



PART 3

UNIT  
**14**

SPRING  
second half

## SHAPE AND SPACE

**SECTION 1** Line symmetry and reflection

**SECTION 2** Measuring angles

**SECTION 3** Naming and estimating angles

**SECTION 4** Drawing angles

**SECTION 5** Calculations involving angles


# 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.

**SECTION 1** Line symmetry and reflection

**SECTION 2** Measuring angles

**SECTION 3** Naming and estimating angles

**SECTION 4** Drawing angles

**SECTION 5** Calculations involving angles

### 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**UNIT  
**14**

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**Line symmetry and reflection**

You will:

- recognise reflective symmetry
- reflect shapes in a mirror line

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**Measuring angles**

You will:

- use a protractor to measure angles to the nearest degree

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**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  $180^\circ$
  - 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*

# Line symmetry and reflection

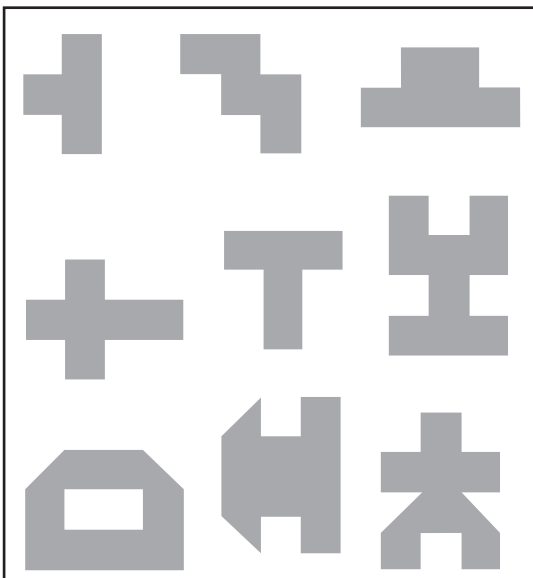
1

## Finding lines of symmetry

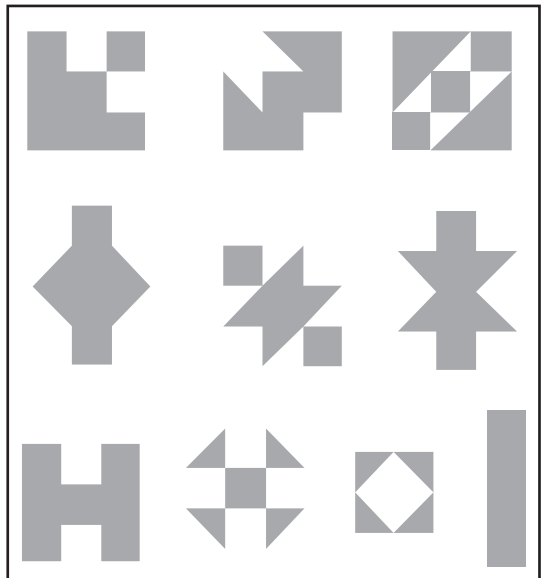


Lines of symmetry are also called mirror lines.  
They are usually drawn like this  $\longleftrightarrow$

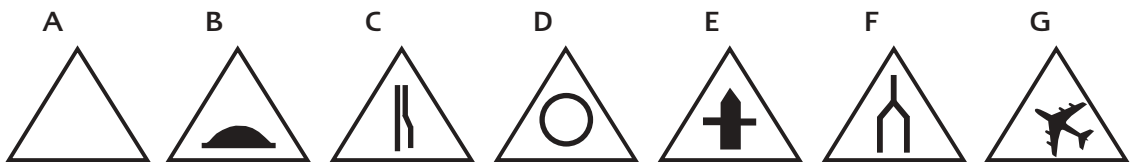
1 Draw in ONE line of symmetry on each shape below:



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



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

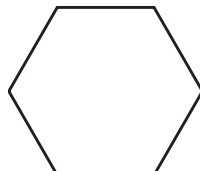


4 Regular polygons



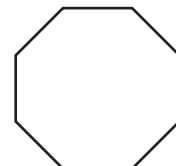
A square has 4 lines of symmetry

Draw them.



A regular hexagon has 6 lines of symmetry

Draw them.

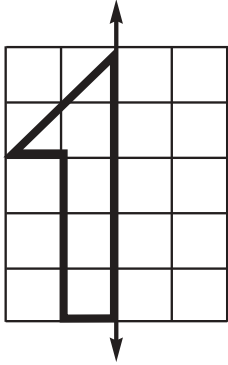


A regular octagon has 8 lines of symmetry

Draw them.

