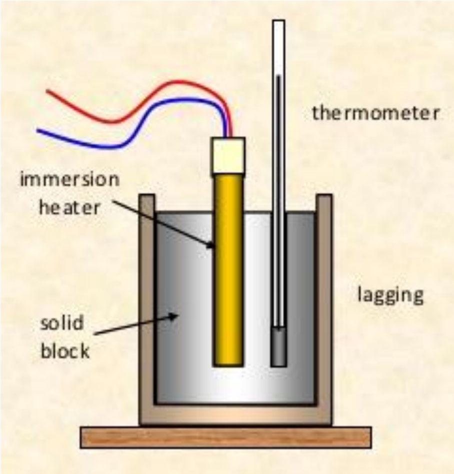
GCSE Combined Science Physics Set Practicals

There may be exam questions on these practicals

Remember Exam Paper 1 covers Topics 1 to 4, Exam Paper 2 covers topics 5 to 7

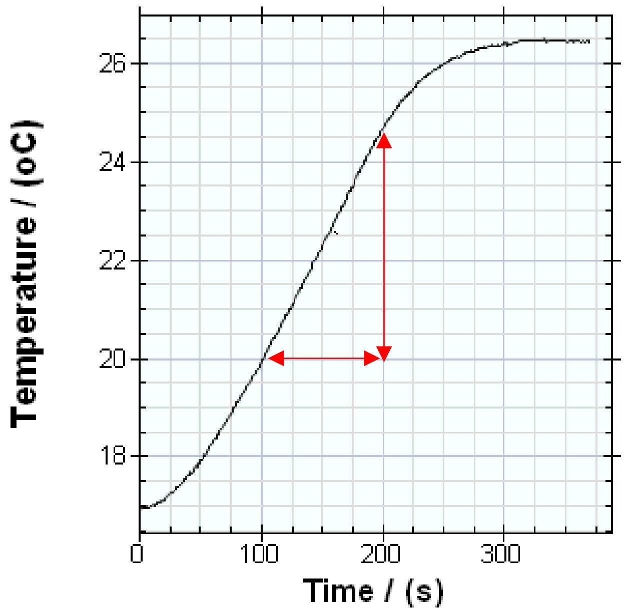
| Practical | Topic |
|---|---|
| 14 Determination of the **specific heat capacity** of one or more materials | 1 |
| 15 Investigation of the factors affecting **resistance of wires** in electric circuits | 2 |
| 16 Investigation of the **voltage v current characteristics** of wires at constant temperature, filament lamps and diodes | 2 |
| 17 Use appropriate measurements to **determine the densities** of regular and irregular-shaped objects and liquids | 3 |
| 18. Investigate the relationship between **force and extension of a spring** | 5 |
| 19. Investigate the effect of varying the force on acceleration of an object of constant mass and the effect of varying the mass on acceleration of an object subjected to a constant force, in other words **Newton's 2nd law** | 5 |
| 20. Make suitable measurements to determine the **speed of water waves** in a ripple tank | 6 |
| 21. Investigate how the amount of **infra red radiation absorbed or emitted** by a surface depends on the nature of the surface | 6 |

14 Determination of the specific heat capacities of some metals




A 20 Watt electric immersion heater heats a 1kg block of metal and the temperature of the metal is measured every minute for 20 minutes.

A graph of temperature v time is drawn, a typical graph for copper is :-




0 2000 4000 6000

Energy / J

Because Energy = Power x Time, we know that every 100s the energy given to the metal must be 2000 Joules so an Energy axis can be added under the time axis ( in blue )

Heat energy supplied to metal = mass x specific heat capacity x temperature change

$$\text{Specific heat capacity} = \frac{\text{Energy}}{\text{mass x temperature change}} = \frac{(4000 - 2000)\ \text{J}}{1\ \text{kg} \times (24.5 - 20)\ ^{o}\text{C}}$$

$$= 444\ \text{J/kg}^{o}\text{C}$$

Note : the curve at the beginning is due to the heater heating up before it heats up the metal

