

Side and Angle Properties.

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Differentiate and Assess

Not every student will be ready to investigate this concept at this Level and so we will need to differentiate to ensure every student is learning at their leading edge. Select the Differentiate button on this screen.

Integrate

Every mathematical concept is integrally related to other mathematical concepts. Teaching and learning related concepts simultaneously develops deep relational understanding. Select the Integrate button on this screen.

Intervene

Some students may not yet be ready to investigate this concept at any Level, and so we will need to provide some intervention. Select the Intervention button on this screen.

SIDE AND ANGLE PROPERTIES.

EXPLICIT TEACHING PLAN OVERVIEW PAGE

THIS PAGE IS A SUMMARY OF THE EXPLICIT TEACHING PLAN, INCLUDING STRATEGIC QUESTIONS, AND DESCRIBING THE SEQUENCE WHICH WILL OCCUR OVER MULTIPLE LESSONS.

RESOURCES: PROTRACTORS, RULERS, RED TRAPEZIUM PATTERN BLOCK, PENCIL, PAPER

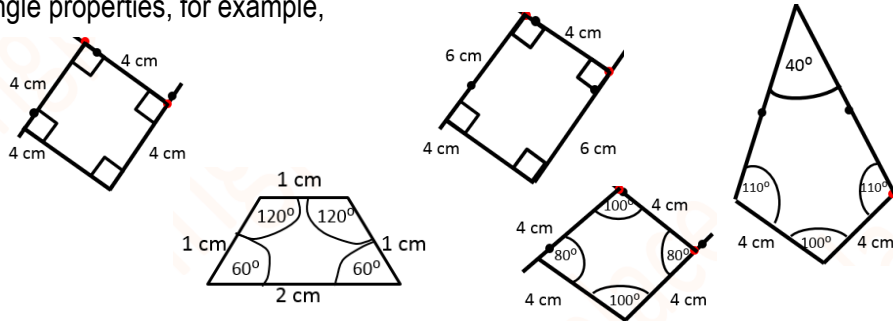
WHAT COULD WE DO?

Children:

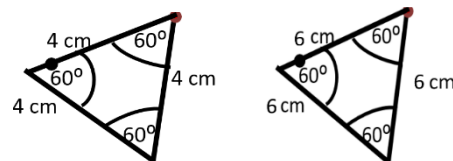
- measure angles in a triangle, identifying 180° , and angles in a quadrilateral, identify 360°
- construct and classify equilateral, isosceles and scalene triangles from side and angle properties, for example,



- construct and classify quadrilaterals - square, rectangle, rhombus, kite, trapezium from side and angle properties, for example,



- enlarge triangles and quadrilaterals, identifying their properties do not change, for example,



WHAT LANGUAGE COULD WE USE TO EXPLAIN AND ASK QUESTIONS?

Children

- ask one another questions about measuring side and angles properties of triangles and quadrilaterals, for example:
 - ▶ How many degrees in a triangle?
 - ▶ How many degrees in a quadrilateral?
 - ▶ What are the side and angles properties of:
 - ▶ equilateral triangles
 - ▶ isosceles triangles
 - ▶ scalene triangles
 - ▶ squares
 - ▶ rectangles
 - ▶ rhombuses
 - ▶ kites
 - ▶ trapeziums
- ▶ How could we enlarge a shape?
- ▶ How does enlarging a shape affect its side and angle properties?

SIDE AND ANGLE PROPERTIES.

EXPLICIT TEACHING PLAN

FULL EXPLICIT TEACHING PLAN, EMBEDDING DEEP RELATIONAL UNDERSTANDING, METALANGUAGE, AND QUESTIONS THAT MAY BE USED OVER MULTIPLE LESSONS.

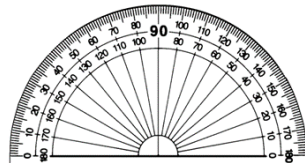
WHAT COULD WE DO?

Children think about, talk and listen to a friend about, then have the opportunity to share what they already know.

Record, for example, An angle is the amount of turn around a vertex.

Record, for example, An angle is the relative slant of 2 arms that meet at a vertex.

Display a protractor, for example,



Children use a ruler to record triangles with sides longer than the radius of their

WHAT LANGUAGE COULD WE USE TO EXPLAIN AND ASK QUESTIONS?

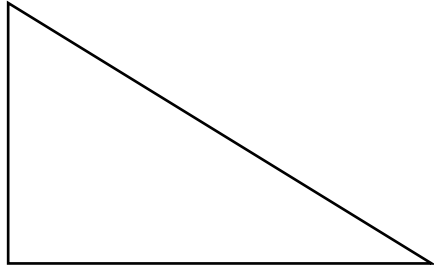
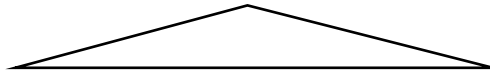
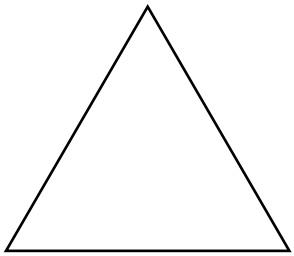
- ▶ Today brings an investigation about angles in two-dimensional shapes.
- ▶ What do you know about angles in two-dimensional shapes?
- ▶ Talk about angles in two-dimensional shapes with a friend.
- ▶ Is anyone ready to share what they are thinking about angles in two-dimensional shapes?

- ▶ We've investigated angles.
- ▶ And we found that angles can be thought of in 2 ways.
- ▶ As the amount of turn around a vertex, and as the relative slant of two arms that meet at a vertex.

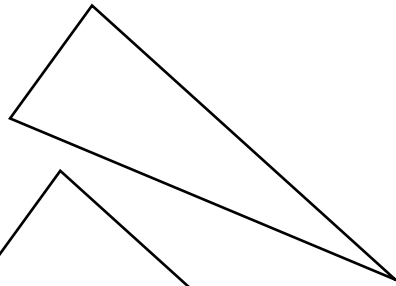
- ▶ We've measured and constructed angles using a protractor.
- ▶ And we've classified angles as acute, right, obtuse, straight, reflex and a revolution.

- ▶ **Today we're going to investigate angles in shapes.**

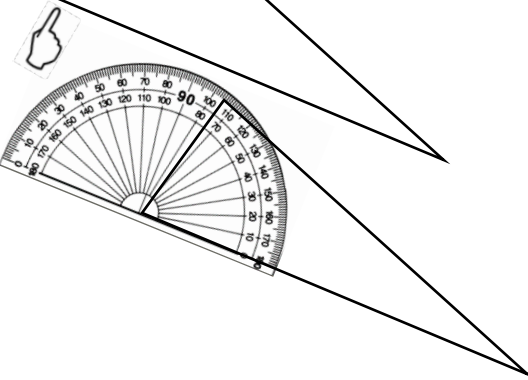
protractor, for example,



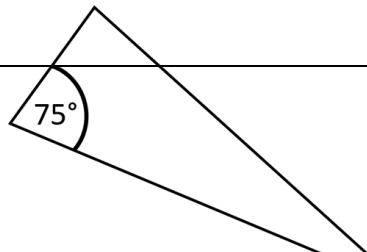
Select one of the triangles, for example,



Select an angle to measure first, for example,



Align the centre of the protractor with the vertex of the angle and the zero mark on the protractor with one of the arms of the angle, for example,



- ▶ Let's record some triangles.
- ▶ Are all of these shapes triangles?
- ▶ How do you know?
- ▶ Do these shapes all have 3 lines?
- ▶ Are the lines straight or curved?
- ▶ Because the lines are straight, are they sides?
- ▶ Where do sides meet?
- ▶ Do sides meet at vertices?
- ▶ Are all shapes with 3 sides and 3 vertices, triangles?
- ▶ This is how we have always described triangles.
- ▶ Now that you are older, we can describe triangles in more detail.

- ▶ We've measured the size of angles using a protractor.
- ▶ Do you think we could measure the sizes of the angles in this triangle?

▶ Let's measure this angle first.

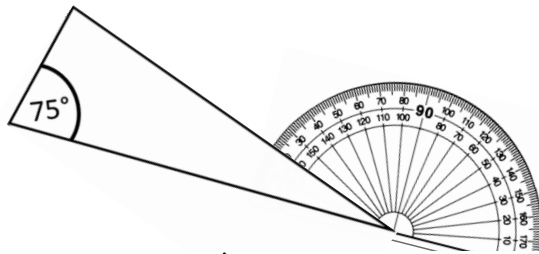
- ▶ Where is the vertex of the angle?
- ▶ Let's align the centre of the protractor with the vertex of the angle.
- ▶ Where are the arms of the angle? Let's align the zero mark on the protractor with one of the arms
- ▶ Is the zero mark on the outside or the inside line on the protractor?
- ▶ Because the zero mark is on the inside line, will we follow the inside line around to see on which mark on the inside line of the protractor is the other arm?
- ▶ On which mark is the other arm? Is the other arm on 75 degrees?

Record, 75° in the angle in the triangle, for example,

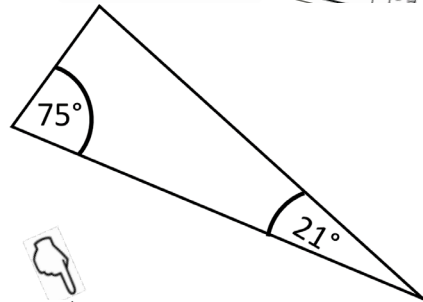
Select another angle in the triangle to measure, for example,



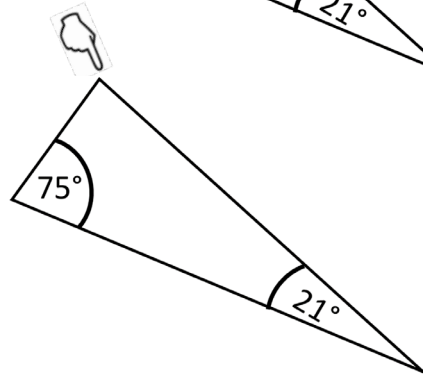
Align the centre of the protractor with the vertex of the angle and the zero mark on the protractor with one of the arms of the angle, for example,



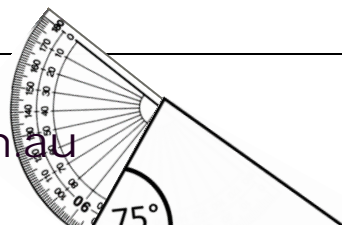
Record, 21° in the angle in the triangle, for example,



Select the third angle in the triangle to measure, for example,



Align the centre of the protractor



- ▶ What is the size of the angle?
- ▶ Could we record size of the angle as 75 degrees?

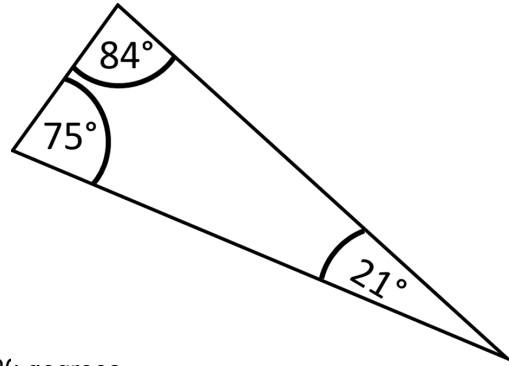
- ▶ Let's measure the size of another angle in the triangle.
- ▶ Where is the vertex of the angle?

