White Rose Maths

Summer - Block 2

Properties of Shape

Overview

Small Steps

1. Identify angles (R)
2. Compare and order angles (R)
3. Measure angles in degrees
4. Measuring with a protractor (1)
5. Measuring with a protractor (2)
6. Drawing lines and angles accurately
7. Calculating angles on a straight line
8. Calculating angles around a point
9. Triangles (R)
10. Quadrilaterals (R)
11. Calculating lengths and angles in shapes
12. Regular and irregular polygons
13. Reasoning about 3-D shapes

Notes for 2020/21

Learning on properties of shape may have been missed during lockdown or covered remotely.

Children should recap the essential prerequisite knowledge from year 4 before moving on to look at year 5 content.

Identify Angles

Notes and Guidance

Children develop their understanding of obtuse and acute angles by comparing with a right angle. They use an angle tester to check whether angles are larger or smaller than a right angle.
Children learn that an acute angle is more than 0 degrees and less than 90 degrees, a right angle is exactly 90 degrees and an obtuse angle is more than 90 degrees but less than 180 degrees.

Mathematical Talk

How many degrees are there in a right angle?

Draw an acute/obtuse angle.

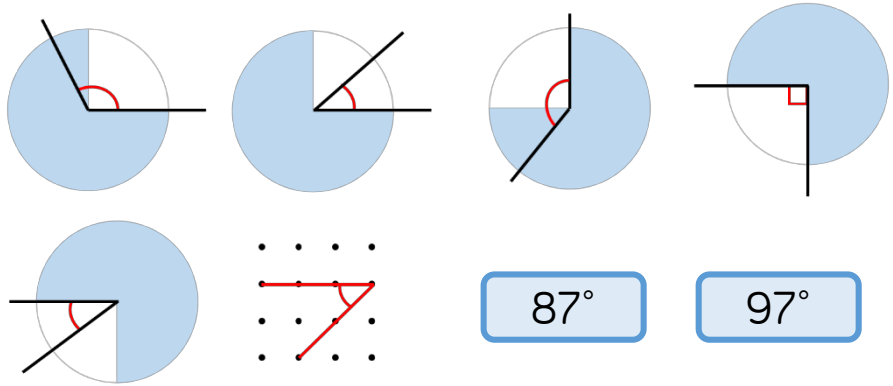
Estimate the size of the angle.

Varied Fluency

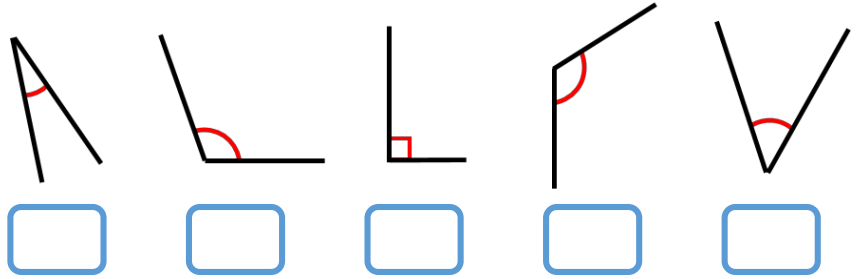
R

- A right angle is _____ degrees.
  Acute angles are _____ than a right angle.
  Obtuse angles are _____ than a right angle.

- Sort the angles into acute, obtuse and right angles.



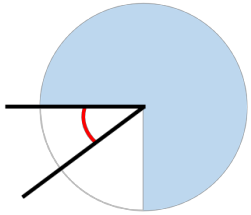
- Label the angles. O for obtuse, A for acute and R for right angle.



Identify Angles

Reasoning and Problem Solving

R



I know the angle is not obtuse.

Teddy

Alex

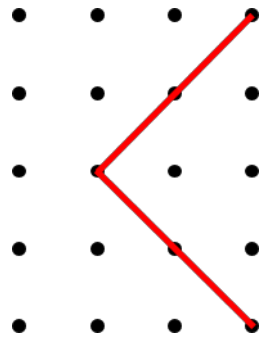
I know the angle is acute.

Whitney

I think the angle is roughly 45°.

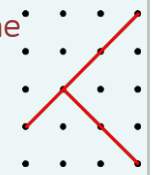
Who is correct?
Explain your reasons.

All are correct. Children may reason about how Whitney has come to her answer and discuss that the angle is about half a right angle. Half of 90 degrees is 45 degrees.



Is the angle acute, obtuse or a right angle?
Can you explain why?

The angle is a right angle.
Children may use an angle tester to demonstrate it, or children may extend the line to show that it is a quarter turn which is the same as a right angle.



Find the sum of the largest acute angle and the smallest obtuse angle in this list:

12° 98° 87° 179° 90° 5°

87° + 98° = 185°

Compare & Order Angles

Notes and Guidance

Children compare and order angles in ascending and descending order.

They use an angle tester to continue to help them to decide if angles are acute or obtuse.

Children identify and order angles in different representations including in shapes and on a grid.

Mathematical Talk

How can you use an angle tester to help you order the angles?

How many obtuse/acute/right angles are there in the diagrams?

