Exercise 14.1

1 See answer to Starter 4.

2 **A** equilateral triangle, **B** trapezium, **C** right-angled triangle, **D** parallelogram, **E** rhombus, **F** square, **G** trapezium, **H** right-angled isosceles triangle, **I** isosceles trapezium, **J** isosceles triangle

3 trapezium **4** No, it could be a rhombus.

Worksheet 14.1

1 Right leg, rectangle **2** Left eye, square
3 Right arm, kite **4** Left hand, pentagon
5 Face, hexagon **6** Left foot, right-angled triangle
7 Neck, trapezium **8** Right hand, isosceles triangle
9 Hat, pentagon **10** Mouth, semicircle
11 Left leg, parallelogram **12** Lower body, octagon
13 Right foot, obtuse-angled triangle
14 Left arm, rhombus **15** Right eye, circle
16 Nose, equilateral triangle

Exercise 14.2

1 a) (i) 12 cm **(ii)** 8 cm^2
b) (i) 30 cm **(ii)** 56 cm^2
c) (i) 30 cm **(ii)** 36 cm^2
d) (i) 60 cm **(ii)** 176 cm^2

2 a) (i) 12 cm **(ii)** 9 cm^2
b) (i) 28 m **(ii)** 49 m^2
c) (i) 18 cm **(ii)** 20.25 cm^2
d) (i) 33.2 cm **(ii)** 68.89 cm^2

3 a) (i) 24 cm **(ii)** 24 cm^2
b) (i) 56 cm **(ii)** 84 cm^2
c) (i) 23.9 cm **(ii)** 24.5 cm^2
d) (i) 42 cm **(ii)** 84.7 cm^2

4 a) 37.7 cm^2 **b)** 12.0 m^2 **c)** 45 cm^2
d) 51.2 cm^2 **e)** 51 m^2 **f)** 21 m^2

5 a) 10.98 m^2 **b)** 24.8 m

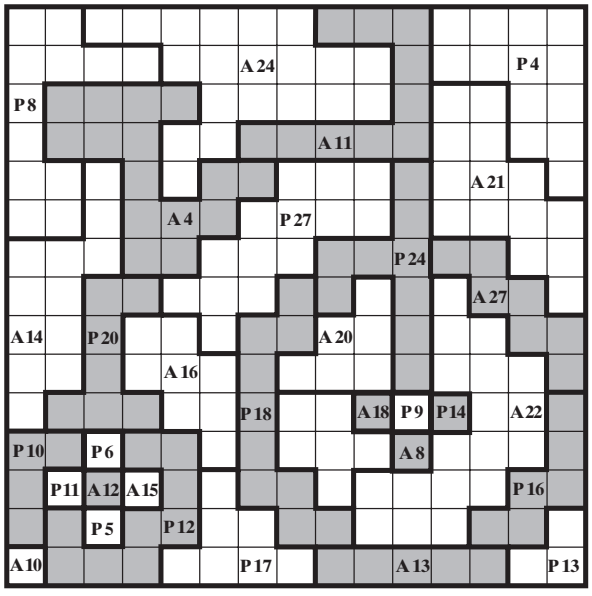
6 a) rectangles could be 1 cm by 20 cm, 2 cm by 10 cm, 4 cm by 5 cm **b)** 4 cm by 5 cm

7 64 cm^2 **8** 24 cm

9 a) 9 m **b)** 30 m **10 a)** 40 m **b)** 800 m^2

Worksheet 14.2/14.5

Shape	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Area	8	11	13	4	27	12	18
Perimeter	12	16	18	10	24	14	20



Exercise 14.3

1 a) $4x + 12$ **b)** $4x + 12 = 32$
c) $x = 5$ **d)** 11 cm by 5 cm

2 a) $2x + 5 = x + 8$ **b)** $x = 3$

3 a) equilateral
b) $4x - 5 = 3x + 1$, $x = 6$
c) 57 units

Exercise 14.4

1 a) 60 cm^2 **b)** 16 m^2

2 a) 64 cm^2 **b)** 140 cm^2

3 a) 48 cm^2 **b)** 42 cm^2
c) 42 cm^2 **d)** 6.3 cm^2

4 a) $3x - 10 = x + 6$, $x = 8$
b) $3y - 1 = 2y + 4$, $y = 5$
c) 14, 14, 14, 14, rhombus

Exercise 14.5

1 a) 34 cm^2 **b)** 56 cm^2 **c)** 120 cm^2
d) 60 cm^2 **e)** 300 cm^2 **f)** 202 cm^2

2 a) (i) 26 cm **(ii)** 36 cm^2
b) (i) 32 cm **(ii)** 36 cm^2
c) (i) 34 cm **(ii)** 46 cm^2
d) (i) 148 mm **(ii)** 1208 mm^2
e) (i) 32 cm **(ii)** 24 cm^2
f) (i) 48 cm **(ii)** 136 cm^2

3 a) 128 cm^2 **b)** 173 cm^2
c) 23.3 cm^2 **d)** 70 cm^2

Exercise 14.6

1 a) (i) 4 cm^3 **(ii)** 16 cm^2
b) (i) 6 cm^3 **(ii)** 24 cm^2
c) (i) 5 cm^3 **(ii)** 22 cm^2

2 a) 600 cm^2 **b)** 1000 cm^3

3 a) 30 cm^2 **b)** 180 cm^3
c) 240 cm^2

4 a) 792 cm^2 **b)** 1440 cm^3

5 a) 440 cm^2 **b)** 35 200 cm^3

6 a) 1728 cm^3 **b)** 864 cm^2

7 a) 9000 cm^3 **b)** 2700 cm^2

8 a) (i) B **(ii)** C **(iii)** A
b) (i) B **(ii)** A **(iii)** C

9 a) 450 m^3 **b)** 450 000 litres

10 a) 5 cm by 5 cm by 5 cm
b) 150 cm^2

11 a) 2 cm by 3 cm by 5 cm or 1 cm by 5 cm by 6 cm
b) 62 cm^2 or 82 cm^2

Review Exercise 14

1 a) (i) 48 cm^2 **(ii)** 28 cm
b) (i) 24 cm^2 **(ii)** 27 cm
c) (i) 170 cm^2 **(ii)** 60 cm
d) (i) 128 cm^2 **(ii)** 62 cm

2 a) 64 cm^2 **b)** 121.5 cm^2
c) 40 cm^2 **d)** 260 cm^2

3 a) 90 cm^3 **b)** 64 cm^3
c) 72 m^3 **d)** 288 m^3

4 a) $x = 4$
b) 34 cm
c) 70 cm^2

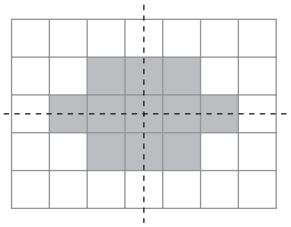
5 150 cm^3

6 66 cm^3

7 264 cm^2

8 **a)** **(i)** 11 cm^2 **(ii)** 16 cm

b)



c) 12 cm^3

9 **a)** **(i)** 4 cm^2 **(ii)** 10 cm

b) 28 cm^3

10 20 cm

11 1 cm by 28 cm, 2 cm by 14 cm, 4 cm by 7 cm

12 8 m^2

13 **a)** 20 000 cm^3 **b)** 4 minutes

14 102 cm^2

15 **a)** 700 cm^3 **b)** 13.5 kg

16 **a)** $6x + 8$ **b)** $x = 7$

17 **a)** $4x + 8$ **b)** 15.5 cm

18 **a)** 16 cm **b)** 2600 cm^3

19 £75.30

20 24 cm

Internet Challenge 14

1 Latin

2 In any triangle, the sum of the lengths of any two sides cannot be shorter than the third side. Algebraically, $a + b \geqslant c$

3 Seven triangles:
7, 7, 1 7, 6, 2 7, 5, 3 7, 4, 4 6, 6, 3 6, 5, 4 5, 5, 5

4 The Bermuda triangle is a notorious region of the Caribbean between Florida, Bermuda and Puerto Rico. Numerous ships and aircraft have disappeared without trace while traveling in this region.

5 Triangulation columns were used by surveyors, especially the Ordnance Survey, when making maps. They are often found on the tops of hills and mountains.

6 Figure 1: 35; Figure 2: 47

Chapter 15: Circles and cylinders

Starter 15

1 $3 + \frac{1}{8} = 3.125$

$\sqrt{10} = 3.16227766$

$\frac{22}{7} = 3.142857143$

$3 + \frac{8}{60} + \frac{30}{60^2} = 3.141666667$

$\frac{333}{106} = 3.141509434$

$\sqrt[4]{\left(\frac{2143}{22}\right)} = 3.141592653$

$\left(\frac{4}{3}\right)^4 = 3.160\,493\,827$

$\frac{88}{\sqrt{785}} = 3.140854685$

$\sqrt{2} + \sqrt{3} = 3.14626437$

$\frac{355}{113} = 3.14159292$

2 $\pi = 3.141592654$

3 $\sqrt[4]{\left(\frac{2143}{22}\right)}$ is closest to π

Exercise 15.1

1 **a)** 25.1 cm **b)** 31.4 mm
c) 18.8 cm **d)** 50.3 m

2 **a)** 154 cm^2 **b)** 19.6 m^2
c) 3.14 cm^2 **d)** 28.3 cm^2

3 75.4 mm **4** 69.1 cm

5 1020 cm^2 **6** 104 cm^2

7 38.5 cm^2 **8** 2.27 m^2

9 785 cm **10** 6.66 m

Exercise 15.2

1 207 mm

2 425 mm^2

3 **a)** 157 m **b)** 32 laps

4 111 cm^2

5 **a)** 12.6 cm^2 **b)** 64.9 cm^2

6 **a)** 356 cm
b) 1728 cm^2 = 1730 cm^2 to 3 s.f.
c) 1099 cm^2 = 1100 cm^2 to 3 s.f.

7 **a)** 1.88 m **b)** 18.8 m **c)** 26.5 revolutions

8 **a)** 113 mm^2 **b)** 28.3 mm^2 **c)** 84.8 mm^2

Exercise 15.3

1 **a)** **(i)** 15.4 cm **(ii)** 14.1 cm^2
b) **(i)** 25.7 cm **(ii)** 39.3 cm^2
c) **(i)** 18.0 cm **(ii)** 19.2 cm^2
d) **(i)** 10.7 cm **(ii)** 7.07 cm^2
e) **(i)** 14.3 cm **(ii)** 12.6 cm^2
f) **(i)** 57.1 cm **(ii)** 101 cm^2
g) **(i)** 20.1 cm **(ii)** 21.2 cm^2
h) **(i)** 44.3 cm **(ii)** 103 cm^2

2 **a)** 90° **(ii)** 28.3 in^2

3 **a)** 359 m **b)** 334 m **c)** 25 m

4 4.57 cm^2

Exercise 15.4

1 4.93 cm **2** 5.98 cm **3** 3.18 m
4 6.37 mm **5** 3.50 cm **6** 8.28 m
7 2.23 cm **8** 1.27 m **9** 4.77 m

Exercise 15.5

1 8600 cm^3

2 62.8 cm^2

3 **a)** 3040 cm^3 **b)** 553 cm^2

4 3050 cm^3

5 1810 cm^2

6 **a)** 2 120 000 cm^3 **b)** 2120 litres

7 3560cm^3

8 **a)** 73.6 cm^3
b) $50 \times 1.5 = 75$ cm^3, which is more than the volume of the cylinder

9 **a)** Jamie
b) Joe forgot to use the radius

Exercise 15.6

1 **a)** 20π cm **b)** 100π cm^2

2 **a)** 22π cm **b)** 121π cm^2

3 **a)** 192π cm^2 **b)** 1152π cm^3

4 **a)** 12 cm **b)** 144π cm^2

5 **a)** 5 cm **b)** 25π cm^2
6 3 cm
7 10 cm
8 **a)** 64π cm^2 **b)** $(8\pi + 32)$ cm
9 **a)** 18π cm^2 **b)** $(72\pi + 144)$ cm^2
10 **a)** 48π cm^2 for both
b) cylinder A: 72π cm^3
cylinder B: 96π cm^3; cylinder B is larger

Review Exercise 15

1 2460 cm^2 **2** 283 mm
3 11.9 cm **4** 3220 mm^2
5 **a)** 20π cm **b)** 100π cm^2
6 **a)** 314 cm^2 **b)** 942 cm^2 **c)** 1570 cm^2
7 **a)** 2.50 cm **b)** 19.6 cm^2
8 72.7 cm^2 **9** 81.7 m^2
10 201 cm **11** 7.7 cm
12 **a)** 28.3 cm^2 **b)** 23.1 cm
13 88.4 cm^2 **14** 218 cm^2
15 754 cm^3 **16** 170 g
17 58.8 cm

Internet Challenge 15

1 The Earth's shadow on the Moon (during a lunar eclipse) is round.
2 The Flat Earth Society.
3 Diameter 12 756 km (7926 miles), circumference 40 074 km (24 900 miles)
4 Diameter 12 714 km (7900 miles), circumference 39 942 km (24 818 miles)
5 A Great Circle is a circle on the surface of a sphere, whose centre coincides with the centre of the sphere. The Equator is a Great Circle.
6 Ferdinand Magellan, from August 1519 to September 1522, taking 3 years. (Magellan died during the voyage; the expedition was commanded by Juan Sebastian del Cano thereafter.)
7 Sir Ranulph Fiennes and Charlie Burton, from 1979 to 1982.
8 Round the world yacht races typically cover over 50 000 km (over 32 000 miles). They do not complete a Great Circle, but they travel a greater equivalent distance, and cross every line of longitude.
9 Greek *geo* = Earth, *metron* = measure
10 Check students' answers.

Chapter 16: Pythagoras' theorem

Starter 16

1 16, 49, 6.25, 1.44, 0.64, 169, 36, 256
2 3.61, 3.16, 4, 4.74, 3.5, 8, 11.4, 11
3 2.83, 3, 3.16, 3.32, 3.46, 3.61, 3.74, 3.87, 4, 4.12
4 Some numbers, e.g. 1, 4, 9, 16, are perfect squares

Exercise 16.1

1 **a)** not right angled
b) right angled
c) not right angled
2 **a)** not right angled **b)** right angle at C
c) right angle at A **d)** not right angled
e) right angle at E **f)** not right angled
g) not right angled **h)** right angle at T

Exercise 16.2

1 **a)** 5.39 cm **b)** 6.71 cm **c)** 2.77 m
d) 2.6 km **e)** 4.22 mm **f)** 4.72 cm
2 **a)** 7.81 cm **b)** 2 km **c)** 8.94 mm
3 **a)** **(i)** 4 cm **(ii)** 5 cm
b) 6.40 cm
4 3.61 cm

Exercise 16.3

1 **a)** 5.29 cm **b)** 8.06 cm **c)** 6.63 cm
d) 4 km **e)** 24 mm **f)** 11.5 cm
2 7 cm **3** 10.6 km

Exercise 16.4

1 **a)** 1 km **b)** 7.91 cm **c)** 4.45 cm
d) 2.24 cm **e)** 5.66 cm **f)** 5.03 m
2 **a)** 7.07 cm **b)** 8.49 cm
3 **a)** 6 cm **b)** 48 cm^2
4 **a)** 677 m **b)** 263 m
5 12 m

Review Exercise 16

1 **a)** 3.91 cm **b)** 9.93 cm **c)** 10.1 km
d) 56.0 cm **e)** 19.4 mm **f)** 11.2 cm
2 **a)** 10 cm **b)** 6.6 cm
3 5 cm
4 **a)** 86.64 cm^2 **b)** 45.6 cm
5 13.7 cm^2
6 **a)** 21.25 m^2 **b)** 9.86 m

Internet Challenge 16

1 $c = 17$
2 3, 4, 5; 5, 12, 13; 6, 8, 10; 7, 24, 25; 8, 15, 17; 9, 12, 15; 12, 16, 20; 15, 20, 25
3 They are multiples of 3, 4, 5
4 $n^2 - m^2$, $2mn$, $n^2 + m^2$ generates all the irreducible triples, and most of the others.
5 Yes
6 Yes, for example $3^2 + 4^2 + 12^2 = 13^2$
7 Fermat's Last Theorem was proved in 1994 by Andrew Wiles.

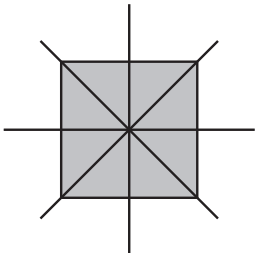
Chapter 17: Transformations

Starter 17

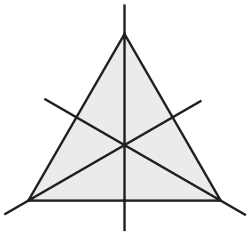
Monkeys A, B, C, D, F, G and H are the same.