- ▶ Let's align the centre of the protractor with the vertex of the angle.
- ▶ Where are the arms of the angle? Let's align the zero mark on the protractor with one of the arms
- ▶ Is the zero mark on the outside or the inside line on the protractor?
- ▶ Because the zero mark is on the outside line, will we follow the outside line around to see on which mark on the outside line of the protractor is the other arm?
- ▶ On which mark is the other arm? Is the other arm on 21 degrees?
- ▶ What is the size of the angle?
- ▶ Could we record the 21 degrees in part of a circle in the angle?

- ▶ Let's measure the size of another angle in the triangle.
- ▶ Where is the vertex of the angle?

with the vertex of the angle and the zero mark on the protractor with one of the arms of the angle, for example,

Record, 84° in the angle in the triangle, for example,



Children add $75 + 21 + 84$ to get 180 degrees.

Children will initially not measure accurately, for example, they may round 84° to 80° or 21° to 20° which will mean the sum of the angles will not be 180° . Allowing them to remeasure each angle more accurately to get the sum of 180° will increase their understanding and capacity to measure angles with a protractor for a reason!

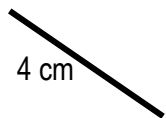
- ▶ Let's align the centre of the protractor with the vertex of the angle.
- ▶ Where are the arms of the angle? Let's align the zero mark on the protractor with one of the arms
- ▶ Is the zero mark on the outside or the inside line on the protractor?
- ▶ Because the zero mark is on the outside line, will we follow the outside line around to see on which mark on the outside line of the protractor is the other arm?
- ▶ On which mark is the other arm? Is the other arm on 84 degrees?
- ▶ What is the size of the angle?
- ▶ Could we record the 84 degrees in part of a circle in the angle?

- ▶ What is the sum of the angles?
- ▶ Is the sum of the angles, 180 degrees?

- ▶ Do you think the sum of the angles in every triangle is 180 degrees?

Allow children to try to draw a regular (equilateral) triangle using just a ruler. They will find that the final side is either shorter or longer than the other 2 because estimating equal angles is difficult.

Record a line 4 centimetres long, for example,

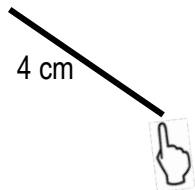


- ▶ We've measured angles in triangles.
- ▶ And we found the sum of the angles.
- ▶ We found that the sum of the angles in a triangle is 180 degrees.
- ▶ **Do you think that we could use this understanding to construct a regular triangle? Let's investigate!**
- ▶ What do we know about regular shapes?
- ▶ Do regular shapes have all sides equal?
- ▶ Do regular shapes have all vertices equal?
- ▶ First, everyone try to draw a regular triangle using just a ruler.

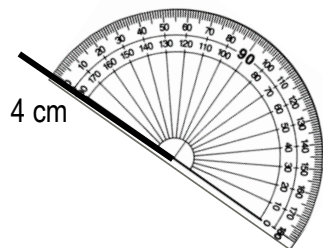
- ▶ So we tried to draw a regular triangle using just a ruler and we found that it is very difficult to get all 3 sides and vertices equal.
- ▶ Let's try with a ruler and a protractor.
- ▶ Let's start by drawing one side of the triangle. How long will we make the side?
- ▶ Let's make the side 4 centimetres.
- ▶ We know that a side is a straight line, so let's draw a straight line 4 centimetres long.
- ▶ Let's record that this side is 4 centimetres

- ▶ Now we know that the sum of the angles in a triangle is 180 degrees.
- ▶ And we also know that a regular shape has equal angles.
- ▶ We also know that a triangle has 3 angles.
- ▶ So, if the sum of our 3 equal angles is 180 degrees, what will be the size of each angle?
- ▶ What is 180 divided by 3?

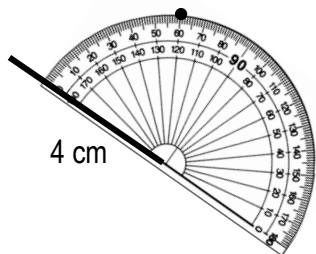
Select one end of the arm to be the vertex, for example,



Align this arm of the angle with one of the zero marks on the protractor, for example,



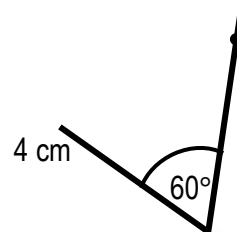
Place a dot next to the 60 degree mark on the protractor, for example,



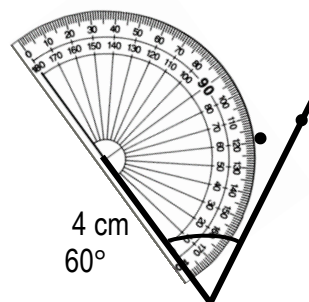
- ▶ Will each angle be 60 degrees?
- ▶ How could we draw another arm of this angle to make it meet this arm at 60 degrees?
- ▶ Where will the vertex of our angle be? Will the vertex be at this end of the line, or this end of the line? Can we choose either end to be our vertex?
- ▶ Let's make this end of the line the vertex.
- ▶ Because this is the vertex of our angle, will the centre of the protractor go here?
- ▶ Will we align this arm of the angle with one of the zero marks on the protractor?
- ▶ Did we align the arm with the zero mark on the inside or the outside line on the protractor?
- ▶ Did we align the zero mark with the outside line?
- ▶
- ▶ Because we aligned the zero mark with the outside line, will we follow the outside line around to 60 degrees?
- ▶ Could we place a dot next to the 60 degree mark on the protractor?
- ▶ Now that we know where 60 degrees is, could we move the protractor out of the

Move the protractor out of the way and draw the other arm of the angle from the vertex to the dot, for example,

Record the size of the angle, for example,

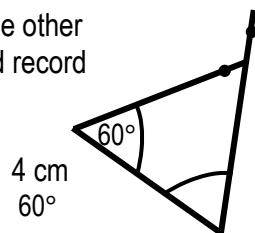


Align this centre of the protractor with the end of the line that will be the vertex of the angle and align the arm of the angle with one of the zero marks on the protractor, for example



Place a dot next to the 60 degree mark on the protractor, for example,

Move the protractor out of the way and draw the other arm of the angle from the vertex to the dot, and record 60 degrees in the angle, for example,



way and draw the other arm of the angle from the vertex to the dot?

- ▶ Did we construct an angle that is 60 degrees?
- ▶ Let's record the size of the angle.

- ▶ We now have 2 sides and 1 vertex of our regular triangle.
- ▶ Let's construct another 60 degree angle.
- ▶ Because this is the vertex of our angle, will the centre of the protractor go here?
- ▶ Will we align this arm of the angle with one of the zero marks on the protractor?
- ▶ Did we align the arm with the zero mark on the inside or the outside line on the protractor?
- ▶ Because we aligned the zero mark with the outside line, will we follow the outside line around to 60 degrees?
- ▶ Could we place a dot next to the 60 degree mark on the protractor?

- ▶ Now that we know where 60 degrees is, could we move the protractor out of the way and draw the other arm of the angle from the vertex to the dot?
- ▶ Did we construct an angle that is 60 degrees?
- ▶ Let's record the size of the angle.

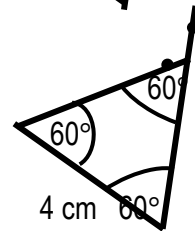
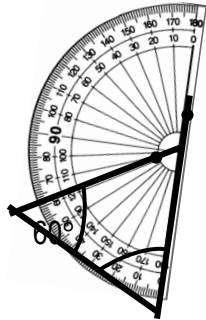
- ▶ So we have a triangle where we know that 2 of the angles are 60 degrees.

- ▶ Let's measure the third angle to check that it is 60 degrees as well.

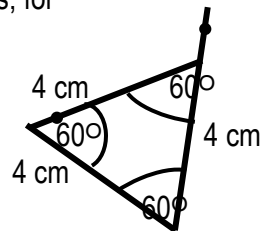
Measure the third angle to check that it is 60 degrees, for example,

4 cm 60°

Record the size of the angle, for example,



Measure and record the length of the other 2 sides, for example,



Record, for example, regular triangle = equilateral triangle

► Does the third angle measure 60 degrees?

► Let's record the size of the angle.

► So we have a triangle where we know that all 3 the angles are 60 degrees and we know that 1 of the sides is 4 centimetres long.

► Let's measure the other 2 sides.

► Do the other 2 sides measure 4 centimetres?

► Let's record the length of the side.

► So we have constructed a regular triangle using a protractor and a ruler!

► Did you know that a regular triangle has a special name?

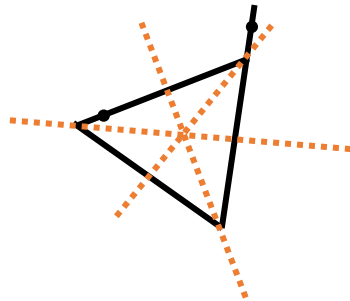
► A regular triangle is called an equilateral triangle.

► Just like lots of other words we use to name shapes, the word equilateral is made up of 2 Latin words – equi and lateral.

Underline 'equi' and 'lateral' in equilateral, for example,
regular triangle = equilateral triangle

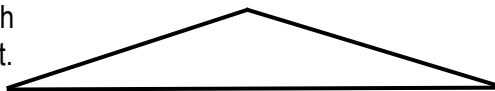
Record equal under 'equi' and sides under 'lateral', for example,
regular triangle = equilateral triangle
equal sides

Draw the lines of symmetry, for example,



Children draw a triangle with 2 sides equal (isosceles), for example,

This is quite easy as the length
of the third side is unimportant.



Children measure the sizes of their angles with protractors.

Children share their measurements with a friend.

- ▶ Can you almost see the word equal in 'equi'? Do you think 'equi' means equal?
- ▶ And we know from quadrilateral that lateral means sides.
- ▶ So equilateral means equal sides!
- ▶ How many lines of symmetry does an equilateral triangle have?
- ▶ Does an equilateral triangle have 3 lines of symmetry?

- ▶ We've investigated using a protractor and a ruler to construct triangles where each side and vertex is equal.
- ▶ And we found that this made an equilateral triangle.
- ▶ But do all triangles have equal sides and vertices?
- ▶ Do some triangles have only 2 sides equal?
- ▶ **Let's draw a triangle with 2 sides equal.**

- ▶ Everyone measure and record the size of the angles.
- ▶ Share your measurements with a friend.
- ▶ Is there anything similar between your angle measurements and your friend's angle measurements?
- ▶ Is the sum of your angles 180 degrees?
- ▶ Are any of your angles the same size?
- ▶ Which angles are equal size?

Record, for example, isosceles

Record, for example, isos and skelos

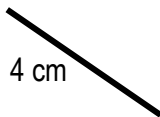
Record, for example, isos means equal.

Record, for example, skelos means legs.

Record equal legs under the word isosceles, for example,

isosceles
equal legs

Draw a line 4 centimetres long and record its length, for example,



Record, for example, 2 equal angles = 50° each

Record, for example, sum of 2 equal angles = 100°

- ▶ Are the angles that are opposite the equal sides, equal?

