Chemistry 1210
Thermochemistry

Date: _____ Names:_____ Section: _____

_____

OBJECT: To determine the enthalpies of reaction for three chemical reactions and to use these data to verify Hess' Law of Enthalpy Summation.

PROCEDURE:

OBSERVATIONS:

DATA:

Part 1:Determination of the heat capacity of the calorimeter

	Run 1	Run 2
Mass of empty calorimeter		
Mass of calorimeter and water		
Initial temperature of water		
Final temperature of water		
Mass of calorimeter, water, and ice		
Calculated mass of ice		
ΔT (warm water)		
ΔT (ice water)		

Part 2:The enthalpy of solution of solid sodium hydroxide.

$NaOH(s) \rightarrow NaOH(aq)$

	Run 1	Run 2
Mass of empty calorimeter		
Mass of calorimeter and water		
Calculated mass of water		
Mass of weigh boat and NaOH		
Mass of empty weigh boat		
Calculated mass of NaOH		
Initial temperature of water		
Final temperature of solution		
Calculated mass of final solution		
ΔT		

Part 3: The enthalpy of neutralization of solid sodium hydroxide.

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

	Run 1	Run 2
Mass of empty calorimeter		
Mass of calorimeter, HCl, and water		
Calculated mass of HCl and water		
Mass of weigh boat and NaOH		
Mass of empty weigh boat		
Calculated mass of NaOH		
Initial temperature of HCl solution		
Final temperature of solution		
Calculated mass of solution		
ΔT		

Part 4: The enthalpy of neutralization of aqueous sodium hydroxide.
$NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$

	Run 1	Run 2
Mass of empty calorimeter		
Mass of calorimeter and HCl solution.		
Calculated mass of HCl solution		
Initial temperature of HCl solution		
Initial temperature of NaOH solution		
Final temperature of the solution.		
Mass of calorimeter and solution		
Calculated mass of NaOH solution		
ΔT for HCl solution		
ΔT for NaOH solution		

CALCULATIONS:

I. Determination of the heat capacity of the calorimeter

1. Calculate the energy required to melt the ice. One mole of ice requires 6010 J to melt.

2. Calculate the energy absorbed by the ice water as it warms up to T_{final}.

3. Calculate the energy lost by the warm water as it cools to T_{final}.

4. Calculate the energy lost by the calorimeter as it cools to T_{final}. *(Hint: What should all these heats add to give?)*

5. Calculate the heat capacity of the calorimeter. Give your answer in J/°C.

II. Determination of the enthalpies of reaction

Show the calculations for **both runs** *in the space provided.*

Part 2: Reaction 1 NaOH(s) → NaOH(aq)

1. The heat energy change of the calorimeter.

2. The heat energy change of the solution.

3. The number of moles of NaOH used.

4. The enthalpy of reaction. Also calculate the average enthalpy.
(Hint: Use unrounded numbers when calculating the average enthalpy.)

Part 3: Reaction 2 $NaOH(s) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$

1. The heat energy change of the calorimeter.

2. The heat energy change of the solution.

3. The number of moles of NaOH used.

4. The number of moles of HCl used.

5. The enthalpy of reaction. Also calculate the average enthalpy.

Part 4: Reaction 3 $NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$

1. The heat energy change of the calorimeter.

2. The heat energy change of the HCl solution, and the heat energy change of the NaOH solution, and the total heat energy change of both solutions.

3. The number of moles of NaOH used.

4. The number of moles of HCl used.

5. The enthalpy of reaction. Also calculate the average enthalpy.

III. Verification of Hess' Law:

In the space provided below, write out the three chemical equations performed in the lab. Show that one of the three reactions is the sum of the other two by chemically adding the two reactions together. Next, show that this summation is confirmed by the summation of the ΔH values that you have determined. Finally, calculate the percent deviation between the two supposedly equal values.

RESULTS:

In the summary table below, state your ΔH values for all three reactions.

	Run 1	Run 2	Average
Reaction 1			
Reaction 2			
Reaction 3			

CONCLUSION: