ii $y = 1.5$

$4(2 \times 1.5 + 3) - 5 \times 1.5 < 18 - 1.5$

$16.5 < 16.5$

False

iii $y = 2$

$4(2 \times 2 + 3) - 5 \times 2 < 18 - 2$

$18 < 16$

False

9 **a** $a < 3.5$ **b** $b \geqslant 11$

c $c \leqslant 6$ **d** $d > -27$

Learner's checks for each solution.

10 **a** $5n + 5 \leqslant 30$ **b** $n \leqslant 5$

c 5, 12 and 13

11 **a** Learner's own answer. For example: To make the x positive, Sergey adds x to both sides and subtracts six from both sides. He then rewrites the final inequality with the x on the left and so he has to change the $<$ to $>$. To make the x positive, Natalia divides both sides by -1, but this has the effect of changing the $<$ to $>$.

b Learner's own answers.

c Learner's own answer. For example:

$2(x - 8) \geqslant 4x - 26$

$2x - 16 \geqslant 4x - 26$

$2x - 4x \geqslant -26 + 16$

$-2x \geqslant -10$

$10 \geqslant 2x$

$5 \geqslant x$

$x \leqslant 5$

12 **a** $x > -4$ or $-4 < x$

b $x \geqslant 5$ or $5 \leqslant x$

c $x > 6$ or $6 < x$

d $x \leqslant -13$ or $-13 \geqslant x$

e $x < 4$ or $4 > x$

f $x \geqslant -2$ or $-2 \leqslant x$

13 **a** $3x - 7 < 4x - 11$

b For example:

$3x - 7 < 4x - 11$

$-7 + 11 < 4x - 3x$

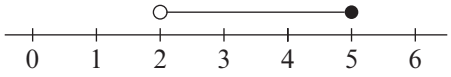
$4 < x$

$x > 4$

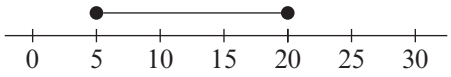
c When $x = 5$, $3 \times 5 - 7 < 4 \times 5 - 11$ $8 < 9$ True

When $x = 4$, $3 \times 4 - 7 < 4 \times 4 - 11$ $5 < 5$ False

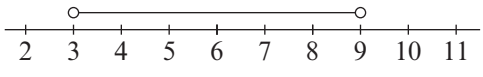
14 **a** $2 < x \leqslant 5$



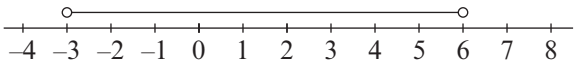
b $5 \leqslant y \leqslant 20$



c $3 < n < 9$



d $-3 < m < 6$



Check your progress

1 **a** $x = -4$ **b** $a = -2.5$ **c** $x = 2.4$

d $y = 9$ **e** $m = 16$ **f** $n = 10$

Learner's own checks for each solution.

2 $x = 5$, $y = 19$

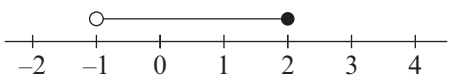
3 $x = 19$, $y = 7$

4 **a** $a < 2$ **b** $b \geqslant 5$

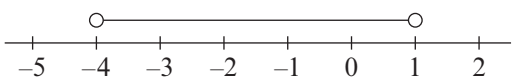
c $c > -1$ **d** $d \geqslant -5$

Learner's own checks for each solution.

5 **a** $-1 < x \leqslant 2$



b $-4 < n < 1$



Unit 5 Getting started

1 140°

2 62°

3 **a** a and d OR b and e OR c and f

b c and d

c a and c OR d and f

4 The angle next to $a = c$ (alternate angles); the third angle at the same point is b (corresponding angles); the 3 angles on a line have a sum of 180°.

5 **a** Learner's own diagram.

b Each angle should be 37.5°.

c Learner's own check.

