

Angles with a Protractor.

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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.

Integrate

Every mathematical concept is integrally related to other mathematical concepts. Teaching and learning related concepts simultaneously develops deep relational understanding.

Intervene

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

ANGLES WITH A PROTRACTOR.

EXPLICIT TEACHING PLAN OVERVIEW PAGE

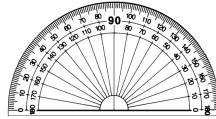
THIS PAGE IS A SUMMARY OF THE EXPLICIT TEACHING PLAN, INCLUDING STRATEGIC QUESTIONS, AND DESCRIBING THE SEQUENCE WHICH WILL OCCUR OVER MULTIPLE LESSONS.

RESOURCES: PROTRACTORS, RULERS, WORLD GLOBE, FURNITURE WITH RIGHT, ACUTE, OBTUSE, STRAIGHT, REFLEX ANGLES, PENCIL, PAPER

WHAT COULD WE DO?

Children:

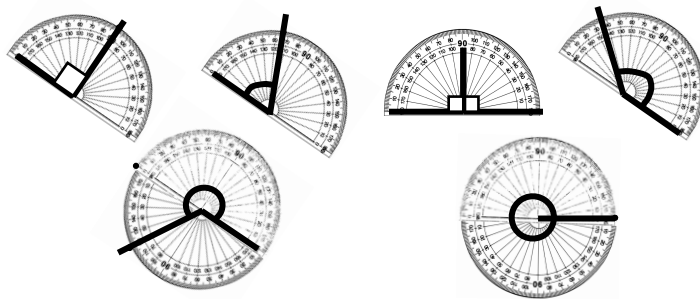
- investigate numbers in each direction on a protractor example,



- measure right, acute, obtuse, straight and reflex angles with a protractor, for example,



- construct right, acute, obtuse, straight and reflex angles with a protractor, for example,



WHAT LANGUAGE COULD WE USE TO EXPLAIN AND ASK QUESTIONS?

Children

- ask one another questions about measuring and constructing angles with a protractor, for example:
 - ▶ What is a protractor?
 - ▶ How do we use a protractor to measure angles?
 - ▶ Why can we measure from both ends of the protractor?
 - ▶ How do we use a protractor to construct angles?
 - ▶ Why can we construct angles from both ends of the protractor?
 - ▶ What is a right angle?
 - ▶ What is an acute angle?
 - ▶ What is an obtuse angle?
 - ▶ What is a straight angle?
 - ▶ What is a reflex angle?
 - ▶ What is a revolution?

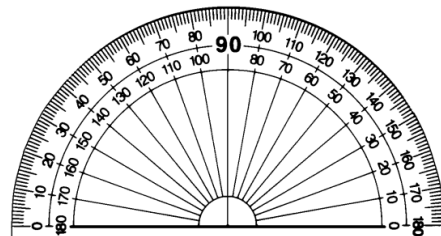
ANGLES WITH A PROTRACTOR.

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?	WHAT LANGUAGE COULD WE USE TO EXPLAIN AND ASK QUESTIONS?
<p>Children think about, talk and listen to a friend about, then have the opportunity to share what they already know.</p> <p>Record, for example, angles are the amount of turn around a vertex.</p> <p>Display angles that are the amount of turn around a vertex, for example, a door opening or the hands on a clock.</p> <p>Record, for example, angles are the relative slant of two arms that meet at a vertex.</p>	<ul style="list-style-type: none">▶ Today brings an investigation about angles.▶ What do you know about angles?▶ Talk about angles with a friend.▶ Is anyone ready to share what they are thinking about angles? ▶ We've investigated angles.▶ And we found that angles can be thought of in 2 ways.▶ We can think of angles as the amount of turn around a vertex.▶ We found that when doors turn, they create an angle.▶ And we found that when a clock's hands turn, they create angles. ▶ We found that we can also think of angles as the as relative slant of two arms that meet at a vertex.▶ We found that shapes had angles where the sides are the arms that meet at a vertex.▶ We found that where two faces or edges of an object meet, they form an angle with the faces or edges as the arms and the corner as the vertex.

Display a protractor, for example,
Record, for example, protractor.

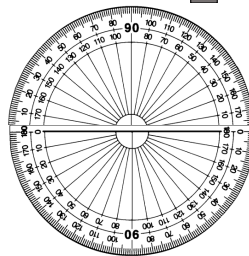


Children say the word protractor.
Distribute protractors to children.
Allow children time to investigate the protractor.

Point to angles in the room that are facing different ways, for example, angles on a table,



Display a round protractor or put 2 semi-circular protractors together to make a full circle, for example,



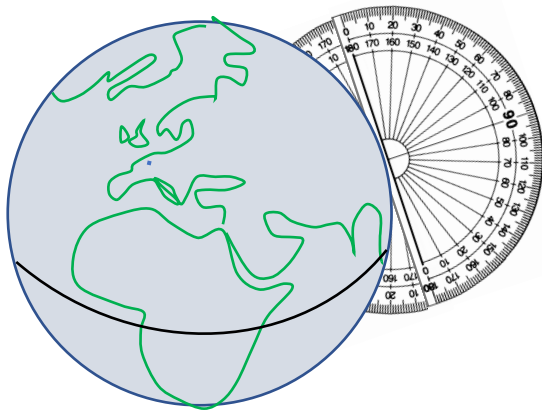
- ▶ We measured angles using angle testers and we classified angles as right angles, less than right angles, greater than right angles, half a right angle, a third of a right angle, two-thirds of a right angle, one-and-a-half right angles, one-and-a-third right angles, one-and-two-thirds right angles, and 2 right angles which we found was a straight line.
- ▶ Today we're going to investigate how we can measure the exact size of an angle.
- ▶ When we want to measure length, we use a ruler, because a ruler has length.
- ▶ When we want to measure angles, we need a tool that has angles.
- ▶ What do you know about this tool?
- ▶ It is called a protractor.

- ▶ Tell your friend this is a protractor.

- ▶ Does a protractor have marks and numbers on it?
- ▶ What numbers are on the protractor?
- ▶ Do the numbers go in both directions?
- ▶ Does it start at zero and go to 180 in both directions?
- ▶ Do you think we can measure angles from either end?
- ▶ Do you think we can measure angles no matter what way they are facing?
- ▶ What shape is this protractor?
- ▶ Is this protractor a half circle – a semi-circle?
- ▶ So the numbers on this half of the circle start at zero and go 180.
- ▶ If this was a full circle, what number would the protractor go up to?
- ▶ Would there be another 180 on the other half of the circle?
- ▶ Would the numbers go up 360?