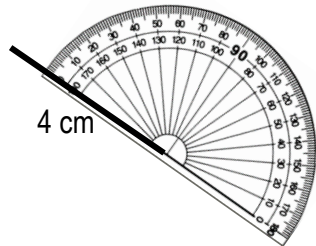
- ▶ Triangles with 2 equal sides and 2 equal angles are called isosceles triangles.
- ▶ Just like lots of names of shapes, the word isosceles is made up of 2 Ancient Greek words – 'isos' and 'skelos'.
- ▶ Isos means equal and skelos means legs.
- ▶ Do you think we get the word skeleton from the Ancient Greek word 'skelos'?
- ▶ So isosceles actually means 'equal legs'

- ▶ Today we're going to use our understanding that the angles opposite the equal sides are also equal, to construct an isosceles triangle using a protractor and ruler.
- ▶ Let's start by drawing one side of the triangle. How long will we make the side?
- ▶ Let's make the side 4 centimetres.

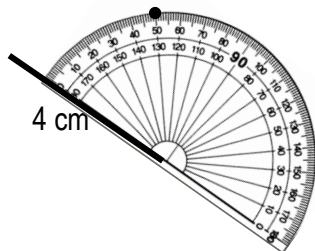
- ▶ Now we know that the sum of the angles in a triangle is 180 degrees.
- ▶ And we also know that an isosceles triangle has only 2 equal angles.
- ▶ So, if the sum of our 3 equal angles is 180 degrees, what will be the size of the 2 equal angles?
- ▶ Could we make each of the 2 equal angles 50 degrees?
- ▶ If each of the 2 equal angles are 50 degrees, what will their sum be?
- ▶ Will their sum be 100 degrees?
- ▶ If the sum of the 2 equal angles is 100 degrees, and there are 180 degrees in a triangle, what will be the size of the third angle?
- ▶ Will the third angle be 80 degrees?

Record, for example, $100^\circ + 80^\circ = 180^\circ$

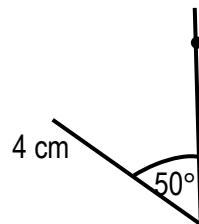
Align the arm of the angle with one of the zero marks on the protractor, for example,



Place a dot next to the 50 degree mark on the protractor, for example,



Move the protractor out of the way and draw the other arm of the angle from the vertex to the dot, for example,



Record the size of the angle, for example,

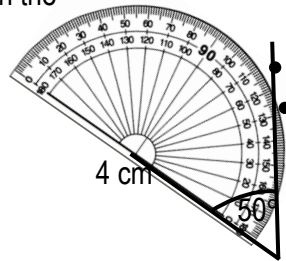
- ▶ How could we draw another arm of this angle to make it 50 degrees?
- ▶ Because this is the vertex of our angle, will the centre of the protractor go here?
- ▶ Will we align this arm of the angle with one of the zero marks on the protractor?
- ▶ Because we aligned the zero mark with the outside line, will we follow the outside line around to 50 degrees?

▶ Did we construct an angle that is 50 degrees?

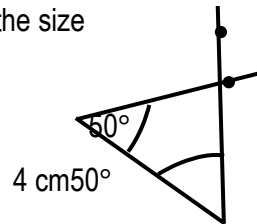
▶ Let's record the size of the angle.

▶ So our isosceles triangle has 2 sides.

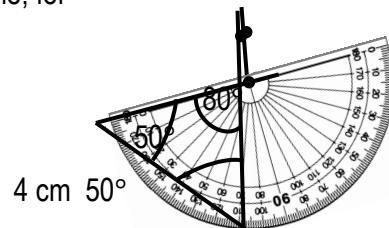
Place a dot next to the 50 degree mark on the protractor, for example,



Move the protractor, draw the arm and record the size of the angle, for example,



Measure and record the size of the third angle, for example,

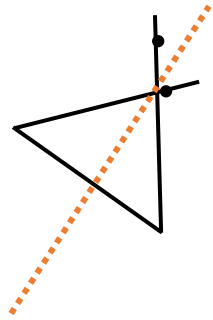


- ▶ Let's construct another 50 degree angle from the other end of our first side.
- ▶ Because we aligned the zero mark with the inside line, will we follow the inside line around to 50 degrees?
- ▶ Could we place a dot next to the 50 degree mark on the protractor?
- ▶ Did we construct an angle that is 50 degrees?
- ▶ Let's record the size of the angle.

- ▶ So we have a triangle where we know that 2 of the angles are 50 degrees and we know that 1 of the sides is 4 centimetres long.

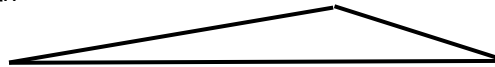
- ▶ We know that the third angle should be 80 degrees.
- ▶ Let's measure the third angle to check that it is 80 degrees as well.
- ▶ Does the third angle measure 80 degrees?
- ▶ So we have a triangle where we know that 2 of the angles are 50 degrees, and 1 of the angles is 80 degrees.
- ▶ We know that 1 of the sides is 4 centimetres long.
- ▶ Because 2 of the angles are the same size, do you think 2 of the sides will be the same length?
- ▶ Which sides do you think will be the same length?
- ▶ Let's measure the sides.
- ▶ Are 2 of the sides the same length?
- ▶ Are the 2 sides that are opposite the equal angles, also equal?
- ▶ Because 2 sides and 2 angles are equal, is this an isosceles triangle?
- ▶ How many lines of symmetry does an isosceles triangle have?

Draw the line of symmetry, for example,



Children draw a triangle with zero sides equal (scalene), for example,

This is quite easy as the length of each side is unimportant.



Children measure the sizes of their angles with protractors.

Children share their measurements with a friend.

Record, for example, scalene

Record, for example, scalene means unequal

▶ Does an isosceles triangle have 1 line of symmetry?

▶ Do all triangles have some equal sides and vertices?

▶ Do some triangles have zero sides equal?

▶ **Let's draw a triangle with zero sides equal.**

▶ Everyone measure and record the size of the angles.

▶ Share your measurements with a friend.

▶ Is there anything similar between your angle measurements and your friend's angle measurements?

▶ Is the sum of your angles 180 degrees?

▶ Are any of your angles the same size?

▶ Are zero angles equal?

▶ Triangles with zero equal sides and zero equal angles are called scalene triangles.

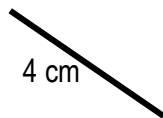
▶ Just like lots of names of shapes, the word scalene is an Ancient Greek word meaning unequal.

▶ Are all of the sides and angles in a scalene triangle unequal?

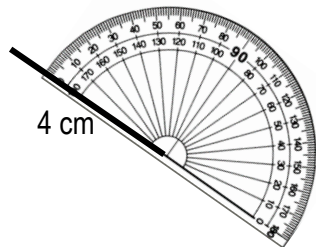
▶ Today we're going to use our understanding that zero sides and zero vertices are equal, to construct a scalene triangle using a protractor and ruler.

Record, for example, 1 angle = 50° , 1 angle = 60° , 1 angle = 70°

Draw a line 4 centimetres long and record its length, for example,



Align the arm of the angle with one of the zero marks on the protractor, for example,



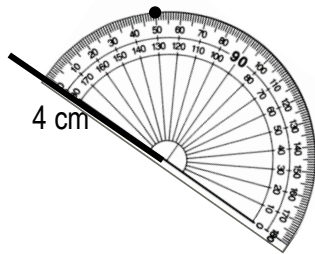
- ▶ Now we know that the sum of the angles in a triangle is 180 degrees.
- ▶ And we also know that a scalene triangle has zero equal angles.
- ▶ So, if the sum of our 3 equal angles is 180 degrees, what could be the size of the unequal angles?
- ▶ Could we make one angle 50 degrees, one angle 60 degrees and one angle 70 degrees?
- ▶ Does 50 plus 60 plus 70 equal 180 degrees?

- ▶ Let's start by drawing one side of the triangle 4 centimetres long.
- ▶ We know that a side is a straight line, so let's draw a straight line 4 centimetres long.

- ▶ How could we draw another arm of this angle to make it 50 degrees?
- ▶ Because this is the vertex of our angle, will the centre of the protractor go here?
- ▶ Because we aligned the zero mark with the outside line, will we follow the outside line around to 50 degrees?

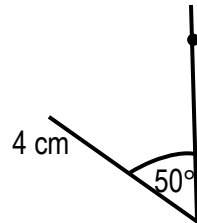
- ▶ Could we place a dot next to the 50 degree mark on the protractor?

Place a dot next to the 50 degree mark on the protractor, for example,

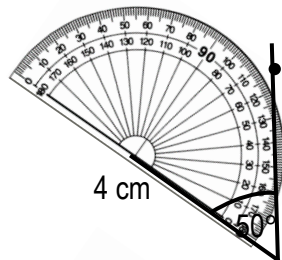


Move the protractor out of the way and draw the other arm of the angle from the vertex to the dot, for example,

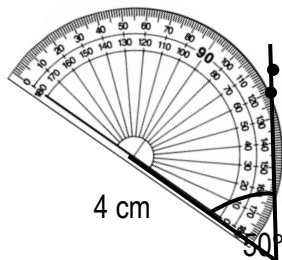
Record the size of the angle, for example,



Align the centre of the protractor with the vertex of the angle, and the arm of the protractor with the side of the triangle, for example,



Place a dot next to the 60 degree mark on the protractor, for example,



Move the protractor, draw the arm and record the

► Did we construct an angle that is 50 degrees?

► Let's record the size of the angle.

► So our scalene triangle has 2 sides, and 1 angle of 50 degrees.

► Let's construct a 60 degree angle from the other end of our first side.

► Because this end of the side is the vertex of our angle, will the centre of the protractor go here?

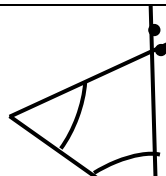
► Because we aligned the zero mark with the inside line, will we follow the inside line around to 60 degrees?

► Could we place a dot next to the 60 degree mark on the protractor?

► Now that we know where 60 degrees is, could we move the protractor out of the way and draw the other arm of the angle from the vertex to the dot?

► Did we construct an angle that is 60 degrees?

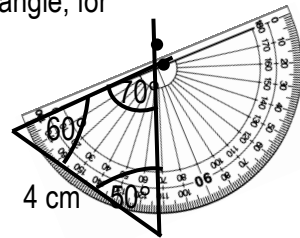
► Let's record the size of the angle.



size of the angle, for example,

60°
4 cm
50°

Measure and record the size of the third angle, for example,



► So we have a triangle where we know that 1 of the angles is 50 degrees, 1 of the angles is 60 degrees, and we know that 1 of the sides is 4 centimetres long.

► We know that the third angle should be 70 degrees.

► Let's measure the third angle to check that it is 70 degrees as well.

► Does the third angle measure 70 degrees?

► So we have a triangle where we know that 1 of the angles is 50 degrees, 1 of the angles is 60 degrees and 1 of the angles is 70 degrees.

► We know that 1 of the sides is 4 centimetres long.

► Because zero of the angles are the same size, do you think zero of the sides will be the same length?

► Let's measure the sides.

► Are zero of the sides the same length?

► Because zero sides and zero angles are equal, is this a scalene triangle?

► Can a triangle have parallel sides?

