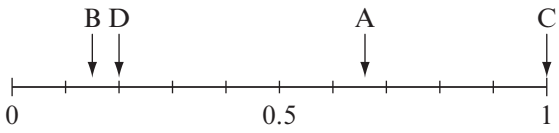
5 46.7%, 60%, $\frac{5}{8}$, $\frac{17}{20}$, 0.9

6 **a** C **b** F **c** E

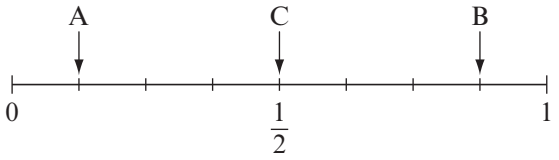
7 **a** 15%

b The probability is 60%, which is more than 50%.

8



9



10 That would be a probability of 120%. A probability cannot be greater than 100%.

11 No; Marcus has assumed that the outcomes are equally likely, but that is not the case.

12 **a** 90%

b It cannot be more than 40%. It will be less than 40% if there is a chance of a draw. The three probabilities for win, draw and lose add up to 100%.

Exercise 13.2

1 **a** 0.6 **b** 0.4 **c** 0

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

3 Learner's own answer.

4 **a** **i** blue 30% **ii** red 40% **iii** green 20% **iv** yellow 10% **v** purple zero

b 60%

c green $\frac{2}{9}$, blue $\frac{1}{3}$, red $\frac{4}{9}$

5 **a** **i–v** Learner's own answers.

b 25% is $\frac{1}{4}$ and there are six equally likely numbers. $\frac{1}{4}$ of 6 is $1\frac{1}{2}$ and you cannot have $1\frac{1}{2}$ numbers.

6 **a** One way is to write each name on a piece of paper, put the pieces of paper in a bag and take one without looking.

b 0.4

7 **a** Because 60% + 30% = 90%, which is less than 100%.

b It cannot be more than 10%.

8 **a** 0.3 **b** 0.1 **c** 0.4

d 0.2 **e** 0.55 **f** 0.95

g 0.8

9 **a** 50%

b Because half the cards are A or B. That must be a whole number. Double a whole number is an even number.

c There could be ten cards because 20% of 10 and 30% of 10 are whole numbers. Ten is the smallest number with this property.

10 **a** There is an even number of faces.

b There could be ten faces. Then there will be 3 multiples of 3. There could also be 20 faces. Then there will be 6 multiples of 3.

11 You could have a five-letter name with the letters A, A, S, _ , _ and no E. SARAH is one possibility, but there are others.

Exercise 13.3

1 **a** 69% **b** 31%

2 **a** 33% **b** 67%

3 **a** 21.5% **b** 33.5% **c** 45%

4 **a** 12% **b** 80% **c** 88%

5 **a** **i** 0.9 **ii** 0.1

b **i** 0.85 **ii** 0.15

c They are based on a bigger sample.

6 **a** **i** 30% **ii** 70%

b **i** 23.6% **ii** 76.4%

c The woman worked out 23.6% of 100.

7 **a** **i** 8.75% **ii** 10.6% **iii** 51.25%

b $\frac{1}{8}$ is 12.5%, which is more than the experimental probability of 8.75%.

c Zero heads is three tails, so the theoretical probability should also be $\frac{1}{8}$. The experimental probability of 10.6% is closer to 12.5% this time.

8 **a** **i** 0.17 **ii** 0.36

iii 0.47 **iv** 0.02

b The numbers 2 and 12 do not occur very often, so the frequencies might be unusual.

9 **a** **i** 0.48 **ii** 0.13 **iii** 0.14

b It is reasonable for 1, 2 and 3, but the larger numbers rarely occur. The estimate for 7 or 9 is zero. A good estimate for those numbers of spins needs a larger sample.

10 **a** 15% **b** 17.5% **c** 80%

Exercise 14.1

1 **a** 10 m **b** 15 m

c $8 \times 5 = 40$ m

2 **a** 40 cm **b** $3 \times 20 = 60$ cm

c $6 \times 20 = 120$ cm

3 **a** 2 cm **b** 3 cm

c $70 \div 10 = 7$ cm

4 **a** 2 cm **b** $150 \div 50 = 3$ cm

c $300 \div 50 = 6$ cm

5 A and iv; B and ii; C and i; D and vi; E and vii; F and iii; G and v

6 **a** 80 m **b** 24 cm

7 **a** 1.2 m **b** 11 cm

8 **a** 2.4 cm **b** 72 km

9 **a** **i** 24 m **ii** 6 m **iii** 8 m
iv 10 m **v** 16 m **vi** 16 m
b 5.5 cm **c** 1.5 cm

10 **a** 2.4 km **b** 50 cm

11 **a** 4 cm **b** 3.6 km
c 11.5 cm

12 **a**

Part of triathlon	Map scale	Distance on map (cm)	Distance in real life (km)
swim	1 : 15 000	18	2.7
cycle	1 : 400 000	16	64
run	1 : 80 000	20.5	16.4

b 83.1 km

13 C

14 52.5 km

15 **a** 1.95 m **b** 1.69 m
c 1.534 m

Exercise 14.2

1 **a** 3 units **b** 10 units
c 7 units **d** 8 units

2 **a** 4 units **b** 5 units
c 5 units **d** 10 units

3 A and iii; B and i; C and vii; D and ii; E and vi; F and v; G and iv

4 **a** 4 units **b** 5 units **c** 8 units

5 **a** 12 units **b** 10 units **c** 2 units

6 **a** C **b** B **c** A **d** C

7 Group 1: *C*, *E*, *G*, *I*; Group 2: *D*, *F*, *H*, *J*

8 Zara is correct. Distance from *A* to *B* = 5 units, *B* to *C* = 4 units, *C* to *D* = 5 units and *D* to *A* = 4 units. Two opposite sides are equal to 5 units and the other two opposite sides are equal to 4 units, so it is a rectangle.

9 A and iii; B and i; C and iv; D and ii

10 **a** 8 units **b** 9 units
c 12 units **d** 32 units

11 **a** **i** 6 units **ii** 8 units

b **i** The diagonals *EG* and *FH* are not the same length.

ii The diagonals *EG* and *FH* are not the same length.

c For example: Opposite vertices *E* and *G* both have a *y*-coordinate of 1, and the other opposite vertices *F* and *H* both have an *x*-coordinate of −1.

d **i** 3 units **ii** 3 units
iii 2 units **iv** 6 units

e **i** For example: *EFGH* is not a rhombus because although *EX* and *XG* are the same length as each other, *FX* and *XH* are not the same length as each other.

ii For example: *EFGH* is a kite because diagonal *EG* is bisected (*EX* and *XG* are the same length as each other) but diagonal *FH* is not bisected (*FX* and *XH* are not the same length as each other).

12 *Q* could be (11, 3), (−7, 3), (2, 12) or (2, −6).

Exercise 14.3

1 *A* (3 , 3) *B* (3 , 1) *C* (4 , 1)
↓ ↓+5 ↓ ↓+5 ↓ ↓+5
A′ (8 , 3) *B′* (8 , 1) *C′* (9 , 1)

2 *A* (3 , 3) *B* (3 , 1) *C* (4 , 1)
↓ ↓−3 ↓ ↓−3 ↓ ↓−3
A′ (0 , 3) *B′* (0 , 1) *C′* (1 , 1)

3 *A* (5 , 3) *B* (8 , 3) *C* (8 , 6) *D* (5 , 6)
↓ ↓−4 ↓ ↓−4 ↓ ↓−4 ↓ ↓−4
A′ (1 , 3) *B′* (4 , 3) *C′* (4 , 6) *D′* (1 , 6)

4 *D* (2 , 5) *E* (2 , 3) *F* (3 , 3)
↓ ↓+1 ↓ ↓+1 ↓ ↓+1
D′ (2 , 6) *E′* (2 , 4) *F′* (3 , 4)

5 D (2 , 5) E (2 , 3) F (3 , 3)

↓ ↓ −2 ↓ ↓ −2 ↓ ↓ −2

D' (2 , 3) E' (2 , 1) F' (3 , 1)

6 A (2 , 7) B (6 , 7) C (6 , 9) D (2 , 9)

↓ ↓ −4 ↓ ↓ −4 ↓ ↓ −4 ↓ ↓ −4

A' (2 , 3) B' (6 , 3) C' (6 , 5) D' (2 , 5)

7 P (4 , 5) Q (7 , 5) R (6 , 9)

↓ ↓+3 ↓+4 ↓ ↓+3 ↓+4 ↓ ↓+3 ↓+4

P' (7 , 9) Q' (10 , 9) R' (9 , 13)

8

A (4 , 8) B (8 , 8) C (8 , 10) D (4 , 10)

↓ ↓−1 ↓ −5 ↓ ↓−1 ↓ −5 ↓ ↓−1 ↓ −5 ↓ ↓−1 ↓ −5

A' (3 , 3) B' (7 , 3) C' (7 , 5) D' (3 , 5)

9 A and iv; B and iii; C and i; D and ii

10 $P'(3, 0)$, $Q'(4, 2)$, $R'(3, 4)$ and $S'(2, 2)$

11 a For example: Ivan has added 3 to the x-coordinates and he should have subtracted 3.

b $A'(1, 5)$, $B'(6, 1)$

c For example: Ivan could work backwards and translate $A'B'$ 3 squares right and 2 squares up and check that the coordinates are the same as AB. Or he could draw a diagram.

12 D. For example: the x-coordinates of $X'Y'Z'$ are 3 less than the x-coordinates of XYZ. The y-coordinates of $X'Y'Z'$ are 3 more than the y-coordinates of XYZ.

13 L' is incorrect. For example: the x-coordinates are all correct. The translation is 3 squares left, so all x-coordinates of $J'K'L'M'$ are 3 less than $JKLM$.