This is a wonderful animation demonstrating how the Incas used angles to follow the rising and setting of the sun across a year. The mounds still exist – and work - today! Chankillo, Ancash region, Peru (<http://www.youtube.com/watch?v=q13Pz-R8OuE>)

Display a globe of the Earth, demonstrate the tilt, then place the protractor on the surface with the centre where the children live, demonstrating how the sky radiates out from the centre of the protractor, for example,



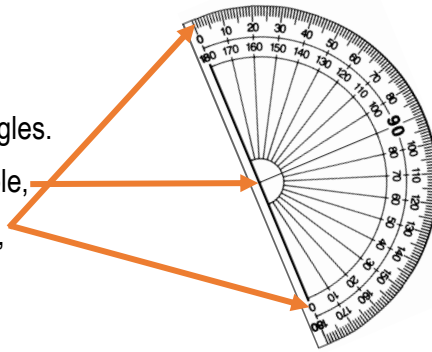
- ▶ Let's take a quick trip back in history to discover why the numbers go up to 360!
- ▶ About 4000 years ago, lots of civilisations were studying the sky. They studied the rising and setting of the sun, movement of the planets, and the solar and lunar eclipses.
- ▶ They did this using angles.
- ▶ Planets, the sun and other stars appear in slightly different parts of the sky throughout the year, because of the tilt of the Earth as we travel around the sun.
- ▶ At different times of the year the sun rises and sets in slightly different places, because of the tilt of the Earth as we travel around the sun.
- ▶ So ancient people divided the sky into 360 parts which we now call 'degrees', so that they could locate the exact position of the sun, stars and planets.
- ▶ Why 360? Because there are 365 days in a year, which they rounded to 360. Many civilisations had calendars that counted only 360 days each year, then had 5 days of waiting for the new year!
- ▶ They made a circular tool which they divided into 360 degrees to divide the sky into 360 degrees.
- ▶ So thanks to them, we now have this really cool tool to measure and construct angles!
- ▶ Their tool looked very much like this protractor!

Record, for example, degree.

Allow children to suggest ways to measure angles.

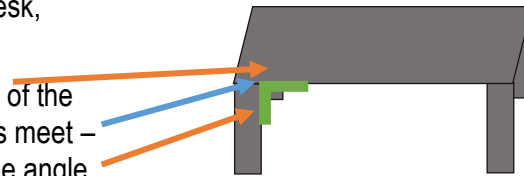
Point to the centre of the protractor, for example,

Point to the zero mark, for example,

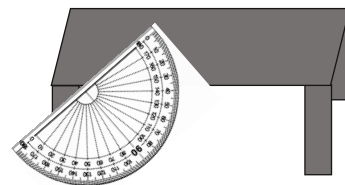


Select an angle, for example, on a desk,

Identify the arms (the top and the leg of the desk) and the vertex (where the arms meet – where the top and the leg meet) of the angle.



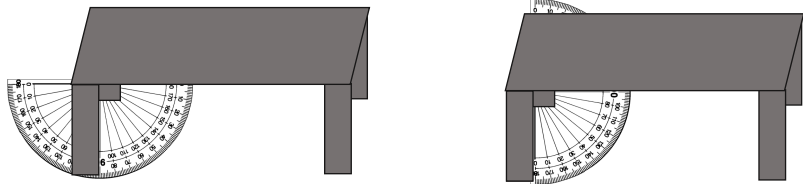
Align the vertex of the selected angle on the desk, with the centre of the protractor, for example,



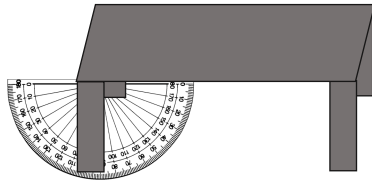
- ▶ So how do you think we could use this protractor to measure the size of angles?
- ▶ We know that the unit of measurement that we use to measure angles is a degree.
- ▶ Could we align the vertex of the angle with the centre of the protractor?
- ▶ Could we align one arm of the angle with one of the zero marks?
- ▶ Then could we look to see what mark the other arm of the angle passes through? Let's try!

- ▶ What angle could we measure?
- ▶ Could we measure an angle on the desk? Could we measure the angle between the top of the desk and the leg of the desk?
- ▶ Where are the arms of the angle?
- ▶ Is one arm, the top of the desk?
- ▶ Is the other arm, the leg of the desk?
- ▶ Where is the vertex of the angle?
- ▶ Is the vertex where the two arms meet? Is the vertex where the top meets the leg?
- ▶ Let's align the vertex of the angle with the centre of the protractor.
- ▶ Could we align one arm of the angle with the zero mark at the end of one arm on the protractor?

Demonstrate aligning each arm (the top and the leg) of the angle with one of the zero marks, for example,

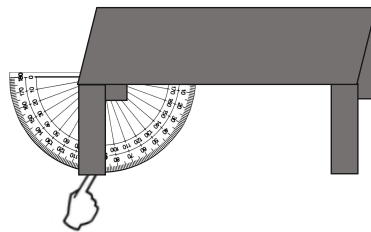


Align the top of the desk with one of the zero marks on the protractor, for example,



Point to the zero on the outside line of the protractor which is aligned to the top of the desk.

Children identify which mark the other arm – the leg- of the angle is passing through – 90, for example,



Record, for example, 90.

Record, for example, 90 degrees.

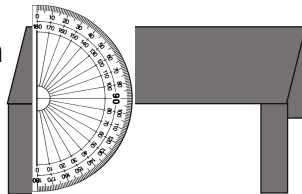
Record, for example, 90°

- ▶ Which arm of our angle could we align with this zero mark?
- ▶ Could we align the arm of our angle that is the top of the desk with this zero mark?
- ▶ Or could we align the arm that is the leg of the desk with this zero mark?
- ▶ Does it matter which arm we align to the zero mark? Let's investigate!

▶ Let's align the top of the desk to the zero mark.

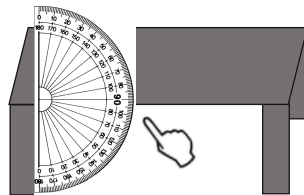
- ▶ Have you noticed that the protractor is transparent? That's so we can see the other arm of the angle through it!
- ▶ We started measuring the angle from this zero mark.
- ▶ Can you see that the zero mark is on the outside line of the protractor?
- ▶ Because we're starting to measure the angle from the zero mark on the outside line of the protractor, we'll follow the outside line around to see what mark on the outside line of the protractor is the other arm – the leg – of the angle passing through.
- ▶ Is the other arm of the angle – the leg - passing through the 90 mark?
- ▶ What is our unit of measurement?
- ▶ Is our unit of measurement degrees?
- ▶ We know that Mathematics is so wonderful because we have a symbol for everything! That means that everyone around the world, regardless of what language they speak, can all read the symbols in Mathematics!
- ▶ Do you think there is a symbol that says degrees?
- ▶ The symbol for degrees is a tiny circle, above the number.

