

Summer Block 1

# Shape

## Small steps

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# Measure and classify angles

## Notes and guidance

In Year 4, children encountered the classifications of angles as acute, right and obtuse. In Year 5, this learning was extended to include the use of degrees, as well as reflex angles. This small step revisits that learning by classifying angles and measuring them with a protractor.

Begin by recapping the types of angles. Move on to using a protractor to measure an angle, taking care when modelling which scale to use. Encourage children to estimate the size of an angle before measuring it, as they are then less likely to read the wrong scale on the protractor. For example, if an angle is seen to be less than a right angle, its size will be less than  $90^\circ$ . Children should practise estimating angles by comparing them to known fractions of a turn.

Similarly, classifying angles first can support children in reading the correct scale. For example, if an angle is acute, then the size of the angle in degrees must be less than 90

## Things to look out for

- Children may read the scale on the protractor from the wrong end.
- Children may require support when measuring reflex angles with a  $180^\circ$  protractor.

## Key questions

- What are the four types of angles?
- How many degrees are there in a right angle?
- How can you describe an acute/obtuse/reflex angle?
- How can you use a protractor to measure an angle? Where on the angle do you place the protractor?
- Does it matter which end of the protractor you start from?
- How can you use a protractor to measure a reflex angle?

## Possible sentence stems

- The angle is \_\_\_\_\_ than \_\_\_\_\_ of a turn.  
It is a/an \_\_\_\_\_ angle.
- A/an \_\_\_\_\_ angle is between \_\_\_\_\_ and \_\_\_\_\_ degrees.

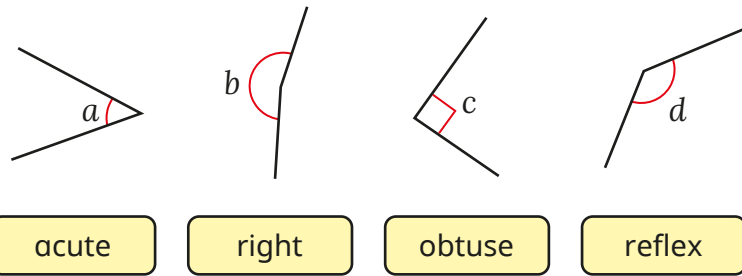
## National Curriculum links

- Recognise angles where they meet at a point, are on a straight line, or are vertically opposite, and find missing angles
- Draw given angles, and measure them in degrees ( $^\circ$ ) (Y5)
- Know angles are measured in degrees: estimate and compare acute, obtuse and reflex angles (Y5)

# Measure and classify angles

## Key learning

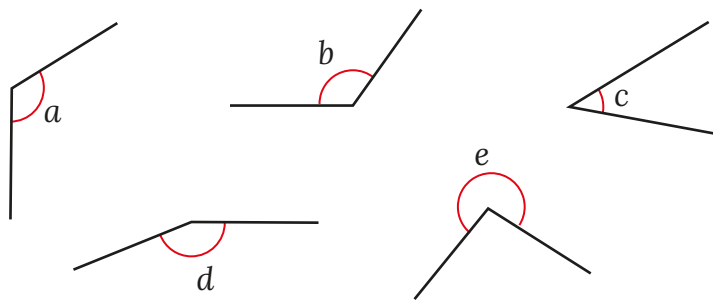
- For each angle, choose a word to complete the sentence.



Angle \_\_\_\_\_ is a/an \_\_\_\_\_ angle.

Order the angles from smallest to greatest.

- Use a protractor to measure each angle, then complete the sentences.



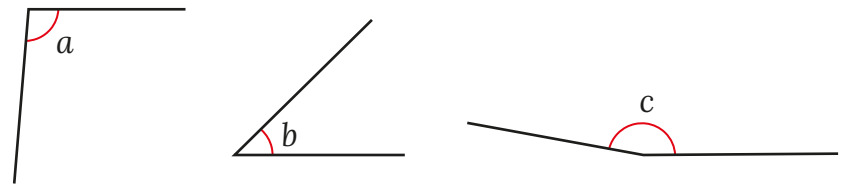
Angle \_\_\_\_\_ is \_\_\_\_\_ degrees.

It is a/an \_\_\_\_\_ angle.

- Nijah knows that this angle is slightly smaller than a right angle, so she estimates that it is approximately 85°.



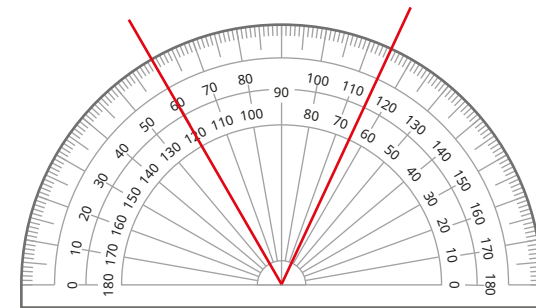
Estimate the sizes of these angles.



Now measure them with a protractor.

How close were your estimates?

- What is the size of this angle?



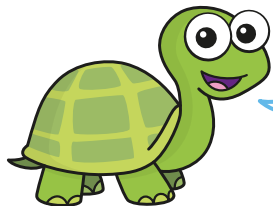
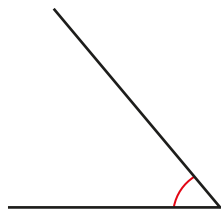
How did you work out your answer?

How else could you measure the angle?

# Measure and classify angles

## Reasoning and problem solving

Tiny is measuring angles.



This angle is  $130^\circ$ .

The angle is acute.

Tiny could have used the wrong scale.

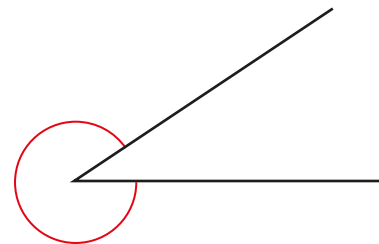
$50^\circ$

Explain why Tiny must be wrong.

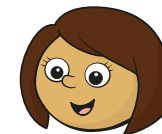
What mistake could Tiny have made?

What could the angle measure?

Kim is trying to measure the size of this reflex angle.



The protractor only measures  $180^\circ$  and this is greater than that, so I cannot measure it.



No

Do you agree with Kim?

Explain your answer.



# Calculate angles

## Notes and guidance

In Year 5, children learnt that angles on a straight line add up to  $180^\circ$  and angles around a point add up to  $360^\circ$ . That learning is revisited in this small step, with children calculating missing angles from given information.

Children also need to know the symbol for a right angle, and that an angle marked with this symbol measures  $90^\circ$ . They should recognise that without this symbol the size of the angle cannot be assumed.

Children start by calculating missing angles within a right angle, using mental or written strategies to subtract the given angle(s) from  $90^\circ$ . They then revisit angles on a straight line and angles around a point. Children should explore both methods: subtracting each known part from the whole in turn; and adding the known parts together and subtracting this from the whole.

### Things to look out for

- Children may try to find missing angles by measuring with a protractor, rather than working them out using given facts.
- Children may make errors when using mental strategies of subtraction, for example  $90 - 75 = 25$

## Key questions

- How can you calculate angles without using a protractor?
- What sort of angle is shown by a square marker?
- What do angles within a right angle add up to?
- What do angles on a straight line add up to?
- What do angles around a point add up to?
- Which angles are already given?  
How can you use these to calculate the missing angle?
- Is there more than one way to work out the answer?

