Al-Mustaqbal University College

Department of Radiology Techniques

First Stage

General Chemistry

Sixth Lecture

Volumetric Analysis

Asst. Lec.

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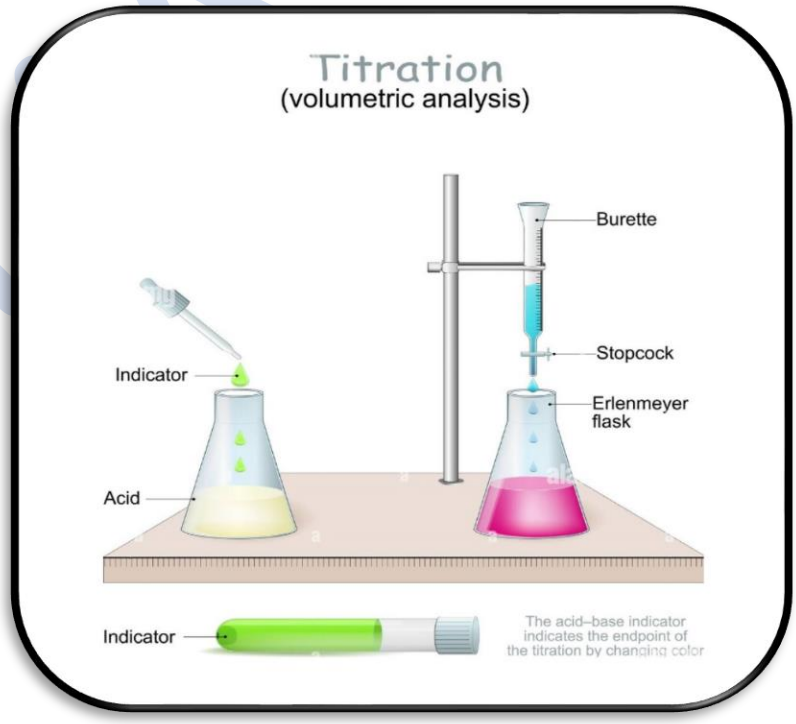
VOLUMETRIC ANALYSIS

Volumetric Analysis: is generally one of the **quantitative methods** that deal with determination of quantity (amount) of analyte (sample) by measuring **the volume**.

Volumetric analysis is carried in liquid media and is one of direct chemical methods. Volumetric analysis based on titration.

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.



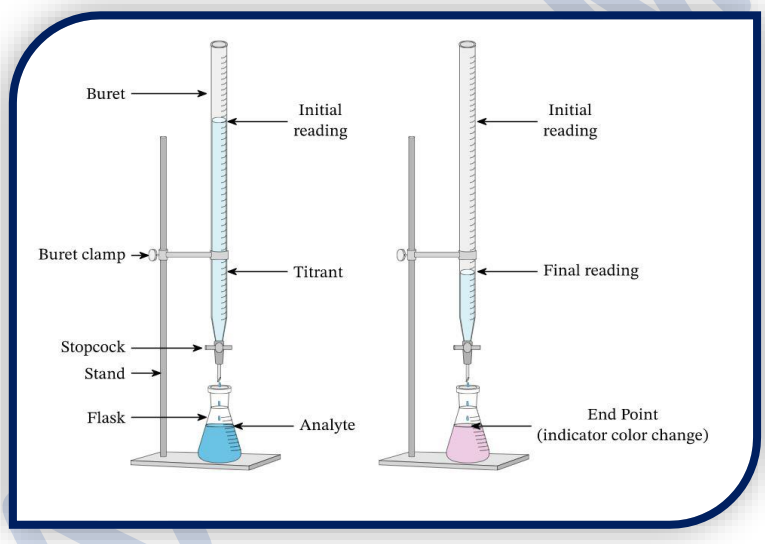
Equivalence Point

It is a **theoretical point** where the amount of two reactants is 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.

