During melting, heat is absorbed by the melting solid. In this experiment, you will determine how much heat is needed to melt 1 g of ice. Heat has units of joules (J). The heat used to melt the ice will come from the cooling of warm water and will be measured with a calorimeter. A calorimeter is an insulated container fitted with a device for measuring temperature. You will use a simple calorimeter made of a Styrofoam cup, a 250-mL beaker, and a temperature probe.

OBJECTIVES

In this experiment, you will

- use a calorimeter
- use LabPro unit, and a temperature probe to measure temperature
- determine heat of fusion for ice (in J/g)

learn to use an electronic balance

MATERIALS

LabPro unit

Temperature Probe

Styrofoam cup
250-mL beaker

balance
warm water
100-mL graduated cylinder
one ice cube
one paper towel

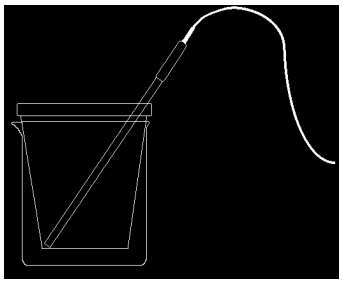


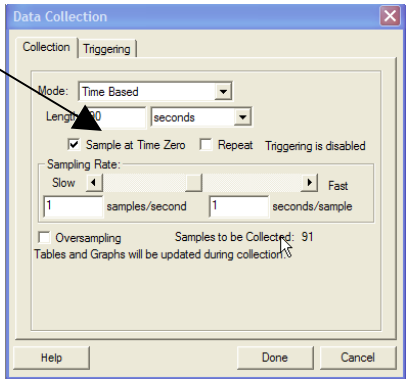
Figure 1

PROCEDURE FOR EXPERIMENT

1. Set-up your LabPro unit
   Plug the LabPro unit in (listen for the beeps)
   Connect the LabPro to the Computer using the USB cable
   Run the Logger Pro software on the PC

2. Plug the temperature probe into Channel 1 of the LabPro System. Make sure it is recognized by the program.

3. Set-up data collection (Experiment menu, data collection option). Enter 240 seconds for the length of the experiment. Enter 1 sample for every 1 second.



4. Label your data table as Water Temperature (Celsius).

5. Get a 250-mL beaker and a Styrofoam cup. Place the Styrofoam cup into the beaker, as shown in Figure 1. Use a balance to measure the mass of the 250-mL beaker and the Styrofoam cup. Record this mass in your data table (under #1).

6. Use a 100-mL graduated cylinder to measure out 100 mL of the warm water into the Styrofoam cup. Measure the mass of the 250-mL beaker, Styrofoam cup, and 100 mL of warm water. Record this value in the data table (under #2).

7. Break an ice cube into a few pieces in a paper towel.

8. Place the temperature probe into the warm water (but not the ice YET!). Monitor the temperature on your calculator until the reading is steady.

8A. Start the data collection by hitting the [F11] key or by clicking on the green collect button. Wait a few seconds, and then add the ice pieces to the water in the Styrofoam cup.

9. Gently stir the contents of the cup as the ice melts. After all the ice has melted, continue stirring for a few more seconds, and then allow the program to continue collecting data until it is finished (should be 240 seconds, or 4 minutes total).

10. When data collection stops, measure and record the mass of the 250-mL beaker, Styrofoam cup, and water (original water + ice melt) (under #4).

11. Print out the data table in portrait mode. Make sure to fill out the footer section with your names and the title of the experiment (“Heat of Fusion for Ice”). Use the data table to record the maximum and minimum values of your temperature. Record this data in the data table.

12. Draw a square 1 cm square on the top left-hand corner of page 1.

13. Print out your graph in landscape mode. The title of your graph should be "Heat of Fusion for Ice".

PROCESSING THE DATA

1. Calculate the mass of the warm water (Mass of beaker/Cup/Warm water [#2 in data table]) – (Mass of Beaker and cup [#1 in data table]). Record your answer in #3.

2. Calculate the mass of the ice added (Mass of beaker, cup, water and ice melt [#4 in data table]) – (Mass of beaker, cup and warm water [#2 in data table]). Record your answer in #5.

3. Calculate Δt (change in temperature) of the water (Final water temp [#7 in data table]) – (intial water temperature [#6 in data table]). Record your answer in #8.

4. Calculate the heat lost (in Joules) by the water using the equation

$$H = \Delta t \bullet m \bullet C_p$$

where H = heat (in Joules), Δt = change in temperature (in °C, #8 in data table), m = mass of water cooled (in g, should be 100.0g), and C_p = specific heat capacity (4.18 J/g°C for water).

5. Calculate the Heat of Fusion for Ice. Use the formula below:

$$H = \frac{H_{water}}{m_{ice}}$$

H_{water} = heat lost in Joules (calculated in step #4 above [data table #9), m_{ice} = mass of the ice (calculated in step #2 [Data table #5]). Record this answer in data table #10.

6. An accepted value for the heat of fusion of ice is 334 J/g. Calculate your percent error using the formula

$$\% \text{ Error} = \quad X\ 100$$

calculated value = value from step #5 above [data table #10]), accepted value = 334 J/g. Record this answer in data table #11.

DATA TABLE	
	Recorded Results
1. Mass of Beaker and Cup (grams)	
2. Mass of Beaker, Cup and Warm Water (grams)	
3. Mass of Warm Water (#2 - #1, in grams)	
4. Mass of Beaker, Cup, Water and Ice Melt (Weigh this AFTER the experiment) (grams)	
5. Mass of Ice (#4 - #2, in grams)	
6. Initial water Temp. (Maximum temperature) (Celsius)	
7. Final water Temp. (Minimum Temperature) (Celsius)	
8. Change in temperature (Δt, Celsius) (#7 - #6)	
9. Heat Lost (in Joules)	
10. Calculated Heat of Fusion of Ice (in Joules)	
11. Calculated Error (no units).	