Exercise 5.1

1 60°, 25°, 95°

2 **a** $x = 36$, $y = 50$ **b** 122°

c $A + B + C + D = 116° + 72° + 122° + 50° = 360°$

3 $a = 40°$, $b = 30°$, $c = 70°$, $d = 120°$

4 75

5 **a** Trapezium. One pair of parallel sides.

b $A = 60°$, $B = 120°$, $C = 135°$, $D = 45°$

6 $C = 40°$, $B = D = 100°$, $A = 120°$

7 **a** 54° (angle of isosceles triangle AOB)

b 36° (angle BOC is 108° and triangle OBC is isosceles)

c $90° = 54° + 36°$

8 $x = 65°$ (angles on a straight line); $y = 45° = 115°$ (corresponding angles) $- 70°$ (alternate angles)

9 105°

Reflection: Learner's own answer

10 **a** $45° + 51° = 96°$

b $A + B + C + D = 96° + 65° + 127° + 72° = 360°$

Exercise 5.2

1 110°

2 40°

3 136°

4 **a** 103° **b** 128°

5 **a** 88° **b** 128°

6 **a, b** Learner's own diagram of a hexagon split into four triangles.

c $4 \times 180° = 720°$ **d** 120°

7 **a** 109° **b** 100

8 **a** Six triangles; $6 \times 180° = 1080°$

b Eight triangles; $8 \times 180° = 1440°$

9 **a**

Polygon	Number of sides	Sum of interior angles
triangle	3	180°
quadrilateral	4	360°
pentagon	5	540°
hexagon	6	720°
octagon	8	1080°
decagon	10	1440°

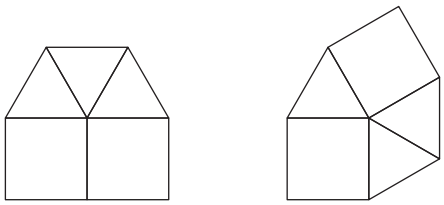
b The sum of the angles $= (n - 2) \times 180°$

c $7 \times 180° = 1260°$; correct because there are seven triangles.

10 **a** 100° **b** 135°

11 144°

12 **a, b** There are two ways:



The second way could be drawn in a reflected form.

c There is no other way. Either the two squares are adjacent or they have one triangle between them on one side and two triangles between them on the other side. This way will look different if it is reflected, but it is still the same arrangement.

13 **a** Learner's own diagram of a regular arrangement of triangles.

b Learner's own diagram of a regular arrangement of hexagons.

c Because 108° is not a factor of 360°.

d Learner's tessellations based on the two drawings in Question **12**.

e Learner's own diagram: two octagons (135° angle) and one square (90°) at every point.

f Learner's own answer.

Reflection: In this case, subtract the 360° at the centre. $5 \times 180 - 360 = 540$ gives the same answer.

Exercise 5.3

1 **a–c** Learner's own diagram and explanation. The explanation is the same as for a pentagon. Walking round the hexagon you turn through each angle in turn and the total is 360°.

2 $a = 99°$; $b = 112°$; $c = 125°$

3 **a** Yes, vertically opposite angles.

b Yes. They are not all on the same side, but the vertically opposite angles will be the same as you walk round the quadrilateral.

4 **a** 120° **b** 90° **c** 72°

5 **a** 360° **b** $360 \div 8 = 45°$

6 **a**

Regular polygon	Sides	Exterior angle
Equilateral triangle	3	120°
Square	4	90°
Regular pentagon	5	72°
Regular hexagon	6	60°
Regular octagon	8	45°
Regular decagon	10	36°

b The exterior angle $= 360 \div n$ degrees

c **i** 30° **ii** 18°

7 **a** 9 **b** 140°

8 **a** **i** 150° **ii** 160° **iii** 170°

b **i** 12 **ii** 18 **iii** 36

9 15 sides

10 **a** 8 **b** 12 **c** 20 **d** 24

11 **a** $360 - 2 \times 135 = 90$

b Learner's own diagram.

12 $(360 - 60) \div 2 = 150°$ is the interior angle. The exterior angle is $180 - 150 = 30°$. The number of sides is $360 \div 30 = 12$.

13 Interior angle 168° means exterior angle 12° and $360 \div 12 = 30$ so it has 30 sides. Interior angle 170° means exterior angle 10° and $360 \div 10 = 36$ so it has 36 sides. But interior angle 169° means exterior angle 11° and 11 is not a factor of 360 so that is not possible.

Reflection: Yes they do. Check with some values for n. It is easier to see if you write $(n - 2) \times 180 \div n$ as $(180n - 360) \div n$

Exercise 5.4

The answers to all the questions in this exercise are diagrams. Each question asks the learner to check their accuracy either by measuring themselves or by asking a partner to measure.

Question **12** asks learners to think about whether there are different ways to complete the construction. They should be able to decide which method is easier or more likely to give an accurate drawing.

