



# Maths

## Key Stage 3

Your name:

Your tutor's name:



## Module 5 - Angles

An angle is a measure of a turn, measured in degrees,  $^{\circ}$ . In this module you will look at how to calculate angles on a line, in a full turn, in triangles, in quadrilaterals, on parallel lines, and finally, in polygons.

Tutorial	Topic
Tutorial 1.1	Basic angle rules
Tutorial 1.2	Triangles and quadrilaterals
Tutorial 1.3	Parallel lines
Tutorial 1.4	Polygons

### Learning objectives

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This module aims to help you:

1. Find missing angles using basic angles rules
2. Find missing angles in triangles and quadrilaterals
3. Find missing angles using parallel lines
4. Find the angles of polygons

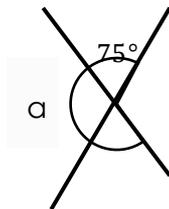
## Knowledge Check #1

You will complete this at the start of every module. If you'd prefer to complete these questions via an online form, go to:

<https://forms.office.com/r/HUaiGPUHMe>



- 1 What is the size of angle  $a$ ?



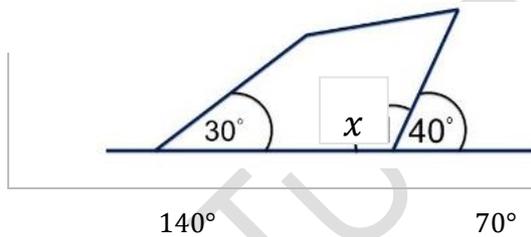
15°

75°

285°

105°

- 2 What is the value of the angle marked  $x$ ?



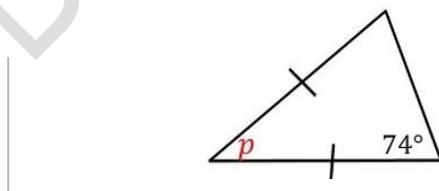
140°

70°

110°

150°

- 3 This is an isosceles triangle.  
Calculate the size of angle  $p$ .



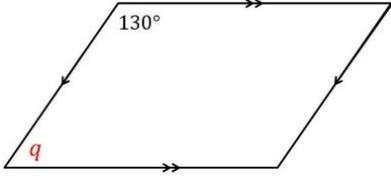
32°

74°

106°

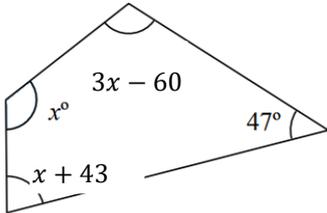
Not enough  
information

- 4 This is a parallelogram.  
Calculate the size of angle  $q$ .



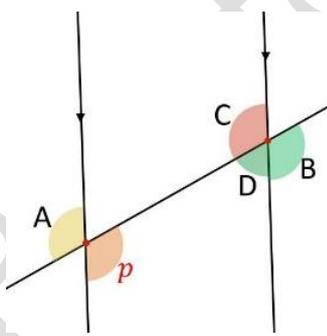

65°                      130°                      50°                      Not enough information

- 5 What is the value of  $x$ ?



30	66	90	300
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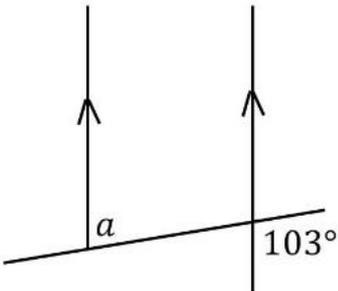
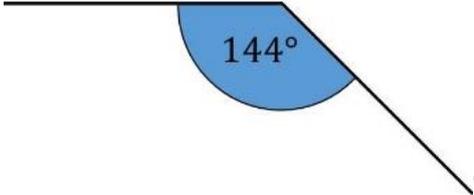
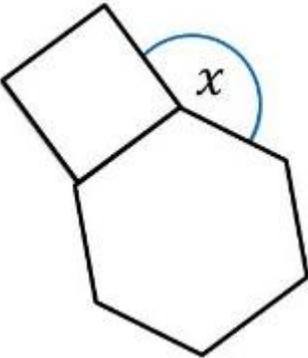
- 6 Which angle is not equal to angle  $p$ ?



A	B	C	D

- 7 Find the missing angle  $a$ .

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77°	103°	257°	Not enough information
<p><b>8</b> This is part of a regular polygon. How many sides does it have?</p>			
			
6	5	10	Not enough information
<p><b>9</b> These are both regular polygons. Calculate the unknown angle <math>x</math>.</p>			
			
210°	180°	225°	150°

## Session 5.1 – Basic angle rules

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In this tutorial we will look at:

- Using basic angle rules to find missing angles
- Using algebra to find missing angles

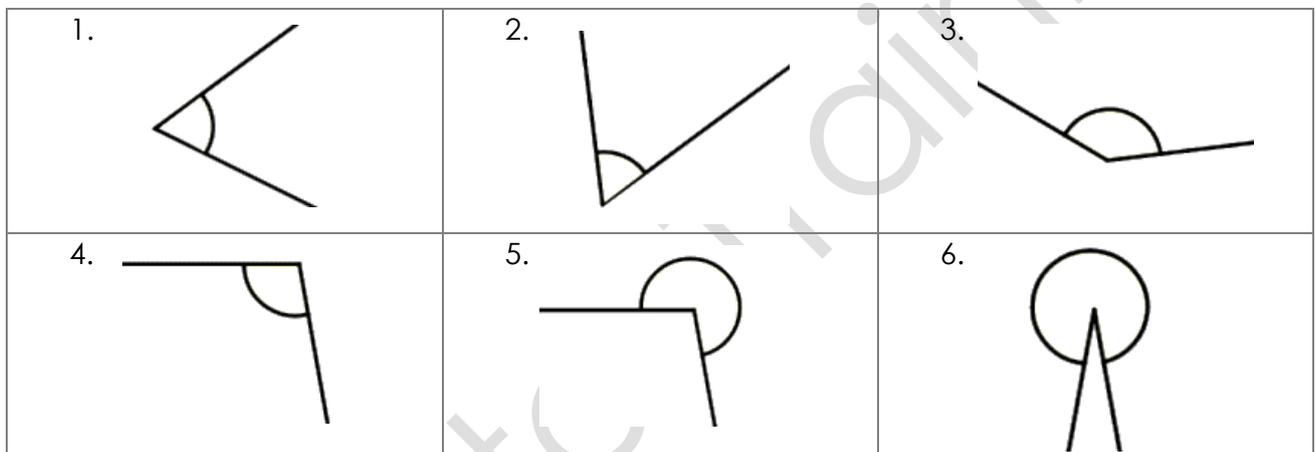
### Learning activities

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#### Angles on lines and points