The y-coordinate of L' is incorrect. The translation is 1 square down. The y-coordinates of $J'K'M'$ are 1 less than JKM, but the y-coordinate of L' is 3 more than L.

14 a C **b** B **c** D **d** A

15 a i 7 squares right and 8 squares up

ii Learner's own answer.

iii For example: you can add the translations; that is, 3 right + 4 right = 7 right, 2 up + 6 up = 8 up.

b i 5 squares left and 5 squares up

ii Learner's own answer.

iii For example: you can add the translations; that is, 2 left + 3 left = 5 left, 4 up + 1 up = 5 up.

16 a i For example: translation 1 square right and 2 squares down followed by 1 square right and 2 squares up.

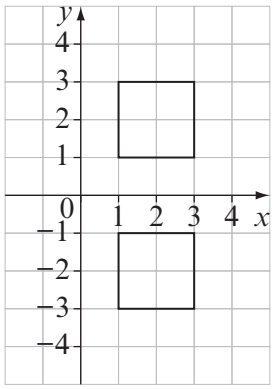
ii 2

b i For example: translation 1 square right and 2 squares up followed by 1 square right and 2 squares down, followed by 1 square right and 2 squares up.

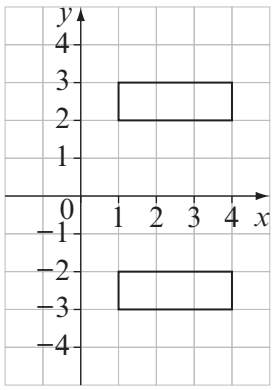
ii 3

Exercise 14.4

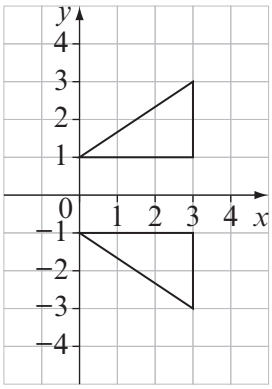
1 a



b

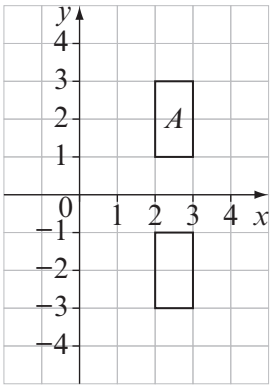


c

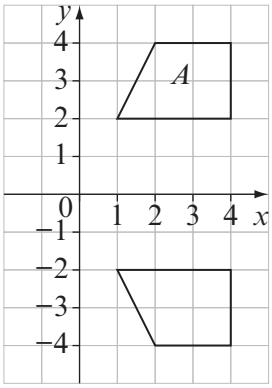


2 a is correct, b and c are incorrect.

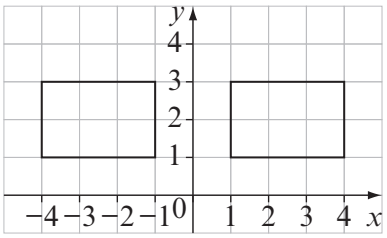
b



c



3 a



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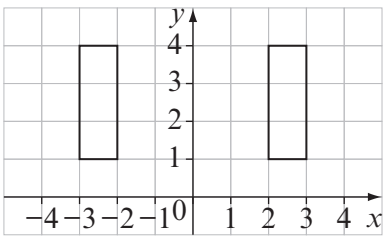
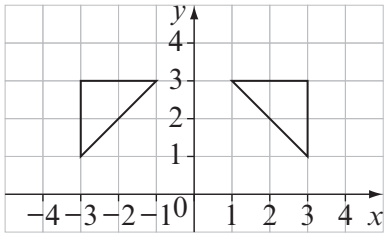
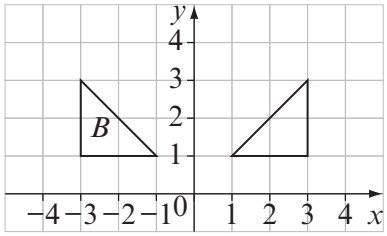


c

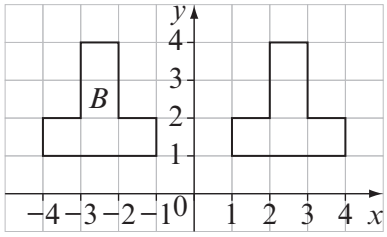


4 b is correct, a and c are incorrect.

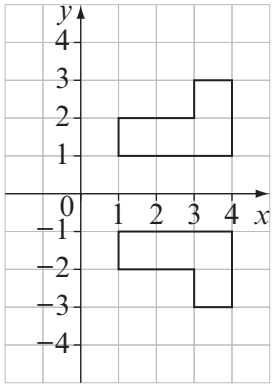
a



c



5 a



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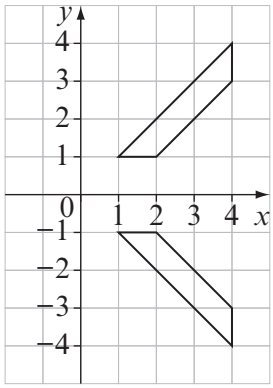

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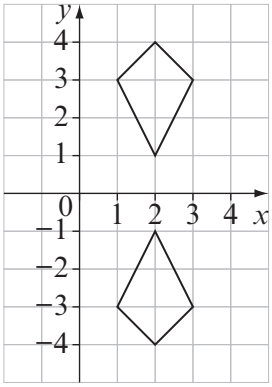
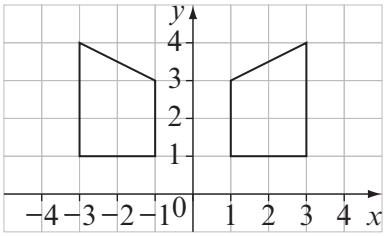
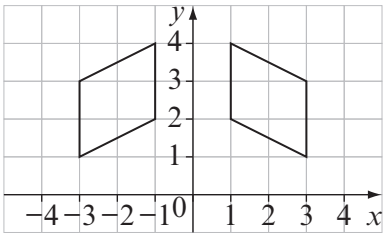


6 a



b



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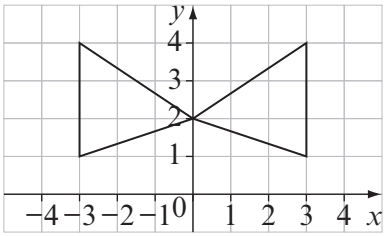
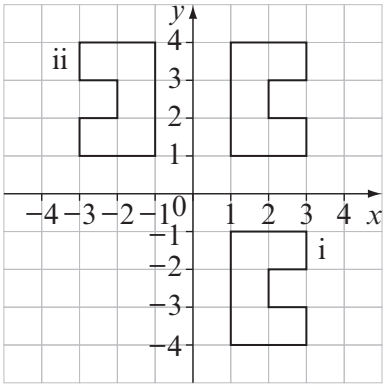
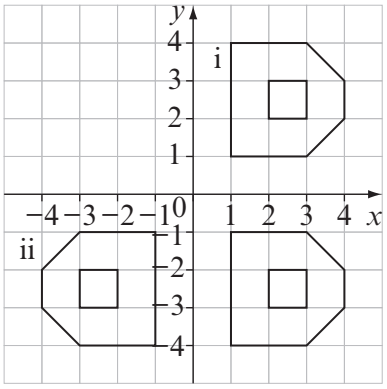


7 a



b



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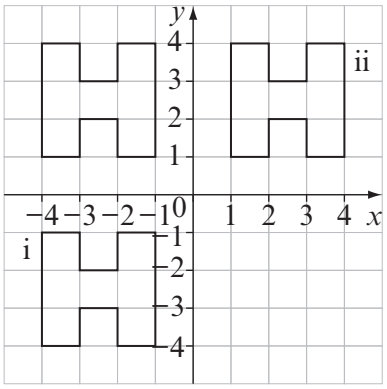
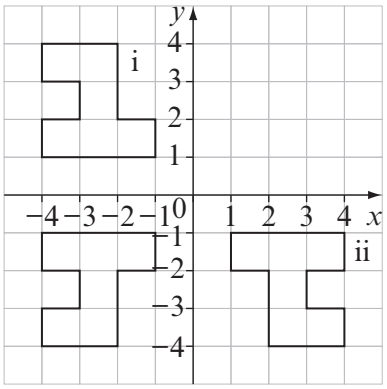


d



8 b D is a reflection of I in the x-axis.

c E is a reflection of C in the y-axis.

d J is a reflection of G in the y-axis.

e H is a reflection of B in the x-axis.

f F is a reflection of C in the x-axis.

