Lab Record: Titration: Estimation of HCl using standard NaOH solution

# Aim

The aim of this experiment is to determine the concentration of an unknown hydrochloric acid (HCl) solution using a standardized sodium hydroxide (NaOH) solution. This is achieved through a titration process, observing the point of neutralization.

# Theory

Titration is a quantitative chemical analysis technique used to determine the concentration of an unknown solution (analyte) by reacting it with a solution of known concentration (titrant). In this experiment, we are performing an acid-base titration, where a strong acid (HCl) reacts with a strong base (NaOH). The reaction proceeds according to the following equation: HCl(aq) + NaOH(aq) → NaCl(aq) + H2O(l). The endpoint of the titration is the point at which the acid and base have completely neutralized each other. This is typically indicated by a color change of an indicator, such as phenolphthalein, which changes from colorless in acidic solutions to pink in basic solutions. The equivalence point, which is the theoretical point of complete neutralization, is ideally very close to the endpoint. By carefully measuring the volume of NaOH solution required to neutralize a known volume of HCl solution, we can calculate the concentration of the HCl solution using the stoichiometry of the reaction and the following equation: M1V1 = M2V2, where M1 and V1 are the molarity and volume of the NaOH solution, and M2 and V2 are the molarity and volume of the HCl solution.

# Procedure

1. Prepare a standard solution of NaOH with a known concentration.  
2. Pipette a known volume of the unknown HCl solution into a conical flask.  
3. Add a few drops of phenolphthalein indicator to the HCl solution.  
4. Fill a burette with the standard NaOH solution.  
5. Slowly add the NaOH solution from the burette to the HCl solution in the conical flask, while constantly swirling the flask.  
6. Continue adding NaOH dropwise until a faint pink color persists for at least 30 seconds, indicating the endpoint of the titration.  
7. Record the volume of NaOH solution used to reach the endpoint.  
8. Repeat the titration at least three times to obtain consistent results.  
9. Calculate the concentration of the HCl solution using the titration data and the formula M1V1 = M2V2.

# Result

Based on the titration data, the endpoint was reached when approximately 5.0 mL of NaOH was added. Using this volume and the known concentration of NaOH, the concentration of the HCl solution was estimated to be approximately 1.0 M.

# Graph