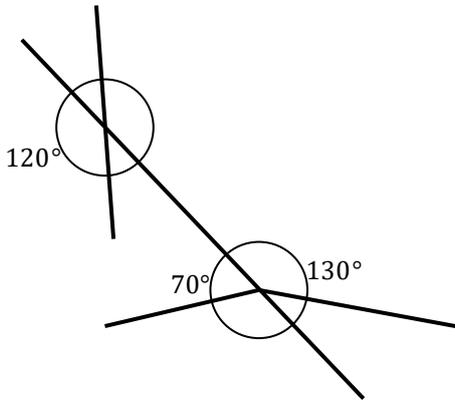
##### 1. Warm up

Estimate the following angles



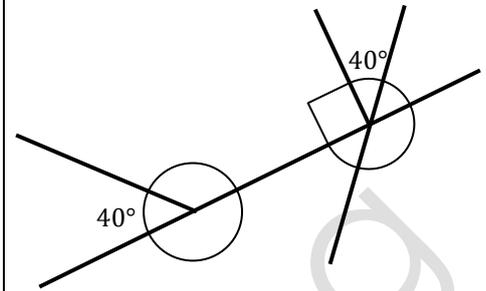
##### 2. Guidance

<b>Worked example</b>		<b>Guided practice</b>
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- Decide which angle rule to use
- ↓
- Decide which angles are relevant
- ↓
- Calculate the missing angle
- ↓
- Use this to calculate further angles

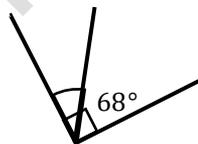
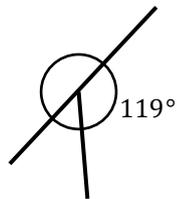
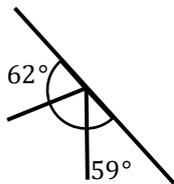
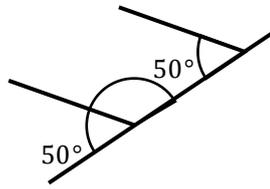
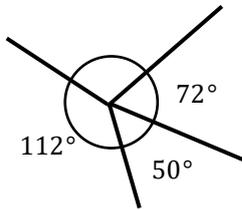
Find the missing angles



**3. Practice**

<b>Fluency</b>	<b>Problem Solving</b>
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BTP Tutor Training



1. Three of these angles together make a straight line. Which three?

24° 36° 42° 58° 60° 120° 175°

2. Which of these are impossible?

- a. acute + acute = right angle
- b. obtuse + obtuse = right angle
- c. obtuse + obtuse = straight line
- d. acute + obtuse = full turn
- e. acute + right = obtuse angle

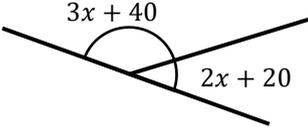
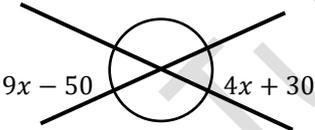
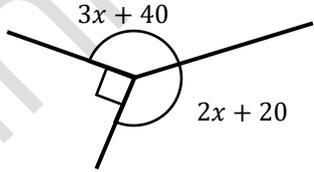
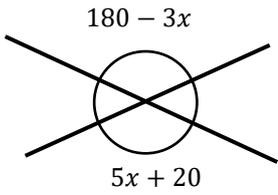
## Angle rules with algebra

### 1. Warm up

Solve the following equations

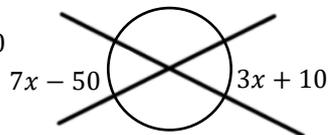
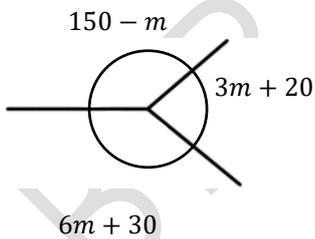
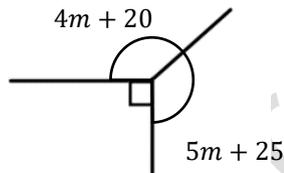
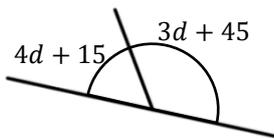
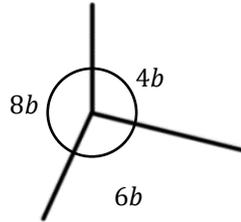
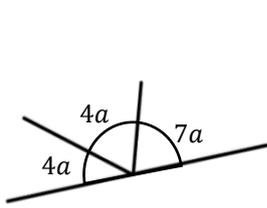
1. $2x = 180$	2. $3x = 360$	3. $x + 140 = 360$
4. $5x + 40 = 180$	5. $2x - 30 = x + 40$	6. $5x - 40 = 2x + 80$

2. Guidance

Worked example		Guided practice
  	<div style="text-align: center;"> <div data-bbox="715 801 960 954" style="background-color: #4b2c82; color: white; padding: 5px; margin-bottom: 5px;">Decide which angle rule to use</div> <div data-bbox="826 958 849 1003" style="text-align: center;">↓</div> <div data-bbox="715 1003 960 1155" style="background-color: #4b2c82; color: white; padding: 5px; margin-bottom: 5px;">Write down the equation matching the angle rule</div> <div data-bbox="826 1160 849 1205" style="text-align: center;">↓</div> <div data-bbox="715 1205 960 1357" style="background-color: #4b2c82; color: white; padding: 5px; margin-bottom: 5px;">Solve the equation</div> <div data-bbox="826 1361 849 1406" style="text-align: center;">↓</div> <div data-bbox="715 1406 960 1559" style="background-color: #4b2c82; color: white; padding: 5px;">Substitute the value back in to find the angles</div> </div>	<p>Find the value of <math>x</math>, then calculate all the missing angles</p>   

### 3. Practice

#### Fluency



#### Problem Solving

- Three angles fit around a point  
The second angle is  $20^\circ$  more than the first.  
The third angle is twice the size of the second.  
Find the size of all three angles.