# Line symmetry and reflection

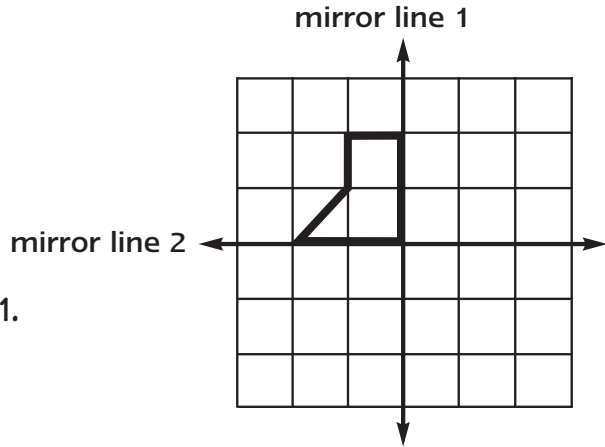
## 2 Mirror images



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

### 2 Two mirror lines

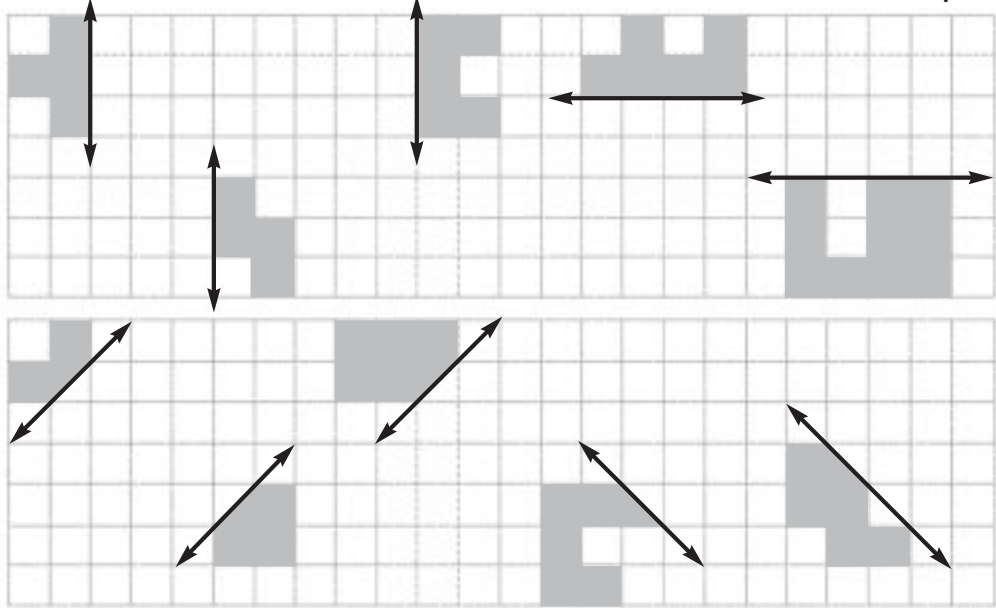
Reflect the shape in mirror line 1. Put your mirror on mirror line 2. Draw in their reflected shape.



## 3 Make symmetric shapes



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



# 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):

MAM  
4

(2 marks)

S

(2 marks)

(2 marks)

(2 marks)

P

(2 marks)

MALT

(2 marks)

(3 marks)

(3 marks)

(3 marks)

STAR CHALLENGE  
2

A real challenge!

Mirror

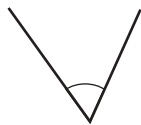
★ ★ ★ ●  
4 correct shapes    3 stars  
3 correct shapes    2 stars  
2 correct shapes    1 star

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

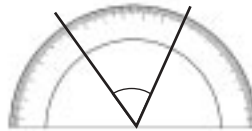
## SECTIONS 2, 3 AND 4: MEASURING ANGLES NAMING AND ESTIMATING ANGLES DRAWING ANGLES

### 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.



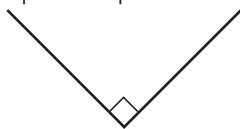
Measure this angle.



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.



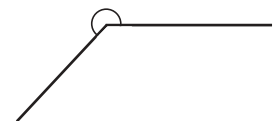
**A right angle**  
=  $90^\circ$



**An acute angle**  
is less than  $90^\circ$



**An obtuse angle**  
is between  $90^\circ$  and  $180^\circ$



**A reflex angle** is  
bigger than  $180^\circ$

- Model how to estimate the size of an angle using 'benchmarks' such as  $90^\circ$ ,  $180^\circ$ , and  $45^\circ$ . 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.

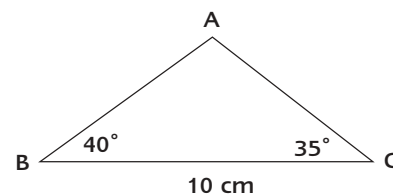
*This is a sketch of a triangle. It is not drawn accurately.*

*You are going to draw the triangle accurately*

*Start with the line BC, which is 10 cm long. Draw*

*angle B, which is  $40^\circ$ , then angle C, which is  $35^\circ$ .*

*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.



