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Analytical chemistry:



is a branch of chemistry that deals with identifying the components of matter.

What is analytical chemistry? Analytical chemistry is the science of obtaining, processing, and communicating information about the composition and structure of matter. In other words, it is the art and science of determining what matter is and how much of it exists.

The analytical chemistry can be divided into two branches.

1) Qualitative analytical chemistry: This type is deals with knowing the type of elements that make up a compound or chemical and also looking at how to separate Elements or substances from mixtures and their identification and the basic and acidic

2) Quantitative analytical chemistry: It is a branch of analytical chemistry that deals with the quantification of elements the amount of a substance can be identified .

Quantitative analytical chemistry can be classified into: -

1. Quantitative gravimetric analysis.
2. Quantitative volumetric analysis.

- Volumetric analysis :-

Volumetric analysis is a general term for a method in quantitative chemical analysis in which the amount of a substance is determined by the measurement of the volume that the substance occupies. It is commonly used to determine the unknown concentration of a known reactant. Volumetric analysis is often referred to as titration.

- Titration :-

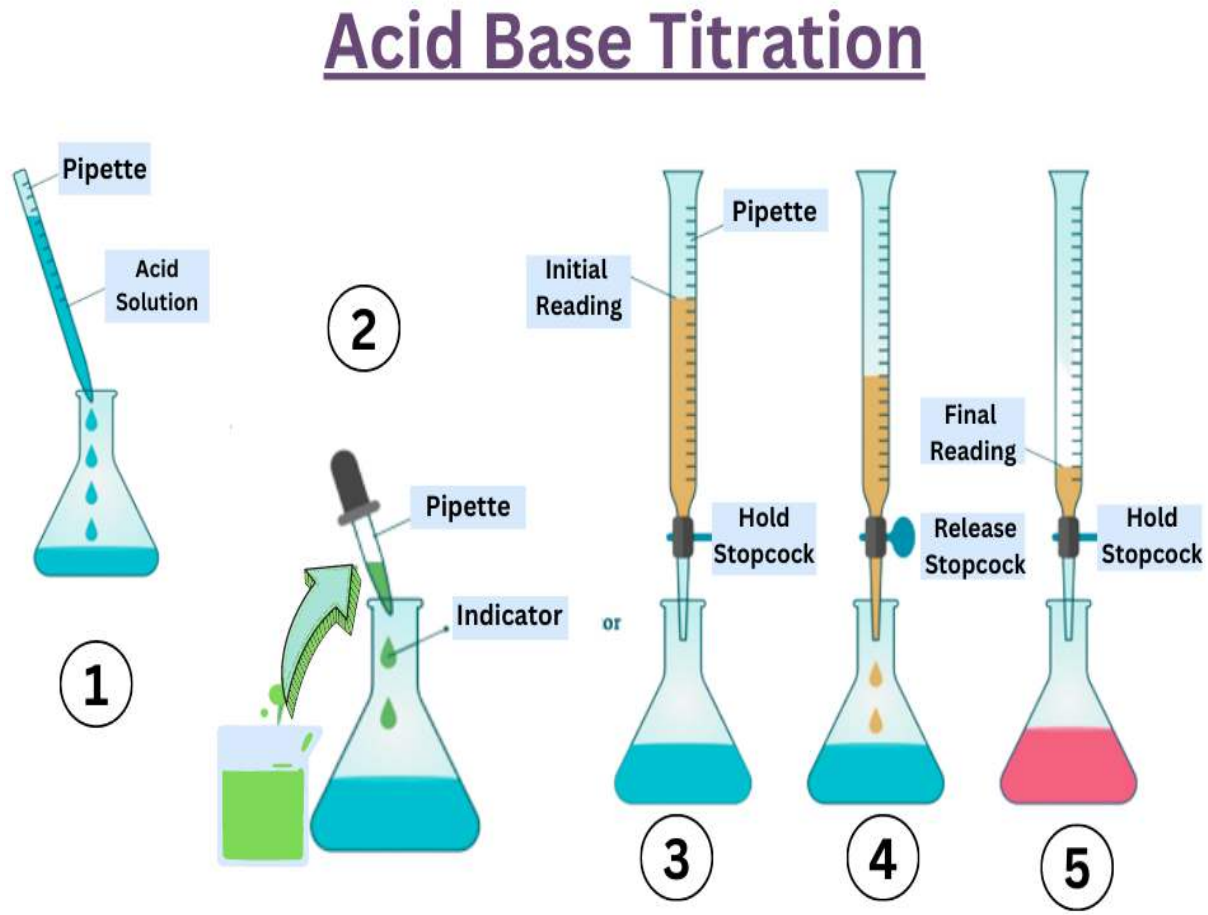
Titrimetric (titration) analysis: is a quantitative analytical method used to determine the concentration of an analyte using a known concentration of a second solution. Is the slow addition of one solution of a known concentration (called a titrant) to a known volume of another solution of unknown concentration until the reaction reaches neutralization, which is often indicated by a color change. The solution called the titrant must satisfy the necessary requirements to be a primary or secondary standard. In a broad sense, titration is a technique to determine the concentration of an unknown solution.

