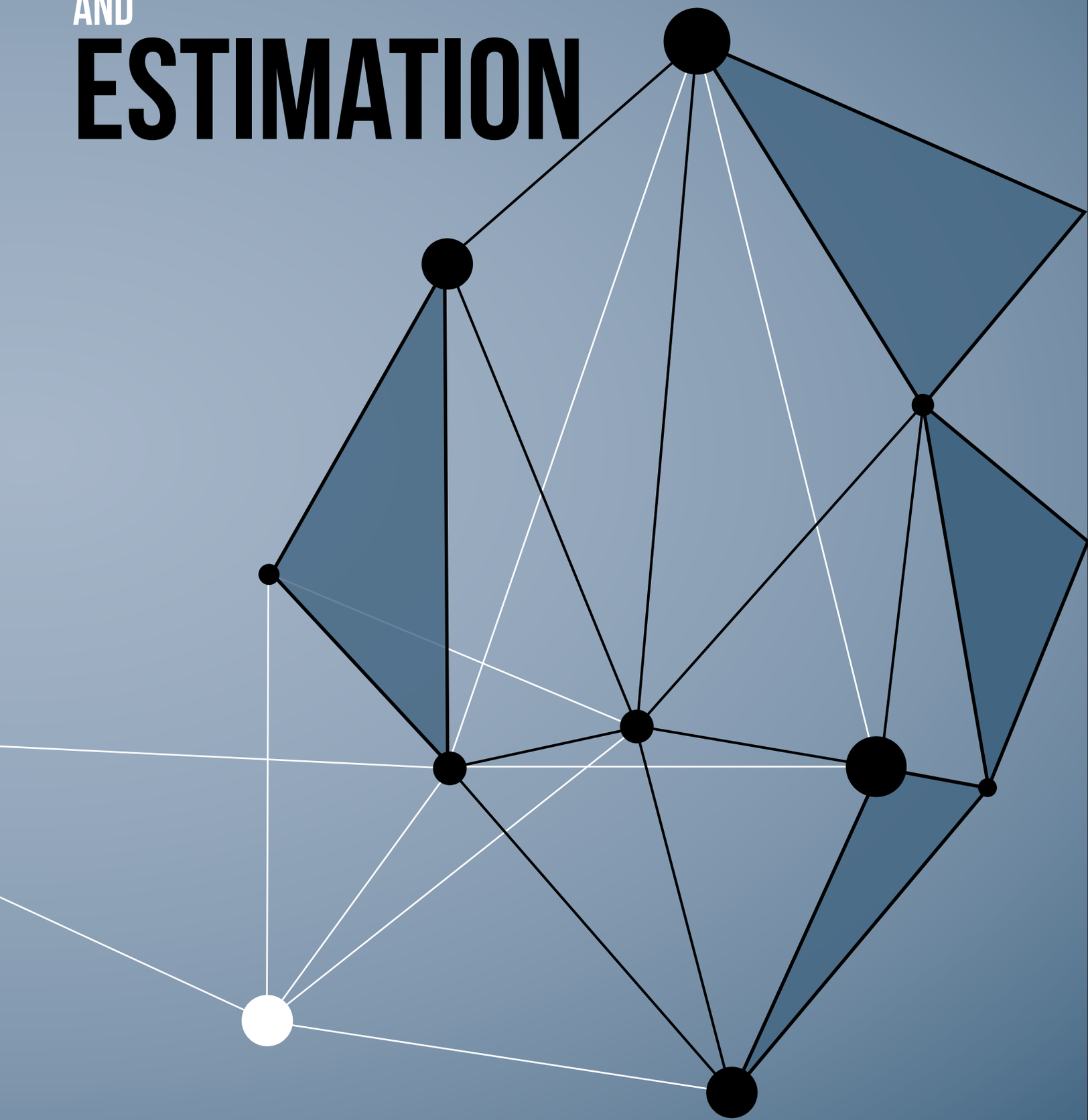
MEASURING, SCALE AND ESTIMATION



NAME:_____ CLASS:_____

WHY WE MEASURE STUFF...

Knowing the size of objects or spaces is critically important to designers and engineers. If we don't understand the size of things, we cannot design new parts or manufacture things we need.

It is **essential** that you learn how to measure things correctly.

In this unit you will learn about measuring and marking things accurately. This will be an important skill to master before manufacturing any project or creating any engineering drawing.

Practice these skills and start measuring anything around you!

REMEMBER YOUR UNITS

There are different units used by designers and engineers. The units you use will be largely determined by what country you work in. Much of the world use 'metric' units, whilst designers and engineers in the United States of America (USA), use 'Imperial' units. Here in the UK, we tend to use both(!), depending on what you are doing...

METRIC UNITS

All of your school work will be based on 'metric' units, which is based on the French "Système international d'unités". This is based on a decimal system and is the system used in science too.