## Possible sentence stems

- Angles in a right angle add up to \_\_\_\_\_ $^\circ$ .
- Angles on a straight line add up to \_\_\_\_\_ $^\circ$ .
- Angles around a point add up to \_\_\_\_\_ $^\circ$ .
- The total of angle \_\_\_\_\_ and angle \_\_\_\_\_ is \_\_\_\_\_ $^\circ$ .  
To find angle \_\_\_\_\_, subtract \_\_\_\_\_ from \_\_\_\_\_

## National Curriculum links

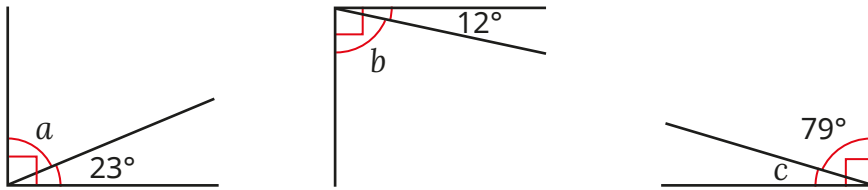
- Recognise angles where they meet at a point, are on a straight line, or are vertically opposite, and find missing angles

# Calculate angles

## Key learning

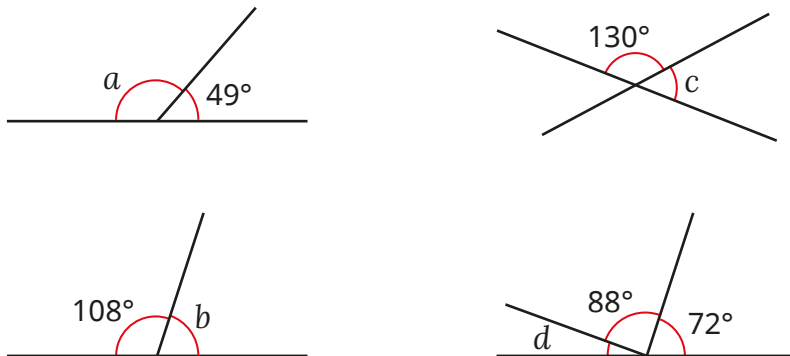
- A right angle measures  $90^\circ$ .

Use this fact to work out the sizes of angles  $a$ ,  $b$  and  $c$ .



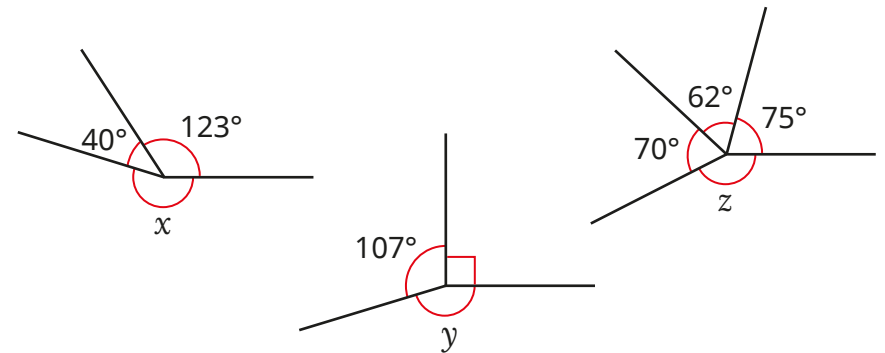
- Angles on a straight line add up to  $180^\circ$ .

Use this fact to work out the sizes of the angles marked with letters.

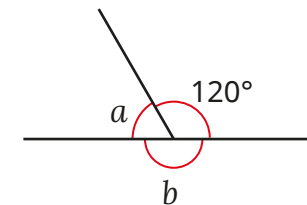


- Angles around a point add up to  $360^\circ$ .

Use this fact to work out the sizes of the angles marked with letters.



- Here are three angles on a straight line.



Which of these statements are true?

$a < b$

$a + 120^\circ = b$

$b - a = 120^\circ$

$a$  is half the size of  $120^\circ$ .

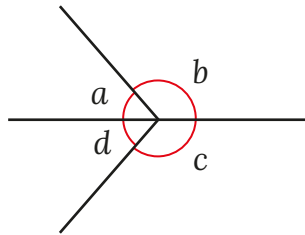
$a + b = 120^\circ$



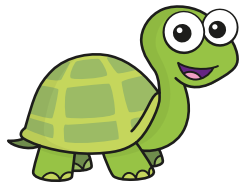
# Calculate angles

## Reasoning and problem solving

Tiny is investigating angles around a point.



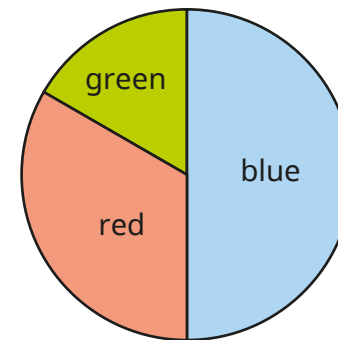
I know that  $a + b + c + d = 360^\circ$ , so angles  $a$ ,  $b$  and  $c$  could each be  $100^\circ$  and  $d$  could be  $60^\circ$ .



Do you agree with Tiny?  
Explain your answer.

No

Here is a pie chart showing the colours of cars sold by a car dealer.



The number of blue cars sold is equal to the total number of red and green cars sold.

The dealer sold twice as many red cars as green cars.

Work out the size of the angle for each sector of the pie chart.

blue:  $180^\circ$   
red:  $120^\circ$   
green:  $60^\circ$

# Vertically opposite angles

## Notes and guidance

In this small step, children learn that vertically opposite angles are equal. Begin by showing what vertically opposite angles are. By drawing two straight lines that intersect at a point, four angles are created. Through investigation, children see that there are two pairs of equal angles. They need to understand that vertically opposite angles are formed when two straight lines cross, and if either of the lines are not straight, then the angles formed are not vertically opposite. Secure this understanding by comparing vertically opposite angles to pairs of angles around a point that are opposite each other, but not vertically opposite, i.e. they are not formed by two straight lines intersecting.

Once children understand that vertically opposite angles are equal, they can use this fact alongside the rules they already know to work out missing angles.

## Things to look out for

- Children may think that vertically opposite angles must be vertical in relation to each other, rather than sharing a common vertex.
- Children may think that all opposite angles are equal, rather than only those formed by intersecting straight lines.

## Key questions

- What are vertically opposite angles?
- How do you know that the angles are vertically opposite?
- Which angles are the same size? How do you know?
- What number sentences can you write about vertically opposite angles?
- How can you find the size of the missing angle?  
Is there more than one way?
- What is the difference between vertically opposite angles and two angles around a point that are opposite each other?

## Possible sentence stems

- Vertically opposite angles are \_\_\_\_\_
- If angle \_\_\_\_\_ is \_\_\_\_\_°, then angle \_\_\_\_\_ is also \_\_\_\_\_°.
- Angles \_\_\_\_\_ and \_\_\_\_\_ are equal, because ...

## National Curriculum links

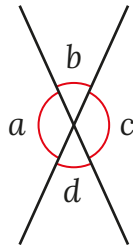
- Recognise angles where they meet at a point, are on a straight line, or are vertically opposite, and find missing angles

# Vertically opposite angles

## Key learning

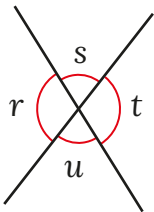
- Take a piece of paper and draw a large “X”.

- ▶ Mark the angles on as shown.
- ▶ Measure each angle.
- ▶ What do you notice about angles  $b$  and  $d$ ?
- ▶ What do you notice about angles  $a$  and  $c$ ?



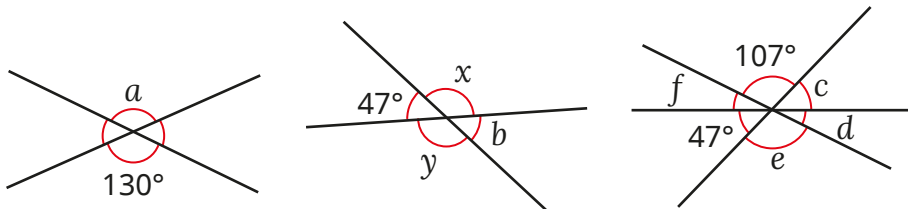
What do you notice about angles  $a$  and  $c$ ?  
Is this always the case? Draw other “X” shapes to investigate.

- Use the letters from the diagram to complete the statements.

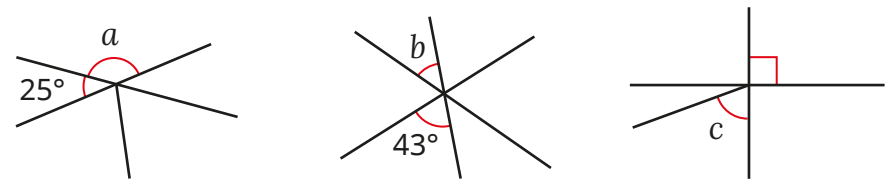


$$\begin{aligned} \underline{\hspace{2cm}} &= \underline{\hspace{2cm}} \\ \underline{\hspace{2cm}} + \underline{\hspace{2cm}} &= 180^\circ \\ \underline{\hspace{2cm}} &= \underline{\hspace{2cm}} \\ \underline{\hspace{2cm}} + \underline{\hspace{2cm}} &= 180^\circ \end{aligned}$$

- Work out the sizes of the angles marked with letters.



- Each diagram has been drawn using three straight lines.