Exercise 17.1

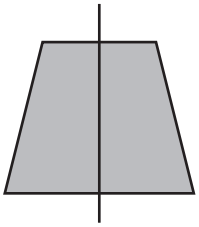
1 **a)** **(i)** **(ii)** 4



b) **(i)** **(ii)** 3

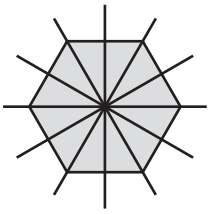


c) (i)



(ii) 1

d) (i)



(ii) 6

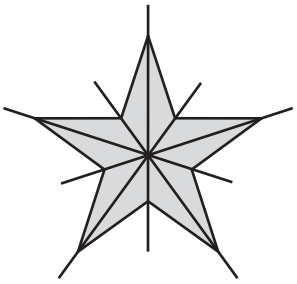
e) (i)

(ii) 0

f) (i)

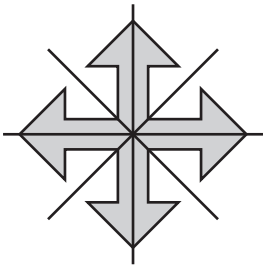
(ii) 5

2 a) (i)



(ii) 5

b) (i)



(ii) 4

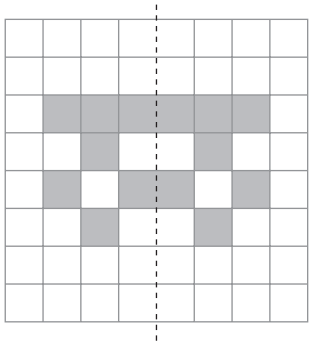
c) (i)

(ii) 1

d) (i)

(ii) 2

3 a)



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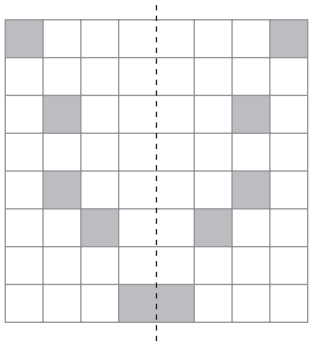
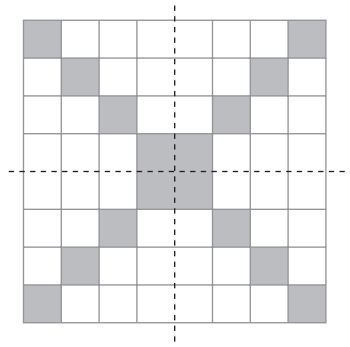
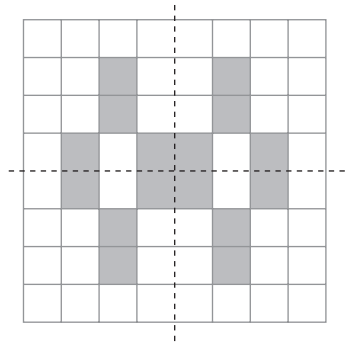


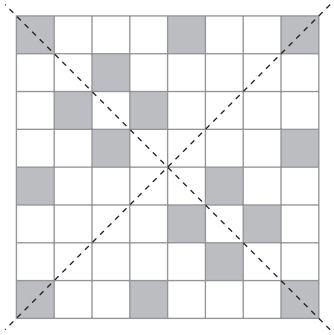
c)



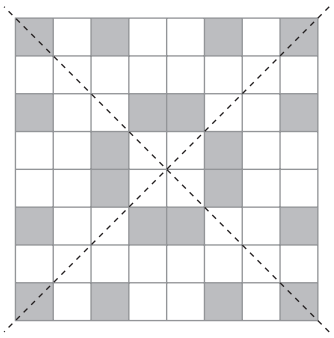
d)



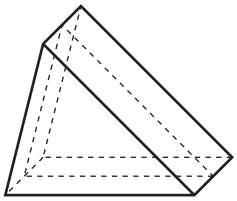
e)



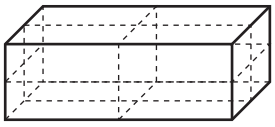
f)



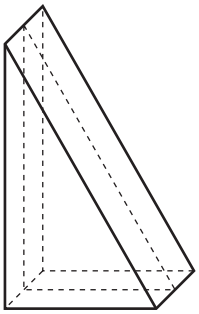
4 a)



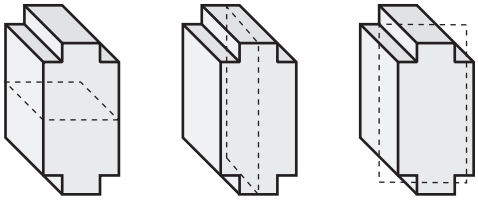
b)



c)



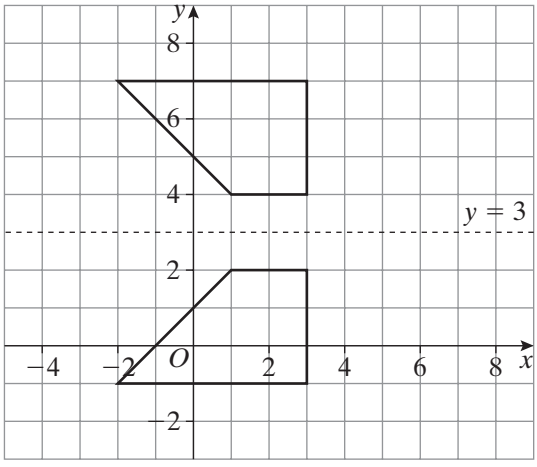
d)



5 A and P; B and R; C and O; D, K and T; E, G and J; H and S; F and Q

Exercise 17.2

1



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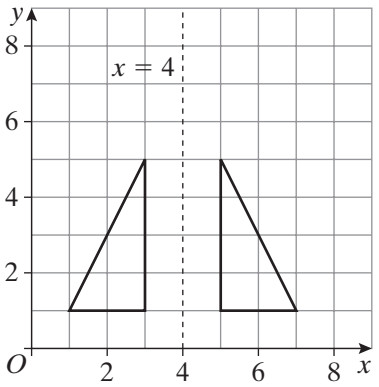

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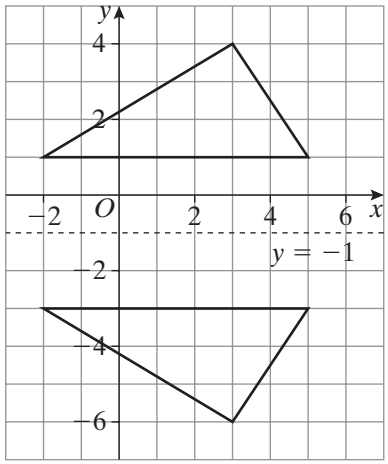

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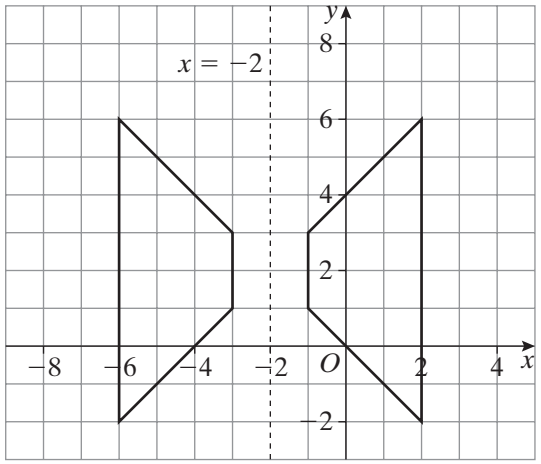

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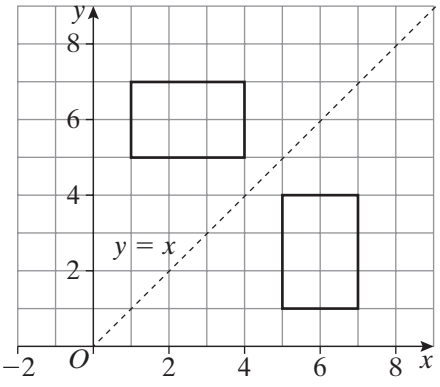

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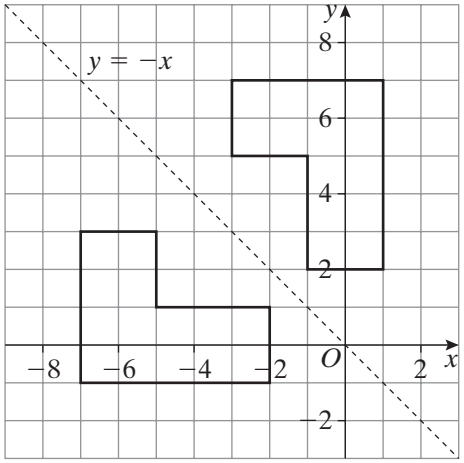

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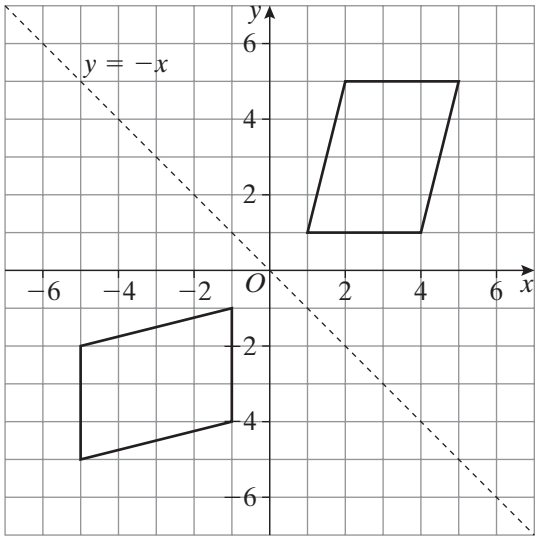
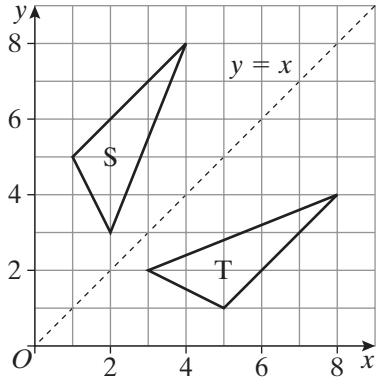
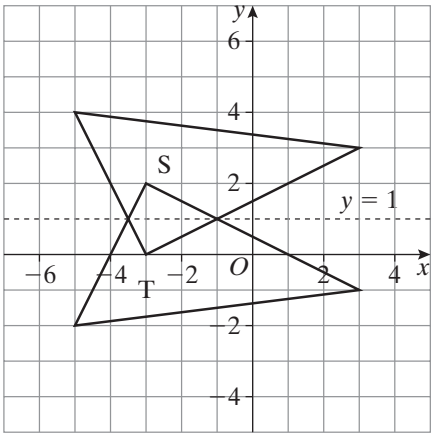


8 a)



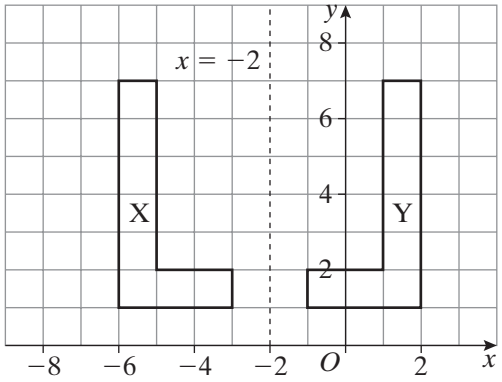
b) $y = x$

9 a)



b) $y = 1$

10



11 a) Two shapes which are exactly the same size and shape

b) $y = -1$ **c)** triangle B

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

12 They are congruent and in the same place on the grid.

Exercise 17.3

1 a) a translation by the vector $\begin{pmatrix}3\\3\end{pmatrix}$

b) a translation by the vector $\begin{pmatrix}-3\\-3\end{pmatrix}$

2 a) a translation by the vector $\begin{pmatrix}10\\-3\end{pmatrix}$

b) a translation by the vector $\begin{pmatrix}-10\\3\end{pmatrix}$

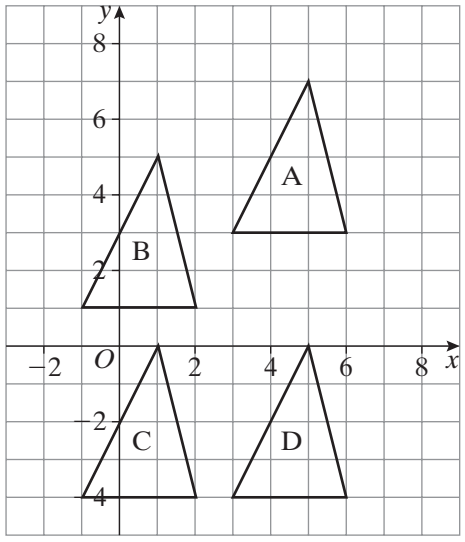
3 a) a translation by the vector $\begin{pmatrix}8\\3\end{pmatrix}$

b) a translation by the vector $\begin{pmatrix}-8\\-3\end{pmatrix}$

4 a) a translation by the vector $\begin{pmatrix}8\\0\end{pmatrix}$

b) a translation by the vector $\begin{pmatrix}-8\\0\end{pmatrix}$

5 a, b, c



d) a translation by the vector $\begin{pmatrix}0\\7\end{pmatrix}$

6 **a)** a translation by the vector $\begin{pmatrix}5\\1\end{pmatrix}$

b) a translation by the vector $\begin{pmatrix}0\\-10\end{pmatrix}$

c) a translation by the vector $\begin{pmatrix}9\\-1\end{pmatrix}$

d) a translation by the vector $\begin{pmatrix}-10\\8\end{pmatrix}$

e) a translation by the vector $\begin{pmatrix}1\\6\end{pmatrix}$

f) a translation by the vector $\begin{pmatrix}-10\\-5\end{pmatrix}$

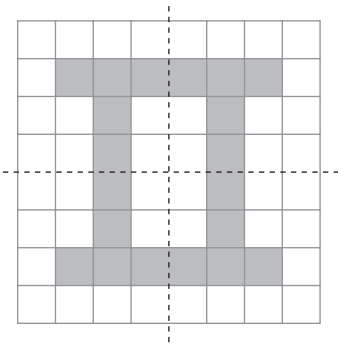
g) a translation by the vector $\begin{pmatrix}5\\-9\end{pmatrix}$

h) a translation by the vector $\begin{pmatrix}-4\\-8\end{pmatrix}$

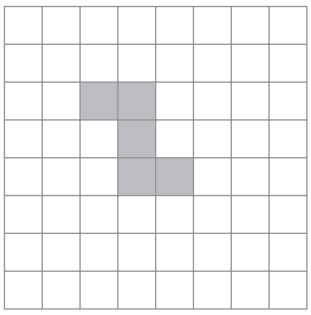
Exercise 17.4

1 **a)** 2 **b)** 1 **c)** 6 **d)** 3
e) 2 **f)** 5 **g)** 4 **h)** 2

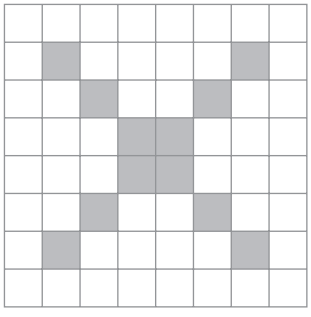
2



3

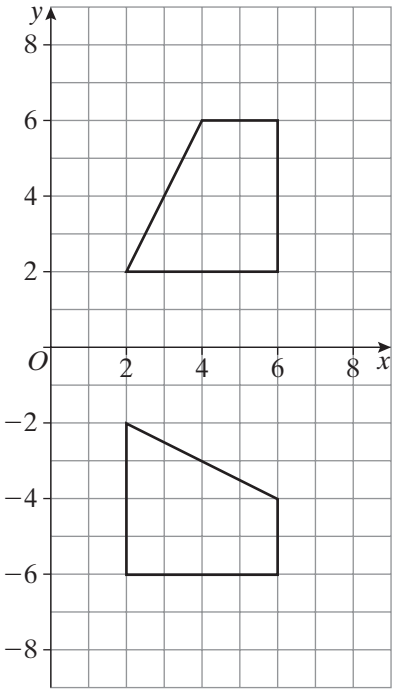


4

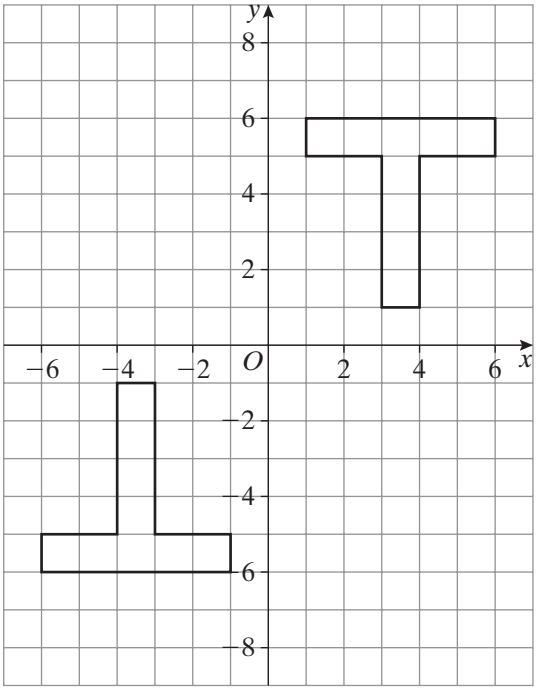


Exercise 17.5

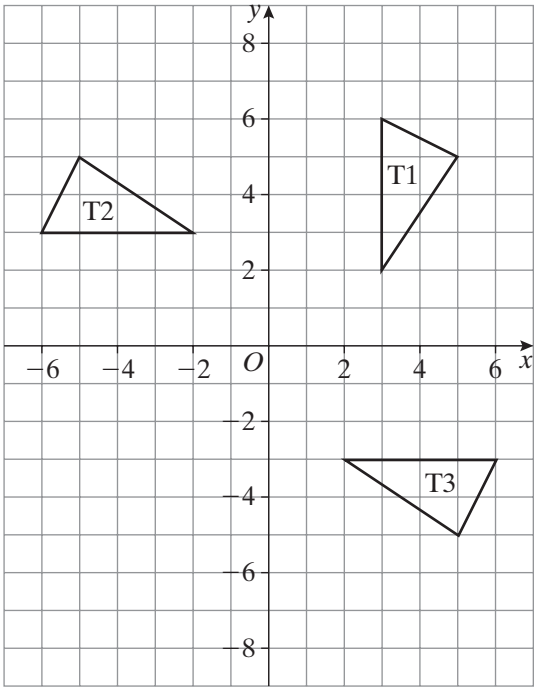
1



2

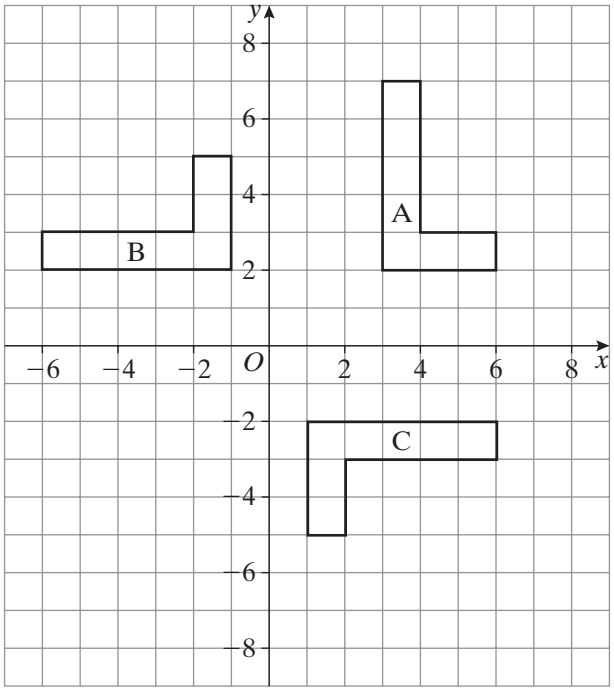


3 a), b)