UNIT RELATIONSHIPS

10mm = 1cm

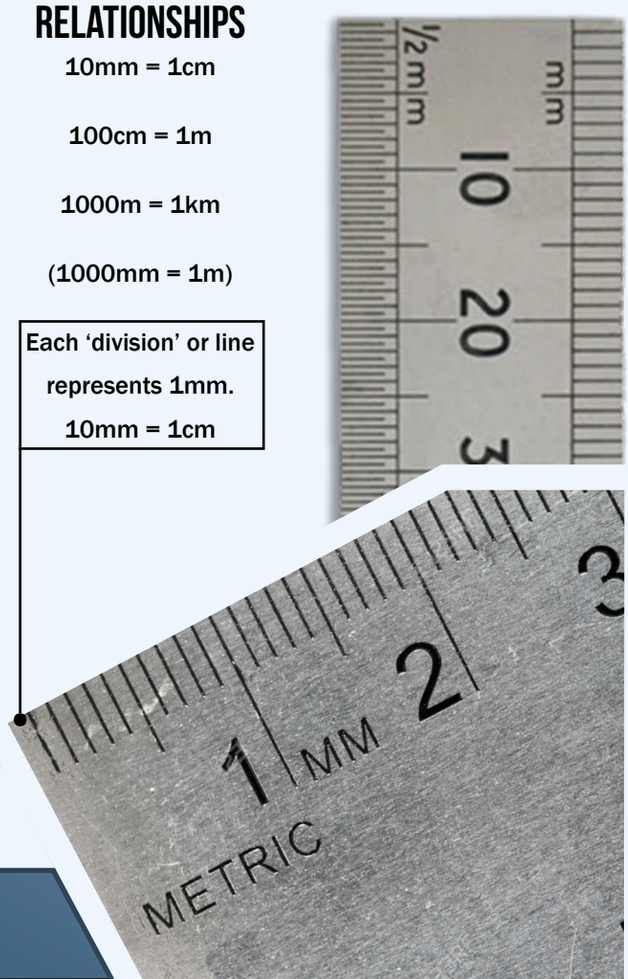
100cm = 1m

1000m = 1km

(1000mm = 1m)

Each 'division' or line represents 1mm. 10mm = 1cm

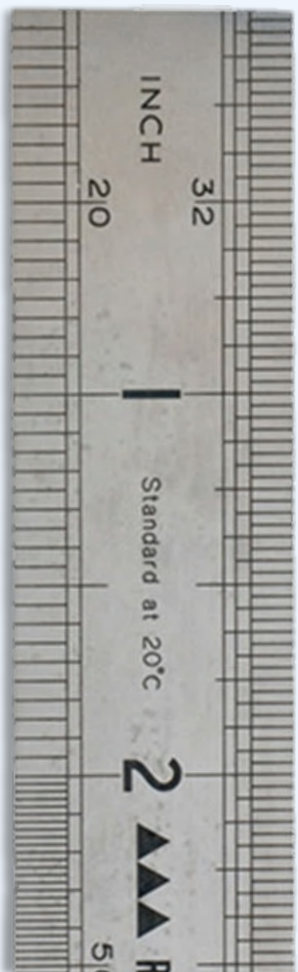
METRIC RULE



IMPERIAL UNITS

'Imperial' units are more traditional and originated in England. The history of how these units were determined has been lost to the past. These units are not based on decimals, but fractions of units.

IMPERIAL RULE



UNIT RELATIONSHIPS

12 inch = 1 foot

3 feet = 1 yard

1760 yards = 1 mile

(5280 feet = 1 mile)

Each 'division' using an Imperial scale represents a fraction of an inch. Common fractions include:

$^1/_2$

$^1/_4$

$^1/_8$

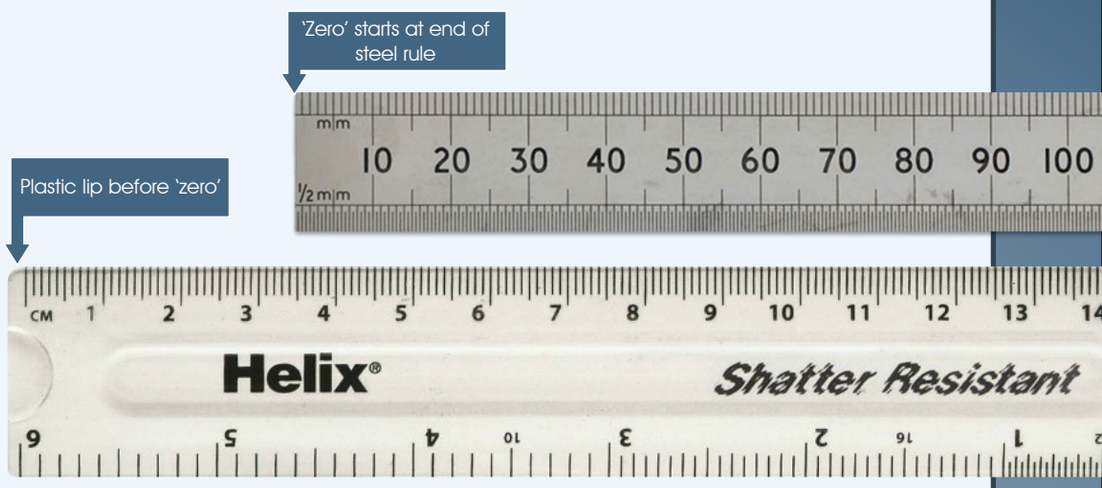
$^1/_{16}$

RULES VS. RULERS

You will be very familiar with ‘rulers’ and have probably used them to measure items.

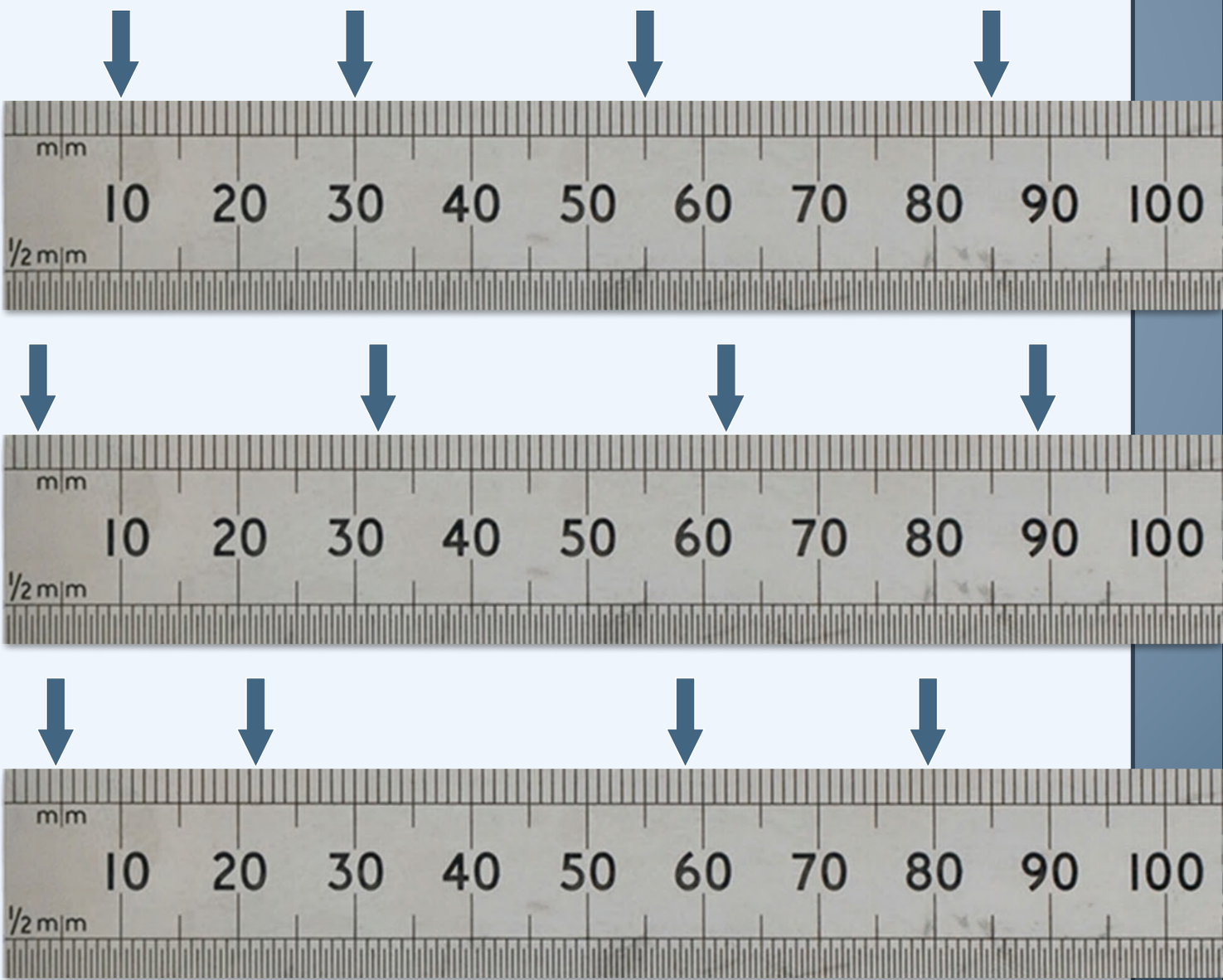
Rulers always have a small plastic lip before the ‘zero’ marker.

‘Rules’ measure from the very end, with no ‘zero’ to line up.



