ESTIMATION OF ABSOLUTE ZERO BY USE OF THE GAS LAWS (CHARLES' LAW)

Specification reference: **A level Component 1.8 – Thermal physics**

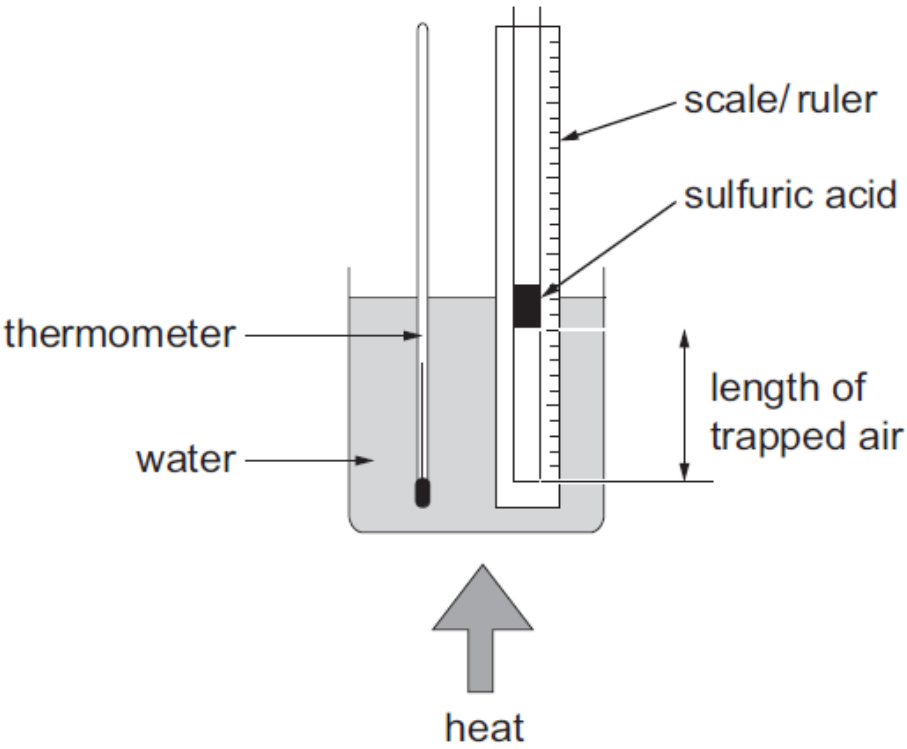
Theory:

Charles' law states that for a constant amount of gas, the volume is proportional to the absolute temperature if the pressure remains constant.

$$V \propto T \text{ for constant } P$$

A plot of volume versus Centigrade temperature intercepts the x-axis at -273 ^{o}C which suggests that the gas would occupy no volume at this temperature. This theoretical value is known as absolute zero, and is also known as 0 Kelvin.

Apparatus:



Further guidance for technicians:

A small bead of concentrated sulfuric acid can be trapped in a capillary tube by first heating the tube with boiling water. When the air cools down it contracts and the sulfuric acid will move down the tube.

Experimental Method:

Heat the water using a Bunsen burner and stir regularly. Measure the length of the trapped air every 10 °C up to 80 °C. Plot a graph of the length of trapped air (y-axis) against temperature (x-axis). The temperature scale should cover the range -400 °C to 100 °C. The length scale should start at zero. Draw a line of best fit extended back until it cuts the x-axis, this is absolute zero.

Extension:

The pressure law will also give a value for absolute zero. Air trapped in a flask can be heated in a water bath and the pressure measured using a pressure gauge. A graph of pressure (y-axis) against Centigrade temperature (x-axis) can be extrapolated back to give a value for absolute zero.

Practical Techniques:

Use ICT such as computer modelling, or data logger with a variety of sensors to collect data, or use of software to process data.