PART 3

UNIT 14

SPRING second half

SHAPE AND SPACE

UNIT 14

SHAPE AND SPACE

SUGGESTED TIME **5 hours**

TEACHING OBJECTIVES

- Recognise reflective symmetry and reflect shapes in a mirror line.
- Measure and draw lines to the nearest millimetre.
- Recognise directions, and perpendicular and parallel lines.
- Understand and use degrees.
- Use a protractor to measure and draw acute and obtuse angles to nearest 1°.
- Calculate angles on a straight line.
- Identify, estimate and order acute and obtuse angles.
- Make patterns from rotating shapes.
- Recognise and explain patterns and relationships, generalise and predict.

HOMEWORK

- Section 1, Star Challenges 1 and 2 on symmetry.
- Section 3, Star Challenge 5 is designed to reinforce mathematical language.
- Consolidate the use of a protractor to measure and draw angles.

Unit 14 Checklist for pupils

Line symmetry and reflection

You will:

- recognise reflective symmetry ☐
- reflect shapes in a mirror line ☐

Measuring angles

You will:

- use a protractor to measure angles to the nearest degree ☐

Naming and estimating angles

You will:

- classify angles according to type and size ☐
- estimate the size of angles ☐

Drawing angles

You will:

- draw angles to the nearest degree ☐
- draw and measure lines to the nearest millimetre ☐

Calculations involving angles

You will:

- use the fact that angles on a straight line add up to 180° ☐
- work out the size of unknown angles without using a protractor ☐

UNIT 14

SECTION 1: LINE SYMMETRY AND REFLECTION

DIRECT TEACHING POINTS

- Provide opportunities for practical work to reinforce this learning.
- Illustrate line symmetry in a variety of contexts and check pupils' understanding. It is important to demonstrate examples where the line of symmetry is not parallel to the edge of the page – exercise 3.
- Star Challenges 1 and 2 illustrate the level of difficulty required at Level 4.

mirror line *line symmetry* *reflect* *reflection*

UNIT 14

Line symmetry and reflection

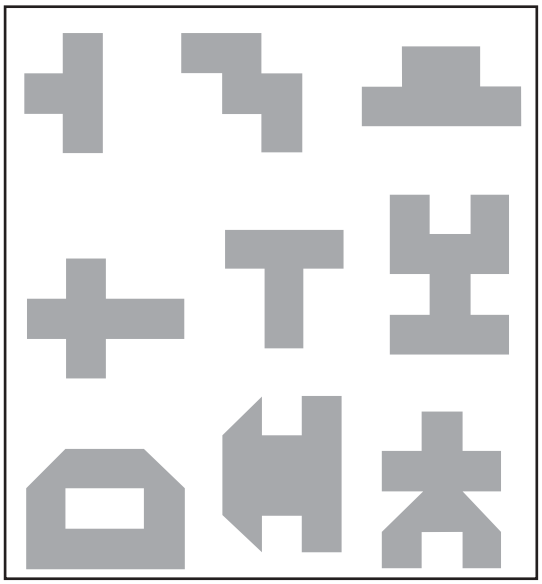
1 Finding lines of symmetry

Mirror

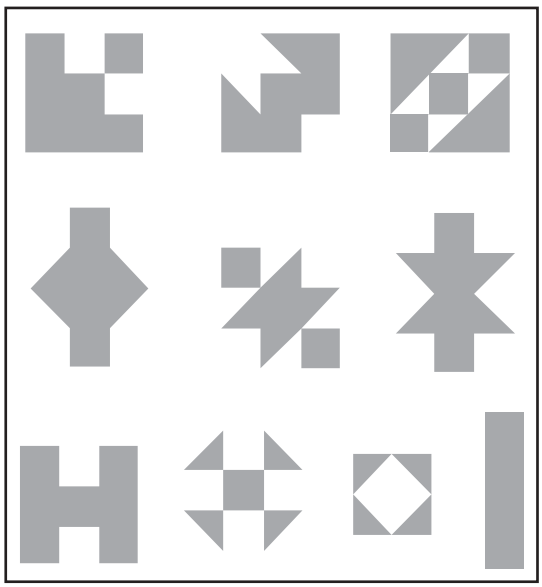
Lines of symmetry are also called mirror lines.

They are usually drawn like this ⟷

1 Draw in ONE line of symmetry on each shape below:



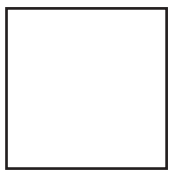
2 Draw in ALL lines of symmetry on the shapes below:



3 Draw in any lines of symmetry in these road signs:

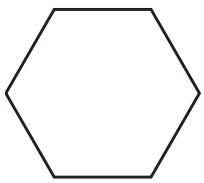
A B C D E F G

4 Regular polygons



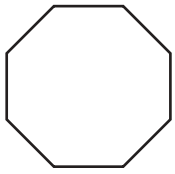
A square has 4 lines of symmetry

Draw them.



A regular hexagon has 6 lines of symmetry

Draw them.



A regular octagon has 8 lines of symmetry

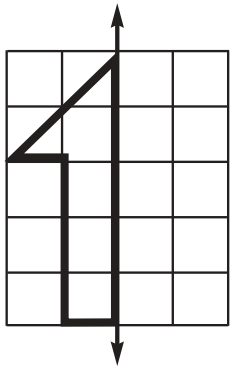
Draw them.