READ THESE UNITS

Three ‘Steel Rules’ are shown below, with arrows pointing to different values. Carefully read where the arrows are pointing to on the steel rule and write down the value next to the arrow.



TEACHER CHECK

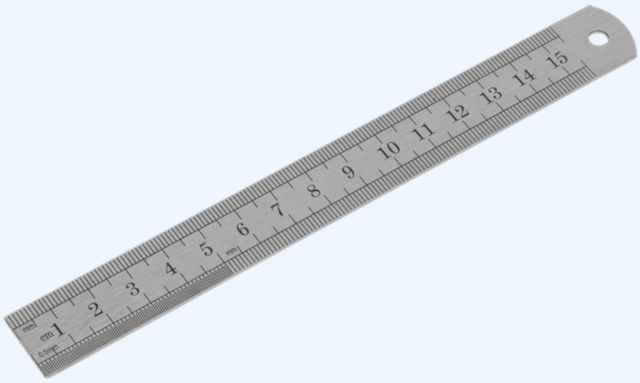
MEASURING TOOLS...

Designers and engineers use different tools for measuring materials or spaces. Each tool has unique advantages and disadvantages and an engineer must know which tool would be the most appropriate in any situation.

There are a wide range of measuring tools. Four of the most common tools are shown below.

Can you think of any other tool for measuring the size of an object of space?

_____



TOOL ONE

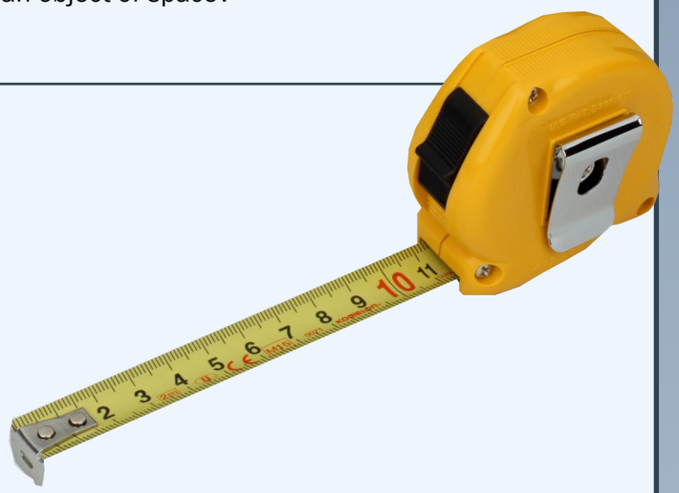
State the name of this tool:

_____

Explain the purpose of this tool:

_____

_____



TOOL TWO

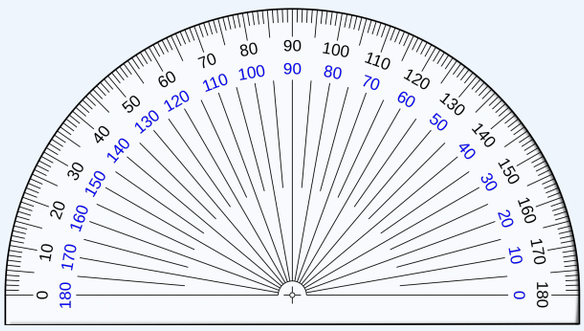
State the name of this tool:

_____

Explain the purpose of this tool:

_____

_____



TOOL THREE

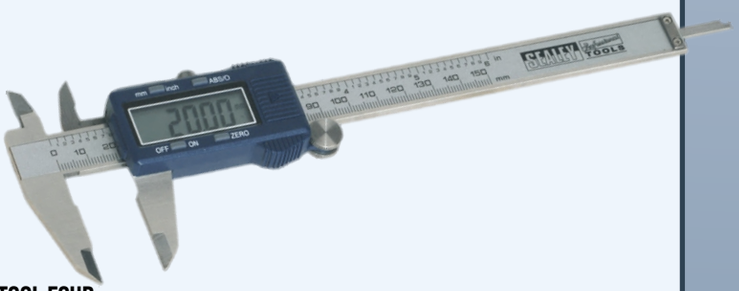
State the name of this tool:

_____

Explain the purpose of this tool:

_____

_____



TOOL FOUR

State the name of this tool:

_____

Explain the purpose of this tool:

_____

_____

MEASURE THESE...