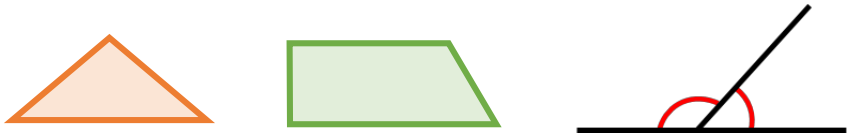
Compare the angles to a right angle. Does it help you to start to order them?

Rotate the angles so one of the lines is horizontal. Does this help you to compare them more efficiently?

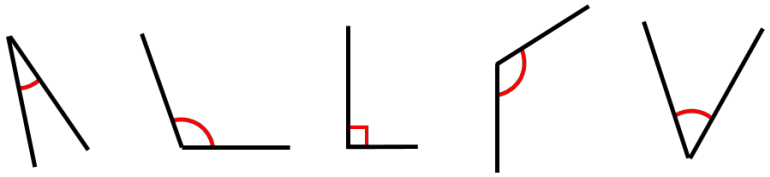
Varied Fluency

R

- Circle the largest angle in each shape or diagram.

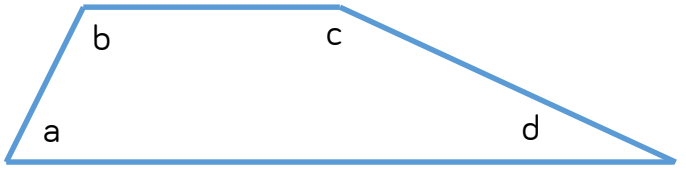


- Order the angles from largest to smallest.



Can you draw a larger obtuse angle?
Can you draw a smaller acute angle?

- Order the angles in the shape from smallest to largest.
Complete the sentences.

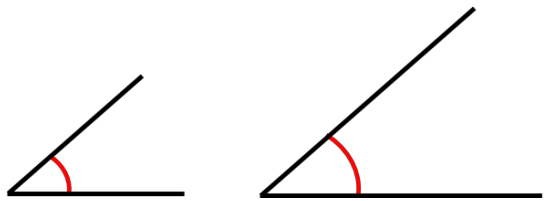


Angle _____ is smaller than angle _____.
Angle _____ is larger than angle _____.

Compare & Order Angles

Reasoning and Problem Solving

R



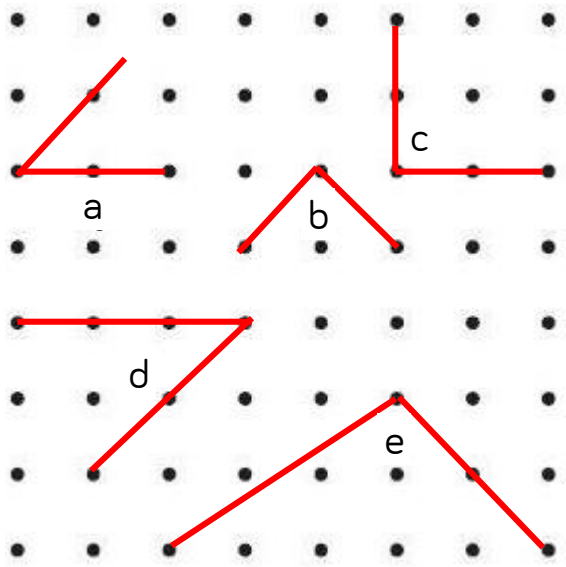
Ron

Angle B is bigger than Angle A because it has longer sides.

Do you agree with Ron? Explain your thinking.

Angle A and Angle B are the same size. Ron has mixed up the lengths of the lines with the size of the angles.

Here are five angles.
There are two pairs of identically sized angles and one odd one out.
Which angle is the odd one out?
Explain your reason.



Angle e is the odd one out.

Angle b and c are both right angles.

Angle a and d are both half of a right angle or 45 degrees.

Angle e is an obtuse angle.

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°?

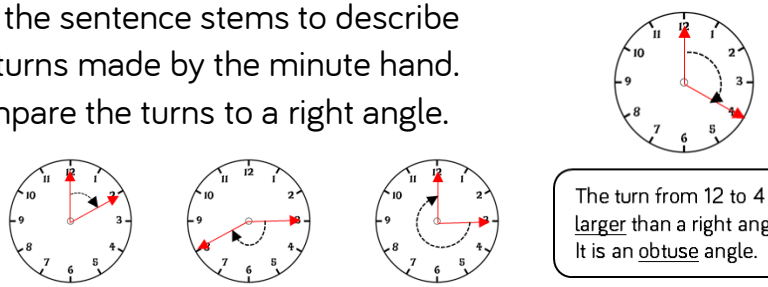
What angles can you identify using compass directions?

What is the size of the angle?

What fraction of a full turn is the angle?

Varied Fluency

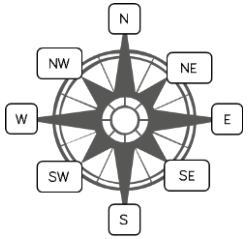
Use the sentence stems to describe the turns made by the minute hand. Compare the turns to a right angle.



