Pre-Lab 7
Heat and Temperature

Purpose:

- Observe the ***first law of thermodynamics***: that energy is conserved.
- Investigate the ***transfer of heat***.
- Determine ***the heat of fusion*** of ice
- Determine ***the heat of neutralization*** of acids and bases.

Theory:

1. **Heat** is another **form of energy**, and can be quantified with familiar units, ***joules***.

2. The **transfer of heat** can be calculated by measuring **a change in the temperature**,

3. The **heat capacity** of a material tells you **how much heat energy** is **required** to **cause a change in temperature**. The heat capacity depends on **how much the material** there is and is therefore referred to as the **specific heat capacity**.

Some **specific heat capacities** of materials:

water has a relatively high specific heat (4.184 J/℃*gr am)

copper has a relatively low specific heat (0.378 J/℃ *gr am)

****To raise the temperature of water by 1 ℃ would take more than **11×** the energy required to raise the temperature of the same mass of copper by 1 ℃.

4. A **calorie** is defined as the **amount of heat** required to **raise the temperature of 1 gram** of **water** by **1℃** . Strictly speaking, the **specific heat of water** is equal to **1 calorie/℃*gram** .

****We will make volumetric measurements using graduated cylinders, so the **effective heat capacity** for all our experiments is **1 calorie/℃*mL. (the density of water is equal to 1g/mL)**

5. **Heat of fusion** - how much **heat** is required to **melt ice**; therefore the heat absorbed for the action of melting an amount of ice. **(calories/gram)**

6. **Heat of neutralization** – amount of heat **given off** in the reaction of an acid with a base.

$HCl\ (aq) + NaOH\ (aq) \rightarrow NaCl\ (aq) + H_2O\ (l) + heat$

PRE-LAB PROBLEMS

1. How much heat is required to raise the temperature of 20 grams of water by 3 °C?

_____(include units)

2. How much heat is required to raise the temperature of 50 grams of water by 4 °C?

_____(include units)

Equation 1 (Eq. 1) $\Delta T = T_{final} - T_{initial}$
It can be positive or negative!!!!!

Equation 2 (Eq. 2) Heat transferred (calories) = Heat capacity (1calorie/ ℃ mL) x vol (mL) x ΔT (℃)

*****The **quantity of heat** that we observe in each experiment **is** the **product** of the **heat capacity, volume, and the change in temperature**.

3. Can the volume ever be negative? _____

4. Can the heat capacity be negative? _____

5. Can the temperature change be negative? _____

6. Can the heat transferred be negative? _____

7. You are given a glass (180 mL) of cold water (T = 5°C) which you allow to come to room temperature (25 °C). If you have a heat capacity of 1 calorie/°C mL, what is the heat gained from this process?

8. You are given a glass (180 mL) of hot water (T = 35°C) which you allow to come to room temperature (25 °C). If you have a heat capacity of 1 calorie/°C mL, what is the heat lost from this process?