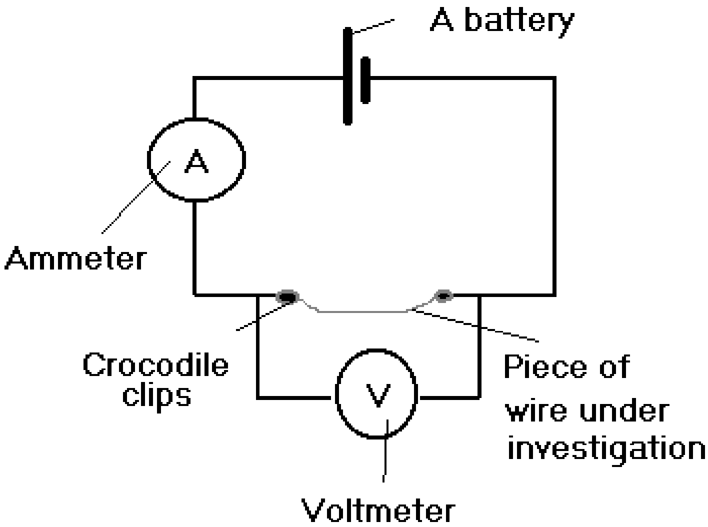
the curve towards the end is due to heat being lost to the surroundings

so we must use measurements in the linear region of the graph

even then some heat will be lost to the surroundings, so the energy supplied to the metal block is more than would be required if perfectly insulated so the experiment gives a value for specific heat capacity which is a bit larger than it should be

The value that would be obtained if there was no heat loss is 386 J/kg$^{o}$C

## 15 Investigating factors affecting resistance of wires




To investigate how the metal affects the resistance we can put wires of different metals between the crocodile clips ensuring that :-

- The length of each wire is the same, eg 30cm
- The thickness ( hence cross sectional area ) is the same

To investigate how the length of wire affects resistance we use a single wire but connect the crocodile clips to different lengths :-

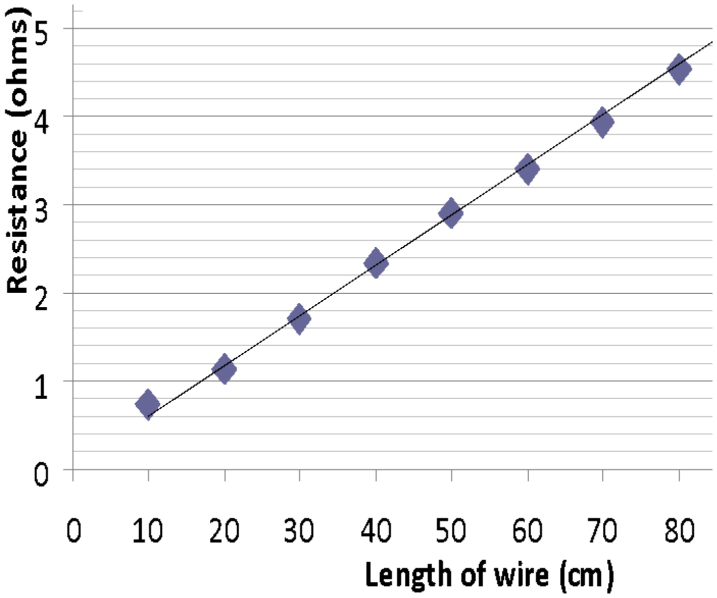
- The metal is the same
- The thickness is the same

To investigate how the thickness affects resistance we use wires of different thicknesses between the crocodile clips ensuring that :-

