

**State Examination Commission – Physics Higher Level, 2007**

**Question 2**

The specific heat capacity of water was found by adding hot copper to water in a copper calorimeter. The following data was recorded.

mass of calorimeter	55.7 g
mass of calorimeter + water	101.2 g
mass of copper + calorimeter + water	131.4 g
initial temperature of water	16.5 °C
temperature of hot copper	99.5 °C
final temperature of water	21.0 °C

Describe how the copper was heated and how its temperature was measured. (9)

Using the data, calculate:

- (i) the energy lost by the hot copper  
 (ii) the specific heat capacity of water. (16)

Give two precautions that were taken to minimise heat loss to the surroundings.

Explain why adding a larger mass of copper would improve the accuracy of the experiment. (15)  
 (specific heat capacity of copper = 390 J kg<sup>-1</sup> K<sup>-1</sup>)

Describe how the copper was heated and how its temperature was measured. (9)

The copper was placed in a boiling tube, plugged with cotton wool, and then placed into a beaker of boiling water for 5 minutes. A thermometer was also left in the boiling tube and it recorded the temperature of the copper.

Using the data, calculate:

- (i) the energy lost by the hot copper

$$E = mc\Delta\theta = (3.02 \times 10^{-2})(390)(78.5) = 924.6 \text{ J}$$

- (ii) the specific heat capacity of water. (16)

$$\text{Heat lost by copper cooling from } 99.5^\circ\text{C to } 21.0^\circ\text{C} = \text{Heat gained by water in calorimeter rising from } 16.5^\circ\text{C to final temperature } 21.0^\circ\text{C} + \text{Heat gained by copper calorimeter rising from } 16.5^\circ\text{C to final temperature } 21.0^\circ\text{C}$$

$$m_{cu}c_{cu}\Delta\theta_{cu} = m_w c_w \Delta\theta_w + m_{cal}c_{cu}\Delta\theta_{cal}$$

$$924.6 = (0.0455)(c_w)(4.5) + (0.0557)(390)(4.5)$$

$$c_w = 4.04 \times 10^3 \text{ J kg}^{-1} \text{ K}^{-1}$$

Give two precautions that were taken to minimise heat loss to the surroundings.

The calorimeter was insulated and a lid was placed on it. The copper was transferred quickly once removed from boiling water.

Explain why adding a larger mass of copper would improve the accuracy of the experiment. (15)

A larger mass of copper would have caused a greater rise in temperature in the water. This is the measurement with the greatest possible percentage error. Increasing its size reduces that possible percentage error