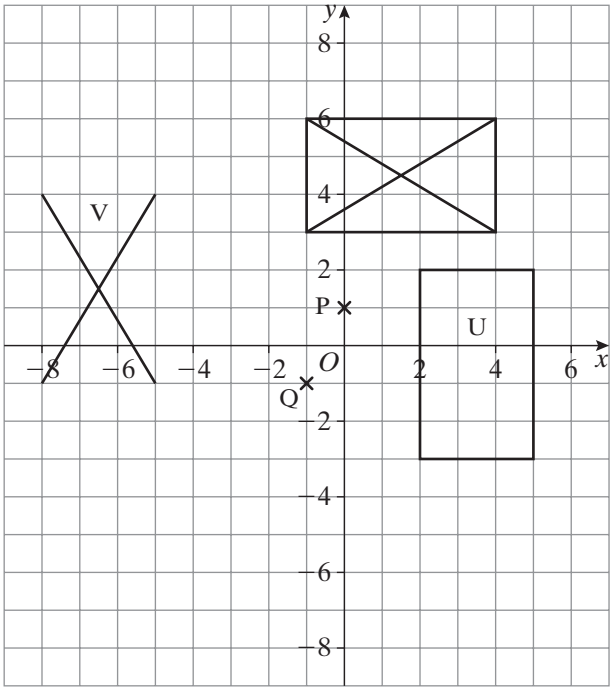
c) a rotation of 90° anticlockwise or 270° clockwise about (0, 0)

4 a), b)

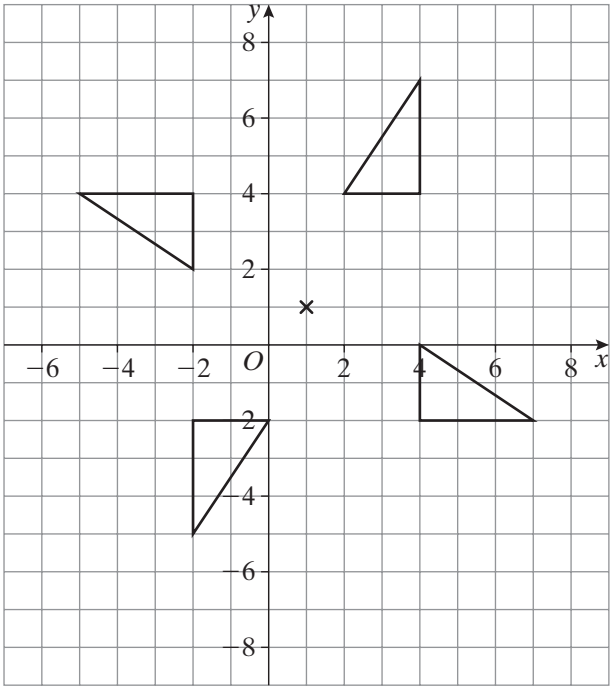


c) a rotation of 90° anticlockwise or 270° clockwise

5 a)



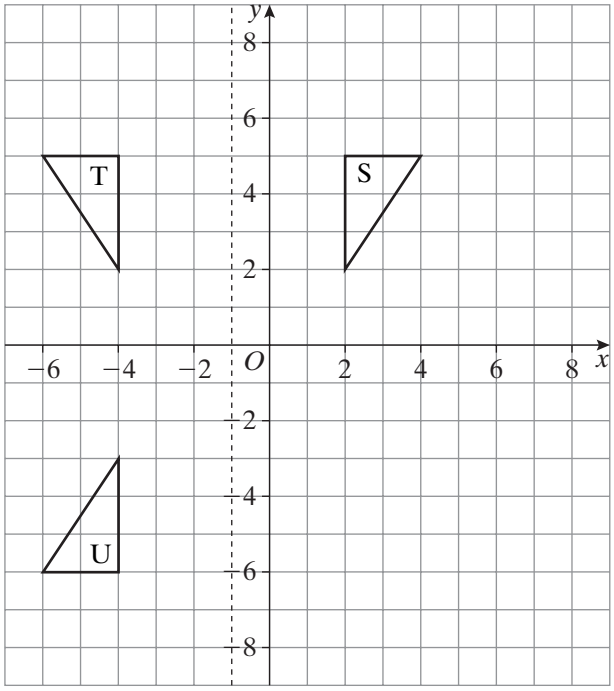
6 a), b)



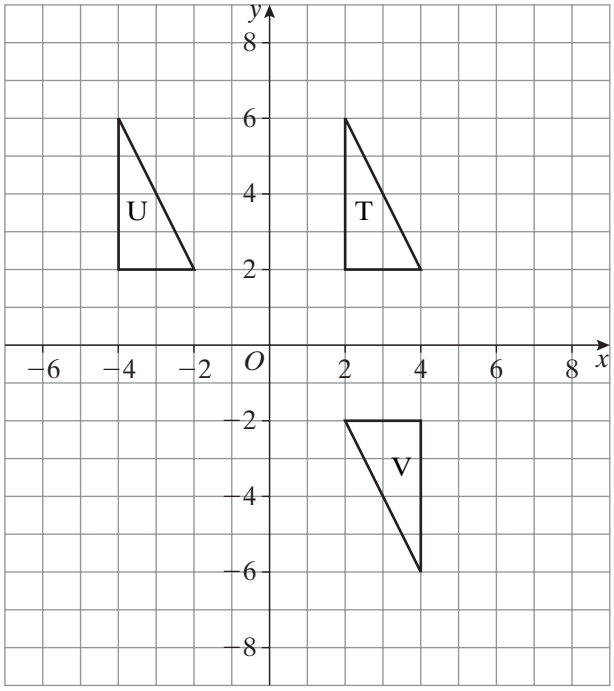
7 a) 90° anticlockwise or 270° clockwise
b) (2, 0)

Exercise 17.6

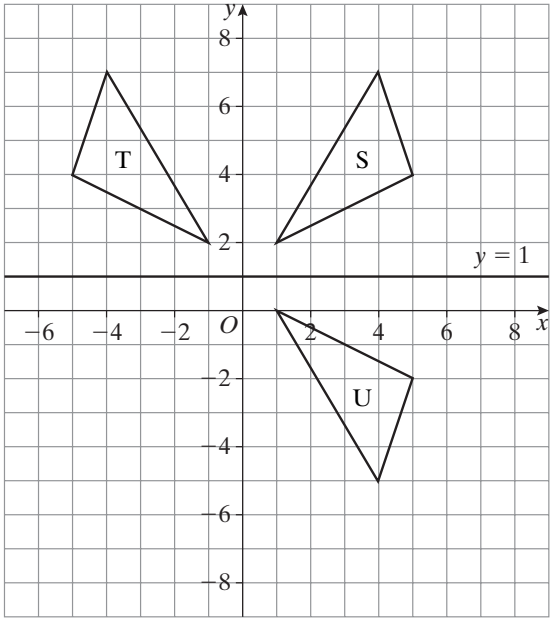
1 a), b)



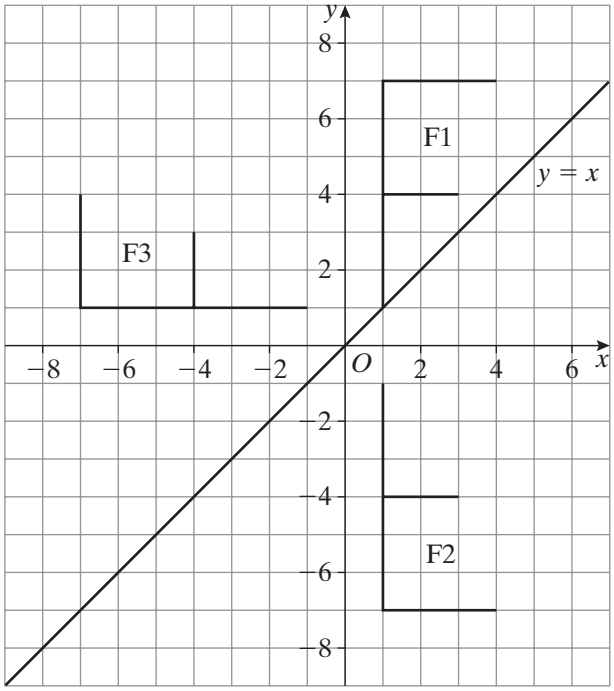
2 a), b)



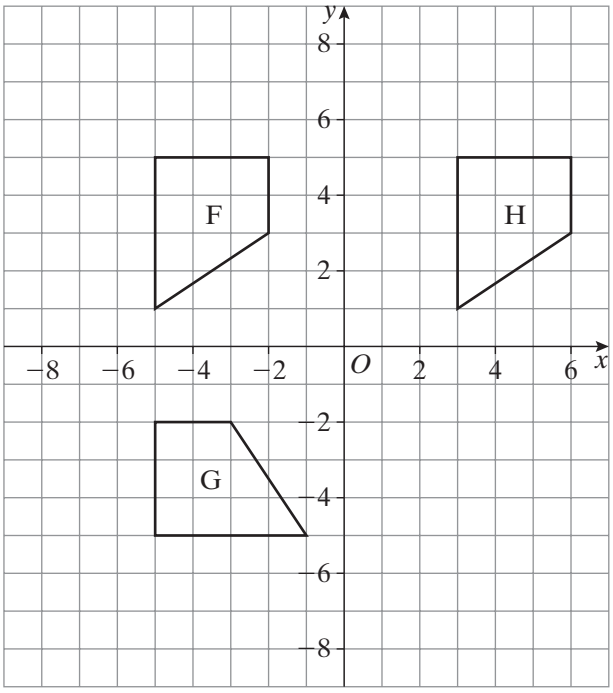
3 a), b)



4 a), b)

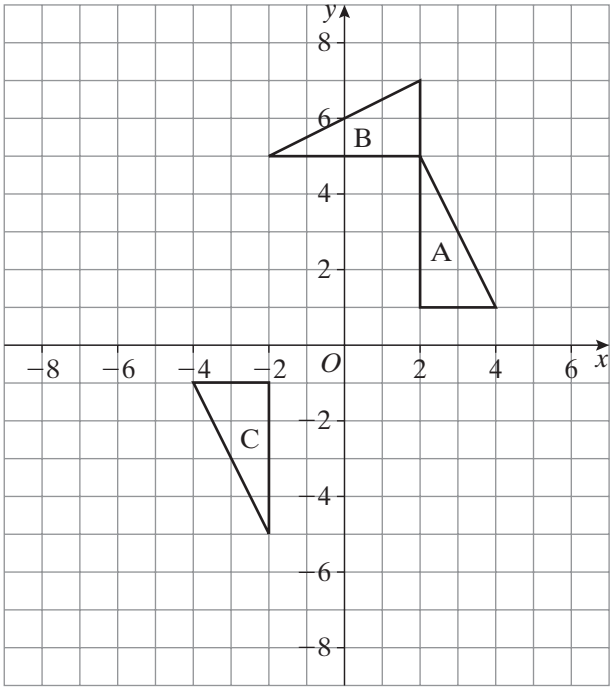


5 a), b)



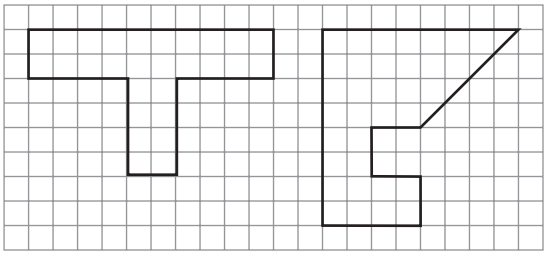
c) a translation by the vector $\begin{pmatrix} -8 \\ 0 \end{pmatrix}$

6 a), b)

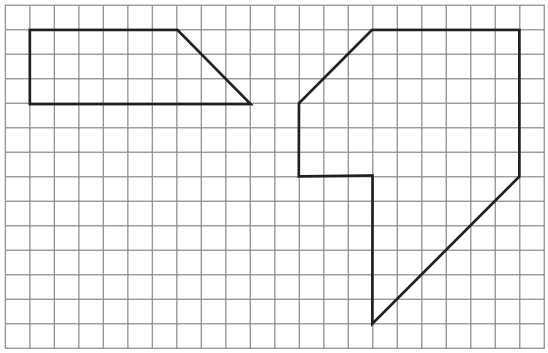


Exercise 17.7

1 a) **b)**



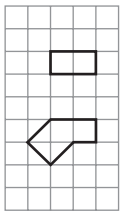
2 a) **b)**



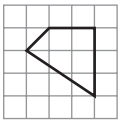
3

a)

b)

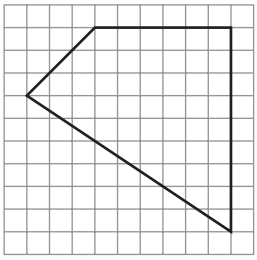


4 a)



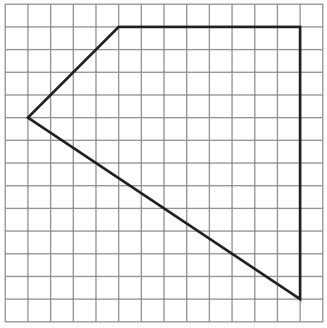
scale factor $\frac{1}{2}$

b)



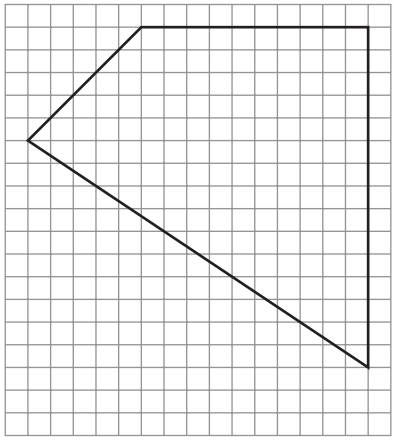
scale factor $1\frac{1}{2}$

c)



scale factor 2

d)



scale factor $2\frac{1}{2}$

5 a) 60 cm **b)** 40 cm
c) 30 cm **d)** 10 cm

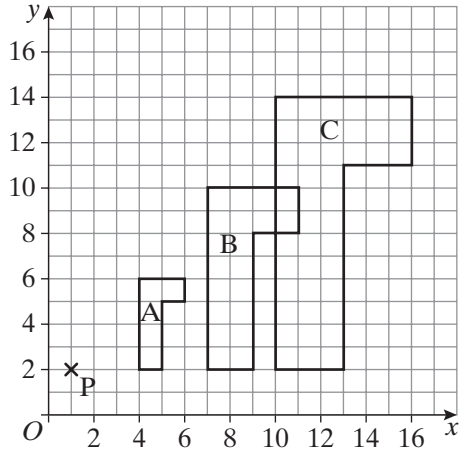
6 a) A, C, E, F, G are similar; B, D, H are similar.
b) A, F, G are congruent; B, D are congruent.

7 A, B, C, E, and J are similar and D, G and F are similar.

8 Yes – any square is an enlargement of another square.
9 Yes – any circle is an enlargement of another circle.
10 No – one rectangle is not necessarily an enlargement of another.
11 **a)** The angles are unchanged.
b) The angles are unchanged.
12 **a)** **(i)** 20 cm **(ii)** 24 cm
b) **(i)** 40 cm **(ii)** 96 cm^2
13 **a)** 24 cm^2 **b)** 192 cm^2

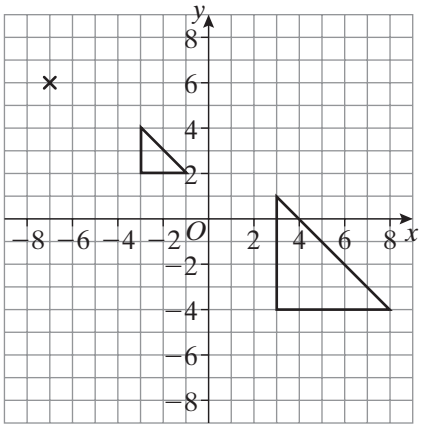
Exercise 17.8

1 **a), b)**

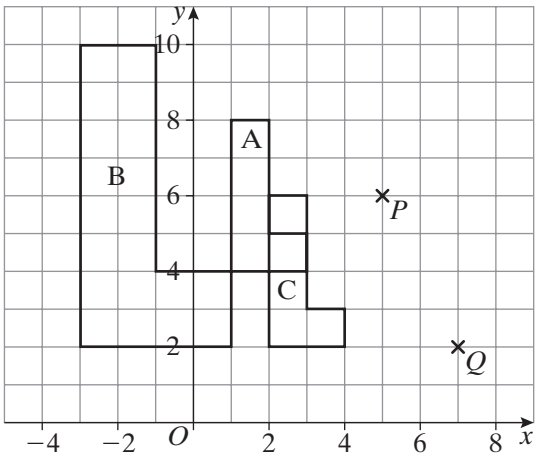


c) **(i)** not congruent **(ii)** similar

2



3 **a), b)**

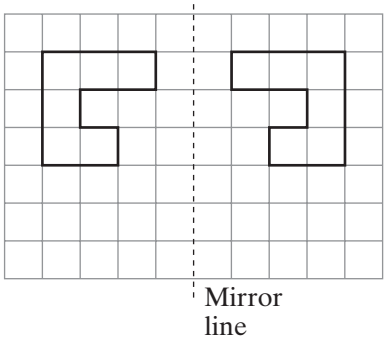


c) **(i)** A and B are not congruent.
(ii) A and B are similar.
d) Yes

4 Scale factor 3

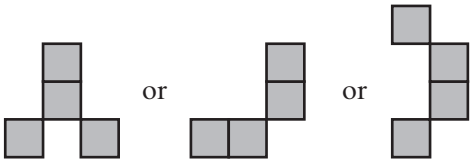
Review Exercise 17

1 **a)** B and D
b) **(i)** A **(ii)** 3
2 **a)** 14 cm **b)** 6 cm^2
c)

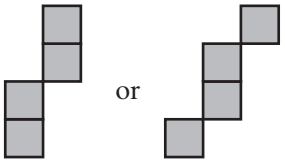


3 **a)** 18 **b)** 11 or 88 **c)** 69
4 **a)** **(i)** 12 cm^2 **(ii)** 14 cm
b) The length of the rectangle is 20 cm
The width of the rectangle is 15 cm

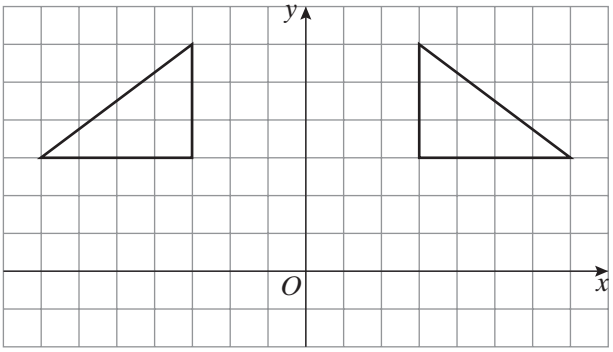
5 **a)**



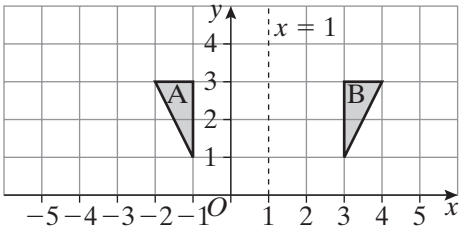
b)



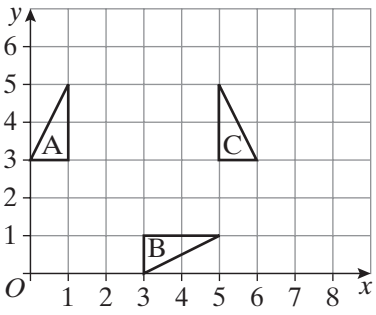
6



7 **a), b)**

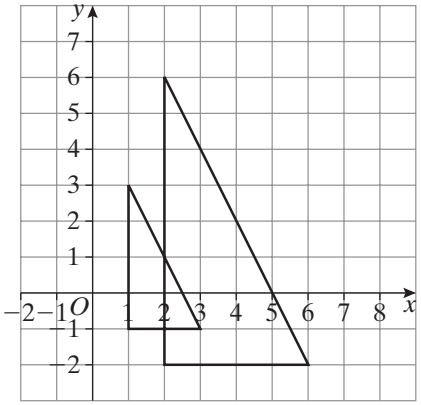


8 **a)**

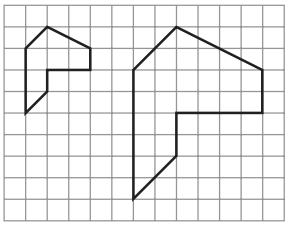


b) A reflection in the line $y = x$.