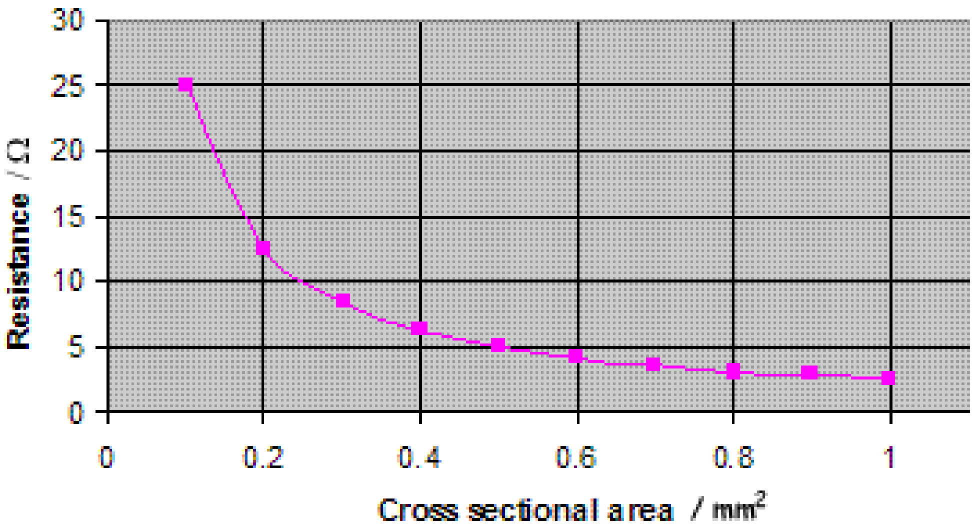
- The metal is the same
- The length of each wire is the same, eg 30cm

In each investigation we measure the voltage and the current, then work out the resistance by dividing the voltage by the current

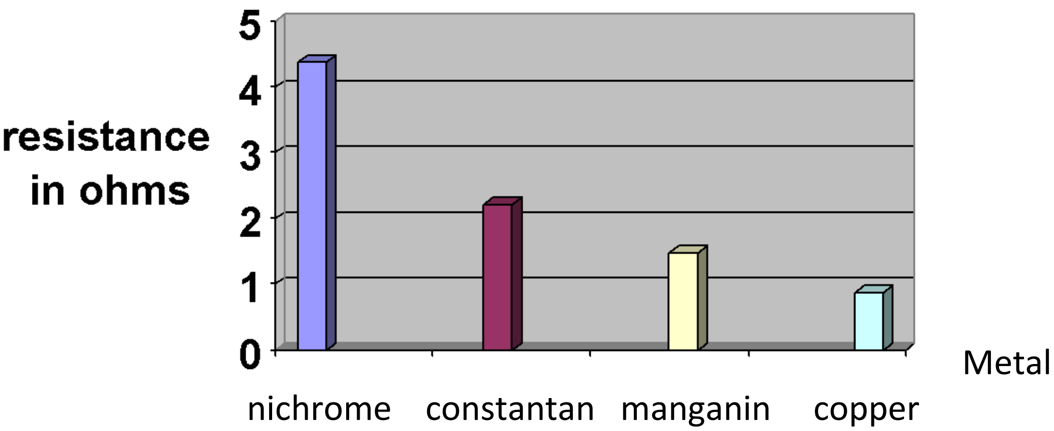
These are the independent variables
These are the control variables
These are the dependent variables




Resistance increases if length increases and there is a proportional relationship ( doubling length doubles resistance etc )

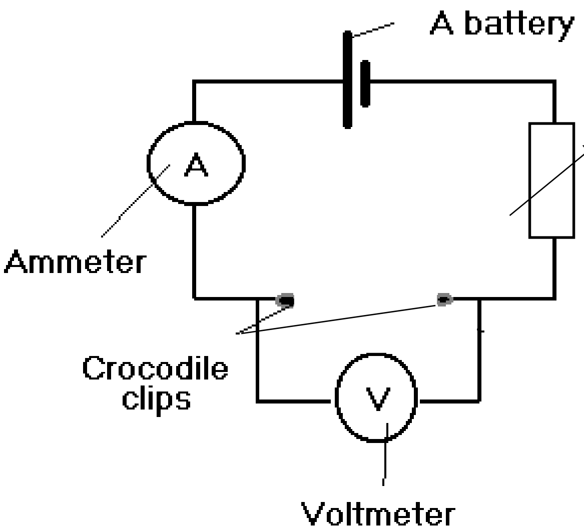



Resistance decreases if cross sectional area increases and there is an inverse proportional relationship ( doubling area halves resistance )



