Ministry of higher Education & Scientific Research
Al-Rasheed University College/
Pharmacy Department

Practical Inorganic pharmaceutical chemistry I

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Lab 1

Introduction

Analytical chemistry is the branch of chemistry that focuses on the **identification** and **quantification** of chemical compounds.

The two main sub-branches of Analytical Chemistry are:

a) **Qualitative analysis:** is the determination of the identity of the unknown based on the criteria provided and the presence or absence of material in a sample.
b) **Quantitative analysis:** focuses on the determination of the measurable properties of the unknown.

Each one of these two types can be classified either as:

1. **Instrumental methods** the modern method of analysis. The reason is that these analytical techniques use modern equipment such as computers and the like. Examples of instrumental methods are spectroscopy and chromatography. Involve the most important instruments like **FT-IR**, **mass** spectrometry, **^{1}H-NMR**, **^{13}C-NMR** and **CHNS** technique, and **HPLC**.

2. **Classical methods** are the techniques, which are the fundamentals of laboratory practices. These are the traditional method of chemical analysis, which is still being used by scientists even up to this date.

Main sub-branches of quantitative classical analysis are:

1. Gravimetric analysis.
2. **Volumetric (Titrimetric) analysis**: the volume of the solution of known concentration is measured required to react with the analyte. Titrimetric methods are classified into four categories based on the type of reaction involved:
   a) **Acid-base titration**
   b) **Redox (Reduction-Oxidation) titration**
   c) Complexometric titration
   d) Precipitation titrations.

Titration: analytical technique, which allows the quantitative determination of a specific substance (analyte), dissolved in a sample. It is based on a complete chemical reaction between the analyte and a reagent (titrant) of a known concentration that is added to the sample.

Figure (1-1) Titration equipment

- **Equivalent point** (theoretical): is the point in the titration when the amount of the standard reagent is equivalent to the amount of the analyte.

- **Endpoint** (experimental or practical): is the point in the titration when physical change occurs that is associated with chemical equivalence.

Notes:

- ✓ The titrant is added until the reaction is complete at the endpoint. The end of a titration reaction should be easily observable mostly by the color of indicators.
- ✓ The reaction involved in titration must be fast, complete, of known mechanism, and observable.
- ✓ There are two types of titration direct titration method and indirect (residual or back) titration.

Standardization: Is the determination of the Molarity or Normality of a solution by titration**.**

- **Standard solution**: is the solution of known normality or molarity.

- **Standardization may be done by:**
  A/ the use of carefully weighted sample of a substance of high purity (primary standard).
  B/ the use of another standard solution, (Secondary standard).

- **Primary standard**: is ultra-pure compound that serve as reference material in the titration analysis and its properties are:

1. Highly pure
2. stable atmospherically
3. has no water of hydration
4. Readily available and of low cost
5. good solubility in the titration medium
6. Have high equivalent weight to minimize errors during weight.

- **Secondary standard**: is a compound whose purity has been established by chemical analysis and can serve as reference material in the titrimetric analysis.

Important terms used in the calculation involved in analytical chemistry

- **No. of moles** = $\frac{\text{Weight (g)}}{\text{Molecular wt. (g/mol)}}$

- **No. of Equivalents** = $\frac{\text{Weight (g)}}{\text{Equivalent wt. (g/eq)}}$

- **Molarity** is an expression used to determine the concentration of a solution in terms of a number of moles of the reagent per liter of solution.

$$\textbf{Molarity (M)} = \frac{\text{No. of moles}}{\text{Volume of solution (L)}}$$

- **Normality** is an expression used to determine the concentration of a solution in terms of a number of equivalents of the reagent per liter of solution.

$$\textbf{Normality (N)} = \frac{\text{No. of equivalents}}{\text{Volume of solution (L)}}$$

Homework:

Q_1/ what is the purpose of titration in chemistry?
Q_2/ what is endpoint in titration?