- Find the values of  $x$  and  $y$ :
  - 
  -

## Tutorial 5.2 – Triangles and quadrilaterals

In this tutorial we will look at:

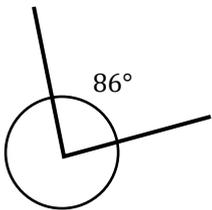
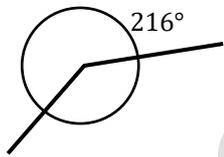
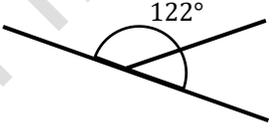
- Using angle rules to find missing angles in triangles and quadrilaterals
- Using algebra to find missing angles in triangles and quadrilaterals

### Learning activities

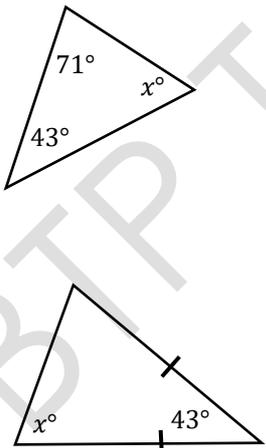
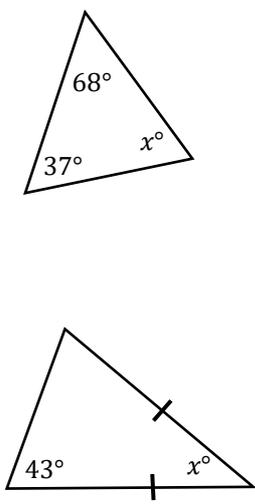
#### Angles in triangles

##### 1. Warm up

Find the missing angles

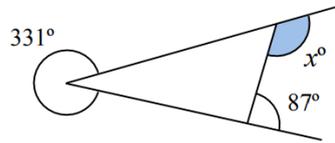
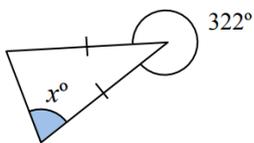
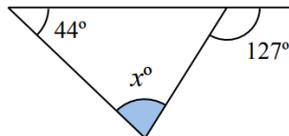
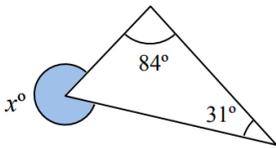
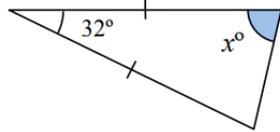
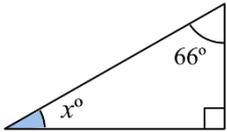
1.		2.		3.	
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##### 2. Guidance

Worked example		Guided practice
	<div style="background-color: #4a4a8a; color: white; padding: 5px; margin-bottom: 10px;">Decide which angle rule to use</div> <div style="text-align: center;">↓</div> <div style="background-color: #4a4a8a; color: white; padding: 5px; margin-bottom: 10px;">Work out if any of the angles are equal</div> <div style="text-align: center;">↓</div> <div style="background-color: #4a4a8a; color: white; padding: 5px;">Use angle rule to calculate missing angles</div>	<p>Find the size of angle <math>x</math> in the following</p> 

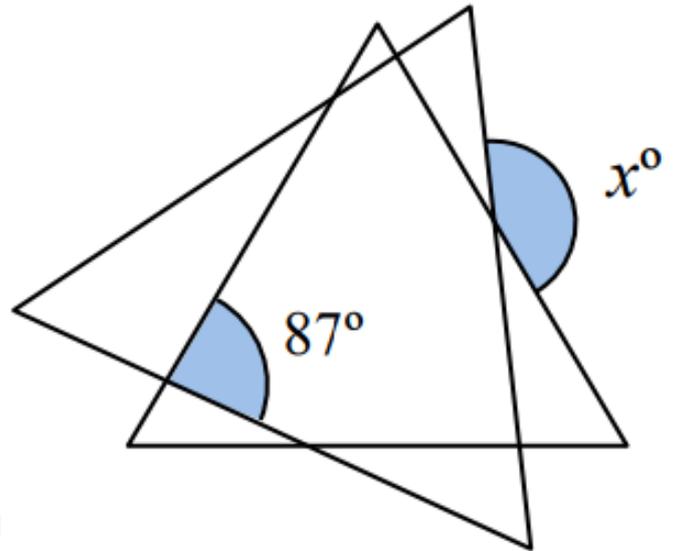
### 3. Practice

#### Fluency



#### Problem Solving

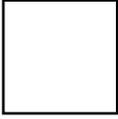
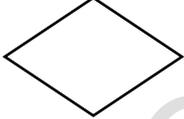
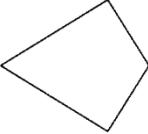
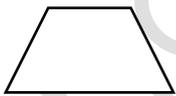
These two triangles are equilateral. Find the value of  $x$



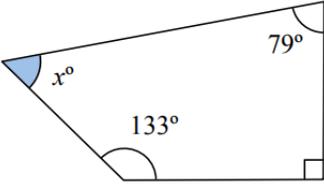
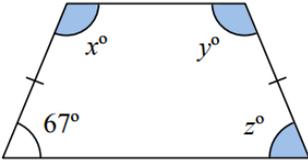
## Angles in quadrilaterals

### 1. Warm up

Name each shape and label their equal angles with the same letter.

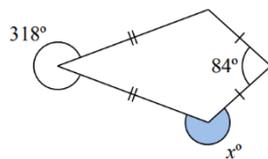
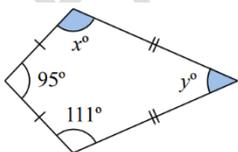
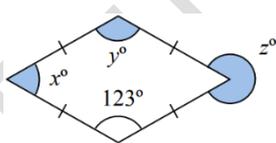
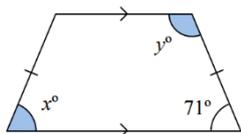
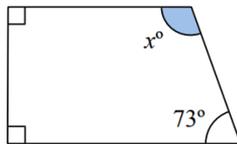
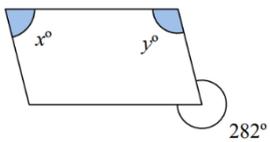
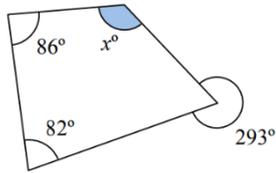
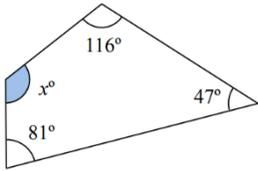
1. 	2. 	3. 
4. 	5. 	6. 