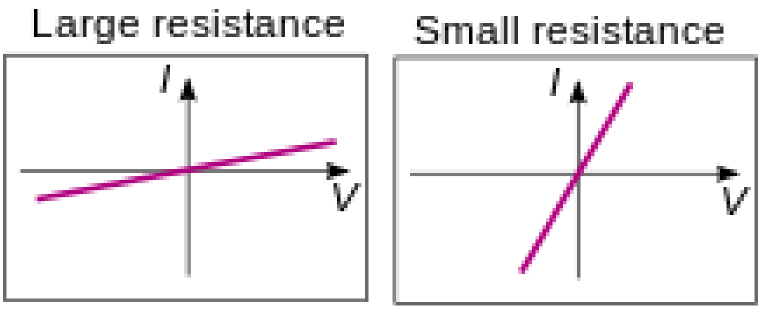

Different metals have different resistances due to the size of their atoms

16 Voltage v Current characteristics for different components

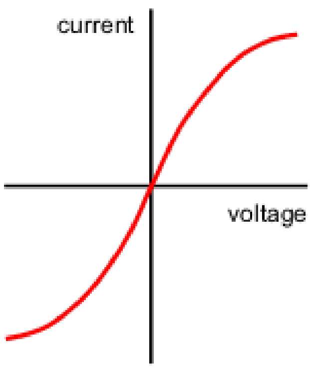


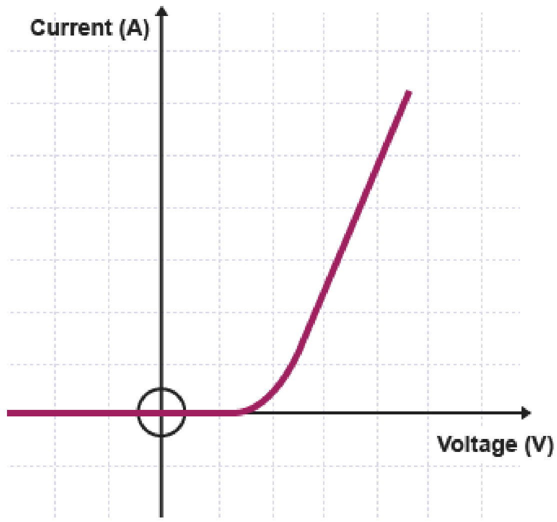

Variable resistor

The component to be tested is put between the crocodile clips
The resistance of the circuit is altered using the variable resistor
The voltage and corresponding current are recorded




Wires at constant temperature have constant resistance




Filament lamp

Diode

Resistance increases as it gets hotter
( atoms vibrate more )

Resistance decreases beyond a certain voltage

( semiconductor atoms give up electrons )

17 Determine the densities of regular and irregular shaped solids and liquids

$$\text{Density} = \frac{\text{mass}}{\text{Volume}}$$

Regular shapes

Note : a cube measuring

2cm x 2cm x 2cm

= 8cm$^3$

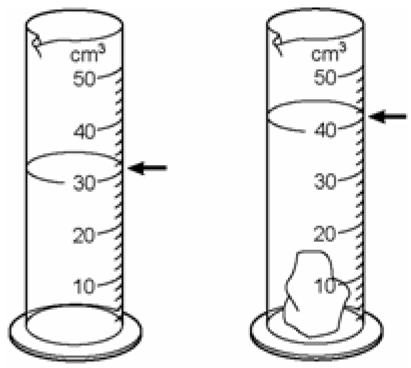
is 0.02m x 0.02m x 0.02m

= 0.000008m$^3$

eg cubes : length x width x height = volume
place on top pan balance to measure mass

