Specific Heat Lab

Name_____

Background information:

When heat is transferred from a warmer object to a cooler one, the law of conservation of energy predicts that the amount of heat gained by the cooler object will equal the amount of heat lost by the warmer object. But the temperature increase of one object will not necessarily equal the temperature decrease of the other object. This is because different materials differ in their ability absorb or conduct heat. This property is called specific heat. Specific heat measures the number of calories needed to raise the temperature of the object by a certain amount. More specifically, the specific heat of an object is the number of calories needed to raise one gram of the substance one degree Celsius. The higher the specific heat, the more heat it takes to raise the objects temperature. The lower the specific heat, the greater the temperature change with the addition of heat.

In this investigation, a hot metal mass will be placed in cool water in a calorimeter. Heat will be transferred from the hot metal to the water and the specific heat of the metal will be calculated.

Materials:

Celsius thermometer
triple-beam balance
Calorimeter
Hotplate
250-ml beaker
metal cubes and holders

Procedure:

1.) Using the triple-balance, find the mass of the inside cup of the calorimeter and put the information in the chart below.
2.) Partially fill the calorimeter cup with cool water and find the mass of the calorimeter cup and the water combined. Put this information also in the chart.
3.) Compute the mass of the water and put this information in the chart.
4.) Record the temperature of the water using the thermometer. Allow it to sit a few minutes to insure that you have an accurate reading and record this information in the chart as the starting temperature of the cool water.
5.) Take one of the cubes of metal from the boiling water and quickly place it in your calorimeter. Allow the temperature of the metal and water to stabilize and record the final temperature of the water and metal.
6.) Mass the metal on the triple-beam balance and then put it carefully back in the boiling water.
7.) Repeat this procedure with the other two metals.
8.) Complete the chart on the next page.

Data Table:

	Metal #1	Metal #2	Metal #3
Mass of Calorimeter (m_c)			
Mass of Calorimeter and water			
Mass of Water (m_w)			
Starting Temperature of Water			
Starting Temperature of metal			
Final Temperature of the water			
Final Temperature of the metal			
Change in temperature of the water (ΔT_w) (it is also ΔT_c)			
Change in temperature of the metal (ΔT_m)			
mass of the metal (m_m)			

1.) Calculate specific heat of each metal cube using the calorimeter and the following equation: (Show all of your work.)

$$m_w c_w \Delta T_w + m_c c_{al} \Delta T_c + m_m c_m \Delta T_m = 0$$

$$c_w = 1 \text{ cal/g-C°} \quad c_{al} = .22 \text{ cal/g-C°}$$

Metal #1

Metal #2

Metal #3

Identify the metals:

Using the chart of specific heats of different substances given your group, identify which metal each of your cubes is.

Metal #1

Metal #2

Metal #3

Critical Thinking and Applications:

1.) How close were your answers to the actual specific heats of the metals?
(give a percentage error)

2.) What variables could have caused inaccuracies in your answers?

3.) Water has a very high specific heat (c_w = 1 cal/g-C°). The specific heat of ethanol is lower and is c_{al} = .59 cal/g-C°. If you spilled boiling alcohol on yourself instead of boiling water, would there be any difference in the severity of the burn compared to that of the boiling water? Explain your answer.

4.) In general, how is the temperature change of a material related to its specific heat? Support your answers with examples from the experiment.