UNIT 14

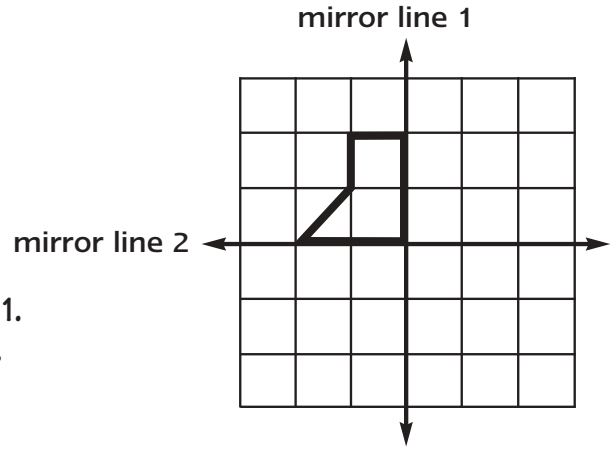
Line symmetry and reflection

2 Mirror images

Mirror



1 This picture shows half a shape.
Draw in the reflected shape, then check it with your mirror.



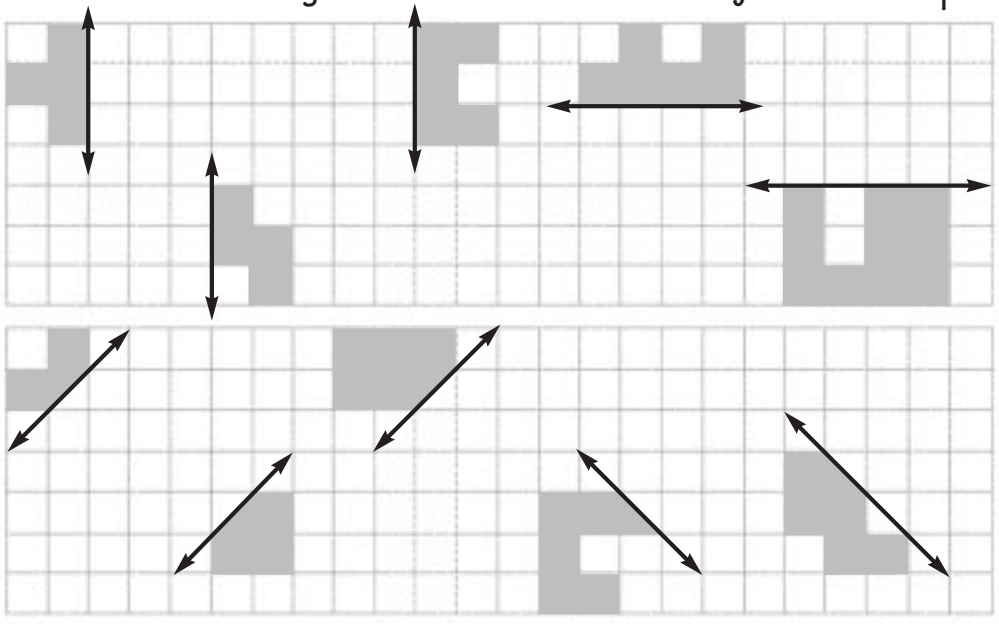
2 Two mirror lines

Reflect the shape in mirror line 1.
Put your mirror on mirror line 2.
Draw in their reflected shape.

3 Make symmetric shapes

Mirror

Reflect each shading in the mirror line to make symmetric shapes:



UNIT 14

Line symmetry and reflection

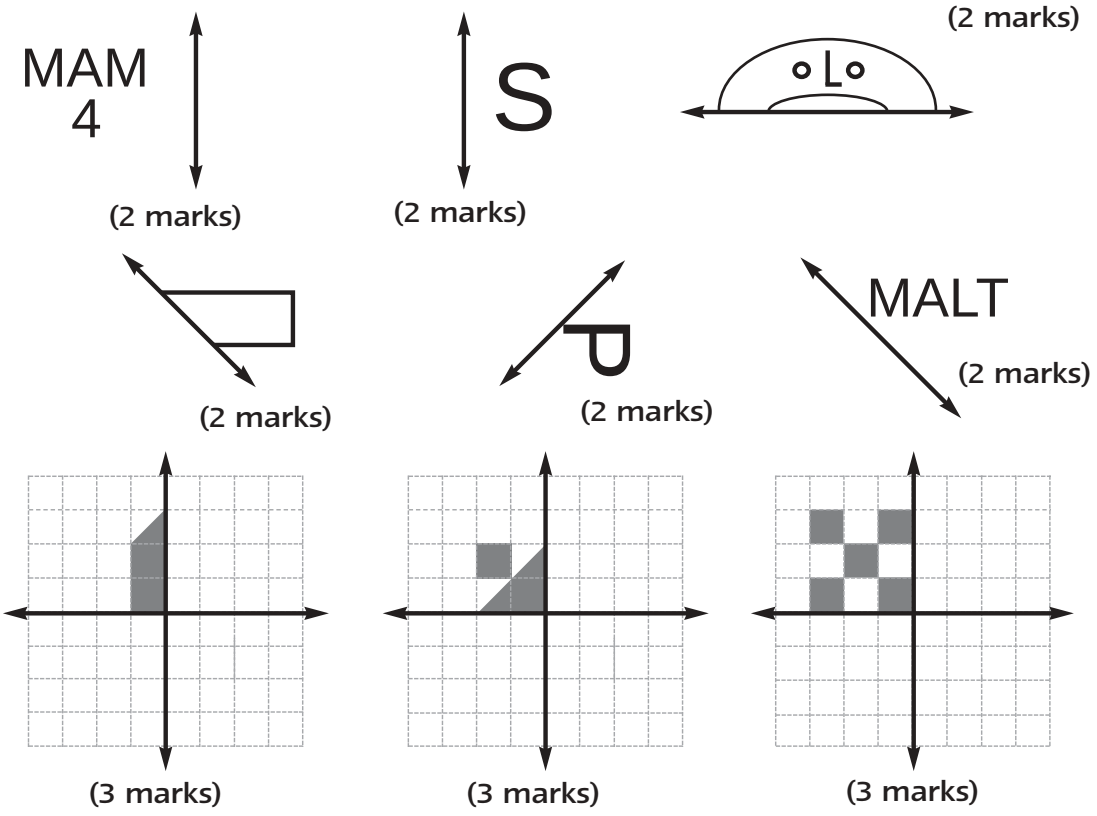
STAR CHALLENGE 1

Getting more difficult

Mirror

21 marks 2 stars
16-20 marks 1 star

Reflect each shape in the mirror line(s):