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 northeast 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. They would relate to compass point..

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 am equivalent to 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?

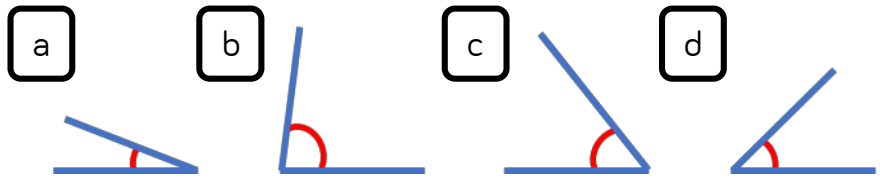
How do we know which scale to use on a protractor?

Where will you place your protractor when measuring an angle?

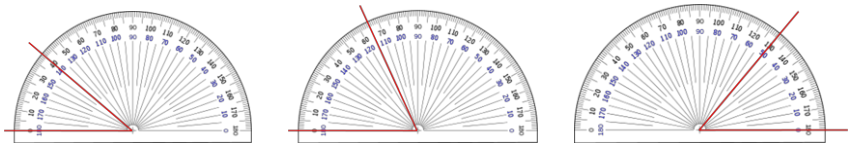
Does moving the paper help you to measure an angle?

Varied Fluency

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

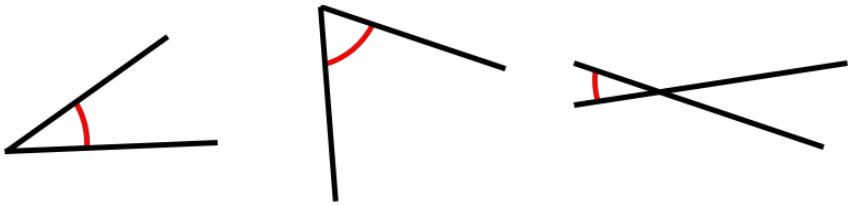


Read the angles shown on the protractor.



What's the same? What's different?

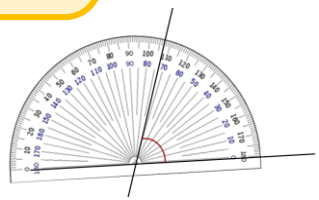
Estimate the size of the angles and then use a protractor to measure them to the nearest degree. How close were your estimates?



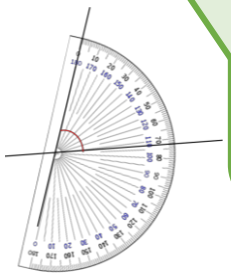
Measuring with a Protractor (1)

Reasoning and Problem Solving

Teddy: I have measured the angle correctly because my protractor is the right way round.



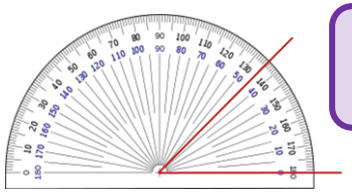
Whitney: I have measured the angle correctly because my protractor is on the line accurately.



Who do you agree with?
Explain why.

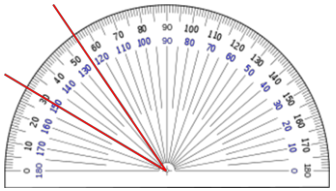
They are both correct. It doesn't matter which way the protractor is as long as it is placed on the angle correctly.

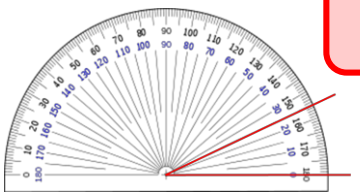
Three children are measuring angles. Can you spot and explain their mistake?



Mo: My angle measures 135°

Dora: My angle measures 55°





Alex: My angle measures 35°

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°.

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?

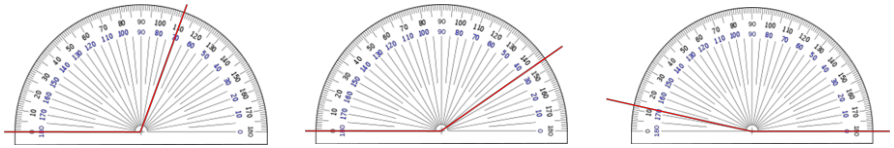
Can you estimate the size of this angle?

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

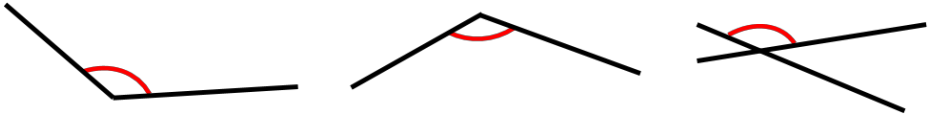
Where will you place your protractor first?

Varied Fluency

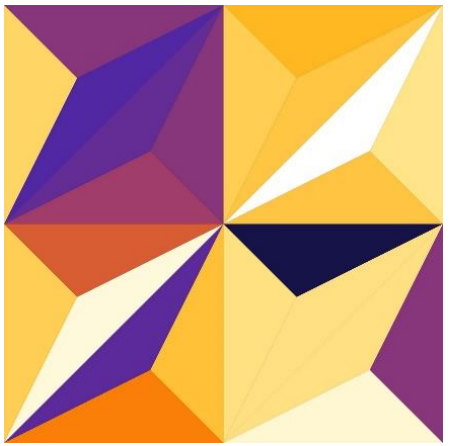
- Measure the angles shown on the protractors.