$$(N_1 \times V_1)_{\text{known}} = (N_2 \times V_2)_{\text{unknown}}$$



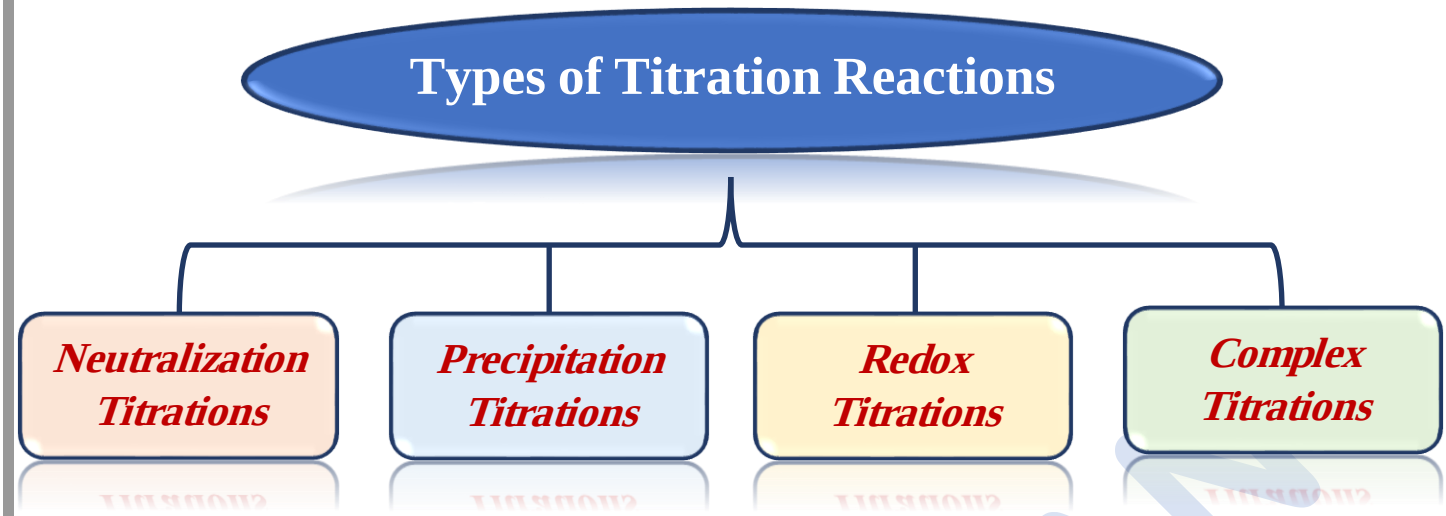
Titration Error

In volumetric methods the titration error E_t is given by:

$$E_t = V_{ep} - V_{eq}$$

Where V_{ep} is the **actual volume** of reagent required to reach the end point.

V_{eq} is the **theoretical volume** to reach the equivalence point.



1. ***Neutralization Titration:*** depend on a chemical reaction between the analyte and a standard reagent, (depend on the neutralization between an acid and a base when mixed in solution).

a- Strong Acid with Strong Base:

Hydrochloric acid and **sodium hydroxide** as typical of a strong acid and a strong base.

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

b- Strong Acid with Weak Base:

Hydrochloric acid as the strong acid and **ammonia** solution as the weak base.

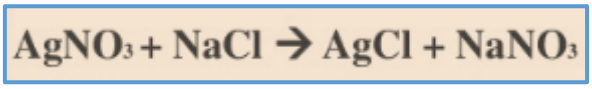
$$HCl + NH_3 \rightarrow NH_4^+ + Cl^-$$

c- Strong Base with Weak Acid:

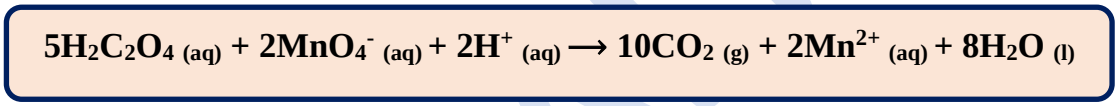
Acetic acid as the weak acid and **sodium hydroxide** as the strong base.

$$\mathbf{CH_3COOH_{(aq)} + NaOH_{(aq)} \longrightarrow CH_3COONa + H_2O}$$

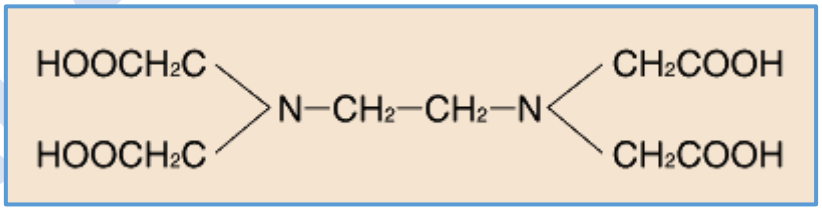
2. ***Precipitation Titrations:*** It involves the reaction leading to formation a precipitate, where the reacting substance and standard solution react to yield a precipitate or a slightly soluble salt as the primary reaction product.



3. ***Redox Titrations:*** These titrations involve oxidation-reduction reactions, where the reacting substance is oxidized or reduced by the standard solution.



4. ***Complex Titrations:*** It is based on complex formation reaction mainly EDTA titrations, where the reacting substance and the standard solution react to form a soluble but very slightly dissociated complex substance.



Theory of indicators

An **indicator** is a substance, which is used to determine the end point in a titration. In acid-base **titrations**, organic substances (weak acids or weak bases) are generally used as **indicators**. They change their colour within a certain **pH** range.

The colour change and the pH range of some common **indicators** are explained below:

Common Acid-Base Indicators			
Common Name	pH Range	Color of Acid Form	Color of Basic Form
Methyl Violet	0.5 – 1.5	Yellow	Blue
Thymol Blue	1.2 – 2.8	Red	Yellow
	8.0 – 9.6	Yellow	Blue
Methyl Yellow	2.9 – 4.0	Red	Yellow
Methyl	3.1 – 4.4	Red	Yellow
Bromcresol Green	3.8 – 5.4	Yellow	Blue
Methyl Red	4.2 – 6.3	Yellow	Red
Bromthymol Blue	6.0 – 7.6	Yellow	Blue
Phenolphthalein	8.0 – 9.6	Colorless	Red/Pink

There are three general types of indicators, including

1. pH indicators
2. Redox indicators.
3. Complexometric indicators.