Summer - Block 2

Properties of Shape

Year 5

Overview

Small Steps

- Measuring angles in degrees
- Measuring with a protractor (1)
- Measuring with a protractor (2)
- Drawing lines and angles accurately
- Calculating angles on a straight line
- Calculating angles around a point
- Calculating lengths and angles in shapes
- Regular and irregular polygons
- Reasoning about 3-D shapes

NC Objectives

Identify 3-D shapes, including cubes and other cuboids, from 2-D representations.

Use the properties of rectangles to deduce related facts and find missing lengths and angles.

Distinguish between regular and irregular polygons based on reasoning about equal sides and angles.

Know angles are measured in degrees: estimate and compare acute, obtuse and reflex angles.

Draw given angles, and measure them in degrees.

Identify: angles at a point and one whole turn (total 360°), angles at a point on a straight line and ½ a turn (total 180°) other multiples of 90°

Measuring Angles in Degrees

Notes and Guidance

Children recap acute and obtuse angles. They recognise a full turn as 360 degrees, a half-turn as 180 degrees and a quarter-turn (or right angle) as 90 degrees. They consider these in the context of compass directions. Children also deduce angles such as 45 degrees, 135 degrees and 270 degrees. Reflex angles are introduced explicitly for the first time. Children define angles in terms of degrees and as fractions of a full turn.

Mathematical Talk

What is an angle?

Can you identify an acute angle on the clock?

Can you identify an obtuse angle?

What do we call angles larger than 180° but smaller than 360°?

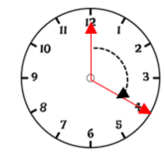
What angles can you identify using compass directions?

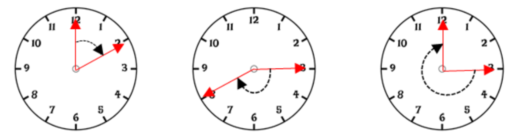
What is the size of the angle?

What fraction of a full turn is the angle?

Varied Fluency

- Use the sentence stems to describe the turns made by the minute hand. Compare the turns to a right angle.

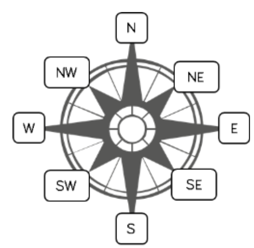




The turn from 12 to 4 is larger than a right angle.
It is an obtuse angle.

The turn from ___ to ___ is ______ than a right angle.
It is an ______ angle.

- Use the compass to complete the table.



Turn	Degrees	Type of angle	Fraction of a turn
North-East to South-East Clockwise	90°	Right angle	$\frac{1}{4}$ of a turn
North-West to North-West Clockwise			
South-West to South-East Anti-clockwise			
South-West to ______ Clockwise	180°		
North-East to East Clockwise			$\frac{1}{8}$ of a turn

Measuring Angles in Degrees

Reasoning and Problem Solving

Which angle is the odd one out? 180° 45° 79° 270° Could another angle be the odd one out for a different reason?	Multiple responses e.g. 79° is the odd one out because the others are multiples of 45 degrees.; 270 degrees is the only reflex angle etc.
Always, sometimes or never true? • If I turn from North-East to North-West, I have turned 90° • If I turn from East to North-West, I will have turned through an obtuse angle. • If I turn from South-West to South, my turn will be larger than 350°	All are sometimes true, depending on whether you turn clockwise or anti-clockwise or even more than one turn.

Pick a starting point on the compass and describe a turn to your partner. Use the mathematical words to describe your turns: • Clockwise • Anti-clockwise • Degrees • Acute • Obtuse • Reflex • Right angle Can your partner identify where you will finish?	Lots of possibilities. Children can be challenged further e.g. I turn three right angles. I start at North-West and turn clockwise, where do I finish?

Measuring with a Protractor (1)

Notes and Guidance

Children are taught to use a protractor for the first time. They begin with measuring angles less than 90°, acute angles. They use their knowledge of right angles to help estimate the size of acute angles e.g. "It's close to a right angle, so about 80°."

Children need to develop their understanding of using both the inside and outside scales of the protractor, and need to be taught how to decide which to use.

Mathematical Talk

What unit do we use to measure angles?

How can we tell whether an angle is acute?

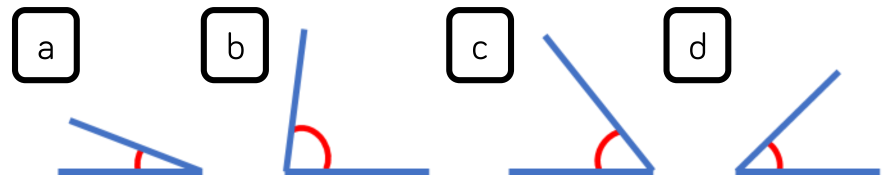
How do we know which scale to use on a protractor?

