Medical Chemistry Laboratory

Experiment 3

Volumetric analysis

Acid- Base Titration

Al-Rasheed University College – Dentistry Department

- ***Titration*** is a common laboratory method of **quantitative chemical analysis** that is used to determine the unknown concentration of known reactant. Because volume measurement play a key role in titration, it is also known as ***volumetric analysis.***

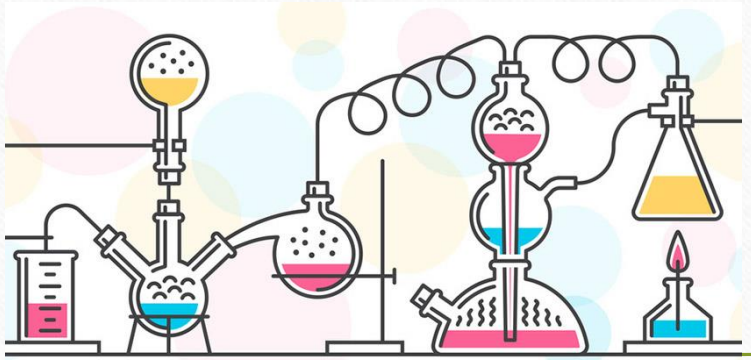
- A reagent, called the titrant of known concentration and volume is used to react with a solution of the analyte, whose concentration is not known. Using a calibrated burette to add the titrant.

- ***A standard solution*** is a solution whose concentration is accurately known.

- ***Primary Standard***: A primary standard is a highly purified compound that serves as a reference material in all volumetric and mass titrimetric methods.

Important Requirement For A Primary Standard Are:

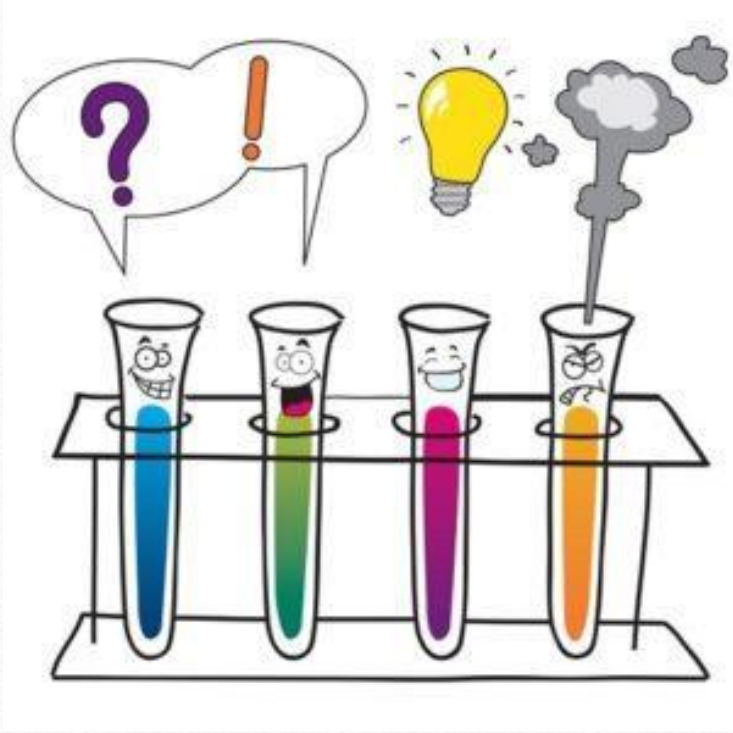
- ✓ High purity.
- ✓ Stability toward air.
- ✓ Absence of hydrate water.
- ✓ Ready availability at modest cost.
- ✓ Reasonable large molar mass so that the relative error associated with weighing the standard is minimized.



- ***The equivalence point*** in a titration is reached when the amount of added titrant is chemically equivalent to the amount of analyte in the sample.
- Many methods can be used to indicate the endpoint of a reaction; titrations often use visual indicators (the reactant mixture changes color). Indicators are complex organic compounds that exist in at least two different colored forms. The colored form is dependent upon whether they are in acid, base or neutral condition.

Types of Titration

- ***Acid-Base Titration*:**
- ***Complexometric Titration*:**
- ***Precipitation Titration*:**
- ***Redox Titration*:**



- The concentrations of solution used in acid-base titration may be expressed in terms of ***Molarity (M) or Normality (N).***

- ***Molarity*** is the number of moles of solute in one liter of solution (moles/liter).