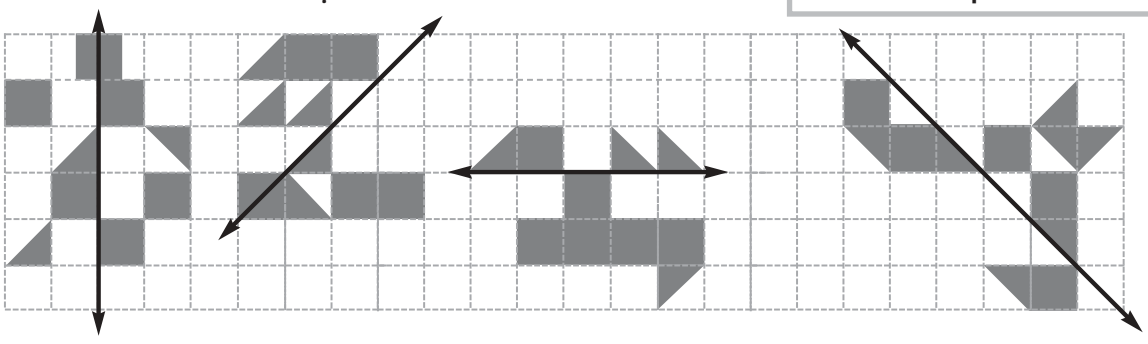
STAR CHALLENGE 2

A real challenge!

Mirror

4 correct shapes 3 stars
3 correct shapes 2 stars
2 correct shapes 1 star

Reflect each shape BOTH WAYS in the mirror line to create symmetric patterns:

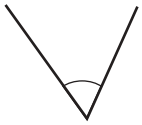


UNIT 14

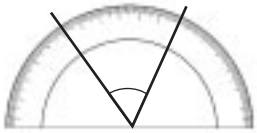
SECTIONS 2, 3 AND 4: MEASURING ANGLES NAMING AND ESTIMATING ANGLES DRAWING ANGLES

DIRECT TEACHING POINTS

- Consolidate measuring length (from Unit 2) before going on to measure angles.
- Clarify the meaning of angle as 'a measure of turn' and correct any misconceptions about its size being related to the length of the arms.
- Use an OHP to demonstrate the use of a protractor. Emphasise the correct use of the scale. Provide opportunities for pupils to use protractors with increasing accuracy.



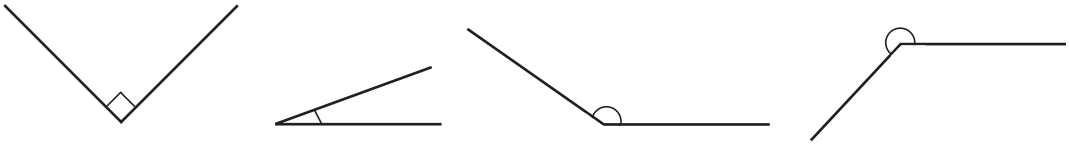
Measure this angle.



I put the protractor like this.

What did I do wrong?

- Teach the classification of angles and the use of correct vocabulary. Exercise 1 provides practice.



A right angle = 90°

An acute angle is less than 90°

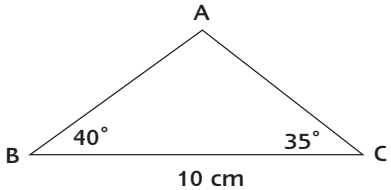
An obtuse angle is between 90° and 180°

A reflex angle is bigger than 180°

- Model how to estimate the size of an angle using 'benchmarks' such as 90°, 180°, and 45°. Exercise 2 and Star Challenge 4 provide examples for discussion. Pupils need immediate feedback on their estimates in order to improve this important skill.
- Demonstrate the construction of triangles as in Section 4 exercise 1.

This is a sketch of a triangle. It is not drawn accurately.
You are going to draw the triangle accurately

Start with the line BC, which is 10 cm long. Draw angle B, which is 40°, then angle C, which is 35°. Extend the lines made by these angles so they cross. This is point A.



- Star Challenge 7 is quite demanding. You may need to consolidate basic ideas with some pupils.

KEY VOCABULARY TO LEARN AND USE

construct accurately straight line right angle degree acute angle obtuse angle reflex angle perpendicular parallel parallelogram angle full turn half turn quarter turn protractor

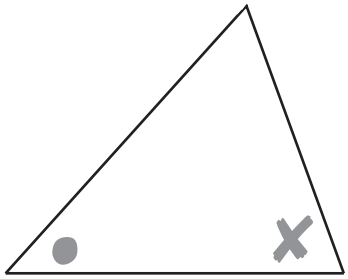
UNIT 14

Measuring angles

1 Measuring angles accurately

(a) Measure each angle ● as accurately as you can.
Write the answer next to the ●.

1



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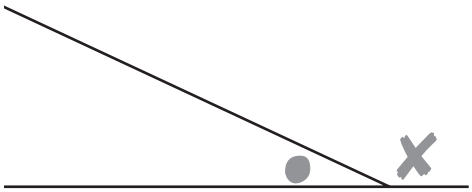

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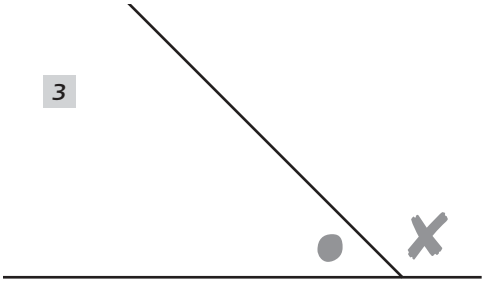
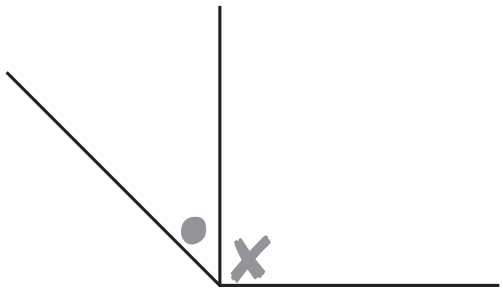
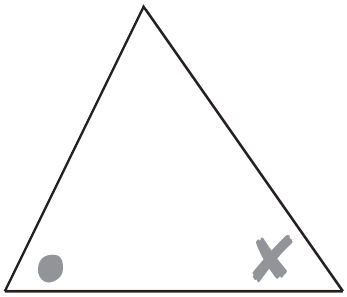


