

Name ST 12.....

Date

Stoichiometry Expt : Volumetric Analysis (Acid-Base Titration)**Learning Objectives**

- Revise volumetric analysis practical (titration)
- Revise mole concept and stoichiometric calculation

Description

One very important area of chemistry is **volumetric analysis**, the determination of concentrations of solutions.

Titration is the process whereby a solution (of known concentration) is added from a burette to a known volume of a second solution in a conical flask, until the chemical reaction between the two is just completed. This is usually shown by a colour change in the resulting solution due to an indicator added.

You are to determine the concentration of hydrochloric acid using standard sodium hydroxide solution.

Chemicals & Apparatus:

You are provided with the following:

FA5	is hydrochloric acid of unknown concentration, HCl
FA6	is 0.200 mol dm ⁻³ sodium hydroxide solution, NaOH
	methyl orange indicator
	50 cm ³ burette, burette clip, funnel and retort stand
	25 cm ³ pipette and pipette filler
	250 cm ³ conical flasks x 2
	50 cm ³ beaker
	white tile and dropper

The colours and pH ranges of methyl orange is given below.

Indicator	pH range colour	End-point colour
Methyl orange	3 4 Red Yellow	Orange (Red + Yellow)

You should consider carefully the most effective way of handling the materials and apparatus in order to obtain the best results.

Procedure

- 1 Wash all the necessary glassware*

	Tap water	Distilled water	Solution they are to contain
Pipette	✓	✓	✓
Burette	✓	✓	✓
Funnel	✓	✓	✓
Conical flasks	✓	✓	-

- 2 Pipette 25.0 cm³ of **sodium hydroxide** into a conical flask and add 2 or 3 drops of **methyl orange** indicator.
- 3 Clamp the burette just high enough for the conical flask to be placed underneath, and fill it with **hydrochloric acid** using a funnel.
- Remove the funnel and adjust the bottom of the meniscus to the zero mark (or any convenient mark). Record down as the "initial burette reading" in the table 1.
- 4 Place the conical flask carefully under the burette. Place a white tile under the conical flask so that the colour changes of the indicator can be seen more clearly.
- 5 Titrate the alkali against the acid by releasing the titrant from the burette with your left hand. At the same time, swirl the conical flask with your right hand in order to ensure even mixing of the two solutions.
- 6 Keep titrating till the end-point is reached (i.e. when the indicator turns orange)
- 7 Note and record the volume of acid used. This first titration reading can be taken as a rough value to give you an indication of the **end point**.
- 8 Carry out further titrations to obtain two consistent readings (readings do not differ by more than ± 0.10 cm³). When approaching the endpoint, (as indicated by the rough titration), add the acid from the burette drop by drop, until one drop of the acid changes the colour of the indicator **permanently**. Record the burette readings in the table 1.

Recording : Table 1 Titration of NaOH with HCl

Titration number	1	2	3	
Final burette reading / cm ³				
Initial burette reading / cm ³				
Volume of HCl used / cm ³				
Consistent results (✓)				

Summary

_____ cm³ of **NaOH** required _____ cm³ of **HCl** for complete reaction.

Calculations

(a) Write the equation (with state symbols) for the reaction of NaOH with HCl.

(b) Calculate the amount of NaOH (in moles) in 25.0 cm³ of NaOH standard solution.

(c) Calculate the amount of HCl reacted during titration and hence calculate the concentration, in mol dm⁻³, of HCl in **FA2**.