AP Physics B
2000 Student Samples

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AA1

6. (10 points)

You are to design a procedure to determine experimentally the specific heat of an unknown liquid. You may not damage or destroy any equipment you use, and your method must be feasible and practical.

(a) List the equipment you would need. Include a labeled diagram.

A Heat source

B 2 Thermometers

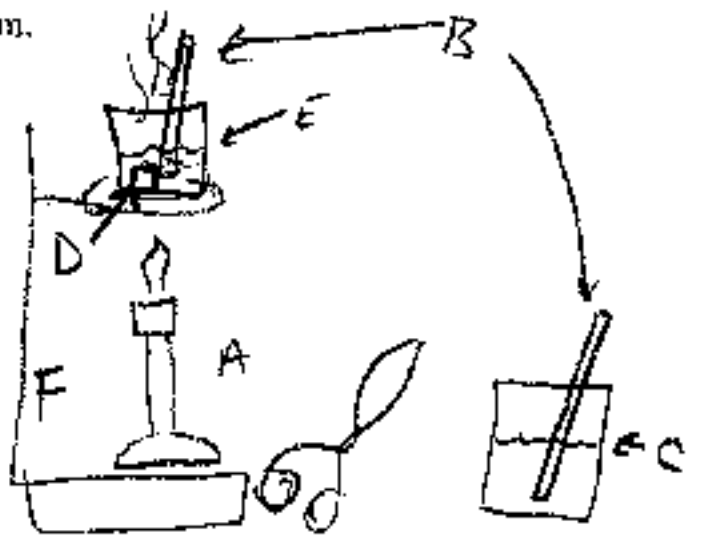
C Insulated beaker - filled with 1.0kg liquid

D Metal block (1.0kg)

E Beaker of water

F Ring stand and clamp

G - Tongs



(b) Describe the measurements you would make. Assign each measurement a symbol (such as time = t).

- Heat block to 100°C
- Measure liquid at room temperature (t_L)
- Measure liquid after putting metal in liquid and allowing time for temperature to equalize. (t_f)
- Obtain C_B for metal from "Hand Book of Chemistry and Physics"

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(c) Show explicitly using equations how the measured quantities would be used to determine the specific heat of the unknown liquid.

$m_B = 1.0\,kg$

C_B = specific heat of metal

$\Delta T_B = t_f - 100°C$

$m_L = 1.0\,kg$

C_L = specific heat of liquid

$\Delta T_L = t_f - t_L$

$$m_B C_B \Delta T = -m_L C_L \Delta T$$

$$C_B \Delta T_B = -C \Delta T_L$$

$$C_L = -\frac{C_B \Delta T_B}{\Delta T_L}$$

(d) Indicate one possible source of experimental error and discuss how it would affect your value for the specific heat. Justify your answer.

One possible error could occur if the metal block is not transferred to the liquid quickly enough. The block will begin to cool immediately in the air, so the slower it is moved to the liquid, the more heat it loses to the air rather than to the liquid. This would result in a lower final temperature (T_f) This would Increase the value for ΔT_B and decrease the value for ΔT_L leading to a larger C_L value.

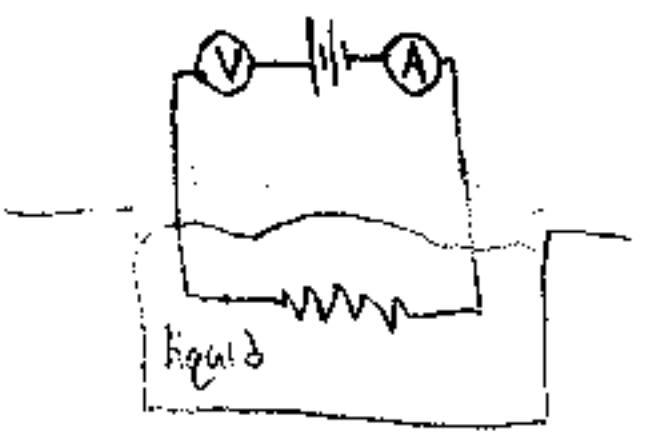
AD1

6. (10 points)

You are to design a procedure to determine experimentally the specific heat of an unknown liquid. You may not damage or destroy any equipment you use, and your method must be feasible and practical.

