Practical General Chemistry

Lecture notes

Medical laboratory Techniques Department

Al-Mustaqbal University College,

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First year students

Three Lecture: Titration

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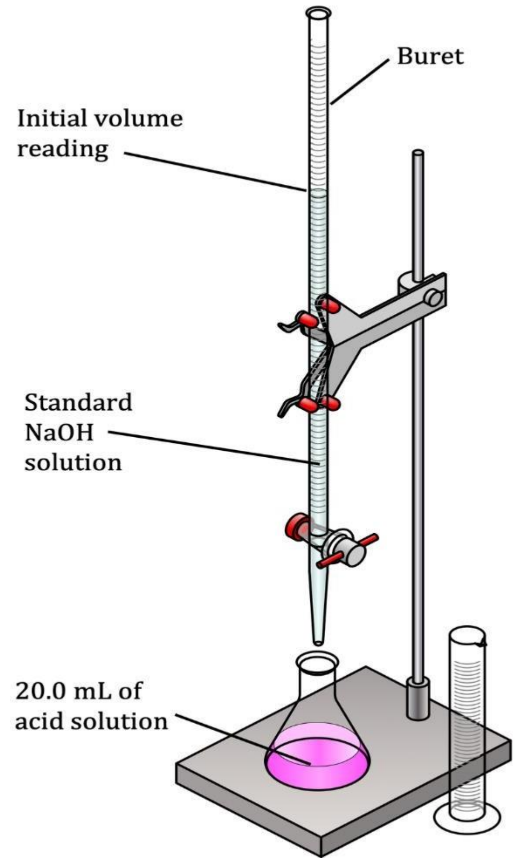
Titration

- A technique for determining the concentration of a solution by measuring the volume of one solution needed to completely react with another solution.

- Titration process involves addition of solution of known concentration from burette to the measured volume of analyte.

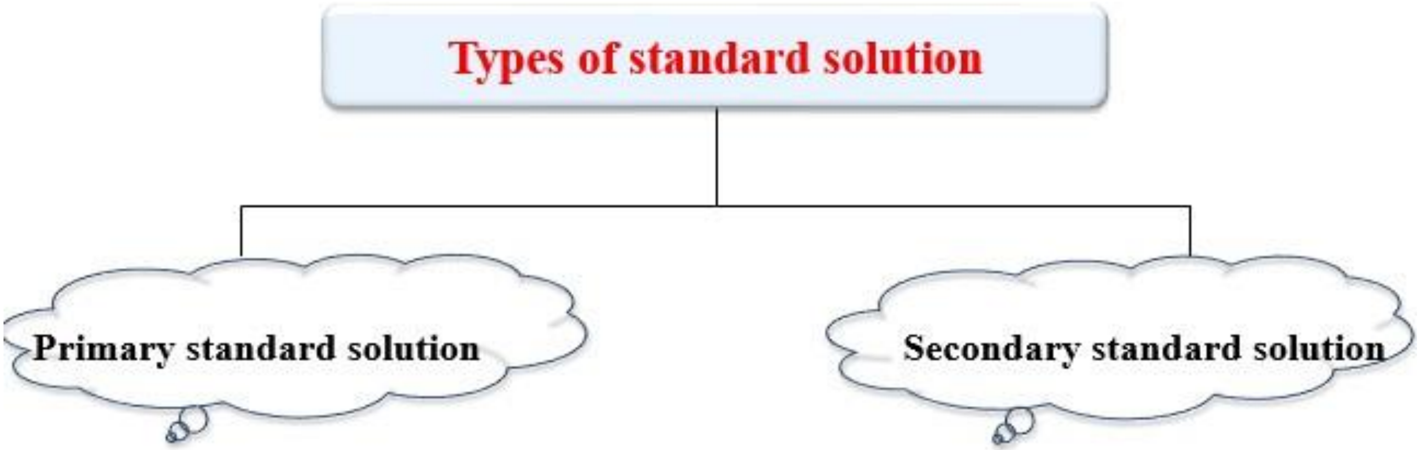


Principle of Titration: It is based on the complete chemical reaction between the analyte and the reagent (titrant) of known concentration.

Analyte: The solution of unknown concentration but known volume put in conical flask.

Titrant: The solution of known concentration put in burette.

Standard Solution: A solution of known concentration is called the standard solution.