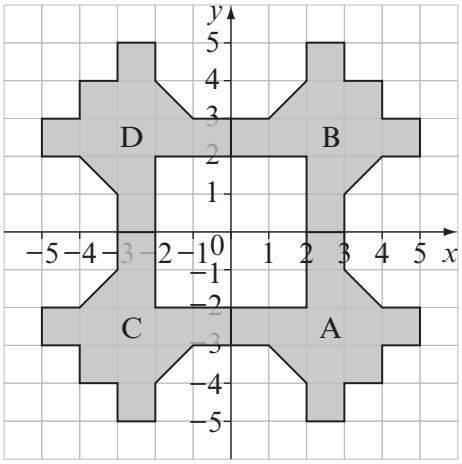
9 a

Object	$J(2, 1)$	$K(5, 1)$	$L(5, 3)$	$M(2, 3)$
Image	$J'(2, -1)$	$K'(5, -1)$	$L'(5, -3)$	$M'(2, -3)$

b

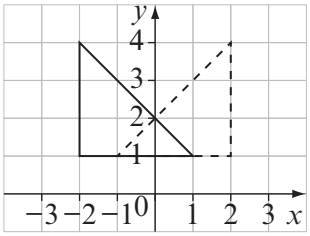
Object	$J(2, 1)$	$K(5, 1)$	$L(5, 3)$	$M(2, 3)$
Image	$J'(-2, 1)$	$K'(-5, 1)$	$L'(-5, 3)$	$M'(-2, 3)$

10 a–c

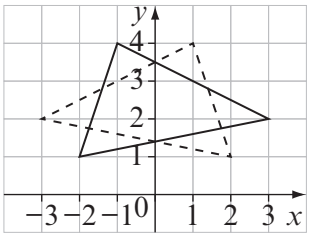


d i 4 **ii** 4

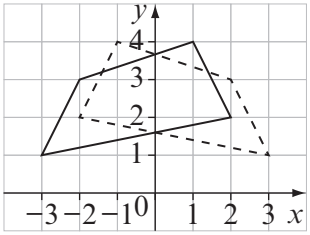
11 a



b



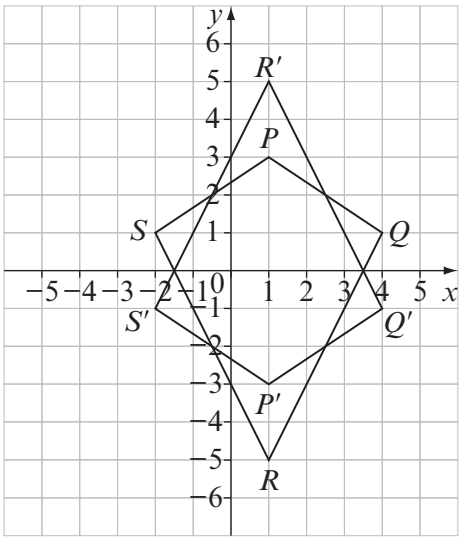
c



12 a R' and S' are incorrect. For example: When reflecting in the x-axis, the x-coordinates stay the same and the y-coordinates change sign.

With R' and S' Arun has changed the sign of the x-coordinate and kept the y-coordinate the same.

b $P'(1, -3)$, $Q'(4, -1)$, $R'(1, 5)$, $S'(-2, -1)$



Exercise 14.5

1 a 90° clockwise

b 180° clockwise

c 90° anticlockwise

d 180° anticlockwise

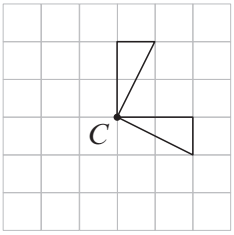
e 90° clockwise

f 90° anticlockwise

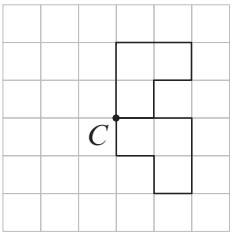
g 180° clockwise

h 180° anticlockwise

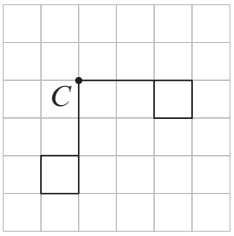
2 a



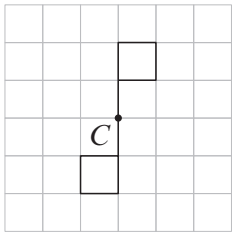
b



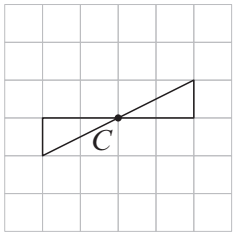
c



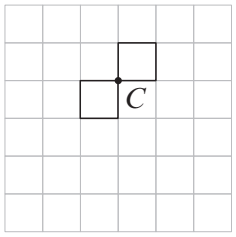
3 **a**



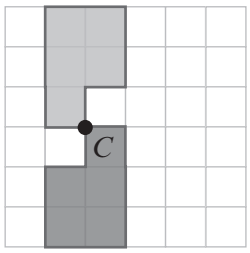
b



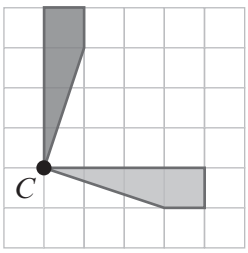
c



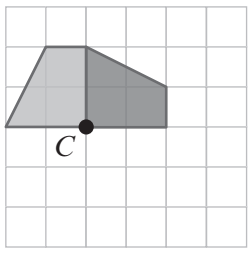
4 **a**



b



c



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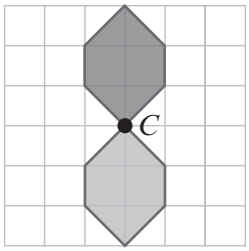
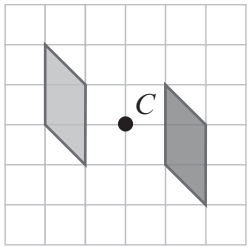


5 **a**



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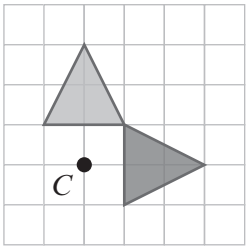

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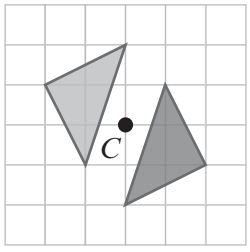

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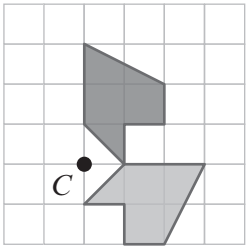
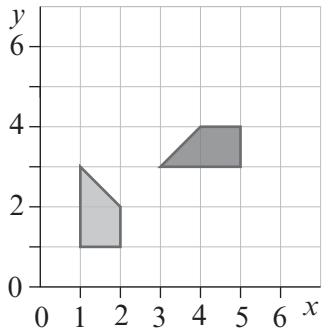


6 **a**



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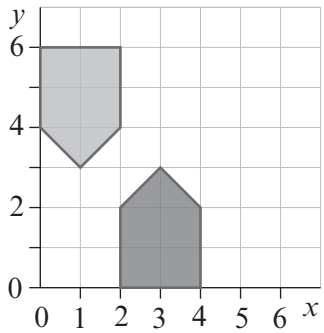

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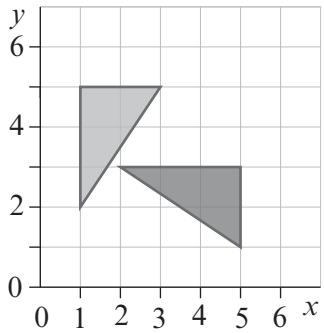
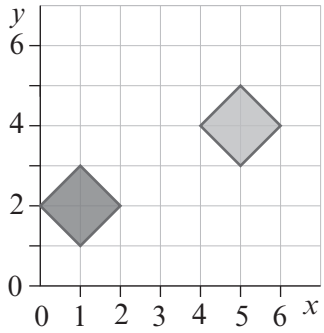
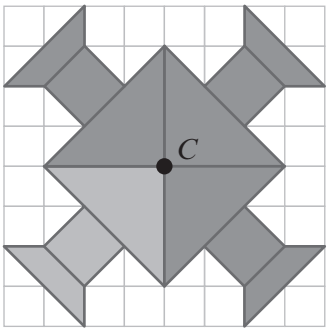


d



7 **a** **i–vi**



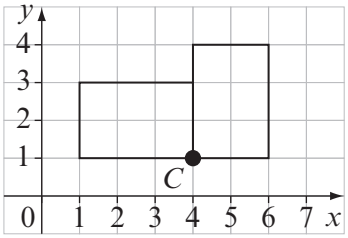
b 4 **c** 4

8 a 10 cm

b No, the perimeter is 16 cm.

For example: Rectangles A and B touch end to end, so each rectangle now has a 2 cm length inside the combined shape and not on the perimeter.

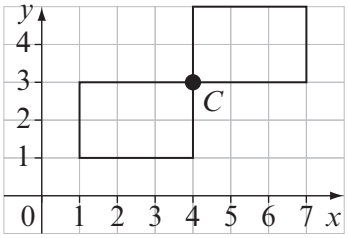
9 a



i 16 cm

ii Learner's own answer. For example: perimeter of shape = 2 × perimeter of rectangle − 2 × 2 cm

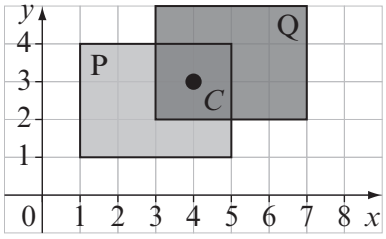
b



i 20 cm

ii Learner's own answer. For example: perimeter of shape = 2 × perimeter of rectangle

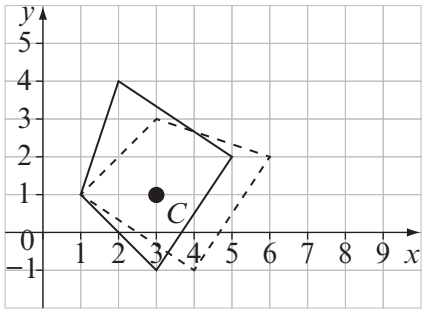
10 a, b



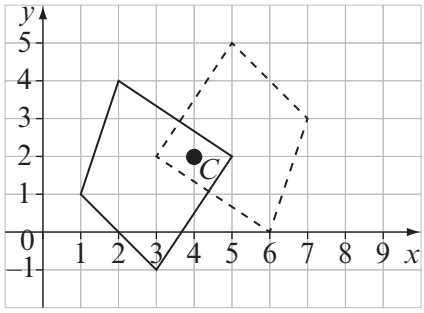
c Statement 1 is incorrect. For example: The area of the combined shape is twice the area of rectangle P take away 4 cm^2 because you subtract the overlap once, not twice.