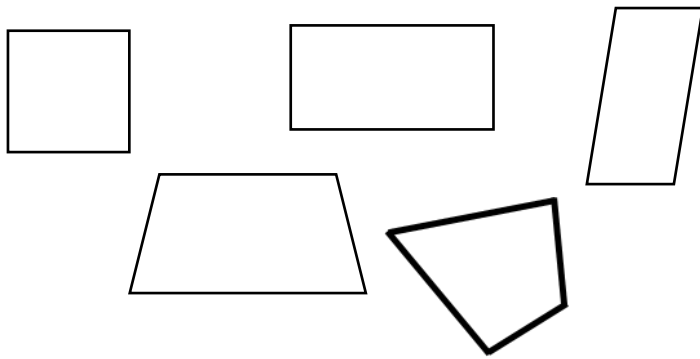
► No, a triangle cannot have parallel sides, because it only has 3 sides!

► How many lines of symmetry does a scalene triangle have?

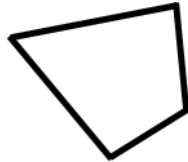
► Does a scalene triangle have zero lines of symmetry?

► Today we're going to continue our investigation about angles in shapes.

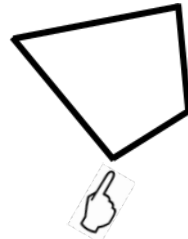
Children record quadrilaterals, for example,



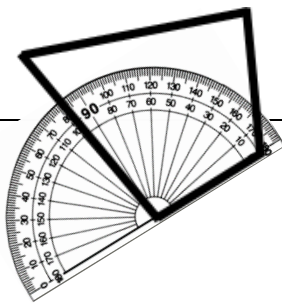
Select one of the quadrilaterals, for example,



Select an angle to measure first, for example,



Align the centre of the protractor with the vertex of the angle and the zero mark on the protractor with one of the arms of the angle, for example,



► **Let's record some quadrilaterals.**

- Are all of these shapes quadrilaterals?
- How do you know?
- Do these shapes all have 4 lines?
- Are the lines straight or curved?
- Because the lines are straight, are they sides?
- Where do sides meet?
- Do sides meet at vertices?
- Are all shapes with 4 sides and 4 vertices, quadrilaterals?
- We've investigated quadrilaterals.
- And we found that some quadrilaterals have special names, like square, rectangle, kite, trapezium and rhombus
- We've measured the size of angles using a protractor.

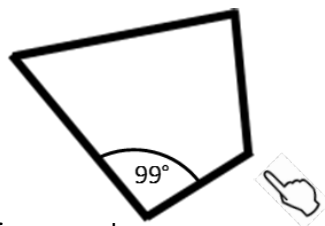
- Do you think we could measure the sizes of the angles in this quadrilateral?

- Let's measure this angle first.

- Where is the vertex of the angle?

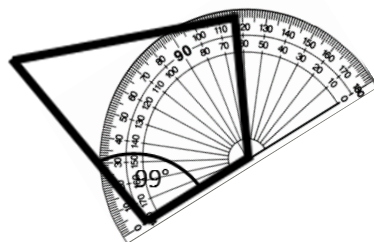
- Let's align the centre of the protractor with the vertex of the angle.

Record, 99° in the angle in the quadrilateral, for example,

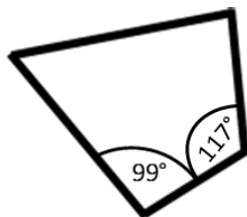


Select another angle in the quadrilateral to measure, for example,

Align the centre of the protractor with the vertex of the angle and the zero mark on the protractor with one of the arms of the angle, for example,

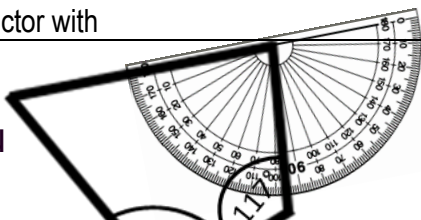


Record, 117° in the angle in the quadrilateral, for example,



Select the third angle in the quadrilateral to measure.

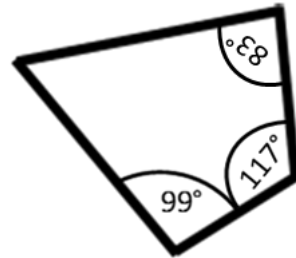
Align the centre of the protractor with the vertex of the angle and the zero mark on the protractor with



- ▶ Where are the arms of the angle? Let's align the zero mark on the protractor with one of the arms
 - ▶ Is the zero mark on the outside or the inside line on the protractor?
 - ▶ Because the zero mark is on the inside line, will we follow the inside line around to see on which mark on the inside line of the protractor is the other arm?
 - ▶ On which mark is the other arm? Is the other arm on 99 degrees?
 - ▶ What is the size of the angle?
 - ▶ Could we record 99 degrees in part of a circle in the angle?
- ▶ Let's measure the size of another angle in the quadrilateral.
- ▶ Where is the vertex of the angle?
 - ▶ Let's align the centre of the protractor with the vertex of the angle.
 - ▶ Where are the arms of the angle? Let's align the zero mark on the protractor with one of the arms
 - ▶ Is the zero mark on the outside or the inside line on the protractor?
 - ▶ Because the zero mark is on the outside line, will we follow the outside line around to see on which mark on the outside line of the protractor is the other arm?
 - ▶ On which mark is the other arm? Is the other arm on 117 degrees?
 - ▶ What is the size of the angle?
 - ▶ Could we record 117 degrees in the angle?
- ▶ Let's measure the size of another angle in the quadrilateral.

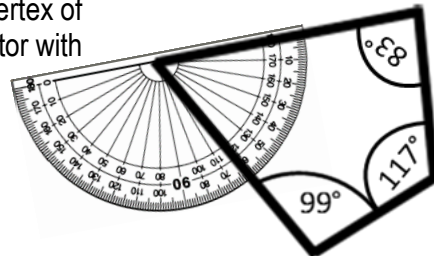
one of the arms of the angle, for example,

Record 83° in the angle in the quadrilateral, for example,



Select the fourth angle in the quadrilateral to measure.

Align the centre of the protractor with the vertex of the angle and the zero mark on the protractor with one of the arms of the angle, for example,



Record 61° in the angle in the quadrilateral, for example,



Children add $99 + 117 + 83 + 61$ to get 360 degrees.

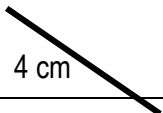
- ▶ Where is the vertex of the angle?
- ▶ Let's align the centre of the protractor with the vertex of the angle.
- ▶ Where are the arms of the angle? Let's align the zero mark on the protractor with one of the arms
- ▶ Is the zero mark on the outside or the inside line on the protractor?
- ▶ Because the zero mark is on the inside line, will we follow the inside line around to see on which mark on the inside line of the protractor is the other arm?
- ▶ On which mark is the other arm? Is the other arm on 83 degrees?
- ▶ What is the size of the angle?
- ▶ Could we record 83 degrees in the angle?

- ▶ Let's measure the size of another angle in the quadrilateral.
- ▶ Where is the vertex of the angle?
- ▶ Let's align the centre of the protractor with the vertex of the angle.
- ▶ Where are the arms of the angle? Let's align the zero mark on the protractor with one of the arms
- ▶ Is the zero mark on the outside or the inside line on the protractor?
- ▶ Because the zero mark is on the outside line, will we follow the outside line around to see on which mark on the outside line of the protractor is the other arm?
- ▶ On which mark is the other arm? Is the other arm on 61 degrees?
- ▶ What is the size of the angle?
- ▶ Could we record 61 degrees in the angle?

- ▶ What is the sum of the angles?

Allow children to try to draw a regular quadrilateral – square - using just a ruler. They will find that the final side is either shorter or longer than the other 3 because estimating equal angles is difficult.

Record a line 4 centimetres long, for example,



- ▶ Is the sum of the angles, 360 degrees?

- ▶ Do you think the sum of angles in every quadrilateral is 360 degrees?

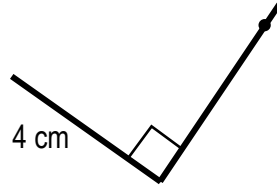
- ▶ We've measured angles in quadrilaterals.
- ▶ And we found the sum of the angles.
- ▶ We found that the sum of the angles in a quadrilateral is 360 degrees.
- ▶ **Do you think that we could use this understanding to construct a regular quadrilateral? Let's investigate!**
- ▶ What do we know about regular shapes?
- ▶ Do regular shapes have all sides equal?
- ▶ Do regular shapes have all vertices equal?
- ▶ Does a regular quadrilateral have a special name?
- ▶ Is a regular quadrilateral, a square?
- ▶ First, everyone try to draw a square using just a ruler.

- ▶ So we tried to draw a square using just a ruler and we found that it is very difficult to get all 4 sides and vertices equal.
- ▶ Let's try with a ruler and a protractor.

- ▶ Let's start by drawing one side of the quadrilateral. How long will we make the

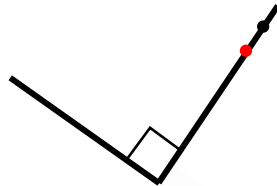
Move the protractor out of the way and draw the other arm of the angle from the vertex to the dot, for example,

Record the size of the angle, for example,

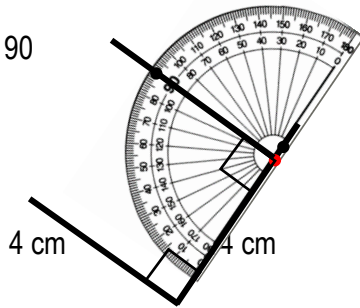


Use a ruler to mark where 4 centimetres is on the second side of the quadrilateral, for example,

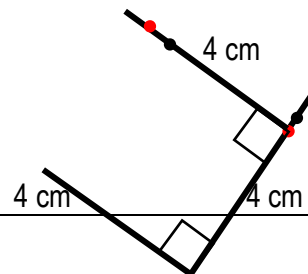
4 cm 4 cm



Use the protractor and ruler to construct a 90 degree angle, for example,



Use a ruler to mark where 4 centimetres is on the third side, for example,



► Could we place a dot next to the 90 degree mark on the protractor?

► Did we construct an angle that is 90 degrees?

► Let's record the size of the angle.

► So our regular quadrilateral has 2 sides.

► But are our sides the same length?

► Could we use our ruler to mark where 4 centimetres is on our second side?

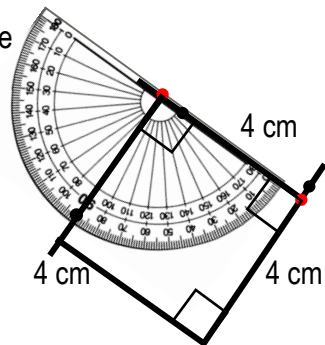
► We now have 2 sides and 1 vertex of our regular quadrilateral.

► Let's construct another 90 degree angle.

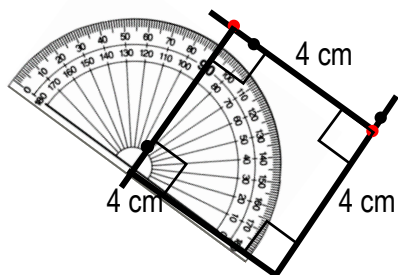
► Let's record the size of the angle.

► Let's use our ruler to mark where 4 centimetres is on our third side.