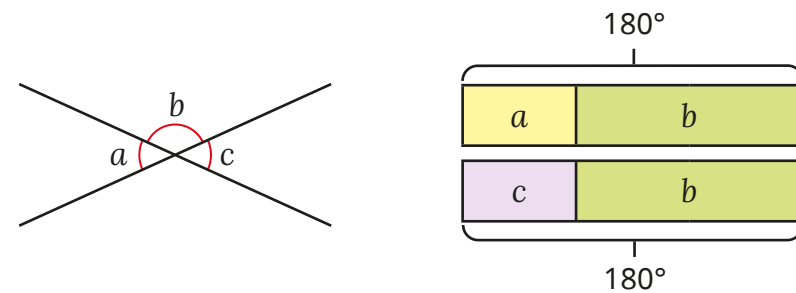


Which of the angle(s) marked with letters can you work out?

Which angle(s) can you not work out?

Talk about it with a partner.

- Brett has drawn a bar model to show the sizes of the angles.

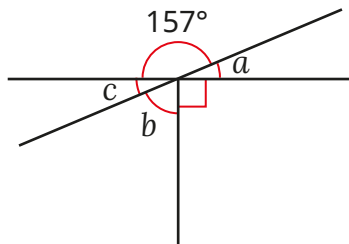


Explain how Brett’s bar model shows that angles  $a$  and  $c$  are the same size.

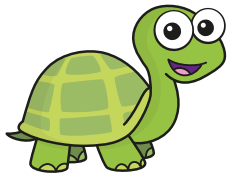
# Vertically opposite angles

## Reasoning and problem solving

This diagram is drawn using three straight lines.

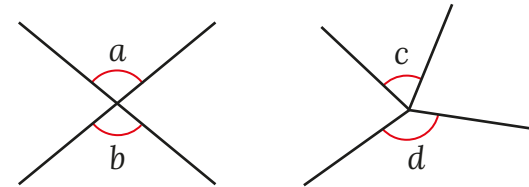


I only have enough information to work out the size of angle  $a$ .



Do you agree with Tiny?  
Explain your answer.

No  
 $a = 23^\circ$   
 $b = 67^\circ$   
 $c = 23^\circ$



Are the statements true or false?

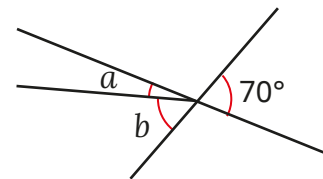
Angles  $a$  and  $b$  are equal.

Angles  $c$  and  $d$  are equal.

Explain your answer.

True  
False

Three straight lines are drawn.



$b$  is two and a half times greater than  $a$ .  
Work out the size of angle  $a$ .

$a = 20^\circ$

# Angles in a triangle

## Notes and guidance

In this small step, children learn that the interior angles of a triangle always sum to  $180^\circ$ .

Get children to measure each angle of a triangle and add them together, doing this for a number of different triangles, in order to discover the rule. Discuss that, when using a protractor, there is the possibility of small inaccuracies causing the total to be slightly different from  $180^\circ$ .

When the rule is established, children work out unknown angles in triangles. They should see each angle as a “part” and  $180^\circ$  as the “whole”. The three parts add to make the whole. This means that they can work out one of the missing parts by subtracting each of the known parts from the whole, or adding the known parts together before subtracting this from the whole. This step is a good opportunity to revisit mental and written calculation methods, as well as using inverse operations to check answers.

## Things to look out for

- Children may try to use a protractor to measure missing angles, rather than working them out based on given facts.
- Children may use  $360^\circ$  (from angles around a point) instead of  $180^\circ$ .

## Key questions

- What does “interior” mean?
- How many interior angles does a triangle have?
- How can you measure the angles in a triangle?
- What do the interior angles of a triangle sum to?
- If you know the size of two interior angles in a triangle, how can you work out the third angle?
- Could you work out the missing angle a different way?

## Possible sentence stems

- The angles in a \_\_\_\_\_ add up to \_\_\_\_\_ $^\circ$ .
- The whole ( $180^\circ$ ) subtract the parts \_\_\_\_\_ $^\circ$  and \_\_\_\_\_ $^\circ$  gives the missing angle, \_\_\_\_\_ $^\circ$ .

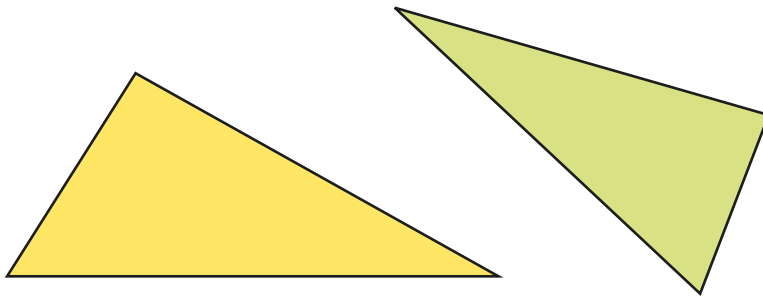
## National Curriculum links

- Compare and classify geometric shapes based on their properties and sizes and find unknown angles in any triangles, quadrilaterals, and regular polygons

# Angles in a triangle

## Key learning

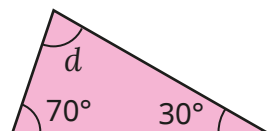
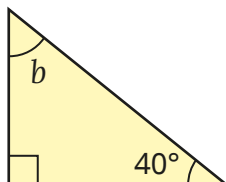
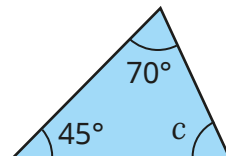
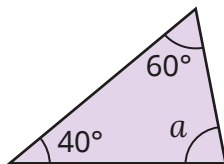
- Use a protractor to measure the angles in each triangle.



What is the sum of the angles in each triangle?

What do you notice?

- Calculate the sizes of the angles marked with letters.

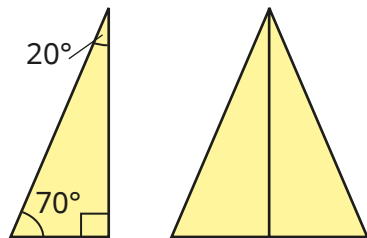


- Two angles in a triangle are  $75^\circ$  and  $28^\circ$ .  
What is the size of the third angle?
- One angle in a right-angled triangle is  $12^\circ$ .  
Find the sizes of the other two angles.
- Two angles in a triangle are  $36.7^\circ$  and  $15.9^\circ$ .  
What is the size of the third angle?
- The first angle in a triangle is  $42^\circ$ .  
The second angle is twice the size of the first angle.  
What is the size of the third angle?
- A triangle has angles  $a$ ,  $b$  and  $c$ .  
Angle  $a$  is twice the size of angle  $b$ .  
Angle  $b$  is three times the size of angle  $c$ .  
What is the size of angle  $c$ ?

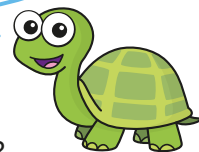
# Angles in a triangle

## Reasoning and problem solving

An isosceles triangle is made by combining two right-angled triangles.



The sum of the angles in the right-angled triangle is  $180^\circ$ , so the sum of the angles in the isosceles triangle must be  $360^\circ$ .



Do you agree with Tiny?  
Explain your answer.

No

Are the statements true or false?

A triangle can have three acute angles.

A triangle can have two right angles.

A triangle must have at least one obtuse angle.

All three angles can be the same in a triangle.

If one of the angles in a triangle is a right angle, the other two angles must be the same as each other.

Explain your answers.

True  
False  
False  
True  
False

# Angles in a triangle – special cases

## Notes and guidance

In Year 4, children learnt to classify triangles as equilateral, isosceles or scalene, based on the lengths of their sides. They also know that a right-angled triangle has one angle of  $90^\circ$ . In this small step, children extend this learning to include the angles of triangles. Using their knowledge of angles in specific triangles, as well as the total of the angles, children work out missing angles in different types of triangles.

Starting with equilateral triangles, as all the angles are equal, children learn that each angle must be  $180^\circ \div 3 = 60^\circ$ . They then move on to investigating isosceles triangles. Children learn that not only do isosceles triangles have two equal sides, but they also have two equal angles. They need to identify which two angles are equal in order to find the sizes of unknown angles in the triangles.

Children may need reminding of hatch mark notation to show that sides of shapes are equal in length.