Irregular shapes

Measure volume by seeing how much water is displaced

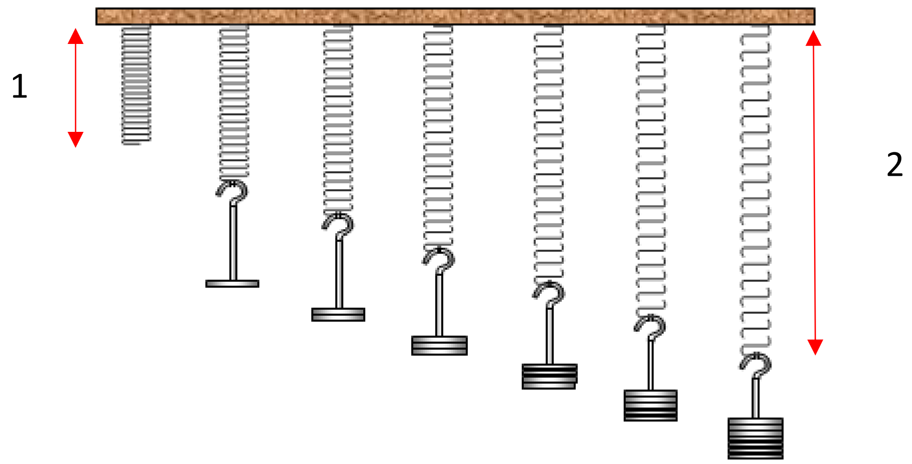



The volume of the solid is (40 – 30) cm$^3$

Liquids

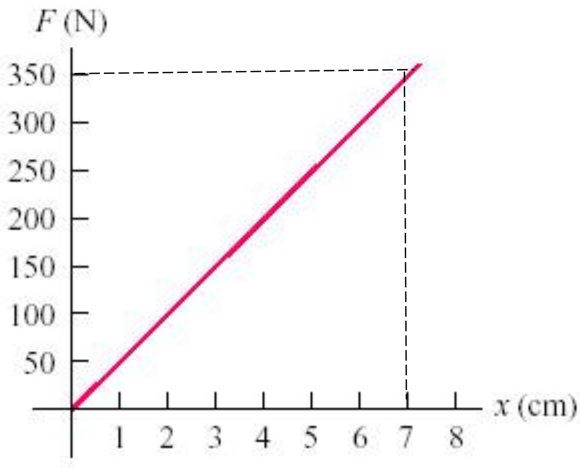
Measure mass of empty measuring cylinder. Add a certain volume of liquid and measure the new mass. Subtract to get mass of liquid alone.

18. Investigating the force and extension of a spring




1. Measure the length of an unstretched spring
2. Measure the length when weights are added
3. Subtract the original length of the spring from the stretched length to get the extension

Draw a Force v extension graph




Increasing the force increases the extension of the spring and there is a proportional relationship

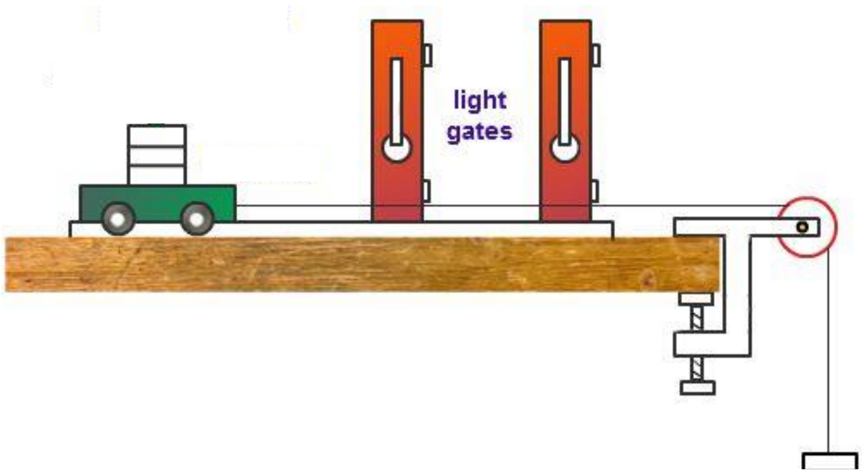
Hooke's law : Force = spring constant x extension $\qquad F = kx$

↓

Gradient of the graph

$$\frac{350\ \text{N}}{0.07\ \text{m}} = 5000\ \text{N/m}$$

19. Investigating Newton's 2nd law




The first light gate can be connected to a stop clock so that it measures the time, $t_1$ , for an interrupt card on the trolley, of length L, to pass through the light gate
The starting velocity, u , is then $L/t_1$

The second light gate can be set up in a similar way to a second stop clock to measure time, $t_2$ , so the final velocity, v , = $L/t_2$

A third stop clock can be connected so that it measures the time, $t_3$ , for the trolley to pass from light gate 1 to light gate 2

The acceleration is then $\frac{v - u}{t_3}$

Start with 100g on the hanger, ie a 1N force pulling the trolley.
Determine the acceleration.
Transfer 100g from the trolley to the hanger so the force is doubled but the moving mass is the same
Keep transferring masses from the trolley to the hanger so testing the effect of force whilst keeping the mass constant

This is the independent variable
This is a control variable
This is the dependent variable

Stop clock 3 can be taken away and, instead of measuring the time between both light gates, we measure the displacement, s, of the second light gate from the first.

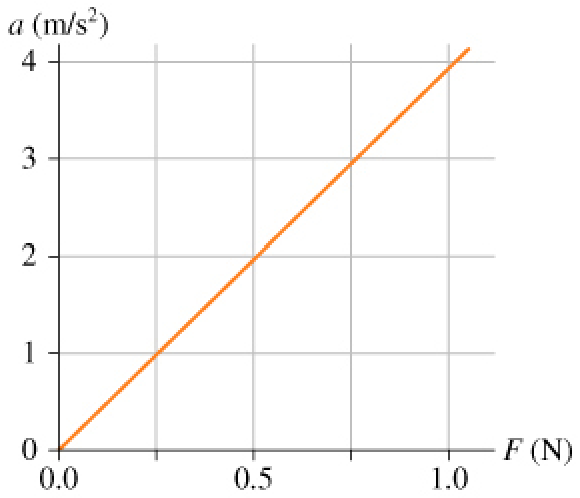
We can use the equation that will be given in exams : $v^2 = u^2 + 2as$
to work out accelerations

$$a = \frac{v^2 - u^2}{2s}$$

Furthermore, if we start the trolley level with the first light gate so that u = 0 we don't need stop clock 1