### 2. Guidance

Worked example	Metacognition	Guided practice
	<p>Write down the name of the shape</p> <p>↓</p> <p>Determine which angles are equal</p> <p>↓</p> <p>Make sure interior angles are used in the angle sum</p> <p>↓</p> <p>Are any other angle rules needed to find the missing angles?</p>	<p>Work out the missing angles</p>  

### 3. Practice

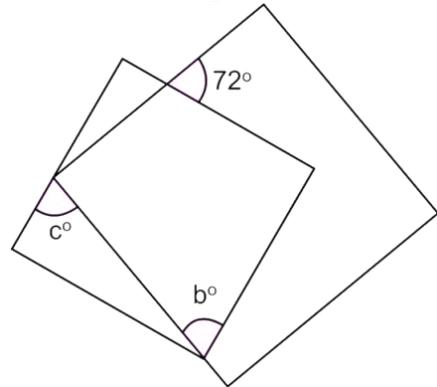
#### Fluency



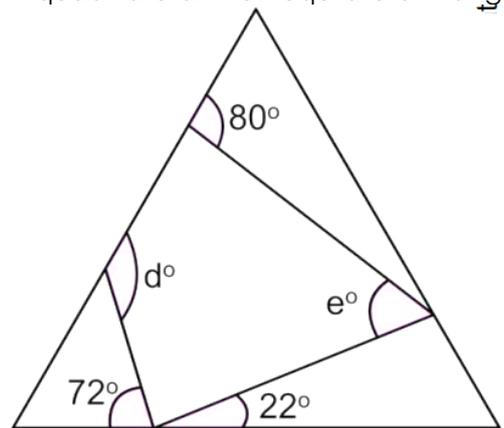
#### Problem Solving

Find the missing angles in the following shapes

- Two overlapping squares



- A quadrilateral in an equilateral triangle



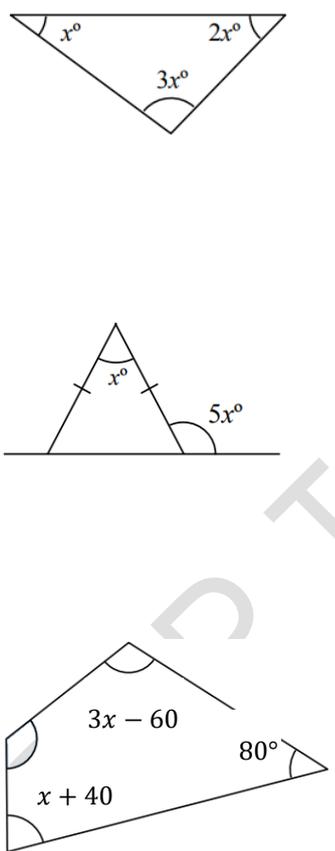
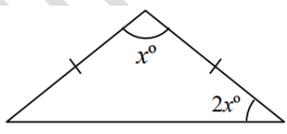
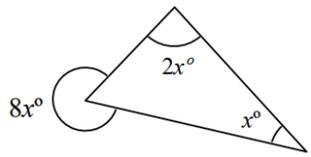
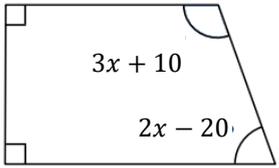
# Triangles, quadrilaterals and algebra

## 1. Warm up

Solve the following equations

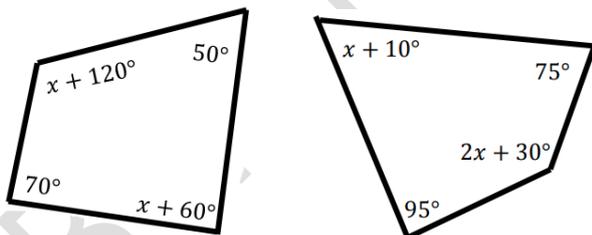
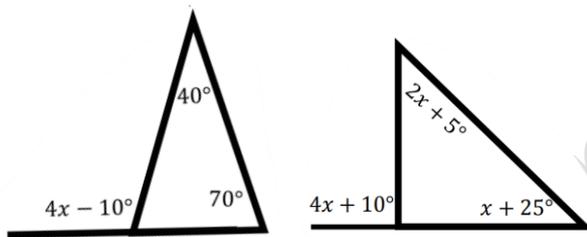
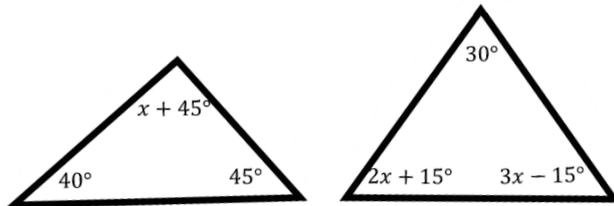
1. $4x = 180$	2. $9x = 360$	3. $x + 70 = 180$
4. $5x + 40 = 360$	5. $3x - 70 = 2x + 80$	6. $5x - 80 = x - 20$

## 2. Guidance

Worked example	Metacognition	Guided practice
	<p>Determine which angles (if any) are equal</p> <p>↓</p> <p>Decide which angle rule to use</p> <p>↓</p> <p>Write down the equation matching the angle rule</p> <p>↓</p> <p>Simplify any expressions</p> <p>↓</p> <p>Solve the equation</p>	<p>Find the value of <math>x</math></p>   

### 3. Practice

#### Fluency



#### Problem Solving

The interior angles of a triangle are  $x^\circ$ ,  $2x^\circ$  and  $3x^\circ$ . Show that this is a right-angled triangle.

