Heat vs. Temperature Calorimetry Activity

Purpose: You will observe how heat is transferred between each solid and boiling water.

Background:

This procedure will walk you through the steps for calorimetry. Calorimetry is a technique used to determine the heat gained or lost by a substance during a chemical or physical change. It is based on the law of conservation of energy, which says that energy is neither created nor destroyed during a chemical reaction. In calorimetry, this means that the heat gained by the water in the calorimeter must have been released by the sample or the reaction taking place in the calorimeter. For this activity, you will place your metal, plastic, or wood sample in boiling water. Remember that heat always flows from hot to cold, so heat will move from the boiling water to the metal, plastic, or wood sample. After a few minutes, your sample will hold as much heat as it can. Now you quickly take your metal, plastic, or wood sample from the hot water and place it into the room temperature water in the calorimeter. Discuss with your lab partners what will happen to the heat in your sample once it is placed into the water in the calorimeter. When your entire group agrees, proceed to the procedure. If you cannot agree, consult with your teacher.

Procedure:

1. Use an electronic balance and record the mass of each sample in Table 2 on the **"**Heat vs. Temperature" student sheet.

2. Place your metal sample in the boiling water bath. Describe what is happening to the 3 samples when they are placed in boiling water in terms of heat. Explain how heat is being transferred and why? How does this affect the temperature of the samples in the boiling water?

3. While it is in the boiling water, measure about 100 ml of tap water and record the exact mass in Table 2. (**Hint:** Why do you know the mass of water if you know the volume of water?)

4. Put the 100 ml of tap water into the calorimeter and record the temperature in Table 2.

5. Quickly remove your metal sample from the boiling water and place it into the calorimeter.

6. Cover with the lid and record the highest temperature reached by the water. Record in Table 2 as the final temperature of the metal sample and water in the calorimeter. Why is this the correct value for both the final temperature of the water in the calorimeter and the final temperature of the sample?

7. Calculate ΔT for the metal and record it in Table 2. Remember $\Delta T = T_f - T_i$ and we are concerned about the change when the hot sample was placed in the cooler tap water.

8. Calculate ΔT for the water in the calorimeter and record it in Table 2. (**Hint**: What are T_f and T_i?)

9. Determine the heat absorbed by the water in the calorimeter using the formula $q=mC\Delta T$. Remember that q = heat (this is what you want to find), m = mass of the water, C = specific heat of water (4.184 J/g ^{o}C) and ΔT is the change in temperature of the water in the calorimeter. Record in Data Table 2 and continue with questions 8 – 12 following the data table.

10. Repeat steps 1 – 9 with the plastic and wood samples.