4



5



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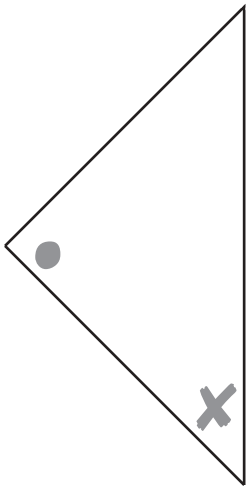
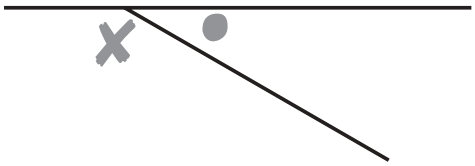


7



(b) Now measure each angle ✗ as accurately as you can.
Write the answer next to the ✗.

UNIT 14

Measuring angles

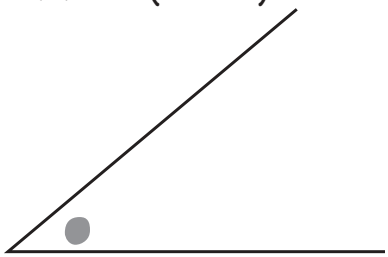
STAR CHALLENGE 3

Measuring angles

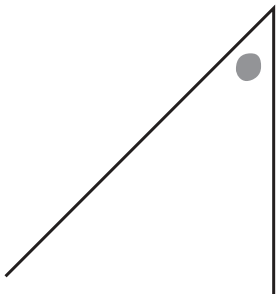
10 marks 3 stars
7-9 marks 2 stars
5-6 marks 1 star

1 Measure each of the angles ●.

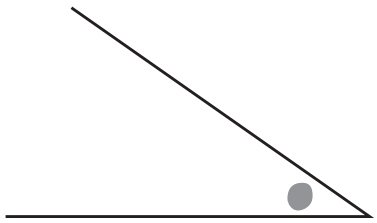
(a) (1 mark)



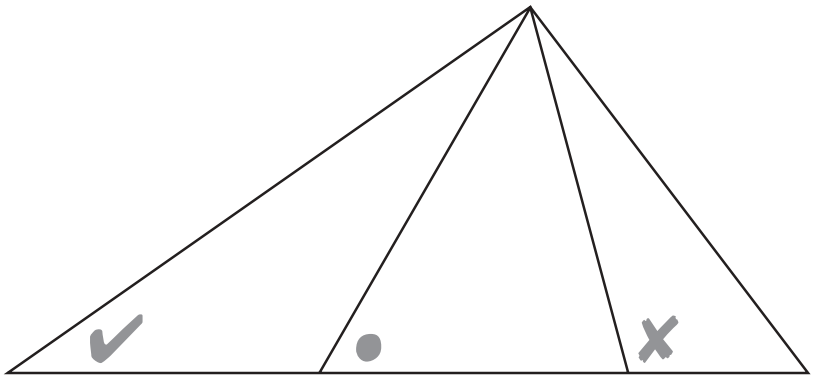
(b) (1 mark)



(c) (1 mark)



2 Measure all three marked angles: (3 marks)



3 Measure: (4 marks)

(a) the angle between the ladder and the ground.

(b) the angle between the ladder and the wall.

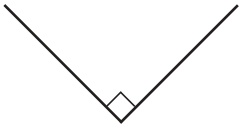
(c) the angle between the man's leg and the ladder.

(d) the angle between the top of the man's arm and the ladder.

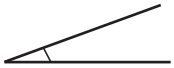
UNIT 14

Naming and estimating angles

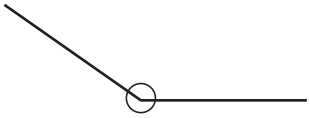
1 Types of angle



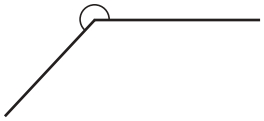
A **right angle** = 90°



An **acute angle** is less than 90°



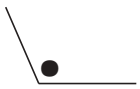
An **obtuse angle** is between 90° and 180°



A **reflex angle** is bigger than 180°

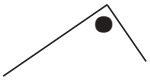
Is each marked angle **acute, obtuse, reflex** or a **right-angle?**

1



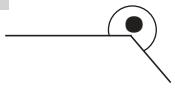
This angle is .....

4



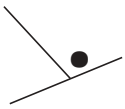
This angle is .....

7



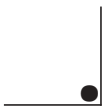
This angle is .....

10



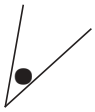
This angle is .....

2



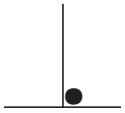
This angle is .....

5



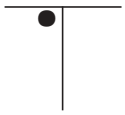
This angle is .....

8



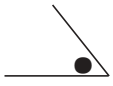
This angle is .....

11



This angle is .....

3



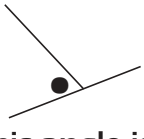
This angle is .....

6

● = 120°

This angle is .....

9



This angle is .....

12

● = 200°

This angle is .....

UNIT 14

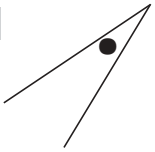
Naming and estimating angles

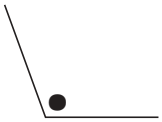
2 Estimating angles

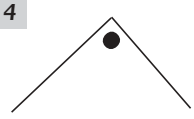
Estimate the size of each angle marked with a ●.

1

My estimate is .....

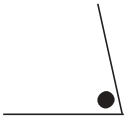
2

My estimate is .....

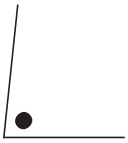
3

My estimate is .....

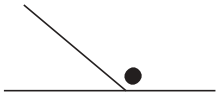
4

My estimate is .....

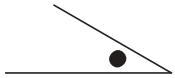
5

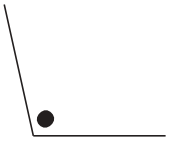
My estimate is .....

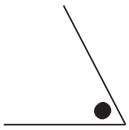
6

My estimate is .....

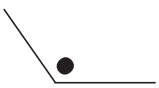
7

My estimate is .....

8

My estimate is .....

9

My estimate is .....

10

My estimate is .....

11

My estimate is .....

12

My estimate is .....

UNIT 14

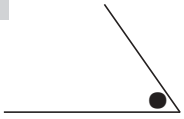
Naming and estimating angles

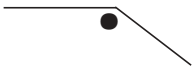
STAR CHALLENGE 4

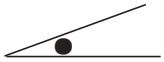
Estimation challenge

All correct 1 star

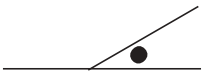
Estimate the size of each angle:

1 
My estimate is .....

2 
My estimate is .....

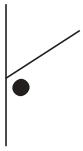
3 
My estimate is .....

4 
My estimate is .....

5 
My estimate is .....

6 
My estimate is .....

7 
My estimate is .....

8 
My estimate is .....

STAR CHALLENGE 5

Mathematical word shapes

7-9 correct 1 star

Illustrate some mathematical words by writing them as the shape they describe.

Example

A
C
U T E

(acute)

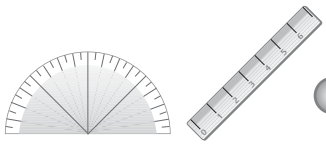
Try to do the same with these words:

OBTUSE	PARALLEL LINES	HALF TURN
FULL TURN	PERPENDICULAR	RIGHT ANGLE
PARALLELOGRAMS	TRIANGLE	REFLEX

UNIT 14

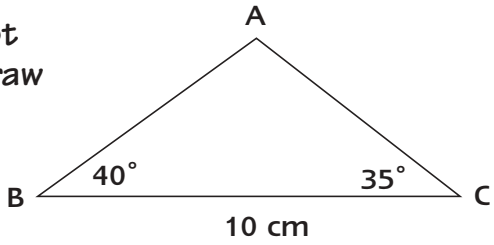
Drawing angles

1 Constructing accurate triangles



1 This is a sketch of a triangle. It is not drawn accurately. You are going to draw the triangle accurately.

Start with the line BC, which is 10 cm long. Draw angle B, which is 40°, then angle C, which is 35°. Extend the lines made by these angles so they cross. This is point A.

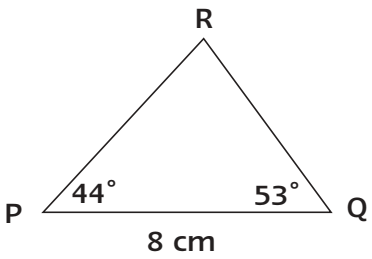


B C

Now measure the lengths of the lines AB and AC to the nearest 0.1 cm.

AB = ...•..... cm AC = ...•..... cm

2 Use the same method to draw triangle PQR accurately on the base line PQ below. Measure the other two sides of the triangle.



P Q

PR = ...•..... cm QR = ...•..... cm

UNIT 14

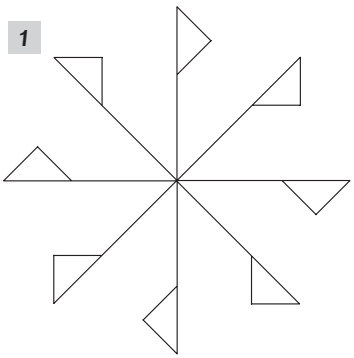
Drawing angles

STAR CHALLENGE 6

Rotating patterns

★

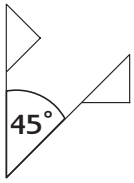
Both patterns accurately drawn 1 star

1 

Rifat made this rotating pattern.

She started with this flag.

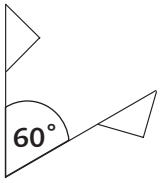
She drew a line at 45° to the stick of the flag to get this:



She then repeated the process.
Each flag is at 45° to the previous flag.

Copy this pattern in exactly the same way.
Make sure your angles are exactly 45°.

2 Make another rotating pattern with the same flag.
This time rotate the flag through 60°.



UNIT 14

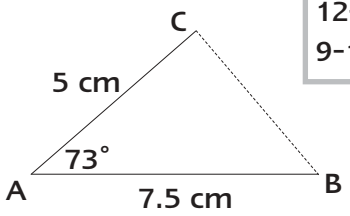
Drawing angles

STAR CHALLENGE 7

More triangles

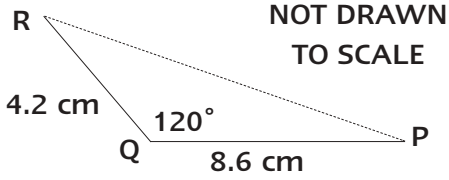
12–13 marks 2 stars
9–11 marks 1 star

1 Draw this diagram accurately.
Measure the length of BC.



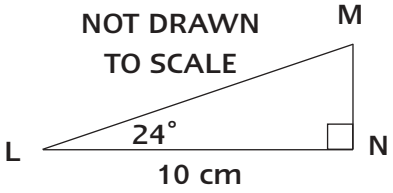
NOT DRAWN TO SCALE

2 Draw this diagram accurately.
Measure the length of PR.



NOT DRAWN TO SCALE

3 Draw this diagram accurately.
Measure the lengths of LM and MN.



NOT DRAWN TO SCALE

3 marks for each drawing. 1 mark for each measurement.