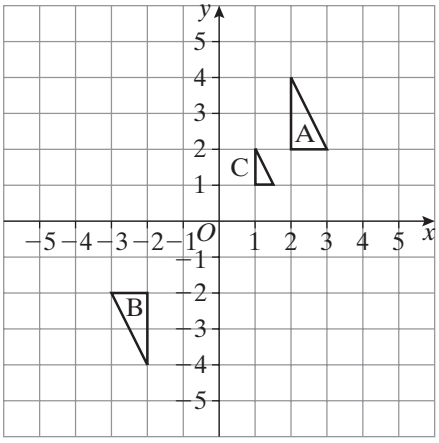
9



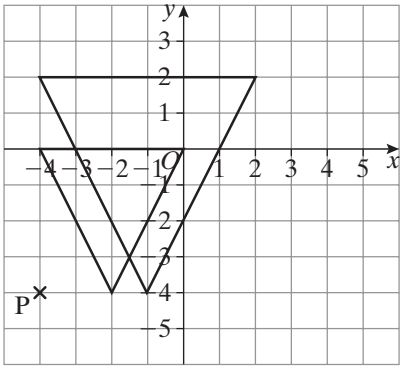
10 a) 6 cm^2 **b)**



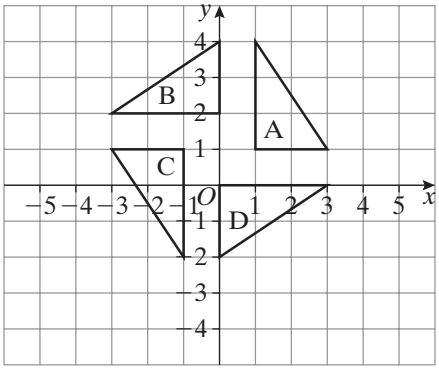
11 a), b)



12

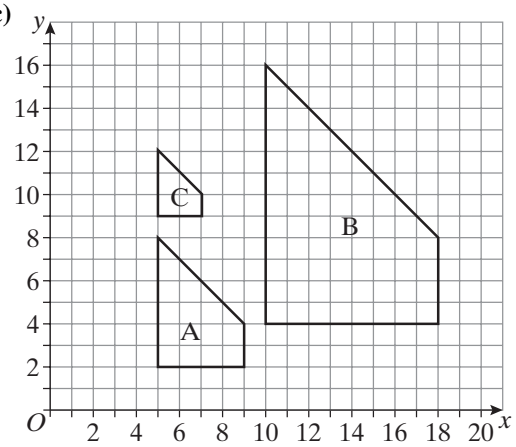


13



14 a) reflection in the y axis
b) rotation of 90° clockwise (270° anticlockwise) about the origin

15 a) 2
b), c)



Internet Challenge 17

1 icosahedron	**2** cylinder	**3** congruent
4 similar	**5** alternate	**6** parallel
7 torus	**8** octagon	**9** hemisphere
10 apex	**11** tetrahedron	**12** rhombus
13 minute, arc	**14** radian	
15 truncated cone, frustum		

Chapter 18: Constructions and loci

Diagrams not accurately drawn throughout Chapter 18.

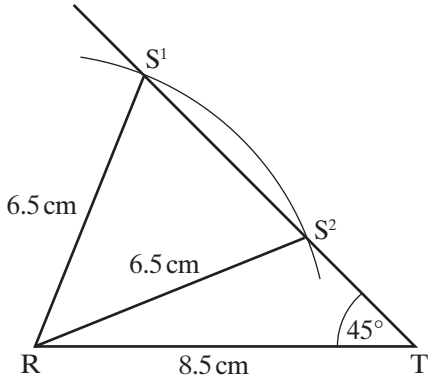
Starter 18

Students' own circle patterns

Exercise 18.1

1–3 Students' accurately constructed triangles

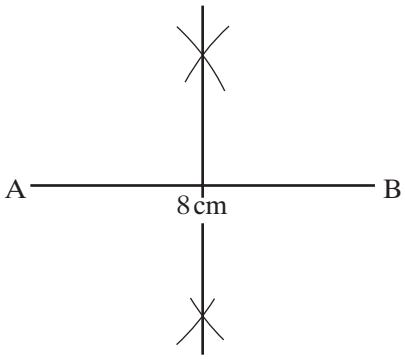
4



5 Construction is impossible since side PQ is larger than the total of QR and RP.

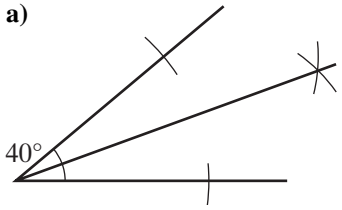
Exercise 18.2

1 a)



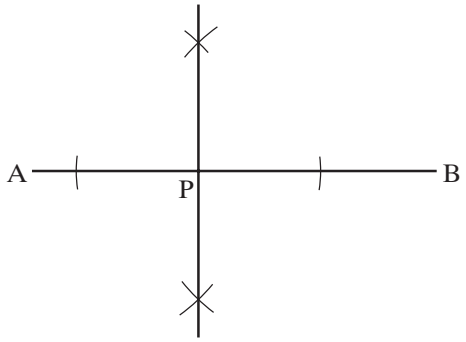
b)–e) Constructions similar to a)

2 a)

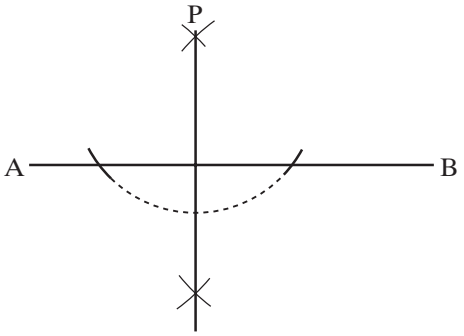


b)–f) Constructions similar to **a)**

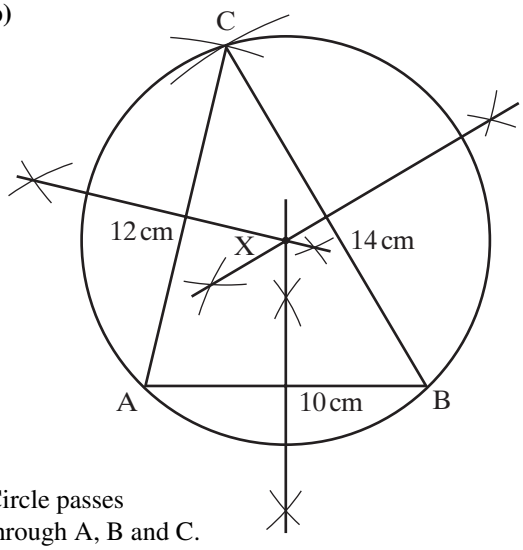
3, 4



5

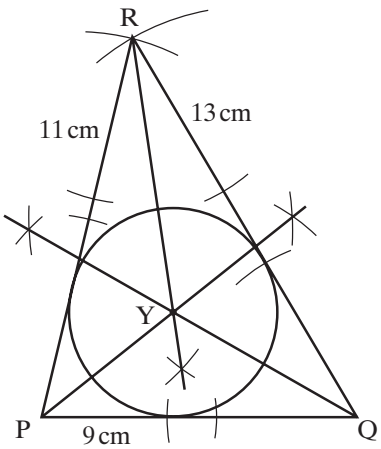


6 a), b)



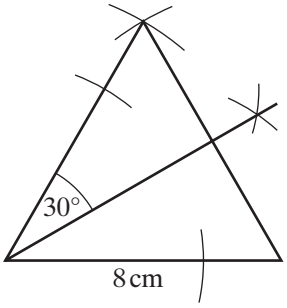
c) Circle passes through A, B and C.

7 a), b)

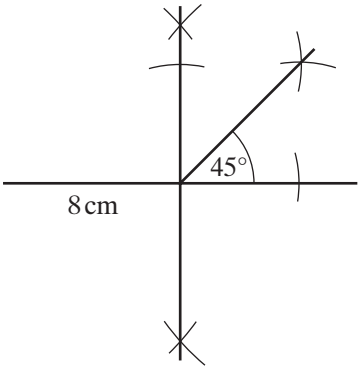


c) Circle **touches** sides PR, PQ and RQ.

8



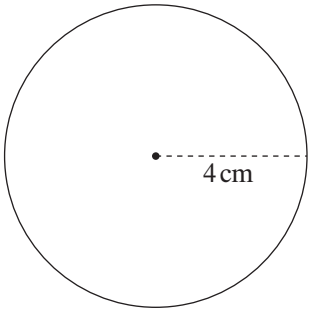
9



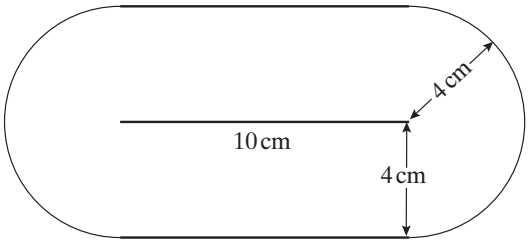
Exercise 18.3

Diagrams are not accurately drawn

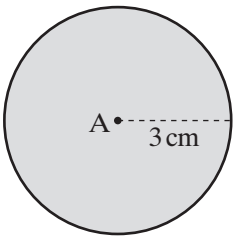
1 a)



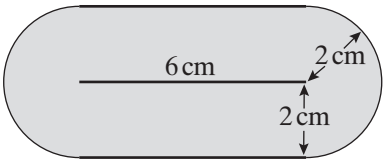
b)



2



3



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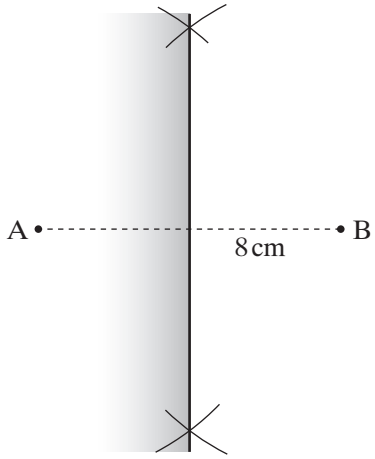

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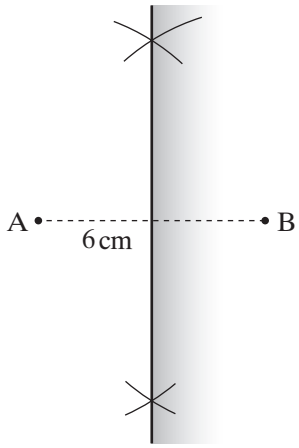

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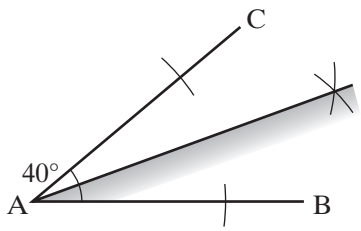

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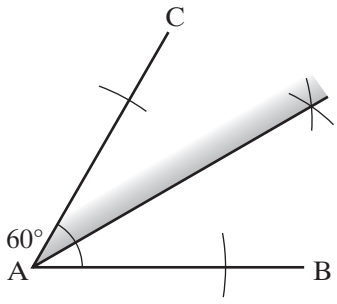

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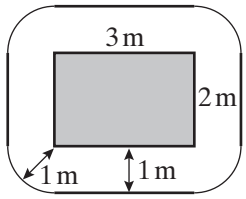

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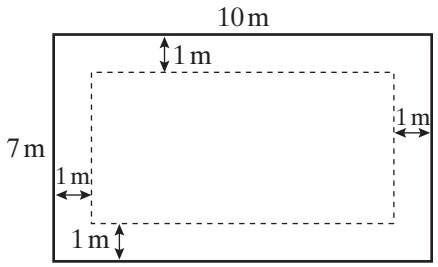

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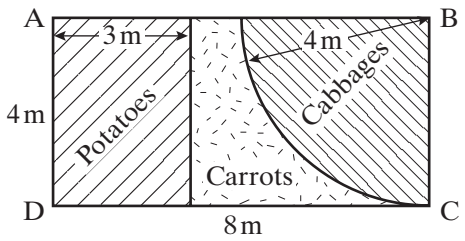

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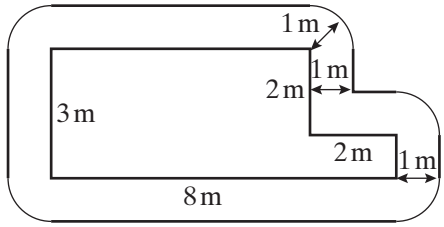

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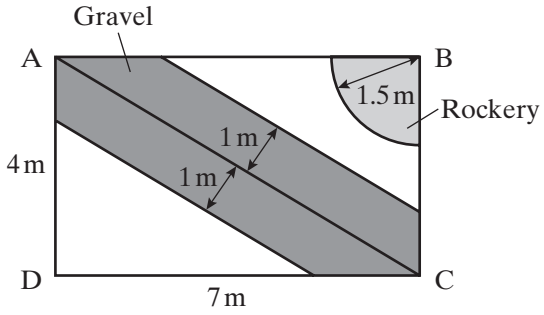

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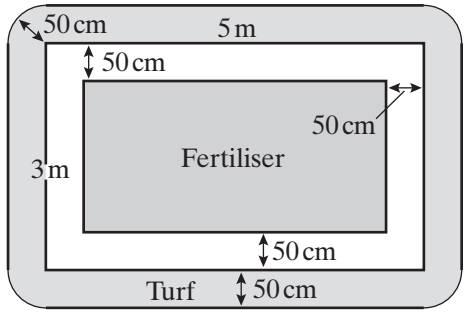

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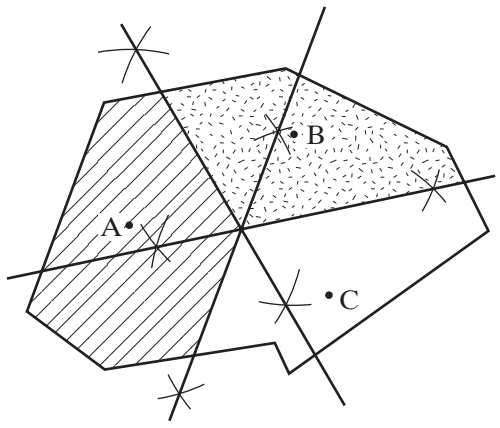
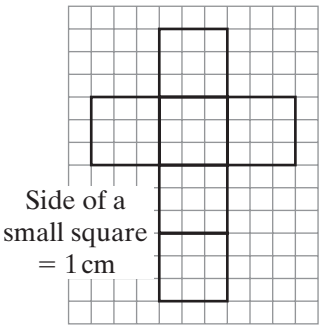


Exercise 18.4

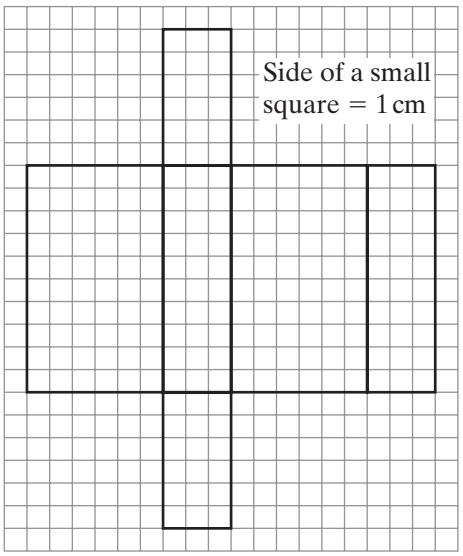
1 A2, B4, C1, D3

2 A, C, F

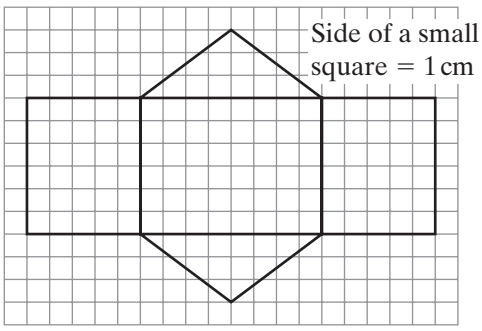
3 a)



