Experiment 5. Determination of Enthalpy of neutralization an Acid-Base reaction

$$\Delta \boldsymbol{H_{neut}}$$

Introduction

When a reaction takes place at constant pressure, the heat measured (Qp) is equivalent to the change in enthalpy (ΔH) of the reaction, which is commonly referred to as the heat of reaction. The heat released or absorbed by a reaction can be determined by measuring the temperature change of the calorimeter. Exothermic reactions release heat and have a negative ΔH value (ΔH< 0). Conversely, reactions that absorb heat are classified as endothermic, with ΔH having a positive value (ΔH> 0).

Heat of neutralization

The heat of neutralization is the energy released when one mole of an acid interacts with one mole of a base to generate one mole of water. The reaction of a strong acid with a strong base is an exothermic reaction that produces water and heat as products.

$$H_3O^+{}_{(aq)} + \ OH^-{}_{(aq)} \ \rightarrow \ \ 2H_2O_{(l)} + heat$$

The heat of neutralization is given by the following equation, and it is generally expressed in units of kJ/mol of acid (or base) reacted and the mass (grams) of the solution equals the combined masses of the acid and base solutions.

$$\boldsymbol{Q_p} = \Delta \boldsymbol{H_{neut}} = \frac{\boldsymbol{Q}}{\boldsymbol{n}}$$

Where:

- **Q** : The heat released by the reaction.
- $\boldsymbol{Q_p}$: The heat of neutralization
- $\Delta \boldsymbol{H_{neut}}$ **:** The enthalpy of neutralization
- **n :** The number of mole

The objective of the experiment

The objective of this experiment is to determine the heat of neutralization of a strong acid (HCl) with a strong base (NaOH) using calorimetry.

Materials and Chemicals

Materials

- Calorimeter with mixer
- Thermometer
- Becher
- Analytical balance

Chemicals

- Distilled water
- HCI 0.5 M
- NaOH 0.5M

Experimental Procedure

1. Using a graduated cylinder, take 50mL of NaOH solution.

2. Put it in the calorimeter.

3. Close the calorimeter, then measure with a thermometer the temperature of the (calorimeter + NaOH solution), and let it be $\mathbf{T_1}$.

4. Also, with using a graduated cylinder, take 50mL of HCl solution.

5. Add it to the calorimeter.

6. Close the calorimeter and wait for thermal equilibrium to be achieved, and take a temperature reading of the system (NaOH + HCl + calorimeter), let it be $\mathbf{T_{eq}}$.

7. If the obtained results are in the table.

	Substance	Mass of mixture HCI+NaOH (g)	Initial Temperature T_1 (K)	Equilibrium Temperature T_{eq} (K)
		50+50	290	293

Questions

1. Calculate the number of moles.

2. Calculate the heat released by the reaction **Q**.

3. Calculate the heat of neutralization $\boldsymbol{Q_p}$

3. Calculate the $\Delta H_{neutralization.}$

4. Predict the reaction type and justify

We give :

K_{cal} = 61. 51 J/g. K

C_{H2O} = 4.185 J / g .K