# Calorimetry

#### **PURPOSE:**

To determine the specific heat of copper by using Calorimetry.

#### **PROCECURE:**

- 1. Mass the inner calorimeter cup and copper cylinder.
- 2. Put just enough tap water into the inner calorimeter cup to cover the copper cylinder when the cylinder is lying in the cup. Mass the cup and water combination to determine the mass of water in the cup.
- 3. Place this inner cup into the large aluminum can using the fiber spacer to hold it in place.
- 4. Place a thermometer in the water and allow it to equilibrate with the water. After this has happened, record the temperature of the water/cup combination. Note that the temperature of the water may not be the same as that of the air. Keep the thermometer in the water. You will need it there soon.
- 5. Tie one end of a piece of string around the cylinder and tie the other end of the string to the wood dowel. The cylinder should rest horizontally when suspended from the string. Adjust the length of the string so that the cylinder is just barely suspended off the bottom of the can when the dowel is resting on the rim of the can.
- 6. Put enough water into the large can so that it completely covers the cylinder when the cylinder is suspended by its string.
- 7. Place the large can with water and suspended copper cylinder on the ring stand and start heating it with the Bunsen burner. The flame should be blue, not yellow. BE CAREFUL TO NOT BURN YOURSELF. It should take about 6 minutes for the water to start boiling. Once it starts boiling take its temperature and record this value.
- 8. After the water has been boiling for about a minute, transfer the cylinder to the inner calorimeter cup, cut the string, and cover the can with the plastic cap that is provided. Do this quickly AND safely.
- 9. Stir the contents. Watch the temperature rise. When the temperature reaches its maximum value, record this temperature.
- 10. Shut off the Bunsen burner and let the hot stuff cool. THE RING STAND STAYS HOT FOR A LONG TIME, SO USE GLOVES TO HANDLE IT.
- 11. Use Calorimetry and the equation below to determine the specific heat of copper.

## $c_{cu} = [m_w * c_w + m_{Al} * c_{Al}] (T_F - T_C) / [m_{cu} * (T_H - T_F)]$

Where:

 $c_{cu}$  specific heat of copper  $m_w$  is the mass of the water in the Inner Cup in Kg  $c_w$  is the specific heat of water  $m_{Al}$  is the mass of the Inner Aluminum Can  $\mathbf{c}_{\mathbf{Al}}$  is the specific heat of the Inner Aluminum Can

- $T_F$  the final temperature equilibrium temperature in degrees Celsius measured in step 9
- $T_C$  the initial temperature in degrees Celsius of the Inner can and the water measured in step 4  $m_{cu}$  mass of the copper cylinder in Kg.

 $T_{\rm H}$  temperature of the boiling water and hot cylinder in degrees Celsius measured in step 7.

12. Compare this to the accepted value by calculating a percent error. If you follow instructions and do the experiment carefully, the error should be under 20%. If it is not, then you need to redo it. Call me over before you do this.

### **Constants Values needed:**

- 1. Specific Heat of water  $(c_w) = 4186 \text{ J/Kg}^{\circ}\text{C}$
- 2. specific heat of copper  $(c_{cu}) = 387 \text{ J/Kg}^{\circ}\text{C}$
- 3. specific heat of aluminum  $(c_{Al}) = 900 \text{ J/Kg}^{\circ}\text{C}$