Where will you place your protractor when measuring an angle?

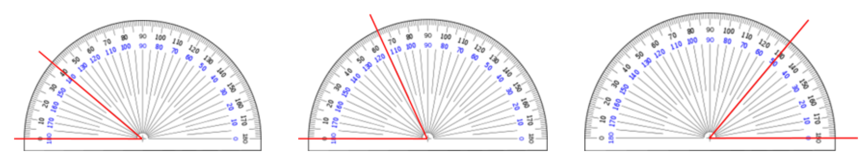
Does moving the paper help you to measure an angle?

Varied Fluency

- Put these angles in order of size. Explain how you know.

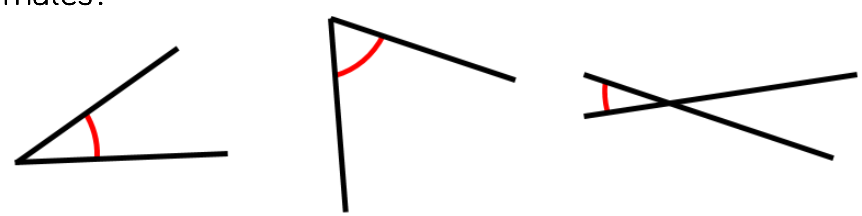


- Read the angles shown on the protractor.



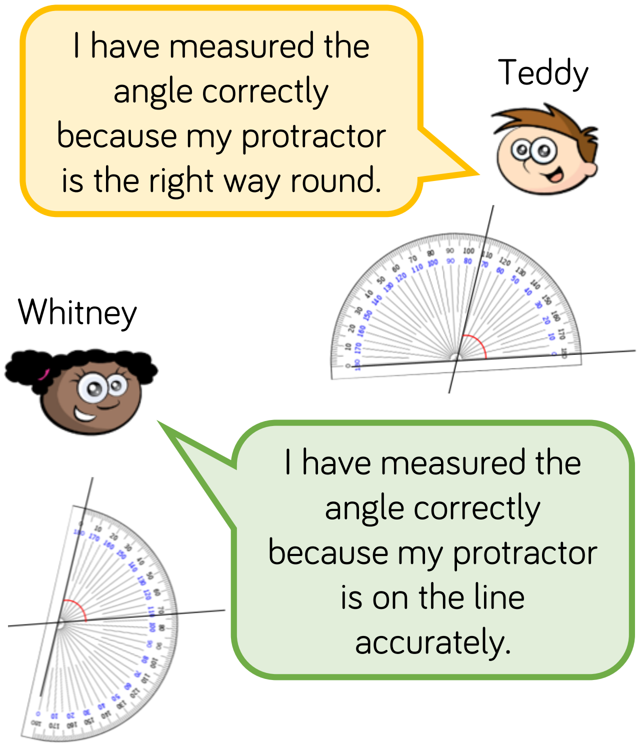
What's the same? What's different?

- Estimate the size of the angles and then use a protractor to measure them to the nearest degree. How close were your estimates?



Measuring with a Protractor (1)

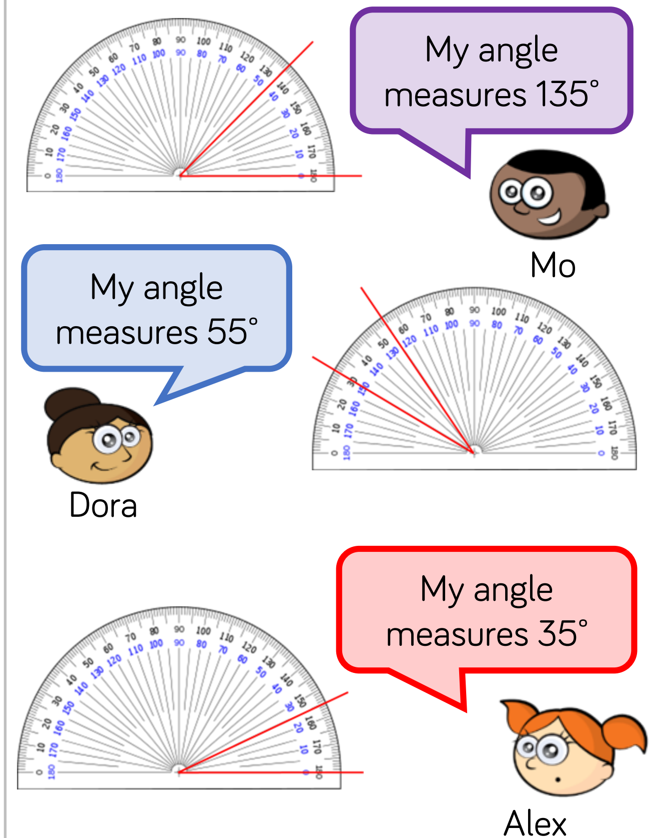
Reasoning and Problem Solving



Who do you agree with? Explain why.