UNIT 14

SECTION 5: CALCULATIONS INVOLVING ANGLES

DIRECT TEACHING POINTS

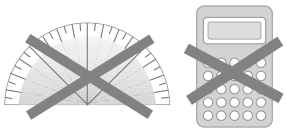
- Take opportunities to practise relevant mental calculation skills, for example complements of 90 and 180.
- Make sure that pupils know and can use the fact that angles on a straight line add up to 180°.
- Emphasise the difference between 'calculate' and 'measure'.

parallel *perpendicular* *straight line*
right angle

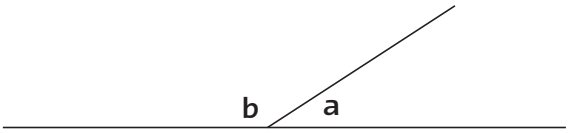
UNIT 14

Calculations involving angles

1 Angles on a straight line

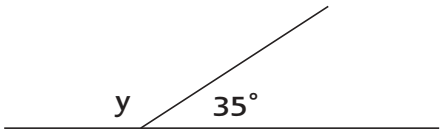


Angles on a straight line add up to 180°.

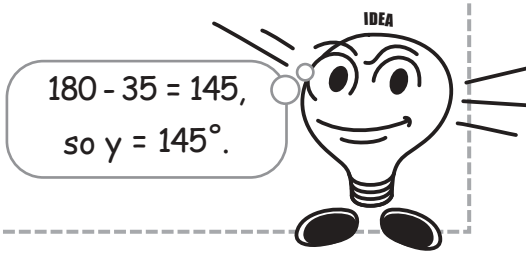


$a + b = 180°$

Example

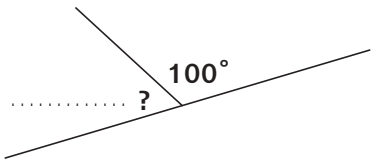


Find angle y

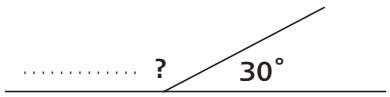


Calculate each ? angle. Do not use a protractor.

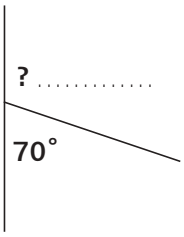
1



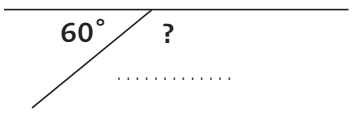
2



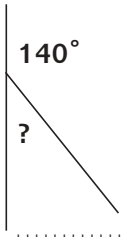
3



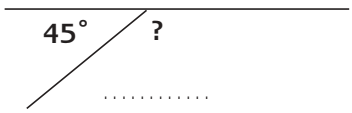
4



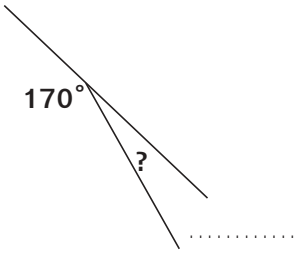
5



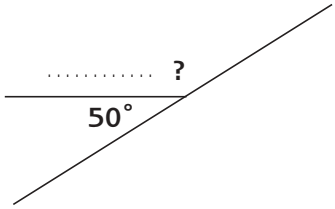
6



7



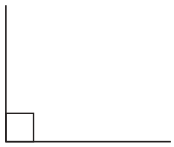
8



UNIT 14

Calculations involving angles

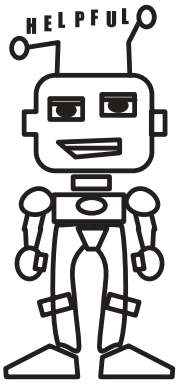
2 Working with right angles

This symbol means a right angle.

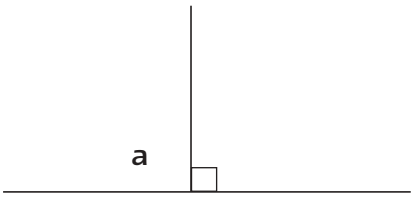
The angle is 90°.

Remember that angles on a straight line add up to 180°.



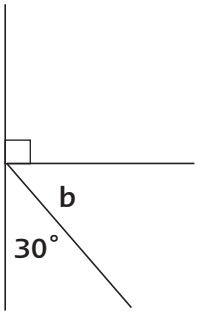
Work out each of the angles:

1



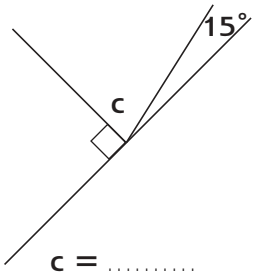
a = ...

2



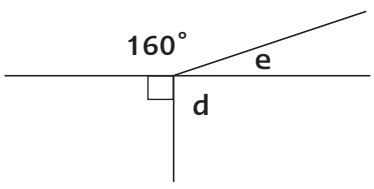
b = ...

3



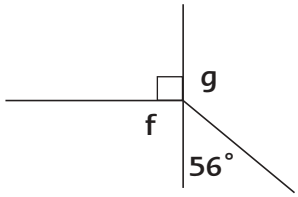
c = ...

4



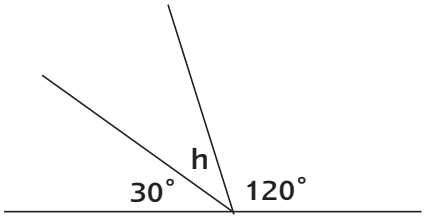
d = ... e = ...

5



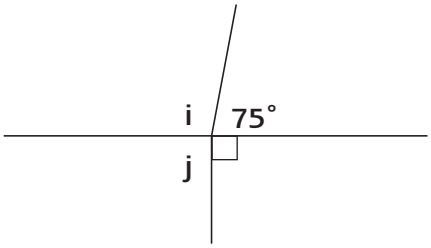
f = ... g = ...

6



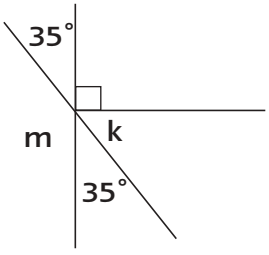
h = ...

7



i = ... j = ...

8



k = ... m = ...