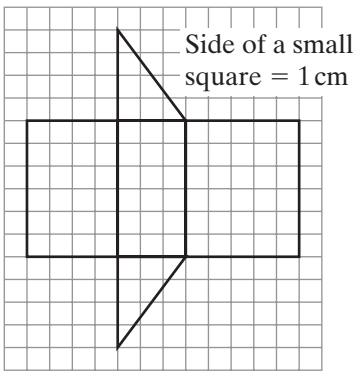
b)



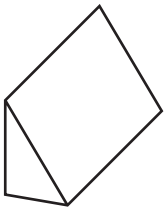
c)



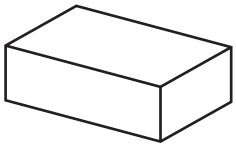
d)



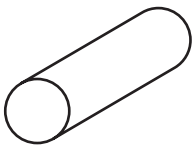
4 a)



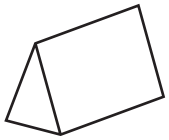
b)



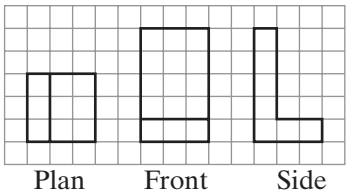
c)



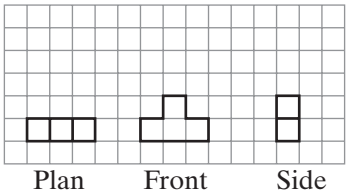
d)



5 b)

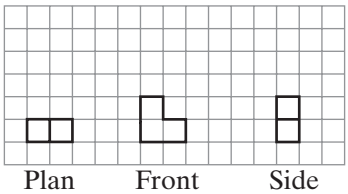


6 a) (ii)



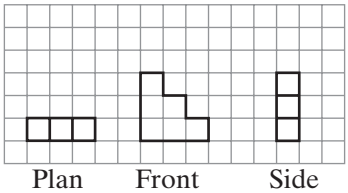
(iii) 4 cm^3

b) (ii)



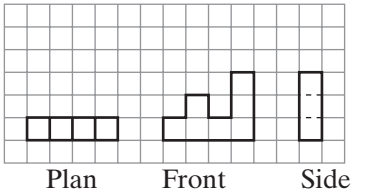
(iii) 3 cm^3

c) (ii)



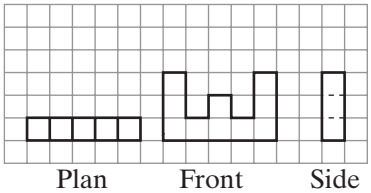
(iii) 6 cm^3

d) (ii)



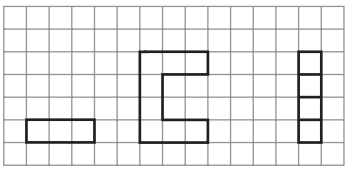
(iii) 7 cm^3

e) (ii)



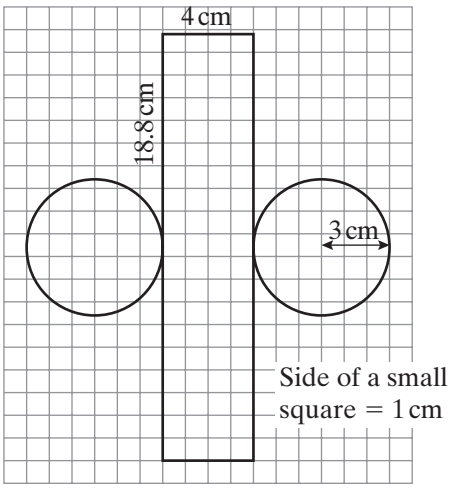
(iii) 10 cm^3

f) (ii)

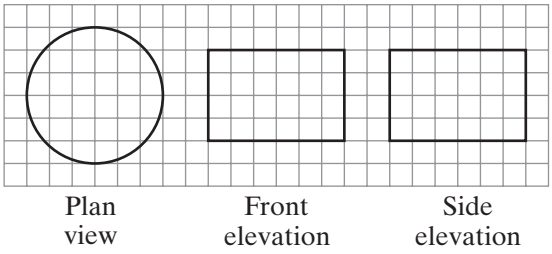


(iii) 8 cm^3

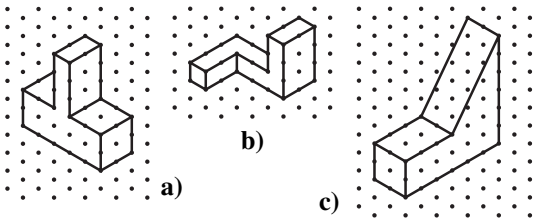
7 a)



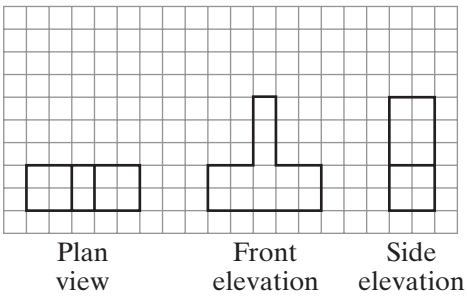
b)



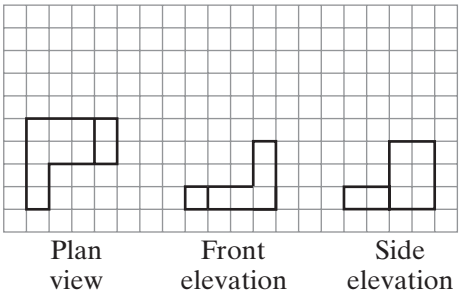
8 (i)



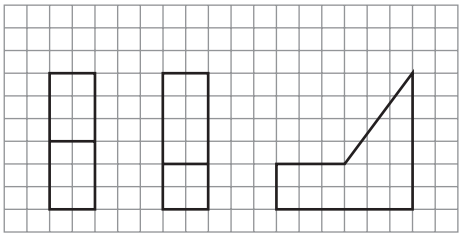
ii) a)



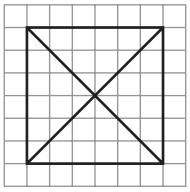
b)



c)



9 a)



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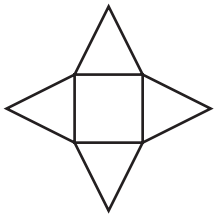
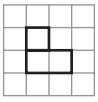
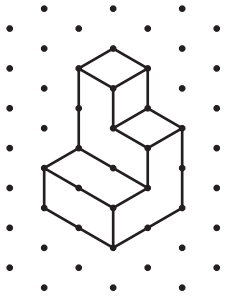


10 a)



b)



11 a) (i) 6 **(ii)** 8 **(iii)** 12

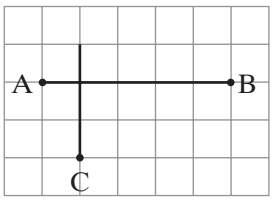
b)

Solid	No. faces	No. vertices	No. edges	Faces + vertices	Edges + 2
cube	6	8	12	14	14
cuboid	6	8	12	14	14
triangular prism	5	6	9	11	11
L-shaped prism	8	12	18	20	20
truncated pyramid	6	8	12	14	14
square-based prism	5	5	8	10	10

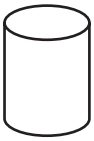
c) For all solids, faces + vertices = edges + 2

Review Exercise 18

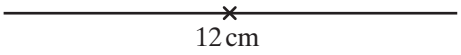
1 a)



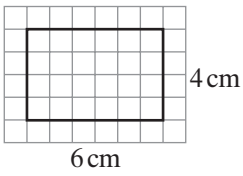
b)



2 a)

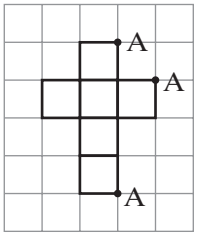


b)



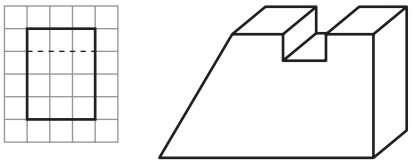
3

4 a)



b) $8\ cm^3$

5



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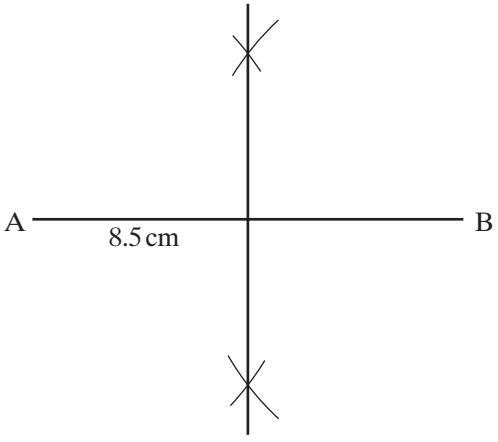
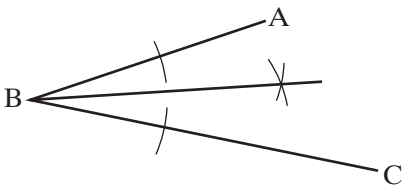
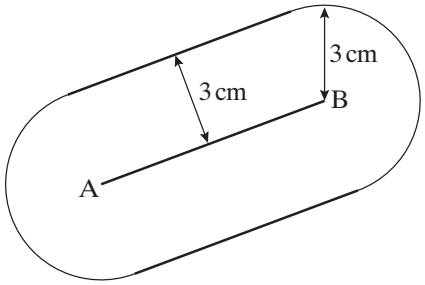


7

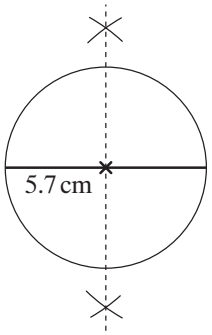


8



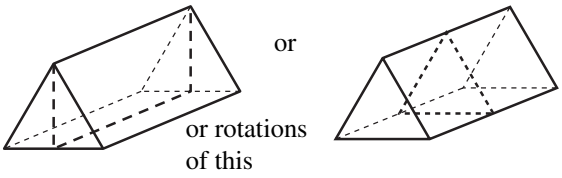
9 a) 5.7 cm

b), c)

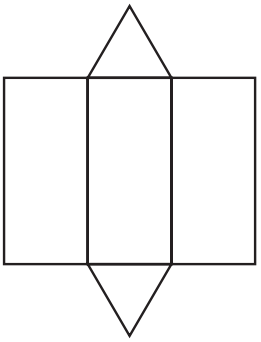


10 From the top, nets are for:
pyramid, right-angled triangular prism, cuboid, cube, cylinder.

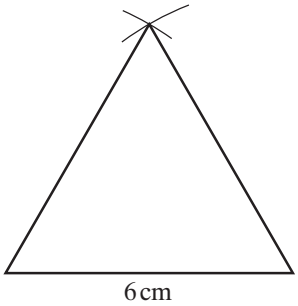
11 a)



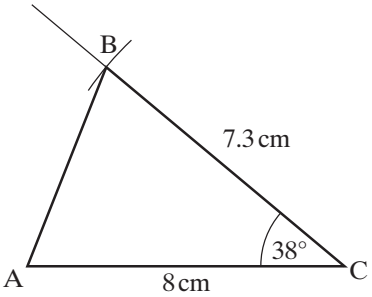
b)



c)

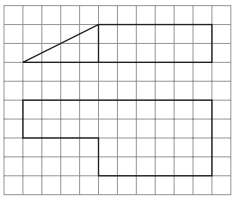


12 a)

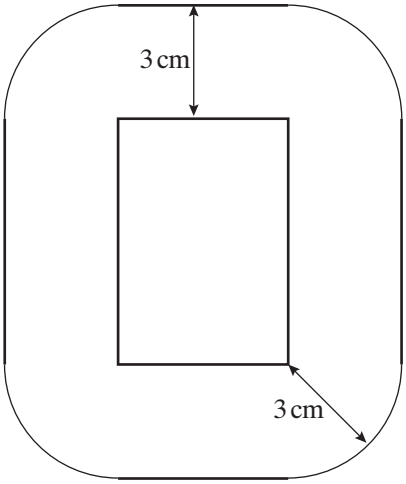


b) 63°

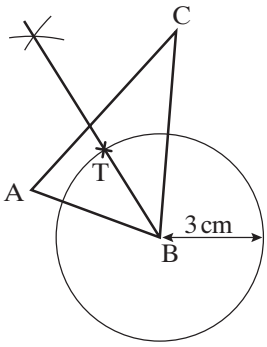
13 a), b)



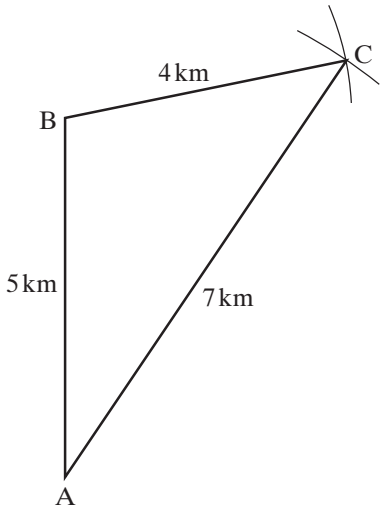
14



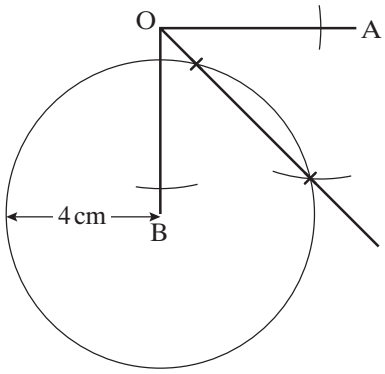
15



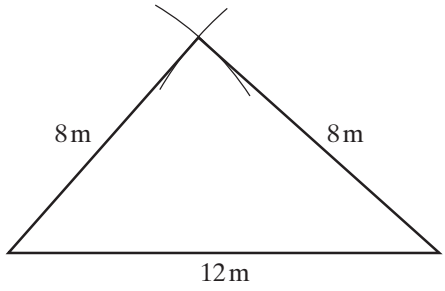
16



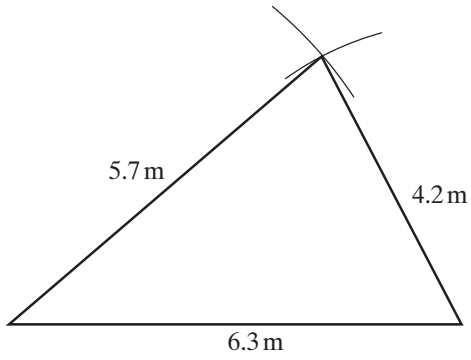
17



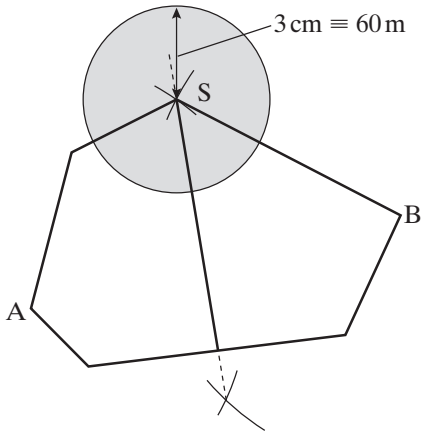
18



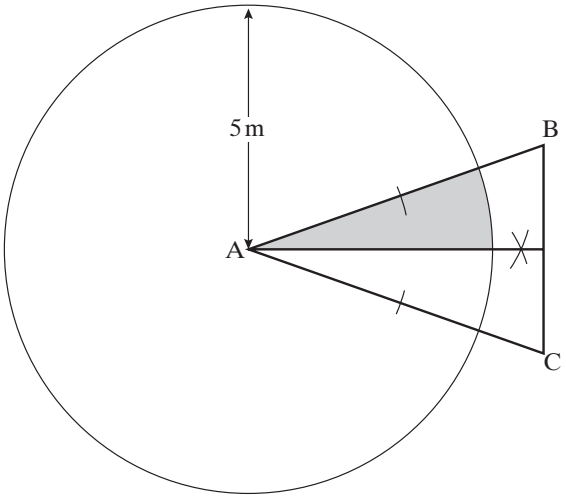
19



20

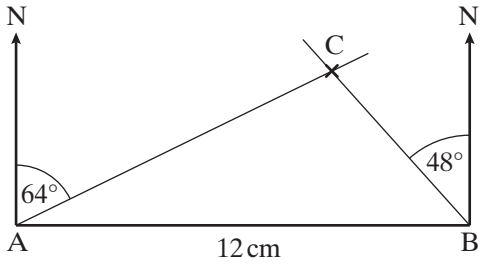


21



22 a) 3 km

b)



Internet Challenge 18

1 There are five; we will never find more. (Euclid proved there are only five.)
2 The Greek mathematician Plato wrote extensively about them.
3 Check students' designs.
4 Check students' answers.
5 Such a football is not a Platonic solid, since it uses two different polyhedra for the faces.

Chapter 19: Collecting data

Starter 19

Enrico's method is too coarse: 0 to 50 has a frequency of 0, so there are only two groups containing any data at all: 51–100 (9) and 101–150 (11).
Similarly, Myra's sheet is too fine; most of the frequencies are 0.
Sunita's table is best; there are 8 groups, with frequencies of 2, 2, 5, 4, 2, 1, 2 respectively.