Exercise 5.5

1 **a** 10 cm **b** 13 cm **c** 17 cm

2 **a** 4.3 cm **b** 12.1 cm **c** 14.2 cm

3 **a** 12 cm **b** 4.8 m **c** 75 mm

4 **a** 6.6 cm **b** 5.0 cm **c** 13.5 m

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

d Learner's own diagram. A continuation of the spiral pattern.

e The 3rd hypotenuse is 2, the 8th hypotenuse is 3 and the 15th hypotenuse is 4.

6 **a** $\sqrt{39^2 + 70^2} = 80$ cm to the nearest cm.

b $\sqrt{105^2 + 58^2} = 120$ cm to the nearest cm.

7 $\sqrt{3.50^2 - 0.91^2} = 3.38$ m to the nearest cm.

8 **a** Learner's drawing.

b $5.1^2 + 6.8^2 = 8.5^2$, so it is a right-angled triangle.

c $5.1^2 + 6.8^2 = 72.25 = 8.5^2$. The triangle satisfies Pythagoras' theorem, and so is right-angled.

9 Either $\sqrt{15^2 + 20^2} = 25$ cm or $\sqrt{20^2 - 15^2} = 13.2$ cm to 1 d.p.

10 **a** $90 + 40 = 130$ m

b $130 - \sqrt{(90^2 + 40^2)} = 31.5$ m to 1 d.p.

11 **a** Square perimeter $= 4 \times 25 = 100$ mm, rectangle perimeter $= (2 \times 20) + (2 \times 30) = 40 + 60 = 100$ mm

b Diagonal of square = 35.4 mm; diagonal of rectangle = 36.1 mm

c Learner's diagram and value.

d The values so far support Sofia's conjecture and any further values should too. The square has the minimum diagonal for a given perimeter. All the examples here are for a perimeter of 100 mm, but it is true for any given perimeter.

12 There are two possible answers. Either the two shorter sides are 1 and 4 OR the hypotenuse is 9 and one of the other sides is 8.

13 a $7.5^2 + 5.5^2 = 86.5$ and so length of diagonal $= \sqrt{86.5}$.

b $x^2 + 5.5^2 = x^2 + 30.25$ and so length of diagonal $= \sqrt{x^2 + 30.25}$.

c $d = \sqrt{x^2 + y^2}$

14 a i $\sqrt{7^2 + 7^2} = \sqrt{98}$

ii $\sqrt{98} = \sqrt{49 \times 2} = \sqrt{7^2 \times 2} = 7\sqrt{2}$

b $\sqrt{x^2 + x^2} = \sqrt{2x^2} = x\sqrt{2}$

Check your progress

1 $a = 65$. The reason could use corresponding angles and the exterior angle of a triangle.

2 116° ($x = 106$)

3 10 sides

4 a Learner's own diagram.

b Each side should be 8.5 cm.

5 35 m or 35.3 m or 35.36 m are possible answers.

6 $x = 10$ and $y = 24$

Unit 6 Getting started

In many questions these are suggested answers and there are many other possibilities. It is not possible to give a complete list of answers.

1 Learner's own answers.

a For example: length or width.

b For example: number of doors or passenger seats.

c For example: colour or manufacturer.

2 Learner's own answer. For example: Using random numbers of position on the register. It could include a specific number from each year group.

3 A number is assigned to each person. 50 numbers between 1 and 632 are generated. Any number that is a repeat is ignored.

Exercise 6.1

These are suggested answers but there are many other possibilities. It is not possible to give a complete list of answers.

1 Learner's own answers.

a For example: Can boys estimate more accurately than girls? Can learners estimate acute angles more accurately than obtuse angles? Can learners accurately estimate how long one minute is?

b For example: Girls can estimate the length of a short line more accurately than boys. Older learners can estimate an obtuse angle more accurately than younger learners. Learners tend to underestimate one minute of time.

c Learner's own answers. This will depend on the predictions. For example: Methods could take names from a hat or use random numbers. The method could take learners from different groups in the school.

d Learner's own answer and explanation.

e Learner's own answer.

f Learner's own generalisation, depending on their data.

2 Learner's own answers.

a For example: Are lessons too long? Are there too many lessons in a day? Should school start earlier in the day?

b For example: Learners want longer lessons. Learners want fewer lessons in a day. Learners would prefer to start school one hour later.

c Learner's own answers. This will depend on the predictions. For example: The method could take learners from different groups in the school.

d Learner's own answer and explanation.

e Learner's own answer.

f Learner's own generalisation, depending on their data.