✓ Molar solution is one, which contains 1 gm molecular weight of the reagent per liter of solution.

✓ **M=(Weight(wt.))/(M.Wt) x 1000/(V(ml))**

- ***Normality*** is the number of the equivalent weights of a compound in a liter of solution (equivalent weight/ liter).

✓ Normal solution is one that contains 1 gm equivalent weight per liter of solution.

✓ **N=(Weight(wt.))/(eq.Wt) x 1000/(V(ml))**

Equivalent weights

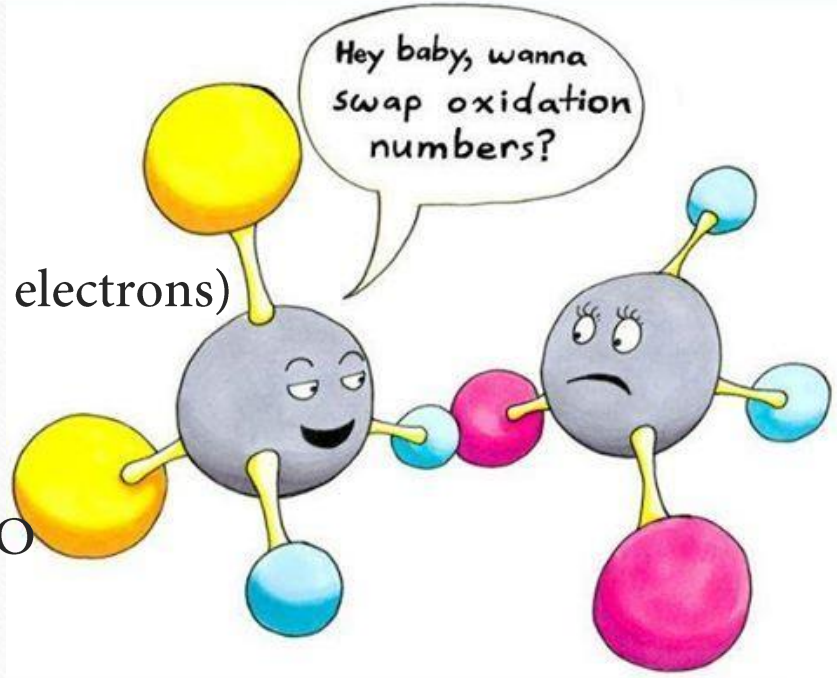
1. ***Equivalent weight in neutralization reactions.***

- The Equivalent weight of acid is that weight of it which contains one-gram atom of replaceable hydrogen group
- $eq.wt\ (acid) = \frac{M.Wt_{acid}}{No.of\ active\ H^+}$....***Examples:*** Equivalent weight of $H_2SO_4 = \frac{M.Wt_{H_2SO_4}}{2}$
- The Equivalent weight of base is that weight of it which contains one-gram atom of replaceable hydroxide group
- $eq.wt\ (base) = \frac{M.Wt_{base}}{No.of\ active\ OH^-}$.....***Examples:*** Equivalent weight of NaOH = $\frac{M.Wt_{NaOH}}{1}$

Equivalent weights

2. Equivalent weight in Oxidation-reduction reaction.

- The equivalent weight of an oxidant or a reductant is the number of electrons which 1mol of the substance gains or losses in the reaction.



- eq.wt.= (Formula weight (gm/mole))/(No.of lost or gained electrons)
- Examples:

$$5C_2O_4^{=} + 2MnO_4^{-} + 16H^{+} \longrightarrow 10CO_2 + 2Mn^{2+} + 8H_2O$$

Standardization of HCl solution with standard solution of Na_2CO_3

1. Clean the burette and Homogenized with HCl solution.
2. Fill the burette with HCl.
3. Transfer 10ml of standard solution (Na_2CO_3) into conical flask by graduated cylinder
4. Add 2 drops of Methyl orange indicator (solution become yellow).
5. Titrate by adding HCl from burette until the solution just beings to change from yellow to red (Onion).
6. Calculate the normality of HCl:

$$N_{acid} \times V_{acid} = N_{base} \times V_{base}$$

- The equation of reaction :

$$Na_2CO_3 + HCl \xrightarrow{M.O} H_2CO_3 + 2NaCl$$