analyte: is the substance in a sample that is being investigated.

❖ Types of titrations

(1)Acid–base titration

is the simplest of the four types of titrations as it involves a strong acid and strong base that completely dissociate in water, thereby resulting in a strong acid strong base neutralization reaction. This titration requires the use of a burette to dispense a strong base into a container of strong acid, or vice-versa, in order to determine the equivalence point.



Indicator: are substances whose solutions change color due to changes in pH. These are called acid-base indicators. They are usually weak acids or bases.

Some important indicators used in a clinical biochemistry laboratory are listed below.

sr,. No.	INDICATOR	Ph range	Colour in acidic ph	Colour in basic ph
1	Phenophthalein	9.3-10.5	colourless	pink
2	Methyl orange	3.1-4.6	red	yellow
3	Bromophenol blue	3.0-4.6	yellow	blue
4	Methyl red	4.4-6.2	Red	yellow
5	Phenol red	6.8 – 8.4	yellow	red
6	Litmus	4.5-8.3	red	Blue

(2)Redox titration:-

are based on a reduction-oxidation reaction between an oxidizing agent and a reducing agent. A potentiometer or a redox indicator is usually used to determine the endpoint of the titration, as when one of the constituents is the oxidizing agent potassium dichromate.

Oxidation	Reduction
1. gain of oxygen	1. Loss of oxygen
2. loss of hydrogen	2. Gain of hydrogen
3. loss of electrons	3. Gain of electrons
4. increase in oxidation number	4. Decrease in oxidation number