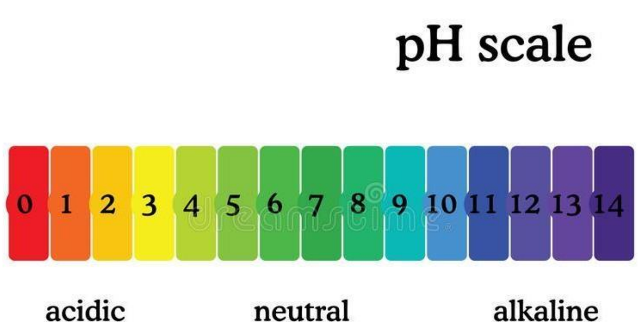
Primary standard solution It has certain properties	***Secondary standard solution*** It has certain properties
❑ Extremely pure.	❑ Less pure than primary standard.
❑ Highly stable.	❑ Less stable than primary standard.
❑ It should not be hygroscopic.	❑ Cannot be weighed easily.
❑ It should be stable toward air.	
❑ It should not undergo any side-reaction.	
❑ Can be weighed easily.	
❑ It should be available and not too expensive.	

Equivalence Point: It is a theoretical point where the amount of two reactants are just equivalent.

End Point: It is a practical point at which the reaction is observed to be complete, this point is usually observe with the help of indicator.

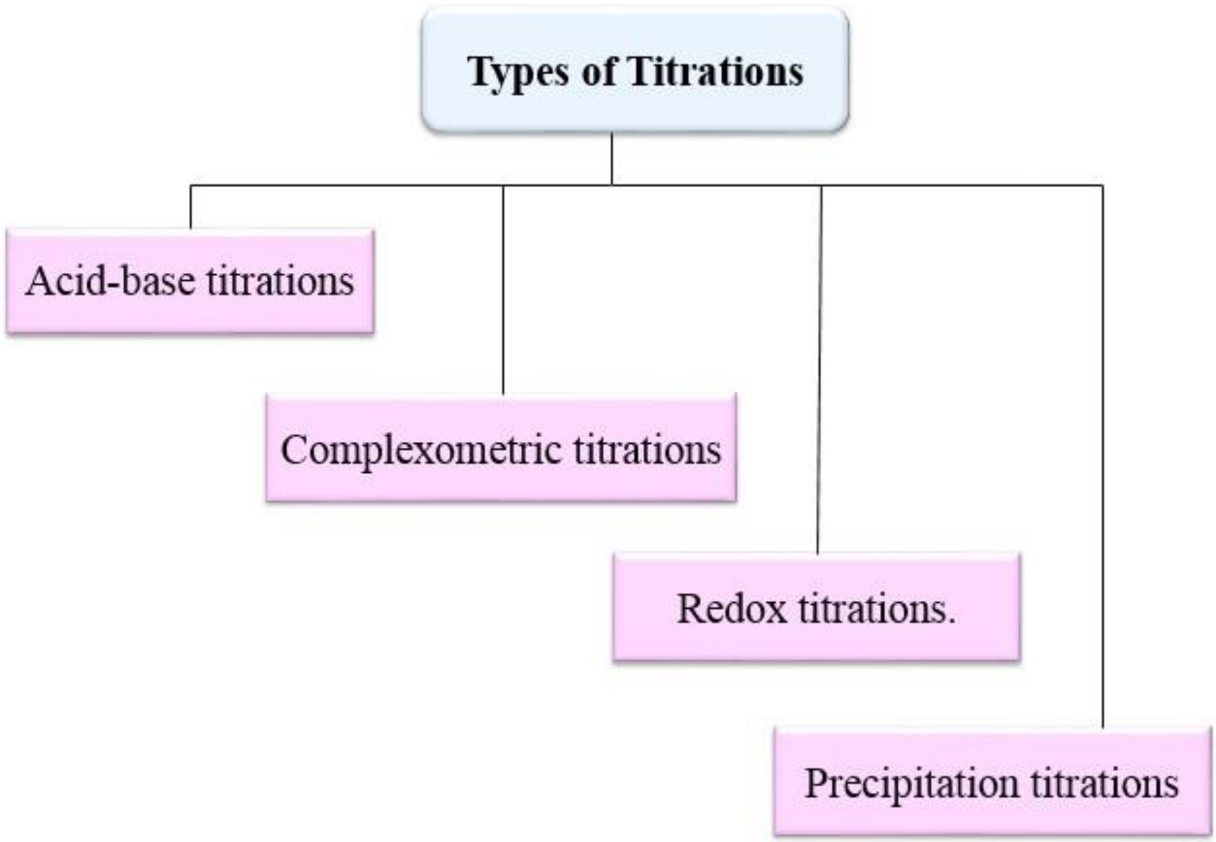
Indicator

An auxiliary substance (either weak acids or weak bases) which helps in the usual detection of the completion of the titration process at the end point. acid-base titrations, are generally used indicators. They change their color within a certain pH range.



acid-base indicator table

indicator	pH range	color for weak acid	color for conjugate base
methyl orange	4-6	orange	yellow
bromophenol blue	6-7	yellow	blue
thymol blue	8-9	yellow	blue
phenolphthalein	9-10	colorless	pink
alizarin yellow	10-12	yellow	red



Acid – base Titration (neutralization)

A sample of unknown concentration of acid is estimated with a known concentrated base or vice-verse.

