Department of biology

((analytical chemistry))

Stage1

LEC 2

Chemistry analytical

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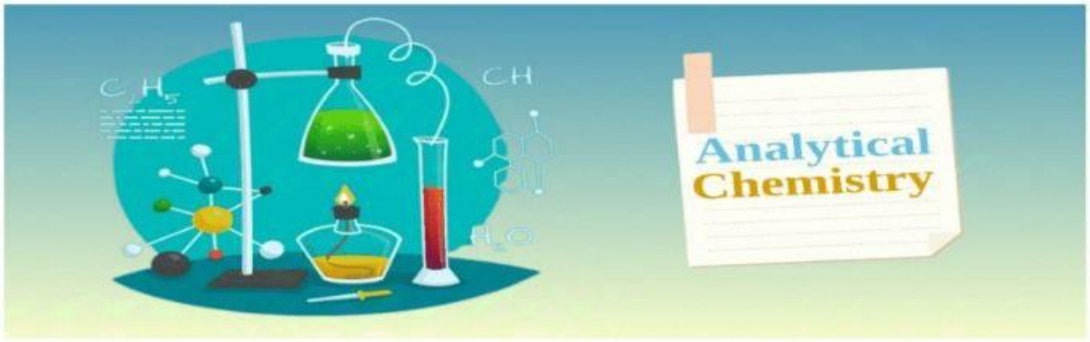
Introduction to Analytical chemistry ,definition, scope ,classification and Gravimetric analysis

Chemistry: is the study of matter, including its composition, structure, physical properties, and reactivity. It is divided into five fields: organic, inorganic, physical,
biochemical, and analytical.



What is Analytical Chemistry?

Analytical chemistry is the branch of chemistry that deals with the analysis of different substances, and it involves the separation, identification, and the quantification of matter. by using of classical methods along with modern scientific instruments to achieve all these purposes.

The scope of analytical chemistry:

1. Identify and define the problem.
2. Design the experimental procedure.
3. Conduct an experiment, and gather data.
4. Analyze the experimental data.

5. Propose a solution to the problem.

Analytical chemistry consists of:

Qualitative Analysis: It deals with the identification of elements, ions or compounds present in the unknown sample.

Quantitative Analysis: It deals with the determination of the quantity of one or more compounds of the sample.

- What chemical species are present in a sample ? (Qualitative Analysis)
- How much of each component is present ? (Quantitative Analysis).

This analysis can be divided into three types:

1. Volumetric Analysis(Titrimetric analysis) :

Base up on the measurement of the volume of the standard reagent to find the quantity of unknown substance.

2. Gravimetric Analysis:

Base up on the measurement of the weight of a precipitate to find the quantity of unknown substance.

3. Instrumental Analysis:

Is a field of analytical chemistry that investigates analyst using scientific instruments.

Well, we are speaking about the volumetric analysis, we shall consider, what the solutions are:

A **solution** is a homogeneous mixture of two or more substances. It is composed of

one or more *solutes*, dissolved in a *solvent*.
For example, when sugar (the solute) is added to water (the solvent), the sugar dissolves in the water to produce a solution.
For the cases where the solvent is water, the homogeneous mixture is refered to as
an aqueous solution.

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Types of Solutions

It can be divided into two types:

1. Depend on the particle size of solute in solvent.

2. Depend on the concentration of solute in solvent.

- Depend on the particle size of solute in solvent

True solution.
Suspension solution: heterogeneous mixtures which settle on standing and its components can be separated by filtrating (Amoxicillin, Antibiotics), particle of solute visible to the naked eye.
Colloidal solution: homogeneous mixture which does not settle nor are their components filterable, solute particle visible with an electron microscope (milk).
We are now considered the standard solution which was defined as:

Standard solution: It is a reagent of known concentration that is used to carry out a titrimetric analysis.

The properties of standard solution are:

1 – Be sufficiently stable so that it is only necessary to determine its concentration once.