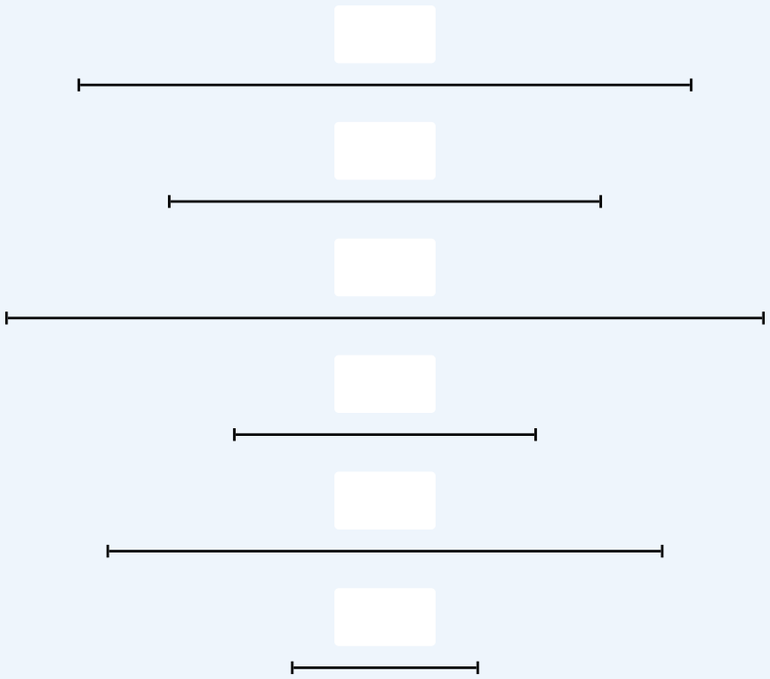
Being able to accurately measure lengths and angles is a critical skill for any designer or engineer.

The best way to learn this skill is to routinely practice!

LINEAR MEASUREMENT

Use a Steel Rule and measure the length of each line and write the value in the box.

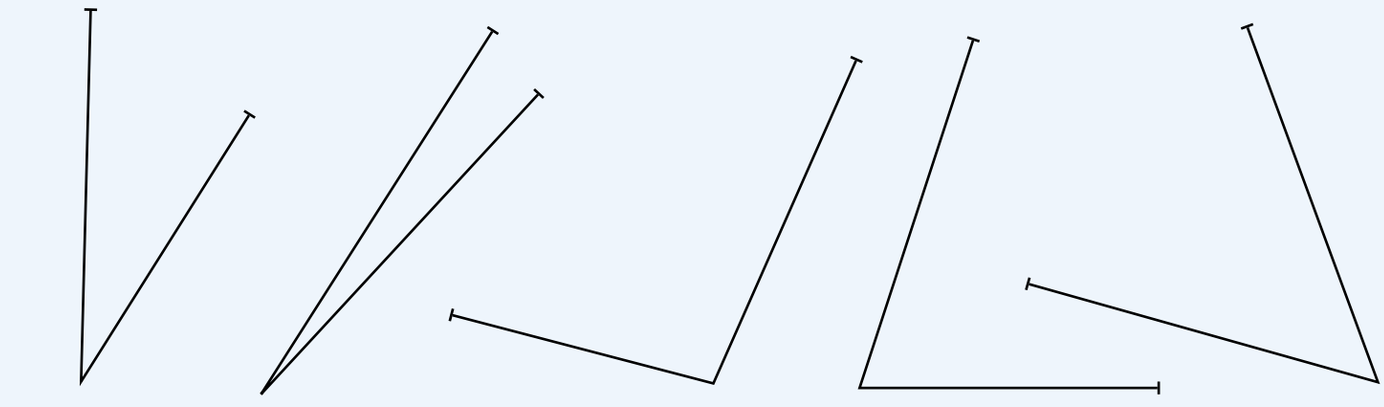
Your answer must be in millimetres (MM).



ANGULAR MEASUREMENT

Use a protractor and measure the angle between these lines and write the and in the box.

For practice, you my also want to measure the length of each line.



TEACHER CHECK

MARKING ON WOOD...

Wood is a material we use frequently to manufacture products. It is environmentally friendly, easy to mark, shape and finish and it is also possible to make things to very precise sizes.

We use a wide range of tools to accurately mark wood for cutting and shaping, and you will be shown these in a later project. One tool we frequently use is the Steel Rule.

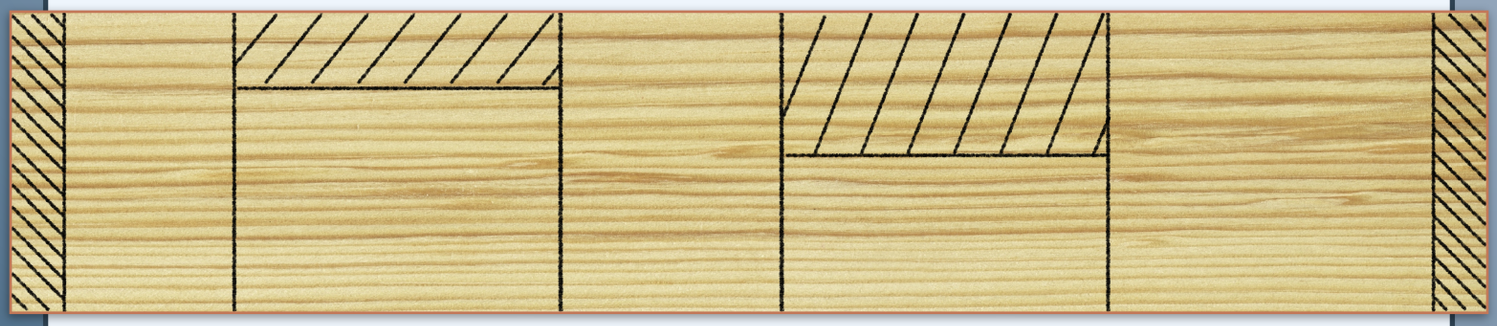
Three lengths of wood are shown below. Each piece of wood has been marked into sections that will be cut. Each section has a small gap called a ‘kerf’, which is where a saw will cut the material - a gap is required as a saw blade has a thickness.

