SPECIFIC HEAT

The method of mixtures is used to determine the specific heat of a metal. Water in a calorimeter (Styrofoam cup) is warmed by a solid as the solid cools.
The heat gained or lost by a substance when it undergoes a change in temperature is calculated as **$Q = mc\Delta T$**, where Q = Joules of heat, m = mass of metal in grams, c = the specific heat in J/kg•°C, and ΔT is the change in temperature.

According to the law of heat exchange, the total amount of heat lost by a hot object equals the total amount of heat gained by the cold object with which it comes in contact. Consequently, in this experiment the total heat lost by the solid on cooling equals the heat gained by the water and calorimeter as they are warmed.

PURPOSE:

Using specific heat capacity to identify using the heat capacity two unknown metals to within 15% difference?

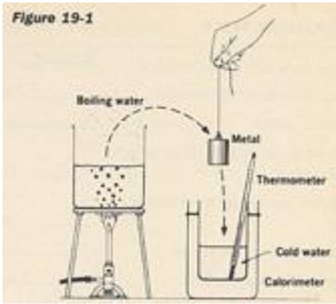
HYPOTHESIS:

Guess as to the identity of the metals used based only on physical characteristics such as density and colour.

PROCEDURE:

1. Use tongs lower a piece metal into the beaker of boiling water. Leave the sample in the boiling water for at least 5 minutes.
2. While the sample is heating to boiling, determine the mass of the Styrofoam cup and record it.
3. Fill the cup **3/4 FULL** with tap water (write on data sheet).
4. Mass the cup **3/4 FULL** of water and subtract the cup's mass (Write on data sheet).
5. Take the temperature of the water.

   WARNING: Thermometers have pointy ends! Do not shove them hard into the cups. They will poke holes!



6. Take and record the temperature of the boiling water with the thermometer. Since the metal is being heated in the boiling water, the metal's original temperature is the temperature of the boiling water (Write on data sheet).
7. Remove the sample from the boiling water and place it in the cup as shown in Figure 19-1.
8. **Gently** stir with the thermometer and measure its highest reading. This is the final temperature for both the metal and the water (Write on the data sheet).
9. Measure the mass of the metal sample in kilograms and record it in the data table below (write on data sheet).
10. Repeat the above for another sample.

DATA: **Metal # 1** ______________________________

Mass of Empty Cup		
Mass of Cup and Water		
Mass of Just the Water (kg)		**m_w**
Temperature of cup water (°C)		**T_{1w}**
Temperature of metal and water (°C)		**T_{2w}**
Change in water's temperature (°C)		**ΔT_w**
Calculate the amount of heat the water collects	$Q_w = m_w$ (4180 J/kg °C) ΔT_w	
		Q_w =
Temperature of hot metal (°C)		**T_{1m}**
Temperature of metal and water (°C)		**T_{2m}**
Change of Metal's Temperature (°C)		**ΔT_m**
Mass of metal (kg)		**m_m**
Heat released by the metal $Q_m = - Q_w$		**Q_m**
Calculate the heat capacity of the metal	$c_m = \dfrac{Q_m}{m_m \Delta T_m}$	
		c_m =

DATA: **Metal # 2** ______________________________

Mass of Empty Cup		
Mass of Cup and Water		
Mass of Just the Water (kg)		**m_w**
Temperature of cup water (°C)		**T_{1w}**
Temperature of metal and water (°C)		**T_{2w}**
Change in water's temperature (°C)		**ΔT_w**
Calculate the amount of heat the water collects	$Q_w = m_w (4180 \text{ J/kg }^{\circ}\text{C}) \Delta T_w$	
		$Q_w =$
Temperature of hot metal (°C)		**T_{1m}**
Temperature of metal and water (°C)		**T_{2m}**
Change of Metal's Temperature (°C)		**ΔT_m**
Mass of metal (kg)		**m_m**
Heat released by the metal $Q_m = - Q_w$		**Q_m**
Calculate the heat capacity of the metal	$c_m = \frac{Q_m}{m_m \Delta T_m}$	
		$c_m =$

ANALYSIS:

1. If you were to place a piece of metal into an oven that is at a temperature of 350°C and leave it there for an hour, what is the heat of the metal?

2. How much heat is required to raise the temperature of 1.0 kg of iron by 1.0°C?

3. The accepted values of the specific heats are in your textbook. Calculate your percentage difference for each metal.

$$\% \, diff = \frac{|your\ value - accepted\ value|}{\left(\frac{your\ value + accepted\ value}{2}\right)} x\ 100$$

Metal #1	Metal #2

4. What are 3 reasons your calculated value for c of the metals did not match the accepted value of c for the metals? These sources of error should not be mistakes in measuring but limitations in the way the lab is set up.