Statement 2 is correct. For example: The perimeter of the combined shape is twice the perimeter of rectangle P take away 8 cm because there are 4 cm of the perimeter of each rectangle now inside the combined shape.

11 a

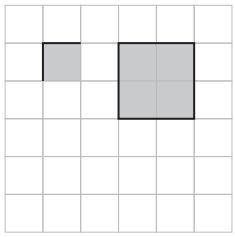


b

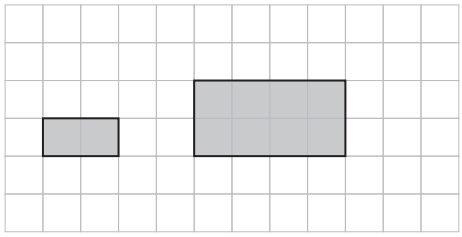


Exercise 14.6

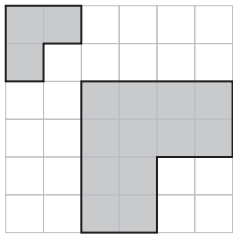
1 a



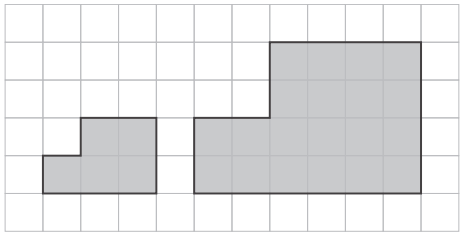
b



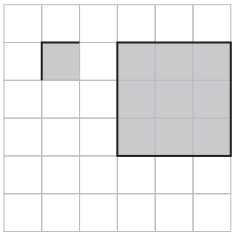
c



d



2 **a**



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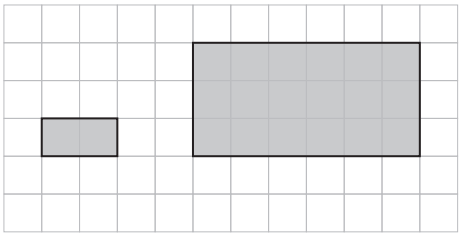

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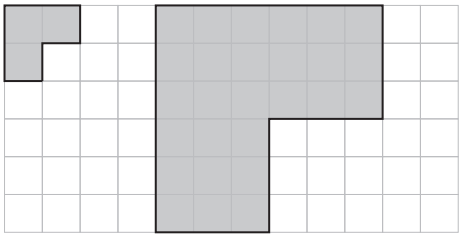

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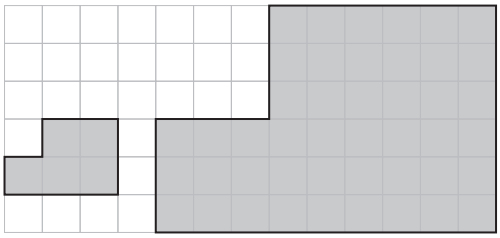
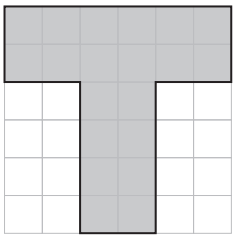


3 **a**



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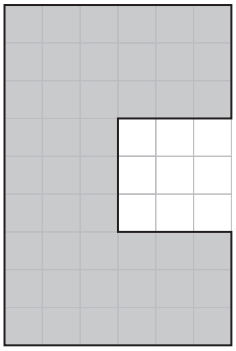

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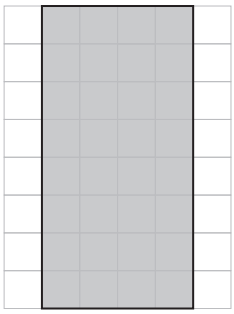
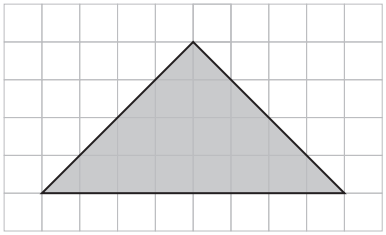


4 **a**



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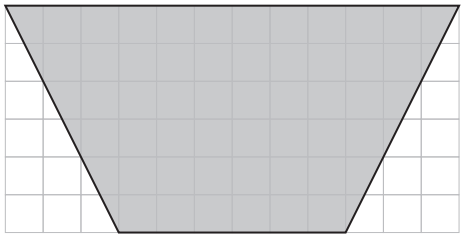

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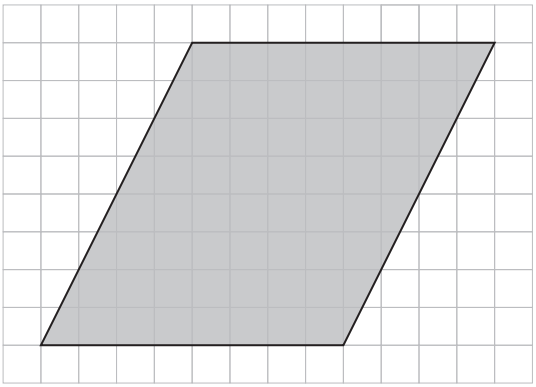
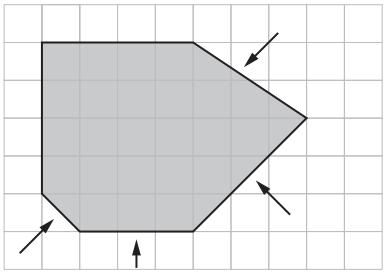
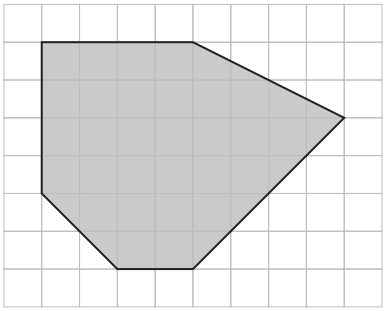


5 **a** Dan has not multiplied all the lengths of the shape by 2. The arrows show the sides he has incorrect.



b



6 scale factor 2

7 **a** For example: The height of B is twice the height of A, but the base length of B is not twice the base length of A.

b Triangle C is an enlargement of A using a scale factor of 3. Triangle D is not an enlargement of A. The height of D is five times the height of A, but the base length of B is not five times the base length of A.

8 A, scale factor 2; C, scale factor 6; E, scale factor 8.

9 For example: Marcus is correct. Shape B is an enlargement of shape A because all the sides are twice as long. Arun is incorrect because it doesn't matter that the shape has been rotated.

10 a, b All possible answers with scale factors are in this table.

A		A to B	B		B to C	C		C to D	D	
h cm	b cm	Scale factor	h cm	b cm	Scale factor	h cm	b cm	Scale factor	h cm	b cm
4	3	4	16	12	3	48	36	2	96	72
4	3	4	16	12	2	32	24	3	96	72
4	3	3	12	9	4	48	36	2	96	72
4	3	3	12	9	2	24	18	4	96	72
4	3	2	8	6	4	32	24	3	96	72
4	3	2	8	6	3	24	18	4	96	72
4	3	6	24	18	2	48	36	2	96	72
4	3	2	8	6	6	48	36	2	96	72
4	3	2	8	6	2	16	12	6	96	72

c There are four different base lengths and heights for triangle B and four for triangle C.

11 **a** **i** 2 **ii** 3 **iii** 4

b **i** 2 cm^2 **ii** 8 cm^2 **iii** 18 cm^2 **iv** 32 cm^2

c

Rectangles	Scale factor of enlargement	Ratio of lengths	Ratio of areas
A : B	2	1 : 2	1 : 4
A : C	3	1 : 3	1 : 9
A : D	4	1 : 4	1 : 16

d For example: If ratio of lengths is $1 : x$, ratio of areas is $1 : x^2$.

e Yes. For example: If you double the lengths of any shape, then when you multiply two lengths to find the area, you will be multiplying the original area by the scale factor twice. This means your enlarged area will be original area $\times 2 \times 2$, which is the same as original area $\times 2^2$.

Exercise 15.1

1 **a** 600 mm^2 **b** 900 mm^2
c 250 mm^2 **d** 50 mm^2

2 **a** 7 cm^2 **b** 4 cm^2
c 15 cm^2 **d** 6.5 cm^2

3 **a** 40 000 cm^2 **b** 80 000 cm^2
c 15 000 cm^2 **d** 6000 cm^2

4 **a** 2 m^2 **b** 5 m^2
c 1.2 m^2 **d** 0.9 m^2

5 **a** 810 mm^2 **b** 83 mm^2
c 8.5 cm^2 **d** 0.89 cm^2
e 84 000 cm^2 **f** 8800 cm^2
g 8.8 m^2 **h** 0.82 m^2

6 **a** mm^2 **b** cm^2
c km^2 **d** m^2

7 **a** 5 m^2 **b** 5.1 m^2
c 25.1 m^2 **d** 400 mm^2
e 680 mm^2 **f** 80 000 cm^2
g 35 000 cm^2 **h** 1 cm^2
i 4.55 cm^2

8 **a** 1100 mm^2 **b** 11 cm^2

9 **a** **i** 17 500 cm^2 **ii** 1.75 m^2
b **i** 14 500 cm^2 **ii** 1.45 m^2

10 **a** 14 225 mm^2 **b** 142.25 cm^2

11 1 cm = 10 mm, but 1 cm^2 = 100 mm^2, so Sao-Yi must multiply 8 cm^2 by 100 to get 800 mm^2.