Measure and record each length of every section of wood. Be as precise as possible.

MATERIAL 1

MATERIAL 2

MATERIAL 3



MARKING ON WOOD...

Mark on these strip of wood to required sizes. Remember a gap for your saw every time!

Three parts 40mm in length.

Two parts 25mm, one part 50mm and one part 60mm.

One part 68mm, one part 36mm and one part 41mm.

Four parts 32.5mm in length.

TEACHER CHECK

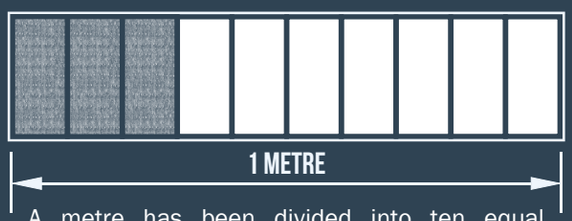
ESTIMATE STUFF...

Designers and engineers will sometimes need to make ‘estimates’. An estimate can best be thought of as an ‘educated guess’; your estimates tend to become better the more experience you have. Designers and engineers will often make estimates as a fraction of well-known size. Most people are comfortable with the size of a ‘metre’, so may ask for “half-a-meter”, for example.

Making estimations can be difficult and you will frequently be wrong, so do not worry! However, the best way to become better at estimation is to practice and then check to see if you were correct. For instance, how many steps does it take to get from your bedroom to your front door - take an educated guess and check when you get home.

Here, we have a metre divided into different parts. We can then divide this unit into smaller equal parts - fractions. This can make estimate of size much easier to do.

A metre has been divided into three equal segments. One segment has been shaded. We can say 1/3 (one-third of a meter or 33.3cm, or 333mm)



A metre has been divided into ten equal segments. Three segments have been shaded. We can say 3/10 (three-tens of a meter or 30cm, or 300mm)

MAKING ESTIMATES

Practicing making estimates is a useful. Shade the following boxes by required amount.

Shade nine-tenths (9/10) of this box.

Shade four-fifths (4/5) of this box.

Shade half (1/2) of this box.

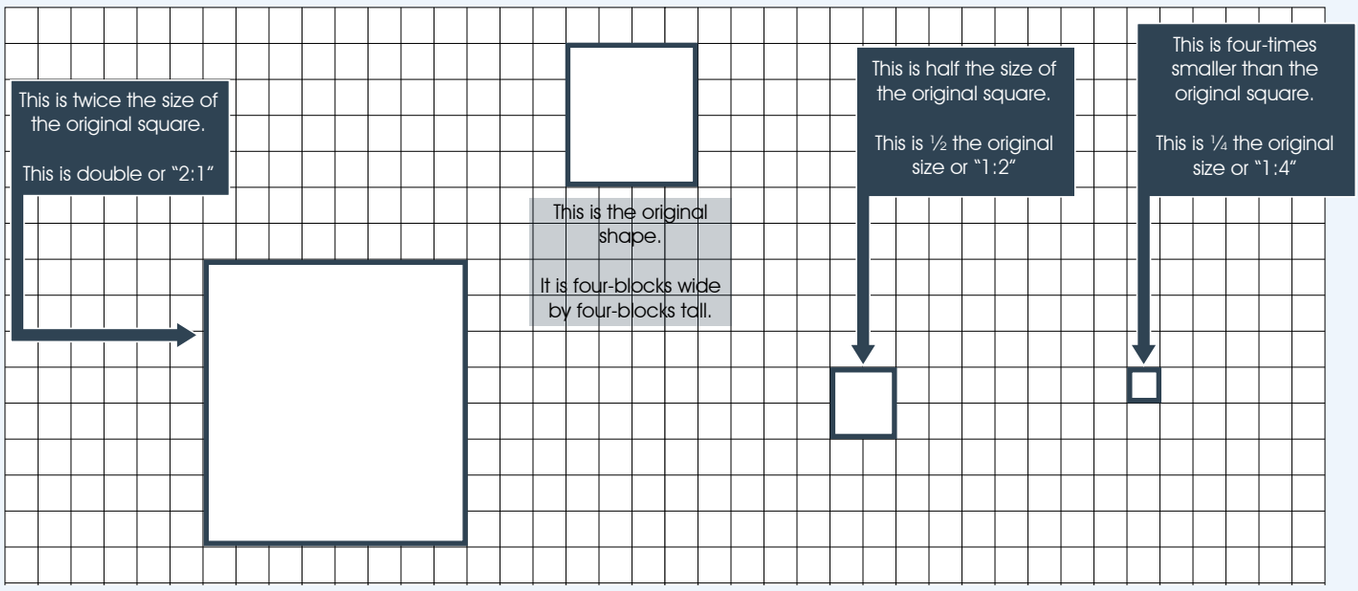
Shade one-quarter (1/4) of this box.