## Things to look out for

- Children may use a protractor to measure unknown angles, rather than working them out from given facts.
- Children may wrongly identify which two angles are equal to each other in an isosceles triangle.

## Key questions

- What do the interior angles in a triangle add up to?
- If a triangle is equilateral, what do you know about its sides/angles? How can you work out the size of one of the angles?
- What are the properties of an isosceles triangle?
- Which of the angles in the triangle are equal? How do you know?
- If you know one angle in an isosceles triangle, how can you calculate the sizes of the other two angles?

## Possible sentence stems

- In an equilateral triangle, all three angles are \_\_\_\_\_°.
- In an isosceles triangle, two \_\_\_\_\_ are equal and two \_\_\_\_\_ are equal.
- In a right-angled triangle, one of the angles is \_\_\_\_\_°.

## National Curriculum links

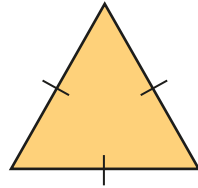
- Compare and classify geometric shapes based on their properties and sizes and find unknown angles in any triangles, quadrilaterals, and regular polygons



# Angles in a triangle – special cases

## Key learning

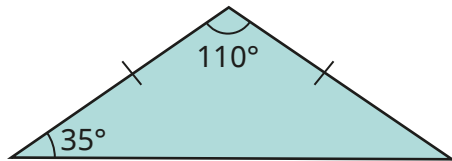
- In an equilateral triangle, all three angles are equal.



What is the size of each angle in an equilateral triangle?

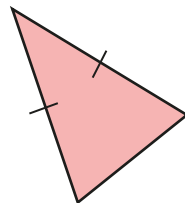
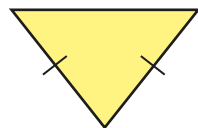
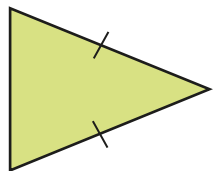
How do you know?

- Work out the missing angle in the isosceles triangle.

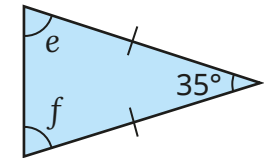
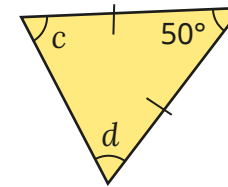
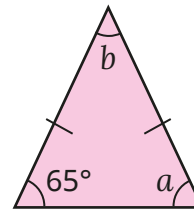


What do you notice?

- Identify which angles will be equal in each isosceles triangle.



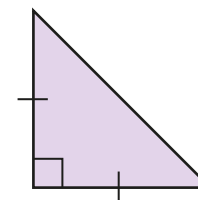
- Here are three isosceles triangles.



Work out the angles marked with letters.

- One of the angles in an isosceles triangle is  $24^\circ$ .  
What could the other two angles be?  
Find more than one possible answer.

- A right-angled triangle is also isosceles.



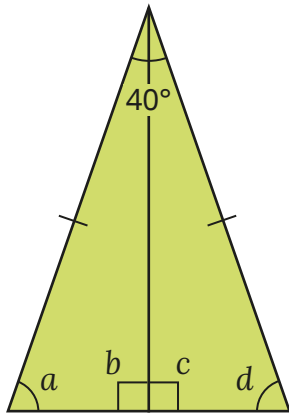
Work out the sizes of all three angles in the triangle.

# Angles in a triangle – special cases

## Reasoning and problem solving

How many sentences can you write to express the relationships between the angles in the triangles?

One has been done for you.



$$40^\circ + a + d = 180^\circ$$

multiple possible answers, e.g.

$$20^\circ + a + b = 180^\circ$$

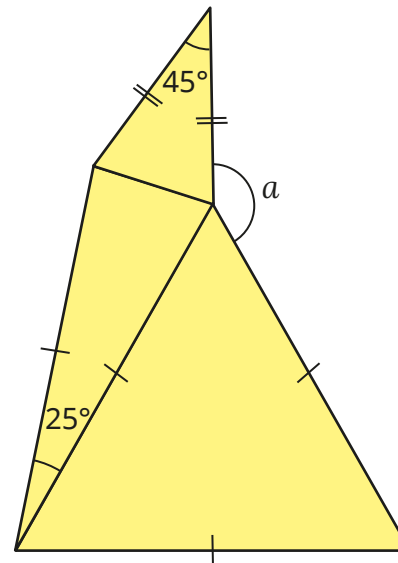
$$20^\circ + c + d = 180^\circ$$

$$b = 90^\circ, c = 90^\circ$$

$$b = c$$

$$a = d$$

The shape is made from two isosceles triangles and an equilateral triangle.



Work out the size of angle  $a$ .

$$a = 155^\circ$$

# Angles in a triangle – missing angles

## Notes and guidance

In this small step, children combine what they have learnt so far in this block to solve a variety of missing angle questions. By thinking about angles in different types of triangles, as well as in right angles, on a straight line and around a point, children should be able to work out the sizes of missing angles in increasingly complex problems.

Begin by recapping the rules of angles they have learnt so far, and then share a problem with the class and discuss what methods are available based on the facts they know. Work through missing angle problems that begin with one focus, but move on to examples that require knowledge of more than one rule. At each stage, ask children to explain what rules they have used to solve the problem. They will find that there are multiple ways of solving most problems, and this will consolidate their understanding of the rules.

### Things to look out for

- Children may measure missing angles with a protractor, rather than working them out based on given facts.
- Children may need support to work out intermediate angles when the required angle cannot be found in one step.

## Key questions

- Why can you not always find the size of the missing angle by measuring?
- What type of triangle is this? How will knowing that help you to find the value of the missing angle?
- Do you need to work out a different angle before you can work out the missing angle?
- Which angles can you work out straight away? How will that help you to work out other angles?
- What do angles in a right angle/on a straight line/around a point add up to?

## Possible sentence stems

- The sum of angles in a triangle is \_\_\_\_\_°.
- The sum of angles on a straight line is \_\_\_\_\_°.
- The sum of angles around a point is \_\_\_\_\_°.
- Vertically opposite angles are \_\_\_\_\_

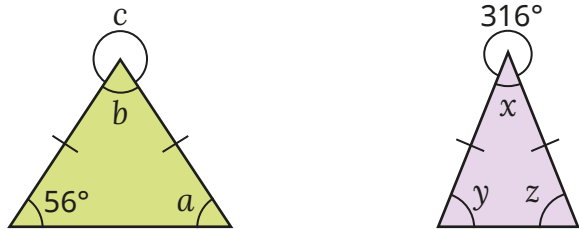
## National Curriculum links

- Compare and classify geometric shapes based on their properties and sizes and find unknown angles in any triangles, quadrilaterals, and regular polygons

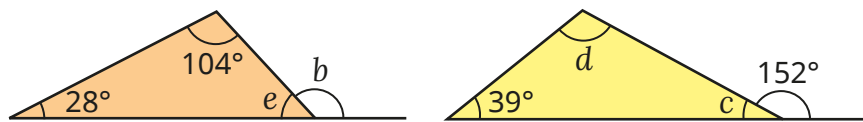
# Angles in a triangle – missing angles

## Key learning

- Work out the sizes of the angles marked with letters. Explain each step in your workings.



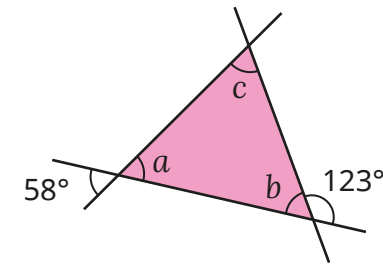
- Work out the sizes of the angles marked with letters. Explain each step in your workings.



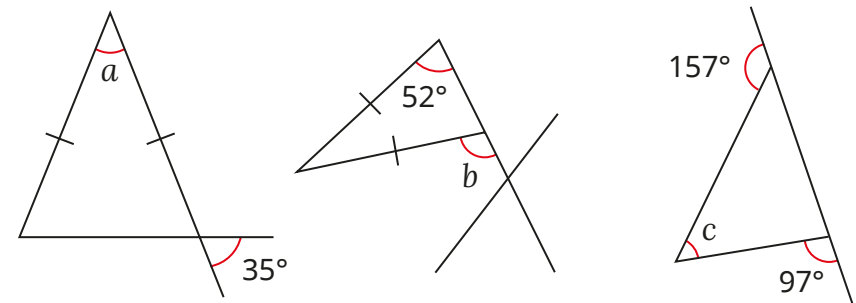
- Work out the sizes of the angles marked with letters. Explain each step in your workings.



