SPECIFIC HEAT OF A METAL

Specific heat is the amount of heat energy, measured in joules, needed to raise the temperature of one gram of the substance one degree celsius. Often applied to metallic elements, specific heat can be used as a basis for comparing energy absorption and transfer.

To measure specific heat a calorimeter, a well-insulated container, of some kind must be used. The calorimeter is insulated to reduce the loss or gain of heat energy (Q) from the surroundings. Heat energy always flows from an object of higher temperature to an object of lower temperature. The heat gained by the cooler object equals the heat lost by the warmer object. However, we must assume that no heat is lost to the surroundings.

$$Q_{lost} = Q_{gained}$$

In this experiment, you will determine the specific heat of a metal sample. The metal sample will be heated to a high temperature than placed into a calorimeter containing a known quantity of water at a lower temperature Having measured the mass of the water in the calorimeter, the temperature change of the water (ΔT), and knowing the specific heat of water, the heat gained by the water (lost by the metal) can be calculated as follows:

$$\Delta H = C_p \times M \times \Delta T$$

From the measured heat lost by the metal, the specific heat of the metal can be determined.

$$\text{Specific Heat of Metal } C_p = \frac{\text{Heat gained by the water}}{\text{Mass of Metal} \times \Delta T \text{ of Metal}}$$

Please read section 2-13 of your text for more information and any constants you need.

PROCEDURE:

MATERIAL	MASS (g)
Test Tube	
Test Tube Plus Metal	
Metal	
Foam Cup	
Cup Plus Water	
Water	

MATERIAL	TEMPERATURE (°C)
Boiling water	
Water in Cup	
Water in Cup Plus Metal	

2. Fill a 250 ml beaker about half full of tap water. Place the beaker on the ring stand with wire gauze. Heat the water to boiling.

3. Measure the mass of an empty, dry 18 x 150 mm test tube and record.

4. Add the sample metal pieces until the test tube is about half-full. Record the mass of the test tube and metal. Make sure the you record the type of metal you are using.

5. Place the test tube containing the metal into the beaker of boiling water. Leave the test tube in the boiling water bath while you complete steps 6 and 7. **Do not let any water into the test tube.**

6. Obtain a foam cup from the supply area to be used as a calorimeter and measure and record its mass.

7. Fill the cup about one/third full with distilled water and record the mass.

8. Measure and record the temperature of the water in the cup.

9. While the test tube containing the metal is still in the boiling water bath, measure and record the temperature of the boiling water. You will assume the temperature of the water and metal are the same.

10. Remove the test tube from the bath and immediately pour the metal into the cup. Use a test tube holder because the glass is hot!

11. Stir the water and metal with a stirring rod, **not the thermometer!** Record the highest temperature reached.

12. Recover the metal by carefully pouring the water off (decanting). Spread the solid metal on a paper towel to dry. **DO NOT LET ANY METAL PARTICLES GET INTO THE LABORATORY SINK.** Your teacher will indicate where your dry metal is to be placed.

QUESTIONS: Show all work. No work, no credit.

1. Calculate the heat gained by the water (lost by the metal) using the equation in the introduction and your text.

2. Calculate the specific heat of the metal that you used, using the answer from question one and the equation in the introduction.

3. What type of metal did you use?

4. Calculate the percent error of your results in this experiment.

BONUS: 2 points. Why is water an excellent material to use in a calorimeter?

Pb = .13 J/g°C

Cu = .38 J/g°C

Al = .90 J/g°C

CALORIMETER

What should be in the conclusion of this experiment?