

Titrimetric Analysis!

→ quantitative technique based on measurement of volume.

It measures the volume of one solution required to react completely with a definite volume of another solution.

Titration :- The process of addition of definite volume of one solution of known concentration to definite volume of another solution of unknown concentration.

→ classical method, fast, accurate, convenient.



1) **Titrant** :-

Reagent added from burette, usually concentration of this solution is known.

2) **Titrand** :-

Analyte (compound of interest) to which titrand is added.

Solution in conical flask whose conc. is usually not known.

3) **Equivalence point** :-

The point at which the reaction b/w titrand and titrant is complete.

4) **Indicator** :-

External reagent added in order to judge the completion of reaction.

5) **End point** :-

Point at which the indicator signals completion of reaction by change in its

colour.

Ideally, indicator should change its colour at equivalence point.

In actual practise, indicator doesnot show colour change at equivalence point.

c) Titration Error :-

The difference between the end-point and equivalence point.

$$\text{Titration error} = (\text{End point} - \text{Equivalence point})$$

Ideally titration error = 0

* For a reaction to be used in titrimetry :-

- ① Reaction should occur as per stoichiometry. There should not be any side reaction.
- ② Under the given conditions of titration, the reaction should be rapid and should go to completion.
- ③ At equivalence point/end-point, there should be a marked change in physical and chemical parameters of reactant or product.
- ④ A suitable indicator should be available to signal the completion of reaction.

* Standard Solution :-

a solution for which the exact concentration or strength is known.

Standardization is the process of determination of exact concentration of the solution.

A standard solution is used to determine the strength of solution whose strength is not known by the process standardization.

* Condition of Standard Solution :-

- 1) concentration of standard solution is exactly known.

- 2) It should be able to maintain the concentration over a long period of time.
- 3) The reaction of standard solution with analyte should be stoichiometric. It should represent completely balanced equation.
- 4) Reaction should go to completion.
- 5) Reaction should be rapid.
- 6) A suitable indicator should be available to signal the end-point with minimum titration error.

Primary standard :- A substance which when dissolved to form a solution will provide concentration exactly as per the amount weighed.

:- Concentration calculated on the basis of amount weighed will be same as actual concentration of the solution.

* **Criteria of Primary Standard** :-

- 1) Substance should be 100% pure. If not, exact percentage purity should be known.
- 2) Substance should be stable and should not react with components of the environment.
- 3) Substance should retain its concentration over a long period of time.
- 4) It should be hygroscopic nor should it be deliquescent.
- 5) It should be easily available and should be of low cost.
- 6) In order to minimize the error in weighing, the substance should have high mol. wt. so that even for dilute solution large amount of solution will be required.

$$M = \frac{n}{V} = \frac{W}{\text{mol. wt} \times V}$$

$$\text{concentration} \propto \frac{1}{\text{Mol. wt.}}$$

• Titration is reaction b/w Titrant and Titrand based on volume.

*Based on Reaction, there are different types of titration :-

1) Acid-Base Titration :-

- Reaction between acid and Base to form salt and water.
- Reaction involving neutralization reaction.
- end-point is determined by suitable indicator.
- During the course of reaction, pH of solution change. Hence indicator used is called as acid-base indicator.
- Colour of such indicators depend upon the pH of the solution.

2) Precipitation Titration :-

- Reaction between titrant and titrand resulting in precipitation of a sparingly soluble salt.
- During the titration, concentration of ion being precipitated changes, indicators used are either adsorption indicator or indicator that will combine with ion and show colour change.
eg. silver salts.

3) Complexometric Titration :-

- The reaction involved in formation of complex between metal ion and complexing agent. (EDTA)
- indicators used are called as metallochromic indicator. They form coloured complex with the metal ions that are less stable than metal-agent complex.

4) Redox Titration :-

- Reaction between an oxidizing agent and reducing agent.
- Indicators are called as redox indicators. They are themselves oxidizing agent or

→ Indicators are called as redox indicators. They are themselves oxidizing agent or reducing agent capable of getting oxidized or reduced depending upon the nature of titrand.

→ The oxidized form and reduced form have different colour.

* Broadly they are classified into two groups:-

① **Group I**:- eg. Redox Titration

Reaction involving transfer of electrons.
change in valency or oxidation state.

② **Group II**:- eg. Acid-Base titration, Precipitation titration, Complexometric Titration
Reaction between ion/molecule but no change in valency or oxidation state.

	Acid-Base	Precipitation	Complexometric	Redox.
<u>Primary</u>	① Succinic acid ② Na_2CO_3 ③ Borax	① KCl ② AgNO_3	① ZnSO_4 ② MgCO_3 ③ As_2O_3	① $\text{K}_2\text{Cr}_2\text{O}_7$ ② Mn complex ③ FAS (II)
<u>Secondary</u>	① All acid (H_2SO_4 , HCl)	—	① EDTA	① $\text{Na}_2\text{S}_2\text{O}_3$.

Thank-You!