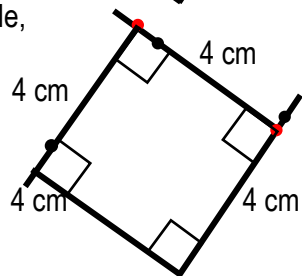
Place a dot next to the 90 degree mark on the protractor, for example,



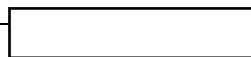
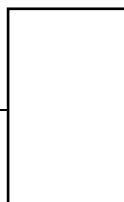
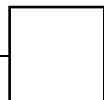
Measure and record the size of the fourth angle, for example,



Record the length of the fourth side, for example,



Display a rectangle, for example,



- ▶ We now have 3 sides and 2 vertices of our regular quadrilateral.
- ▶ Let's construct another 90 degree angle.
- ▶ Let's record the size of the angle.

- ▶ So we have a quadrilateral where we know that 3 of the angles are 90 degrees and we know that 3 of the sides are 4 centimetres long.
- ▶ Let's measure the fourth angle to check that it is 90 degrees as well.
- ▶ Does the fourth angle measure 90 degrees?
- ▶ Let's record the size of the angle.

- ▶ So we have a quadrilateral where we know that all 4 of the angles are 90 degrees and we know that 3 of the sides are 4 centimetres long.
- ▶ Let's measure the fourth side to check that it is 4 centimetres as well.
- ▶ Does the fourth side measure 4 centimetres?
- ▶ Let's measure and record the length of the side.

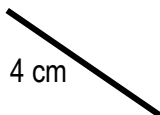
- ▶ So we have constructed a regular quadrilateral – a square - using a protractor and a ruler!

square / regular rectangle

irregular rectangles

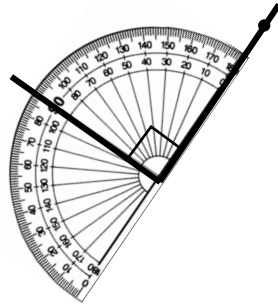
Allow children to try to draw an irregular quadrilateral – rectangle - using just a ruler. They will find that the final side is either shorter or longer than it should be because estimating equal angles is difficult.

Draw a line 4 centimetres long and record its length, for example,

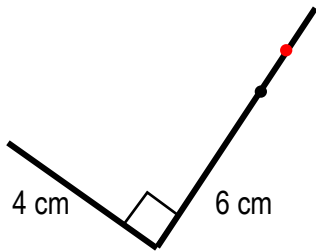


- ▶ Could we also call this square, an equilateral quadrilateral?
- ▶ Do you think we could construct other special quadrilaterals using a protractor and a ruler?
- ▶ **Could we construct a rectangle?**
- ▶ What do you know about the sides of rectangles?
- ▶ Are the opposite sides of rectangles equal?
- ▶ What do you know about the angles in rectangles?
- ▶ Are the angles in rectangle right angles?
- ▶ Is a rectangle a quadrilateral with opposite sides equal and 4 right angles?
- ▶ Is a square a rectangle?
- ▶ Are the opposite sides in a square equal?
- ▶ Is a square a regular rectangle?
- ▶ We've already investigated squares, so today let's draw a rectangle that is not a square – an irregular rectangle.
- ▶ First, everyone try to draw an irregular quadrilateral – a rectangle using just a ruler.
- ▶ So we tried to draw a rectangle using just a ruler and we found that it is very difficult to get the opposite sides equal and all vertices equal.
- ▶ Today we're going to use our understanding that the opposite sides are equal, and each angles is 90 degrees, to construct a rectangle using a protractor and ruler.
- ▶ Let's start by drawing one side of the quadrilateral 4 centimetres.

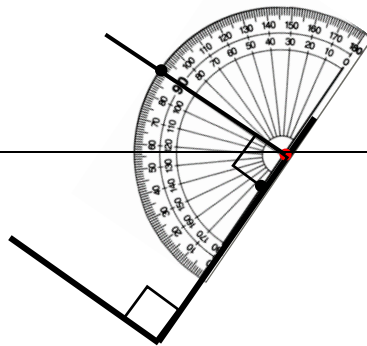
Record the size of the angle, for example,



Use a ruler to mark where 6 centimetres is on the second side of the quadrilateral, for example,



Construct a 90 degree angle using the protractor, for example,



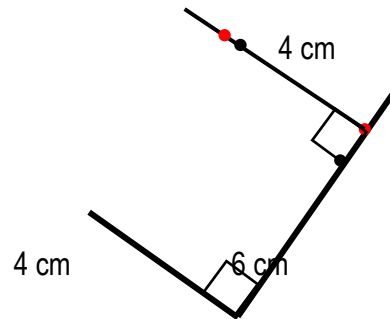
- ▶ Now we know that the sum of the angles in a quadrilateral is 360 degrees.
- ▶ And we also know that a rectangle has 4 right angles.
- ▶ Will each angle be 90 degrees?
- ▶ Let's draw another arm of this angle to make it 90 degrees.
- ▶ Did we construct an angle that is 90 degrees?
- ▶ Let's record the size of the angle.

- ▶ So our irregular quadrilateral has 2 sides.
- ▶ We know that the sides in our irregular quadrilateral, our rectangle, are not all the same. In our rectangle the opposite sides are equal and the adjacent sides are unequal.
- ▶ So we need to make these adjacent sides different lengths.
- ▶ We have one side 4 centimetres long, so let's make the adjacent side 6 centimetres long.
- ▶ Could we use our ruler to mark where 6 centimetres is on our second side?

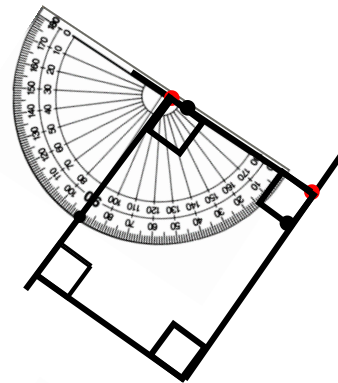
- ▶ We now have 2 sides and 1 vertex of our irregular quadrilateral.

4 cm 6 cm

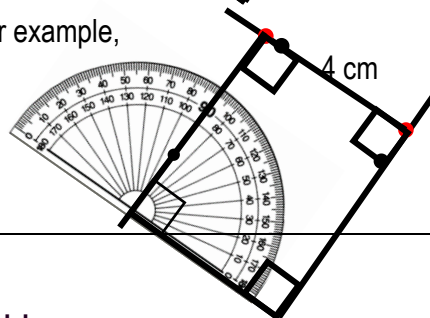
Use a ruler to mark where 4 centimetres is on the third side, for example,



Construct a 90 degree angle using the protractor, for example,



Measure the size of the fourth angle, for example,



▶ Let's construct another 90 degree angle.

▶ So our irregular quadrilateral has 3 sides.

▶ We know that the sides in our irregular quadrilateral, our rectangle, are not all the same. In our rectangle the opposite sides are equal and the adjacent sides are unequal.

▶ So we need to make this side the same length as the opposite side

▶ Could we use our ruler to mark where 4 centimetres is on our second side?

▶ We now have 3 sides and 1 vertex of our regular quadrilateral.

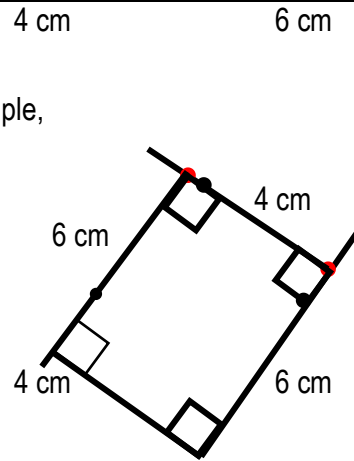
▶ Let's construct another 90 degree angle.

▶ Did we construct an angle that is 90 degrees?

▶ Let's record the size of the angle.

▶ The fourth angle should also be 90 degrees. Let's measure it to check.

Record the length of the fourth side, for example,



- ▶ Does the fourth angle measure 90 degrees?
- ▶ Let's record the size of the angle.

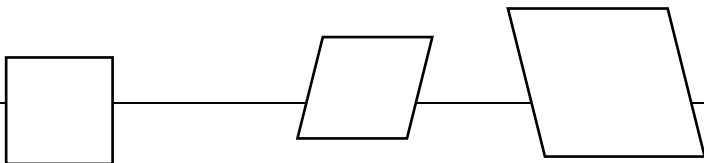
- ▶ So we have an irregular quadrilateral where we know that 3 of the angles are 90 degrees and we know that 2 of the sides are 4 centimetres long and 1 side is 6 centimetres long.
- ▶ What should be the length of the fourth side?
- ▶ The fourth side is opposite the 6 centimetre side, so it should also be 6 centimetres long. Let's measure the side.
- ▶ Let's record the length of the side.

- ▶ So we have constructed an irregular quadrilateral – a rectangle - using a protractor and a ruler!

- ▶ Is each angle on this irregular quadrilateral 90 degrees?
- ▶ Is each side equal to its opposite side?
- ▶ So if we have an irregular quadrilateral with opposite sides equal and each angle 90 degrees, have we constructed a rectangle?
- ▶ Because adjacent sides are not equal, have we constructed an irregular rectangle?

- ▶ Do you think we could construct other special irregular quadrilaterals using a protractor and a ruler?

Display some rhombuses, for example,

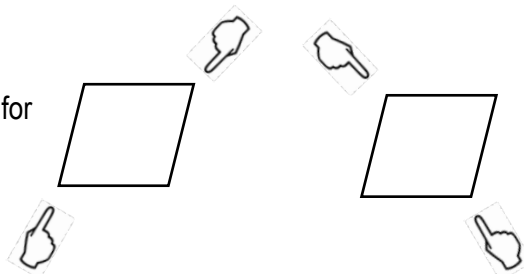


square / regular rhombus

irregular rhombus

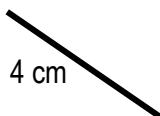
Measure the sides.

Measure the opposite angles, for example,



Allow children to try to draw an irregular quadrilateral – irregular rhombus - using just a ruler. They will find that the final side is either shorter or longer than the other 3 because estimating angles is difficult.

Draw a line 4 centimetres long and record its length, for example,



► Could we construct a rhombus?

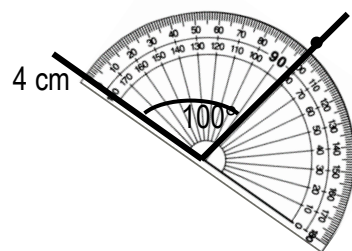
- What do you know about the sides of a rhombus?
- Is a rhombus a quadrilateral with 4 equal sides?
- Is a square a rhombus?
- Are the sides in a square equal?
- Is a square a regular rhombus?

- We've already investigated squares, so today let's draw a rhombus that is not a square – an irregular rhombus.
- Let's look at the irregular rhombus.
- Let's measure the sides.
- Are the sides equal?
- Do any of the angles look like they are equal?
- Do the opposite angles look like they are equal?
- Let's measure the angles.
- Are the opposite angles equal?
- Are adjacent angles unequal?
- First, everyone try to draw an irregular rhombus using just a ruler.
- So we tried to draw an irregular rhombus using just a ruler and we found that it is very difficult to get the sides equal and the opposite angles equal.

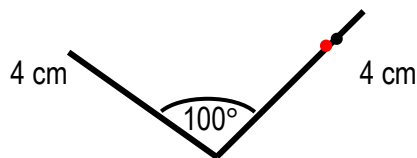
- Today we're going to use our understanding that the sides are equal, the opposite angles are equal and the adjacent angles are unequal, to construct an irregular rhombus using a protractor and ruler.

- Let's start by drawing one side of the quadrilateral 4 centimetres.

Construct and record the size of the angle, for example,



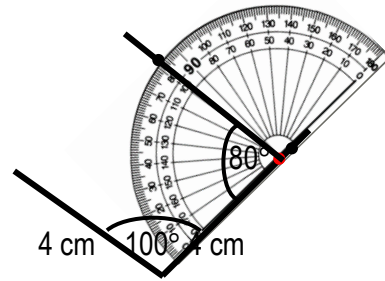
Use a ruler to mark where 4 centimetres is on the second side of the quadrilateral, for example,



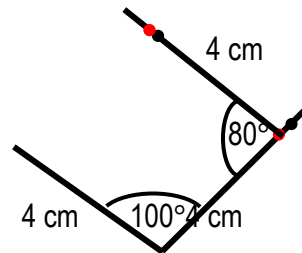
- ▶ Now we know that the sum of the angles in a quadrilateral is 360 degrees.
- ▶ And we also know that a regular rhombus - a square - has 4 right angles.
- ▶ But we don't want to construct a regular rhombus, a square.
- ▶ We want to construct an irregular rhombus.
- ▶ So our angle can't be 90 degrees, or, because the sides are all equal, they'll all end up being 90 degrees – which would make a regular quadrilateral – a square!
- ▶ So let's make this angle a little more than 90 degrees – how about 100 degrees?
- ▶ How could we draw another arm of this angle to make it 100 degrees?
- ▶ Did we construct an angle that is 100 degrees?
- ▶ Let's record the size of the angle.

- ▶ So our irregular quadrilateral has 2 sides.
- ▶ We know that the sides in our irregular quadrilateral, our rhombus, are all the same.
- ▶ So we need to make these sides the same length.
- ▶ Could we use our ruler to mark where 4 centimetres is on our second side?
- ▶ We now have 2 sides and 1 vertex of our irregular quadrilateral, our rhombus.
- ▶ Our first angle is 100 degrees.
- ▶ But we know that adjacent angles in our quadrilateral, our rhombus, are not the same.
- ▶ But we also know that opposite angles are equal!
- ▶ So if this angle is 100 degrees. And the opposite angle is 100 degrees. That

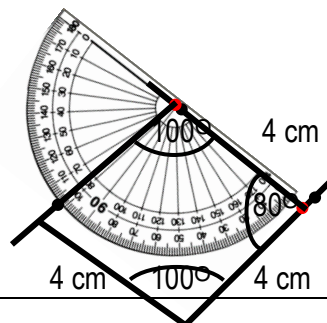
Construct an 80 degree angle, for example,



Use a ruler to mark where 4 centimetres is on the third side, for example,



Move the protractor out of the way and draw the other arm of the angle from the vertex to the dot, for example,

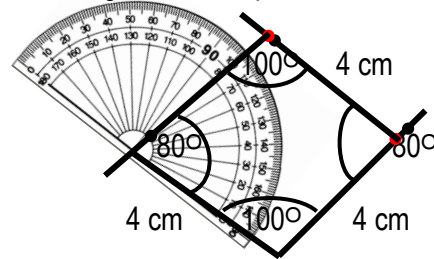


equals 200 degrees.

- ▶ We know there are 360 degrees in a quadrilateral.
- ▶ And we already have 200 in 2 angles.
- ▶ So we have 160 degrees left.
- ▶ And we have 2 equal angles left.
- ▶ How many degrees in each of the 2 remaining equal angles?
- ▶ Are there 80 degrees in each of the 2 remaining equal angles?
- ▶ Let's construct an 80 degree angle.

- ▶ So our irregular quadrilateral, our rhombus, has 3 sides.
- ▶ We know that the sides in our irregular quadrilateral, our rhombus, are all the same.
- ▶ So we need to make this side the same length.
- ▶ Could we use our ruler to mark where 4 centimetres is on our third side?
- ▶ We now have 3 sides and 2 vertices of our irregular quadrilateral, our rhombus.
- ▶ Our first angle is 100 degrees.
- ▶ But we know that adjacent angles in our quadrilateral, our rhombus, are not the same.
- ▶ But we also know that opposite angles are equal!
- ▶ This angle is opposite the first angle, so it is equal to the first angle.
- ▶ Let's construct another 100 degree angle.

Measure and record the size of the fourth angle, for example,



▶ Did we construct an angle that is 100 degrees?

▶ Let's record the size of the angle.

▶ Because the fourth angle is opposite the second angle, it should also be 80 degrees. Let's measure it to check.

▶ Does the fourth angle measure 80 degrees?

▶ Let's record the size of the angle.

▶ So we have an irregular quadrilateral, a rhombus, where we know that 2 opposite angles are 100 degrees, and the other 2 opposite angles are 80 degrees.

▶ We know that 3 of the sides are 4 centimetres long and that all of the sides should be equal.

▶ What should be the length of the fourth side?

▶ Should the length of the fourth side also be 4 centimetres?

▶ Let's measure and record the length of the side.

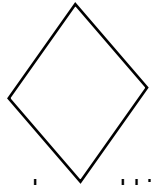
▶ So we have constructed an irregular quadrilateral – a rhombus - using a protractor and a ruler!

▶ Our irregular quadrilateral has 4 equal sides, and opposite angles equal, and adjacent angles unequal.

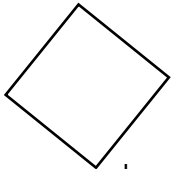
▶ Have we constructed an irregular rhombus?

▶ Do you think we could construct other special irregular quadrilaterals using a

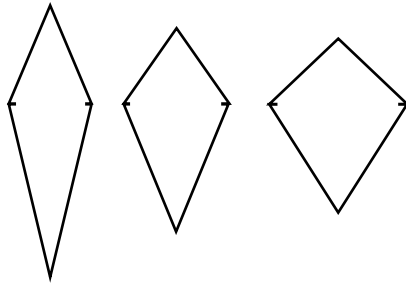
Display some kites, for example,



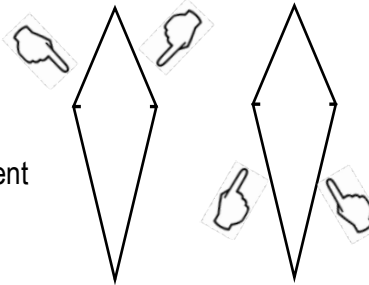
rhombus and kite (with all sides equal)



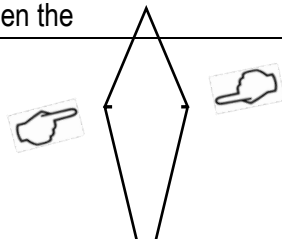
square and regular kite



Measure the sides, identifying that 2 pairs of adjacent sides are equal, for example,



Measure the angles identifying the angles between the



protractor and a ruler?

► **Could we construct a kite?**

- What do you know about the sides of a kite?
- Is a kite a quadrilateral with 2 pairs of equal sides?
- Are the equal sides adjacent or opposite one another?
- Are the equal sides adjacent to one another?
- Is a square a kite?
- Are the pairs of adjacent sides in a square equal?
- Is a square a regular kite?
- Is a rhombus a kite?
- Are the pairs of adjacent sides in a rhombus equal?
- Is a rhombus a kite with equal sides?

- We've already investigated squares and rhombuses, so today let's draw a kite that is not a square, and that is not a rhombus.

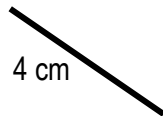
- Let's look at a kite that is not a rhombus or a square.
- Let's measure the sides.
- Are these 2 adjacent sides equal? And are these 2 adjacent sides equal?
- Do any of the angles look like they are equal?
- Do these 2 opposite angles look like they are equal?

- Let's measure the angles.

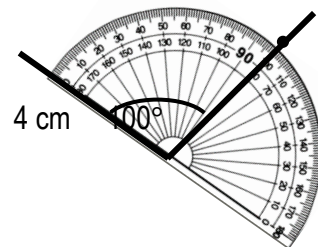
unequal sides are equal, for example,

Allow children to try to draw an irregular quadrilateral – a kite - using just a ruler. They will find that the final side is either shorter or longer than the other 3 because estimating angles is difficult.

Draw a line 4 centimetres long and record its length, for example,



Construct and record a 100 degree angle, for example,



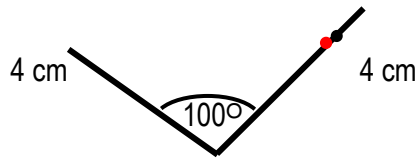
- ▶ Which angles are equal?
- ▶ Are the angles that are between non-equal sides, equal?

- ▶ First, everyone try to draw a kite that is not a rhombus or a square using just a ruler.
- ▶ So we tried to draw a kite that is not a rhombus or a square using just a ruler and we found that it is very difficult.
- ▶ Today we're going to use our understanding that pairs of adjacent sides are equal, and the angles between non-equal sides are equal, to construct, our kite that is not a rhombus or a square using a protractor and ruler.
- ▶ Let's start by drawing one side of the quadrilateral 4 centimetres.

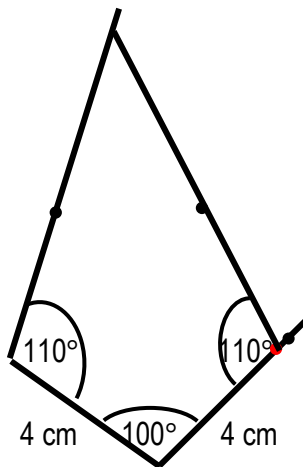
- ▶ Now we know that the sum of the angles in a quadrilateral is 360 degrees.
- ▶ We want to construct a kite with only 1 pair of opposite angles equal.
- ▶ So our angle could be acute, right or obtuse!
- ▶ So let's make this angle obtuse – how about 100 degrees?
- ▶ Did we construct an angle that is 100 degrees?
- ▶ Let's record the size of the angle.

- ▶ So our kite that is not a rhombus or a square, has 2 sides.

Use a ruler to mark where 4 centimetres is on the second side of the quadrilateral, for example,

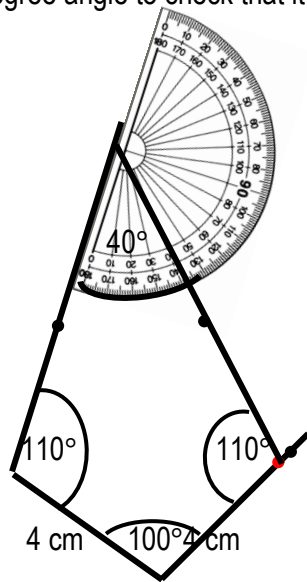


Construct and record two 110 degree angles, for example,



- ▶ We know that 2 pairs of adjacent sides in our kite that is not a rhombus or a square, are all the same.
- ▶ So we can make these sides the same length.
- ▶ Could we use our ruler to mark where 4 centimetres is on our second side?
- ▶ We now have 2 sides and 1 vertex of our irregular quadrilateral, our kite.
- ▶ Our first angle is 100 degrees.
- ▶ But we know that adjacent angles in our kite that is not a rhombus or a square, are not the same.
- ▶ So this angle cannot be 100 degrees.
- ▶ We also know that this angle, and the angle opposite, the fourth angle, will be the same size.
- ▶ And we know that the third angle will not be equal to the first angle.
- ▶ So the first angle is 100 degrees. If we make these two angles each 110 degrees, that will total 320 degrees. We know there are 360 degrees in a quadrilateral, so the angle at the top will be 40 degrees.
- ▶ Let's construct two 110 degree angles.
- ▶ Let's record the size of each angle.
- ▶ So our kite that is not a rhombus or a square, has 4 sides and 4 angles.
- ▶ The 2 adjacent sides at the top should be the same length. Let's measure them to check.
- ▶ Are they the same length?
- ▶ The angle opposite the 100 degree angle should be 40 degrees. Let's measure it to check.