## Tutorial 5.3 – Parallel lines

In this tutorial we will look at:

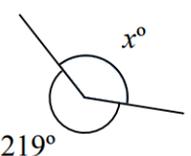
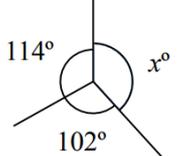
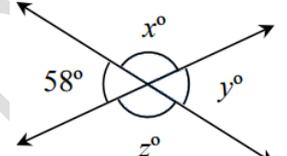
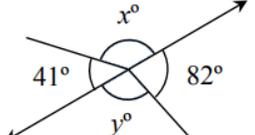
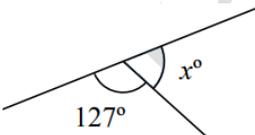
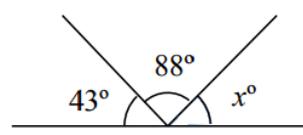
- Using angle rules to find missing angles on parallel lines
- Using algebra to find missing angles on parallel lines

### Learning activities

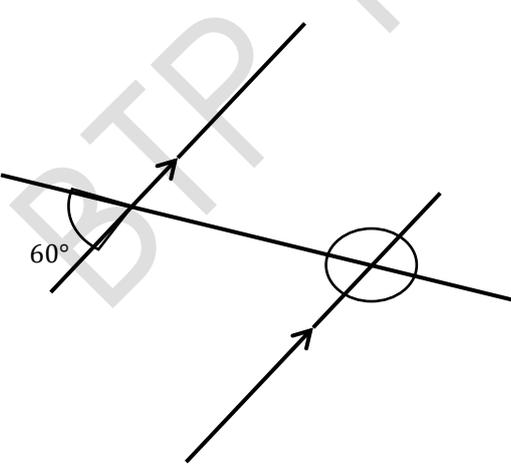
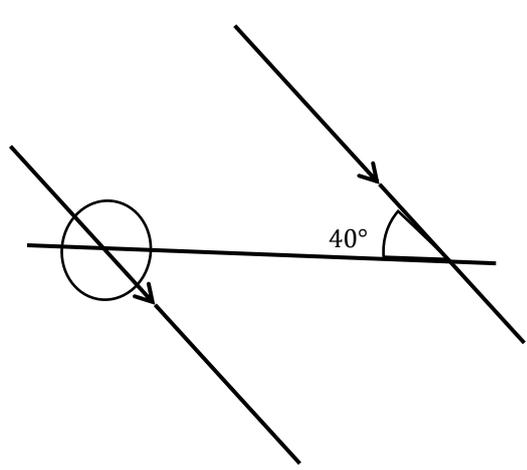
#### Angles in parallel lines

##### 1. Warm up

Find the missing angles

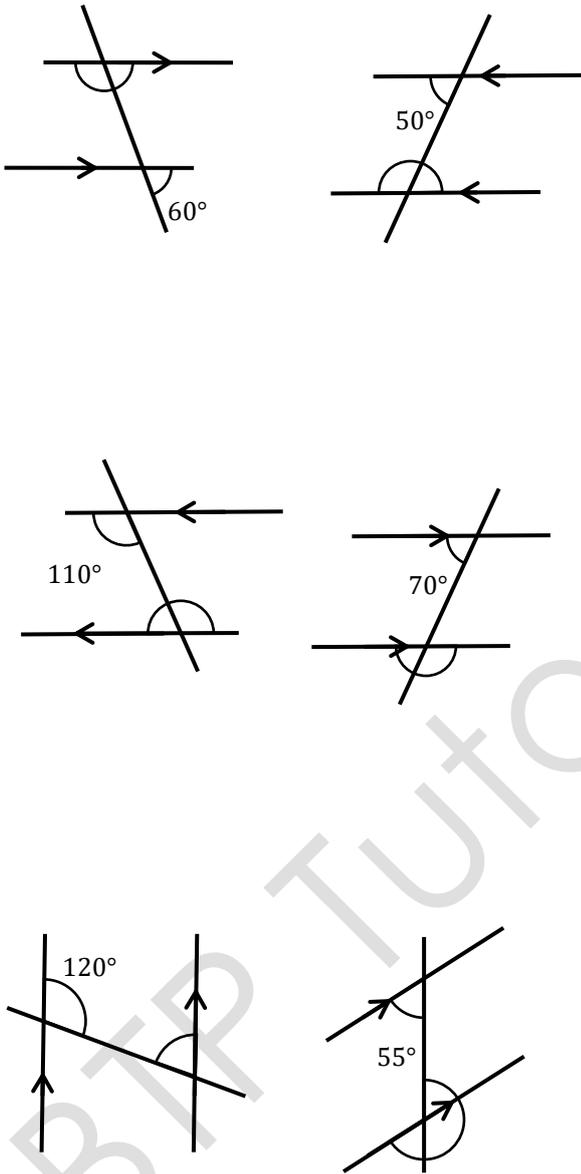
1. 	2. 	3. 
4. 	5. 	6. 

##### 2. Guidance

Worked example		Guided practice
	<p>Identify the parallel lines</p> <p>↓</p> <p>Match up the angles on each line</p> <p>↓</p> <p>Decide which angle rule to use</p> <p>↓</p> <p>Check the angles fit the other angle rules</p>	<p>Find the missing angles, giving a reason for your answer.</p> 

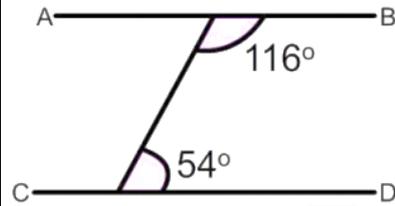
### 3. Practice

#### Fluency

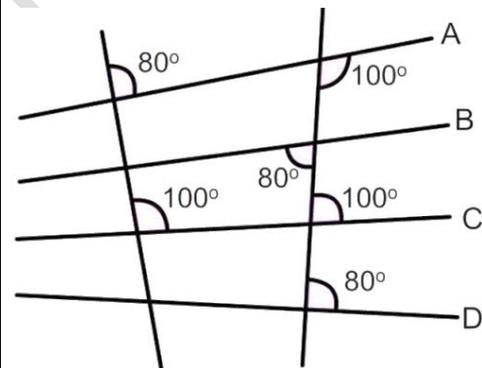


#### Problem Solving

Are lines AB and CD parallel? Give a reason for your answer.