Exercise 19.1

1 a) 1. The first 50 students to arrive are more likely to be the most keen on school.
2. The question is leading.

b) Fred could ask 50 students in the canteen at lunchtime, or survey on student from each class (say, the first student on the register).

c) Possibilities include: Do you think the school is:
excellent ☐ good ☐
satisfactory ☐ unsatisfactory ☐
poor? ☐

2 a) Question 1 is an open question; it needs some response boxes.
Question 2 is too open; it needs some response boxes.
Question 3 is leading.

b) Question 1: How old are you?
20 or under ☐
21–40 ☐
41–60 ☐
61 or more ☐
Question 2: Which type of newspaper do you read?
tabloid ☐ broadsheet ☐
Question 3: Do you think that newspapers are:
too expensive ☐
about the right price ☐
too cheap? ☐

3 a) Question 2 is an open question. It needs some response boxes.
Question 3 is not precise enough. 'A lot' to one person may be 'not much' to another.

b) Question 2: How old are you?
11–12 ☐
13–14 ☐
15 or more ☐
Question 3: How much television to the nearest hour, did you watch yesterday?
None ☐
1–2 hours ☐
3–4 hours ☐
more than 5 hours ☐

4 a) Question 1 is too open.
Question 2 is not relevant.
Question 3 has overlapping categories. Most students will earn less than £5 per hour.

b) Question 1: Do you have a part-time job?
Yes ☐
No ☐
Question 3. How much do you earn per hour?
less than £5 ☐
£5–£6 ☐
more than £6 ☐

5 For example:
Which sex are you?
M ☐ F ☐
What type of music do you like?
rap ☐ pop ☐
classical ☐ jazz ☐
R & B ☐ country/folk ☐

6 For example, three of
Which sex are you?
M ☐ F ☐
Do you have a mobile phone?
Yes ☐ No ☐
How many calls/texts did you make yesterday?
0 ☐ 1–4 ☐
5–8 ☐ 9 or more ☐
How many minutes to the nearest minute, did you spend on the phone yesterday?
0 ☐ under 30 ☐
30–60 ☐ more than 60 ☐

7 Both methods should give a representative sample. However, Joe's method is more time consuming.

Exercise 19.2

1 Discrete
2 Continuous
3 Categorical
4 Discrete
5 Categorical
6 Categorical
7 Continuous
8 Continuous
9 Discrete
10 Discrete
11 Discrete
12 Continuous
13 Discrete
14 Categorical
15 Discrete

Exercise 19.3

1 a)

Subject	Tally	Frequency
Maths	𝍸 𝍸 |	11
Art	𝍸 𝍸 |||	13
PE	𝍸 ||	7
Drama	𝍸 𝍸 𝍸	15
Science	||||	4
English	𝍸 𝍸	10

b) 10 **c)** Drama **d)** 60

2

Subject	Tally	Frequency
Black	|||	3
Blue	𝍸 𝍸	10
Red	𝍸 ||||	9
Silver	𝍸 |	6
White	||	2

b) Blue
c) 2

3 a)

Subject	Tally	Frequency
Under 5	|||	3
5–10	||||	4
11–20	𝍸 ||	7
21–30	||||	4
31–40	|	1
41–50	||||	4
51–65	|||	3
Over 65	||||	4

b) 3 **c)** 7 **d)** 30

4

Height, h in cm	Tally	Frequency
$100 \leqslant h < 120$	|||	3
$120 \leqslant h < 140$	𝍸	5
$140 \leqslant h < 160$	𝍸 ||	7
$160 \leqslant h < 180$	|||	3
$180 \leqslant h < 200$	𝍸 |||	8
$200 \leqslant h < 220$	||||	4

5

Number of phone calls	Tally	Frequency
1	𝍸	5
2	𝍸 ||	7
3	𝍸 |	6
4	𝍸	5
5	|||	3
6	||	2
7	||	2

b) 6 **c)** 18 **d)** 98 phone calls

Exercise 19.4

1 a)

	Local shop	Supermarket	Total
Men aged 30 or below	16	9	25
Men aged over 30	19	6	25
Women aged 30 or below	7	18	25
Women aged over 30	10	15	25
Total	52	48	100

b) 33 **c)** 35 **d)** 21

2 a)

	0 hours	1 hour	2 hours	3 hours	4 or more hours	Total
Boys	5	2	5	10	8	30
Girls	10	8	3	5	4	30
Total	15	10	8	15	12	60

b) 12 **c)** 12 **d)** 7

3 a)

	Walk	Car	Cycle	Train	Bus	Total
Male students	10	2	8	3	2	25
Female students	8	1	6	6	4	25
Male teachers	2	10	3	8	2	25
Female teachers	3	13	1	5	3	25
Total	23	26	18	22	11	100

b) 14 **c)** 10 **d)** 18 **e)** 4
4 a) 8 **b)** 4 **c)** 25 **d)** 22 **e)** 60
5 a) 4 **b)** 20 **c)** 24 **d)** 30
6 a) You can't tell which sports were preferred by boys and which by girls.

b)

	Hockey	Soccer	Tennis	Other	Total
Boys					
Girls					
Total					

7 For example:

	CDs	Magazines	Food\Drink	Social	Other	Total
Boys						
Girls						
Total						

Review Exercise 19

1

	Tea bags	Packet tea	Herbal tea	Total
50 g	2	0	5	7
100 g	35	20	5	60
200 g	15	5	13	33
Total	52	25	23	100

2

	French	German	Spanish	Total
Female	15	11	13	39
Male	16	17	8	41
Total	31	28	21	80

3 For example:
How many homeworks were you set last week?
0 ☐ 1–4 ☐ 5–9 ☐ more than 10 ☐

4 a) For example:
What type of restaurant do you like?
Italian ☐ Indian ☐
Chinese ☐ English ☐ Other ☐

b) 1. The question is leading, so will give biased results.
2. Mr Beeton's family are more likely to like the same food, so it will not be a representative sample. It is also too small a sample.

5 a)

Flavour of crisps	Tally	Frequency
Plain	𝍸 |||	8
Chicken	|||	3
Bovril	𝍸	5
Salt & Vinegar	||||	4

b) 4

c) Plain

6 a) There are no response boxes for those students who are not happy with the changes.

b) (i) The question is too subjective and vague. 'A lot' for one student is 'not much' to another.

(ii) For example:
How much did you spend in the canteen yesterday?
Nothing ☐
less than £2 ☐
£2–£4 ☐
more than £4 ☐

7 For example:
1. 'What did you buy for lunch today?'
2. Include response boxes:
Pasta ☐ Chips ☐ Salad ☐
Fruit ☐ Chocolate ☐

8 1. Which sex are you?
M ☐ F ☐
2. Do you have a part time job?
Yes ☐ No ☐

9 For example:

Type of vehicle	Tally	Frequency
Car		
Lorry		
Van		
Bus		
Motor bike		
Bicycle		

10 a)

	School dinners	Sandwiches	Other	Totals
Boys	12	3	1	16
Girls	8	4	2	14
Total	27	7	3	30

b) 4

11 a) 30 **b)** 38

12 For example:

	Girls	Boys	Total
Romance			
Comedy			
Crime			
Science fiction			
Drama			
Other			
Total			

Internet Challenge 19

1 1841
2 2011
3 A fine of £1000
4 1086
5 The Domesday survey
6 William the Conqueror
7 c) 336 000
8 b) 22 million
9 a) 15%
10 a) 52 million

Chapter 20: Working with statistics

Starter 20

a) 5 **b)** 5 **c)** 5
d) 11 **e)** 6

Exercise 20.1

1 **a)** **(i)** 4 **(ii)** 3 **(iii)** 2
b) **(i)** 13 **(ii)** 14 **(iii)** 16
c) **(i)** 12 **(ii)** 13 **(iii)** 13

2 Football

3 Crime

4 **a)** **(i)** 3 **(ii)** 3 **(iii)** 3
b) **(i)** 47 **(ii)** 45 **(iii)** 45
c) **(i)** 16 **(ii)** 17 **(iii)** 18

5 **a)** **(i)** 110.8 **(ii)** 110.5 **(iii)** 110
b) **(i)** 50.7 **(ii)** 51 **(iii)** 51
c) **(i)** 22.6 **(ii)** 21 **(iii)** 20

6 **a)** £25 000 **b)** £18 000 **c)** Mean
No, the data is skewed by owner's large wage, so the median would be more representative of the data.

7 **a)** −1 °C
b) −0.5 °C
c) 0 °C

Exercise 20.2

1 **a)** **(i)** 6.3 **(ii)** 5.5 **(iii)** 5 **(iv)** 7
b) **(i)** 16.3 **(ii)** 15.5 **(iii)** 15 **(iv)** 7
c) **(i)** 56.3 **(ii)** 55.5 **(iii)** 55 **(iv)** 7
d) **(i)** 106.3 **(ii)** 105.5 **(iii)** 105 **(iv)** 7
e) Each value of data in set **b)** is 10 more than in set **a)**.
The mean, median and mode have all increased by 10.
Each value of data in set **c)** is 50 more than in set **a)**.
The mean, median and mode have all increased by 50.
Each value of data in set **d)** is 100 more than in set **a)**.
The mean, median and mode have all increased by 100.
The range is the same for each data set.

2 **a)** 32 **b)** 27 **c)** 25.6 **d)** 27

3 **a)** **(i)** 69.1% **(ii)** 70% **(iii)** 42%
b) **(i)** 70.4% **(ii)** 70% **(iii)** 22%
c) The medians are the same for both sets of data and the means are very similar. However, the range of Felicity's results is much less than Jay's. So Felicity is more consistent and so is probably the better student overall.

Exercise 20.3

1 **a), b)**

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

Key 4 | 1 = 41 years

c) 47.5 years old
d) 60 years

2 **a), b)**

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

Key 2 | 1 = 21 minutes

c) 18 minutes **d)** 38 minutes

3

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

Key 2 | 9 = 29 marks

b) 31 marks **c)** 35 marks

4 **a)**

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

Key 6 | 1 = 61 °F

b) 43 °F **c)** 79 °F

5 **a)**

8	8
9	3 4 6 7
10	0 0 2 5 6
11	1 3

Key 10 | 2 = 102 ohms

b) 100 ohms

Exercise 20.4

1 **a)** 100 **b)** 3 **c)** 3 **d)** 2.98 **e)** 5

2 **a)** 40
b) Emily didn't see any cars with 5 occupants.
c) 2 **d)** 3 **e)** 2.53 **f)** 2

3 **a)** 100 **b)** 5 **c)** 5 **d)** 5.03 **e)** 8

Exercise 20.5

1 **a)** $24 \leqslant L < 26$
b) $24 \leqslant L < 26$
c) 24.7 cm

2 **a)**

Number of people at work	Frequency	Midpoint
25 to 29	3	27
30 to 34	7	32
35 to 39	11	37
40 to 44	4	42
Total	25	

b) 35.2 **c)** 35 to 39
d) 35 to 39
e) The greatest the range could be is 44 − 25 = 19

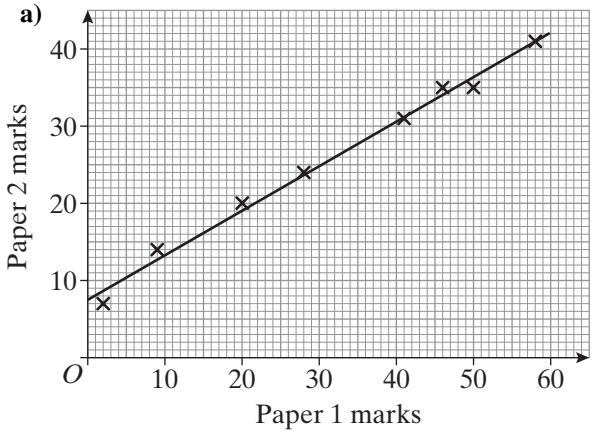
3 **a)** $30 \leqslant A < 40$ **b)** $30 \leqslant A < 40$
c) 42.3 years

4 **a)** $15 \leqslant T < 20$ **b)** $15 \leqslant T < 20$
c) 18.6 minutes
b) Midpoints were used rather than the actual data values.

Exercise 20.6

1 1C, 2A, 3B

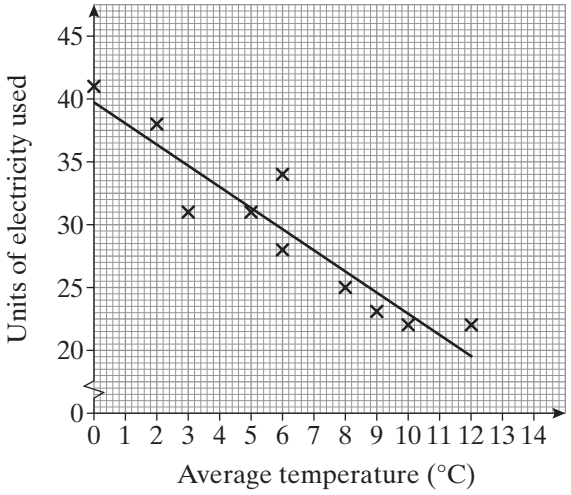
2 a)



b) positive correlation

d) 39

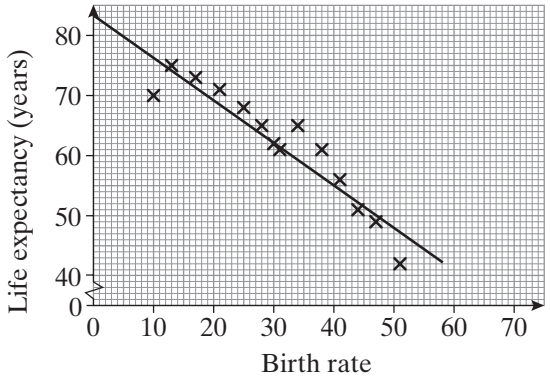
3 a), c)



b) negative correlation

d) (i) 2.8 °C **(ii)** 28 units

4 a)



b) 54 years **c)** 25

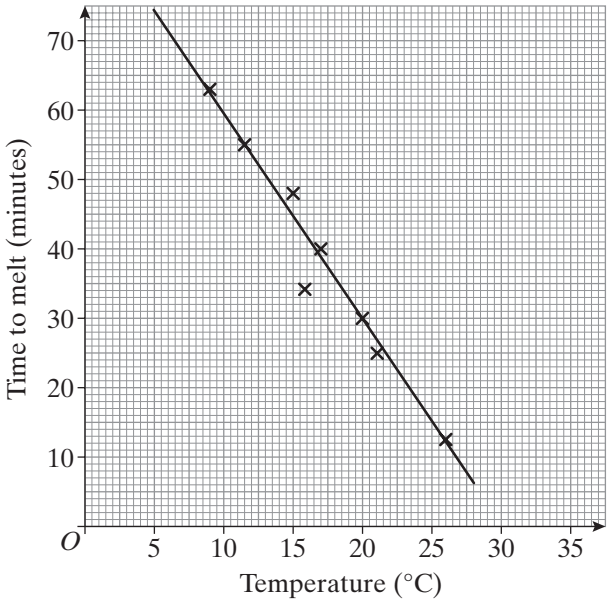
5 a) (i) no (linear) correlation

(ii) length of hair

b) (i) positive correlation

(ii) waist measurement

6 a), c)



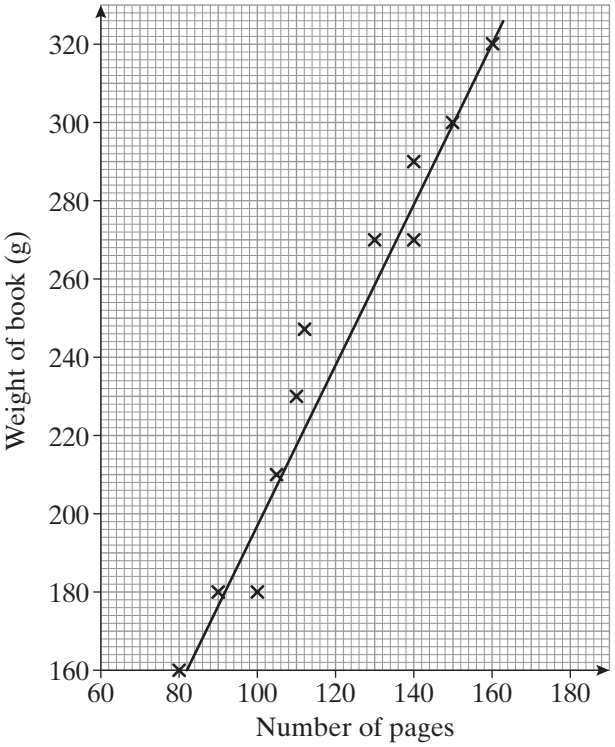
b) negative correlation

d) 51 minutes

e) 24°C

f) Because the line of best fit would be below the x axis here which would imply it would take a negative amount of time to melt the ice cube. More data is needed.

7 a), c)



b) Positive correlation – as the number of pages increases the weight of the book increases.

d) (i) 140 pages

(ii) 239 g

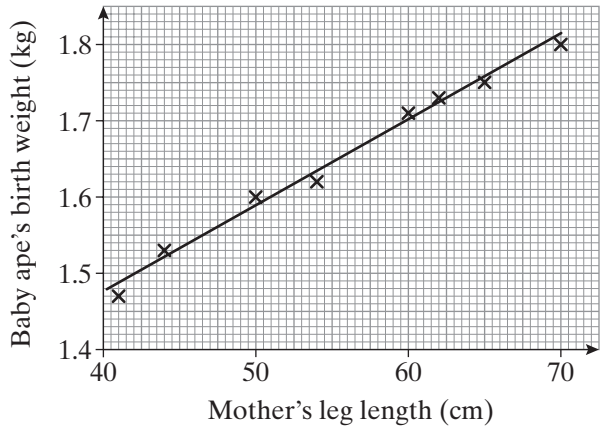
Review Exercise 20

1 a) 2.5 years **b)** 3 years

2 a) 16 **b)** 22

3 a) 30 **b)** 3 **c)** 30.2

4 a), c)



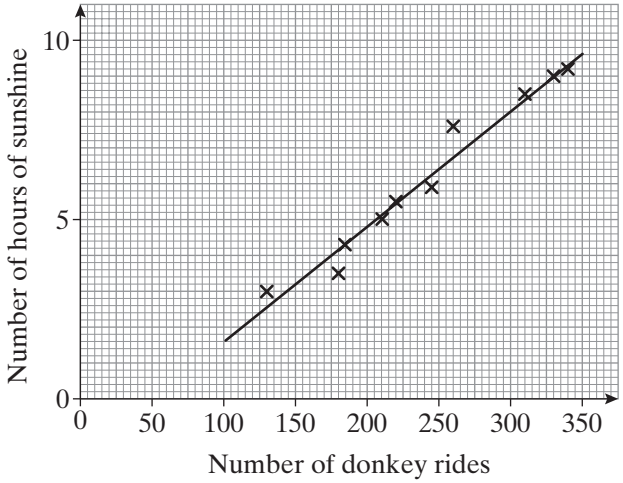
b) positive correlation
d) 1.64 kg

5 a) 1 **b)** 3 **c)** 2.1

6 a) 15 **b)** 29 **c)** 18

7 a) 22
b) Nobody drank more than 6 cups of coffee. So 7 can't be the average.