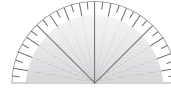
construct accurately straight line right angle degree  
acute angle obtuse angle reflex angle perpendicular  
parallel parallelogram angle full turn half turn  
quarter turn protractor



# Measuring angles

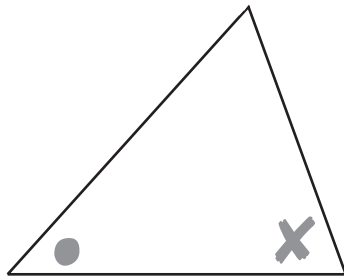
1

## Measuring angles accurately

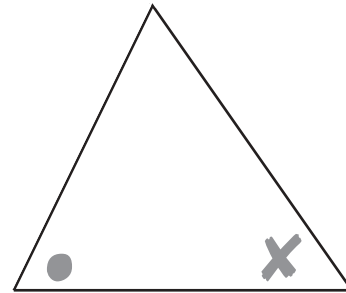


(a) Measure each angle ● as accurately as you can.  
Write the answer next to the ●.

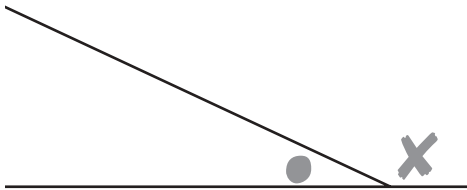
1



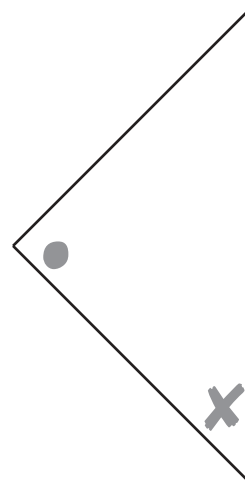
5



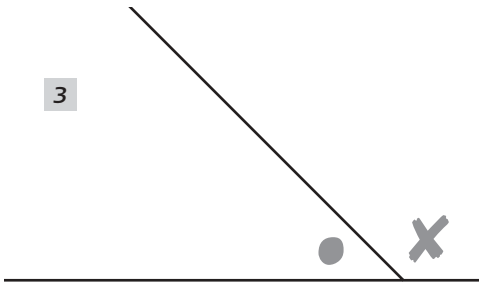
2



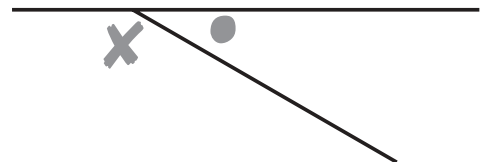
6



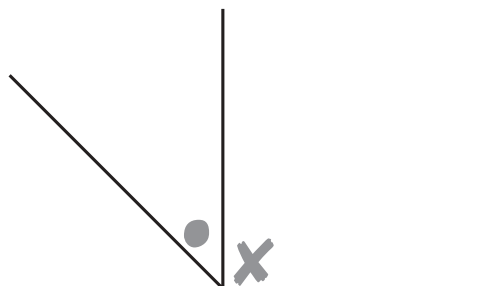
3



7



4

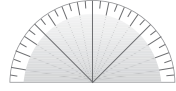


(b) Now measure each angle X as accurately as you can.  
Write the answer next to the X.

# Measuring angles

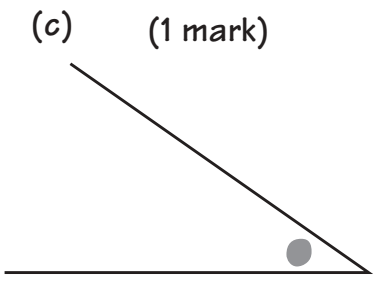
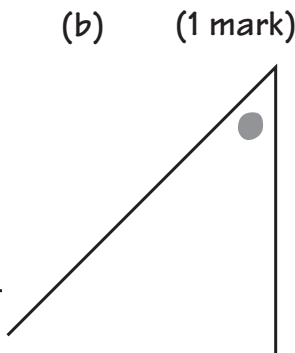
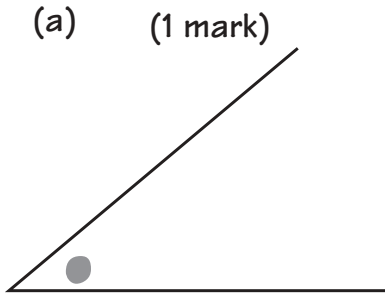