They are both correct. It doesn't matter which way the protractor is as long as it is placed on the angle correctly.

Three children are measuring angles. Can you spot and explain their mistake?



Mo hasn't recognised his angle is acute, so his measurement is wrong.

Alex has not placed one of her lines on 0. Her angle measures 25°.

Dora has misread the scale. Her angle measures 25°.

White Rose Maths

Measuring with a Protractor (2)

Notes and Guidance

Children continue to learn how to use a protractor and focus on measuring obtuse angles.
They use their knowledge of right angles to help estimate the size of obtuse angles e.g. "It's just over a right angle, so about 100°."
Children need to develop their understanding of using both the inside and outside scales of the protractor, and need to be taught how to decide which to use.

Mathematical Talk

How do you know an angle is obtuse?

Can you see where obtuse angles would be measured on the protractor?

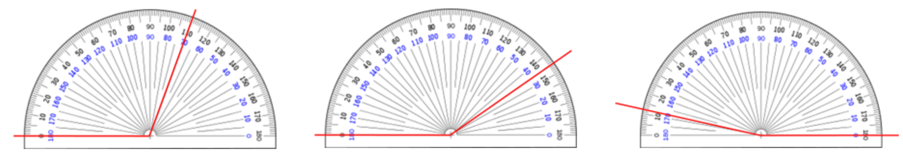
Can you estimate the size of this angle?

What is the size of the angle? What mistake might someone make?

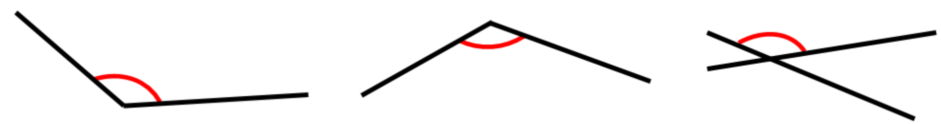
Where will you place your protractor first?

Varied Fluency

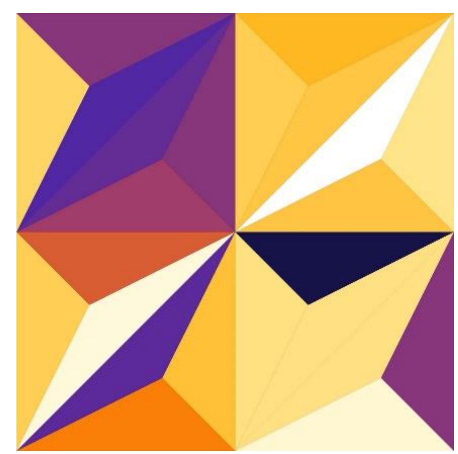
- Measure the angles shown on the protractors.



- Estimate the size of the angles and then use a protractor to measure them to the nearest degree.



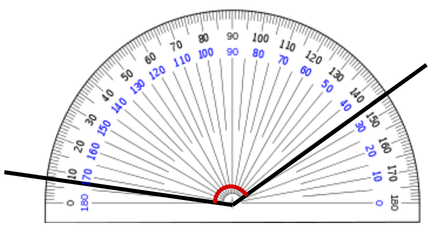
- Identify obtuse angles in the image.
Estimate the size of the angles, and then measure them.



Measuring with a Protractor (2)

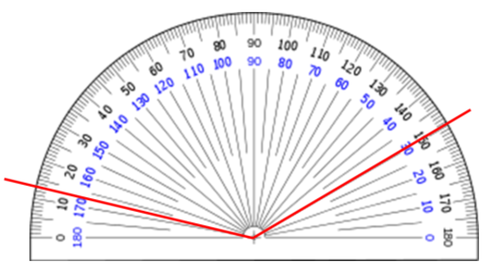
Reasoning and Problem Solving

Rosie is measuring an obtuse angle.
What's her mistake?



Rosie has not placed the 0 line of the protractor on one of the arms of the angle.

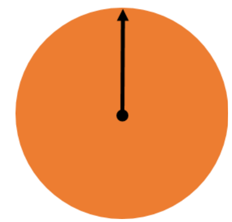
How many ways can you find the value of the angle?



Children may:

- subtract 150 – 13 = 137°
- add up on the protractor as a number line e.g. +7 +100 +30 = 137°
- place the protractor correctly.

Use a cut out of a circle and place a spinner in the centre.



- Point the arrow in the starting position above.
- Move the spinner to try to make the angles shown on the cards below.
- Check how close you are with a protractor.

40° 72° 154°

Drawing Accurately

Notes and Guidance

Children need to draw lines correct to the nearest millimetre. They use a protractor to draw angles of a given size, and will need to be shown this new skill.

Children continue to develop their estimation skills whilst drawing and measuring lines and angles. They also continue to use precise language to describe the types of angles they are drawing.