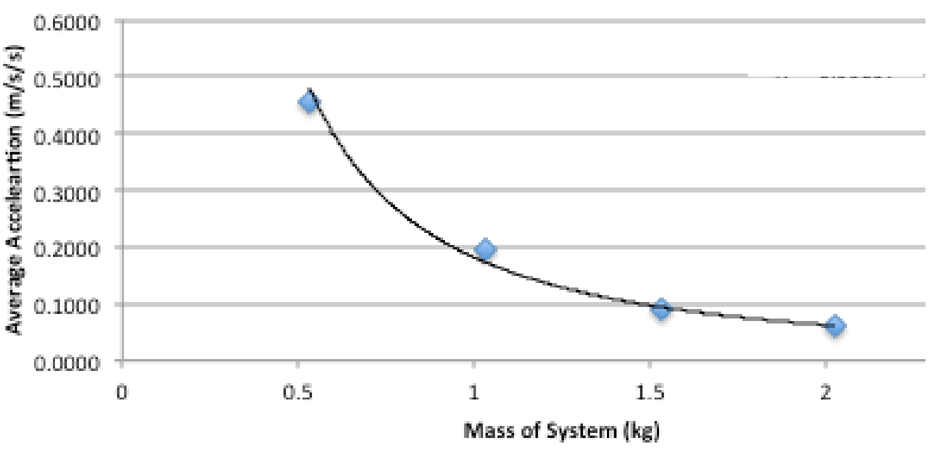
$$a = \frac{v^2}{2s}$$

If we want to investigate how the mass of the trolley affects its acceleration, we can, instead of transferring mass from the trolley to the hanger, just remove mass from the trolley and not place it on the hanger

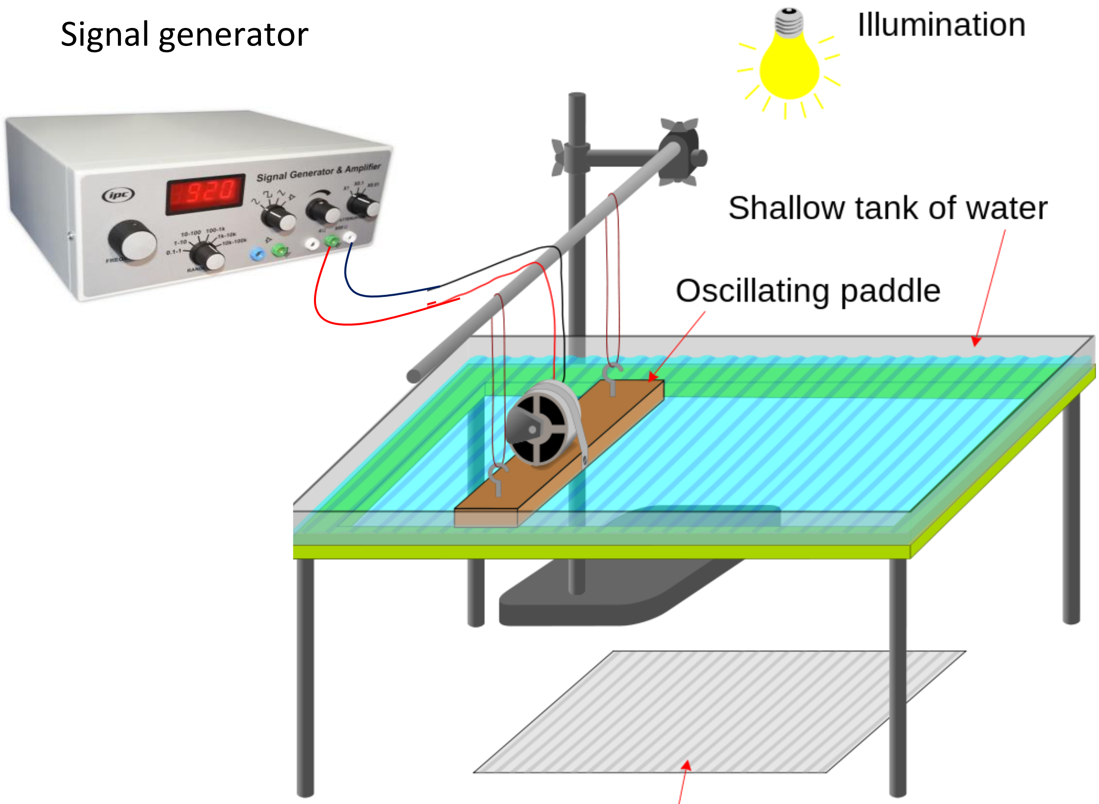



Acceleration increases if force increases – proportional relationship

Acceleration decreases if mass increases – inverse proportional relationship



20. Determining speed of water waves in a ripple tank




The frequency of the waves is varied using the signal generator.

A stroboscope is used to 'freeze' the waves ( make then appear to stand still ) so that the wavelength can be measured.

