

Chemistry - Laboratory #4
Specific Heat of an Unknown Metal

Goal

The goal of this lab is to determine the identity of an unknown metal sample by determining the metal's specific heat capacity.

Research Questions

1. What is the definition of specific heat capacity? Is specific heat capacity a physical or chemical property? Explain your answer.
2. What equation is used to calculate specific heat capacity? Explain what each symbol means.
3. What is a system? What are surroundings? What are the system and surroundings in this experiment?
4. Where are metals listed on the periodic table? What are the two other kinds of elements listed on the periodic table that aren't metals? Where are they located?
5. Here is a sample problem similar to yours! Solve it AND IDENTIFY THE METAL!

A 9.8 g sample of an unknown metal was heated to 98.0 °C. It was then dumped into a calorimeter containing 100.00 g of water at a temperature of 19.8 °C. The final temperature of the system and surroundings was 20.5 °C. What was the specific heat of the metal? What is the identity of the metal?

Background/Introduction

Energy (heat) is either absorbed or given off in nearly all chemical and physical changes. If heat is absorbed, the process is endothermic. If heat is given off, the process is exothermic. In the laboratory, the heat flow is measured in an apparatus called a calorimeter. A calorimeter is a thermally insulated vessel equipped with a cover in which there are holes for a thermometer and a stirrer.

The specific heat of a substance is the amount of energy needed to change the temperature of one gram of a substance by one degree Celsius. It is a characteristic property of matter and may be used to identify substances.

In this experiment, you will need to heat the metal sample to 100 °C and then transfer it to the calorimeter. Knowing the specific heat of the water, mass of the water, and temperature change of the water, you will be able to calculate the amount of heat absorbed by the water. The law of conservation of energy assures you that the amount of heat absorbed by the water will be equal to the amount of heat given off by the metal. If you know the mass and temperature change of the metal, you can then calculate its specific heat capacity.

There are a few things you will need to work out:

- how to heat the metal sample indirectly without getting it wet or melting it
- how to heat the entire sample to the same temperature
- what measurements and masses you will need to take
- how to minimize the loss of heat into the air

You will want to minimize the amount of distilled water you use. Only use enough to completely cover the metal when it is transferred to the calorimeter and to cover the tip of a thermometer bulb (but we will be using digital thermometers, so about 2.5 cm [1 inch] of water should be sufficient).

You will calculate the precision of your answer compared to the other groups in your class that had your metal. You will calculate percent error based on what metal you think you had.

The answer part of your conclusion will need to be what metal you had. The process used to conclude its identity (including your calculated answer of the specific heat capacity) should also be included and described in your "I know this because" sentence. A list of metals you considered and why you considered them may also be included. Other properties of the metal may be used to determine the identity of the metal, but specific heat capacity **MUST** be included as part of your decision.

