SPECIFIC HEAT

Reminder – Goggles must be worn at all times in the lab

PRE-LAB DISCUSSION:

The amount of heat required to raise the temperature of a solid body depends on its change in temperature (ΔT), its mass (m), and an intrinsic characteristic of the material forming the body called specific heat. The heat is calculated from the equation

When two bodies in an isolated system, initially at different temperatures, are placed in direct contact with each other, in time they will come to equilibrium at some common intermediate temperature. Because of energy conservation, the quantity of heat lost by the hot object is equal to that gained by the cold object provided that no heat is lost to the surroundings. This is the basis for the method of calorimetry through mixture: A metal sample is heated in boiling water to 100 °C. It is then quickly transferred to a Styrofoam calorimeter cup which contains a known volume of water of known temperature. When the metal specimen and the calorimeter (including the water) come to equilibrium, the final temperature is measured with a thermometer. It is assumed that the heat loss to the Styrofoam cup and thermometer is negligible and if the heat exchange with the environment is kept small, then the heat lost by the metal sample is equal to the total heat gained by the water.

PURPOSE:

The purpose of the lab is to apply the experimental methods of calorimetry in the determination of the relative specific heats of water and a metal.

MATERIALS

Metal samples
Styrofoam cup
100 mL graduated cylinder
Hot Plate
Milligram balance
Crucible tongs
Thermometer

PROCEDURE:

1. Set up a hot plate, and begin heating approximately 200 mL of water in a 400 mL glass beaker. Heat the water to boiling.
2. Get a metal object from the counter. Determine its mass, and record the results in the data section.
3. Lower the metal object into the water with your crucible tongs. Be careful not to drop the piece of metal into the beaker (you might crack the beaker).
4. Obtain a Styrofoam cup "calorimeter" and add to it a mass of water EQUAL to the mass of the metal piece. Remembering that the density of water is 1 gram per mL, record the mass of the water in your data table.
5. Place the thermometer in the Styrofoam cup, and record the initial temperature of the water.
6. When the metal object has been in the boiling water for 3 minutes, quickly move the metal to the Styrofoam cup using tongs. Do not allow the thermometer to come in direct contact with the piece of brass.
7. Record the temperature when the water and metal reach thermal equilibrium.
8. When done with everything, return the metal and the Styrofoam cup to the counter. Do not attempt to empty the hot water beaker until it has cooled enough to allow safe handling of the beaker. This will usually be at least 30 minutes!

RESULTS

Observations and Data:

	Trial #1
1. Mass of the metal object	g
2. Volume of water in the calorimeter	mL
3. Initial temperature of water in calorimeter	°C
4. Initial temperature of metal	100 °C
5. Final (highest) temperature of calorimeter	°C

Sketch:

In the results section of your lab, sketch a picture a picture of a thermometer, such as the one shown on the left.

On the left side of the thermometer, indicate where the initial temperatures of the metal and water were, as well as the final temperature where they came to equilibrium.

In your abstract, you need to address the relative specific heats of the two substances involved.

When water and a metal of equal mass come in contact, which experiences the smaller temperature change? Which experiences the greater temperature change? The substance that experiences the SMALLER temperature change has the LARGER specific heat. That is, it takes more energy to change the temperature of that substance. The substance that experiences the LARGER temperature change has the SMALLER specific heat.