## Measuring angles

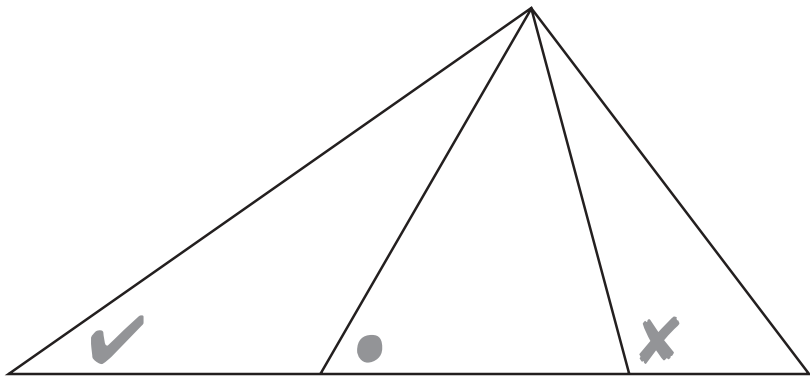


10 marks 3 stars  
7-9 marks 2 stars  
5-6 marks 1 star

1 Measure each of the angles ●.



2 Measure all three marked angles: (3 marks)



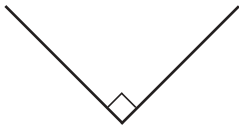
3 Measure: (4 marks)

- (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.

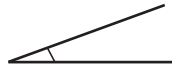
## Naming and estimating angles

1

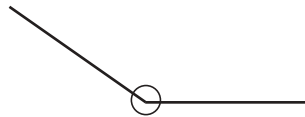
### Types of angle



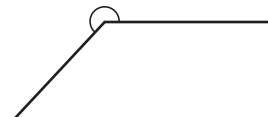
A **right angle**  
=  $90^\circ$



An **acute angle**  
is less than  $90^\circ$



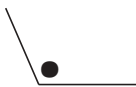
An **obtuse angle**  
is between  $90^\circ$   
and  $180^\circ$



A **reflex angle** is  
bigger than  $180^\circ$

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

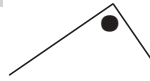
1



This angle is

.....

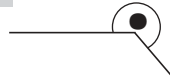
4



This angle is

.....

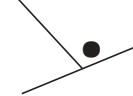
7



This angle is

.....

10



This angle is

.....

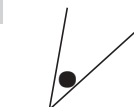
2



This angle is

.....

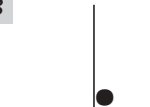
5



This angle is

.....

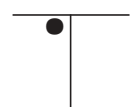
8



This angle is

.....

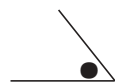
11



This angle is

.....

3



This angle is

.....

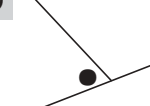
6

● =  $120^\circ$

This angle is

.....

9



This angle is

.....

12

● =  $200^\circ$

This angle is

.....

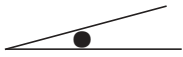
# Naming and estimating angles

## 2

### Estimating angles

Estimate the size of each angle marked with a ●.


1



My estimate is

.....

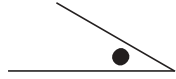
5



My estimate is

.....

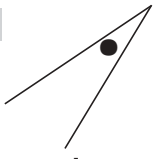
9



My estimate is

.....

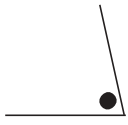
2



My estimate is

.....

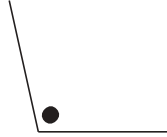
6



My estimate is

.....

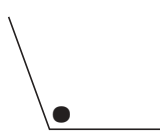
10



My estimate is

.....


3



My estimate is

.....

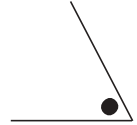
7



My estimate is

.....


11



My estimate is

.....

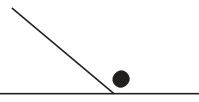
4



My estimate is

.....

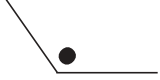
8



My estimate is

.....

12



My estimate is

.....

## Naming and estimating angles

STAR CHALLENGE

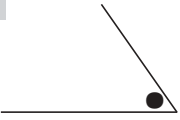
4

### Estimation challenge




All correct 1 star

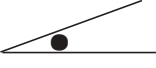
Estimate the size of each angle:

1 


My estimate is .....

2 


My estimate is .....

3 


My estimate is .....

4 


My estimate is .....

5 

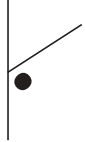
My estimate is .....

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

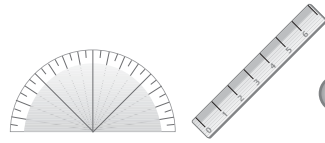
PARALLELOGRAMS

TRIANGLE

REFLEX

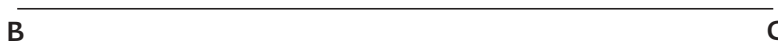
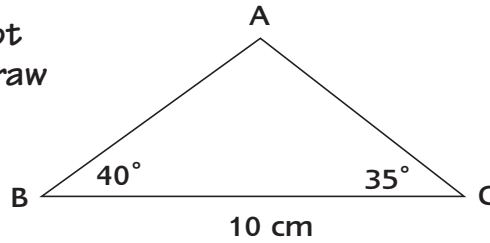
# Drawing angles

## 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.

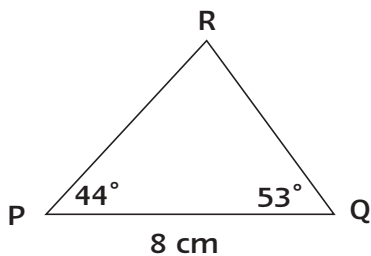
Start with the line BC, which is 10 cm long. Draw angle B, which is 40°, then angle C, which is 35°. Extend the lines made by these angles so they cross. This is point A.