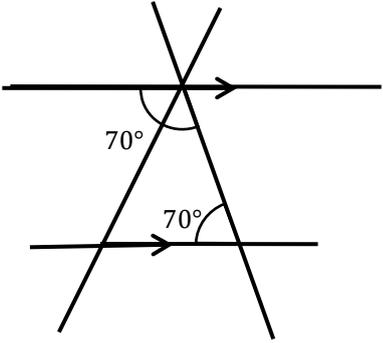
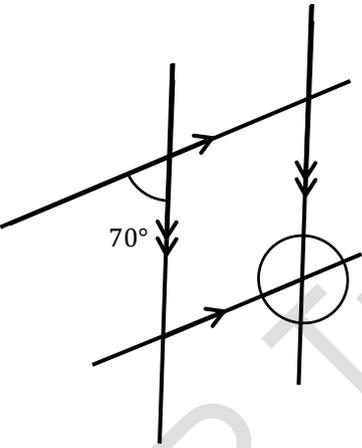
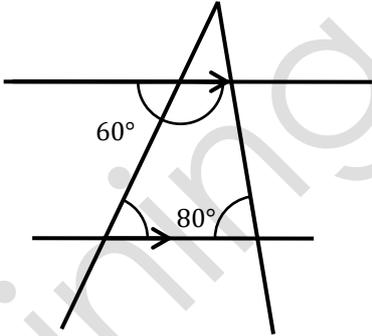
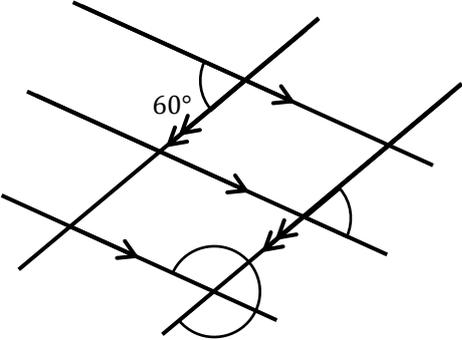


Which of the lines A, B, C and D are parallel to each other?



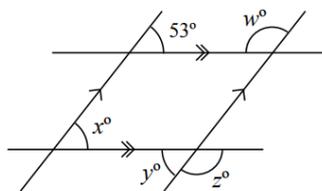
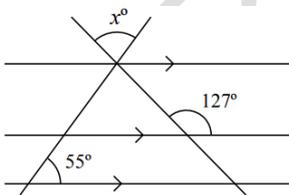
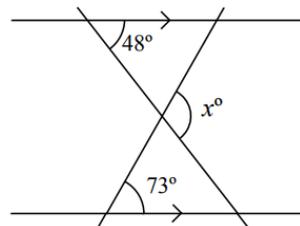
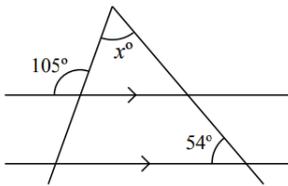
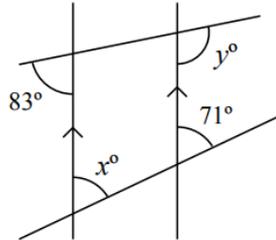
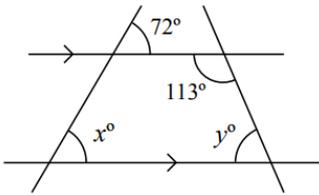
# Shapes on parallel lines

## 1. Guidance

Worked example		Guided practice
 	<p>Identify the parallel lines</p> <p>↓</p> <p>Match up the angles on each line</p> <p>↓</p> <p>Decide which angle rule to use</p> <p>↓</p> <p>Check the angles fit the other angle rules</p>	<p>Work out the missing angles. Give a reason for your answers.</p>  

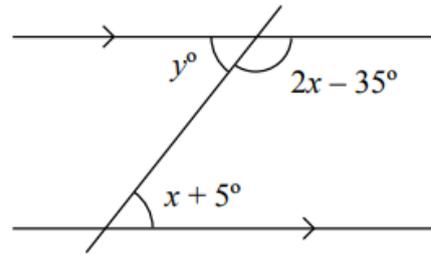
### 3. Practice

#### Fluency



#### Problem Solving

Find the values of  $x$  and  $y$



## Tutorial 5.4 – Polygons

In this tutorial we will look at:

- Calculating the interior angles of regular polygons
- Calculating the exterior angles of regular polygons

### Learning activities

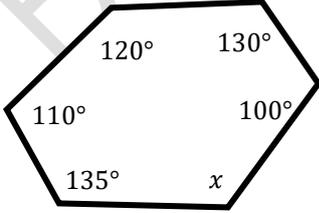
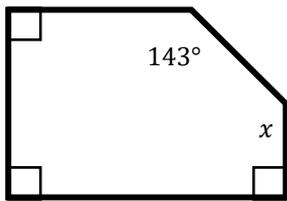
#### Angle sum of polygons

##### 1. Warm up

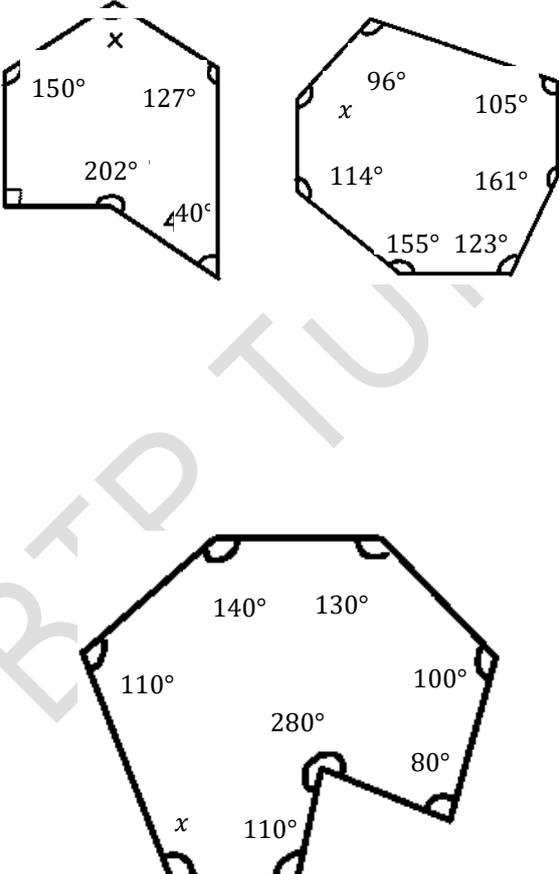
Draw a sketch of the following polygons

1. Equilateral triangle	2. Regular pentagon	3. Irregular hexagon

##### 2. Guidance

<b>Worked example</b>		<b>Guided practice</b>
<p>Calculate the interior angle sum of a hexagon.</p> <p>Find the missing angle in the following polygon.</p> 	<div style="background-color: #4b2c82; color: white; padding: 5px; margin-bottom: 5px;">Work out how many sides the shape has</div> <div style="text-align: center;">↓</div> <div style="background-color: #4b2c82; color: white; padding: 5px; margin-bottom: 5px;">Calculate the number of triangles that make it</div> <div style="text-align: center;">↓</div> <div style="background-color: #4b2c82; color: white; padding: 5px; margin-bottom: 5px;">Find the total angle sum using the triangles</div> <div style="text-align: center;">↓</div> <div style="background-color: #4b2c82; color: white; padding: 5px;">Work out any missing angles</div>	<p>Calculate the interior angle sum of a pentagon.</p> <p>Find the missing angle in the following polygon.</p> 