8



b) Positive correlation: as the number of hours of sunshine increases the number of donkey rides increases.
d) (i) 270 **(ii)** 4.7 hours

9

14	7 7 7 8
15	1 2 3 5 8 8
16	4 5 6 6 7
17	1 2 8
18	9 9

Key 14 | 7 = 147 mm

10

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

Key 0 | 5 = 5 minutes

11 6.08 hours

12 a) $150 < C \leqslant 200$
b) No. The median will now be the 21st data value which also lies in the $150 < C \leqslant 200$ class interval.

13 £4.92

Internet Challenge 20

1 Values vary, depending on the source

	Name of country	Population in millions	Area in millions of square kilometres
1	China	1306	9.60
2	India	1080	3.29
3	United States of America	296	9.63
4	Indonesia	242	1.92
5	Brazil	186	8.51
6	Pakistan	162	0.80
7	Bangladesh	144	0.14
8	Russia	143	17.10
9	Nigeria	129	0.92
10	Japan	127	0.38
11	Mexico	106	1.97
12	Philippines	88	0.30

Chapter 21: Presenting data

Starter 21

Medical research: The *y* axis should be drawn all the way down to zero, then the recent growth may be seen to be much more gradual.
Milk bottles: The bottle for Sykes Farm is 60% taller and 60% wider, making it look much more than just 60% more volume.
Staff cars: The yellow sector looks much bigger because it is at the front of the pseudo-3-D diagram.

Exercise 21.1

1 a) Sunday **b)** 5 hours
c) Monday and Wednesday **d)** 23 hours

2 a) 400
b) Week 3
c) 450
d) 325
e)

Key: ◎ = 100 CDs

Week 1	◎ ◎ ◎ ◎
Week 2	◎ ◎ ◎ ◔
Week 3	◎ ◎
Week 4	◎ ◎ ◎ ◎ ◎ ◎ ◔
Week 5	◎ ◎ ◎ ◎ ◔
Week 6	◎ ◎ ◎ ◎ ◎
Week 7	◎ ◎ ◎
Week 8	◎ ◎ ◎ ◎ ◎ ◔

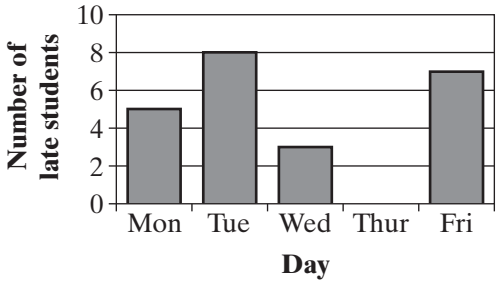
3 a) (i) Raffle **(ii)** Cakes
b) (i) Plants **(ii)** Books
c) (i) £160 **(ii)** £190
d) (i) this year **(ii)** £40

4 **a)** Saturday **b)** Thursday
c) Monday **d)** Tuesday and Thursday
e) 35 **f)** 10
g) 25 **h)** 25

5 ▤ represents 4 sales

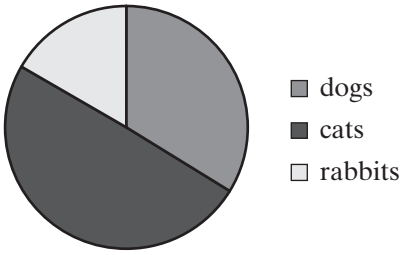
Fiction	▤ ▤ ▤ ▤
Children's books	▤ ▤ ▤ ▤ ▤
Bioigraphies	▤ ▤ ▤ ▤ ▤ ▭
Science Fiction	▤ ▭
Crime Fiction	▤ ▤ ▭
Non-Fiction	▤ ▤ ▤ ▭

6

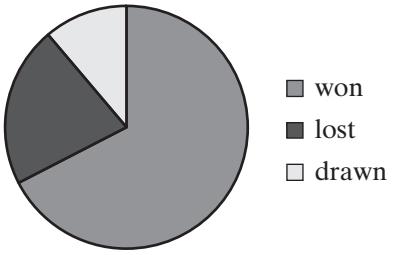


Exercise 21.2

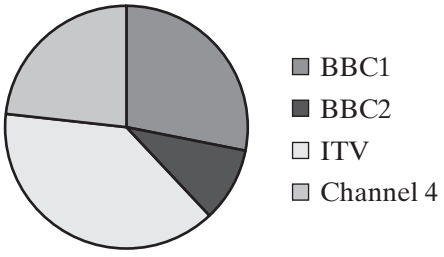
1



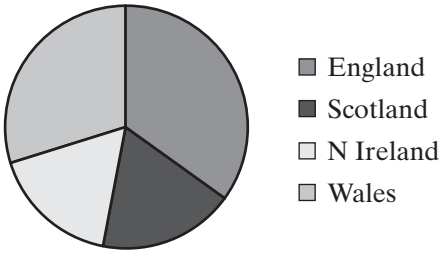
2



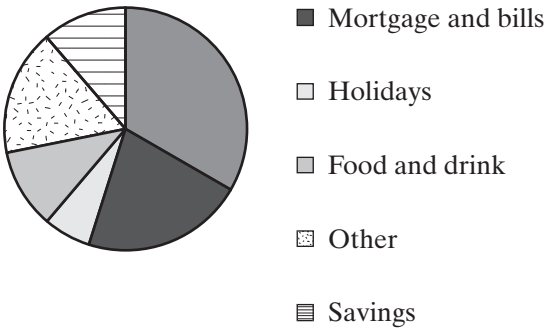
3



4



5

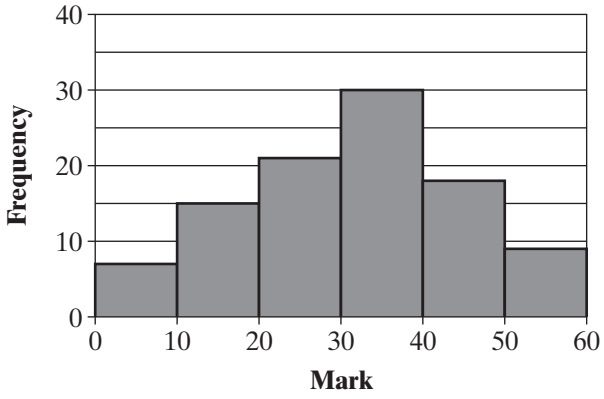


6 **a)** sleeping
b) **(i)** 6 hours
(ii) 8 hours
(iii) 4 hours
(iv) 1 hour

7 **a)** **(i)** news
(ii) features
b) **(i)** broadsheet 5 pages, tabloid 10 pages
(ii) broadsheet 10 pages, tabloid 18 pages

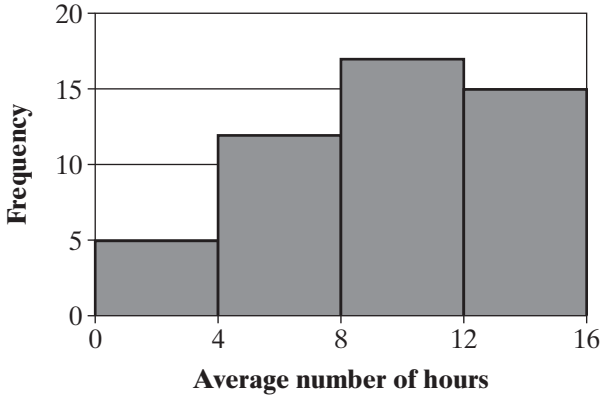
Exercise 21.3

1 **a)**

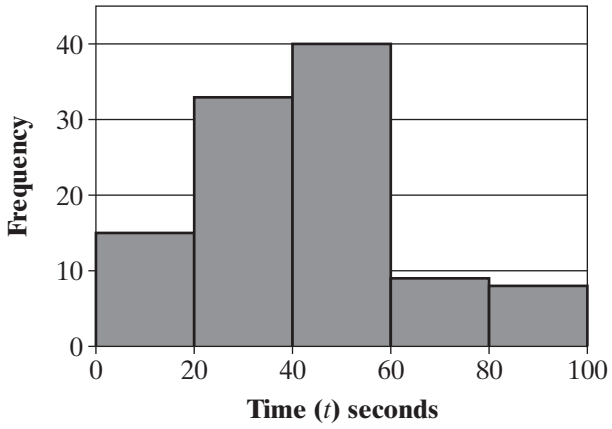


b) 100
c) $30 < m \leqslant 40$

2 **a)**

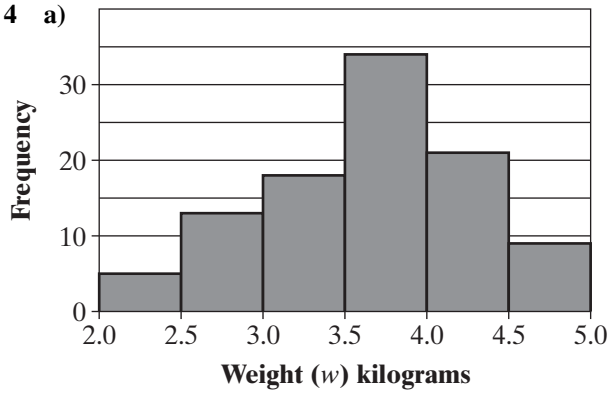


3 **a)**



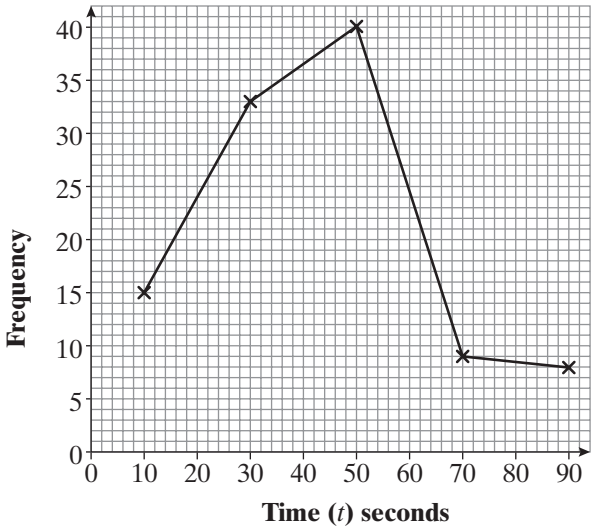
b) $40 < t \leqslant 60$ **c)** 105
d) 4490 seconds **e)** 42.8 seconds

4 **a)**

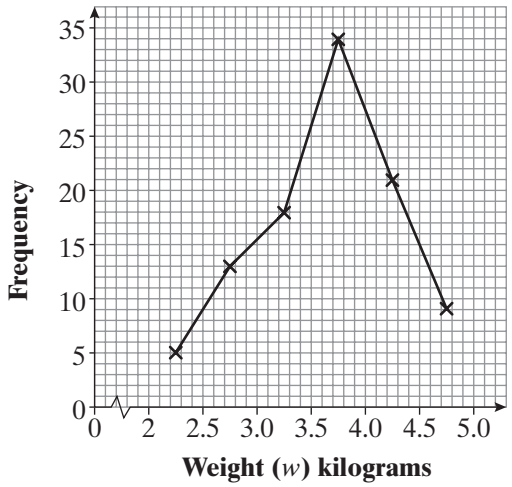


b) $3.5 \leqslant w < 4$ **c)** 3.65 kg
d) $3.5 \leqslant w < 4$

c)

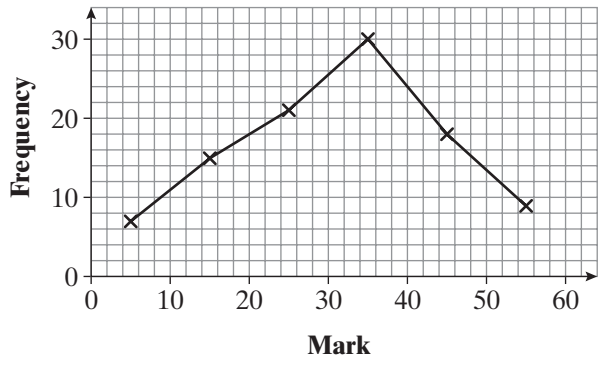


d)

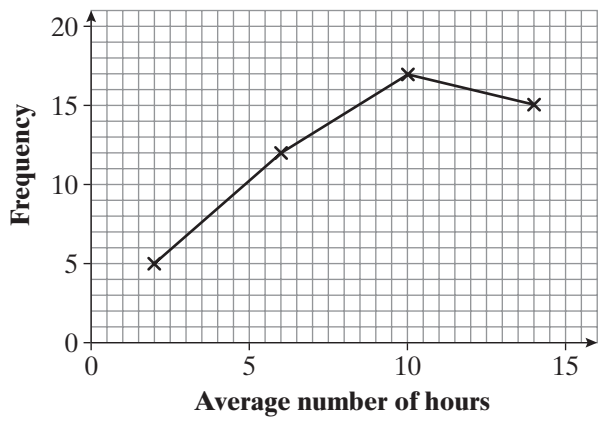


Exercise 21.4

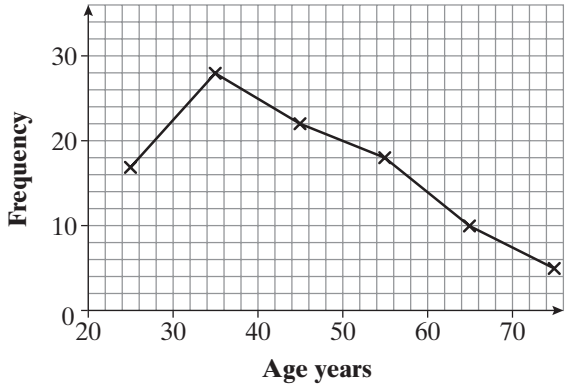
1 **a)**



b)

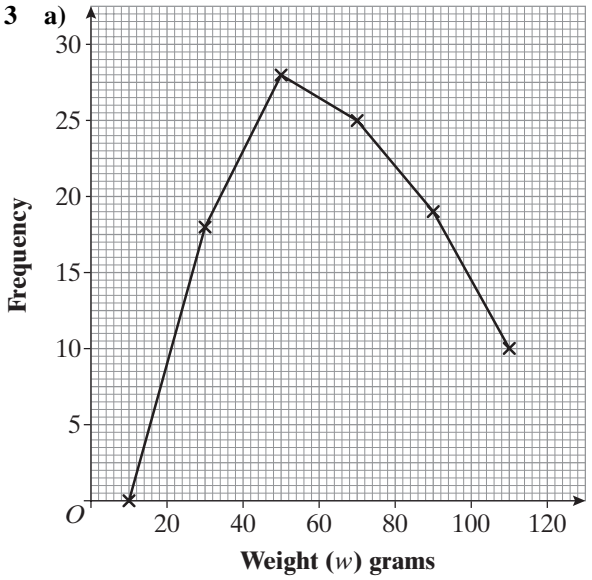


2 **a)**



b) $30 \leqslant y < 40$ **c)** $40 \leqslant y < 50$
d) 44.1 years

3 a)



b) 65 g

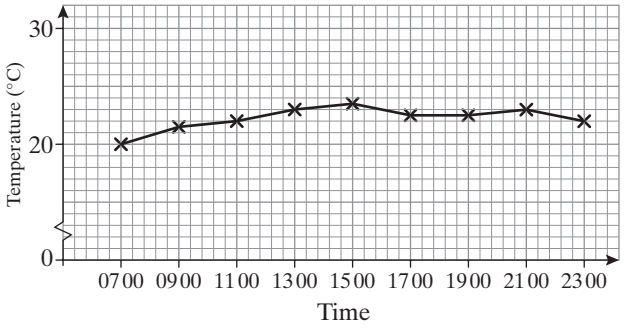
c) $60 \leqslant w < 80$

Exercise 21.5

1 a) 3.5 °C

b) (i) 22 °C **(ii)** 23 °C

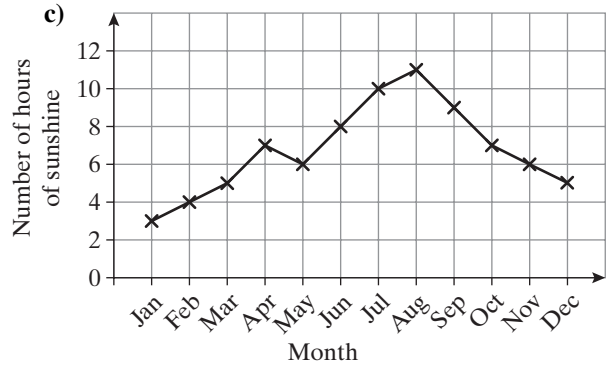
c)



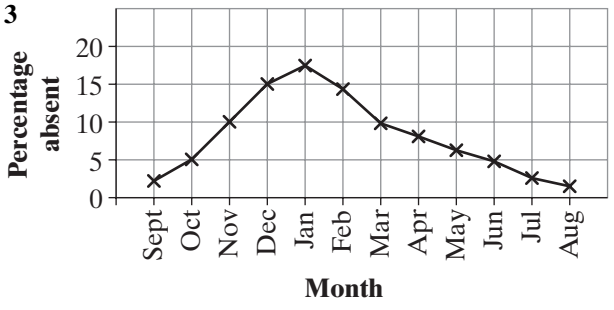
2 a) 8 hours

b) April and October

c)