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.



PR = ..... cm      QR = ..... cm

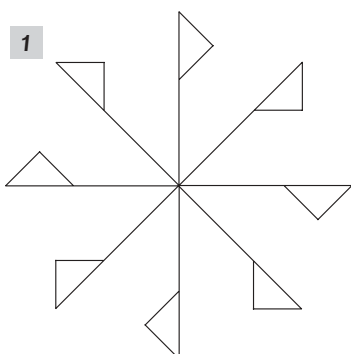
## Drawing angles

STAR CHALLENGE  
6

### Rotating patterns



Both patterns  
accurately drawn 1 star

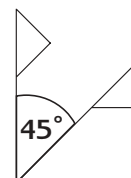


Rifat made this rotating pattern.

She started with this flag.



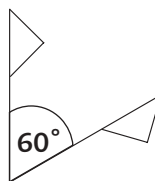
She drew a line at  $45^\circ$  to the stick of the flag to get this:



She then repeated the process.  
Each flag is at  $45^\circ$  to the previous flag.

Copy this pattern in exactly the same way.  
Make sure your angles are exactly  $45^\circ$ .

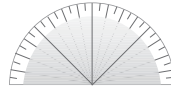
- 2 Make another rotating pattern with the same flag.  
This time rotate the flag through  $60^\circ$ .



# Drawing angles

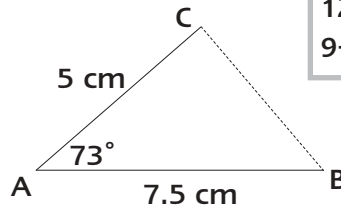


## More triangles



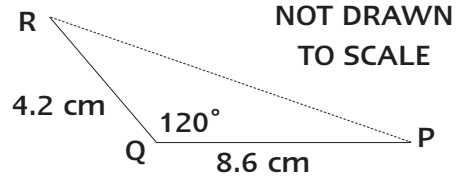
12-13 marks 2 stars  
9-11 marks 1 star

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



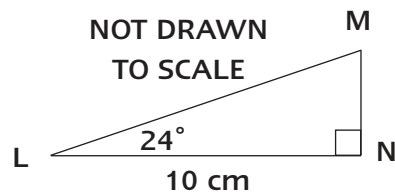
NOT DRAWN  
TO SCALE

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'.

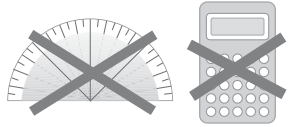


*parallel perpendicular straight line  
right angle*

# Calculations involving angles

## 1

### Angles on a straight line



Angles on a straight line add up to  $180^\circ$ .

$a + b = 180^\circ$

### Example

Find angle  $y$

**IDEA**

$180 - 35 = 145,$   
so  $y = 145^\circ$ .

Calculate each ? angle. Do not use a protractor.