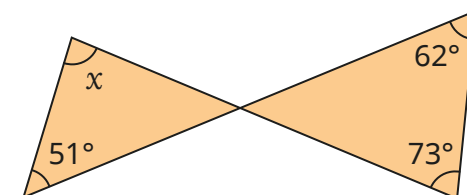
- Work out the sizes of the angles marked with letters.



- Discuss with a partner how you could work out each of the angles marked with letters. How many ways can you find to work out each one?

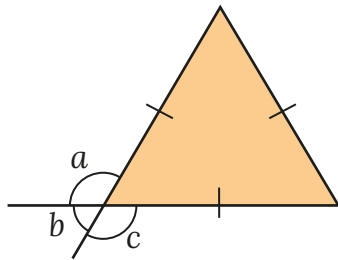


- Work out the size of angle x.

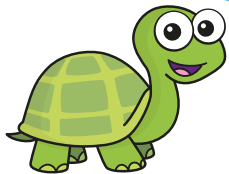


# Angles in a triangle – missing angles

## Reasoning and problem solving



I cannot work out the missing angles, because there are no known angles to work from.



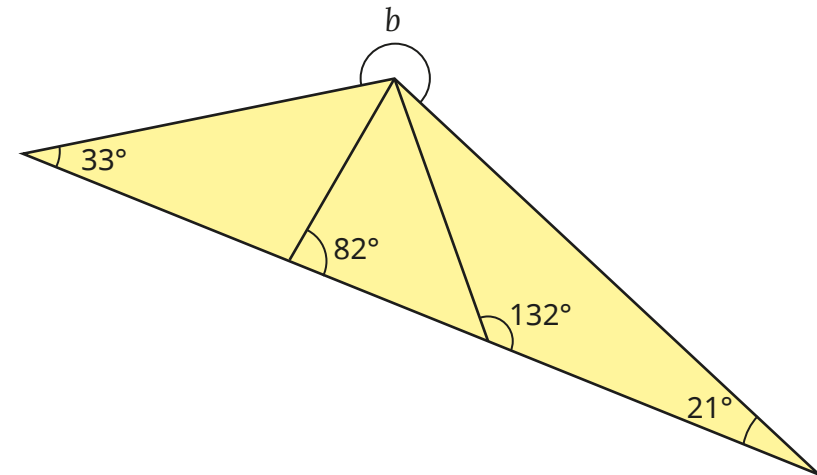
Do you agree with Tiny?

Explain your answer.

The triangle is an equilateral triangle, so each angle is  $60^\circ$ .

Tiny can then use other rules to work out angles  $a$ ,  $b$  and  $c$ .

Work out the size of the reflex angle  $b$ .



What other angles can you work out?

$$b = 234^\circ$$

# Angles in a quadrilateral

## Notes and guidance

In Year 4, children explored the properties of different quadrilaterals and they should be familiar with the words “trapezium”, “rhombus”, “square”, “rectangle”, “parallelogram” and “kite”. They learnt about the equal and parallel sides in quadrilaterals, as well as which ones have right angles. In this small step, that learning is extended to include the properties of the angles in these quadrilaterals.

For a square and a rectangle, the fact that the angles add up to  $360^\circ$  can be worked out quickly. For other quadrilaterals, children can investigate by measuring the angles with a protractor. Show that, as any quadrilateral can be split into two triangles, the sum of the interior angles is twice that of a triangle and compare this with the totals found by measuring.

Children then move on to explore the relationships between angles in a rhombus and a parallelogram, where opposite angles are equal.

## Things to look out for

- Children may incorrectly identify equal sides and/or angles.
- Children may try to use  $180^\circ$  instead of  $360^\circ$  as the sum of the angles in a quadrilateral.

## Key questions

- What is a quadrilateral?
- In what ways can quadrilaterals be different from one another?
- What is the sum of the interior angles in a quadrilateral?
- What is the same/different about a rhombus and a square?
- If you know one angle in a parallelogram, how can you work out the sizes of the missing angles?

## Possible sentence stems

- The sum of interior angles in any quadrilateral is \_\_\_\_\_ $^\circ$ .
- A parallelogram has two pairs of equal \_\_\_\_\_ and two pairs of equal \_\_\_\_\_
- A rhombus has two pairs of equal \_\_\_\_\_ and two pairs of equal \_\_\_\_\_

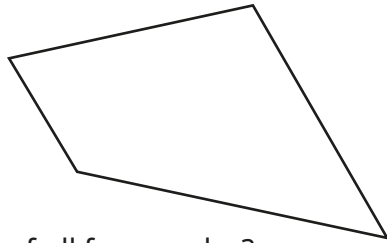
## National Curriculum links

- Compare and classify geometric shapes based on their properties and sizes and find unknown angles in any triangles, quadrilaterals, and regular polygons

# Angles in a quadrilateral

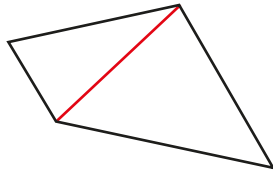
## Key learning

- Measure the angles of the quadrilateral.



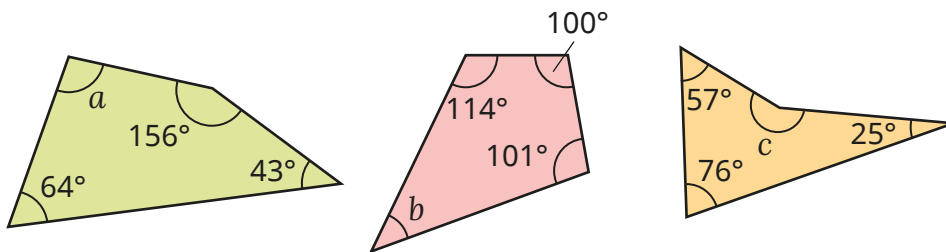
What is the sum of all four angles?

Huan draws a line on the quadrilateral to prove that the angles in any quadrilateral add up to  $360^\circ$ .

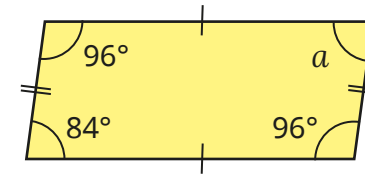


Explain Huan's reasoning.

- Work out the missing angles in the quadrilaterals.

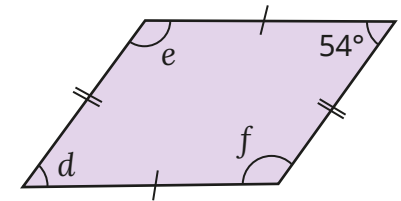
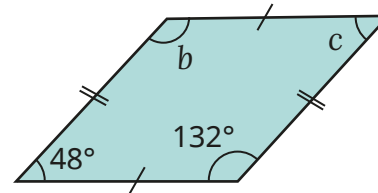


- Work out the size of angle  $a$  in the parallelogram.

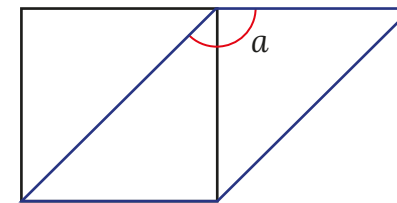


What do you notice about the opposite angles in a parallelogram?

Use this to work out the angles marked with letters in the parallelograms.



- A parallelogram has been drawn over the top of a square.

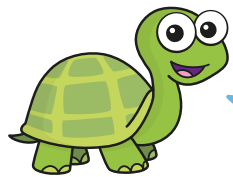


Work out the size of angle  $a$ .

# Angles in a quadrilateral

## Reasoning and problem solving

Tiny draws a quadrilateral with four equal sides.



My shape must be a square, so the angles are all  $90^\circ$ .

No

Do you agree with Tiny?

Explain your answer.

Esther draws a quadrilateral with exactly two right angles.

What types of quadrilaterals could she have drawn?

Is it possible to draw a quadrilateral with exactly three right angles?

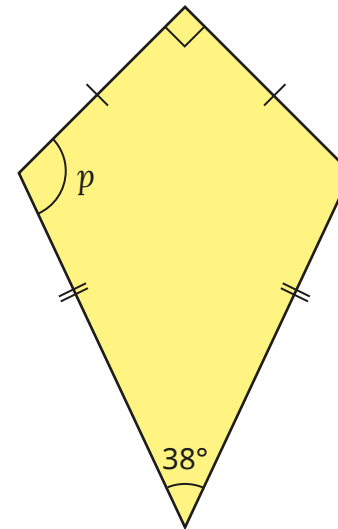
Explain your answer.

trapezium or kite

No

3 right angles sum to  $270^\circ$ , so the 4th angle must be  $360^\circ - 270^\circ = 90^\circ$ .