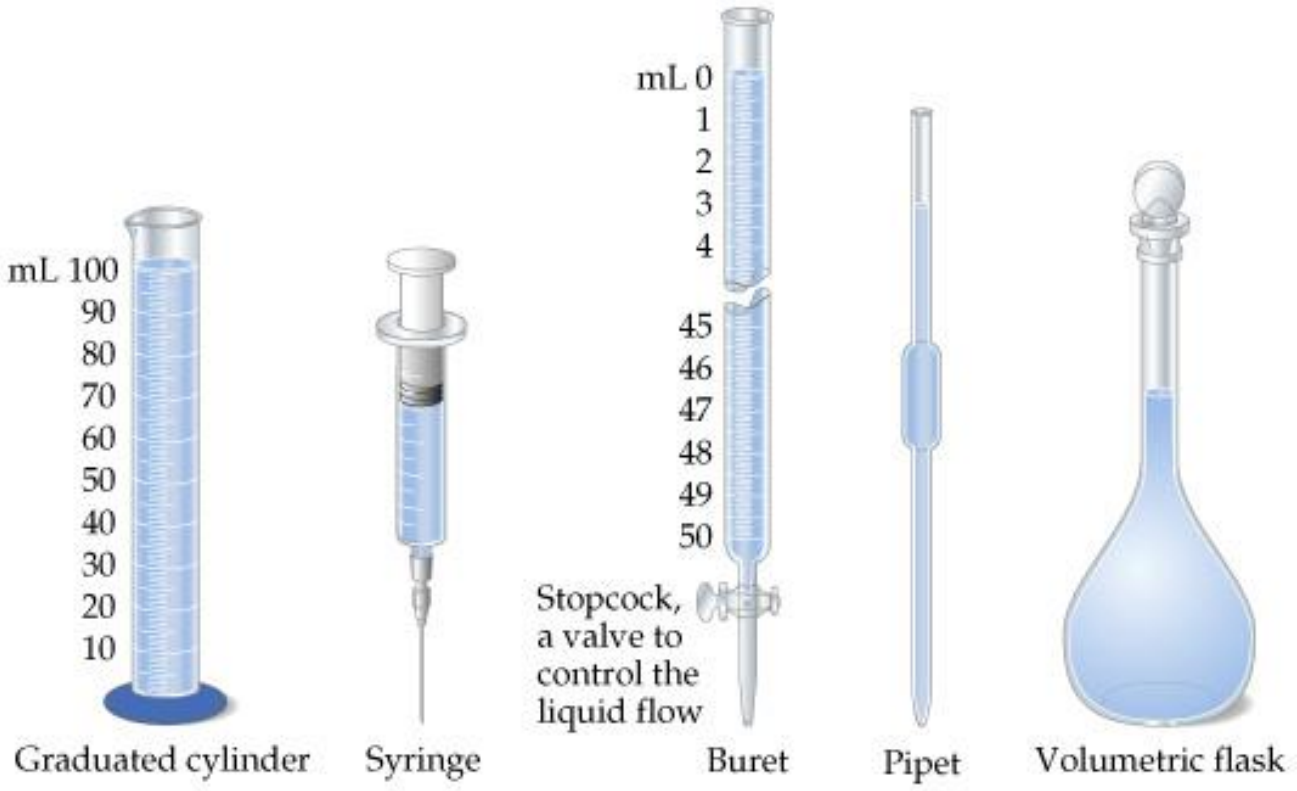
(3)Complex titration

In it, the proportions of many metal ions are determined by titration them with organic reagents that have the ability to form compounds that are soluble in water.

(4)precipitation titration

Precipitation titration is a type of titration which involves the formation of precipitate during the titration technique. In precipitation titration, the titrant reacts with analyte and forms an insoluble substance called precipitate. It continues till the last amount of analyte is consumed.

what tool is used to measure liquid volume



Equivalence point: The point at which the amount of the standard solution added from Burette is chemically equivalent to the amount of dissolved substance

End point: It is the point at which the reaction appears to have taken place (practically) with a change occurring Physical, such as changing the color of a solution or the appearance of a precipitate.

Method of Expressing Concentrations

1. .Molarity

2.Normality

3.Percent Solution

1. Molarity :-

The molar symbol is (M) and its unity (Mole/L) it is the number of moles of solute in 1 liter of solution.

$$M = \frac{n}{V(L)} \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$n = \frac{wt}{M.wt} \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$M = \frac{\frac{wt}{M.wt}}{V(L)} \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$M = \frac{wt}{M.wt * V(L)} \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Whereas:

M: molar concentration in (mole/L).

n: number of moles (mole).