1

5

2

6

3

7

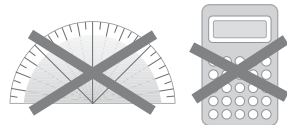
4

8

# Calculations involving angles

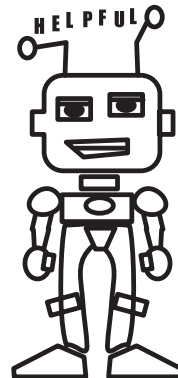
2

## Working with right angles

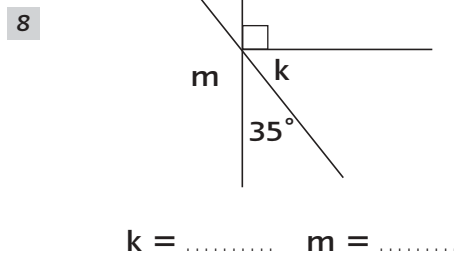
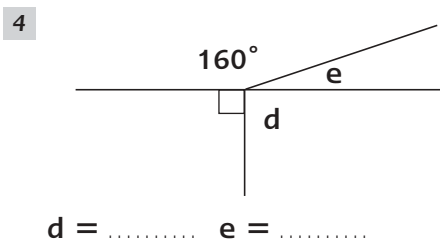
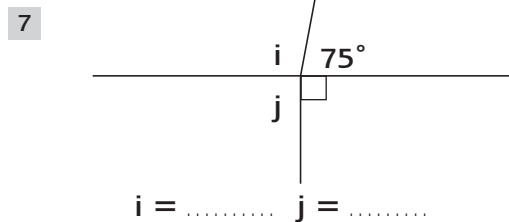
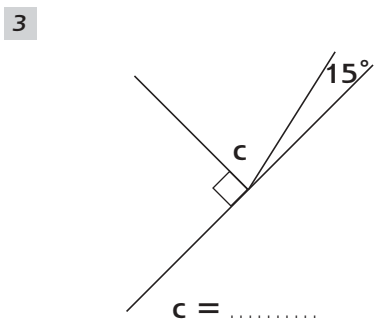
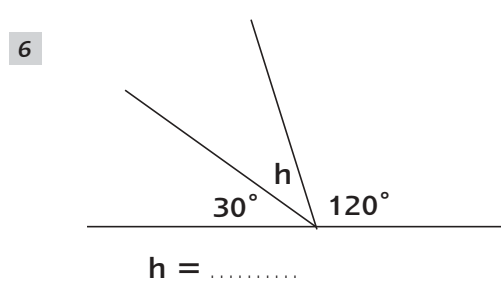
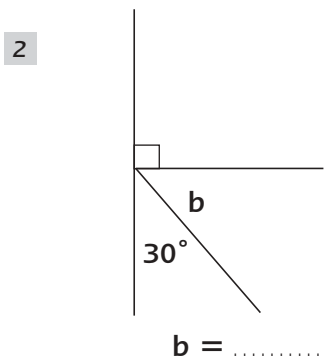
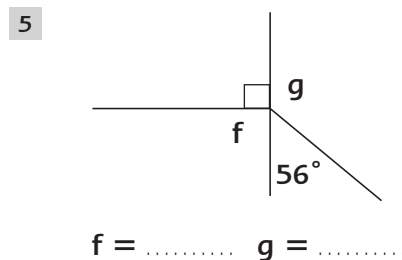
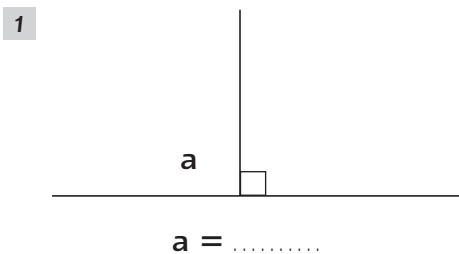


This symbol means a right angle.  
The angle is  $90^\circ$ .

Remember that angles on a straight line add up to  $180^\circ$ .



Work out each of the angles:



# Calculations involving angles

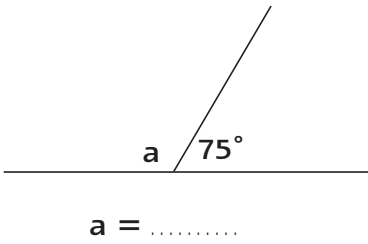


**What's the angle?**

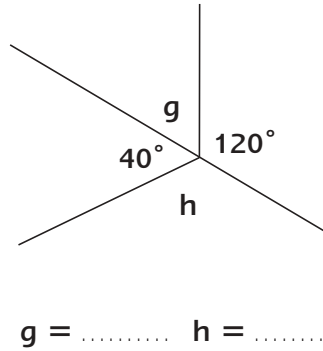
12-13 correct 2 stars  
10-11 correct 1 star

Calculate each angle:

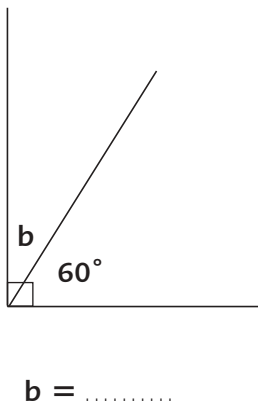
1



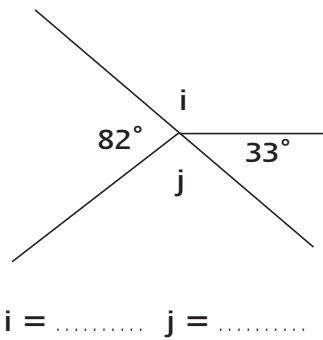
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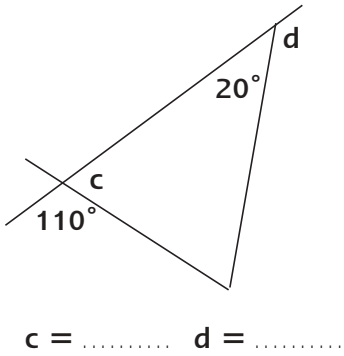
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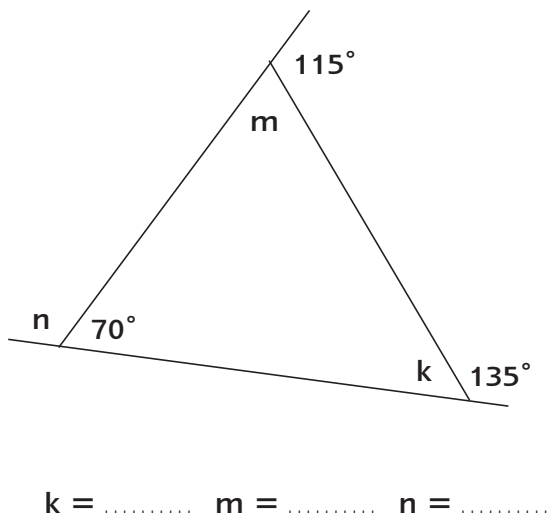
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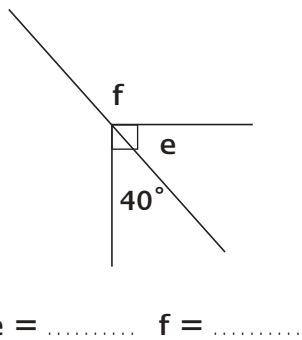
3