Mathematical Talk

How many millimetres are in a centimetre?

How do we draw a line that measures ___?

Explain how to draw an angle.

What's the same and what's different about drawing angles of 80° and 100° ?

How can I make this angle measure ___ but one of the lines have a length of ___?

Varied Fluency

Draw lines that measure:

4 cm and 5 mm	45 mm	4.5 cm

What's the same? What's different?

Draw:
- angles of 45° and 135°
- angles of 80° and 100°
- angles of 20° and 160°

What do you notice about your pairs of angles?

Draw:
- an acute angle that measures 60° with the arms of the angle 6 cm long
- an obtuse angle that measures 130° but less than 140° with the arms of the angle 6.5 cm long

Compare your angles with your partner's.

Drawing Accurately

Reasoning and Problem Solving

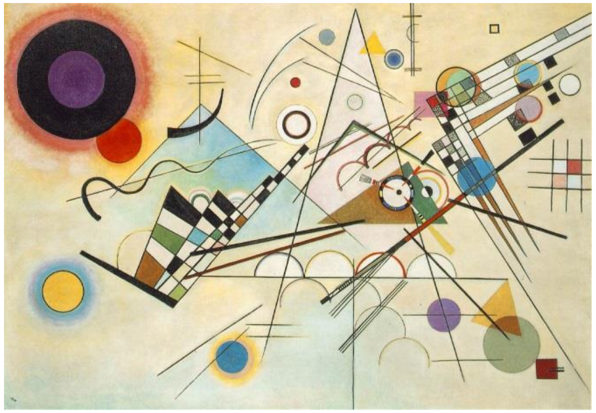
Draw a range of angles for a friend.
Estimate the sizes of the angles to order them from smallest to largest.
Measure the angles to see how close you were.

Always, sometimes or never true?

- Two acute angles next to each other make an obtuse angle.
- Half an obtuse angle is an acute angle.
- 180° is an obtuse angle

- Sometimes
- Always
- Never

Use Kandinsky's artwork to practice measuring lines and angles.



Create clues for your partner to work out which line or angle you have measured.

For example, "My line is horizontal and has an obtuse angle of 110° on it."

Angles on a Straight Line

Notes and Guidance

Children build on their knowledge of a right angle and recognise two right angles are equivalent to a straight line, or a straight line is a half of a turn.
Once children are aware that angles on a straight line add to 180 degrees, they use this to calculate missing angles on straight lines.
Part-whole and bar models may be used to represent missing angles.

Mathematical Talk

How many degrees are there in a right angle?

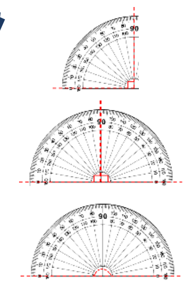
How many will there be in two right angles?

If we place two right angles together, what do we notice?

How can we calculate the missing angles?

How can we subtract a number from 180 mentally?

Varied Fluency

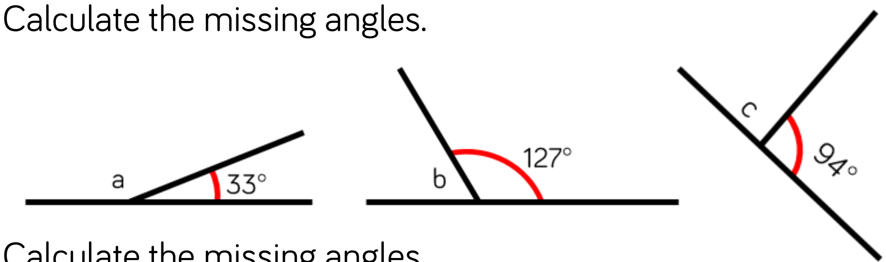


There are ______degrees in a right angle.

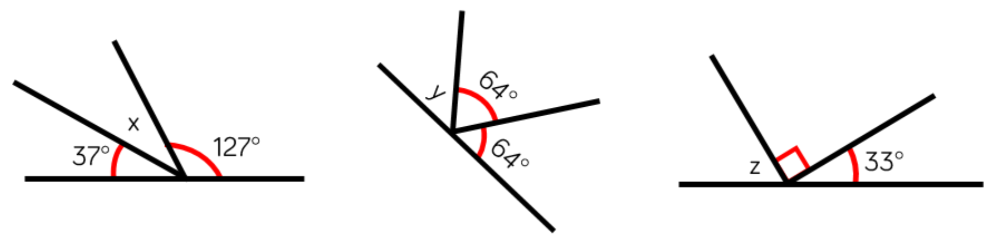
There are ______right angles on a straight line.

There are ______degrees on a straight line.

Calculate the missing angles.



Calculate the missing angles.

