Practical 1 – Topic 3

Specific heat capacity of a solid

Criteria assessed

- CE

Safety

- Take care with the container of boiling water.
- Take care when transferring the metal from the container of boiling water to the calorimeter.
- Be careful with the thermometers as they are taken in and out of the boiling water.

Materials needed

- A small block of a known metal attached to a string.
- A heating plate.
- A container in which to boil water.
- Thermometers.
- Well-insulated calorimeter (of known heat capacity).

What to do

Place the metal in the boiling water. After some time quickly transfer the metal into the calorimeter, holding the metal by its string.

Record the following temperatures:

- θ_{boiling}, the temperature of the boiling water immediately before the transfer
- θ_{water}, the temperature of the water in the calorimeter immediately before the transfer
- θ_{max}, the maximum temperature reached by the water in the calorimeter after the metal has been put into the calorimeter.

You also need to know the following:

- C, the heat capacity of the calorimeter
- M, the mass of the water in the calorimeter
- m, the mass of the piece of metal.

It is easily seen that:

$$mc\Delta\theta_{\text{metal}} = C\Delta\theta_{\text{cal}} + Mc_{\text{water}}\Delta\theta_{\text{water}}$$

where

m = mass of metal

c = specific heat capacity of metal

C = heat capacity of calorimeter

c_{water} = specific heat capacity of water

$\Delta\theta_{\text{metal}} = \theta_{\text{boiling}} - \theta_{\text{max}}$

$\Delta\theta_{\text{cal}} = \Delta\theta_{\text{water}} = \theta_{\text{max}} - \theta_{\text{water}}$

M = mass of water

The heat capacity of the calorimeter is found from its mass and specific heat capacity. You must know what metal it is made out of so you can look up its specific heat capacity.

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The specific heat capacity of the metal is found from

$$c = \frac{C\Delta\theta_{\text{cal}} + Mc_{\text{water}}\Delta\theta_{\text{water}}}{m\Delta\theta_{\text{metal}}}$$

- What value do you obtain and what is its uncertainty?
- How close is your value to the accepted value for the metal you are using?

This lab is assessed against the CE criterion. There is a lot to say here, including:

- how much does the temperature of metal change during the transfer?
- how much boiling water gets transferred along with metal into the calorimeter?

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