Chemistry **Name ______________________**

Endothermic & Exothermic Dissolving Processes Lab Makeup **Date _____________ Block ___**

Background:

All physical changes and chemical reactions are accompanied by an energy change. The energy change is usually made evident by a heat effect. If a physical change or a chemical reaction produces heat energy the process is EXOTHERMIC. In an exothermic process the surrounding gains the heat that is released. When methane gas is burned, the system loses energy as the surroundings gain this energy. The combustion reaction results in the surroundings being considerably hotter. The amount of heat lost is equal to the decrease in chemical potential energy of the reactants when they formed products. For an ENDOTHERMIC process the reverse is true. If the surroundings are cooled in the course of the reaction it is because heat is being absorbed to form the products and the products have a greater chemical potential (stored) energy than the original reactants. The chemical “Cold Packs” used by injured athletes illustrate a chemical reaction with is endothermic.

In this experiment a water calorimeter (insulated cup containing water) will be used to contain the heat involved in a dissolving process. It is assumed that no heat will leak into or out of the calorimeter. In the exothermic process, the heat gained by the water in the calorimeter (the surroundings) is equal to the decrease in potential energy of the chemicals (the system) as they dissolve. In the endothermic process, the heat lost by the water in the calorimeter (the surroundings) is equal to the increase in potential energy of the chemical in the dissolving process.

Purpose:

The purpose of the exercise it to determine the heat of solution for two solids. You will be assigned one exothermic process and one endothermic process.

Procedure: ***Reading what your classmates did in the lab will be helpful to answer questions!***

1. Assemble a calorimeter from Styrofoam cups and a beaker. These cups are easily tipped. Do not leave a thermometer sitting in the cups. Always hold the thermometer with your hand.
2. Measure precisely 50 mL of water and pour it into the calorimeter.
3. Weigh out about five (5) grams of a compound into a small beaker. Record the mass of the compound to the nearest 0.01 grams. Record the formula of the compound.
4. Measure the temperature of the water to the nearest 0.1C. Add the compound to the water and stir so that it will dissolve rapidly. Record the maximum or minimum temperature reached during the dissolving process.
5. Repeat the process with another 50 mL of water and a second compound.

Data Table:	**Trial 1**	**Trial 2**
Formula of Compound	**$CaCl_2$**	**NH4Cl**
Mass of Compound	**5.05 g**	**5.23 g**
Mass of water	**50.5 g**	**50.0 g**
Water temperature (initial)	**20.0◦C**	**20.2◦C**
Water temperature (final)	**33.0◦C**	**13.5◦C**
Temperature change (increase or decrease)	____________	____________

For each set of data answer the questions below. Use another piece of paper.

1. Calculate the change in temperature of the water solution. Did the water temperature increase or decrease?

2. Determine the amount of heat energy gained (or lost) by the water in calorie units. Convert this to joule units.

3. Why did the water gain (or lose) heat energy?

4. Energy is neither created nor destroyed. As the water gained energy the compound is losing chemical bonding (potential) energy. (Also, as the water loses energy the compound is gaining in chemical bonding energy.) Is the dissolving process of the compound (heat of solution) an exothermic or endothermic process? Explain.

5. Is the ΔH (change in chemical bonding energy) decreasing or increasing?
   (i.e. is ΔH negative or positive?)

6. Calculate the number of moles of your compound that dissolved.

7. How much energy did your compound lose (or gain)? Since the dissolving process occurred in a calorimeter we will assume that the heat energy gained by the water (the surroundings) is equal to the chemical bonding energy lost by the compound (the system).
   And vice versa.

8. Determine how much heat energy would be released (or absorbed) in joules for 1.00 mole of the compound. *First divide your answer to question 7 by your answer to question 6. Then, convert this into kilojoules/mole*.

9. Write the thermochemical equation. This is the chemical equation that includes the energy released (or absorbed) during the dissolving process of 1.00 mole of the compound. *Note: If the dissolving process is exothermic then energy is released and is a product of the reaction. If the dissolving process is endothermic then energy is absorbed and is required with the reactants for the reaction to occur.*

10. Sketch the Energy Diagram (*from our* notes) for each of the dissolving processes. Include the Heat of Solvation (dissolving) – *this is your answer to question 8 in kJ/mol*.