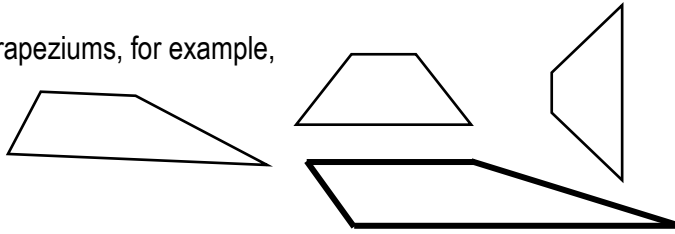
Measure the angle opposite the 100 degree angle to check that it is 40 degrees, for example,



- ▶ Is it 40 degrees?
- ▶ Let's record the angle size.
- ▶ Have we constructed a quadrilateral with adjacent sides equal and the angles between non-equal sides equal?
- ▶ Have we constructed a kite?
- ▶ Have we constructed a kite that is not a rhombus or a square using a protractor and a ruler?

- ▶ Do you think we could construct other special irregular quadrilaterals using a protractor and a ruler?

Display some trapeziums, for example,



NB: The trapezium investigated here is an isosceles with 2 bases and 2 equal length 'legs'. This 'legs' on this trapezium can be extended to create an isosceles triangle.

A scalene trapezium has no equal sides. The definition of trapezium is either 'at least 1 pair of parallel sides' or 'only 1 pair of parallel sides'.

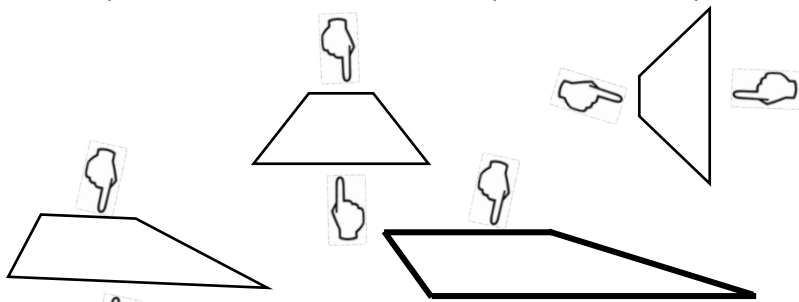
If we take the first definition, then squares, rectangles and rhombuses are also trapeziums.

If we take the second definition, then only trapeziums are trapeziums.

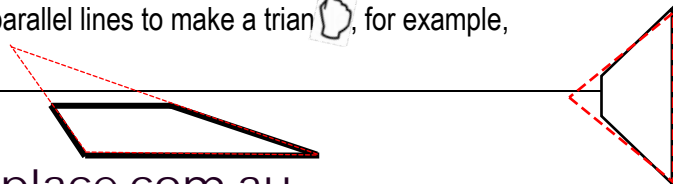
The first definition ('at least 1 pair of parallel sides') is used in calculus, and is the definition we use.

In the US, this is a trapezoid. In Australia, a trapezoid has no parallel sides - in the US that is a trapezium.

Point to the parallel sides in each different trapezium, for example,



Extend the non-parallel lines to make a triangle, for example,



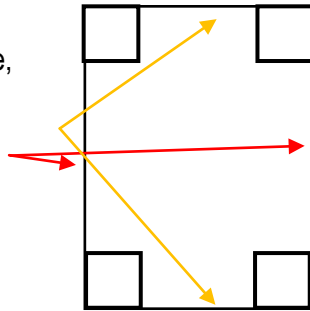
► Could we construct a trapezium?

- A trapezium is a really interesting shape! All of these are trapeziums.
- What do you know about the sides of a trapezium?
- The only property of a trapezium is that there is 1 pair of parallel sides.
- Because of that, a trapezium can look like this, or this, or even this!

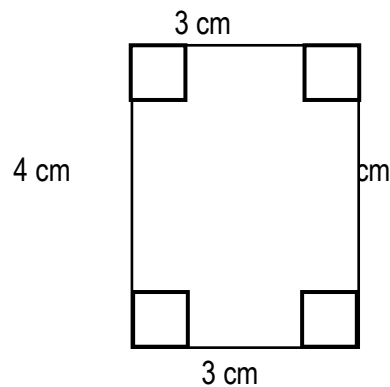
- Have you noticed that if we made the two sides that are not parallel long enough to meet, the trapezium would turn into a triangle?

Allow children to try to draw an irregular quadrilateral – a trapezium - using just a ruler. They will find that the final side is either shorter or longer than the other 3 because estimating angles is difficult.

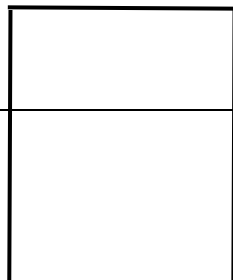
Display a rectangle constructed previously, for example, Point to the pairs of parallel lines, for example,



Construct a rectangle, for example,

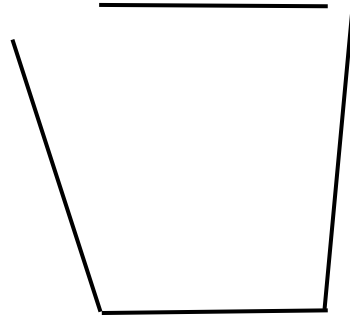


Display the rectangle with side lengths and angle sizes unlabelled, for example,

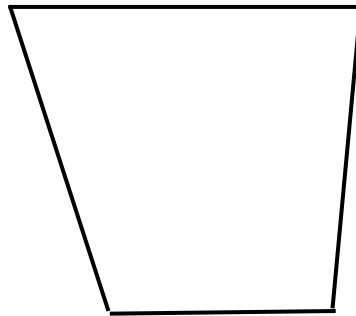


- ▶ First, everyone try to draw a trapezium using just a ruler.
- ▶ So drawing a trapezium with just a ruler seems easy – but how can you be sure that the parallel sides are parallel?
- ▶ Let's use our understanding of parallel lines to construct a trapezium using a protractor and ruler.
- ▶ Could we start with a rectangle?
- ▶ If we construct a rectangle, will we have 2 pairs of parallel sides because each angle is a right angle?
- ▶ So if we construct a rectangle, could we than keep 1 pair of parallel lines, and make the other pair of parallel lines non-parallel?
- ▶ Let's start by constructing a rectangle.
- ▶ A trapezium has only one pair of parallel lines.

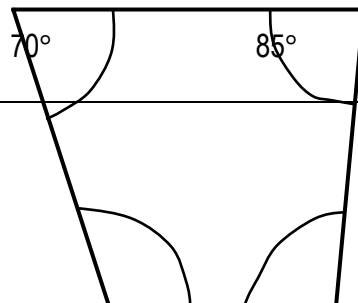
Slant one vertical side to the right and the other to the left, for example,



Make the top parallel side longer, adjusting the lengths of the vertical non-parallel sides to meet the top horizontal side at a vertex, for example,



Use a protractor to measure the angles in the trapezium, for example,



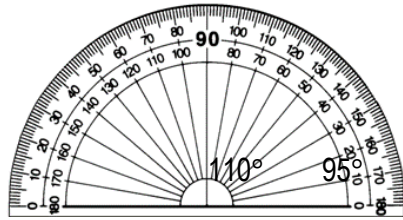
- ▶ Which pair of parallel lines will we keep parallel – the vertical or the horizontal?
- ▶ Does it matter?

- ▶ Let's just choose one - let's keep the horizontal lines parallel.
- ▶ Let's make the vertical sides non-parallel.

- ▶ Let's make this side slant to the right, and this side slant to the left.
- ▶ Hmm, the vertical sides no longer meet the top horizontal side at a vertex!
- ▶ Do the parallel sides have to be equal length?
- ▶ If the parallel sides are equal, will we have a rectangle?
- ▶ So, the parallel sides need to be different lengths!

- ▶ Because we slanted the vertical sides outwards, do we need to make the top parallel side longer?
- ▶ Did we need to adjust the lengths of the vertical non-parallel sides to meet the top horizontal side at a vertex?
- ▶ Did we need longer vertical sides because they no longer go straight up to the top parallel side?
- ▶ Did we need longer vertical sides because they are on a slant?

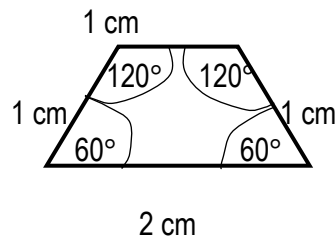
- ▶ If we measure the angles in this trapezium, what should they total?



Display a trapezium pattern block (an isosceles trapezium), for example,

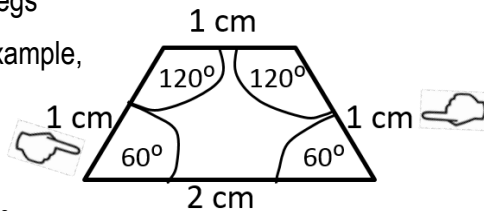


Measure the sides and angles, then construct the trapezium, for example,



Record, for example, isosceles = equal legs

Point to the 'legs' of the trapezium, for example,



Record, for example, isosceles trapezium.

- ▶ What is that the sum of the angles in a quadrilateral?
- ▶ Is the sum of the angles in a quadrilateral 360 degrees?
- ▶ Is a trapezium a quadrilateral?
- ▶ Let's measure the angles to check that they total 360 degrees.
- ▶ So the sum of the angles is 360 degrees.

- ▶ So we have constructed a trapezium using a ruler and protractor. And we found that a trapezium is a quadrilateral with only 1 pair of parallel sides.
- ▶ You are probably used to seeing this shape as a trapezium.
- ▶ This is a special trapezium, because of its side and angle properties.
- ▶ Let's measure the sides and angles, then construct this trapezium.
- ▶ What are the side properties of this special trapezium?
- ▶ Are 3 sides equal?
- ▶ Is the other side twice as long as the equal sides?

- ▶ We've investigated triangles, and we found that an isosceles triangle had 2 equal sides.
- ▶ We found that isosceles means 'equal legs' in Ancient Greek.
- ▶ Let's look at this special trapezium.
- ▶ Could we say that the 'legs' of the trapezium are equal?
- ▶ Because the legs of this trapezium are equal, could we call it an isosceles trapezium?
- ▶ What are the angle properties of this special 'isosceles' trapezium?