12 No; Yuuma has divided by 100 and not by 1 000 000.

13 160 tiles

14 **a** **i** 950 mm^2 **ii** 9.5 cm^2
b **i** 275 mm^2 **ii** 2.75 cm^2

15 **a** **i** 14 500 cm^2 **ii** 1.45 m^2
b **i** 472 000 cm^2 **ii** 47.2 m^2

16 **a** 0.32 m^2 **b** 3200 cm^2

Exercise 15.2

1 **a** 70 000 m^2 **b** 130 000 m^2
c 35 000 m^2 **d** 4000 m^2

2 **a** 6 ha **b** 12 ha
c 3.4 ha **d** 0.9 ha

3 **a** Area = 300 × 50 = 15 000 m^2
b 15 000 m^2 ÷ 10 000 = 1.5 ha

4 **a** 40 000 m^2 **b** 52 000 m^2
c 9000 m^2 **d** 452 000 m^2
e 8200 m^2 **f** 340 m^2

5 **a** 7 ha **b** 3.2 ha
c 67 ha **d** 0.88 ha
e 0.07 ha **f** 237.5 ha

6 **a** 151 200 m^2 **b** 15.12 ha

7 **a** 28 275 m^2 **b** 2.8275 ha
c $6220.50

8 **a** 9800 m^2 **b** 140 m

9 13 000 m^2

10 Area = 98 701 m^2
Cost = $38 493.39
$38 493.39 < $40 000, so builder can afford it.

11 **a**

Island	kilometres^2	hectares	miles^2	acres
Kyushu	37 437	3 743 700	14 454	9 250 560
Sardinia	23 949	2 394 900	9 247	918 080
Spitsbergen	38 982	3 898 200	15 051	9 632 640
Timor	28 417	2 841 700	10 972	7 022 080

b Spitsbergen, Kyushu, Timor, Sardinia

Exercise 15.3

1 **a** Area of rectangle = 3 × 2 = 6 cm^2
Area of triangle = $\frac{1}{2}$ × 6 = 3 cm^2

b Area of rectangle $= 4 \times 3 = 12\,\text{cm}^2$

Area of triangle $= \frac{1}{2} \times 12 = 6\,\text{cm}^2$

c Area of rectangle $= 5 \times 2 = 10\,\text{cm}^2$

Area of triangle $= \frac{1}{2} \times 10 = 5\,\text{cm}^2$

2 A and iv; B and i; C and ii; D and v; E and iii

3 **a** Area $= \frac{1}{2} \times 10 \times 4 = 20\,\text{cm}^2$

b $A = \frac{1}{2} \times 30 \times 8 = 120\,\text{m}^2$

c Area $= \frac{1}{2} \times 12 \times 5 = 30\,\text{cm}^2$

d $A = \frac{1}{2} \times 20 \times 18 = 180\,\text{mm}^2$

4 **a** $21\,\text{cm}^2$ **b** $81\,\text{m}^2$

c $144\,\text{mm}^2$

5 $45\,\text{cm}^2$

6 $7260\,\text{cm}^2$

7 No; the base is 8 cm because $\frac{1}{2} \times 8 \times 8 = 32\,\text{cm}^2$.

8 **a** $76\,\text{cm}^2$ **b** $114\,\text{m}^2$

9 $288\,\text{cm}^2$

10 **a** 7 cm **b** $310\,\text{cm}^2$

11 **a** 16 cm **b** 13 cm

12 **a** $15\,\text{cm}^2$ or $1500\,\text{mm}^2$

b $0.64\,\text{m}^2$ or $6400\,\text{cm}^2$

13 Any five triangles that have an area of $12\,\text{cm}^2$. For example: 24 cm and 1 cm, 12 cm and 2 cm, 6 cm and 4 cm, 3 cm and 8 cm, 1.5 cm and 16 cm, 2.4 cm and 10 cm, 4.8 cm and 5 cm, 9.6 cm and 2.5 cm, etc.

14 18 cm

15 No; the area is $4.24\,\text{cm}^2$.

Exercise 15.4

1 **a** $4\,\text{cm}^3$ **b** $4\,\text{cm}^3$

c $8\,\text{cm}^3$ **d** $9\,\text{cm}^3$

2 **a** Number of cubes on top layer = 6

Number of layers = 2

Volume of cuboid $= 6 + 6 = 12\,\text{cm}^3$

b Number of cubes on top layer = 4

Number of layers = 2

Volume of cuboid $= 8\,\text{cm}^3$

c Number of cubes on top layer = 8

Number of layers = 2

Volume of cuboid $= 16\,\text{cm}^3$

d Number of cubes on top layer = 4

Number of layers = 3

Volume of cuboid $= 12\,\text{cm}^3$

3 **a** volume $= 5 \times 3 \times 2 = 30\,\text{cm}^3$

b volume $= 8 \times 4 \times 3 = 96\,\text{mm}^3$

4 **a** volume $= 2 \times 2 \times 2 = 8\,\text{cm}^3$

b volume $= 4 \times 4 \times 4 = 64\,\text{m}^3$

5 **a** $120\,\text{mm}^3$ **b** $240\,\text{cm}^3$

c $18\,000\,\text{cm}^3$

6 **a** $60\,000\,\text{cm}^3$ or $0.06\,\text{m}^3$

b $8000\,\text{mm}^3$ or $8\,\text{cm}^3$

7 Arun mistook the cm for m. Volume = $0.002\,\text{m}^3$ or $2000\,\text{cm}^3$.

8 **a** 12 500 **b** 16

c 1.2 **d** 99 000

9 **a** 5 cm

b Top cuboid: $V = 4 \times 5 \times 2 = 40\,\text{cm}^3$

Bottom cuboid: $V = 12 \times 5 \times 8 = 480\,\text{cm}^3$

Volume of shape: $40 + 480 = 520\,\text{cm}^3$

10 **a** $396\,\text{m}^3$ **b** $750\,\text{mm}^3$

11 7 mm

12 6 cm

13 **a** $480\,cm^3$

b Any three other cuboids that have a volume of $480\,cm^3$. For example: 16 cm by 3 cm by 10 cm, 4 cm by 12 cm by 10 cm, 2 cm by 24 cm by 10 cm, 8 cm by 3 cm by 20 cm, 4 cm by 3 cm by 40 cm, 16 cm by 6 cm by 5 cm, etc.

14 38

15 150 kg

16 8 cm

Exercise 15.5

1 **a** Area of one face $= 9\,cm^2$

Total surface area $= 6 \times 9 = 54\,cm^2$

b Area of one face $= 25\,cm^2$

Total surface area $= 6 \times 25 = 150\,cm^2$

c Area of one face $= 100\,cm^2$

Total surface area $= 6 \times 100 = 600\,cm^2$

2 **a** Total surface area $= 12 + 12 + 8 + 8 + 6 + 6 = 52\,cm^2$

b Front face $= 30\,cm^2$

Back face $= 30\,cm^2$

Top face $= 18\,cm^2$

Bottom face $= 18\,cm^2$

Left end face $= 15\,cm^2$

Right end face $= 15\,cm^2$

Total surface area $= 30 + 30 + 18 + 18 + 15 + 15 = 126\,cm^2$

3 **a** Area of one face $= 4 \times 4 = 16\,cm^2$

Surface area of cube $= 6 \times 16 = 96\,cm^2$

b Area of one face $= 6 \times 6 = 36\,cm^2$

Surface area of cube $= 6 \times 36 = 216\,cm^2$

4 **a** Area of top face $= 8 \times 3 = 24\,cm^2$

Area of front face $= 8 \times 5 = 40\,cm^2$

Area of side face $= 5 \times 3 = 15\,cm^2$

$$\text{Surface area} = 2 \times 24 + 2 \times 40 + 2 \times 15$$
$$= 48 + 80 + 30$$
$$= 158\ cm^2$$

b Area of top face $= 10 \times 4 = 40\,mm^2$

Area of front face $= 10 \times 6 = 60\,mm^2$

Area of side face $= 6 \times 4 = 24\,mm^2$

$$\text{Surface area} = 2 \times 40 + 2 \times 60 + 2 \times 24$$
$$= 80 + 120 + 48$$
$$= 248\ mm^2$$

5 **a** $76\,m^2$ **b** $310\,mm^2$ **c** $88\,cm^2$

6 A; surface area of A $= 600\,mm^2$, surface area of B $= 700\,mm^2$.

7 B; surface area of A $= 24\,cm^2$, surface area of B $= 22\,cm^2$.

8 **a** $60\,000\,cm^2$ **b** $6\,m^2$

9 **a** 7 tins **b** \$90.93

10 $38\,400\,cm^2$

11 **a** $64\,m^2$ **b** 8 m

12 $684\,cm^2$

13 $1900\,cm^2$

14 Total area $= 24\,400\,cm^2$, so Liwei does have enough paint because $24\,400\,cm^2 < 30\,000\,cm^2$.

15 3 cm

16 Height $= 864 \div (18 \times 12) = 4$ cm

$$\text{Surface area} = 2 \times 18 \times 12 + 2 \times 18 \times 4 + 2 \times 12 \times 4$$
$$= 432 + 144 + 96$$
$$= 672\ cm^2$$

17 **a** B: 4 cm, C: 2 cm

b A: $92\,cm^2$, B: $80\,cm^2$, C: $88\,cm^2$

c Box B because it uses the least area of cardboard.

d **i** Box F because it has the dimensions that are the most varied.

ii Box D because it has the dimensions that are the most similar.

Surface areas are D: $96\,cm^2$, E: $112\,cm^2$, F: $168\,cm^2$.