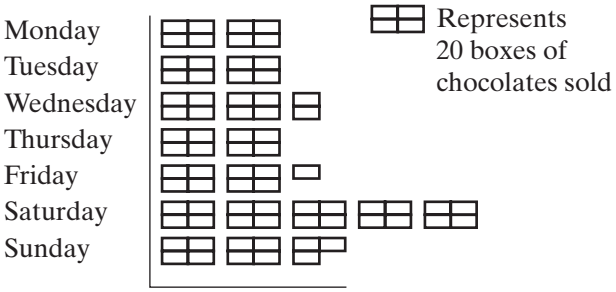
3



Review Exercise 21

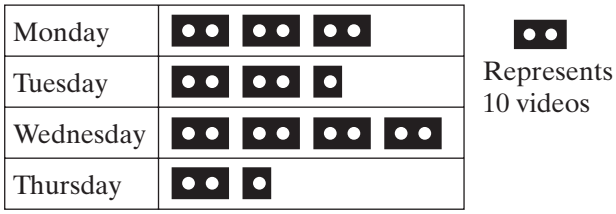
1 a) (i) 40 **(ii)** 50

b)

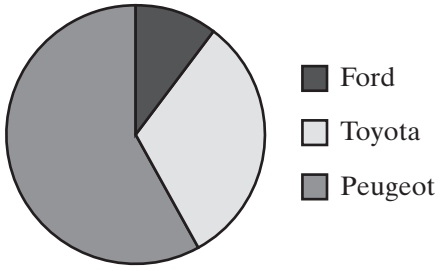


2 a) (i) 30 **(ii)** 25

b), c)



3

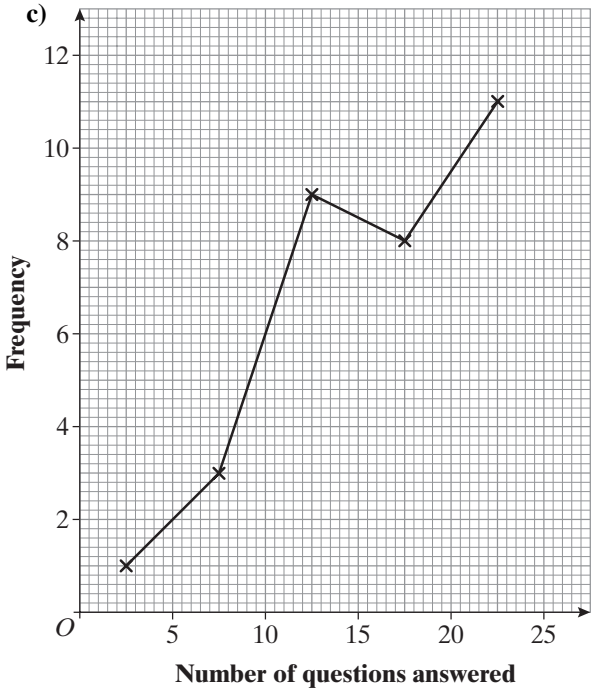


4 a) 7 °C **b)** 7 °C **c)** 4.5 °C

5 a) 21–25

b) 16–20

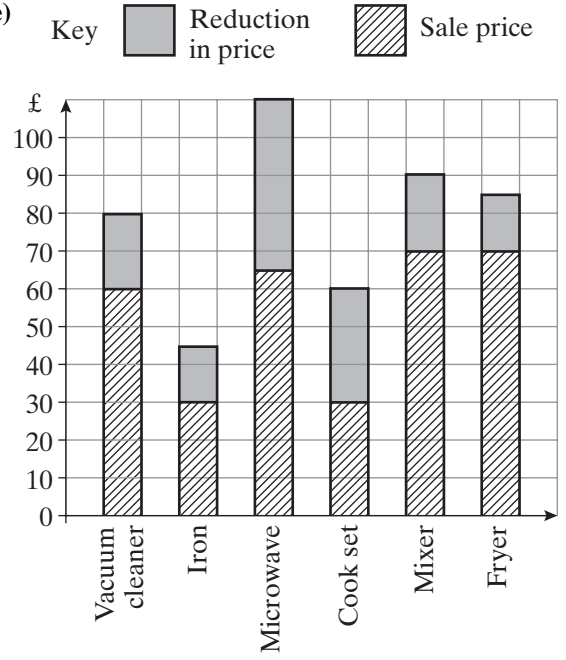
c)



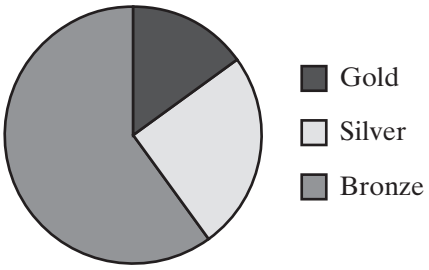
6 a) $\frac{3}{4}$ **b)** £15

c) Iron and cook set **d)** Microwave

e)

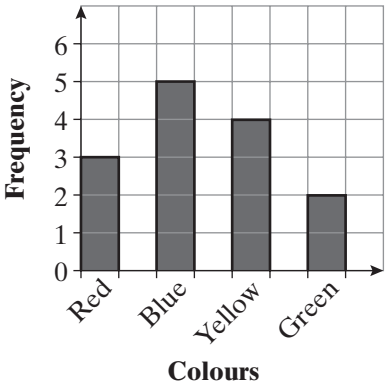


7



8 a) The number '1' is missing along the vertical axis
One of the bars isn't labelled.

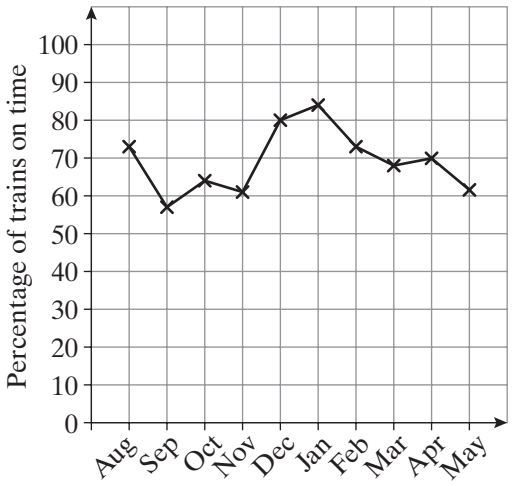
b)



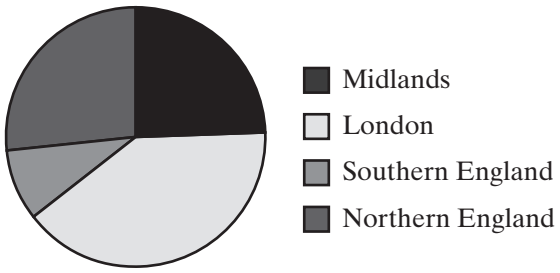
c) Blue **d)** 14 **e)** $\frac{3}{14}$

9 a) (i) 80% **(ii)** 58%

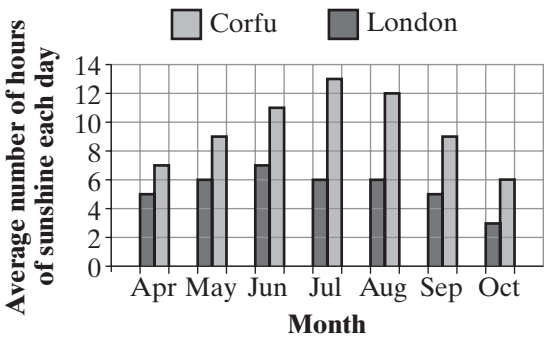
b)



10

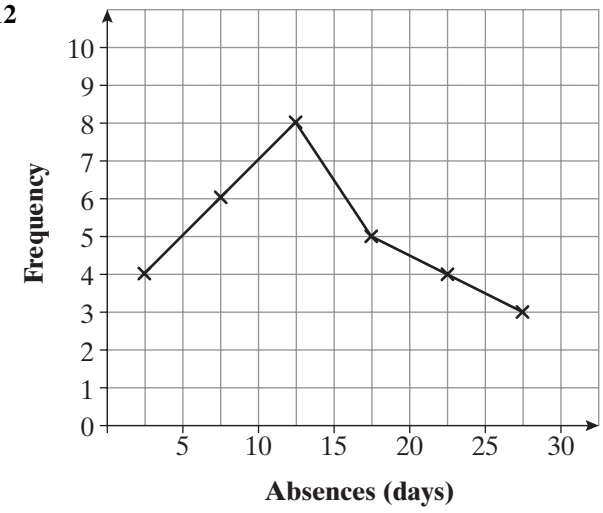


11 a) 6 hours
b) 9 hours
c) June
d)

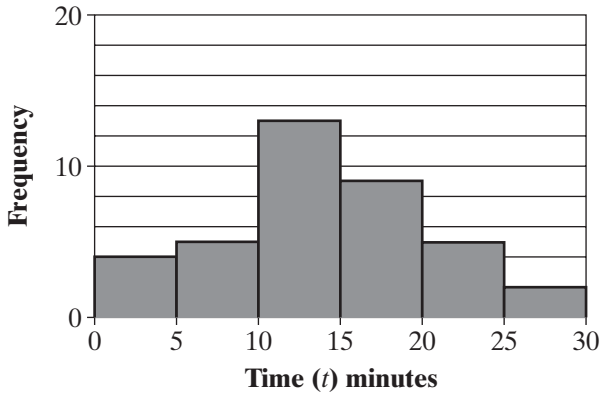


e) 270 hours

12



13 a)



b) $10 < t \leqslant 15$
c) 13.8 minutes
d) $10 < t \leqslant 15$

Internet Challenge 21

1 Benjamin Disraeli
2 Mark Twain
3 Oscar Wilde
4 WIE Gates
5 Rex Stout
6 JR 'Bob' Dobbs
7 H.G. Wells
8 Abraham Maslow
9 Joseph Stalin
10 Albert Einstein

Chapter 22: Probability

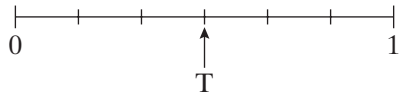
Starter 22

1 A: Yes, fair, since 2 heads and 2 tails have the same chance as 1 head and 1 tail.
B: No, not fair since a total of 6, 7, 8 or 9 is more likely.
2 Class discussion

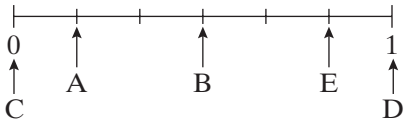
Exercise 22.1

1 a) $\frac{1}{7}$ **b)** $\frac{6}{7}$ **c)** 0

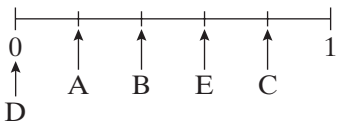
2



3 a)–e)



4 a)–e)



5 0.35
6 a) $\frac{15}{40} = \frac{3}{8}$ **b)** $\frac{31}{40}$ **c)** $\frac{16}{40} = \frac{2}{5}$
7 0.8
8 a) $\frac{10}{30} = \frac{1}{3}$ **b)** $\frac{20}{30} = \frac{2}{3}$ **c)** $\frac{5}{30} = \frac{1}{6}$

Exercise 22.2

1 a)

	Red	Blue	Total
Triangle	3	4	7
Cross	4	2	6
Total	7	6	13

b) $\frac{7}{13}$ **c)** $\frac{6}{13}$ **d)** $\frac{3}{13}$

2 a)

	Science	History	Total
Hardback	10	18	28
Paperback	20	32	52
Total	30	50	80

b) $\frac{10}{30} = \frac{1}{3}$ **c)** $\frac{32}{52} = \frac{8}{13}$
3 a) $\frac{3}{50}$ **b)** $\frac{21}{29}$
c) Disagree. Most pupils who arrived late came by bus so it is more likely to be a problem with the bus service

4 a)

	Tea	Coffee	Other	Total
Morning	78	32	0	110
Afternoon	22	48	20	90
Total	100	80	20	200

b) $\frac{32}{110} = \frac{16}{55}$ **c)** $\frac{22}{90} = \frac{11}{45}$

Exercise 22.3

1 a)

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

b) 36
c) (i) $\frac{1}{36}$ **(ii)** $\frac{6}{36} = \frac{1}{6}$ **(iii)** $\frac{3}{36} = \frac{1}{12}$
(iv) $\frac{31}{36}$ **(v)** $\frac{18}{36} = \frac{1}{2}$ **(vi)** $\frac{21}{36} = \frac{7}{12}$

2 a) T1, T2, T3, T4, T5, T6
H1, H2, H3, H4, H5, H6
b) (i) $\frac{1}{12}$ **(ii)** $\frac{3}{12} = \frac{1}{4}$

3 a)

×	1	2	3	4	5	6
1	1	2	3	4	5	6
2	2	4	6	8	10	12
3	3	6	9	12	15	18
4	4	8	12	16	20	24
5	5	10	15	20	25	30
6	6	12	18	24	30	36

b) 36
c) (i) $\frac{4}{36} = \frac{1}{9}$ **(ii)** $\frac{2}{36} = \frac{11}{18}$ **(iii)** $\frac{2}{36} = \frac{11}{18}$
(iv) $\frac{34}{36} = \frac{17}{18}$ **(v)** $\frac{27}{36} = \frac{3}{4}$ **(vi)** $\frac{10}{36} = \frac{15}{18}$

4 a) soup, beef, pie
soup, beef, cake
soup, pasta, pie
soup, pasta, cake
soup, fish, pie
soup, fish, cake
b) (i) $\frac{1}{3}$ **(ii)** $\frac{1}{6}$ **(iii)** 1

5 a)

Difference	1	2	3	4	5	6
1	0	1	2	3	4	5
2	1	0	1	2	3	4
3	2	1	0	1	2	3
4	3	2	1	0	1	2
5	4	3	2	1	0	1
6	5	4	3	2	1	0

b) 36

c) **(i)** $\frac{1}{6}$ **(ii)** $\frac{1}{9}$ **(iii)** $\frac{1}{6}$
(iv) $\frac{5}{6}$ **(v)** $\frac{1}{2}$ **(vi)** $\frac{5}{9}$

6 **a)** red triangle, red circle
red triangle, blue square
blue triangle, red circle
blue triangle, blue square
red square, red circle
red square, blue square

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

7 **a)** (1, 2, 3), (1, 2, 4), (1, 2, 9), (1, 6, 3), (1, 6, 4), (1, 6, 9), (7, 2, 3), (7, 2, 4), (7, 2, 9), (7, 6, 3), (7, 6, 4), (7, 6, 9)

b) $\frac{1}{12}$ **c)** $\frac{1}{2}$ **d)** $\frac{1}{2}$ **e)** $\frac{1}{4}$ **f)** $\frac{1}{3}$

Exercise 22.4

1 200

2 2

3 **a)** $\frac{3}{10}$ **b)** $\frac{1}{10}$ **c)** $\frac{7}{10}$

4 **a)** 0.3 **b)** 9

5 **a)** $\frac{1}{20}$ **b)** 5

6 **a)** $\frac{6}{25}$ **b)** 96

7 **a)** $\frac{2}{25}$ **b)** 28

8 **a)** $\frac{3}{5}$ **b)** 288

c) Class 10G might not be representative of the whole school.

Exercise 22.5

1 0.1

2 0.45

3 **a)** $\frac{4}{7}$ **b)** 40

4 **a)** 0.3 **b)** 0.3 **c)** 0.6

5 **a)** 0.2 **b)** 0.9 **c)** 0.2 **d)** 0.6

6 **a)** 0.3

b) Have a pizza

c) 0.75

7 **a)**

Type of bird	Blackbird	Sparrow	Starling	Robin
Probability	0.35	0.25	0.3	0.1

b) Blackbird **c)** **(i)** 0.65 **(ii)** 0.55

8 **a)** 0.1 **b)** 0.6

9 **a)** 0.3 **b)** 0.4

10 **a)** 0.42 **b)** 0.58

11 **a)** 0.7 **b)** 0.3 **c)** 0.15

12 **a)**

Year group	First Year	Second Year	Third Year
Probability	36%	33%	31%

b) 144

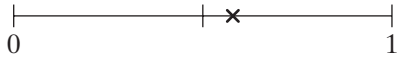
13 **a)** 0.2 **b)** 70

Review Exercise 22

1 **a)** April and May **b)** Daffodils
c) February **d)** Tulip

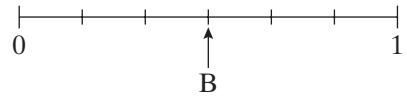
e) **(i)** $\frac{1}{5}$

(ii)



2 $\frac{9}{20}$

3 **a)**



b) **(i)** (1, black), (2, black), (3, black), (4, black), (5, black), (6, black), (1, white), (2, white), (3, white), (4, white), (5, white), (6, white)

(ii) $\frac{1}{12}$

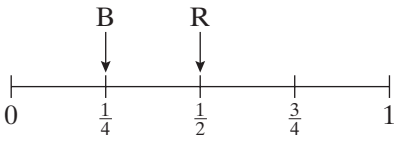
4 40

5 **a)** **(i)** 0.2 **(ii)** 2

b) 40

6 0.45

7 **a)**



b) There is no green, so P(green) = 0

8 **a)**

	White	**Black**
Circle	3	4
Square	6	5

b) $\frac{5}{18}$

9 **a)** $\frac{1}{2}$ **b)** $\frac{7}{20}$

10 $\frac{3}{8}$

11 **a)**

		Spinner B			
	×	1	2	3	4
Spinner A	1	1	2	3	4
	2	2	4	6	8
	3	3	6	9	12

b) $\frac{1}{6}$ **c)** $\frac{1}{3}$

12 **a)** $\frac{12}{25}$ **b)** $\frac{1}{5}$

13 **a)** **(i)** $\frac{1}{2}$ **(ii)** 0 **(iii)** $\frac{7}{20}$

b) $\frac{3}{4}$

14 **a)**

+	**1**	**2**	**3**	**4**	**5**	**6**
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10

b) **(i)** $\frac{1}{6}$ **(ii)** $\frac{5}{12}$ **(iii)** $\frac{1}{2}$ **(iv)** $\frac{1}{4}$

15 **a)**

	France	**Germany**	**Spain**	**Total**
Female	2	23	9	34
Male	15	2	9	26
Total	17	25	18	60

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

16 **a)** $\frac{1}{2}$

b) Throwing a coin is a random event.

17 **a)** 0.91 **b)** 3 sixes

18 0.45

19 **a)** 0.93 **b)** 0.39 **c)** 15

20 **a)** (1, H), (2, H), (3, H), (4, H), (5, H), (1, T),(2, T), (3, T), (4, T), (5, T)

b) **(i)** 0.14 **(ii)** 0 **(iii)** 1 **(iv)** 0.25

21 **a)** **(i)** 0.2 **(ii)** 0

b) 40

Internet Challenge 22