Align the leg of the desk with the zero mark on the other end of the protractor, for example,



Point to the zero on the inside line of the protractor which is aligned to the leg of the desk.

Children identify which mark the other arm – the arm- of the angle is passing through – 90, for example,



Record, for example, 90.

Record, for example, 90 degrees.

Record, for example, 90°

- ▶ Today, you'll record the size of the angle using the word degrees and the symbol for degrees.
- ▶ So we measured the angle between the top of the desk and the leg of the desk by aligning the zero mark with the top of the desk.
- ▶ Do you think we'll get the same measurement if we align the leg of the desk with the zero mark? Let's investigate!
- ▶ Because the leg of the desk is facing a different direction, could we use the zero mark at the other end of the protractor?
- ▶ Let's align the leg of the desk to the zero mark at the other end of the protractor.

- ▶ We started measuring the angle from this zero mark. Can you see that the zero mark is on the inside line of the protractor?
- ▶ Because we're starting to measure the angle from the zero mark on the inside line of the protractor, we'll follow the inside line around to see what mark on the inside line of the protractor is the other arm – the table top – of the angle passing through.
- ▶ Is the other arm of the angle – the table top - passing through the 90 degree mark?
- ▶ What is our unit of measurement?
- ▶ Is our unit of measurement degrees?
- ▶ What is the symbol that says degrees?
- ▶ Is the symbol for degrees is a tiny circle, above the number?

Point to the arms on the angle, for example,

Record, for example, perpendicular.

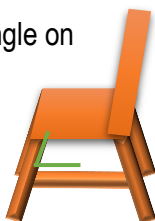
Record for example, right angle.

Record, for example, right angle = 90 degrees

Record, for example right angle = 90°



Select an angle that is less than 90°, for example an angle on a chair,



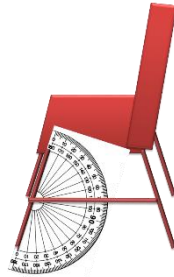
Children identify the arms and the vertex of the angle.

(NB: The wooden rail is technically called a stretcher.)

- ▶ So we measured the angle between the top of the desk and the leg of the desk, first using the desk top as the beginning of the angle, then using the desk leg as the beginning of the angle.
- ▶ Was the angle the same size both times?
- ▶ Does it matter which arm we begin measuring from?
- ▶ Is one arm of this angle perpendicular to the other arm of this angle?
- ▶ We've investigated angles where one arm is perpendicular to the other arm.
- ▶ And we found that they are called right angles because one is upright from the other arm.
- ▶ Is this angle a right angle?
- ▶ How many degrees in a right angle?
- ▶ Are there 90 degrees in a right angle?
- ▶ Can you see any other angles in the room that look like they are right angles?
- ▶ Can you see any other angles in the room that look like they are 90 degrees?

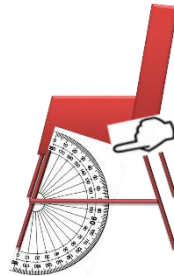
- ▶ Let's measure another angle using our protractor.
- ▶ A chair has lots of interesting small angles - let's measure this small angle on the chair!
- ▶ Where are the arms of the angle?
- ▶ Is one arm, the leg of the chair?
- ▶ Is the other arm, the rail of the chair?
- ▶ Where is the vertex of the angle?
- ▶ Is the vertex where the two arms meet? Is the vertex where the leg meets the rail?

Align the leg of the chair with the zero mark on the other end of the protractor, for example,



Point to the zero on the outside line of the protractor which is aligned to the leg of the chair.

Children identify which mark the other arm – the arm- of the angle is passing through – 70, for example,

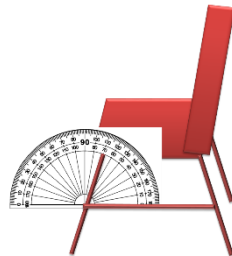


Record, for example, 70.

Record, for example, 70 degrees.

Record, for example, 70°

Align the rail of the chair with the zero mark, for example,



Record, for example, less than 90°

Record, for example, less than a right angle.

Record, for example, acute angle

- ▶ Let's align the vertex of the angle with the centre of the protractor.
- ▶ Could we align one arm of the angle with one of the zero marks?
- ▶ Which arm could we align with this zero mark? Could we align the arm that is the leg of the chair with this zero mark? Or could we align the arm that is the rail of the chair with this zero mark?
- ▶ Does it matter which arm we align to the zero mark?
- ▶ Let's align the leg of the chair to the zero mark.
- ▶ Are we starting to measure the angle from the zero mark on the outside line or the inside line of the protractor?
- ▶ Because we're starting to measure the angle from the zero mark on the outside line of the protractor, we'll follow the outside line around to see what mark on the outside line of the protractor is the other arm – the rail – of the angle passing through.
- ▶ Is the other arm of the angle – the rail - passing through the 70 degree mark?
- ▶ What is our unit of measurement?
- ▶ Is our unit of measurement degrees?
- ▶ Is the symbol for degrees is a tiny circle, above the number?
- ▶ Today, you'll record the size of the angle using the word degrees and the symbol for degrees.
- ▶ So we measured the angle between the leg of the chair and the rail of the chair by aligning the zero mark with the leg of the chair.
- ▶ Do you think we'll get the same measurement of we align the rail of the chair with the zero mark?

- ▶ Was this angle less than 90 degrees?
- ▶ Was this angle less than a right angle?
- ▶ We call angles that are less than right angles, acute angles.

Select an angle that is greater than 90° , for example an angle on a chair,



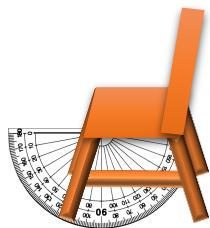
Children identify the arms and the vertex of the angle.
(NB: The wooden rail is technically called a stretcher.)

- ▶ Can you see any angles in the room that look like they are less than 90 degrees?
- ▶ Can you see any angles in the room that look like they are less than right angles?
- ▶ Can you see any other acute angles in the room?

- ▶ Let's measure another angle using our protractor.
- ▶ A chair has lots of interesting large angles - let's measure this large angle on the chair!
- ▶ Where are the arms of the angle?
- ▶ Is one arm, the seat of the chair?
- ▶ Is the other arm, the leg of the chair?
- ▶ Where is the vertex of the angle?
- ▶ Is the vertex where the two arms meet? Is the vertex where the seat meets the leg?

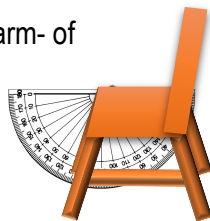
- ▶ Let's align the vertex of the angle with the centre of the protractor.
- ▶ Could we align one arm of the angle with one of the zero marks?
- ▶ Which arm could we align with this zero mark? Could we align the arm that is the seat of the chair with this zero mark? Or could we align the arm that is the leg of the chair with this zero mark?
- ▶ Does it matter which arm we align to the zero mark?
- ▶ Let's align the seat of the chair to the zero mark.
- ▶ Are we starting to measure the angle from the zero mark on the outside line or the inside line of the protractor?