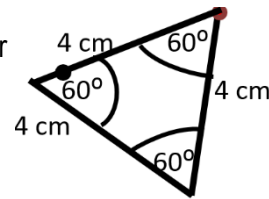
- ▶ Are there 2 pairs of adjacent angles equal?
- ▶ Is it still a trapezium?

Record, for example, enlarge

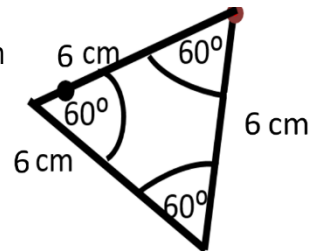
▶ **Today we're going to investigate how we can use a ruler and**

Record, for example, enlarge = make larger

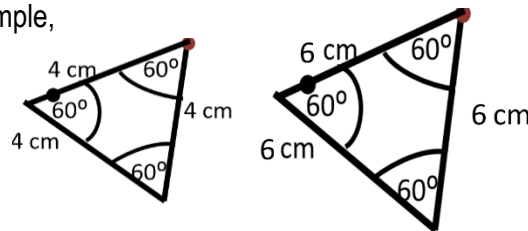
Children construct an equilateral triangle with side lengths 4 centimetres and angles of 60° using a ruler and protractor, for example,



Children construct an enlarged equilateral triangle with side lengths 6 centimetres and angles of 60° using a ruler and protractor, for example,



Children cut out the triangles, for example,



protractor, and how we can use a computer, to enlarge a shape.

- ▶ What do you think enlarge means?
- ▶ Do you think enlarge means to make larger?
- ▶ Let's construct and label an equilateral triangle with side lengths of 4 centimetres, and each angle 60 degrees.
- ▶ What are the properties of this triangle?
- ▶ Does this triangle have 3 equal sides and 3 equal angles?
- ▶ The length of this triangle's sides is 4 centimetres.
- ▶ What is the size of each angle?
- ▶ Is each angle 60 degrees?
- ▶ Is this an equilateral triangle because it has equal sides and angles?

- ▶ Let's enlarge this triangle!
- ▶ How could we enlarge this triangle?
- ▶ Could we make the lengths of the sides longer?
- ▶ How long could we make the sides?
- ▶ Could we make the length of the sides 6 centimetres?
- ▶ Would that make a larger triangle?

- ▶ Let's cut out each triangle to compare them.

- ▶ What is different about these triangles?

Children superimpose the triangles to compare the areas.

Children superimpose each angle to compare the angle sizes.

Record, for example, Different = perimeter, area

Record, for example, Same = shape, angles

- ▶ Are their side lengths different?
- ▶ If their side lengths are different, will their perimeters be different?
- ▶ What is the perimeter of this triangle?
- ▶ Is the perimeter 12 centimetres?
- ▶ What is the perimeter of this triangle?
- ▶ Is the perimeter 18 centimetres?

- ▶ Are the areas different?
- ▶ Could we superimpose the triangles to compare their areas?
- ▶ Are their areas different?

- ▶ Are their angles different?
- ▶ Could we superimpose each angle to compare their sizes?
- ▶ Are their angles the same?
- ▶ Is the shape the same?
- ▶ Are these both equilateral triangles?

- ▶ When we enlarged our shape, what changed?
- ▶ Did the area, side lengths and perimeter change?
- ▶ When we enlarged our shape, what stayed the same?
- ▶ Do both triangles have 3 equal sides and 3 equal angles?

- ▶ Are the sizes of the angles and the relative lengths of the sides, the shape's properties?

Record, for example, similar

Record, for example, enlarging a shape makes a similar shape.

Record, for example, similar shapes have the same properties in a different size.

Use a word processing program, for example, Microsoft Word, to construct a quadrilateral.

Select the insert toolbar.

Select the shape menu.

Select a quadrilateral.

Click on a spot on the page, hold down the left mouse button and drag to construct the quadrilateral, for example,

Select the quadrilateral.

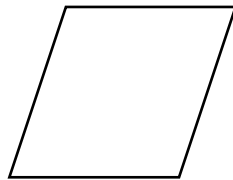
Select the home toolbar.

Select copy.

Click on a spot on the page. Select paste.

(Alternatively, you can select the quadrilateral, press control and c on the keyboard, click on a spot on the page, press control and v on the keyboard.)

(Alternatively, you can right click on the quadrilateral, select copy on the dropdown menu, right click on a spot on the page, and select paste from the dropdown menu.)



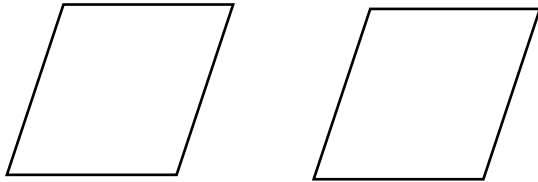
- ▶ Do both of these triangles have the same properties?
- ▶ Would we describe each triangle as having equal sides and equal angles?
- ▶ When we enlarge a shape, do the shape's properties stay the same?
- ▶ When we enlarge a shape, does the shape's size change while its properties remain the same?
- ▶ We call shapes with the same properties in different sizes, similar shapes.
- ▶ Does enlarging a shape make a similar shape?
- ▶ Do similar shapes have the same properties in different sizes?

- ▶ Let's use a word processing computer program to construct a quadrilateral, then to enlarge it to make similar quadrilateral!

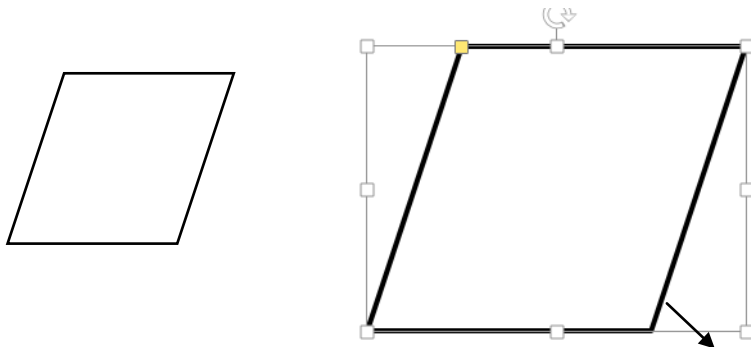
- ▶ Let's select the insert toolbar, then the shape menu, then select a quadrilateral.
- ▶ Let's construct a quadrilateral by clicking and dragging on the page.

- ▶ Let's make this our original quadrilateral, and make a copy to enlarge.

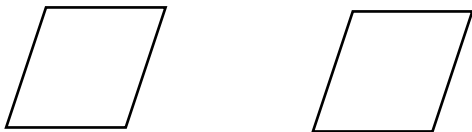
Display the two identical quadrilaterals, for example,



Enlarge one of the shapes by selecting the shape, holding down the shift key, and dragging one of the shape's vertices, for example,



Display the two identical quadrilaterals, for example,



Select one shape

Select the drawing tool format toolbar, and select the arrow in the bottom right hand corner of the size menu.

From the menu box, select lock aspect ratio, then change the height or width, for

► We now have two identical quadrilaterals.

► Let's enlarge one of the quadrilaterals to make a similar quadrilateral.

► Let's select the shape, then while holding down the shift key, drag one corner of the selected frame.

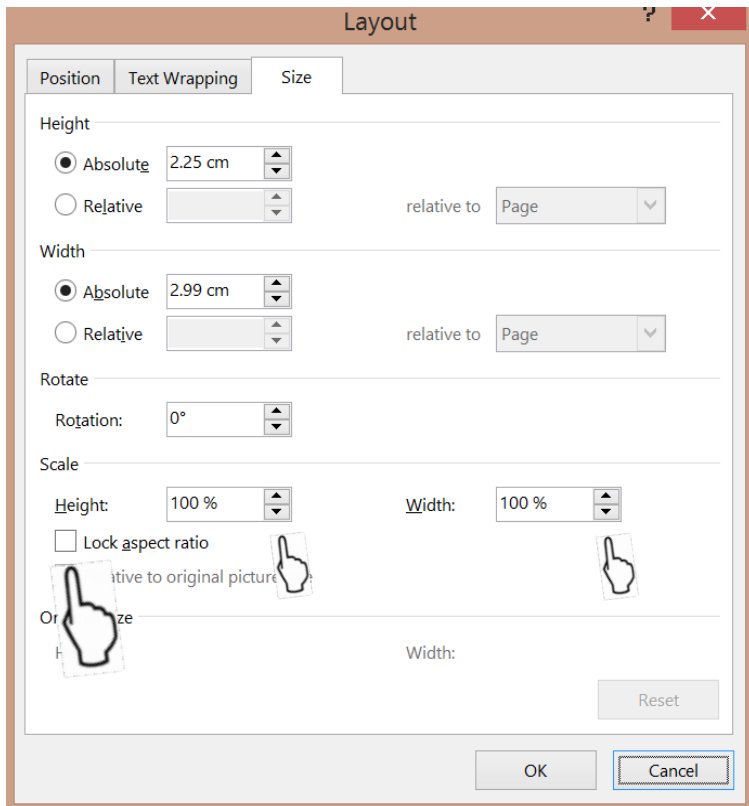
► Holding down the shift key keep the shape's properties the same.

► There is another way to enlarge the shape to make a similar quadrilateral.

► Let's select one shape, select the drawing tool format toolbar, and select the arrow in the bottom right hand corner of the size menu on the far right of the toolbar.

► We now have a menu box.

example,



- ▶ Let's first tell the computer to keep the shape's properties the same.
- ▶ We need to tell the computer to 'lock aspect ratio'. This means that the relative sizes of the angles and the relative lengths of the sides – the shape's properties – will remain the same.
- ▶ Now we can change the shape's size by changing the height and the width.
- ▶ Because we have locked the aspect ratio, when we change the height, the width will change too.
- ▶ And when we change the shape's width, its height will change too.

- ▶ Let's change the height to 120 percent.
- ▶ Did the width change to 120 percent too?
- ▶ Let's click OK.

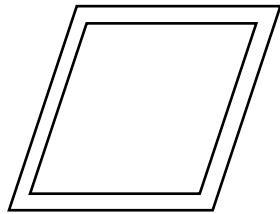
Display both quadrilaterals, for example,



- ▶ Did the shape change size?

Superimpose the small shape onto the large shape to compare the side lengths, perimeters, areas and angles, by clicking on the small quadrilateral and dragging it on top of the large quadrilateral, for example,

NB: If the small quadrilateral goes behind the large quadrilateral, right click on the small quadrilateral and select bring to front from the drop down menu.



- ▶ Did we create a similar shape? Let's check!
- ▶ If these shapes are similar, their properties will be the same but their sizes will be different?
- ▶ Will the shapes' angle sizes be the same as one another?
- ▶ Will the relative length of the shapes' sides be the same?
- ▶ How could we check?
- ▶ Could we superimpose the small shape onto the large shape?
- ▶ Do both quadrilaterals have 4 equal sides and 4 equal angles?
- ▶ Are the relative sizes of the angles and the relative lengths of the sides, the shape's properties?
- ▶ Do both of these quadrilaterals have the same properties?
- ▶ When we enlarge a shape, do the shape's properties stay the same?
- ▶ When we enlarge a shape, does the shape's size change while its properties remain the same?
- ▶ When we enlarged the shape, did we get a similar shape?
- ▶ Do our similar shapes have the same properties in different sizes?