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



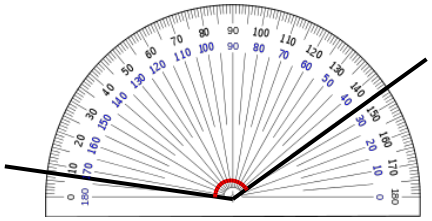
- Identify obtuse angles in the image.
Estimate the size of the angles, and then measure them?



Measuring with a Protractor (2)

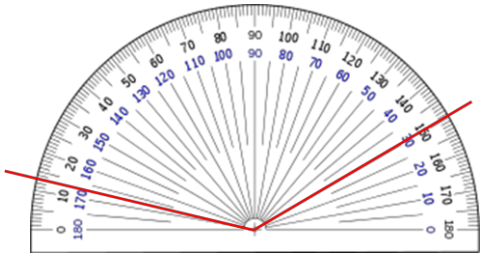
Reasoning and Problem Solving

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.

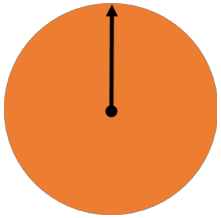
How many ways can you find the value of the angle?



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

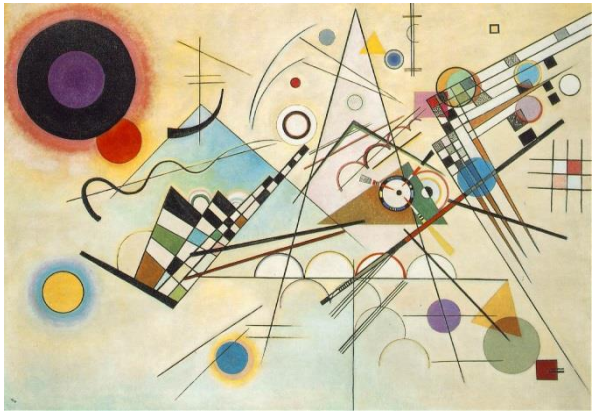
Draw a range of angles for a friend.
Estimate the sizes of the angles to order them from smallest to largest.
Measure the angles to see how close you were.

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?

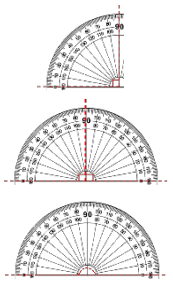
How many will there be in two right angles?

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

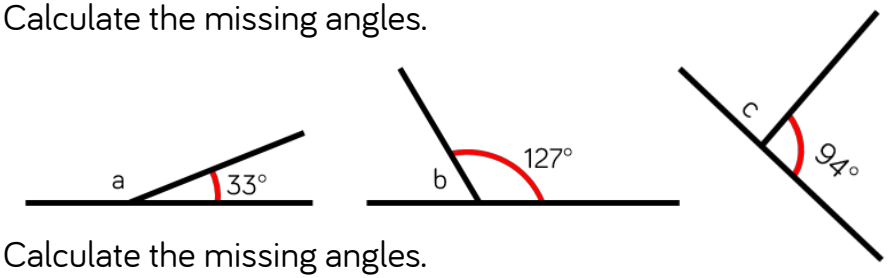


There are _____degrees in a right angle.

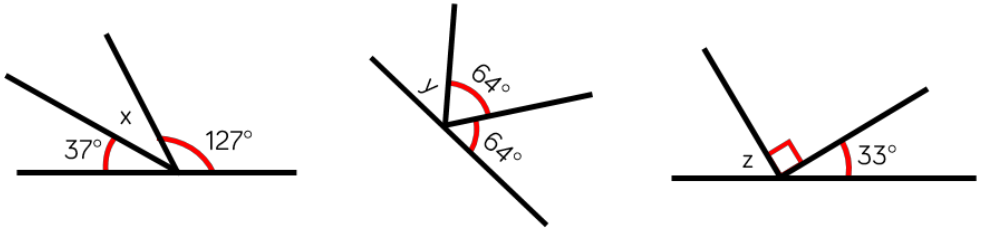
There are _____right angles on a straight line.

There are _____degrees on a straight line.

Calculate the missing angles.



Calculate the missing angles.

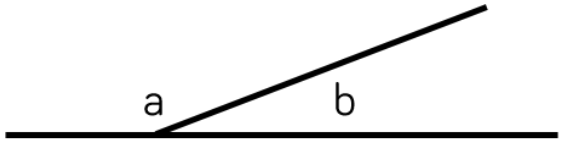


Is there more than one way to calculate the missing angles?

Angles on a Straight Line

Reasoning and Problem Solving

Here are two angles.