Align the seat of the chair with the zero mark on the other end of the protractor, for example,



Point to the zero on the outside line of the protractor which is aligned to the seat of the chair.

Children identify which mark the other arm – the arm- of the angle is passing through – 115, for example,



Record, for example, 115.

Record, for example, 115 degrees.

Record, for example, 115°

Record, for example, greater than 90°

Record, for example, greater than a right angle.

Record, for example, obtuse angle

► Because we're starting to measure the angle from the zero mark on the outside line of the protractor, we'll follow the outside line around to see what mark on the outside line of the protractor is the other arm – the leg – of the angle passing through.

► Is the other arm of the angle – the leg - passing through the 115 degree mark?

► What is our unit of measurement?

► Is our unit of measurement degrees?

► Is the symbol for degrees is a tiny circle, above the number?

► Today, you'll record the size of the angle using the word degrees and the symbol for degrees.

► So we measured the angle between the seat of the chair and the leg of the chair by aligning the zero mark with the seat of the chair.

► Do you think we'll get the same measurement if we align the leg of the chair with the zero mark?

► Was this angle greater than 90 degrees?

► Was this angle greater than a right angle?

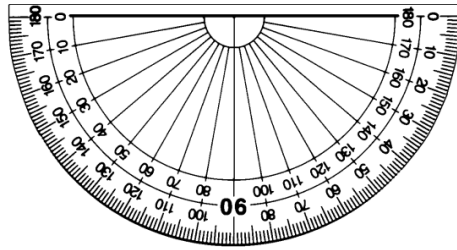
► We call angles that are greater than right angles, obtuse angles.

► Can you see any angles in the room that look like they are greater than 90 degrees?

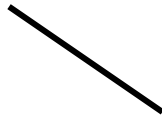
► Can you see any angles in the room that look like they are greater than right angles?

► Can you see any other obtuse angles in the room?

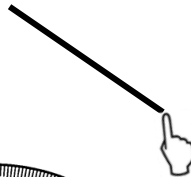
Display a protractor, for example,
Distribute protractors to children.



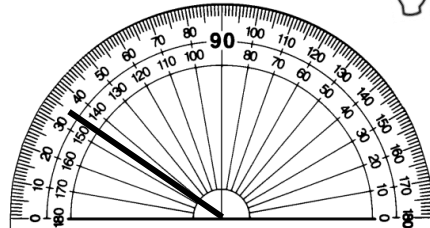
Draw one arm of the angle using a ruler, for example,



Select one end of the line to be the vertex of the angle,
for example,



Place the centre of the protractor over
the vertex of the angle, for example,



► So we have measured right angles, acute angles and obtuse angles with our protractor.

► **Let's investigate how we can construct an angle using the protractor.**

► Could we use a protractor to draw an angle that is 90 degrees?

► How many arms will our angle have?

► Will our angle have 2 arms?

► What will be the relative slant between the 2 arms?

► Will the relative slant be 90 degrees?

► Let's start by drawing one of the arms using our ruler.

► Does it matter how long our arm is?

► Does the length of the arm change the size of the angle at the vertex?

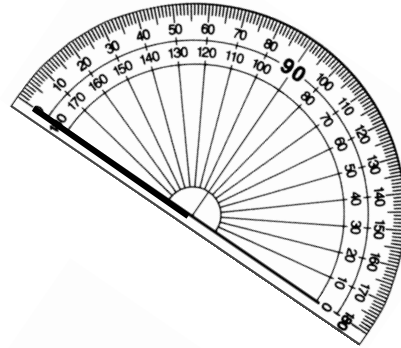
► Is the vertex of the angle the same, no matter how long the arms are?

► 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?

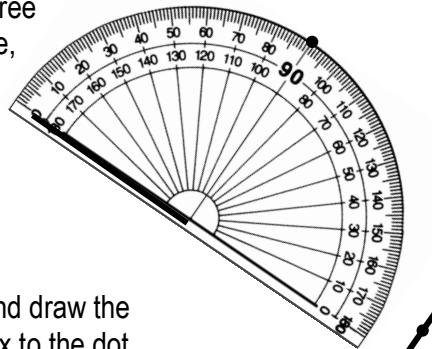
► Let's make this end of the line the vertex of our angle.

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

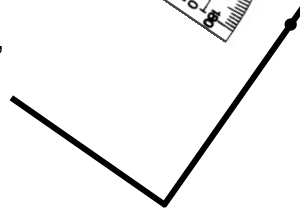
Align the arm of the angle with a zero mark on the protractor, for example,



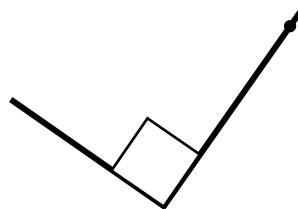
Put a dot on the paper where 90 degree mark is on the protractor, for example,



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

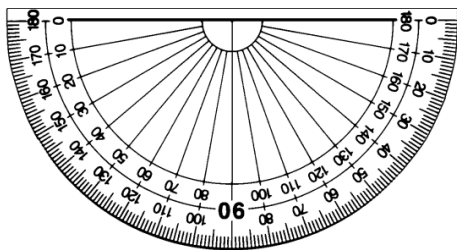


Draw a square in the angle to show that it is a right angle, for example,

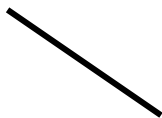


- ▶ Just like when we measured angles, will we align this arm of the angle with one of the zero marks?
 - ▶ Did we align the arm with the zero mark on the inside or the outside line on the protractor?
 - ▶ Did we align the zero mark with the outside line?
 - ▶ Because we aligned the zero mark with the outside line, will we follow the outside line around to 90 degrees?
 - ▶ Could we place a dot next to the 90 degree mark on the protractor?
-
- ▶ Now that we know where 90 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 90 degrees?
-
- ▶ Is this a right angle?
 - ▶ Do we have a symbol that we draw in the angle to show that it is a right angle?
 - ▶ Do we draw a square in the angle?

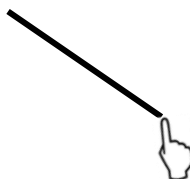
Display a protractor, for example,
Distribute protractors to children.