### 3. Practice

Fluency	Problem Solving
<p>1. Calculate the interior angle sum of:</p> <ol style="list-style-type: none"> <li>a heptagon</li> <li>an octagon</li> <li>a nonagon</li> <li>a decagon</li> <li>a dodecagon</li> </ol> <p>2. Find the missing angles in the following polygons</p>  <p>The first polygon is a pentagon with interior angles of 150°, 127°, 202°, 40°, and x. The second is a heptagon with interior angles of 96°, 105°, 161°, 123°, 155°, 114°, and x. The third is a nonagon with interior angles of 140°, 130°, 100°, 80°, 110°, x, 110°, 280°, and 110°.</p>	<p>The sum of the interior angles of a polygon is 2700°. Work out the number of sides the polygon has.</p>

## Exterior angles and regular polygons

### 1. Guidance

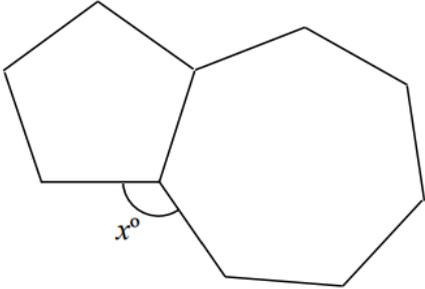
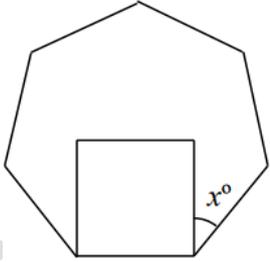
Worked example		Guided practice
Work out the exterior angle of a regular hexagon.		Work out the exterior angle of a regular pentagon.
Work out the interior angle of a regular hexagon.	<p data-bbox="707 600 975 763">Write down the total of the angles (interior or exterior)</p> <p data-bbox="826 763 855 808">↓</p> <p data-bbox="707 824 975 987">Divide by the number of sides of the polygon</p> <p data-bbox="826 987 855 1032">↓</p> <p data-bbox="707 1048 975 1211">Do your answers fit the other angle rules?</p>	Work out the interior angle of a regular pentagon.

## 2. Practice

Fluency	Problem Solving
<p>1. For each regular polygon,</p> <ol style="list-style-type: none"><li>calculate the sum of the interior angles using the triangle method</li><li>work out the size of one interior angle</li><li>work out the size of one exterior angle using "angles on a straight line"<ol style="list-style-type: none"><li>regular octagon</li><li>regular decagon</li><li>regular dodecagon</li></ol></li></ol> <p>2. For each regular polygon in Question 1</p> <ol style="list-style-type: none"><li>work out the size of one exterior angle using the total of the exterior angles</li><li>work out the size of one interior angle using "angles on a straight line"</li><li>Work out the sum of the interior angles using your answer to part ii</li></ol>	<p>The size of each interior angle of a regular polygon is <math>140^\circ</math> bigger than the size of each exterior angle.</p> <p>Work out the number of sides the polygon has.</p>

## Polygon problems

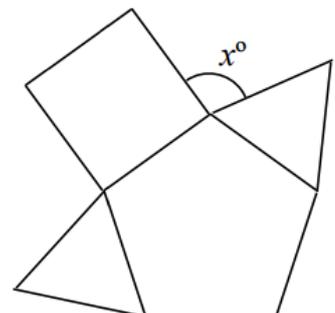
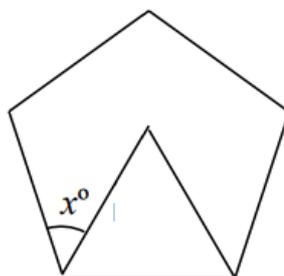
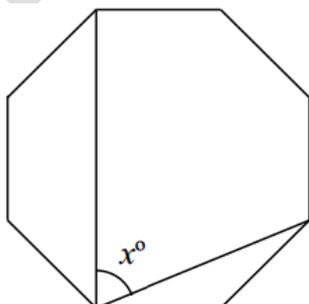
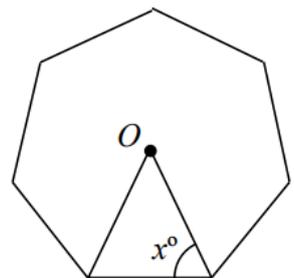
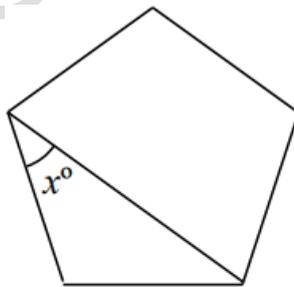
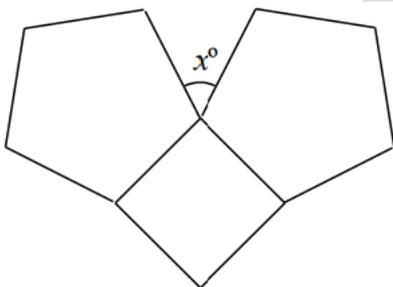
### 1. Guidance

Worked example		Guided practice
<p>Work out the value of <math>x</math></p> 	<p>Determine which polygons appear in the question</p> <p>↓</p> <p>Find the interior/exterior angles of the polygons</p> <p>↓</p> <p>Use angle rules to find the missing angles</p>	<p>Work out the value of <math>x</math></p> 

### 2. Practice

#### Problem solving

Work out the value of  $x$  in each of the following



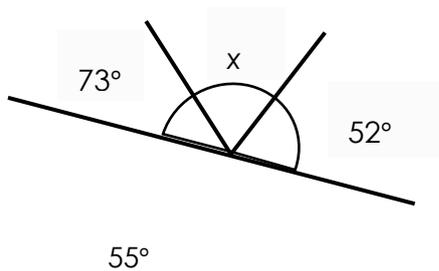
## Knowledge Check #2: End of Module

If you'd prefer to complete these questions via an online form, go to:

<https://forms.office.com/r/5BHKVGC5NQ>



- 1 What is the size of the angle marked  $x$ ?