Angle b is a prime number between 40 and 50

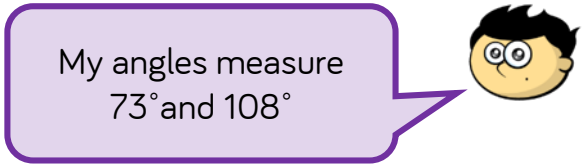
Use the clue to calculate what the missing angles could be.

b = 41°, a = 139°

b = 43°, a = 137°

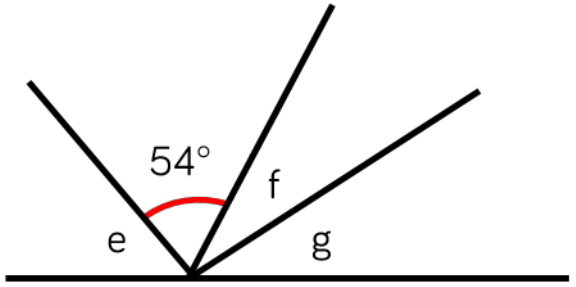
b = 47°, a = 133°

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, full turns 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?

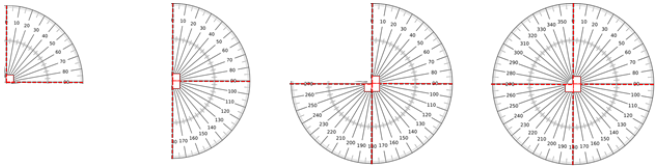
If you know a half turn/full turn is 180/360 degrees, how can this help you calculate the missing angle?

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.



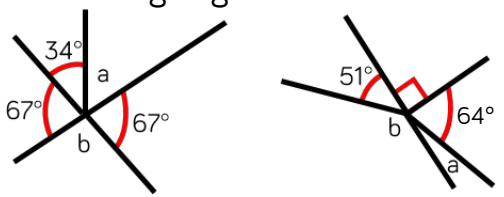
$\frac{1}{4}$ of a turn = 1 right angle = 90°

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

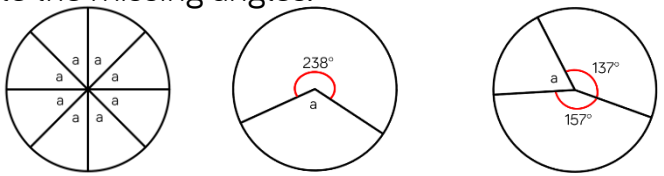
$\frac{\square}{\square}$ of a turn = 3 right angles = ____°

A full turn = __ right angles = ____°

Calculate the missing angles.

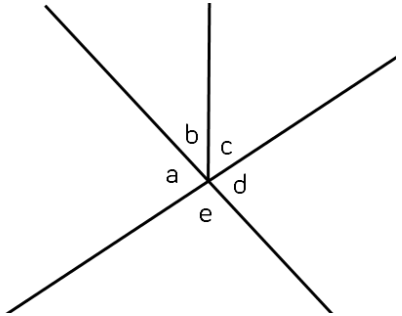


Calculate the missing angles.



Angles around a Point

Reasoning and Problem Solving



$a + b + c + d + e = 360^\circ$

$d + e = 180^\circ$

Write other sentences about this picture.

Various answers e.g.

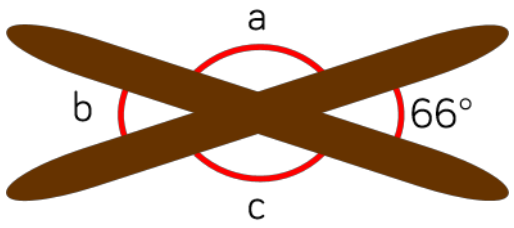
$a + b + c = e + d$

$360^\circ - e - d = 180^\circ$

Etc.

Two sticks are on a table.

Without measuring, find the three missing angles.



$a = 114^\circ$

$b = 66^\circ$

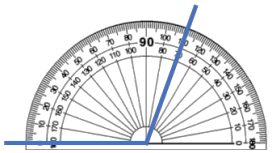
$c = 114^\circ$

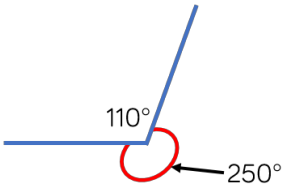
Eva says,

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°

Triangles

Notes and Guidance

Teachers might start this small step by recapping the definition of a polygon. An activity might be to sort shapes into examples and non-examples of polygons.
Children will classify triangles for the first time using the names 'isosceles', 'scalene' and 'equilateral'. Children will use rulers to measure the sides in order to classify them correctly.
Children will compare the similarities and differences between triangles and use these to help them identify, sort and draw.

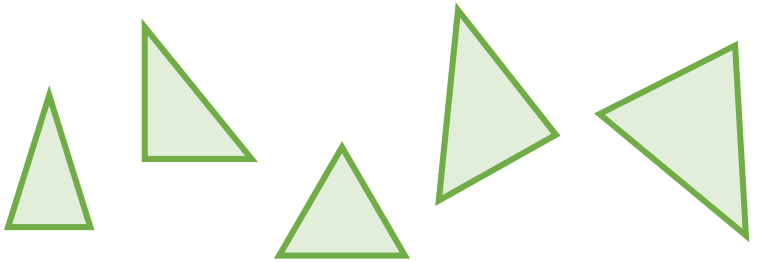
Mathematical Talk

What is a polygon? What isn't a polygon?
What are the names of the different types of triangles?
What are the properties of an isosceles triangles?
What are the properties of a scalene triangle?
What are the properties of an equilateral triangle?
Which types of triangle can also be right-angled?
How are the triangles different?
Do any of the sides need to be the same length?