Here is a kite.



$p = 116^\circ$

Work out the size of angle  $p$ .

Talk to a partner about how you worked it out.



# Angles in polygons

## Notes and guidance

In this small step, children develop their understanding of interior angles in 2-D shapes by looking at polygons with five or more sides.

Building on the fact that a quadrilateral can be split into two triangles, so the interior angles add up to  $180 \times 2 = 360^\circ$ , children explore how many triangles polygons with a greater number of sides can be split into using a vertex of the polygon. They learn that the number of triangles is two fewer than the number of sides. Multiplying the number of triangles by  $180^\circ$  gives the sum of the interior angles in the polygon. Using this information, they can find unknown angles for any polygon. The main focus of this step is on regular polygons, where children can divide the total by the number of sides to work out the size of each angle.

### Things to look out for

- Children may use a protractor instead of calculating a missing angle.
- Children may multiply the number of sides by  $180^\circ$  to find the sum of the interior angles.
- When looking for the number of triangles, children may draw too many triangles by drawing lines from more than one vertex of the polygon.

## Key questions

- What is a polygon?
- What is the difference between a regular and an irregular polygon?
- How many triangles can you make in this polygon?
- Why is it important to draw the triangles from a single vertex?
- If the sum of interior angles in each triangle adds up to  $180^\circ$ , how can you work out the sum of the interior angles in the polygon?
- If you know the sum of the interior angles in a polygon, how can you use this information to find a missing angle?

## Possible sentence stems

- If there are \_\_\_\_\_ sides, then there are \_\_\_\_\_ triangles.
- The sum of the angles is \_\_\_\_\_  $\times 180^\circ =$  \_\_\_\_\_  $^\circ$ .
- The sum of the interior angles in a \_\_\_\_\_ is \_\_\_\_\_  $^\circ$ .

## National Curriculum links

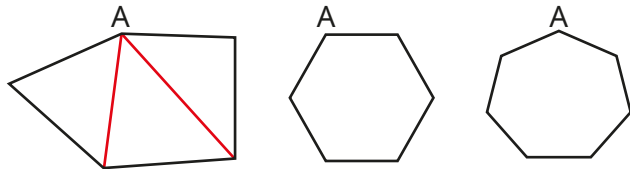
- Compare and classify geometric shapes based on their properties and sizes and find unknown angles in any triangles, quadrilaterals, and regular polygons

# Angles in polygons

## Key learning

- Aisha splits a pentagon into three triangles by drawing lines from vertex A.

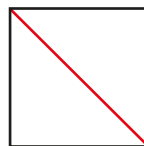
Use Aisha's method to split the other shapes into triangles.



What do you notice about the number of sides a shape has and the smallest number of triangles each one can be split into?

- Scott can make two triangles from a quadrilateral.

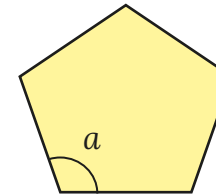
He then knows that the sum of the interior angles in a quadrilateral must be  $360^\circ$ .



Use Scott's method to complete the table.

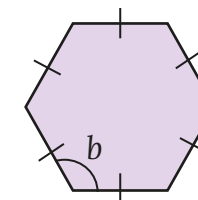
Shape	Number of sides	Number of triangles	$180 \times$ number of triangles	Sum of interior angles
square	4	2	$180 \times 2$	$360^\circ$
pentagon	5	3		
hexagon				
heptagon				
octagon				

- Here is a regular pentagon.

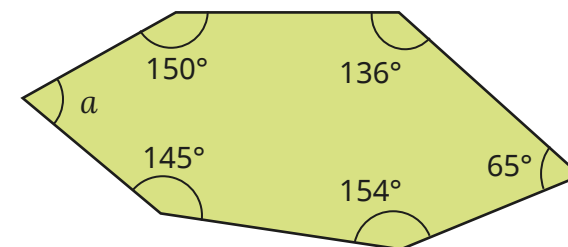


- ▶ What is the sum of the interior angles of a pentagon?  
How do you know?
- ▶ What is the size of angle  $a$ ?  
How do you know?

- Calculate the size of the angle  $b$ .



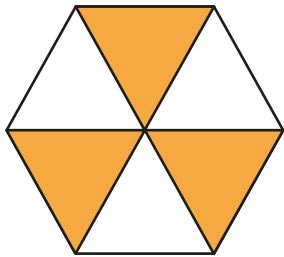
- Work out the size of angle  $a$ .



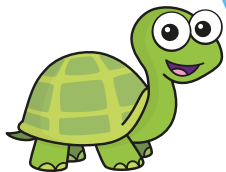
# Angles in polygons

## Reasoning and problem solving

Tiny draws six triangles inside a hexagon.



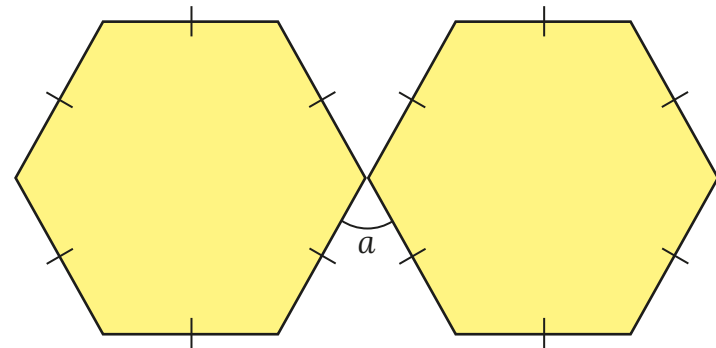
This means that the sum of angles in a hexagon is  $1,080^\circ$  because  $6 \times 180 = 1,080$ .



Do you agree with Tiny?  
Explain your answer.

No  
Tiny's total includes the angles at the centre of the hexagon, not just those at the vertices.

Here are two regular hexagons.



Work out the size of angle  $a$ .

$$a = 60^\circ$$

# Circles

## Notes and guidance

Children used circles in pie charts in the Statistics block in the Spring term. In this small step, they develop their learning to ensure understanding of the words “radius”, “diameter” and “circumference”.

Children need to understand the importance of the centre of a circle: it is the point that is an equal distance from every part of the edge of the circle. They then move on to looking at the connection between the radius and the diameter. It is important that they realise that both of these are related to the centre. Showing examples and non-examples of radii and diameters will help to reinforce this understanding.

At this stage, children do not need to be able to calculate the circumference. It may be useful to discuss that using a piece of string around the outside of a circle, then measuring it, will give an approximate measure for this.

### Things to look out for

- Children may confuse the terms “radius” and “diameter”.
- Children may think that a diameter is any line across a circle, even if it does not go through the centre.

## Key questions

- What does the term “radius”/“diameter”/“circumference” mean?
- What is the relationship between the radius and the diameter of a circle?
- What point must the diameter of a circle go through?
- If you know the diameter of a circle, how can you calculate its radius?
- If you know the radius of a circle, how can you calculate its diameter?
- How can you tell if a line across a circle is a diameter or not?

## Possible sentence stems

- The radius of a circle is \_\_\_\_\_ the size of the diameter of the circle.
- The diameter of a circle is \_\_\_\_\_ the size of the radius of the circle.
- All the points on the circumference of a circle are an \_\_\_\_\_ distance from the \_\_\_\_\_

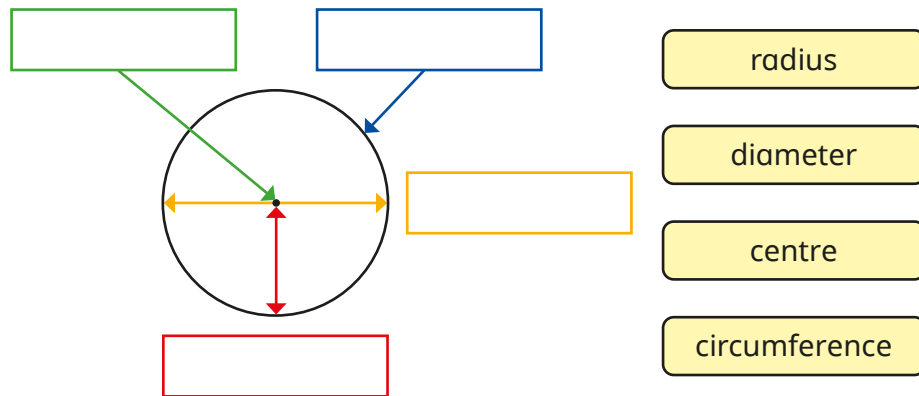
## National Curriculum links

- Illustrate and name parts of circles, including radius, diameter and circumference and know that the diameter is twice the radius

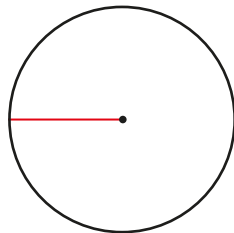
# Circles

## Key learning

- Use the labels to complete the diagram.