UNIT 14

Calculations involving angles

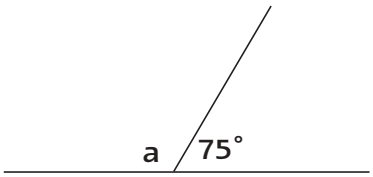
STAR CHALLENGE 8

What's the angle?

12-13 correct 2 stars
10-11 correct 1 star

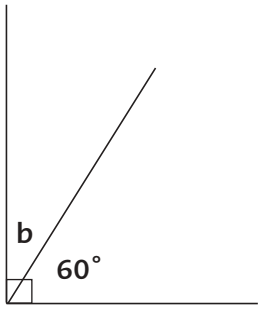
Calculate each angle:

1



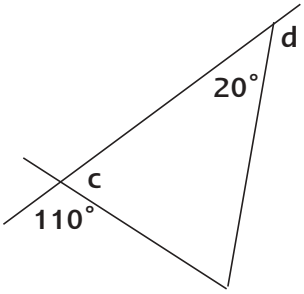
a = ...

2



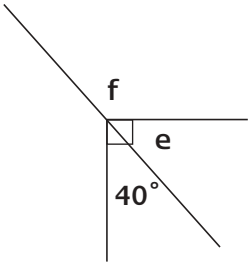
b = ...

3



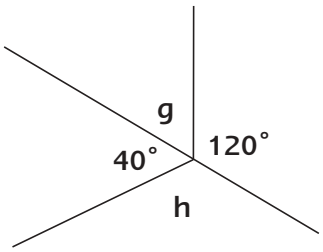
c = ... d = ...

4



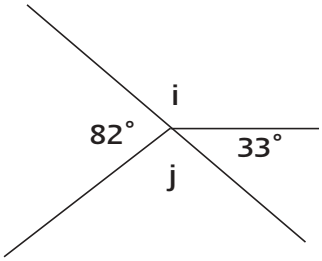
e = ... f = ...

5



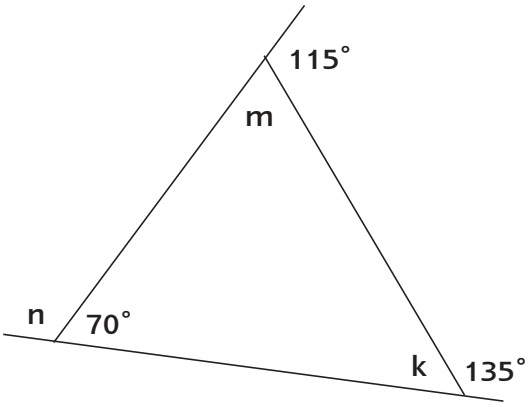
g = ... h = ...

6



i = ... j = ...

7



k = ... m = ... n = ...

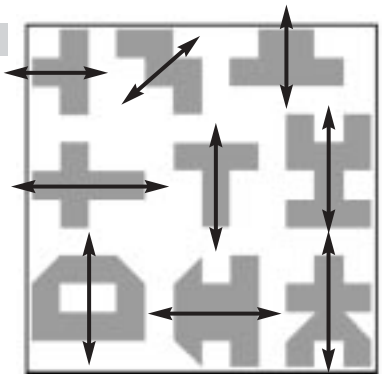
UNIT 14

Unit 14 Answers

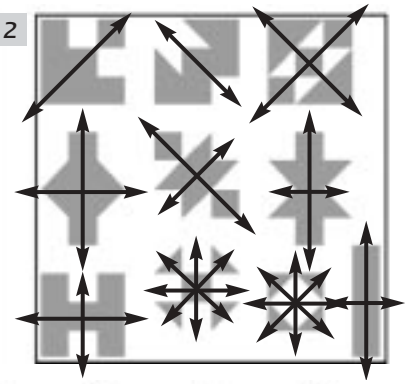
Section 1 Line symmetry and reflection

1 Finding lines of symmetry

1

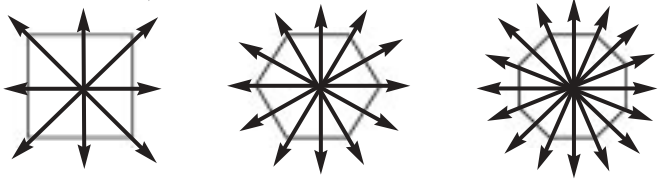


2



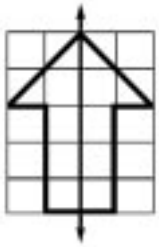
3

4

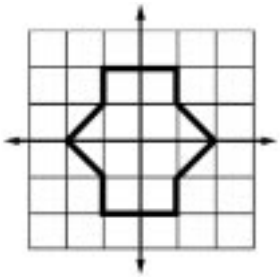


2 Mirror images

1 mirror line or axis of symmetry



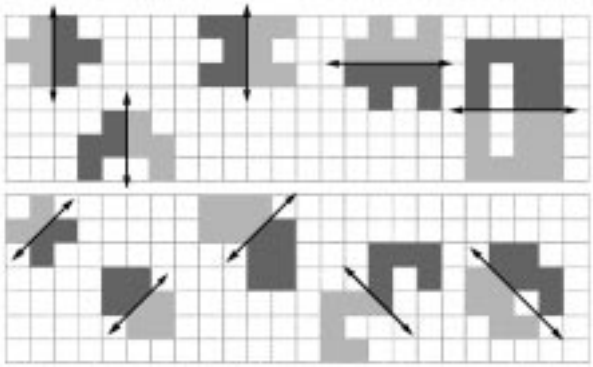
2



mirror line 2

mirror line 1

3 Make symmetric shapes



UNIT 14

Unit 14 Answers

Section 2 Measuring angles

1 Measuring angles accurately

(a)
1. 48°
2. 25°
3. 45°
4. 45°
5. 64°
6. 90°
7. 30°

(b)
1. 70°
2. 155°
3. 135°
4. 90°
5. 55°
6. 45°
7. 150°

Section 3 Naming and estimating angles

1 Types of angle

1. obtuse
2. right
3. acute
4. right
5. acute
6. obtuse
7. reflex
8. right
9. acute
10. obtuse
11. right
12. reflex