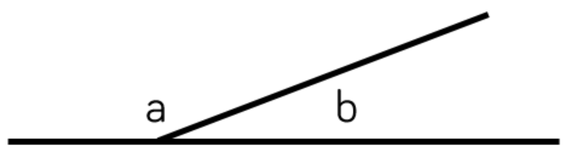


Is there more than one way to calculate the missing angles?

Angles on a Straight Line

Reasoning and Problem Solving

Here are two angles.



Angle b is a prime number between 40 and 50

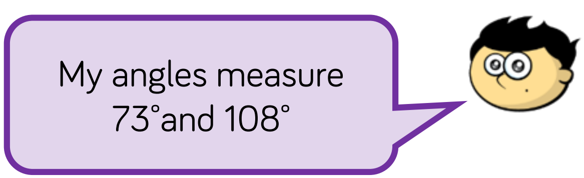
Use the clue to calculate what the missing angles could be.

b = 41°, a = 139°

b = 43°, a = 137°

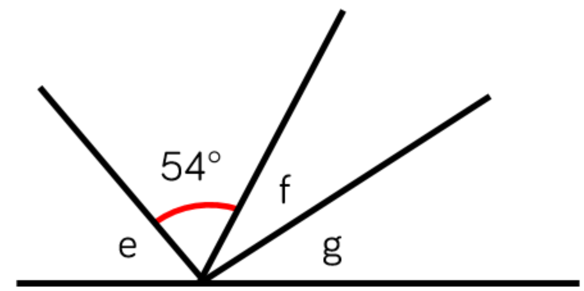
b = 47°, a = 133°

Jack is measuring two angles on a straight line.



Explain why at least one of Jack's angles must be wrong.

His angles total more than 180°.



- The total of angle f and g are the same as angle e
- Angle e is 9° more than the size of the given angle.
- Angle f is 11° more than angle g

Calculate the size of the angles.

Create your own straight line problem like this one for your partner.

e = 63°

f = 37°

g = 26 °

Angles around a Point

Notes and Guidance

Children need to know that there are 360 degrees in a full turn. This connects to their knowledge of right angles, straight lines and compass points.

Children need to know when they should measure an angle and when they should calculate the size of angle from given facts.

Mathematical Talk

How many right angles are there in $\frac{1}{4}, \frac{1}{2}, \frac{3}{4}$ of a full turn?

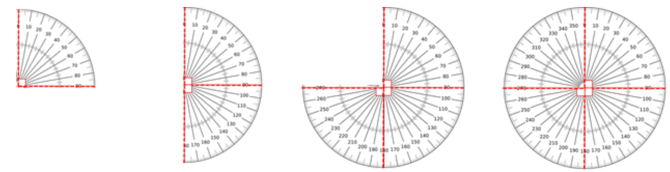
If you know a half turn/full turn is 180/360 degrees, how can this help you calculate the missing angle?

What is the most efficient way to calculate a missing angle? Would you use a mental or written method?

When you have several angles, is it better to add them first or to subtract them one by one?

Varied Fluency

Complete the sentences.



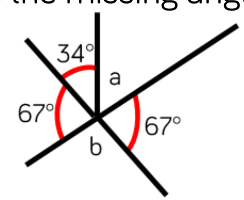
$\frac{1}{4}$ of a turn = 1 right angle = 90°

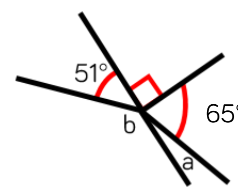
$\frac{1}{2}$ of a turn = __ right angles = _____°

$\frac{\square}{\square}$ of a turn = 3 right angles = _____°

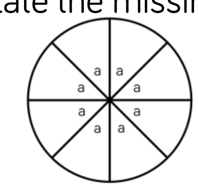
A full turn = __ right angles = _____°

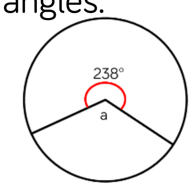
Calculate the missing angles.

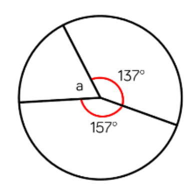




Calculate the missing angles.

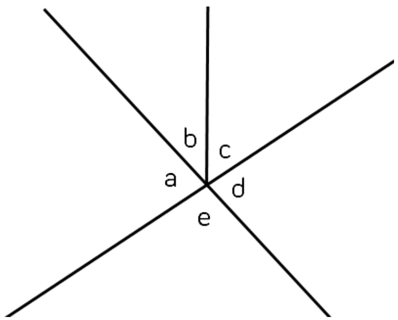






Angles around a Point

Reasoning and Problem Solving



$a + b + c + d + e = 360°$
$d + e = 180°$
Write other sentences about this picture.

