A Hot Bath

Apparatus

test tube, small measuring cylinder, water, thermometer, matches

Action

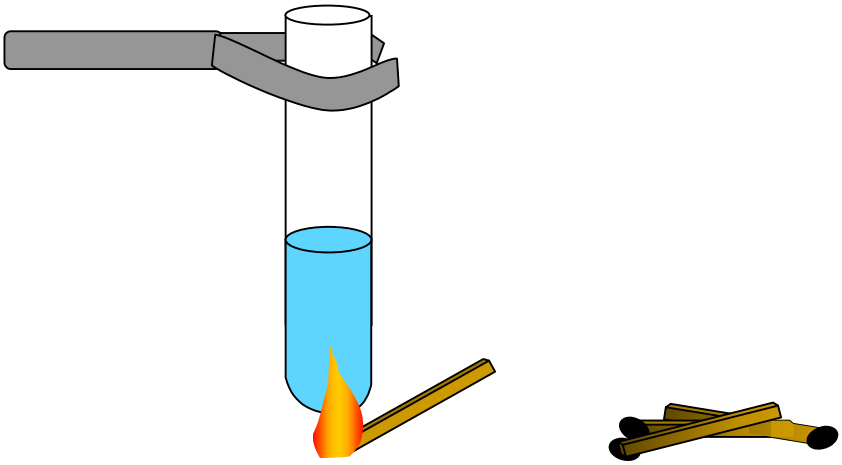
The students put 5 ml of water into the test tube, and measure the temperature of the water. They then light a match and hold it under the tube until it burns down to almost the end. They measure the temperature of the water again and calculate, using the heat capacity, the energy gained by the water. They can then calculate how many matches would be needed to heat a bath tub full of water to a comfortable temperature.

Note – the thermometer should have a small thermal capacity, for example a thermocouple with small probe.

The Physics

The energy gained by the water is the E_{match} = 4180 J.kg^{-1}.K^{-1} × m × ΔT. This is the energy supplied by the match. A bath tub contains around 300 l or 0.3 m^3 which is around 300 kg of water. A nice hot bath is around 50^{o}C, and tap water is typically at around 20^{o}C, so you need a temperature change of 30^{o}C. This requires an energy of E = 4180 J.kg^{-1}.K^{-1} × 300 kg × 30 K = 38 MJ of energy.

If one match gives you E_{match}, then you need around (38 × 10^6 J / E_{match}) matches to heat up water for a bath.



Accompanying sheet

A Hot Bath

Pour about 5 ml of water into a test tube.
Measure the temperature of the water.

Hold a match under the test tube
and note the change in temperature of the water.

How much energy is gained by the water.

Estimate how many matches you need to take a hot bath