AP LAB 05d: Enthalpy of Neutralization ($\Delta H^\circ_{neutralization}$)

Aim To calculate a value for the standard enthalpy of neutralization

Apparatus Insulated cups (the calorimeter), thermometer, graduated cylinder

Chemicals 2.00 M hydrochloric acid solution, 2.00 M sodium hydroxide solution

Method

1. Using a graduated cylinder, place 50.0 mL of 2.00 M HCl solution into an insulated cup.

2. Allow a thermometer to sit in the acid solution for a few minutes and then record the initial temperature of the 2.00 M HCl solution.

3. Using a graduated cylinder, place 50.0 mL of 2.00 M NaOH solution into a second insulated cup.

4. Allow a thermometer to sit in the base solution for a few minutes and then record the initial temperature of the 2.00 M NaOH solution.

5. **Carefully** combine the contents of the two cups in a single cup.

6. Keep stirring the mixture for several minutes, and record the **highest** temperature reached.

7. Repeat the steps 1-6, this time using only 30.0 mL of each solution.

Results

With 50.0 mL of each solution

	HCl	NaOH
Initial temperature		
Average initial temp of the solutions **(before mixing)**		
Temp of solutions **(after mixing)**		
Change in temp		

With 30.0 mL of each solution

	HCl	NaOH
Initial temperature		
Average initial temp of the solutions **(before mixing)**		
Temp of solutions **(after mixing)**		
Change in temp		

Conclusion/Calculation

1. The heat capacity of the calorimeter is known to be 11.0 J/°C. Using that information, and your data, calculate the energy change in the surroundings ($q_{surroundings}$), in each of your experiments.

   (Assume the density of all solutions to be 1.00 g/mL and their specific heat capacity to be 4.18 J/gK)

With 50.0 mL of each solution	With 30.0 mL of each solution

2. What sign should be associated with $q_{surroundings}$? Explain.

3. What does your answer to Q2 suggest about the chemical reaction (q_{system})? Explain.

4. By using your answers in Q1, and given the definition below, calculate the **standard enthalpy of neutralization for each experiment**.

"The standard enthalpy of neutralization is the enthalpy change per mole of water, formed in a reaction between an acid and a base"

With 50.0 mL of each solution	With 30.0 mL of each solution