Varied Fluency

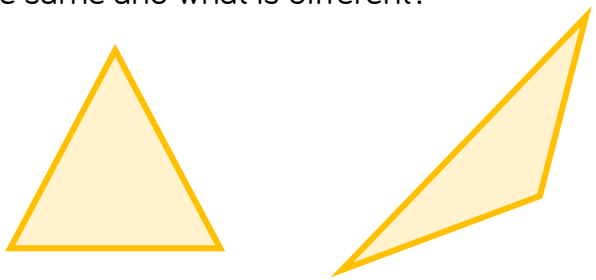
R

- Label each of these triangles: isosceles, scalene or equilateral.



Are any of these triangles also right-angled?

- Look at these triangles.
What is the same and what is different?



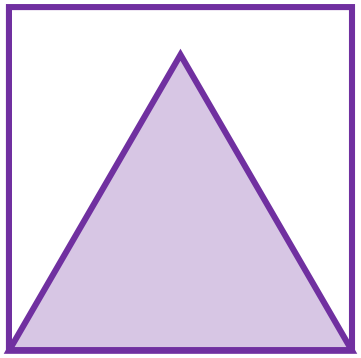
- Using a ruler, draw:
  - An isosceles triangle
  - A scalene triangle

Triangles

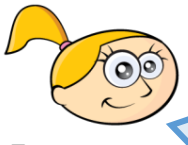
Reasoning and Problem Solving

R

Here is a square.
Inside the square is an equilateral triangle.
The perimeter of the square is 60 cm.
Find the perimeter of the triangle.



The perimeter of the triangle is 45 cm.



Eva

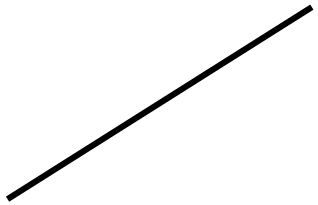
If I use 6 straws to make a triangle, I can only make an equilateral triangle.

Investigate whether Eva is correct.

Eva is correct.
2, 2, 2 is the only possible construction. 1, 1, 4 and 1, 2, 3 are not possible.

Draw two more sides to create:

- An equilateral triangle
- A scalene triangle
- An isosceles triangle



Which is the hardest to draw?

Children will draw a range of triangles. Get them to use a ruler to check their answers.
Equilateral will be difficult to draw accurately because the angle between the first two sides drawn, must be 60°

Quadrilaterals

Notes and Guidance

Children name quadrilaterals including a square, rectangle, rhombus, parallelogram and trapezium. They describe their properties and highlight the similarities and differences between different quadrilaterals.
Children draw quadrilaterals accurately using knowledge of their properties.
Teachers could use a Frayer Model with the children to explore the concept of quadrilaterals further.

Mathematical Talk

What's the same about the quadrilaterals?

What's different about the quadrilaterals?

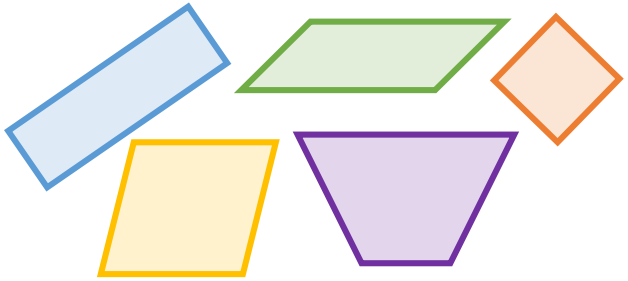
Why is a square a special type of rectangle?

Why is a rhombus a special type of parallelogram?

Varied Fluency

R

- Label the quadrilaterals using the word bank.



trapezium
square
rhombus
rectangle
parallelogram

- Use the criteria to describe the shapes.

four sides	2 pairs of parallel sides	four equal sides
polygon	1 pair of parallel sides	4 right angles

Which criteria can be used more than once?
Which shapes share the same criteria?

- Draw and label:
  - a rhombus.
  - a parallelogram.
  - 3 different trapeziums

Quadrilaterals

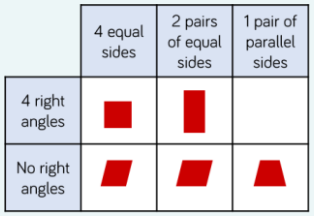
Reasoning and Problem Solving

R

Complete each of the boxes in the table with a different quadrilateral.

	4 equal sides	2 pairs of equal sides	1 pair of parallel sides
4 right angles			
No right angles			

Which box cannot be completed? Explain why.



Children can discuss if there are any shapes that can go in the top right corner. Some children may justify it could be a square or a rectangle however these have 2 pairs of parallel sides.