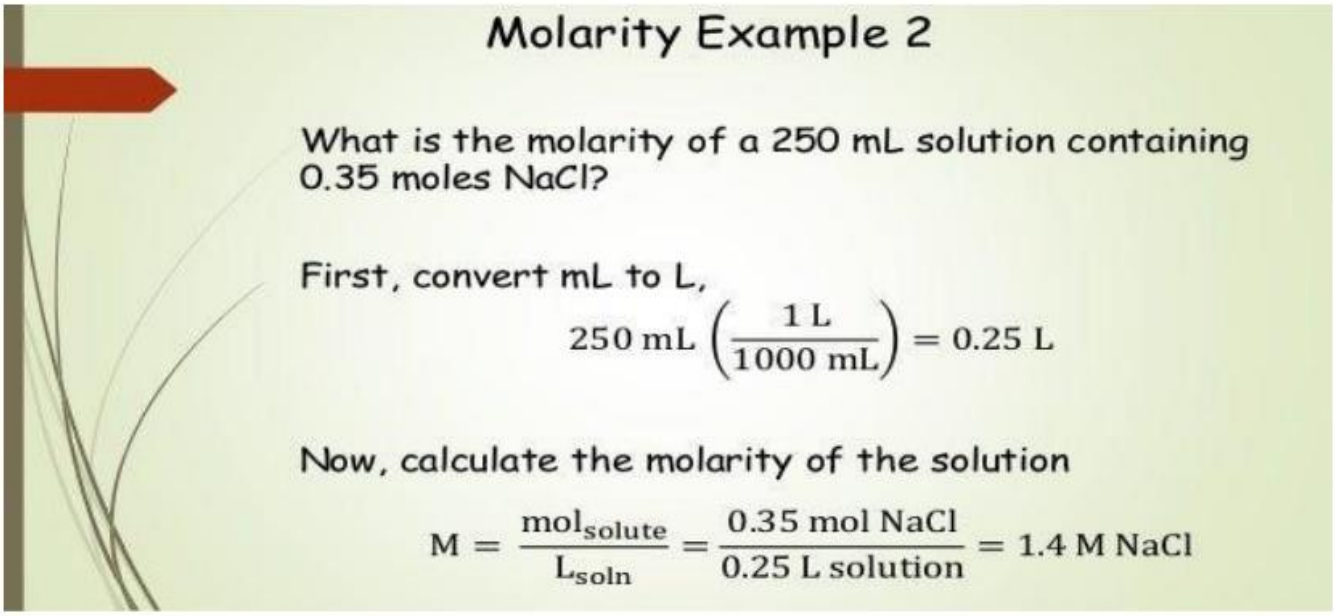
wt.: weight of solute in gram (g).

M.wt: molecular weight in (g/mole).

V: volume of solution in liter (L).

Example

- What is molarity of 50 ml solution containing 2.355 g H_2SO_4?
  - Molar mass H_2SO_4 = 98.1 g/mol
  - Moles H_2SO_4 = 0.0240 mol $\quad \frac{2.355\ g}{98.1\ g/mol}$
  - Volume of solution = 0.050 L $\quad 50\ mL \times \frac{1\ L}{1000\ mL}$
  - Concentration = moles/volume = 0.480 M $\quad \frac{0.0240\ mol}{0.050\ L}$



2. Normality (N)

It is the number of gram equivalents of the solute in one liter of solution, and the following relationship is used to calculate the titrate of a solution of any chemical, and it is symbol (N).

$$N = \frac{Eq}{V(L)} \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$Eq = \frac{wt}{Eq.wt} \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$N = \frac{\frac{wt}{Eq.wt}}{V(L)} \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

$$N = \frac{wt}{Eq.wt * V(L)} \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Whereas:

Eq: number of equivalent in (Eq)

N: normality in (Eq/L).

Eq.wt: equivalent weight of solute in (Eq /mole).

Equivalent weight:

It is the number of fines of this substance that combine or substitute one gram of hydrogen and we use these solutions in the preparation of acids, bases and salts.

*How calculate the equivalent weight

a. If the compound is an acid then the equivalent weight in this case becomes the molecular weight over the number of H+

$$Eq.wt = \frac{M.wt}{nomber\ of\ H}$$

b. If the compound is an base then the equivalent weight in this case becomes the molecular weight over the number of OH

$$Eq.wt = \frac{M.wt}{nomber\ of\ OH}$$

c. If the compound is an salt then the equivalent weight in this case becomes the molecular weight over the number of (anion) X (cation)

$$Eq.wt = \frac{M.wt}{(anion)\ X\ (cation)}$$

As for the following relationship, it is used to calculate the standard of the concentrated solutions (acid and base solutions).

$$N = \frac{d * \% * 1000}{100\ Eq.wt}$$

$$N = \frac{d * \% * 10}{Eq.wt}$$

Whereas:

d: density for conc. Solution in (Kg/L).

%: Percentage of solution.

Eq.wt: Equivalent weight of acid or base concentrates (Eq/mole).

3. Dilution

It is the process of reducing the concentration of the solution; dilute a solution of one of the salts by adding an amount of the solvent to it.

$C1*V1 = C2*V2$

Whereas:

C1: Concentration of the first solution.

C2: Concentration of the second solution.

V1: Volume of the first solution.

V2: Volume of the second solution.