7



4

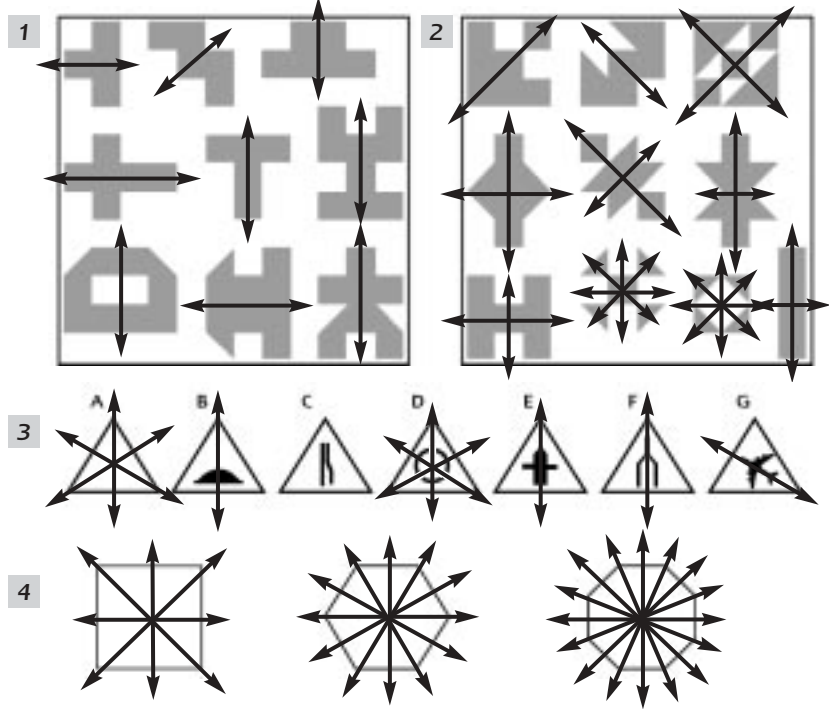


# Unit 14 Answers

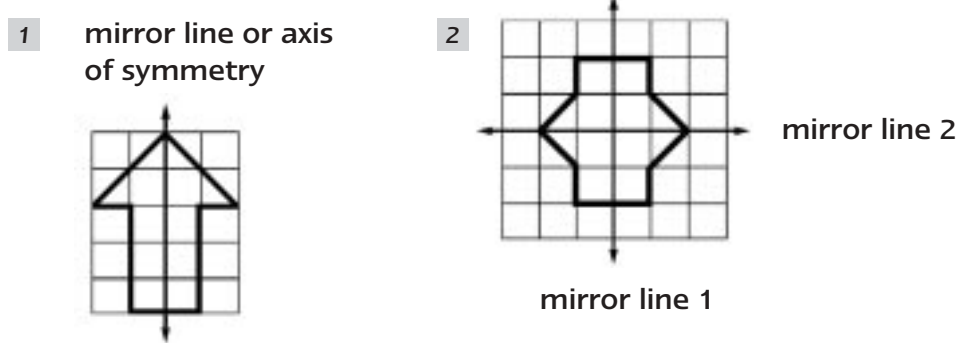
## Section 1

## Line symmetry and reflection

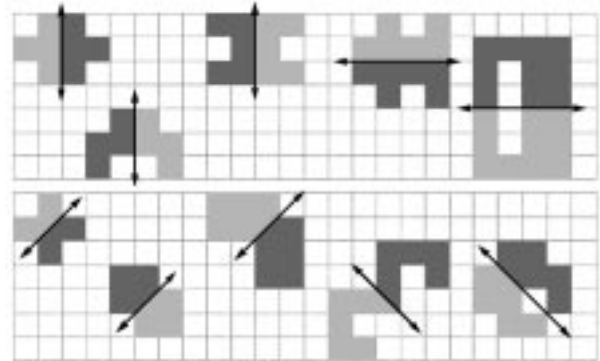
### 1 Finding lines of symmetry



### 2 Mirror images



### 3 Make symmetric shapes



## Unit 14 Answers

## Section 2

## Measuring angles

## 1 Measuring angles accurately

- (a) 1  $48^\circ$       3  $45^\circ$       5  $64^\circ$       7  $30^\circ$   
 2  $25^\circ$       4  $45^\circ$       6  $90^\circ$
- (b) 1  $70^\circ$       3  $135^\circ$       5  $55^\circ$       7  $150^\circ$   
 2  $155^\circ$       4  $90^\circ$       6  $45^\circ$