You will need:

Some 4 centimetre straws
Some 6 centimetre straws

How many different quadrilaterals can you make using the straws?

Calculate the perimeter of each shape.

Square: Four 4 cm - perimeter is 16 cm or four 6 cm- perimeter is 24 cm
Rectangle: Two 4 cm and two 6 cm- perimeter is 20 cm
Rhombus: Four 4 cm - perimeter is 16 cm
Four 6 cm straws- perimeter is 24 cm
Parallelogram: Two 4 cm and two 6 cm - perimeter is 20 cm
Trapezium: Three 4 cm and one 6 cm- perimeter is 18 cm

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 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?

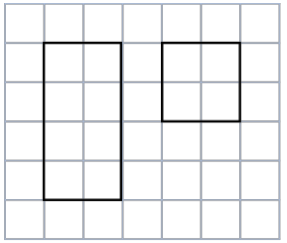
What can you say about the lengths of the sides in a rectangle or in a _____?

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

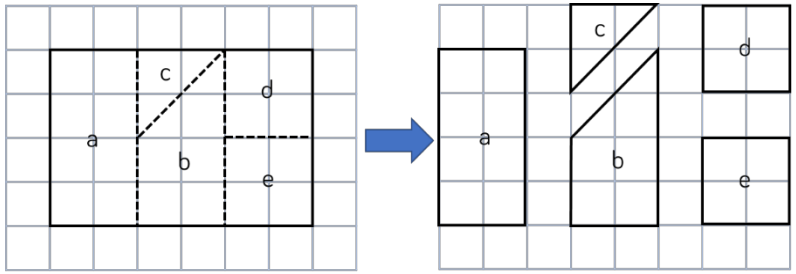
Using what you know about squares and rectangles, how can you calculate the size of the angles?

Varied Fluency

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

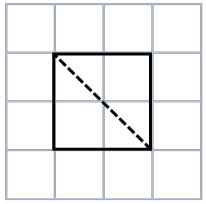


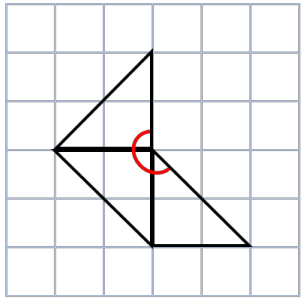
- Calculate the size of the angles in each shape.



What's the same? What's different?

- Here is a square cut into two triangles.



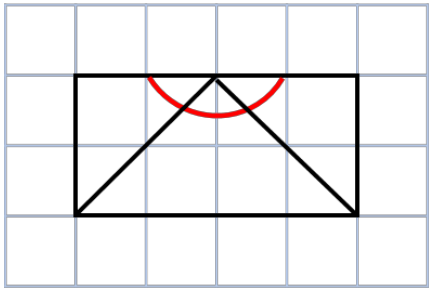


Use the square to calculate the size of the angle.

Lengths and Angles in Shapes

Reasoning and Problem Solving

Whitney is calculating the missing angles in the shape.



She says,

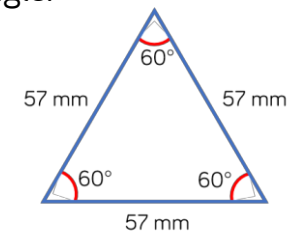
The missing angles are 60 degrees because 180 ÷ 3 = 60

Do you agree?
Explain why.

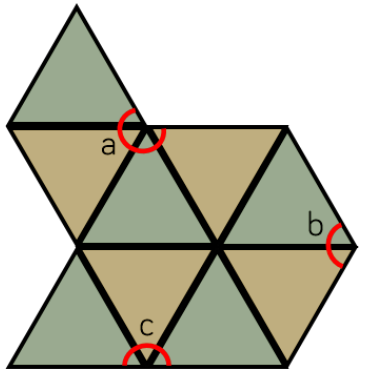
Whitney is wrong. The angles are not equal.

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 identical triangles 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 × 9 = 513 mm

a = 60 × 4

a = 240°

b = 60 × 2

b = 120°

c = 60 × 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 and 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.

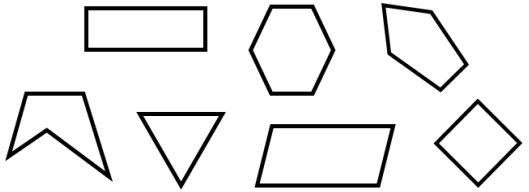
What makes a polygon irregular or regular?

Is a square regular?

Are all hexagons regular?

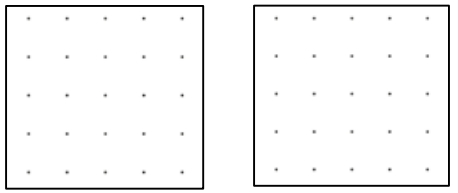
Varied Fluency

- Sort the shapes in to irregular and regular polygons.