- Filip has drawn a 5 cm straight line from the centre of the circle to its edge.

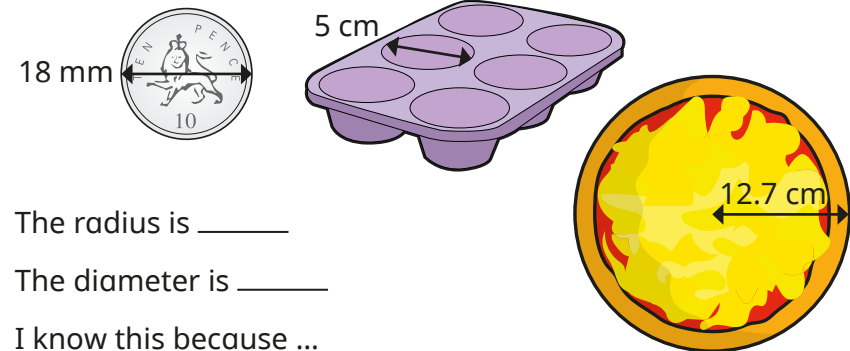


- ▶ What is the name of the line Filip has drawn?
- ▶ Explain to a partner how Filip can use this line to help him find the diameter of the circle.

- Complete the table.

Radius	Diameter
26 cm	
	37 mm
2.55 m	
	99 cm
	19.36 cm

- Find the radius and the diameter for each object.



The radius is \_\_\_\_\_

The diameter is \_\_\_\_\_

I know this because ...

- If the radius of a circle is  $r$  and the diameter is  $d$ , which formula shows the relationship between the radius and diameter of the circle?

$2r = d$

$2d = r$

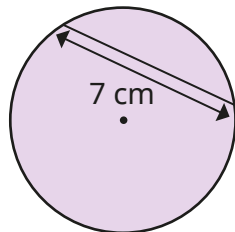
$r + 2 = d$

$d + 2 = r$

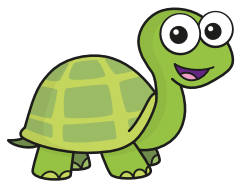
# Circles

## Reasoning and problem solving

Tiny is trying to find the radius of the circle.



I know that the diameter is 7 cm, so the radius is 3.5 cm.

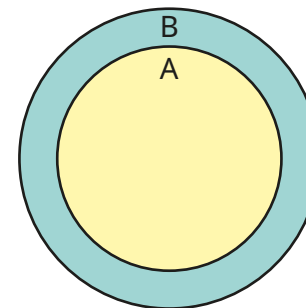


Do you agree with Tiny?  
Explain your answer.

No  
The diameter needs to pass through the centre of the circle and this line does not.

Circle A has been drawn on top of circle B.

The diameter of circle A is  $\frac{3}{4}$  the diameter of circle B.



If the diameter of circle B is 12 cm, what is the diameter of circle A?

If the diameter of circle A is 12 cm, what is the diameter of circle B?

If the radius of circle B is 6 cm, what is the radius of circle A?

If the radius of circle A is 6 cm, what is the diameter of circle B?

9 cm

---

16 cm

---

4.5 cm

---

16 cm

# Draw shapes accurately

## Notes and guidance

In this small step, children use skills learnt so far in this block to accurately draw shapes when given specific dimensions.

Children begin drawing simple shapes that can be done on squared paper, such as rectangles and right-angled triangles where the base and height are given. This could be extended to drawing shapes where the perimeter and some of the sides are known.

Children then produce an accurate drawing of a shape with known angles. They may need to begin by practising using a protractor. Children should work systematically, starting with a side and then drawing the angle(s) from the correct end(s). They should also use their understanding of the features of different quadrilaterals and triangles to recreate these accurately.

This step is a good opportunity to revisit converting between centimetres and millimetres.

## Things to look out for

- Children may need support to decide which part of the shape to draw first.
- Children may start from the wrong end of the scale on a protractor.

## Key questions

- How can you use squared paper to draw a shape with right angles?
- What tools can you use to help you draw a shape accurately?
- What do you know about the shape that will help you to draw it accurately?
- Which part of the shape can you draw first? Then what can you draw?
- How can you check if your shape is drawn accurately?
- What labels can you add to your drawing?
- Which scale on the protractor do you need to use?

## Possible sentence stems

- If the perimeter of the rectangle is \_\_\_\_\_ cm and one side is \_\_\_\_\_ cm, then the other sides must be \_\_\_\_\_ cm, \_\_\_\_\_ cm and \_\_\_\_\_ cm.
- If an angle is \_\_\_\_\_ than  $90^\circ$ , I need to use the \_\_\_\_\_ scale on the protractor.

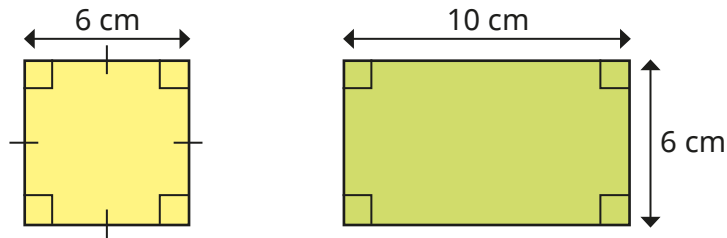
## National Curriculum links

- Draw 2-D shapes using given dimensions and angles

# Draw shapes accurately

## Key learning

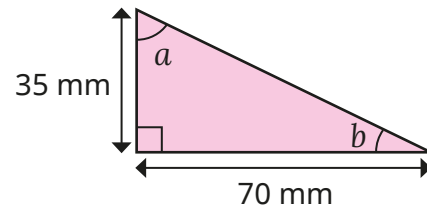
- Draw the shapes accurately on squared paper.



- Draw the right-angled triangle accurately on squared paper.

What is the missing length?

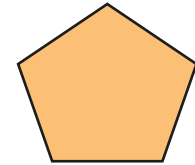
Measure the sizes of angles  $a$  and  $b$ .



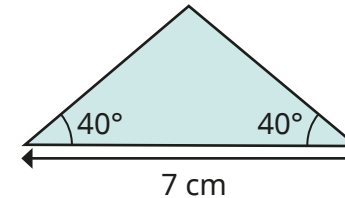
- Draw the shapes accurately on squared paper.
  - ▶ a square with a perimeter of 16 cm
  - ▶ a rectangle with an area of  $20 \text{ cm}^2$
  - ▶ a right-angled triangle with a height of 8 cm and a base of 6 cm
- The sides of a right-angled triangle are 3 cm, 4 cm and 5 cm. Draw the triangle and measure the sizes of its angles. Label the triangle with as much information as you can.

- What is the size of each interior angle of the regular polygon?

Accurately draw a regular pentagon with a side length of 5 cm.



- Write a step-by-step plan to draw the triangle.



Use your plan to make an accurate copy of the triangle.

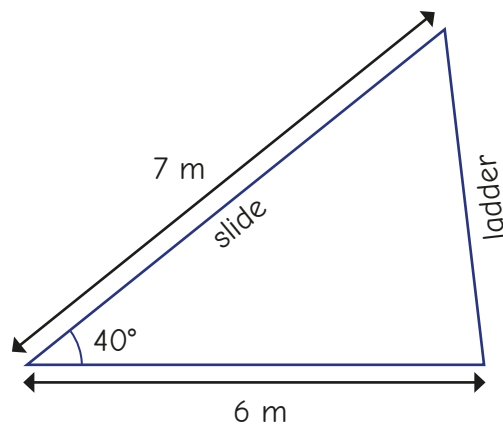
- Use a ruler and a protractor to draw the shapes. Label the information that is given to you on the shape, as well as any equal or parallel lines.
  - ▶ a right-angled triangle with one angle of  $38^\circ$
  - ▶ a parallelogram with two angles of  $40^\circ$  and two sides of 6 cm
  - ▶ an equilateral triangle with a perimeter of 21 cm
  - ▶ an irregular pentagon with a perimeter of 75 cm and two interior right angles



# Draw shapes accurately

## Reasoning and problem solving

Mr Hall is designing a slide for the playground.



