Specific Heat of a Metal Lab

Purpose

Determine the specific heat of a metal using a calorimeter. Identify the composition of the metal using the value of its specific heat.

Background

Specific heat is the amount of energy required to increase the temperature of 1 gram of a substance by 1 ºC (molar heat capacity is similar, but for 1 mole of a substance). Different substances require different amounts of energy to increase temperature, as shown in Table 1 below.
A calorimeter is an apparatus that traps energy inside a closed container. By using the energy released from a substance to warm surrounding water inside the calorimeter, the amount of energy transferred can be measured. This is done by comparing the temperature change of both the water and the substance.

Table 1: Specific heat and molar heat capacity of water and select metals

Substance	**Specific Heat (J/(g·°C))**	**Molar Heat Capacity (J/(mol·°C))**
Aluminum	0.902	24.3
Iron	0.450	25.1
Copper	0.385	24.5
Zinc	0.386	25.2
Brass (alloy of Cu/Zn)	0.377	----
Silver	0.235	25.3
Gold	0.129	25.4

I. Procedure: follow procedure given at front of room on overhead.

II. Data Collection/Observations (NO CALCULATIONS!)

Table 1: Initial Mass Measurements of Metal and Calorimeter

	Appearance of Sample	
A	Mass of Unknown Metal (g)	
B	Volume of Water (mL)	

Table 2: Temperature Measurements

C	Initial Temperature (T_i) of Water in Calorimeter (°C)	
D	Temperature of Hot Metal = Temperature of Boiling Water (°C)	
E	Final Temperature (T_f) of Metal + Calorimeter (°C)	

III. Data Analysis:

Table 3: Calculations of Mass and Temperature Change

F	Mass of Water in Calorimeter (g)	
G	ΔT *of Water*: $\Delta T = T_{final} - T_{initial}$ (°C)	
H	ΔT *of Metal:* $\Delta T = T_{final} - T_{initial}$ (°C)	

Calculations:

1) Calculate the specific heat of the metal using your specific heat equation. (Which is the isolated variable? Which temperatures should be used for ΔT?) Remember that the heat gained by the calorimeter is equal to the heat lost by the metal.

IV. Analysis Questions:

1. What is the identity of the metal you used in this experiment? _____

2. How do you know that is the metal? Could it be a different metal? Why or why not?

3. What is the percent error for the experimentally determined specific heat?

4. Name two sources of error. Would that cause your specific heat to be higher or lower? How do you know?

5. Based on the identity of the metal sample and the average specific heat value you determined, what is its molar heat capacity? (Units for molar heat capacity; ——)

6. How can the concept of molar heat capacity help explain why large bodies of water can dramatically affect local climate?