In this experiment, we will quantitatively study an acid-base reaction. **Strong acids and strong bases dissociate completely in water.**

Determination normality of sodium hydroxide solution by a standard solution of hydrochloric acid.

HCl reacts with sodium hydroxide according to the following equation:

$$\textbf{Acid + Base} \longrightarrow \textbf{Salt + Water}$$

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

The eq.wt. of both the HCl and NaOH is equal to their molecular weights.

Note// Both the acid and base are **strong**, any **indicator** may be used.

Glassware

- Burette
- Stand
- Conical flask
- Funnel
- Beaker
- Pipette
- Graduated Cylinder
- Dropper
- Washing bottle.

Materials

- **HCl** solution (standard) known normality.
- **NaOH** solution of ***unknown*** normality.
- Phenol naphthalene indicator.

Procedure

Standardization of the NaOH solution by titrating with standard of HCl solution:

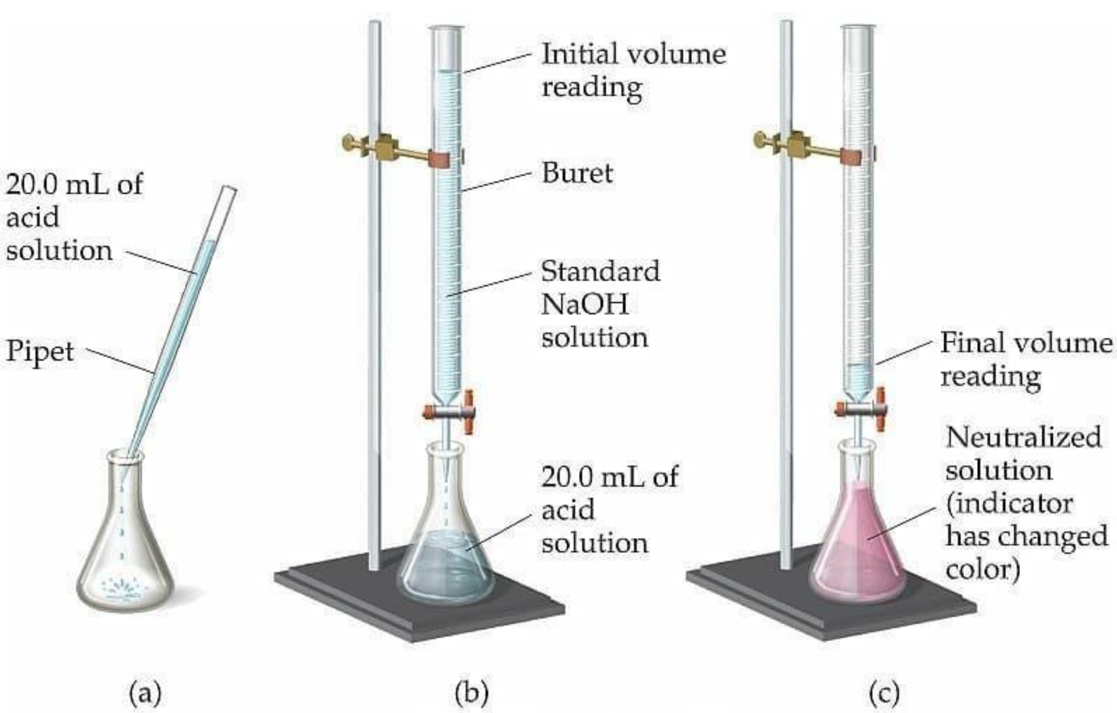
1- Transfer by a pipette **5 ml** of unknown **NaOH** solution to a conical flask.

2- Add to the conical flask two or three drops of phenol naphthalene indicator.

3- Fill the burette with **HCl** solution to zero mark.

4- Titrate NaOH against HCl until the color of solution changes from **colorless to pink**.

5- Repeat the experiment **three** times and record your results.



Calculations

1. Titrations results

Titrations	1(trial)	2	3
Final burette reading(ml)			
Initial burette reading(ml)			
Volume of HCI (ml)			

The volume of NaOH used in three times is **5 ml.**

2. Average volume of HCl used = (calculated from burette).

$$V\ average = \frac{V_1 + V_2 + V_3}{3}$$

3. Then the unknown concentration calculated by using the law:

$$(N_1 \times V_1)HCI = (N_2 \times V_2)NaOH$$