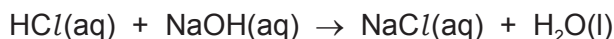# EXPERIMENT NO. 4

1 You will determine the concentration of a solution of hydrochloric acid by diluting it and then titrating the diluted solution against an alkali.

$$HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$$

FA 1 was made by dissolving 1.06 g of sodium hydroxide, NaOH, in distilled water to make 250 cm³ of solution.
FA 2 is hydrochloric acid, HCl.
bromophenol blue indicator

(a) Method

- Pipette 25.0 cm³ of **FA 2** into the 250 cm³ volumetric flask.
- Add distilled water to make 250 cm³ of solution and shake the flask thoroughly. Label this solution **FA 3**.
- Fill the burette with **FA 3**.
- Use the second pipette to transfer 25.0 cm³ of **FA 1** into a conical flask.
- Add about 10 drops of bromophenol blue.
- Perform a rough titration and record your burette readings in the space below. The end point is reached when the solution becomes a permanent yellow colour.

final burette reading/cm³	28.30
initial burette reading /cm³	2.50
titre /cm³	25.80

The rough titre is ..**25.80**.. cm³.

- Carry out as many accurate titrations as you think necessary to obtain consistent results.
- Make certain 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 3** added in each accurate titration.

final burette reading/cm³	38.70	34.90	43.00	
initial burette reading /cm³	13.50	9.70	18.05	
titre /cm³	24.90	25.20	24.95	
best titre	✓		✓	

I	
II	
III	
IV	
V	
VI	
VII	

[7]

(b) From your accurate titration results, obtain a suitable value for the volume of **FA 3** to be used in your calculations. Show clearly how you obtained this value.

$$\frac{24.90 + 24.95}{2}$$

25.0 cm³ of **FA 1** required ..**24.925**.. cm³ of **FA 3**. [1]

(c) Calculations

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

(i) Calculate the concentration, in $mol\,dm^{-3}$, of sodium hydroxide in **FA 1**.
Ar of Na: 23, O: 16, H: 1.

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

$$= \frac{1.06}{40} \quad 0.0265\,mol/250\,cm^3$$

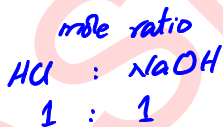$$c = \frac{n}{V} = \frac{0.0265}{250/1000}$$

$$\boxed{0.106\,mol\,dm^{-3}}$$

concentration of NaOH in **FA 1** = ...**0.106**...... $mol\,dm^{-3}$

(ii) Calculate the number of moles of sodium hydroxide present in $25.0\,cm^3$ of **FA 1**.

$$n = cV$$
$$= 0.106 \times \frac{25.0}{1000}$$

moles of NaOH = ...**2.65×10^{-3}**... mol

(iii) Deduce the number of moles of hydrochloric acid present in the volume of **FA 3** you have calculated in **(b)**.

mole ratio

$$HCl : NaOH$$
$$1 : 1$$

moles of HCl = ...**2.65×10^{-3}**... mol

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

Conc. of FA3

$$C = \frac{n}{V} = \frac{2.65\times10^{-3}}{24.925/1000}$$

$$\boxed{FA3: 0.106\,mol\,dm^{-3}}$$

Conc. of FA2

$$\underset{FA2}{C_1V_1} = \underset{FA3}{C_2V_2}$$

$$C_1 \times \frac{25.0}{1000} = 0.106 \times \frac{250}{1000}$$

$$\boxed{FA2 = 1.06\,mol\,dm^{-3}}$$

concentration of HCl in **FA 2** = ...**1.06**...... $mol\,dm^{-3}$

[5]

[Total: 13]