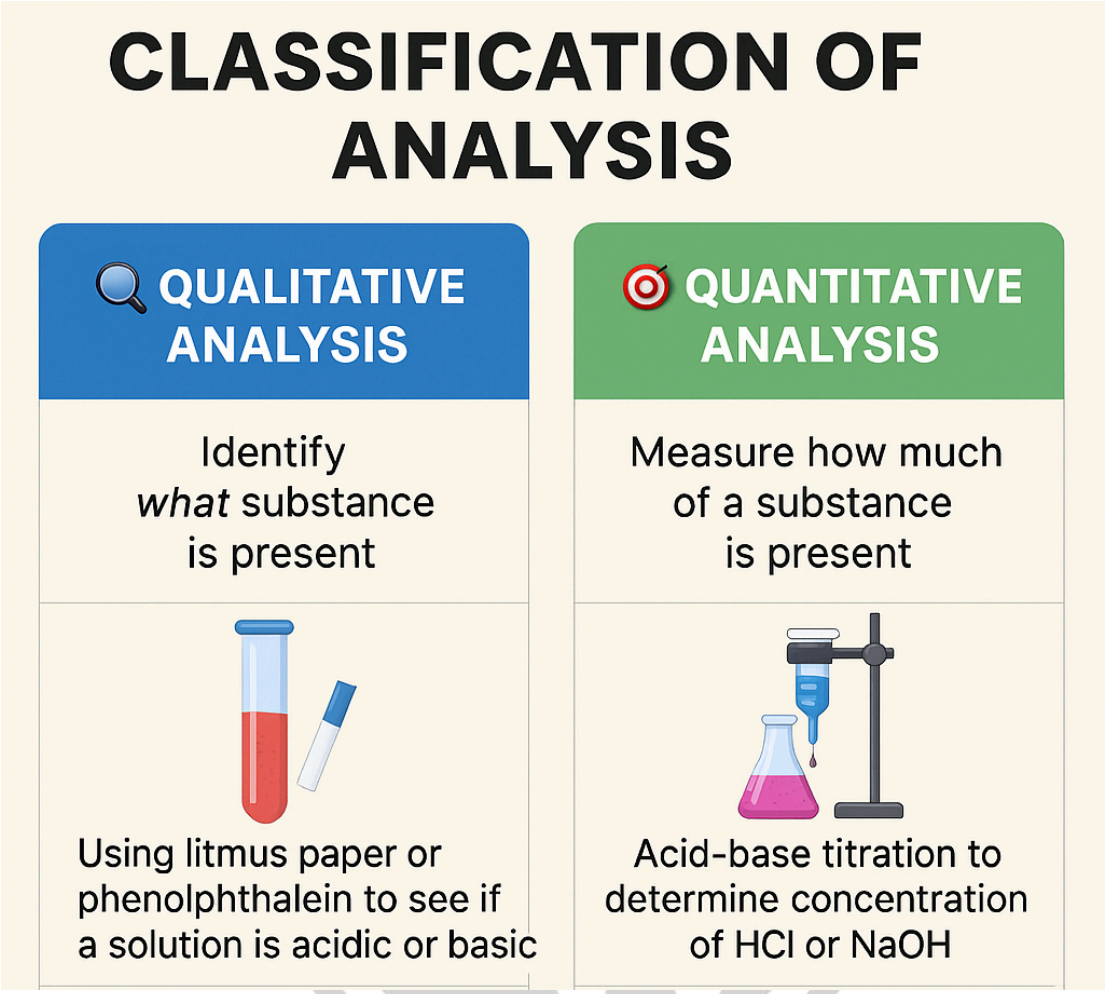
PHARMA

CHAPTERWISE NOTES

Pharmaceutical Analysis

Basics of Pharmaceutical Analysis



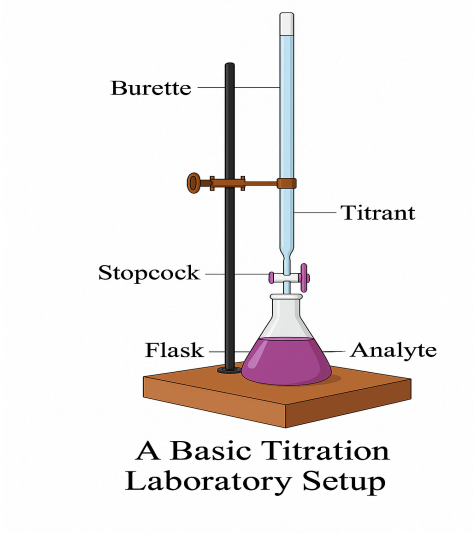
Basics of Titration

Titration is an analytical technique used to determine the concentration of an unknown concentration of an identified analyte by using a standard solution whose concentration is known.

Components of Titration

1. **Analyte**—The solution of **unknown concentration** to be analyzed.
2. **Titrant**—The solution of **known concentration** used to react with the analyte.
3. **Burette**—A long, graduated tube to deliver titrant **accurately**.
4. **Conical Flask** – Holds the analyte during titration.
5. **Indicator**—A Substance that changes **colour** at the endpoint.

6. **Clamp Stand**—Holds the burette steady during the experiment.



