Raw Data Sheet

Student Name: ____________________

Team members:
1.- ____________________ 2.- ____________________

3.- ____________________ 4.- ____________________

Instructor: ____________________

Heat capacity of metals

Follow the instructions given by your TA and collect the following information.

Table 1.- Data collected to estimate the heat capacity for various metals. Columns left to right represent: metal name, metal mass, water mass, metal initial temperature, water initial temperature, final equilibrium temperature.

Metal	M_m(g)	M_w(g)	T_{mi}(°C)	T_{wi}(°C)	T_{ef}(°C)

Heat capacity of Water

Follow the instructions on page 75 in the manual and record your observations.

Table 2.- Data collected to estimate the heat capacity of water. Columns left to right represent: water mass, ice mass, ice initial temperature, water initial temperature, final equilibrium temperature.

M_w(g)	M_i(g)	T_{ii}(°C)	T_{wi}(°C)	T_{ef}(°C)

Introduction

Analysis

In what follows, c_w and c_{pm} represent the specific heat capacities, in J g^{-1} K^{-1}, for water and metal samples respectively.

Heat Capacity of Metals

In this section, we first develop a formula for the specific heat of metals c_{pm} in terms of the quantities that we have measured: the initial temperatures of the water (T_{wi}), ice (T_{mi}), equilibrium temperature (T_{ef}) and the mass of the metal (M_m) and water (M_w) samples. Next, we use our formula and our data to obtain numeric values for the specific heats.

1. **Metal cools down**. Without using any numbers yet, use equation 12.4 to write an expression for the change in internal energy of the metal (ΔU_m) when its temperature drops from its initial temperature (T_{mi}) to its equilibrium temperature (T_{ef}).

2. **Water warms up**. Without using any numbers yet, use equation 12.4 to write an expression for the change in internal energy of the water (ΔU_w) when its temperature rises from its initial temperature (T_{wi}) to its equilibrium temperature (T_{ef}).

3. Assume that all energy lost by the metal is gained by the water ($\Delta_w = -\Delta_m$) and use the expressions derived in the previous two parts to obtain a formula for c_{pm} in terms of c_w.

4. Look for the accepted value of the specific heat capacity of your metal samples and record them in Table 3 –note the source in your references.

5. Use your formula for c_{pm} and the data collected in Table 1 to estimate the specific heat capacities of the various metal samples. Show your work here; report your results in Table 3 (below).

6. For your metal samples, calculate the percentage difference between your estimate and the accepted value of the specific heat capacity. Explain any discrepancies here and report your results in Table 3 (below).

Table 3.- Results for the specific heat capacity of metals. Columns left to right represent: metal name, accepted value, experimental value, percentage difference.

Metal	c_t (J g^{-1} K^{-1})	c_d (J g^{-1} K^{-1})	diff %

Heat Capacity of Water

Similarly to what you did in the previous section, here you first derive a formula for the heat capacity of the water (c_w) and then use your formula and data to get a numerical value for c_w. Your formula should be written in terms of the initial temperatures of water (T_{wi}), ice sample (T_{ii}), equilibrium temperature (T_{ef}), and the masses of ice (M_i), and water (M_w) samples.

1. **Ice melting**. During this process, there is no external work done on the ice. Hence the change in internal energy of the ice is equal to the heat required to melt the ice. Use equation 12.5 to write an expression for the heat required to melt the ice, in terms of L_i, and the mass of the ice sample (M_i).

2. **Warming up of melted Ice**. During the melting of the ice, its temperature does not change (all the energy is used to melt it). However once it has melted, its temperature will change until it is in equilibrium with its environment.
   Use equation 12.4 to write an expression for the change in internal energy of the melted ice when its temperature increases from its initial temperature (T_{ii}) to the equilibrium temperature (T_{ef}).

3. **Change in water sample**. When the ice sample was introduced, the water sample was originally at room temperature (T_{wi}). The ice first melted and then reached the equilibrium temperature (T_{ef}) with the original water sample. Use equation 12.4 to write an expression for the change in the internal energy of the water sample during these processes in which its temperature drops from T_{wi} to T_{ef}.

4. Assume that the energy required to first melt the ice and then increase its temperature to the equilibrium temperature is provided by the water sample and use your previous results to write a formula for the heat capacity of water.

5. Use your Formula, your data from Table 2, and the value for the latent heat of ice ($L_i = 333$ J g^{-1}) to estimate the value for the specific heat capacity of water.

6. Compare your estimate of the specific heat of water to the accepted value of $c_w = 4.186$ J g^{-1}K^{-1}. Give your answer as a relative percentage difference. Explain any discrepancies.

Conclusions

(Write a concise paragraph that reflects on the procedure used to collect the data and the results obtained.)

Questions

1. In your own words explain what is specific heat.

2. From your lab manual answer question 2.