## Section 3

## Naming and estimating angles

## 1 Types of angle

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

## 2 Estimating angles

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

## 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  $80^\circ$       3  $110^\circ$       5  $40^\circ$       7  $10^\circ$   
 2  $150^\circ$       4  $120^\circ$       6  $135^\circ$       8  $130^\circ$

## 2 Working with right angles

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

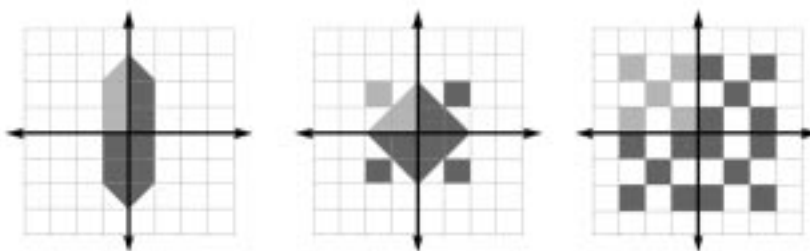
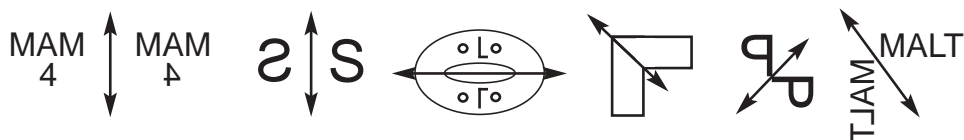
# Unit 14 Answers

## Star Challenge answers



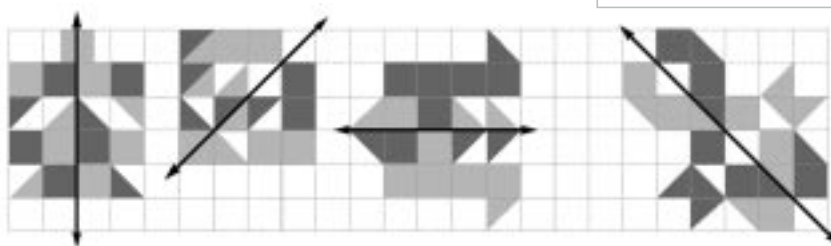
### 1 Getting more difficult

21 marks 2 stars  
16-20 marks 1 star



### 2 A real challenge!

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



### 3 Measuring angles

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

- |   |         |         |         |          |
|---|---------|---------|---------|----------|
| 1 | (a) 40° | (b) 45° | (c) 35° |          |
| 2 | ✓ 35°   | • 60°   | ✗ 105°  |          |
| 3 | (a) 65° | (b) 24° | (c) 24° | (d) 115° |



### 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*



### 5 Mathematical word shapes

7-9 correct 1 star

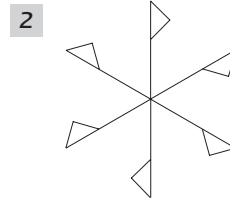
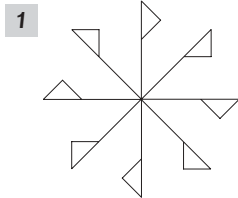
(Suggested shapes; others are possible)

		A R A L L	F L E X
O		P E	E
B	R N F U	S L R	
T U S E	U T L L	M A R G O	(reflex)
(obtuse)	(full turn)	(parallelograms)	T
P	P E N D I C U L A R	R E	
A L	(perpendicular)	I A N G L	
R I		(triangle)	
A N			
L E		G	H N
L S		H	A R
E		T A N G L E	L F T U
L (parallel lines)		(right angle)	(half turn)



### 6 Rotating patterns

Both patterns accurately drawn 1 star



Check all angles are  $45^\circ$

Check all angles are  $60^\circ$



### 7 More triangles

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

- BC = 7.7 cm. So, if BC = 7.6 – 7.8 cm, the diagram is likely to be fairly accurate.
- PR = 11.3 cm. So, if PR = 11.2 – 11.4 cm, the diagram is likely to be fairly accurate.
- 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.



### 8 What's the angle?

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

- |                                  |   |
|----------------------------------|---|
| 1 a = $105^\circ$                | 5 g = $60^\circ$ h = $140^\circ$                |
| 2 b = $30^\circ$                 | 6 i = $147^\circ$ j = $98^\circ$                |
| 3 c = $70^\circ$ d = $160^\circ$ | 7 k = $45^\circ$ m = $65^\circ$ n = $110^\circ$ |
| 4 e = $50^\circ$ f = $130^\circ$ |   |