PHYS 102 Specific Heat Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Purpose: To determine the specific heat of metals by calorimetry.

Apparatus: Styrofoam calorimeter, metal objects, temperature sensor, PC w/interface, electronic balance, hot plate, beakers (small & big), and thread.

NOTE: Follow procedure 1, in order for the boiling water to be ready, before going through the theory.

Theory:



In this experiment metal objects, one at a time, will be heated in boiling water (temperature = 1000C) and transferred to the Styrofoam cup with water. The rise in temperature will be measured with a temperature sensor. In order to calculate the specific heat you need to derive an expression for the specific heat of the metal, Cm in terms of measurable quantities.

1. Write down an expression for the heat loss by the metal object = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(Use the following measurable quantities: Mm = mass of the metal object, Cm = specific heat of the metal object, temperature of the hot metal = 1000C, and Tf = final temperature of water).

2. Write down an expression for the heat gain by water = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(Use the following measurable quantities: Mw = mass of water, Cw = specific heat of water, Tf = final temperature of water, Ti = initial temperature of water).

Equating Heat loss by metal to Heat gain by water will give an expression for, Cm:

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| accepted specific heat (cal/g.C0) | Al0.215 | Fe0.11 | Cu0.093 | Pb0.031 | Water1.0 |

Procedure:

1) Fill the big beaker with water (about 2/3 full), place it on the hot plate, and bring the water to boil.

2) Find the mass of a metal object.

3) Get some cold tap-water in the small beaker. Place the Styrofoam cup on the scale (without the lid), and tare it. Pour cold water inside, about half-full, and find the mass of water. Place the lid.

4) Lower the metal object into the boiling water by means of a thread. Be sure the object is completely immersed and not to touch the bottom or sides of the beaker. You need to hold the metal in the hot water for about 2-3 minutes.

5) While you are holding the metal in the hot water, let your partner measure the initial temperature of the water in the Styrofoam cup.

6) To measure temperature:
a. Make sure that the power for the interface is turned on.
b. Plug in the temperature sensor to analog input A, white arrow on top.
c. Open **PASCO Capstone** software from the desktop.
d. Click **Hardware Setup** under Tools on the left, click on the interface input where the sensor is connected and select **Temperature Sensor**. Click **Hardware Setup** again to close it.
e. Double-Click **Digits** under Displays on the right, click **Select Measurement**, and select **Temperature**.
f. Click **Record**.

7) Place the temperature sensor inside the calorimeter cup and record the temperature of the water, Ti.

8) Open the lid and transfer the metal object from the hot water, quickly to the calorimeter cup. Stir the water and watch the temperature until the temperature peaks. Record this peak temperature, Tf.

9) Enter your data in Excel, and calculate the specific heat of the metal, including accepted values and %error. If the % error is high consult the instructor.

10) Repeat procedures 2-9 for other metal objects, using fresh cold-tap-water each time.

11) Attach the data table, and write a conclusion.