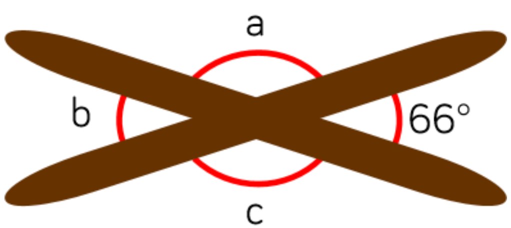
Various answers e.g.

$a + b + c = e + d$

$360° - e - d = 180°$

etc.

Two sticks are on a table.
Without measuring, find the three missing angles.



$a = 114°$

$b = 66°$

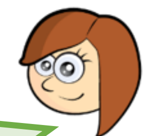
$c = 114°$

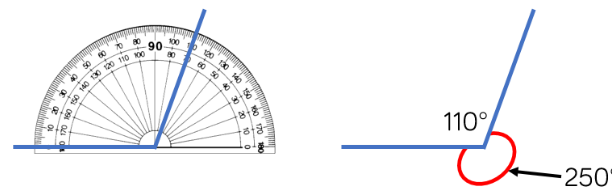
Eva says,

My protractor only goes to 180 degrees, so I can't draw reflex angles like 250 degrees.

Rosie says,

I know a full turn is 360 degrees so I can draw 110 degrees instead and have an angle of 250 degrees as well.





Use Rosie's method to draw angles of:
- 300°
- 200°
- 280°

Lengths and Angles in Shapes

Notes and Guidance

Children look at squares and rectangles on a grid to identify right angles.
Children use the square grids to reason about length and angles, for example to deduce that half a right angle is 45 degrees.
Children should be confident in understanding parallel and perpendicular lines and right angles in relation to squares and rectangles.

Mathematical Talk

Look at the rectangle and square, where can you see parallel lines? How many right angles do they have?

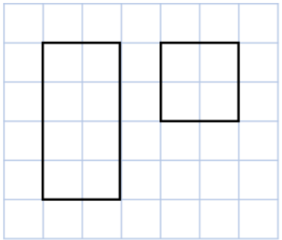
What can you say about the lengths of the sides in a rectangle or in a ______?

If I fold a square in half diagonally to make a triangle, what will the size of each of the angles in the triangle be?

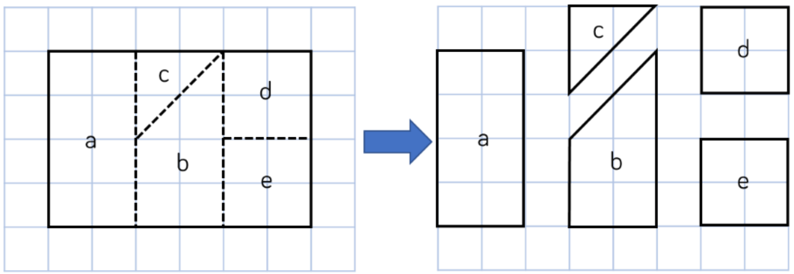
Using what you know about squares and rectangles, how can you calculate the sizes of the angles?

Varied Fluency

- Look at the square and the rectangle.
  What's the same? What's different?

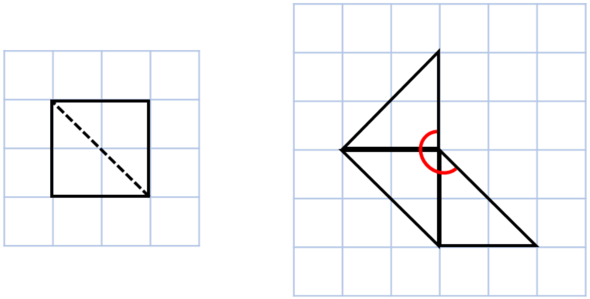


- Calculate the size of the angles in each shape.



What's the same? What's different?

- Here is a square cut into two triangles.

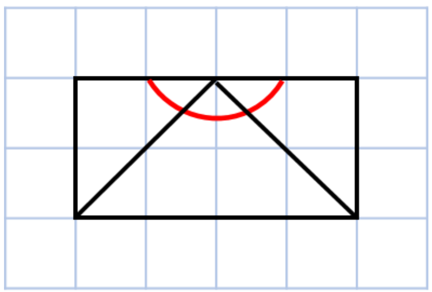


Use the square to calculate the size of the angle.

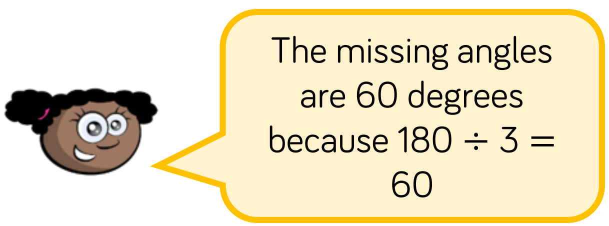
Lengths and Angles in Shapes

Reasoning and Problem Solving

Whitney is calculating the missing angles in the shape.



