Experiment 5. Determination of Enthalpy of neutralization $\Delta \boldsymbol{H_{neut}}$

Introduction

When a reaction takes place at constant pressure, the heat measured ($\mathbf{Q_p}$) is equivalent to the change in enthalpy ($\mathbf{\Delta H}$) 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 of the solution equals the combined masses of the acid and base solutions.

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

Where:

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

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	Chemicals
• Calorimeter with mixer • Thermometer • Beaker	• Distilled water • HCl 0.5 M • NaOH 0.5M

Experimental Procedure

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

2. Put the NaOH solution into the calorimeter.

3. Close the calorimeter, then measure 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 the HCl solution into 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 $\mathbf{T_{eq}}$.

Questions

1. Record the obtained results in the table.

Mass of NaOH (g)	Mass of HCl (g)	Total Mass (g)	Temperature T_1(K)	Temperature T_{eq} (K)

2. Calculate the number of moles.

3. Calculate the heat released by the reaction $\mathbf{Q_1}$.

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

5. Predict the reaction type and justify

6. Write the equation reaction with the enthalpy change.

Given : K_{cal} = 61. 51 J/g. K, C_{H2O} = 4.185 J / g .K, M_{NaOH} = 40 g/mol, M_{HCl} = 36.5g/mol