2 – React rapidly with the analyte so that the time required to complete the analysis is minimized.

3 – React completely with the analyte so that satisfactory end point is realized.

4 – Undergo a selective reaction with the analyte.

5 – The reaction with the analyte can be described by a balanced equation.

- Depend on the concentration of solute in solvent

Unsaturated solutions: if the amount of solute dissolved is less than the solubility limit, or if the amount of solute is less than the capacity of the solvent.

Saturated solutions: is one in which no more solute can dissolve in a given amount of solvent at a given temperature, or if the amount of solute equal to capacity of solvent.

Super saturated solutions: solution that contains a dissolved amount of solute that exceeds the normal solubility limit (saturated solution). Or a solution contains a larger amount of solute than the capacity of solvent at high temperature.

Methods of expressing concentration of solutions

The mole:

Is a unit for the amount of a chemical species , always associated with a chemical

formula and represents Avogadro's number (6.022 x 1023) of particles and represented by that formula .

Molar Mass : Is the mass in grams of 1 mole of the substance ,it is calculated by

summing the atomic masses of all the atoms appearing in a chemical formula .

$$\text{Molar mass} = \Sigma\ atomic\ mass$$

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Example :- Molar mass of glucose C_6H12O_6 :

$$MC_6H_{12}O6 = \Sigma(6 mole\ carbon + 12 mole\ hydrogen + 6 mole\ oxygen) atom$$

$$MC_6H_{12}O_6 = 6x12.0 + 12x\ 1.0 + 6x\ 16.0 = 180\ g/mole$$

Important Relations:-

M.wt = g /mole or mg /mmole

No. of moles = wt(g) / M. wt(g)

Wt (g) = No. of moles x M.wt

Mole =10^3mmole , mmole = 10^{-3}mole

Example1: How many grams of Na^+ (M.wt = 22.99 g /mole) are contained in (25 g) of Na_2SO_4 (M.wt = 142 g /mole)?

1. Formality (F)

★ Defined as the number of formula weight of substance dissolved per liter of the solution.

★ Unit of formality is (F).

$$F = \text{Wt/ F. wt} \times 1000/ \text{Vml}$$

2. Molarity (M)

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★ A concentration that is defined as the number of moles per Liter of solution (solvent).

★ Unit of molarity is (M) or (mol / L).

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$$\text{M} = \text{Wt/ M. wt} \times 1000/ \text{Vml}$$

3. Normality (N)

★ A concentration that is defined as number of equivalent per Liter of solution (solvent).

★ Unit of normality is (N).

$$\text{N} = \text{Wt/ Eq. wt} \times 1000/ \text{Vml}$$

4. Percentage Compositions

There are three ways:

A. Weight / Weight W/W%

B. Volume / Volume V/V%

C. Weight / Volume W/V%

Example:

Intravenous dextrose injections are given to restore sugar levels in patients. What is

the mass of sugar dissolved in 25 g of a 10 % dextrose solution?

Solution:

❖ Volume / Volume V/V% : ml of solute within100 ml of solvent for dilute solution.

Example:

What is the volume of acetic acid needed for the preparation of 500 mL of vinegar ,aqueous solution of 7.5% (v/v) of acetic acid ?

Solution:

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❖ Weight / Volume W/V% : gram of solute per 100 ml of solvent.

6. Molality (m)

★ Number of moles of solute (n) per (Kg) of solvent this concentration is used for very specified preparation.

★ Unit of molality is m = mol / Kg

The relationship between molarity, normality and part per million

1- ppm= M×M.wt×1000

2- ppm= N×M.wt×1000

Example :(a) Calculate the molar conc. of 1.0 ppm solutions each of Li^{+} and Pb^{+2}.(b) What weight of $Pb(NO_3)_2$ will have to be dissolved in 1 liter of water to prepare a 100 ppm Pb^{+2}

solution:

THANK YOU