She says,

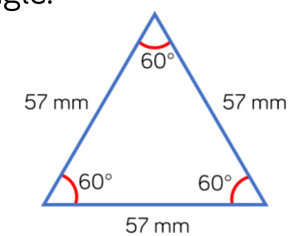


Do you agree?
Explain why.

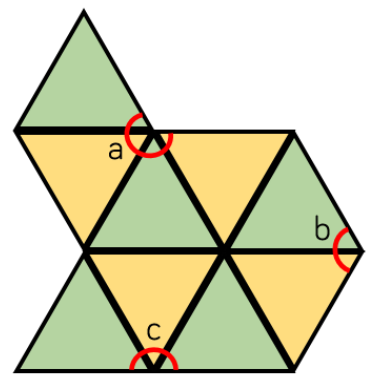
Whitney is wrong. The angles are not equal.

The angles will be worth 45°, 90° and 45° because the line shows a square being split in half diagonally. This means 90° has been divided by 2.

Alex has this triangle.



She makes this composite shape using triangles identical to the one above.



- Calculate the perimeter of the shape.
- Calculate the missing angles.

Use your own triangle, square or rectangle to make a similar problem?

Perimeter = $57 \times 9 = 513$ mm

$a = 60 \times 4$

$a = 240°$

$b = 60 \times 2$

$b = 120°$

$c = 60 \times 3$

$c = 180°$

Regular & Irregular Polygons

Notes and Guidance

Children distinguish between regular and irregular polygons. They need to be taught that "regular" means all the sides and angles in a shape are equal e.g. an equilateral triangle and a square are regular but a rectangle with unequal sides and an isosceles triangle are irregular polygons.
Once they are confident with this definition they can work out the sizes of missing angles and sides.

Mathematical Talk

What is a polygon?

Can a polygon have a curved line?

Name a shape which isn't a polygon.

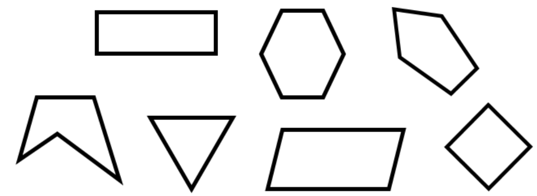
What makes a polygon irregular or regular?

Is a square regular?

Are all hexagons regular?

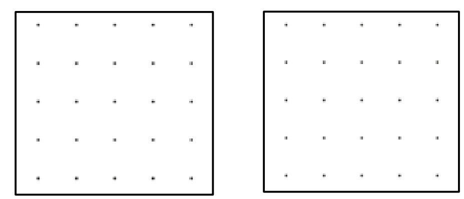
Varied Fluency

- Sort the shapes in to irregular and regular polygons.

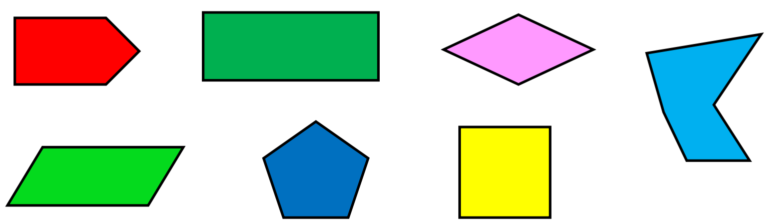


What's the same? What's different?

- Draw a regular polygon and an irregular polygon on the grids.



- Look at the 2D shapes. Decide whether the shape is a regular or irregular polygon. Measure the angles to check.



Regular & Irregular Polygons

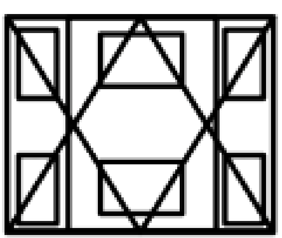
Reasoning and Problem Solving

Always, sometimes or never true?

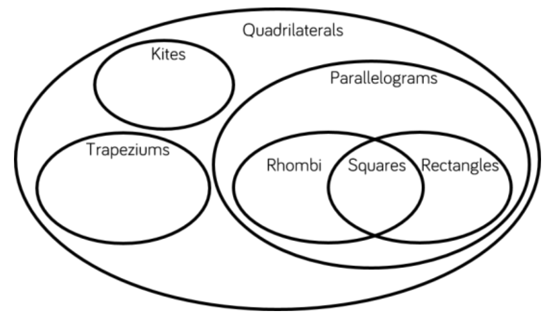
- A regular polygon has equal sides but not equal angles.
- A triangle is a regular polygon.
- A rhombus is a regular polygon.
- The number of angles is the same as the number of sides in any polygon.

- Never true – equal sides and equal angles.
- Sometimes true – equilateral triangles are, scalene are not.
- Sometimes true – if the rhombus has right angles and is a square.
- Always true.

How many regular and irregular polygons can you find in this picture?