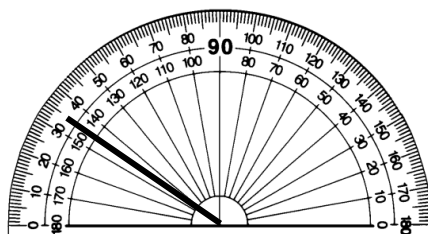
Draw one arm of the angle using a ruler, for example,



Select one end of the line to be the vertex of the angle, for example,



Place the centre of the protractor or vertex of the angle, for example,

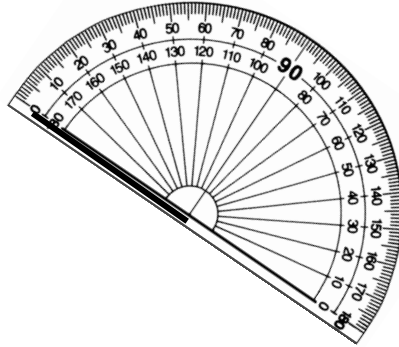


- ▶ Let's investigate how we can construct an acute angle using the protractor.
- ▶ How many arms will our angle have?
- ▶ Will our angle have 2 arms?
- ▶ What will be the relative slant between the 2 arms?
- ▶ Will the relative slant be less than 90 degrees?

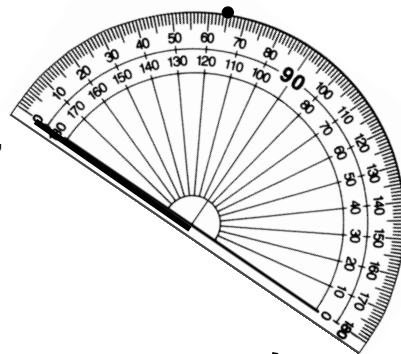
- ▶ Let's start by drawing one of the arms using our ruler.
- ▶ Does it matter how long our arm is?
- ▶ Does the length of the arm change the size of the angle at the vertex?
- ▶ Is the vertex of the angle the same, no matter how long the arms are?
- ▶ Where will the vertex of our angle be? Will the 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?

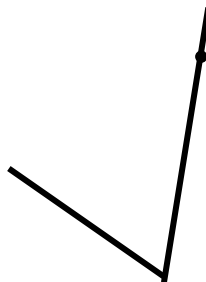
Align the arm of the angle with a zero mark on the protractor, for example,



Put a dot on the paper where 65 degree mark is on the outside line of 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,



▶ Just like when we measured angles, will we align this arm of the angle with one of the zero marks?

▶ So we want to draw an acute angle – an angle that is less than 90 degrees.

▶ How many degrees could we have?

▶ Is 65 degrees less than 90 degrees?

▶ Did we align the arm with the zero mark on the inside or the outside line on the protractor?

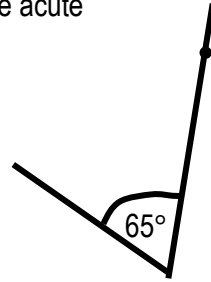
▶ Did we align the zero mark with the outside line?

▶ Because we aligned the zero mark with the outside line, will we follow the outside line around to 65 degrees?

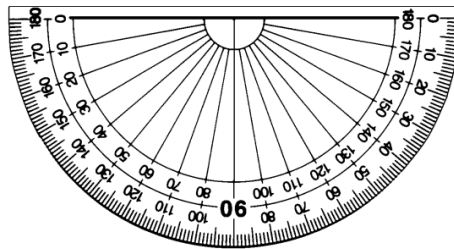
▶ Could we place a dot next to the 65 degree mark on the protractor?

▶ Now that we know where 65 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?

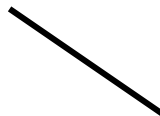
Draw a square in the angle to show the size of the acute angle, for example,



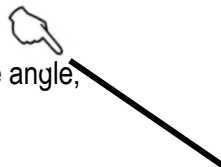
Display a protractor, for example,
Distribute protractors to children.



Draw one arm of the angle using a ruler, for example,

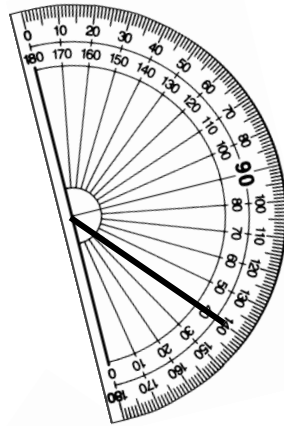


Select one end of the line to be the vertex of the angle, for example,

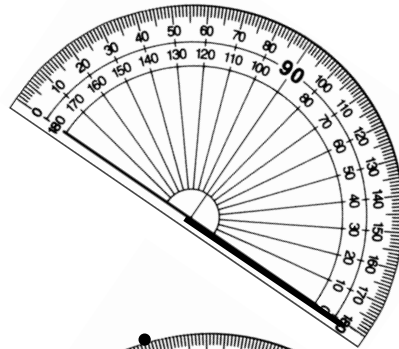


- ▶ Did we construct an angle that is 65 degrees?
 - ▶ Is this an acute angle?
 - ▶ We don't have a special symbol that we draw in the angle to show that it is an acute angle, so we just record the size of the angle in part of a circle.
-
- ▶ Let's investigate how we can construct an obtuse angle using the protractor.
 - ▶ How many arms will our angle have?
 - ▶ Will our angle have 2 arms?
 - ▶ What will be the relative slant between the 2 arms?
 - ▶ Will the relative slant be greater than 90 degrees?
-
- ▶ Let's start by drawing one of the arms using our ruler.
 - ▶ Does it matter how long our arm is?
 - ▶ Does the length of the arm change the size of the angle at the vertex?
 - ▶ Is the vertex of the angle the same, no matter how long the arms are?
 - ▶ 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.

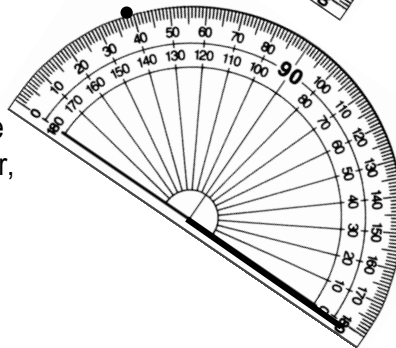
Place the centre of the protractor on the vertex of the angle, for example,



Align the arm of the angle with a zero mark on the protractor, for example,



Put a dot on the paper where 142 degree mark is on the inside line of the protractor, for example,



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

► Just like when we measured angles, will we align this arm of the angle with one of the zero marks?

► So we want to draw an obtuse angle – an angle that is greater than 90 degrees.

► How many degrees could we have?

► Is 142 degrees greater than 90 degrees?

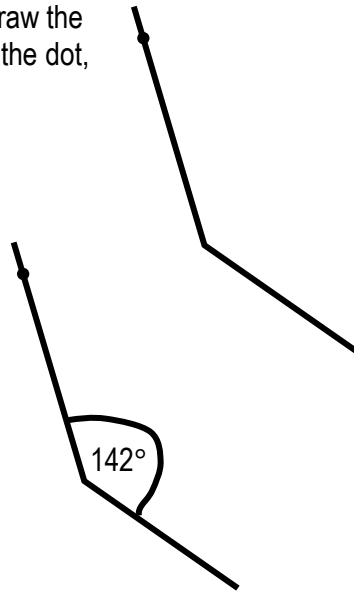
► Did we align the arm with the zero mark on the inside or the outside line on the protractor?

