

Name: _____ Per _____

The Specific Heat Capacity of an Unknown Metal

Thermochemistry Lab

Purpose: In this lab you will calculate the specific heat capacity of a mystery metal from the calorimeter data and use the specific heat capacity to identify the metal.

Materials:

Mystery metal	Test Tube	600 mL Beaker	Graduated Cylinder
(2) thermometers	Hot Plate	Styrofoam cup with lid	Balance

Procedure:

1. Weigh approximately 30.0 g of your DRY metal sample to the nearest 0.01 g and **record the mass of the metal in table 1 below.**
2. Fill the beaker labeled room temperature water with approximately 500 mL of water. Leave this sitting out so that it can reach room temperature.
3. Fill a 600 mL beaker with tap water and heat the water on high continuously. Place the glass thermometer inside the beaker
4. Record the color, and the unknown # of your metal in the data table below.
5. Place your metal into the test tube and loosely stopper the test tube. **DO NOT** wedge the stopper in too tight, this will be very difficult to remove later, and you will need to do this quickly.
6. Place the test tube in the beaker of hot water with the thermometer. **Make sure that metal sits in the boiling water for at least 15 minutes!**
7. Put exactly 50.0 mL of the room temperature (water that is in the beaker labelled room temperature) into the calorimeter. Record this volume in **Table 2.**
8. Read and record the temperature of the water in the calorimeter until it stabilizes. Record this temperature into **Table 3. The stabilized temperature will be the initial temperature of the water in the calorimeter.**
9. After the metal has heated for at least 15 minutes record the temperature of the boiling water (this is the temperature of the metal). Record the temperature in **Table 1.**

*****Read all of this step before performing anything****

10. Carefully remove the test tube from the water bath and remove the stopper and transfer only the metal to the calorimeter (Styrofoam cup). Put the lid on the calorimeter as soon as possible so you do not lose heat. Make sure that you do not accidentally add any hot water from the water bath. Add your thermometer to the calorimeter, and begin watching the temperature immediately (make sure you press start on the temperature probe). You must RECORD what the maximum temperature is before it starts to decrease. (The temperature may not rise more than a few degrees). Record the maximum temperature observed as the final temperature of the water and the final temperature of the metal (Table 1 and table 2).
11. Once your reaction is complete make sure that your hot plate is off. Leave the water in the beaker for the next group. Empty the metal sample out of the calorimeter, being sure not to dump any down the sink. DRY the unknown metal sample and put this back into the container. Get a clean up stamp when done.

Results:

Table 1: Metal Unknown # _____

Initial Mass of Metal	
Color of Metal	
Temperature of water in water bath= initial temperature of metal	
Final temperature of the metal	
ΔT	

Table 2: Water

Volume of Water in the Calorimeter	
Mass of Water in the Calorimeter	
Initial Temperature of the Water in the calorimeter (from Table 3)	
Final Temperature of the water	
ΔT	

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Calculations:

- Using the above data, determine how much heat the water absorbed.
(Make sure to use the correct sign for ΔH)
- Using the above information, determine how much heat the metal released.
(Make sure to use the correct sign for ΔH)
- Using the information that you just calculated, determine the specific heat capacity of the metal
- Using the table below and your observations of the metal, determine the identity of your unknown metal sample.

Metal	Specific Heat Capacity ($\text{J K}^{-1} \text{g}^{-1}$)
Li	3.561
Mg	1.024
Al	0.903
Fe	0.449
Ni	0.444
Zn	0.389
Cu	0.385
Ag	0.235
Au	0.129
Pb	0.128

- Fill out the following chart from your calculations above.

Variable	For the Metal	For the Water
Heat of Reaction (ΔH)		
Mass (m)-		
Specific Heat (c)-		$4.18 \frac{\text{J}}{\text{g}^\circ\text{C}}$
ΔT		

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Additional Questions:

1. In your own words, explain what you did in this lab in 2 to 3 sentences.
2. Give at least two possible sources of error for this experiment, and explain each source of error. It is not acceptable to state "Human Error" or "Calculation Error"
3. Why did you need to heat the metal for at least 10 minutes?
4. What is a calorimeter? Explain in your own words.
5. In this experiment, if the hot metal sample was wet, before it was transferred to the water in the calorimeter, how would this affect the experimental heat capacity of the metal? Explain your answer in terms of specific heat of water relative to that of the metal you used in this experiment.
6. A 10.0 g piece of metal at 100.0 °C is transferred to a calorimeter containing 50.0 mL of water initially at 23 °C. Calculate the specific heat capacity of the metal if the final temperature is 25.6 °C.