

Ministry of Higher Education and Scientific Research

Mustansiriyah University

College of Science / Department of Chemistry



Practical Analytical Chemistry

For First Year Students Biology Department

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Volumetric Analysis

(Titrimetric Methods of Analysis)

Volumetric analysis is one of the most useful and accurate analytical techniques, especially used for smaller amounts of substance to be analyzed. It is based on the measurement of the volume of the added standard solution of (known concentration) which is sufficient to react with all of the analyzed substance in the sample, and then the concentration of the unknown substance in the sample can be calculated.

- ❖ **Titration:** Is an analytical technique which allows the quantitative determination of a reagent of known concentration (titrant) that is slowly added from a burette to a solution of a specific substance dissolved in a sample (analyte). It is based on a complete chemical reaction between the (analyte) and the reagent (titrant).

- ❖ **Equivalence point:** The point in a titration between standard reagent and unknown analyte sample when the amount of added standard reagent is equivalent to the amount of analyte.
- ❖ **End point:** The point in a titration employ with indicator, when a physical change (color change) occurs in solution which associated with the condition of chemical equivalence.
- ❖ **Indicators:** A weak organic acids or bases that change their color depending on the pH of the solution.

Indicator	Color in the acidic medias	Transition interval color pH	Color in the alkaline medias
Phenolphthalein	Colorless	8.2 - 10.5	Raspberry
Methyl orange	Pink	3.1 - 4.4	Yellow
Methyl red	Red	4.2 - 6.2	Yellow

Types Of Titration Reaction

- ❖ Acid-Base Titration.



- ❖ Oxidation-reduction Titrations (Redox titrations).



- ❖ Precipitation Titrations.



Standard solution:

A solution having a precisely known concentration of a solute to make as specific volume.

- ❖ **Primary standard:** The important requirements for a primary standard substances include the following:
 - Highly purity.
 - Absence of hydrate water.
 - Reasonably large molecular weight to minimize errors in weighing.
 - Have a good solubility in different solvents.
 - It is less hygroscopic and easily drying and weighing.
 - Should be preferably nontoxic.
 - Ready available at a modest cost.

The most common primary standards

- **Acid titration:** We use basic primary standard chemical such as sodium carbonate (Na_2CO_3), sodium tetraborate ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$).
- **Base titration:** We use acidic primary standard chemical such as, potassium hydrogen phthalate [(KHP): $\text{KHC}_8\text{H}_4\text{O}_4$], benzoic acid $\text{C}_6\text{H}_5\text{COOH}$, oxalic acid $\text{H}_2\text{C}_2\text{O}_4$.
- **Redox titration:** We use potassium dichromate ($\text{K}_2\text{Cr}_2\text{O}_7$), sodium oxalate ($\text{Na}_2\text{C}_2\text{O}_4$).

❖ **Secondary standard:** A secondary standard is a chemical or reagents, which is usually standardized with a primary standard substance in a standardization process.

❖ **Secondary standard has certain properties such as:**

- It has less purity than primary standard.
- Less stable and more reactive than primary standard.
- Titrated against primary standard.

❖ **The most common secondary standards:**

- ❑ Sodium hydroxide (NaOH), Potassium permanganate (KMnO₄).