Exercise 16.1

1

	Yes	No	Total
Girls	25	3	28
Boys	20	2	22
Total	45	5	50

2 **a** 20 **b** 11 **c** 26
d 17 **e** 50

3 **a** 6 **b** 7 **c** 9 **d** 20

4 **a** 7 **b** 8 **c** 30 **d** 11

5

	Tennis	Squash	Badminton	Total
Girls	6	1	8	15
Boys	4	7	6	17
Total	10	8	14	32

6

	Latte	Cappuccino	Americano	Total
Men	8	0	10	18
Women	5	3	14	22
Total	13	3	24	40

7 **a**

	Arabian	Morgan	Thoroughbred	Other	Total
Female owner	42	18	55	4	119
Male owner	26	44	25	8	103
Total	68	62	80	12	222

b 44 **c** 142

8 **a**

	Algebra	Geometry	Number	Statistics	Total
Girls	12	6	10	2	30
Boys	8	5	6	1	20
Total	20	11	16	3	50

b 5 **c** 30 **d** 19

9 **a**

	Essays	Poems	Stories	Total
Zara	16	9	10	35
Sofia	9	11	18	38
Total	25	20	28	73

b Stories = 18, essays = 9 and $9 \times 2 = 18$.

c $\frac{2}{7}$

d $\frac{9}{20} = \frac{9 \times 5}{20 \times 5} = \frac{45}{100} = 45\%$

e 36% **f** 8 : 5

10 **a**

	Saturday	Sunday	Total
Salads	20	10	30
Sandwiches	25	8	33
Cakes	12	25	37
Fruit	18	12	30
Total	75	55	130

b Saturday **c** Cakes

d Learner's own answer. For example: Erin makes only $1 profit on each cake, which is much less than on salads and sandwiches, so even though she sells more cakes, she's unlikely to make the most profit on this item.

e $227.50

11

	AAA	AA	C cell	Total
Ordinary	3000	6000	15000	24000
Rechargeable	1000	4000	1500	6500
Total	4000	10000	16500	30500

12

	Chocolate bar	Ice cream	Popcorn	Total
Boys	3	3	8	14
Girls	10	2	4	16
Total	13	5	12	30

13

	Arsenal	Chelsea	Liverpool	Manchester City	Manchester United	Total
Boys	12	0	16	5	15	48
Girls	15	8	0	8	1	32
Total	27	8	16	13	16	80

14

	Eating	Walking	Running	Playing	Total
Elephant	500	150	0	100	750
Monkey	0	180	45	225	450
Impala	100	15	40	25	180
Warthog	45	30	45	0	120
Total	645	375	130	350	1500

Exercise 16.2

1 **a** 8 **b** 4 **c** 4 **d** 30

e **i** musical **ii** science fiction

iii musical

2 **a** Mrs Khan **b** Mr Harris **c** 1

d **i** 25 **ii** 26

3 **a** Miss Davies received 6 work emails.

b Miss Davies received a total of 18 emails from work and from friends.

c Miss Davies received a total of 20 junk emails and emails from work and from friends.

d Miss Davies received $18 - 6 = 12$ emails from friends.

e Miss Davies received $20 - 18 = 2$ junk emails.

4 **a** 30

b **i** sport **ii** fashion

c **i** 12 **ii** 8

iii 2 **iv** 8

5 **a** **i** Biology **ii** Physics

b **i** 10 **ii** 20

c **i** 13 **ii** 15

6 a i Hungary

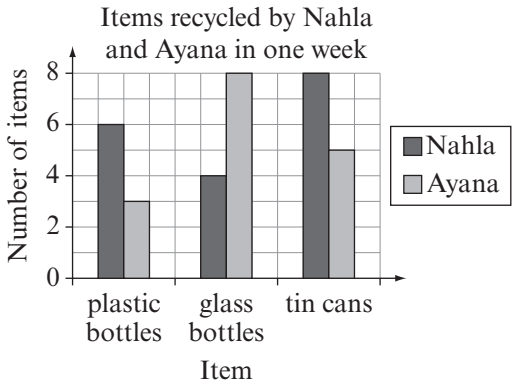
ii New Zealand

b Azerbaijan

c Hungary won 8 gold medals, New Zealand won 4 gold medals and $4 \times 2 = 8$.

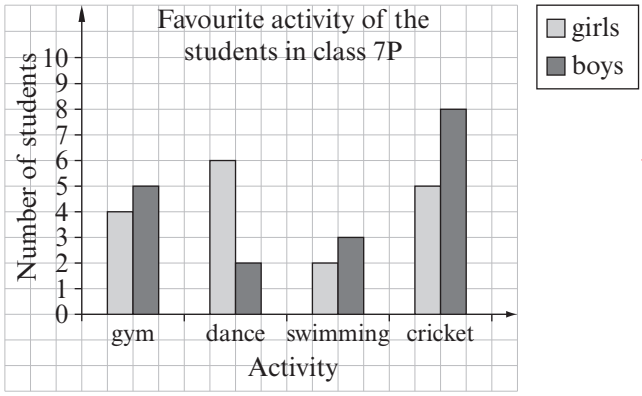
d Learner's own comments. For example: Brazil won twice as many silver medals as Hungary. Hungary won 7 more gold medals than Azerbaijan.

7 a



b Learner's own comments. For example: Nahla recycled twice as many tin cans as she did glass bottles. Ayana recycled half as many plastic bottles as Nahla.

8 a



b Learner's own comments. For example: The most popular activity for the boys is cricket. Twice as many girls choose gym compared with swimming.

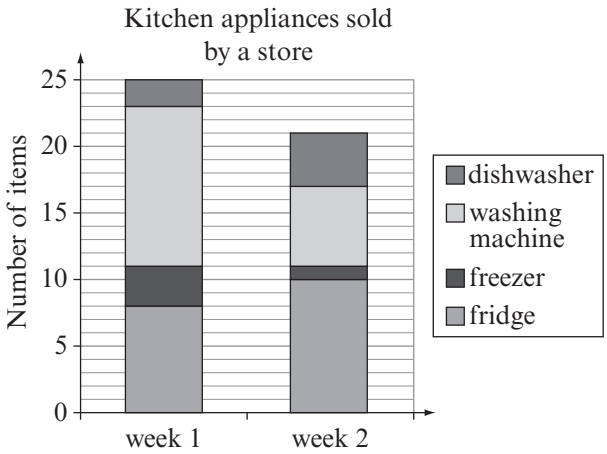
9 a 20 minutes

b 80 minutes

c 30 minutes

d Carlos is correct. He spends 80 minutes on texts and calls and Rio spends 80 minutes on the internet.

10 a



b Learner's own comments. For example: In week 1, the most popular appliance sold is washing machines. In week 2, the least popular appliance sold is freezers.

11 a test 3 **b** tests 2 and 4

c No, Brad scored 6 more than Kurt in test 2.

d Learner's own comments. For example: Kurt scored 7 more than Brad in test 1. Brad scored 3 more than Kurt in test 4.

e Learner's own answer. For example: Brad is better at spelling because he got the greatest total out of all the tests.

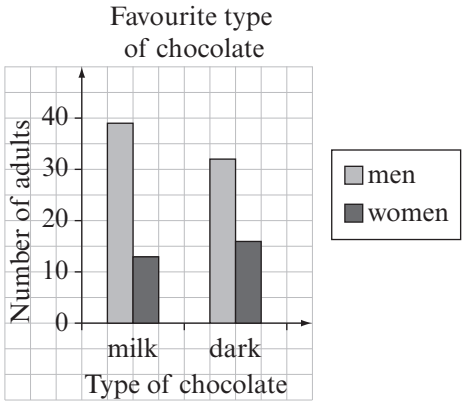
f i $\frac{36}{60} = \frac{3}{5}$ **ii** 60%

12 a

	Early	On time	Late	Total
Glasgow	30	70	40	140
Cardiff	50	35	10	95
Bristol	25	95	30	150
Total	105	200	80	385

b $\frac{1}{5}$ **c** 35% **d** 1 : 2

13 a i



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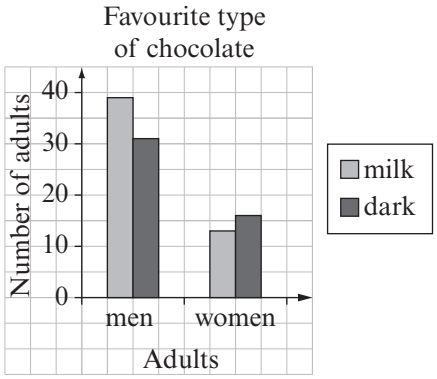
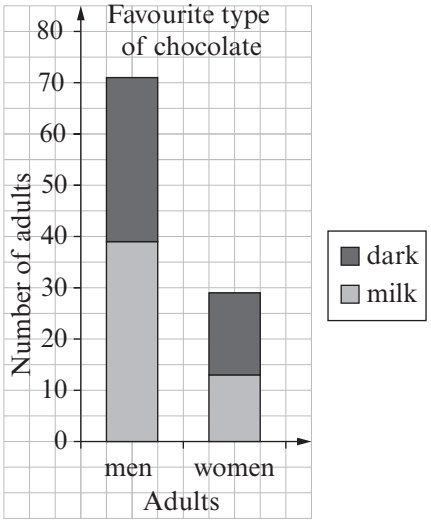
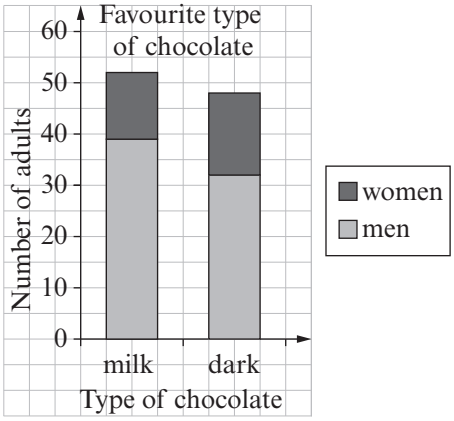


ii Learner's own answer. For example: Men preferred milk chocolate and women preferred dark chocolate.

b i



or



ii Learner's own answer. For example: Overall, milk chocolate was more popular than dark chocolate.

c Learner's own answer. For example: A dual bar chart, as you can see easily which chocolate the men and women preferred. Example: A compound bar chart, as you can see easily the total number of adults who preferred each type of chocolate.

