

Experiment 5. Determination of Enthalpy of neutralization ΔH_{neut}

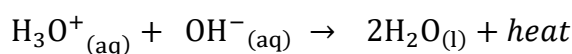
Introduction

When a reaction takes place at constant pressure, the heat measured (Q_p) 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 ($\Delta H < 0$). Conversely, reactions that absorb heat are classified as endothermic, with ΔH having a positive value ($\Delta H > 0$).

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.



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.

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

Where:

- Q_p : The heat released by the reaction
- ΔH_{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
<ul style="list-style-type: none">• Calorimeter with mixer• Thermometer• Beaker	<ul style="list-style-type: none">• 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 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 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 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 : $K_{cal} = 61.51 \text{ J/g} \cdot \text{K}$, $C_{H_2O} = 4.185 \text{ J/g} \cdot \text{K}$, $M_{NaOH} = 40 \text{ g/mol}$, $M_{HCl} = 36.5 \text{ g/mol}$