A Basic Titration Laboratory Setup

Indicators

- Auxiliary substances that change color at (or near) the endpoint.
- Can be synthetic **(phenolphthalein, methyl orange)** or natural **(red cabbage, hibiscus)**

End Point

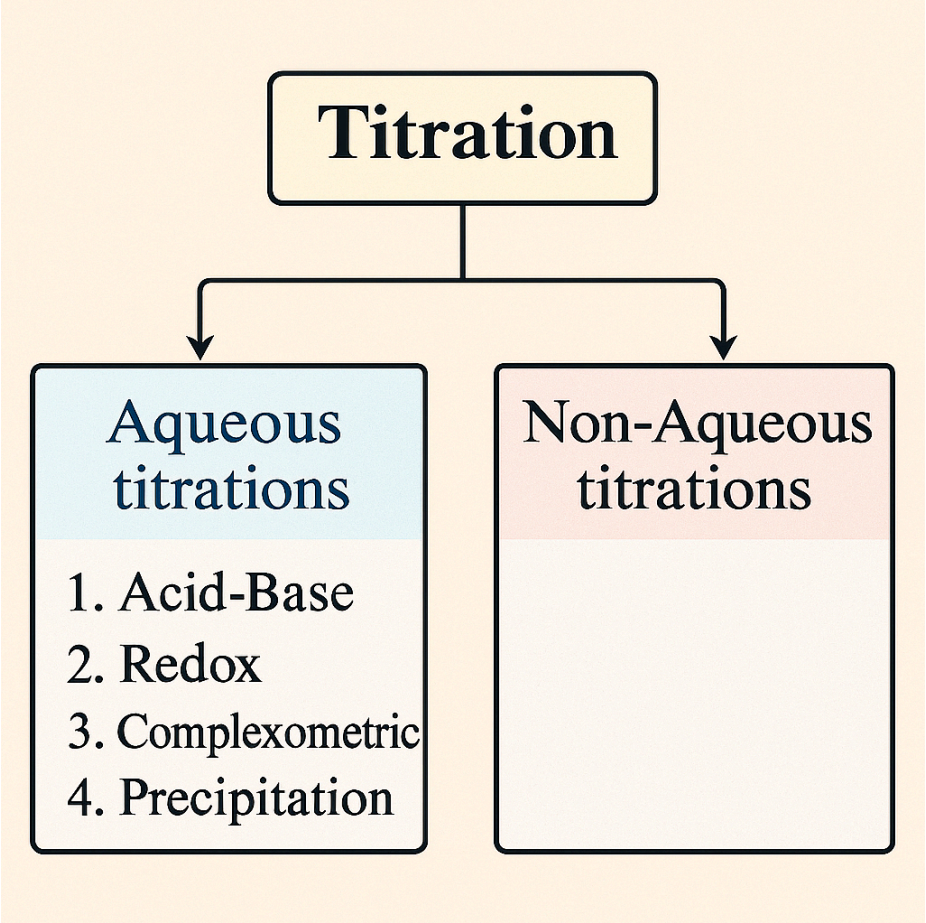
- The point in a titration at which the indicator shows a **colour change,** signifying that the reaction is complete.
- Should be as close as possible to the **equivalence point** (where stoichiometric amounts have reacted)

Equivalence Point

- **Definition:**

  The stage in a titration where the **amount of titrant added** is **chemically equivalent** to the amount of analyte present, according to the reaction's stoichiometry

- **Difference from End Point :**
  - **Equivalence Point** = Theoretical (exact stoichiometric completion)
  - **End Point** = Practical (when indicator changes color)



CONCENTRATION TERMS

1. **Molarity (M)**

- **Molarity is defined as the moles of solute per volume of solution in litres**
- Mathematically, it is expressed as
- $M = Moles\ of\ solute\ /\ volume\ of\ solution\ in\ litres$
- The unit of molarity is **mol L^{-1}.**

Problem 1: Calculate the molarity of the solution containing 5 g of sodium hydroxide in 450 mL of solution

Solution: Given: Mass of NaOH = 5 g, Volume of solution = 450 mL = 0.450 L, Molar mass of NaOH = 40 g/mol

STEP 1: Calculate moles of NaOH

Moles=Mass/Molar Mass=540=0.125 mol\text

Moles = 5/40 = 0.125

STEP 2: Calculate molarity

$$M = \frac{\text{Moles of solute}}{\text{Volume of solution in liters}}$$

$$M = \frac{0.125}{0.450} \approx 0.278\ M$$

2. **Molality (m)**

- **Molality is defined as moles of solute per mass of solvent in kilograms**
- Mathematically, it is expressed as
- $m = moles\ of\ solute/mass\ of\ solvent\ in\ kg$

3. **Normality (N)**

- **Normality is defined as the equivalent of solute per volume of solution in litres.**
- Mathematically, it is expressed as

  N = Equivalents of solute/volume of solution in L
- If 40 grams of sodium hydroxide is dissolved in 1 litre of solution, then the normality is found to be 1, and the solution is often termed a 1 normal solution

SUMMARY

MOLARITY, MOLALITY, AND NORMALITY			
Symbol	**Molarity**	**Molality**	**Normality**
Symbol	**M**	**m**	**N**
Definition	Moles of solute per liter of solution	Moles of solute per kilogram of solvent	Gram equivalents of solute per liter of solution
Unit	mol/L	mol/kg	eq/L
Formula	$M = \frac{\text{Moles of solute}}{\text{Volume of solution l}}$	$m = \frac{\text{Moles of solute}}{\text{Mass of solvent in kg}}$	$N = \frac{\text{Gram equivalents of solute}}{}$ (or $N = M \times$ Valency factor)
Temperature Dependence	**Yes** (volume changes with temperature)	**No** (mass doesn't change with temperature)	**Yes** (depends on volume)
Example	**1 M NaCl** 1 mol NaCl in 1 L solution	**1 m NaCl** 1 mol NaCl in 1 kg solvent	**1 N H_2SO_4** 1 eq (49 g) H_2SO_4 in 1 L