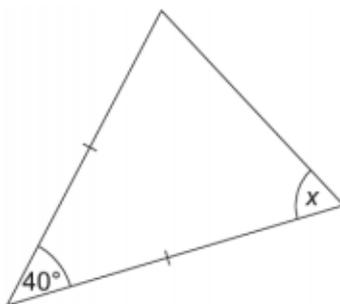
55°

60°

235°

90°

- 2 This diagram shows a triangle. What is the value of  $x$ ?



Not to scale

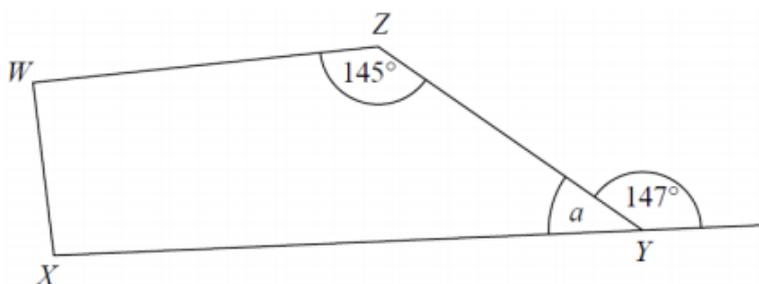
160°

70°

40°

Not enough information

- 3 WXYZ is a quadrilateral.  
XYV is a straight line.



a) What is the size of the angle marked  $a$ ?

$33^\circ$

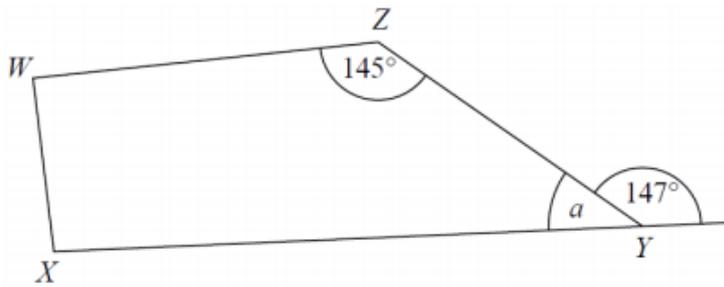
$213^\circ$

$75^\circ$

$35^\circ$

b) Angle  $x$  is equal to angle  $y$ .

What is the size of angle  $x$ ?



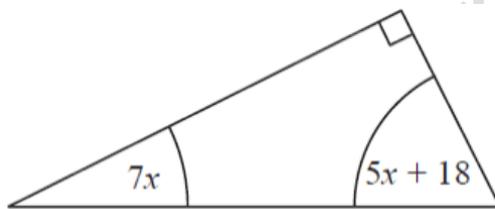
$72^\circ$

$33^\circ$

$91^\circ$

$101^\circ$

4 The diagram shows a right-angled triangle. All angles are in degrees.



a) What is the value of  $x$ ?

3

6

9

21

b) What is the size of the smallest angle?

$21^\circ$

$42^\circ$

$47^\circ$

$90^\circ$

5  $AB$  and  $CPD$  are parallel straight lines.  
 $PQ$  and  $PR$  are straight lines.

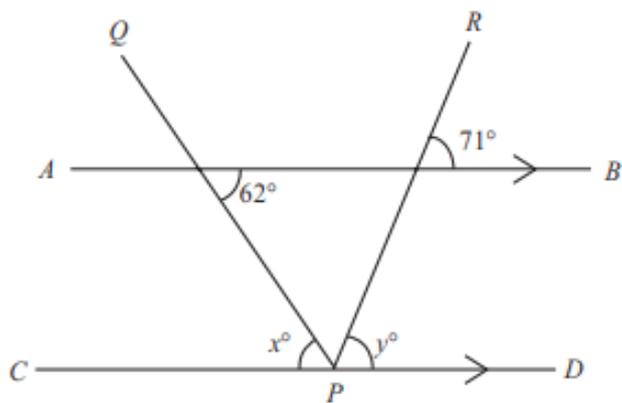


Diagram NOT accurately drawn

a) What is the size of the angle marked  $x$ ?

118°

71°

109°

62°

b) What is the size of the angle marked  $y$ ?

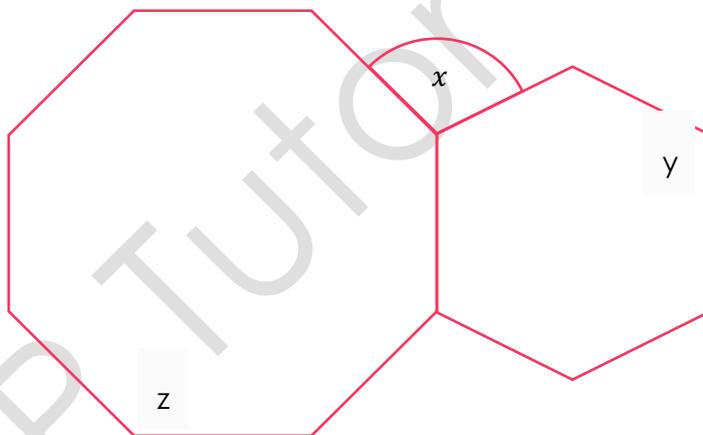
118°

71°

109°

62°

6 The diagram shows a regular octagon and a regular hexagon.



a) What is the size of angle  $y$ ?

60°

135°

108°

120°

b) What is the size of angle  $z$ ?

60°

135°

108°

120°

c) What is the size of angle  $x$ ?

---

105°

60°

75°

---

115°

BTP Tutor Training

## Module 5 review

### How do you feel now?

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This module aimed to help you:

1. Find missing angles using basic angles rules
2. Find missing angles in triangles and quadrilaterals
3. Find missing angles using parallel lines
4. Find the angles of polygons

### What next?

---

Reflection is important because it helps you review and improve the way you approach tasks, rather than just carrying on doing things as you have always done them.

Take a few minutes to think about where you think you did well during the last four tutorials, and what you think you could improve on. Write your thoughts in the boxes below.

What I did well...	What I could have improved on...
What I could do differently to make the most of my next tutorials...	



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