Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Date:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Time:\_\_\_\_\_\_\_\_\_\_\_

Partner's Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Course:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
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Specific Heat

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

Apparatus: Styrofoam cup, calorimeter jacket and lid, metal objects, temperature sensor, PC w/interface, electronic balance, hot plate, beaker, 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/gm.C0) | Al 0.215 | Fe 0.11 | Cu 0.093 | Pb 0.031 | Water 1.0 |

Procedure:

1) Fill the 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 and find the mass of the styrofoam cup.

3) Get some tap-water (about 1/2 full) in the Styrofoam cup and find the mass of the water and cup.

4) Set the Styrofoam cup inside the calorimeter jacket and close the lid.

5) 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 of the beaker. You need to hold the metal in the hot water for about 2-3 minutes.

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

To measure temperature:   
a. Make sure that the power for the interface is turned on.  
b. Plug in the temperature sensor to analog channel A, white arrow on top.  
c. Double-click the "DataStudio" icon in the desktop.  
d. Click "Create Experiment".  
e. Scroll down the sensors and click on "Temperature Sensor".  
f. Double-click the "Digits Display" and click "start".

7) Place the temperature sensor inside the calorimeter cup and record the temperature of the water, Ti , to the nearest tenth of a degree.

8) Transfer the metal object from the hot water, quickly to the calorimeter cup. Stir the water and watch the temperature until the temperature peaks and starts to drop. Record this peak temperature. (Tf)

10) Calculate the specific heat and compare it with the accepted value.

11) If the % error is high consult the instructor.

12) Repeat procedures 2-11 for other metal objects, using fresh cold-tap-water each time.

13) Enter your data in Excel, and calculate the specific heat of the metals, including accepted values and %error.

14) Attach a hard copy of the data table, and write a conclusion.