Cut out lots of different regular and irregular shapes. Ask children to work in pairs and sort them into groups. Once they have sorted them, can they find a different way to sort them again?
Children could use Venn diagrams and Carroll diagrams to deepen their understanding, for example:



	Regular polygon	Irregular polygon
Has at least one right angle		
Has no right angles		

Multiple responses

Reasoning about 3-D Shapes

Notes and Guidance

Children identify 3-D shapes, including cubes and cuboids, from their 2-D nets. They should have a secure understanding of language associated with the properties of 3-D shapes, for example, faces, curved surfaces, vertices, edges etc.

Children also look at properties of 3-D shapes from 2-D projections, including plans and elevations.

Mathematical Talk

What's the difference between a face and a curved surface?

Name some 3-D solids which have curved surfaces and some which don't.

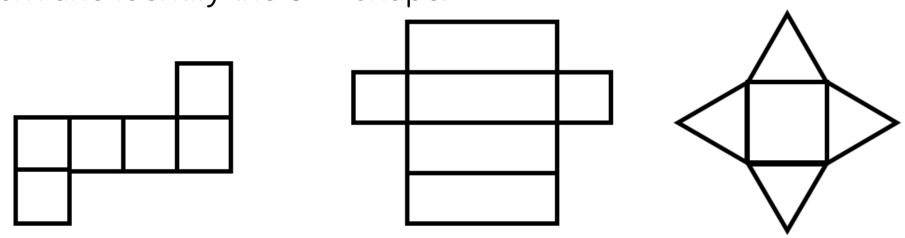
What faces can we see in the net? What shape will this make?

Which face will be opposite this face? Why?

Can we spot a pattern between the number of faces and the number of vertices a prism or pyramid has?

Varied Fluency

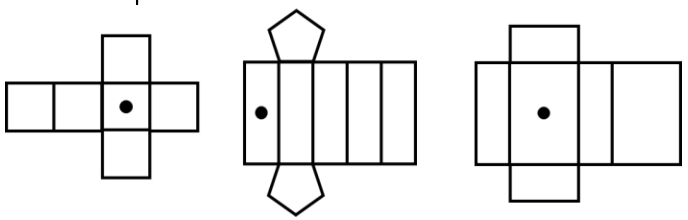
- Look at the different nets. Describe the 2-D shapes used to make them and identify the 3-D shape.



- Use equipment, such as Polydron or 2-D shapes, to build the 3-D solids being described.
  - My faces are made up of a square and four triangles.
  - My faces are made up of rectangles and triangles.

  Can the descriptions make more than one shape?

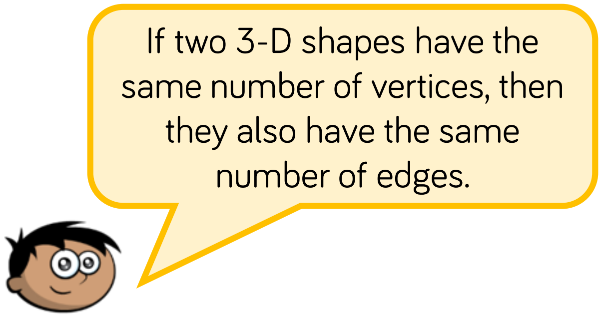
- Draw another dot on the nets so the dots are on opposite faces when the 3D shape is constructed.



Reasoning about 3-D Shapes

Reasoning and Problem Solving

Amir says,



Do you agree?
Explain why.

No e.g. a square-based pyramid and a triangular prism.

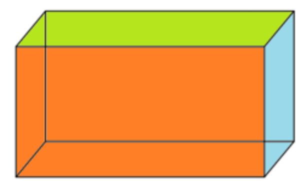
Children could investigate this and look for a pattern.

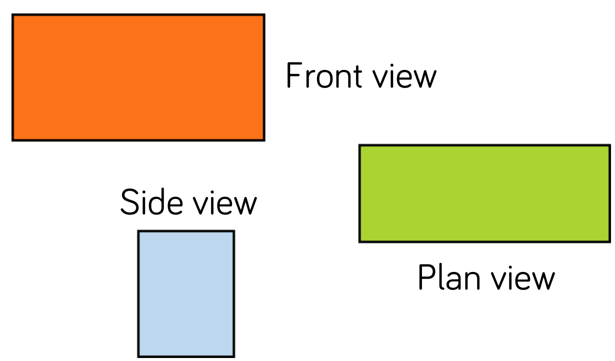
Create cubes and cuboids by using multilink cubes.
Draw these on isometric paper.
Would it be harder if you had to draw something other than squares or rectangles?

Multiple responses.

Using different 3-D solids, how can you represent them from different views? Work out which representation goes with which solid.

For example,





Children may explore a certain view for a prism and discover that it could always look like a cuboid or cube due to the rectilinear faces.