► Did we align the zero mark with the inside line?

► Because we aligned the zero mark with the inside line, will we follow the inside line around to 142 degrees?

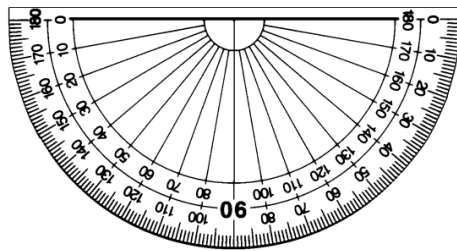
► Could we place a dot next to the 142 degree mark on the protractor?

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

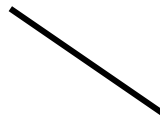


Draw a square in the angle to show the size of the obtuse angle, for example,

Display a protractor, for example,
Distribute protractors to children.



Draw one arm of the angle using a ruler, for example,



► Now that we know where 142 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 142 degrees?

► Is this an obtuse angle?

► We don't have a special symbol that we draw in the angle to show that it is an obtuse angle, so we just record the size of the angle in part of a circle.

► Let's investigate how we can construct a straight angle using the protractor.

► A straight angle looks like a straight line!

► How many arms will our angle have?

► Will our angle have 2 arms?

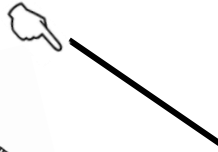
► Let's start by drawing one of the arms using our ruler.

► Does it matter how long our arm is?

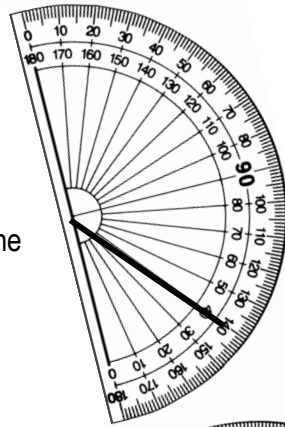
► Does the length of the arm change the size of the angle at the vertex?

► Is the vertex of the angle the same, no matter how long the arms are?

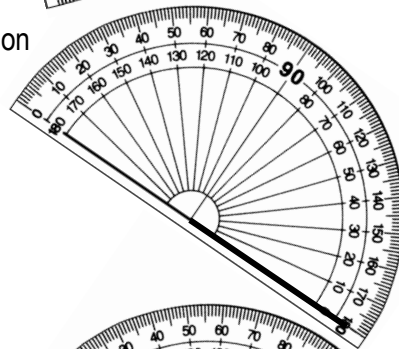
Select one end of the line to be the vertex of the angle, for example,



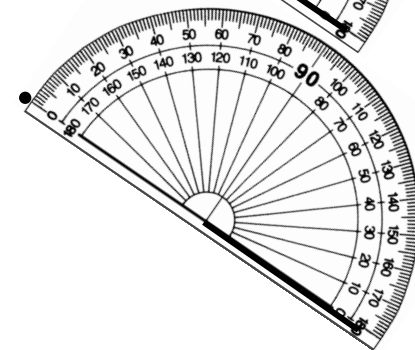
Place the centre of the protractor on the vertex of the angle, for example,



Align the arm of the angle with a zero mark on the protractor, for example,



Indicate all the way around the protractor to 180 degrees, for example,



Put a dot on the paper where 180 degree mark is on the inside line of the protractor, for example,

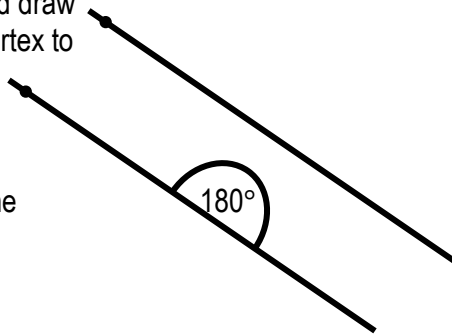
- ▶ Where will the vertex of our angle be? Will the vertex be at this end of the line, or this end of the line? Can we choose either end to be our vertex?
- ▶ Let's make this end of the line the vertex.

- ▶ Because this is the vertex of our angle, will the centre of the protractor go here?

- ▶ Let's align this arm of the angle with one of the zero marks.

- ▶ So we want to draw a straight angle – an angle that is like a straight line.
- ▶ How many degrees would we have?
- ▶ To make a straight line, would we go all the way around the protractor to 180 degrees?
- ▶ If we now join the vertex of our angle to the dot at 180 degrees, will we have a straight angle??
- ▶ Could we place a dot next to the 180 degree mark on the protractor?

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

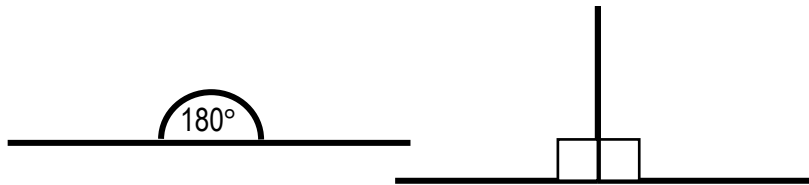


Draw a square in the angle to show the size of the straight angle, for example

Display a right angle and a straight angle, for example,



Display a right angle and a straight angle, for example,



► Now that we know where 180 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 180 degrees?

► Is this a straight angle?

► We don't have a special symbol that we draw in the angle to show that it is a straight angle, so we just record the size of the angle in part of a circle.

► Let's investigate the relationship between a straight angle and a right angle.

► How many right angles in a straight angle?

► This is one right angle.

► And this is one straight angle.

► If we had another right angle on the other side, would we have a straight angle?

► Is a straight angle, the same size as 2 right angles?

► How many degrees in a right angle?

► Are there 90 degrees in a right angle?

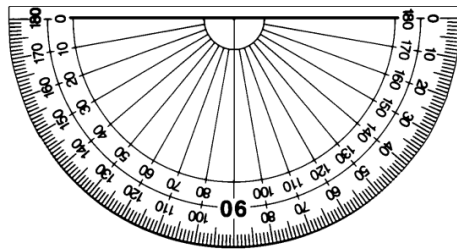
► How many degrees in a straight angle?

► Are there 180 degrees in a straight angle?

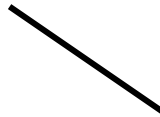
► Is 180, 2 times 90?

► Is a straight angle, 2 right angles?

Display a protractor, for example,
Distribute protractors to children.



