

Name \_\_\_\_\_

Date \_\_\_\_\_

Period \_\_\_\_\_

Partners \_\_\_\_\_

### Specific Heat

#### **Pre Lab Discussion-**

The specific heat of a substance (C) is the amount of energy required to raise the temperature of 1 g of the substance by 1°C. In this laboratory exercise, a piece of metal will give off a certain amount of heat energy. The energy given off by the metal will be directly absorbed by some water such that:

The heat energy lost by the metal = the heat energy gained by the water

$$-\Delta Q_{\text{metal}} = \Delta Q_{\text{water}}$$

Heat lost by the metal = heat gained by the water

$$(C_{\text{metal}})(m_{\text{metal}})(\Delta T_{\text{metal}}) = (C_{\text{water}})(m_{\text{water}})(\Delta T_{\text{water}})$$

**I. Objective:** students will learn to calculate the specific heat of several different metals and calculate the percent error of these values.

**II. Materials & Equipment:**

1. Pb Al Cu Zn
2. Styrofoam calorimeter
3. balance
4. thermometer
5. hot plate
6. 100 mL graduated cylinder
7. 400 mL beaker
8. distilled water
9. beaker tongs
10. crucible tongs

**III. Procedure:**

1. **Mass and record the mass** of all of the pieces of metal separately.
2. In a 600 mL, boil about 350mL of distilled water.
3. Place all the pieces of metal in the boiling water for at least 2 minutes.
4. Using the 100 mL graduated cylinder, fill the Styrofoam calorimeter with exactly 100.0 mL of tap water.
5. Just before transferring the metal, **record the temperature of the water** in the calorimeter.
6. Carefully but quickly transfer the metal to the Styrofoam calorimeter using crucible tongs.
7. Gently stir with the thermometer while monitoring the temperature.
8. Record the final temperature of the water when the temperature stops rising.
9. Repeat steps 4-8 for each piece of metal.

Data Tables

Metal Symbol \_\_\_\_\_

Mass of Metal \_\_\_\_\_ grams

Temperature Initial of Calorimeter water \_\_\_\_\_ °C

Temperature Final of Calorimeter water \_\_\_\_\_ °C

Metal Symbol \_\_\_\_\_

Mass of Metal \_\_\_\_\_ grams

Temperature Initial of Calorimeter water \_\_\_\_\_ °C

Temperature Final of Calorimeter water \_\_\_\_\_ °C

## Calculations

1. Your lab group used 100.0mL of water. Using the density of water, determine the mass of water you used to 4 significant figures.
2. Determine the amount of heat energy in Joules that the water gained for each metal.

Metal\_\_\_\_\_

Metal\_\_\_\_\_

3. Water boils at 100.0°C at 1 atm of pressure. Determine the change in temperature of the metal assuming the initial temperature is 100.0°C and the final temperature is the same as the final temperature of the water in the calorimeter.

Metal\_\_\_\_\_

$\Delta T =$

Metal\_\_\_\_\_

$\Delta T =$

4. Since the amount for heat energy lost by the metal is the same as the amount of heat energy gain by the water, calculate the specific heat of each metal.

5. Determine your percent error for each metal. (Look up the actual value of you metals.)

## Questions

1. State the Law of Conservation of Energy.
2. When a hot metal is placed into cold water, what happens to the temperature of the metal?
3. When a hot metal is placed into cold water, what happens to the temperature of the water?
4. 50.0 grams of water at 10.0°C is added to 50.0g of water at 50.0°C are mixed in an insulated vessel. What is the final temperature?
5. 100.0g of hot lead is added to 100.0 grams of cold water. Compare the actual specific heats of both substances?
6. Based on the specific heats (since masses are held constant), which substance will have the largest temperature change?

Conclusion-