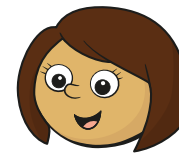
approximately  
4.5 m

Use a scale of 1 cm to represent 1 m.

Draw a scale diagram.

Use the diagram to find out approximately how long the ladder needs to be.

Kim has drawn a scalene triangle.



- Angle  $a$  is the greatest angle.
- Angle  $b$  is  $20^\circ$  larger than angle  $c$ .
- Angle  $c$  is  $70^\circ$  smaller than angle  $a$ .

Use a bar model to help you calculate the size of each angle.

Then draw Kim's triangle.

Is there more than one way to draw the triangle?

$$a = 100^\circ$$

$$b = 50^\circ$$

$$c = 30^\circ$$

These angles work with different side lengths.

# Nets of 3-D shapes

## Notes and guidance

In the final small step of this block, children learn that they can make a 3-D shape using knowledge of the 2-D shapes that make up its faces.

Children should be familiar with 3-D shapes from earlier years, but you may need to remind them how to describe these shapes using edges, faces, vertices and curved surfaces. They should explore this step practically, starting with nets of a cube, made up of six squares, and investigating which arrangements will and will not fold to make a cube. Children can then move on to looking at other 3-D shapes and what 2-D shapes are needed to make their nets. Again, they first need to explore this with cut-out nets, which will help them to become more adept at visualising how nets fold up. Children can then work from a 3-D shape to decide how the net will look.

### Things to look out for

- Children may have the correct number of 2-D shapes in a net, but not in an arrangement that will create the correct shape.
- Children may need a reminder of vocabulary such as “prism” when naming 3-D shapes.

## Key questions

- How many faces does a \_\_\_\_\_ have? What shapes are they?
- What is the difference between a 2-D and a 3-D shape?
- What 2-D shapes are needed to create the net of a \_\_\_\_\_?
- What 3-D shape will this net create?
- Which two faces of the 3-D shape made from this net will be opposite each other?
- How many different ways can you arrange the faces of the net so that it still folds up to make the \_\_\_\_\_?

## Possible sentence stems

- The net needed to make a \_\_\_\_\_ will contain \_\_\_\_\_ and \_\_\_\_\_ (e.g. triangular prism, three rectangles, two triangles)
- I know that this net will make a \_\_\_\_\_ because ...

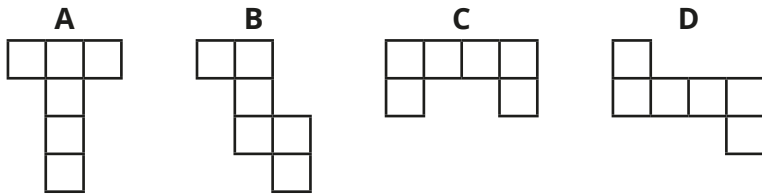
## National Curriculum links

- Recognise, describe and build simple 3-D shapes, including making nets

# Nets of 3-D shapes

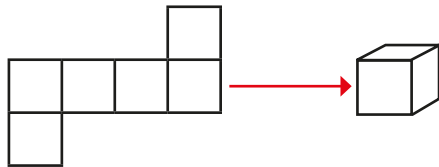
## Key learning

- Which nets will fold up to make a cube?

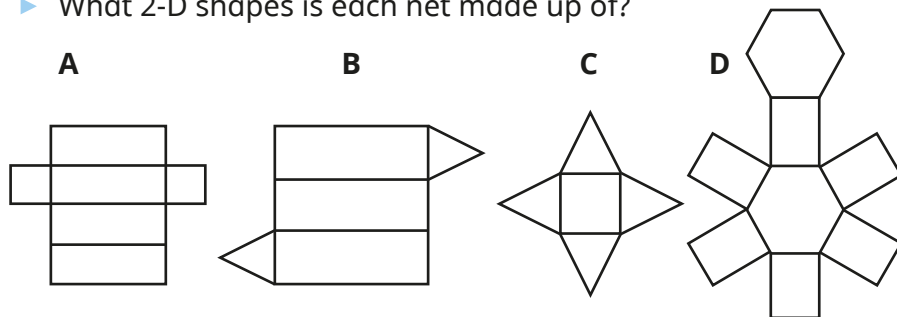


Investigate other possible nets for a cube.

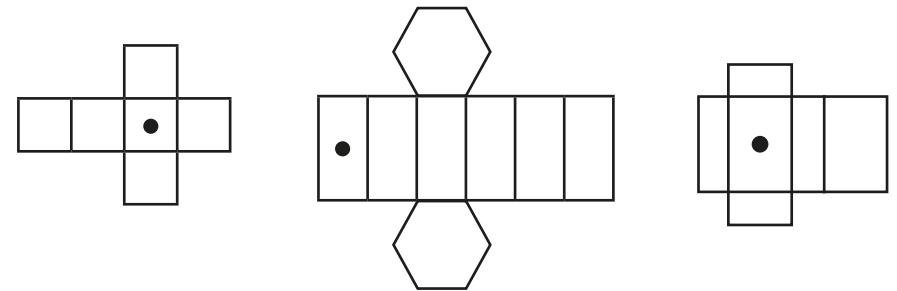
- The net of a cube is made up of six squares.



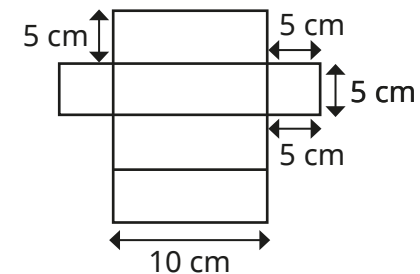
- ▶ Which 3-D shapes will these nets make?
- ▶ What 2-D shapes is each net made up of?



- Draw another dot on each net so that the dots are on opposite faces when the net is folded to make the 3-D shape.



- Draw the net accurately on squared paper.



- Draw nets for the 3-D shapes described.
  - The faces are made up of a square and four triangles.
  - The faces are made up of rectangles and triangles.

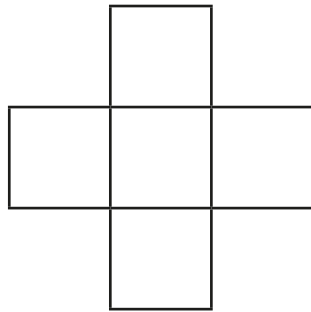
Find as many shapes as you can for each description.

Make the 3-D shapes from your nets.

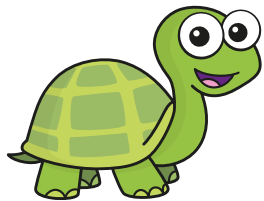
# Nets of 3-D shapes

## Reasoning and problem solving

Tiny is making nets.



This net will make a cube.

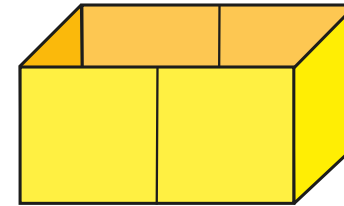


Do you agree with Tiny?

Explain your answer.

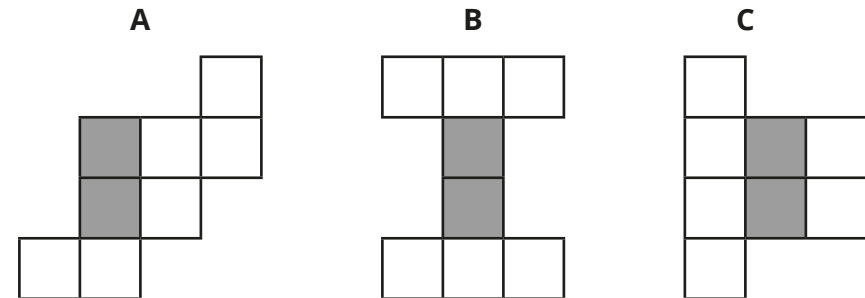
No  
A cube has six faces, but the net only has five.

Here is an open box.



Which nets will fold to make the box?

The grey squares show the base.



B and C