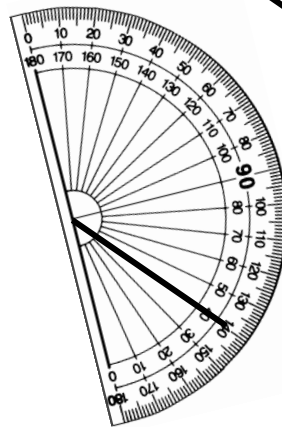
Draw one arm of the angle using a ruler, for example,



Select one end of the line to be the vertex of the angle,
for example,

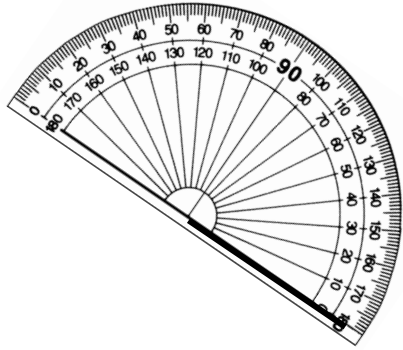


Place the centre of the protractor on the
vertex of the angle, for example,

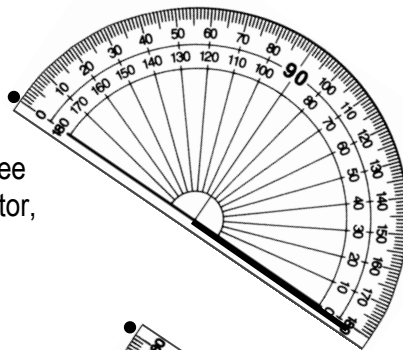


- ▶ Let's investigate angles that are greater than a straight line.
 - ▶ These angles are called reflex angles.
 - ▶ A reflex angle is greater than 180 degrees but less than a revolution.
 - ▶ Let's investigate how we can construct a reflex angle using the protractor.
 - ▶ How many arms will our angle have?
 - ▶ Will our angle have 2 arms?
 - ▶ What will be the relative slant between the 2 arms?
 - ▶ Will the relative slant be greater than 180 degrees?
-
- ▶ Let's start by drawing one of the arms using our ruler.
 - ▶ Does it matter how long our arm is?
 - ▶ Does the length of the arm change the size of the angle at the vertex?
 - ▶ Is the vertex of the angle the same, no matter how long the arms are?
 - ▶ 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?

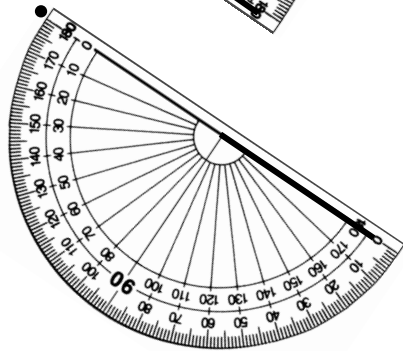
Align the arm of the angle with a zero mark on the protractor, for example,



Put a dot on the paper where 180 degree mark is on the inside line of the protractor, for example,



Move the protractor out of the way, for example,



▶ Just like when we measured angles, will we align this arm of the angle with one of the zero marks?

▶ So we want to draw a reflex angle – an angle that is greater than 180 degrees.

▶ How many degrees could we have?

▶ Is 242 degrees greater than 180 degrees?

▶ Now we have some problematic knowledge!

▶ We want to construct an angle that is 242 degrees, but our protractor only goes up to 180 degrees.

▶ We could go and buy a protractor that is a full circle that goes up to 360 degrees, but I wonder if we could somehow use this protractor that only goes up to 180 degrees.

▶ We know that there are 180 degrees in a straight angle.

▶ Could we put a dot on the paper next to the 180 degrees, then move the protractor to add on the extra degrees?

▶ Let's place a dot next to the 180 degree mark on the protractor.

▶ Now that we know where 180 degrees is, could we move the protractor out of the way?

▶ So we have one arm of our angle, and a dot at 180 degrees.

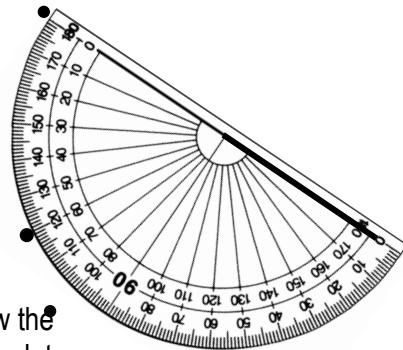
▶ We want to construct an angle that is 242 degrees.

▶ How many more degrees do we need?

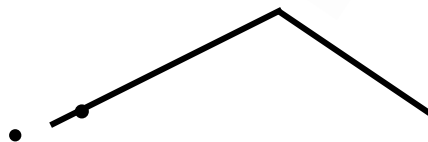
▶ Do we need 62 more degrees?

Rotate the protractor and align the vertex of the angle with the centre of the protractor and the zero with the dot that we placed at 180 degrees, for example,

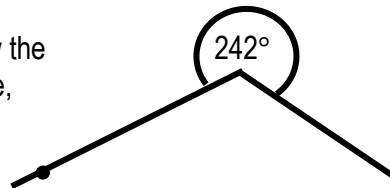
Place a dot next to the 62 degree mark on the protractor, for example,



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

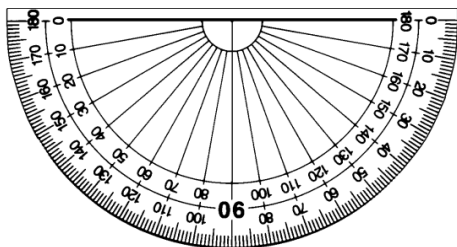


Draw a square in the angle to show the size of the reflex angle, for example,

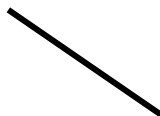


- ▶ Could we rotate the protractor, and add on the extra 62 degrees?
 - ▶ Let's rotate the protractor and align the vertex of the angle with the centre of the protractor and the zero with the dot that we placed at 180 degrees, because we're adding 62 degrees to 180 degrees.
 - ▶ Did we align the dot with the zero mark on the inside or the outside line on the protractor?
 - ▶ Did we align the zero mark with the inside line?
 - ▶ Because we aligned the zero mark with the inside line, will we follow the inside line around to 62 degrees?
 - ▶ Could we place a dot next to the 62 degree mark on the protractor?
-
- ▶ Now that we know where 62 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 242 degrees?
 - ▶ Is this a reflex angle?
 - ▶ We don't have a special symbol that we draw in the angle to show that it is a reflex angle, so we just record the size of the angle in part of a circle.

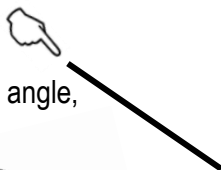
Display a protractor, for example,
Distribute protractors to children.



