Physics: Finding the Specific Heat of a Metal Names:

**Introduction**: To measure specific heat in the laboratory, a calorimeter of some kind must be used. A calorimeter is a well-insulated container used in measuring energy changes. The calorimeter is insulated to reduce the loss or gain of energy to or from the surroundings. Energy always flows from an object at higher temperature to an object at lower temperature. The heat gained by the cooler substance equals the heat lost by the warmer, if we assume no loss of heat to the surroundings.

(Heat lost)metal = (Heat gained)water

-(m c T) metal = (m c T) water

In this experiment, you will determine the specific heat of a metal sample. The metal sample will be heated to a high temperature then 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 (T), and specific heat of the water, we can calculate the heat gained by the water. This should be equal to the heat lost by the metal, which then will allow us to calculate the specific heat of the metal.

**Equipment**: 250 mL beaker, styrofoam cup, thermometer, balance, metal samples, (hot water), test tube

**Procedure:**

1. Record the mass the empty test tube in the data table (#1).
2. Add metal pieces until the test tube is about half full. Be sure the pieces are fully dry. Record the mass of the test tube and metal pieces (#2).
3. Fill a 250 mL beaker about half full of hot water. (Teacher will do this.)
4. Place the test tube containing the metal pieces into the hot water bath until the temperature of the pieces stabilizes. This could take a few minutes.
5. While your metal is heating, record the mass of a dry Styrofoam cup (#3). This will be used as your calorimeter.
6. Fill the Styrofoam cup about half full of distilled water at room temperature. Record the mass of the cup and water (#4).
7. Record the temperature of the water in the calorimeter to the nearest 0.1 oC (#6).
8. While still in the hot bath, gently place a thermometer/temperature probe in the middle of the metal pieces, and record the temperature of the metal pieces to the nearest 0.1 oC (#5).
9. Remove the test tube containing the metal pieces and immediately pour the metal into the Styrofoam cup.
10. Gently stir the water in the Styrofoam cup with the thermometer. Record the highest temperature of the water/metal mixture to the nearest 0.1 oC (#7).
11. Recover the metal by carefully pouring off the water. Spread the metal pieces on a paper towel to dry.

**Data Table:**

|  |  |
| --- | --- |
| 1. Mass of empty test tube | g |
| 2. Mass of metal + test tube | g |
| 3. Mass of Styrofoam cup | g |
| 4. Mass of Styrofoam cup + water | g |
| 5. Initial temperature of metal in boiling water | oC |
| 6. Initial temperature of water in Styrofoam cup | oC |
| 7. Final temperature of water and metal pieces | oC |

# Analysis: Be sure to show your work and include the units

1. Calculate the mass of the metal pieces in grams
2. Calculate the mass of the water in the calorimeter in grams
3. Calculate the change in temperature of the metal pieces
4. Calculate the change in temperature of the water in the calorimeter
5. Calculate the heat gained by the water
6. Find the heat lost by the metal
7. Calculate the experimental specific heat for the metal.
8. Look up in your textbook the accepted specific heat for this metal.
9. Calculate the percent error for your lab.

**Questions & Conclusions**:

1. What is specific heat?
2. How does a calorimeter allow researchers to calculate heat changes.
3. A 26.7 g sample of iron was placed in a calorimeter containing 250.0 mL of distilled water at 22.1 oC. If the equilibrium temperature of the calorimeter was 29.5 oC, how hot was the iron initially? Assume no heat loss to the environment or evaporation of the water from the calorimeter. Show your work. CFe= 450 J/kg \* C
4. What possible errors can be associated with this experiment?