(a) List the equipment you would need. Include a labeled diagram.

Voltmeter
Ammeter
Wire of negligable resistance
A resistor of resistance R
A power source of voltage V
A container
thermometer
Scale
100 g of the liquid.



(b) Describe the measurements you would make. Assign each measurement a symbol (such as time = t).

I would record the initial temperature of the substance = t_1
Then I would let the current run for 100 seconds & measure Voltage and Amps.
I would after the 100 seconds, record the temperature of the substance = t_2

AD2

(c) Show explicitly using equations how the measured quantities would be used to determine the specific heat of the unknown liquid.

$\text{Power} = I^2R$

$Q = mc\Delta T = 100_g\, c\,(t_2 - t_1) = (I^2R)\,100 \text{ seconds}$

$(I^2R)100 = 100_g\, c(t_2 - t_1)$

$c = \dfrac{(I^2R)100}{100_g\,(t_2 - t_1)}$

$c = \dfrac{I^2R}{t_2 - t_1}$

(d) Indicate one possible source of experimental error and discuss how it would affect your value for the specific heat. Justify your answer.

The container would absorb energy. That would make the specific heat value a little higher than what it really is. But still, for experimental reasons that is not much.

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AE1

6. (10 points)

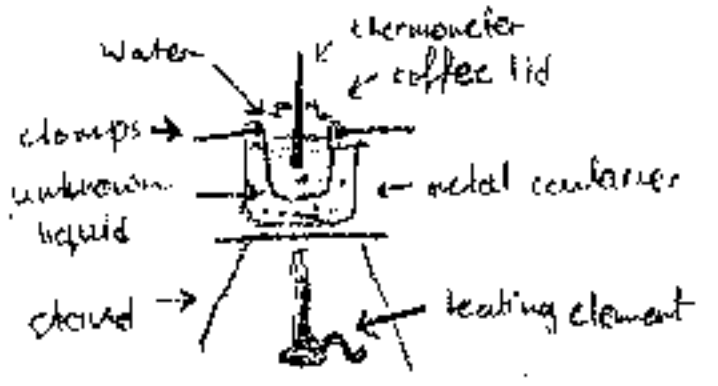
You are to design a procedure to determine experimentally the specific heat of an unknown liquid. You may not damage or destroy any equipment you use, and your method must be feasible and practical.

(a) List the equipment you would need. Include a labeled diagram.

My list of equipment would all be based on the following formula:

$$Q = Vc\Delta t$$ (V is used because the substance is a liquid)

Items needed:
- A coffee-cup (2 of them made from styrofoam)
- 1 thermometer
- water
- A heating element
- A metal container
- A bunsen stand
- A set of clamps
- coffee cup lids (2)
- 1 flask or beaker.



(b) Describe the measurements you would make. Assign each measurement a symbol (such as time = t).

The measurements I would make would be.

⇒ Volume of liquid = V

Temperature = T_1 (before heating) and T_2 (after)

Amount of heat transferred = Q

Volume of calorimeter water = V_{water}

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(c) Show explicitly using equations how the measured quantities would be used to determine the specific heat of the unknown liquid.

The process of finding the unknown liquid specific heat is calorimetry

where heat lost = heat gained

$$Q_{\substack{\text{unknown} \\ \text{liquid}}} = Q_{\text{water}}$$

$$(mc\Delta t)_{\text{liquid}} = (mc\Delta t)_{\text{water}}$$

where Δt for both sides, along with m would be found by proper measuring c_{water} is known already ∴

$$c_{liquid} = \frac{\left(\frac{m_{water}\, c_{water}\, \Delta t_{water}}{\Delta t_{water}}\right)}{m_{water}}$$

(d) Indicate one possible source of experimental error and discuss how it would affect your value for the specific heat. Justify your answer.

One source of experimental error could occur by incorrect temperature readings by one of the laboratory technicians or just a faulty thermometer. This is an important error as the temperature at various points of the experiment are read and used in calculating for c. eg.

$$Q = mc \times \Delta t \quad \Rightarrow \quad Q = mc \times (t_2 - t_1)$$

Even a minute error, of perhaps a few degrees would offset the entire end result, as further calculations would be needed to isolate the value of c calculations which would take for granted that the value Δt was automatically i) correct, and ii) precise