Shade one-sixth (1/6) of this box.

Shade three-fifths (3/5) of this box.

SCALE...

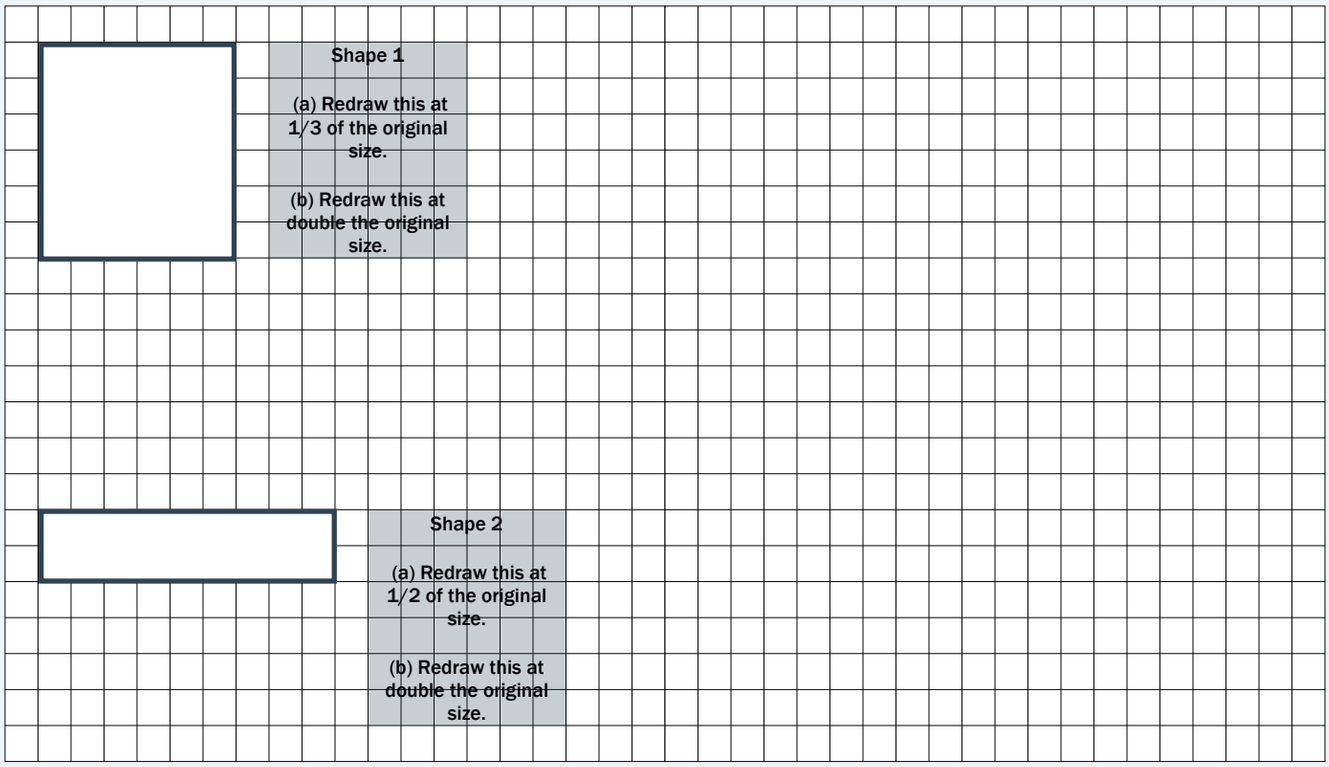
Sometimes, something we want to draw - such as a room or a building - would be too big to fit on a single piece of paper. To solve this problem we can draw things at a different scale. This means drawing a shape bigger or smaller by a set value; drawing something twice as big, or half-size, for example.



DRAWING TO DIFFERENT SCALE

Drawing at scale is an important skill.

Redraw these shapes by the stated scale.

