

Unit 2: Matter and Energy

Specific Heat of Metal Lab

Name _____

Block # _____

Introduction:

Metals have low specific heat capacities. This means that metals heat up quickly, and lose the heat quickly. In this experiment, a piece of metal will be heated and transferred into room temperature water. The Law of Energy Conservation states that energy is neither created nor destroyed. Therefore, the heat energy transferred from the metal will be equal to the heat energy absorbed by the water. The purpose of this lab is to calculate the amount of heat absorbed by the water and use it to calculate the specific heat of the metal.

Procedure:

- 1.) Record the mass of a metal sample in the data table.
- 2.) Turn on a hot plate to the highest setting.
- 3.) Place the metal on the hot plate for about 10 minutes.
- 4.) Record the mass of a Styrofoam cup in the data table.
- 5.) Add approximately 100 ml of tap water to the cup.
- 6.) Record the exact mass of the water in the data table.
- 7.) Place a thermometer in the cup of water and record the initial temperature of the water.
- 8.) Use a digit infrared thermometer to measure the temperature of the metal sample on the hot plate.
- 9.) Remove the thermometer from the cup of water.
- 10.) Use tongs to carefully transfer the hot metal sample into the cup of cool water.
- 11.) Place the thermometer back into the cup of water but be careful not to touch the metal.
- 12.) Set the cup aside so that it won't tip over.
- 13.) Record the final temperature of the mixture after 5 minutes. ($T_{\text{final water}} = T_{\text{final metal}}$)
- 14.) **Clean up:** Pour the water in the sink. Return the thermometer and metal sample to the teacher.

Data Table:

Type of Metal	
Mass of Metal	
Initial Temp of Metal	
Final Temp of Metal	
Mass of Styrofoam Cup	
Mass of Water	
Initial Temp of Water	
Final Temp of Water	

Definitions:

(Q) Heat is _____.

- Heat is measured in units of **Joules** or **calories**. (_____ Joules = _____ calories)
- Q stands for the **quantity of heat** based on the change in temperature.
- Q is **positive**, when heat is _____, and **negative**, when heat is _____.

(m) Mass is _____.

(s) Specific Heat is _____.

*Specific Heat is measured in units of **J/g °C** or **cal/ g °C**.

(T) Temperature is _____.

* **Tf** = final temperature and **Ti** = initial temperature

Calculations:

1. Calculate the quantity of heat absorbed by the water when the hot metal was added.
(The specific heat of water is 4.184 J/g °C.)

$$+Q_{\text{water}} = m_{\text{water}} \times s_{\text{water}} \times (Tf_{\text{water}} - Ti_{\text{water}})$$

2. According to the Law of Energy Conservation, the amount of heat absorbed by the water is equal to the amount of heat transferred from the metal. Therefore, **+ Q water = - Q metal**. Using the answer from #1 above calculate the specific heat of the metal.

$$- Q_{\text{metal}} = m_{\text{metal}} \times s_{\text{metal}} \times (Tf_{\text{metal}} - Ti_{\text{metal}})$$

3. Use the internet to find the actual specific heat of the metal sample. Calculate the percent error for this experiment. **The actual specific heat = _____ J/g °C.**

$$\frac{|\text{actual} - \text{experimental}|}{\text{actual}} \times 100 = \%$$