EXPERIMENT NO. 4

Quantitative Analysis

Read through the whole method before starting any practical work. Where appropriate, prepare a table for your results in the space provided.

Show your working and appropriate significant figures in the final answer to **each** step of your calculations.

1 In this experiment you will determine the concentration of a solution of hydrochloric acid by titration with an alkali.

FA 1 is a solution containing 6.00 g dm^{-3} of sodium hydroxide, NaOH.
FA 2 is hydrochloric acid, HC*l*.
thymolphthalein indicator

(a) Method

Dilution of FA 2

- Pipette **10.0 cm^3** of **FA 2** into the 250 cm^3 volumetric flask.
- Make the solution up to the mark using distilled water.
- Shake the solution in the volumetric flask thoroughly.
- This solution of hydrochloric acid is **FA 3**. Label the volumetric flask **FA 3**.

Titration

- Fill the burette with **FA 1**.
- Pipette **25.0 cm^3** of **FA 3** into a conical flask.
- Add several drops of thymolphtalein indicator.
- Perform a **rough** titration and record your burette readings in the space below.

final burette reading/cm^3	28.90
initial burette reading/cm^3	2.80
titre/cm^3	26.10

The rough titre is .....26.10..... cm^3.

I	
II	
III	
IV	
V	
VI	
VII	

- Carry out as many accurate titrations as you think necessary to obtain consistent results.
- Make sure any recorded results show the precision of your practical work.
- Record in a suitable form below all of your burette readings and the volume of **FA 1** added in each accurate titration.

final burette reading/cm^3	31.40	36.20	
initial burette reading/cm^3	5.60	10.40	
titre/cm^3	25.80	25.80	
Best titres	✓	✓	

[7]

(b) From your accurate titration results, obtain a suitable value for the volume of **FA 1** to be used in your calculations.
Show clearly how you obtained this value.

$\frac{25.80 + 25.80}{2}$

25.0 cm^3 of **FA 3** required ....25.80..... cm^3 of **FA 1**. [1]

(c) Calculations

(i) Give your answers to **(ii)**, **(iii)** and **(iv)** to the appropriate number of significant figures. [1]

(ii) Calculate the number of moles of sodium hydroxide, NaOH, in the volume of **FA 1** calculated in **(b)**.

$n = \frac{m}{M_r}$

$= \frac{6.00 g dm^{-3}}{40}$

$0.150 mol dm^{-3}$

$n = CV$

$= 0.150 \times \frac{25.80}{1000}$

moles of NaOH = ... 3.87×10^{-3} mol [1]

(iii) Write the equation for the neutralisation of hydrochloric acid with sodium hydroxide. Include state symbols.

$HCl_{(aq)} + NaOH_{(aq)} \longrightarrow NaCl_{(aq)} + H_2O_{(l)}$

Deduce the number of moles of hydrochloric acid that reacted with the sodium hydroxide in **(ii)**. mole ratio is 1 : 1

moles of hydrochloric acid =..... 3.87×10^{-3} mol [1]

(iv) Calculate the concentration, in mol dm^{-3}, of hydrochloric acid in **FA 2**.

Conc. of HCl in FA3

$c = \frac{n}{V} = \frac{3.87 \times 10^{-3}}{25.0/1000}$

$0.1548 mol dm^{-3}$

Conc. of HCl in FA2

FA2 FA3

$C_1V_1 = C_2V_2$

$C_1 \times \frac{10.0}{1000} = 0.1548 \times \frac{250}{1000}$

Conc. of FA2 = $3.87 mol dm^{-3}$

concentration of HCl in **FA 2** = ... 3.87 mol dm^{-3} [2]

[Total: 13]