Exercise 16.3

1 a Total number of customers = 9 + 12 + 11 + 8 = 40 customers

Number of degrees per customer = 360 ÷ 40 = 9°

Number of degrees for each sector:

Ice cream = 9 × 9 = 81°

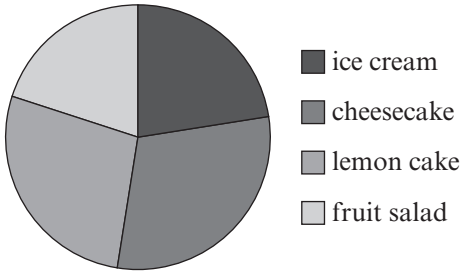
Cheesecake = 12 × 9 = 108°

Lemon cake = 11 × 9 = 99°

Fruit salad = 8 × 9 = 72°

b

Desserts chosen by customers in a restaurant



2 a Total number of students = 5 + 8 + 14 + 6 + 27 = 60 students

Number of degrees per student = 360 ÷ 60 = 6°

Number of degrees for each sector:

Monday = 5 × 6 = 30°

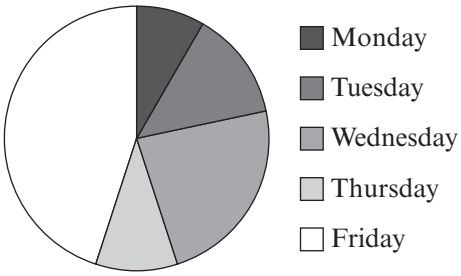
Tuesday = 8 × 6 = 48°

Wednesday = 14 × 6 = 84°

Thursday = 6 × 6 = 36°

Friday = 27 × 6 = 162°

b **Students' favourite weekday**



3 a

Number of times people ate potatoes	Number of people
0	2
1	8
2	4
3	10
Total	24

b Number of degrees per person = 360 ÷ 24 = 15°

Number of degrees for each sector:

Zero times = 2 × 15 = 30°

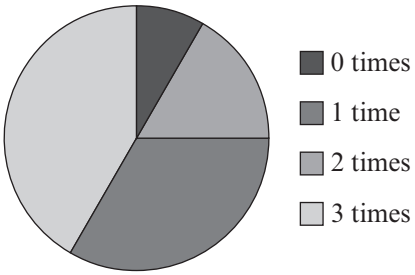
One time = 8 × 15 = 120°

Two times = 4 × 15 = 60°

Three times = 10 × 15 = 150°

c

Number of times people ate potatoes in one week

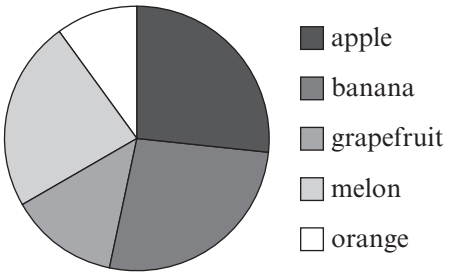


4 a

Fruit	Number of students	Degrees for pie chart
apple	8	96
banana	8	96
grapefruit	4	48
melon	7	84
orange	3	36

b

Favourite fruit of students in class 7P



5 a Xtreme **b** $\frac{54}{360} = \frac{3}{20}$

c 30% **d** 75

6 a basmati **b** $\frac{90}{360} = \frac{1}{4}$

c 10% **d** 50 kg

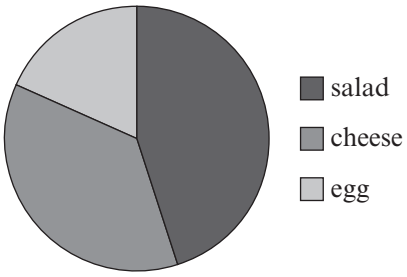
7 a raisin **b** $\frac{75}{360} = \frac{5}{24}$

c 4 **d** 11

8

Sandwiches	Number of sandwiches	Degrees
salad	54	162
cheese	44	132
egg	22	66

Sandwiches sold in a café one day



9 Nine men = 135°, so 135 ÷ 9 = 15° per man.

Kiwi = 360 − (90 + 135 + 60) = 75° and 75 ÷ 15 = 5 men.

Bo is incorrect. Five men chose Kiwi, not six.

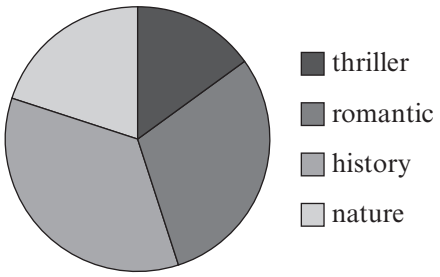
10 Banana = 120°, Peach = 80°, 120 − 80 = 40° and 40° = 8 women. 40 ÷ 8 = 5° per woman.

Kiwi = 360 − (80 + 120 + 85) = 75° and 75 ÷ 5 = 15 women.

11

Favourite type of book	Frequency	Percentage	Number of degrees
thriller	9	15	54
romantic	18	30	108
history	21	35	126
nature	12	20	72

Favourite type of book



Exercise 16.4

1 **a** Zimbabwe **b** 7.8 million **c** 8.7

2 **a** Yes; half is 50% and 60% is greater than 50%.

b $\frac{60}{100} = \frac{3}{5}$ **c** 40%

3 **a** **i** 61% **ii** 42%

b **i** 60% **ii** 78%

4 **a** C **b** B **c** A

d B **e** C

5 **a** Maths **b** Physics **c** 18%

d **i** 40 **ii** 80

6 **a** Russia **b** Saudi Arabia

c **i** 9.4 million barrels per day

ii 1.2 million barrels per day

d 10.6 − 4.9 = 5.7 million barrels per day

e **i** USA; on the graph it is the country with the biggest difference between the two bars.

ii USA keeps 8.2 million barrels per day.

f Yes; it produces about 10 million barrels per day and exports about 5 million barrels per day, and 10 ÷ 2 = 5.

g Learner's own comments. For example: Saudi Arabia exports about 70% of its oil. Iran produces about half as much oil as the USA.

7 **a** Argentina **b** Brazil

c Learner's own answer. For example: towns and cities, industry

d Learner's own answer.

8 **a** 45 **b** 17

c 1295 calories

9 **a**, **b** Learner's own answers. For example: The units on the numbers are not shown. All the units should be days except for Jupiter, which is years. Jupiter looks like it takes the shortest time, but actually it takes the longest. It would look better if the distance of the planets from the Sun was further, the longer they took to orbit the Sun. So, Mars needs to be further away from the Sun than Earth, and Jupiter (moved to after Mars) is the furthest.

Exercise 16.5

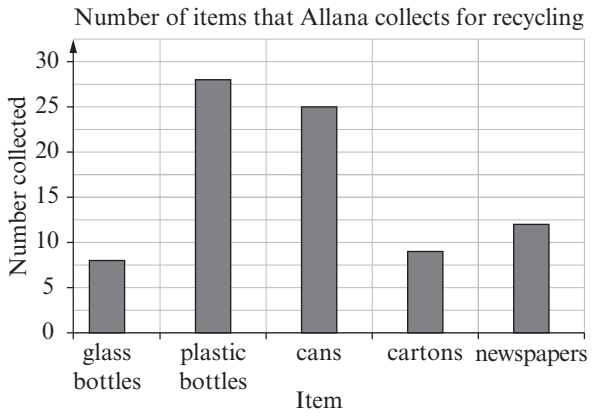
1 **a** Dual bar chart. For example: Two sets of discrete data.

b Bar chart. For example: Discrete data. Easy to compare heights of bars.

c Line graph. For example: It shows how sales change over time.

d Scatter graph. For example: Two sets of data points to compare. Easy to see if there is any correlation between the two sets of data.

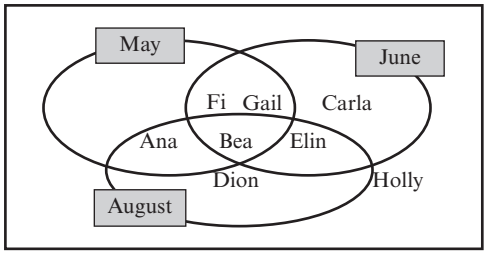
2 **a**



b Bar chart. For example: Discrete data. Easy to compare heights of bars.

c Learner's own comment. For example: Allana collected more plastic bottles than any other item.

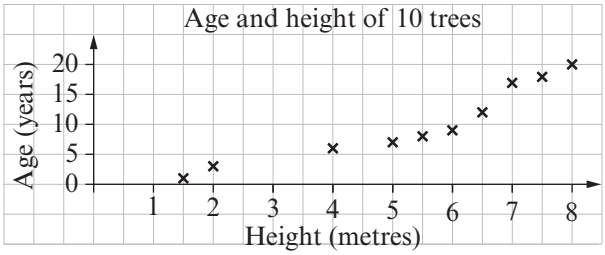
3 **a**



b Venn diagram. For example: It is the best diagram to use to sort data into groups.

c Learner's own comment. For example: Bea is the only member who entered in all three tournaments.

4 **a**

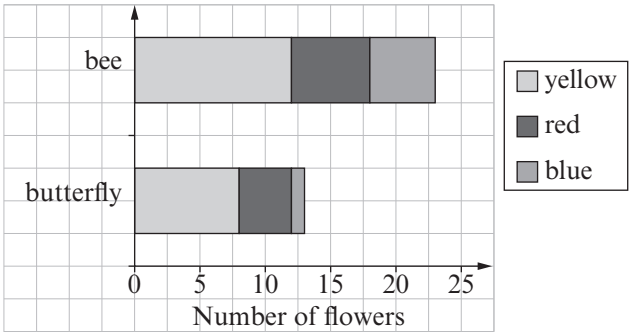


b Scatter graph. For example: Two sets of data points to compare. Easy to see if there is any correlation between the two sets of data.

c Learner's own comment. For example: There is a positive correlation, which shows that, in general, the older the tree the taller it is.