2 Estimating angles

1. accept 5°– 25°
2. accept 15°– 35°
3. accept 100°– 120°
4. accept 85°- 90°
5. accept 130°- 170°
6. accept 70°- 85°
7. accept 80°– 88°
8. accept 120°– 160°
9. accept 20°– 40°
10. accept 95°– 110°
11. accept 50°– 75°
12. accept 110°– 140°

Section 4 Drawing angles

1 Constructing accurate triangles

1. AB = 5.9 or 6.0 cm AC = 6.6 or 6.7 cm
2. PR = 6.4 or 6.5 cm QR = 5.5 or 5.6 cm

Section 5 Calculations involving angles

1 Angles on a straight line

1. 80°
2. 150°
3. 110°
4. 120°
5. 40°
6. 135°
7. 10°
8. 130°

2 Working with right angles

1. a = 90°
2. b = 60°
3. c = 75°
4. d = 90° e = 20°
5. f = 90° g = 124°
6. h = 30°
7. i = 105° j = 90°
8. k = 55° m = 145°

UNIT 14

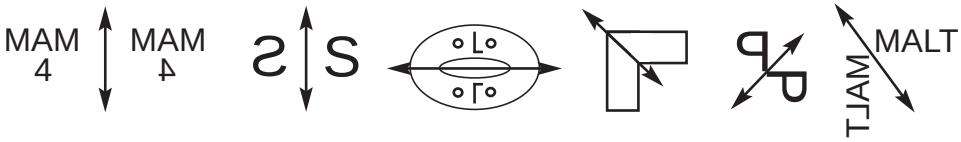
Unit 14 Answers

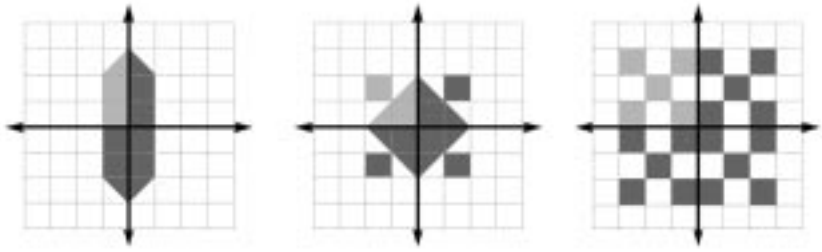
Star Challenge answers

STAR CHALLENGE 1

Getting more difficult

21 marks	2 stars
16-20 marks	1 star

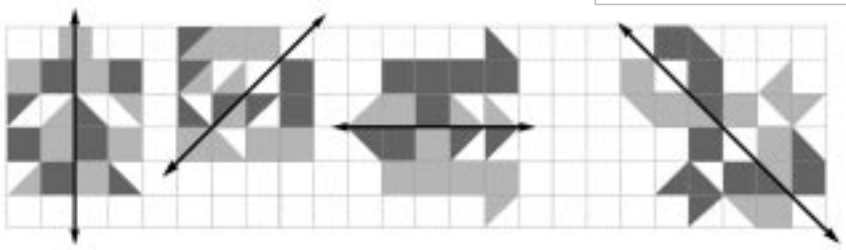




STAR CHALLENGE 2

A real challenge!

4 correct shapes	3 stars
3 correct shapes	2 stars
2 correct shapes	1 star



STAR CHALLENGE 3

Measuring angles

1	(a) 40°	(b) 45°	(c) 35°	
2	✔ 35°	• 60°	✘ 105°	
3	(a) 65°	(b) 24°	(c) 24°	(d) 115°

10 marks	3 stars
7-9 marks	2 stars
5-6 marks	1 star

STAR CHALLENGE 4

Estimation challenge

All correct 1 star

1	accept 40°– 70°	5	accept 20°– 40°
2	accept 115°- 150°	6	accept 110°– 140°
3	accept 15°– 35°	7	accept 120°– 140°
4	accept 150°– 170°	8	accept 110°– 140°

Unit 14 Answers

Star Challenge answers *continued*

STAR CHALLENGE 5

Mathematical word shapes

7–9 correct 1 star

(Suggested shapes; others are possible)

O
B
T U S E
(obtuse)

R N F U
U T L L
(full turn)

A R A L L F L E X
P E E
S L R
M A R G O
(parallelograms)
(reflex)

T
R E
I A N G L
(triangle)

P
A L
R I
A N
L E
L S
E
L (parallel lines)

P E N D I C U L A R
R
E
P
(perpendicular)

R
I
G
H
T A N G L E
(right angle)

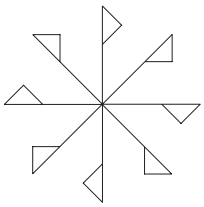
H N
A R
L F T U
(half turn)

STAR CHALLENGE 6

Rotating patterns

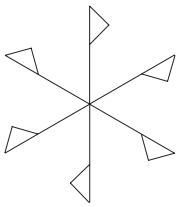
Both patterns accurately drawn 1 star

1



Check all angles are 45°

2



Check all angles are 60°

STAR CHALLENGE 7

More triangles

12–13 marks 2 stars
9–11 marks 1 star

1 BC = 7.7 cm. So, if BC = 7.6 – 7.8 cm, the diagram is likely to be fairly accurate.

2 PR = 11.3 cm. So, if PR = 11.2 – 11.4 cm, the diagram is likely to be fairly accurate.

3 MN = 4.5 cm and LM = 11 cm. So, if MN = 4.4 – 4.6 cm and LM = 10.9 – 11.1 cm, the diagram is likely to be fairly accurate.

STAR CHALLENGE 8

What's the angle?

12–13 correct 2 stars
10–11 correct 1 star

1 a = 105°

2 b = 30°

3 c = 70° d = 160°

4 e = 50° f = 130°

5 g = 60° h = 140°

6 i = 147° j = 98°

7 k = 45° m = 65° n = 110°