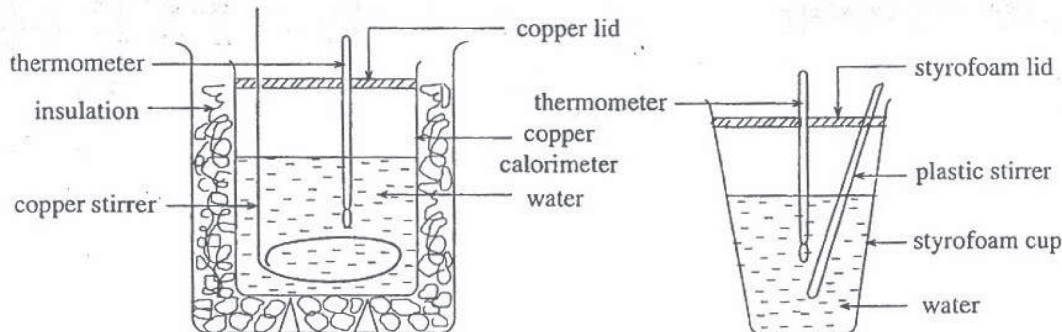


2011 A/L Structured Essay Question No (02)

2. The material called Styrofoam, Rigifoam or polystyrene is widely used for making disposable cups. The thermal conductivity of this material is less than 0.0001 times that of copper while its specific heat capacity is about 4 times that of copper.

In order to investigate the suitability of using a styrofoam cup instead of a copper calorimeter in heat experiments, a student selected the “experiment of determination of specific heat capacity of iron in the form of iron balls using method of mixtures”, and arranged two experimental setups to perform the experiment, one using a copper calorimeter and the other using a Styrofoam cup. The figure shows his experimental arrangement.



After taking the required initial temperature and mass measurements, he added iron balls heated to 100 °C to the water in the calorimeter/Styrofoam cup and obtained the necessary temperature and mass measurements. The readings he obtained are shown below.

	Experiment with copper calorimeter	Experiment with Styrofoam cup
Mass of the empty vessel with stirrer	100 g	10 g
Mass of the vessel with water and stirrer	150 g	60 g
Initial temperature of water	30 °C	30 °C
Maximum temperature of water after adding iron balls	45 °C	47 °C
Mass of the final system	300 g	210 g

- (a) (i) Calculate the amount of heat absorbed by the calorimeter with stirrer (Take specific heat capacity of copper as 375 J kg⁻¹ K⁻¹).

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- (ii) Using the data obtained with the copper calorimeter, show that the specific heat capacity of iron is 450 J kg⁻¹ K⁻¹. (Specific heat capacity of water is 4200 J kg⁻¹ K⁻¹)

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(b) Taking the specific heat capacity of iron as $450 \text{ J kg}^{-1} \text{ K}^{-1}$, calculate the amount of heat absorbed by the styrofoam cup. (Assume that heat lost to surroundings from the Styrofoam cup and heat absorbed by the plastic stirrer are negligible).

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(c) In heat experiments where Styrofoam cups are used the amount of heat absorbed by the cups can be neglected compared to copper calorimeters. Justify this statement using the results obtained under (a) (i) and (b) above.

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(d) State a practical advantage of using a Styrofoam cup compared to a copper calorimeter in this experiment.

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(e) A copper calorimeter cannot be replaced by a Styrofoam cup in the verification of Newton's law of cooling. Give **two** experimental reasons for this.

- (1)
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- (2)
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