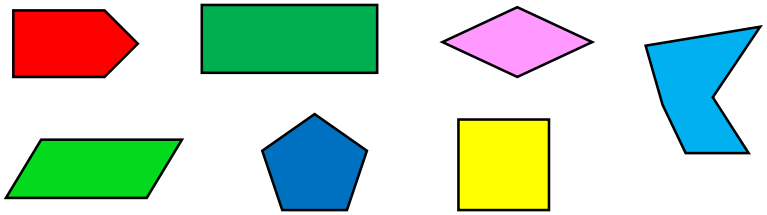


What's the same? What's different?

- 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

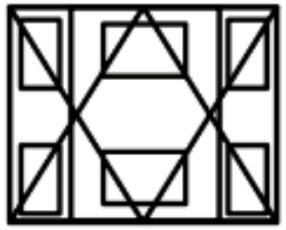
Reasoning and Problem Solving

Always, sometimes or never true?

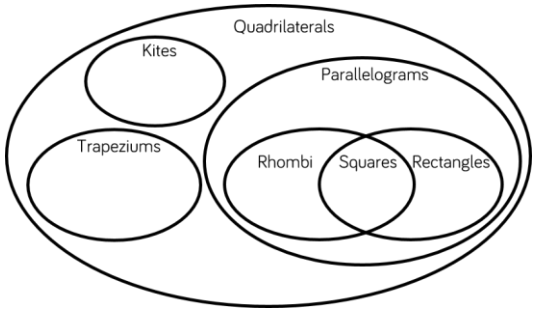
- A regular polygon has equal sides but not equal angles.
- A triangle is a regular polygon.
- A rhombus is a regular polygon.
- The number of angles is the same as the number of sides in any polygon.

- Never true – equal sides and equal angles.
- Sometimes true – equilateral triangles are, isosceles 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 2-D shapes. 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.

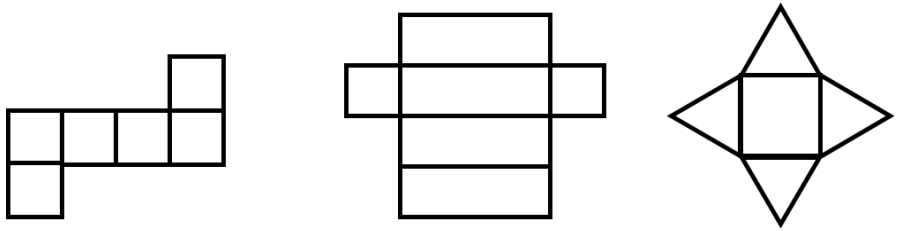
What faces can we see in the net? What shape will this make?

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

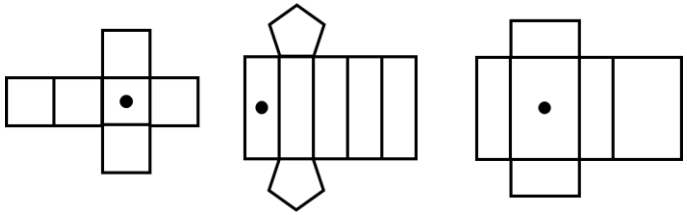
- Look at the different nets. Describe the 2-D shapes used to make them and identify the 3-D shape.



- 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?

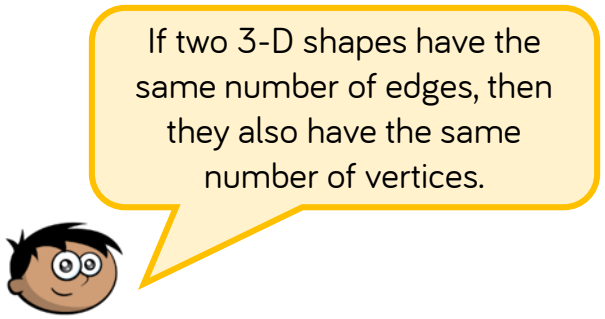
- Draw another dot on the nets so the dots are on opposite faces when the 3D shape is constructed.



Reasoning about 3-D Shapes

Reasoning and Problem Solving

Amir says,



Do you agree?
Explain why.

No. If the 3-D shape is a prism then there will be more vertices than edges.

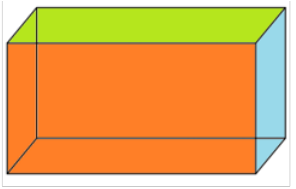
Children could investigate this and look for a pattern.

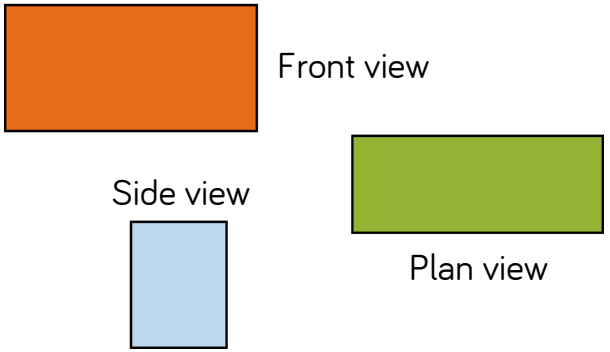
Create cubes and cuboids by using multilink cubes.
Draw these on isometric paper.
Would it be harder if you had to draw something other than squares or rectangles?

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.