Draw one arm of the angle using a ruler, for example,



Select one end of the line to be the vertex of the angle,
for example,

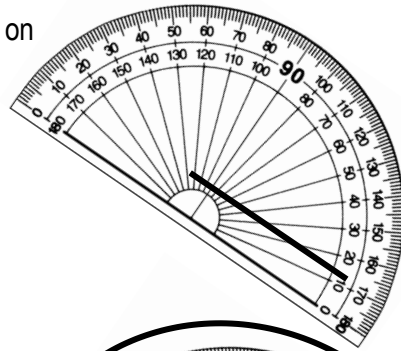


Place the centre of the protractor on the
vertex of the angle, for example,

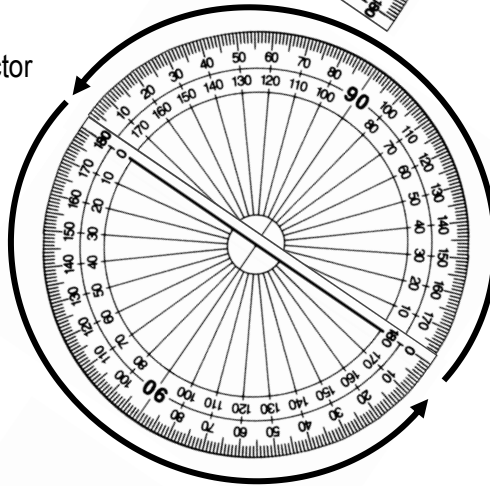


- ▶ Let's investigate how we can construct a revolution using the protractor.
- ▶ A revolution means we have gone all of the way around in a circle!
- ▶ How many arms will our angle have?
- ▶ Will our angle have 2 arms?
- ▶ Let's start by drawing one of the arms using our ruler.
- ▶ Does it matter how long our arm is?
- ▶ Does the length of the arm change the size of the angle at the vertex?
- ▶ Is the vertex of the angle the same, no matter how long the arms are?
- ▶ 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?

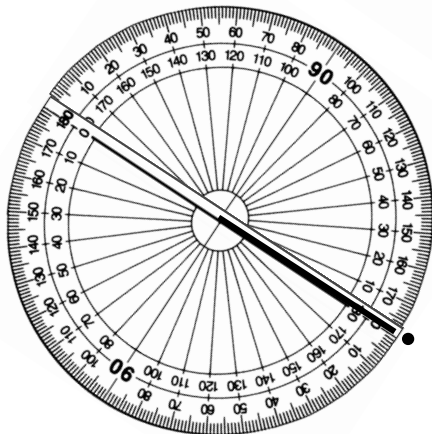
Align the arm of the angle with a zero mark on the protractor, for example,



Indicate all the way around the protractor to 180°, for example,



Place the protractor and indicate all the way around the other side of the protractor to 180°, for example,



Place a dot where 360° is, for example,

► Let's align this arm of the angle with one of the zero marks.

► So we want to draw a revolution – an angle that goes all the way around in a circle.

► How many degrees would we have?

► If we go half way around the circle, how many degrees do we have?

► Do we have 180 degrees?

► If we then go around the other half of the circle, how many degrees do we have?

► Do we have another 180 degrees?

► Do we have 180 degrees in each half of the circle?

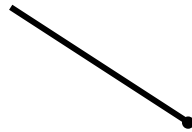
► How many degrees do we have if we go all the way around in a circle – a revolution?

► Do we have 360 degrees?

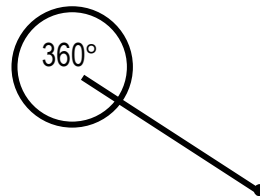
► Could we place a dot next to where we have 360 degrees?

► Now that we know where 360 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?

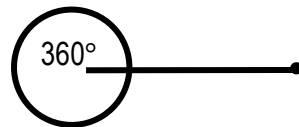
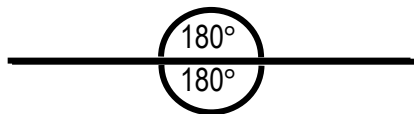
Move the protractor out of the way and draw the other arm of the angle from the vertex to the dot, for example,



Draw a circle in the angle to show the size of the revolution, for example



Display a straight angle and a revolution, for example,



Record, for example, straight angle = 180°

Record, for example, revolution = 360°

Record, for example, 2 straight angles = 1 revolution

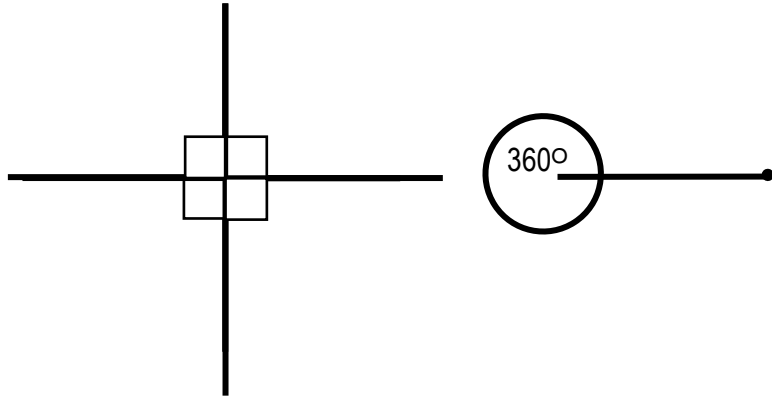
- ▶ Does this arm go on top of the other arm?
- ▶ So when we complete 1 revolution are we back where we started from?
- ▶ Is 360 degrees and zero degrees in the same place?
- ▶ How can we show that we have a revolution?
- ▶ Did we construct an angle that is 360 degrees?
- ▶ Is this a revolution?

- ▶ We don't have a special symbol that we draw in the angle to show that it is a revolution, so we just record the size of the angle in part of a circle.

- ▶ Let's investigate the relationship between a revolution and a straight angle.
- ▶ We know that a straight angle is the same size as 2 right angles.
- ▶ How many straight angles in a revolution?
- ▶ When the angle has gone half way around in a circle, we have a straight angle. When the angle goes the other half of the way around in a circle, we have a revolution.
- ▶ Are there 2 straight angles in a revolution?
- ▶ How many degrees in a straight angle?
- ▶ Are there 180 degrees in a straight angle?
- ▶ How many degrees in a revolution?
- ▶ Are there 360 degrees in a revolution?
- ▶ Is 360, 2 times 180?

- ▶ Let's investigate the relationship between a revolution and a right angle.
- ▶ We know that if we have 2 right angles we have a straight angle.

Display a right angle and a straight angle, for example,



- ▶ If we have 2 more right angles, we have 2 straight angles, which is a revolution.
- ▶ Are there 4 right angles in a revolution?
- ▶ How many degrees in a revolution?
- ▶ Are there 360 degrees in a revolution?
- ▶ How many degrees in a right angle?
- ▶ Are there 90 degrees in a right angle?
- ▶ Is 360, 4 times 90?