The distance between, say, 5 waves can be measured and divided by 5 to get the wavelength

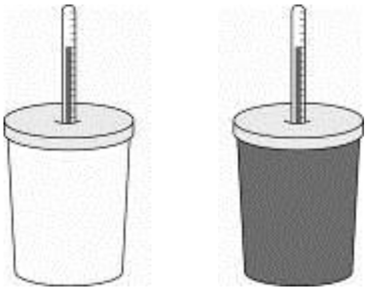
The wave speed is then the frequency x wavelength

Note : we have to take into account the fact that the ripple tank is a projector so magnifies the image of the waves
Put an object of known length in the water, measure how long it appears on screen and work out the magnification ( image length / object length )

21. Investigate the emission and absorption of infra red radiation ( heat waves )

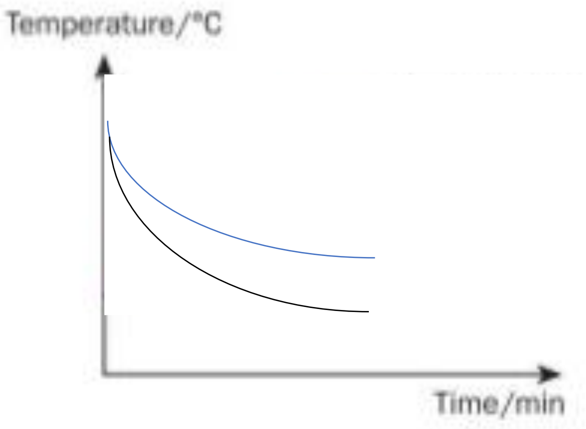
Experiment 1 : to see which colour is the best emitter of infra red waves

Pour boiling water into two equal sized containers, made of the same material, until they are full. One container is light and shiny, the other dull and black.
Put a lid on each container having a hole in the top through which a thermometer can be inserted. Leave to stand for 30 minutes, record the temperature every 2 minutes



A B

Control variables
Independent variable
Dependent variable



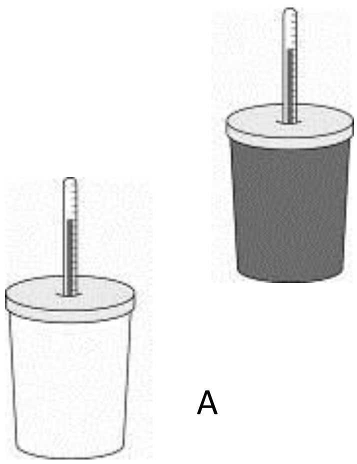

A

B

Dull, black surfaces are better emitters of infra red radiation

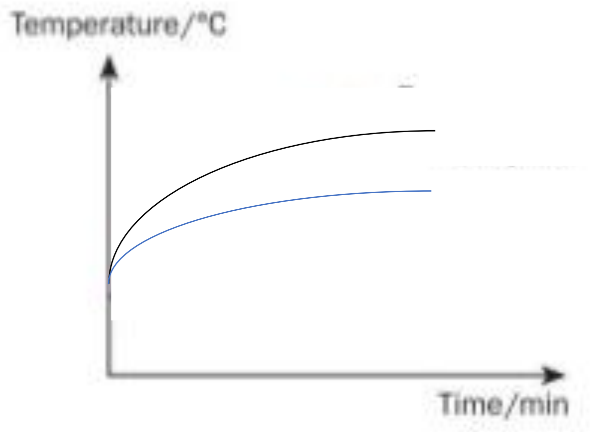
Experiment 2 : to see which colour is the best absorber of infra red waves

Pour cold water into two equal sized containers, made of the same material, until they are full. One container B is dull and black, the other L light and shiny. Put a lid on each container having a hole in the top through which a thermometer can be inserted. Place each container 10cm away from a radiant heat source. Leave to stand for 30 minutes, record the temperature every 2 minutes.

B

A




B

A

Dull, black surface are better absorbers of infra red radiation