5 **a**

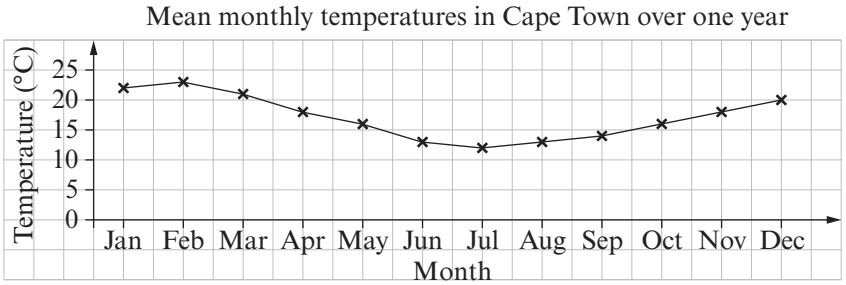
The number of butterflies and bees that landed on different colour flowers in the garden



b Compound bar chart. For example: It compares each flower colour with the total number of flowers.

c Learner's own comment. For example: The number of bees that landed on yellow flowers is the same as the number of butterflies that landed on the total number of yellow and red flowers.

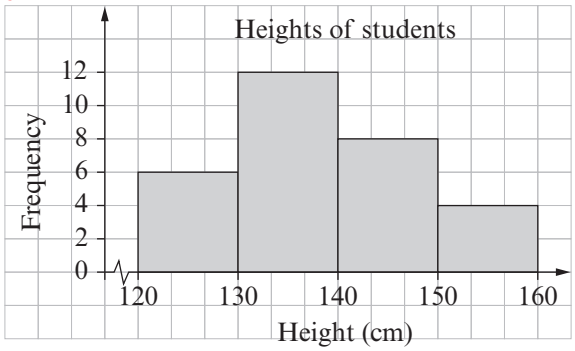
6 a



b Line graph. For example: It shows how the temperature changes over time.

c Learner's own comment. For example: The highest temperature is in February.

7 a



b Learner's own answer. For example: Data are continuous.

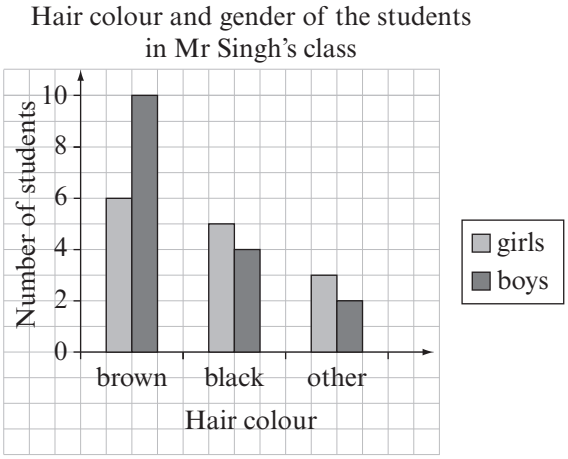
c Learner's own comment. For example: The fewest number of students are in the 150–160 cm group.

d i 135 cm is halfway into the 130–140 group, so half of 12 = 6 students. So 6 + 8 + 4 = 18 students.

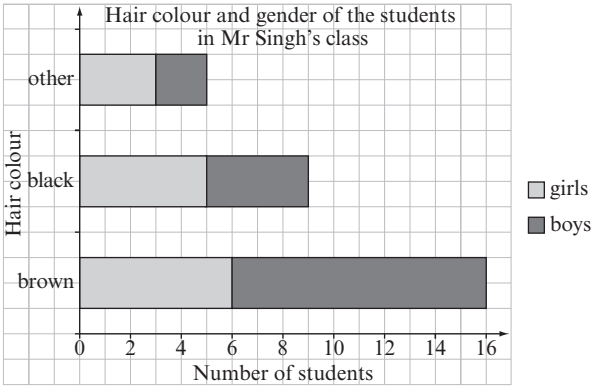
ii Learner's own answer. For example: Yes, because 135 cm is halfway through the group, it is a good idea to estimate that half of the students will be between 135 cm and 140 cm.

8 a, b Learner's own diagrams and reasons. For example:

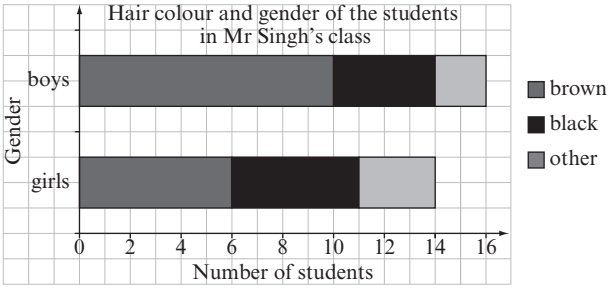
Dual bar chart: two sets of discrete data; easy to compare different hair colours.



Compound bar chart: easy to compare total number of students with different hair colours.

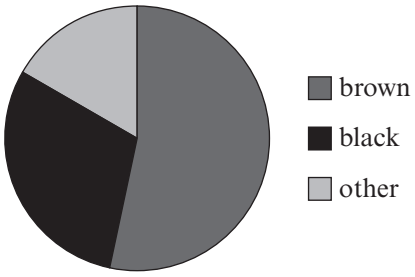


Compound bar chart: easy to compare total number of boys and girls in the class.



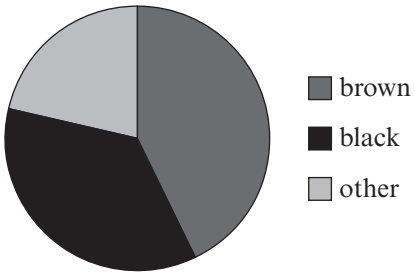
Pie chart: shows proportions of the students with different hair colours, but doesn't show gender.

Hair colour of the students in Mr Singh's class



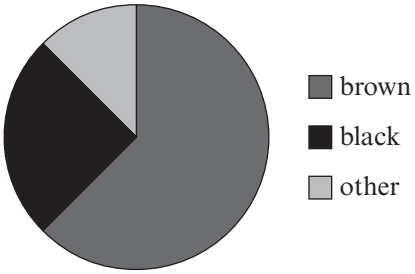
Pie chart: shows proportions of the girls with different hair colours.

Hair colour of the girls in Mr Singh's class



Pie chart: shows proportions of the boys with different hair colours.

Hair colour of the boys in Mr Singh's class



Exercise 16.6

1 **a** **i** 20 seconds **ii** 18 seconds

iii 19 seconds

b Zara

2 **a** **i** 32 and 44 marks **ii** 40 marks

iii 38.4 marks

b Learner's own answer: mean or median with an appropriate reason.

3 **a** 0 0 0 0 1 1 2 2 2 3 3 3 4 4 4 4 4 4 5 6

b **i** 4 goals **ii** 3 goals **iii** 2.6 goals

c Learner's own answer: mean or median with an appropriate reason.

d 6 goals **e** January

4 **a** one car **b** one car

c

$$\text{Total number of cars} = 0\times5+1\times8+2\times4+3\times2+4\times1$$
$$= 0+8+8+6+4$$
$$= 26$$

$$\text{Mean number of cars} = 26\div20 = 1.3$$

d Learner's own answer: mode or median with an appropriate reason.

e four cars **f** first group

5 **a** **i** 6 years old **ii** 8 years old

iii 8 years old (to nearest whole number)

b Learner's own answer: mean or median with an appropriate reason.

c 5 years

d second school

6 **a** **i** 4 lengths **ii** 3 lengths

iii 2 lengths (to nearest whole number)

b Median because mode is too high, only ten values sit below the mean and 16 sit above. Median is better because 12 values sit below and ten values sit above.

c 4 **d** first club

7 **a**

Total number of goals in the match	Tally	Frequency
3	I	2
4	IIII	4
5	𝍸	5
6	𝍸 I	6
7	I	1

b **i** 6 goals **ii** 5 goals **iii** 5 goals

c Learner's own answer: mean or median with an appropriate reason.

d 4 goals **e** 27th of September

8 **a** 3

b Learner's own answer. For example: the median is not the middle value in the 'Number of days' row in the table. It is the number of days that the 'middle person' worked if all the people were lined up from least number of days worked to most number of days worked. So, in this case, it is the number of days worked by the 15th/16th person. Median = 10 days

c It has the greatest number of people.

d $4 \times 2 + 5 \times 0 + 6 \times 4 + 7 \times 2 + 8 \times 1 + 9 \times 3 + 10 \times 18 = 261$ and $261 \div 30 = 8.7$

e Learner's own answer: mode or median with an appropriate reason.

9 **a** **i** 40 games

ii modes are 1 goal and 3 goals

iii 2 goals

iv 2.25 goals

b Median of 2 goals because there are 17 values below 2 goals and 18 above 2 goals, so it is sitting centrally in the whole of the data.

10 **a** **i** 51 matches **ii** 51 matches

iii 50.6 matches **iv** 7 matches

b No because the mode and the median are 51 and the mean is also 51, to the nearest whole number.

11 **a** **i** 25 minutes **ii** 35 minutes

iii 40 minutes **iv** 45.5 minutes

b The mode, to see what the most common length of lesson is that is used by other schools.

c **i** 25 minutes

ii 40 minutes and 60 minutes

iii 45 minutes

iv 46.5 minutes

12 **a** **i** 13 years (to nearest whole number)

ii 12 years

iii 12 years

iv 5 years

b Learner's own answer: mean, mode or median with an appropriate reason.

c Correct for the mean, median and mode, but the range will not change as the largest and smallest ages have both increased by 1 year, so the difference between them stays the same.