Calorimeter Heat Capacity Determination Experiment
Procedure, Assignment & *Mini*-Report Guidelines

READING Experiment (this handout)

Chemistry, 5th ed. by Silberberg: Section 6.3

BACKGROUND

The calorimeter

In the next experiment, we will determine the heat of various acid-base reactions. The calorimeter that we will use to carry out our chemical reactions will consist of two nested Styrofoam cups and a lid. However, before we can make us of the calorimeter, we need to determine the heat capacity of the calorimeter – how much heat the calorimeter absorbs for every 1 C° change in temperature. We will accomplish this by mixing hot & cold water in our calorimeter. The heat lost by the hot water should equal the heat gained by the cold water and by the calorimeter. We can write this as an equation:

$- q_{lost} = q_{gained}$

$- q_{hot\ water} = q_{cold\ water} + q_{calorimeter}$

Because water is a substance for which we know the specific heat capacity, we can replace the heats for water with $q_{water} = mC_p\Delta T$. However, because the calorimeter is an *object*, we need to measure its heat capacity (H_c). We can replace the heat of the calorimeter with $q_{calorimeter} = H_c\Delta T$.

PROCEDURE / DATA /CALCULATIONS / RESULTS

Determining the Calorimeter Constant of your coffee-cup calorimeter:

1. Prepare a data table to include the following for multiple trial (minimum 3, leave room for up to 6): volume of cold water, temperature of cold water, volume of hot water, temperature of hot water, final temperature of the mixture, and the calculated heat capacity.

   Note: Measure all temperatures in this experiment to the ***correct precision***. Use the same thermometer for all measurements to minimize error.

2. Obtain two styrofoam cups, a lid and a thermometer.
3. Heat 300-400 mL of water to 75-80º C. This will be the hot water.
4. Place 50.0 mL of cold tap water into the stacked styrofoam cups (calorimeter).
5. Measure out 50.0 mL of hot water in the graduated cylinder, and measure the temperature of the water in the center of the graduated cylinder. The temperature will drop significantly (up to 10ºC in the graduated cylinder).
6. Put the thermometer into a cold water bath to cool it, then measure the temperature of the cold water in the calorimeter.
7. Pour the hot water into the calorimeter and record the final temperature of the mixture.

   Note: Always measure a rising temperature, as it gives you a more accurate reading. If the thermometer is in the hot water, transfer it to cold water for several seconds before using to measure cooler liquids.

8. Use your data to determine ΔT_H and ΔT_C. From these, determine the heat capacity (calorimeter constant) for your calorimeter. Assume the density of water is 1.00 g/mL and the specific heat of water is 4.18 J/g•C°. You should get calorimeter constants between 20 and 100 J/C°.

   Repeat this experimental determination until you obtain at least three consistent values (within 10-15 J/C° of one another). Average these closest three values and use the results as your calorimeter constant.

   Save your calorimeter for the next experiment!