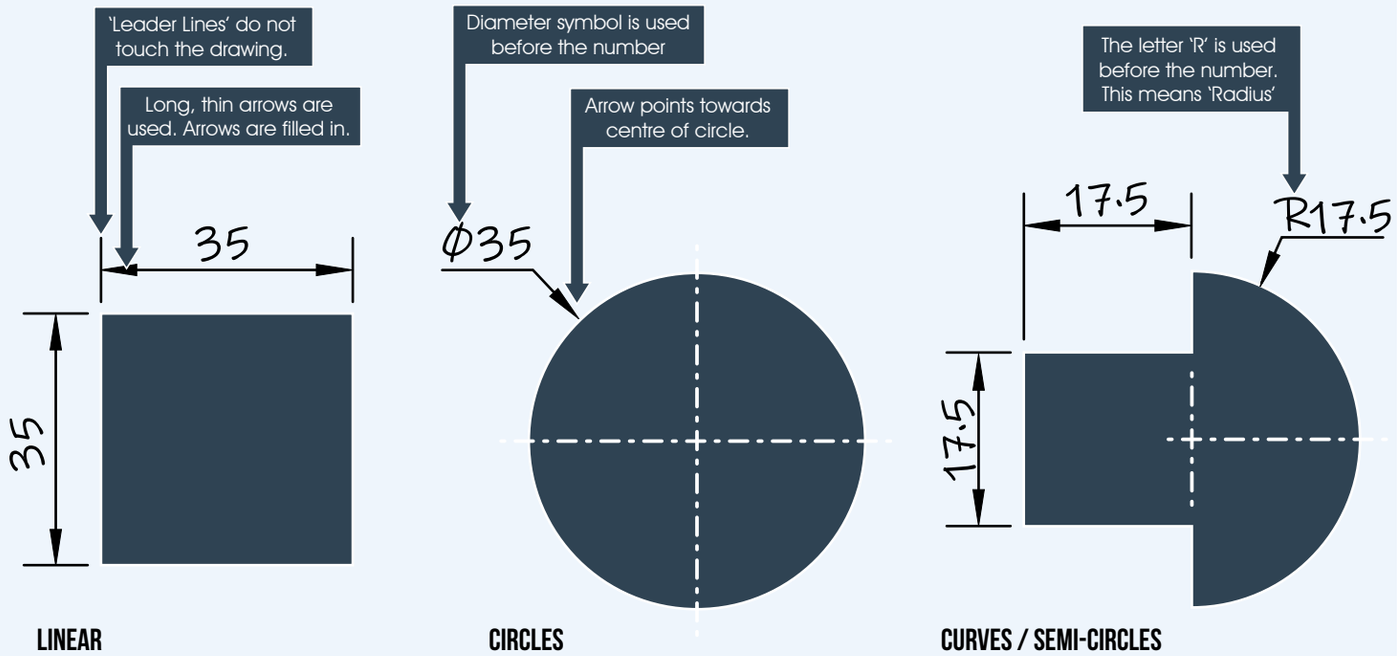


TEACHER CHECK

ADDING SIZES TO SKETCHES & DRAWINGS

Designers and engineers need to communicate sizes on sketches and drawings. To avoid any confusion, it is important that sizes of parts are clearly.

To make sure sizes are clear, a standard, common method is used to show sizes. These standard 'rules' must be followed when recording sizes. In the UK, we follow British Standards Institute rules, "B.S.8888".



LINEAR

Small lines, called 'leader lines', come away from the drawing, but do not touch.

These are connected with a line with long,thin arrows at either end.

The size is written above this line.

CIRCLES

Circles are measured as a 'diameter' - a measurement from one edge of the circle to the other, passing through the centre.

An arrow points towards the centre of the circle and the diameter symbol Ø is used.

CURVES / SEMI-CIRCLES

Curves, semi-circles and arcs are measured as a 'radius'. A measurement from the centre of the curve is taken (Which means it is half a diameter!)

An arrow points towards the centre of the curve and the letter 'R' is used before the number.

QUESTIONS

a. **Explain** why designers and engineers use the same technique to apply sizes to sketches and drawings.

_____

_____

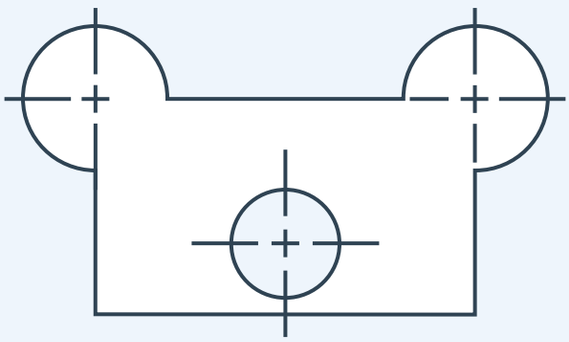
b. **Describe** two techniques that can be used to make sketches with dimensions clear to a person reading them.

_____

_____

APPLYING DIMENSIONS TO BRITISH STANDARDS...

Measure these shapes and apply the dimensions to the drawings, using your understanding of British Standards.



TEACHER CHECK

the DESIGN class

COURSE NOTES V2.0