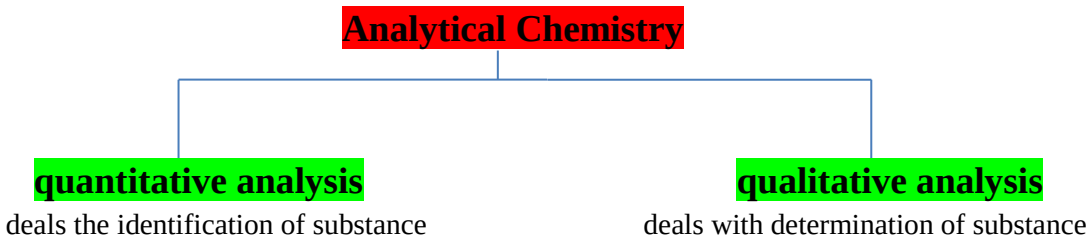
Basic Chemistry

Analytical Chemistry

Analytical chemistry is concerned with the chemical characterization of matter or substances to find out what the matter is (qualitative analysis) and how much is it (quantitative analysis).



Role of Analytical Chemistry: Both quantitative and qualitative can be followed either classical method or instruments method.

Analytical Chemistry Plays an important role in about all aspects as in: Agricultural, Clinical, Environmental and pollution, Pharmaceutical, Food, Manufacturing, ...

Electrolytes are solutes which ionize in solvent / solution to produce an electrically Conducting media Strong electrolyte: are solutes which completely dissociated in solvent

weak electrolyte: are solutes which partially ionize in solvent to produce an electrically conducting medium

$$\mathbf{CH_3\,COOH \leftrightarrow CH_3\,COO^- + H^+}$$

The dissociation of weak electrolyte undergoes in two directions

$$NH_4OH \leftrightarrow NH^{+4} + OH^-$$

Strong electrolyte:

1-Many inorganic acids: Hydrochloric acid HCl, nitric acid HNO_3, perchloric acid $HClO_4$, sulfuric acid H_2SO_4

2-Alkali and alkalian-earth hydroxides. Sodium hydroxide NaOH , potassium hydroxide KOH, calcium hydroxide $Ca(OH)_2$, barium hydroxide $Ba(OH)_2$

$$Ba(OH)_2 \rightarrow Ba^{+2} + 2OH^-$$

3- Most salts

Sodium chloride NaCl, sodium fluoride NaF, potassium fluoride KI, sodium nitrate $NaNO_3$

$$NaCl \rightarrow Na^{+} + Cl^{-}$$

$$NaNO_3 \rightarrow Na^{+} + NO^{-3}$$

Weak electrolytes :-

1-Some inorganic acid: carbonic acid H_2CO_3, boric acid H_3BO_3, phosphoric acid

H_3PO_4, Hydrogen sulfide H_2S

$$H_2CO_3 \leftrightarrow 2H^{+} + CO^{2-}{}_3$$

2-Most organic acid : (acetic acid H_3COOH), formic acid HCOOH), (ethylene diamine tetracetic acid EDTA), (erochromeblack T EBT)

(phenol phthalein Ph.Ph.)

$$H_3PO_4 \leftrightarrow 3H^{+} + PO_4$$

$$HCOOH \leftrightarrow HCOO^{-} + H^{+}$$

3-Many organic bases and ammonia , $H_2N\text{-}CH_2\text{-}CH_2\text{–}NH_2$

$$NH_4OH \leftrightarrow NH_4{+} + OH^{-}$$

4-Halides (chloride Cl^{-}, bromide Br^{-}, fluoride F^{-}, iodide I^{-}), cyanides (CN)and thiocyanate (SCN^{-}) of Hg, Zn and Cd.

$$ZnCl_2 \leftrightarrow Zn^{+2} + 2Cl^{-}$$

$$HgCl_2 \leftrightarrow Hg^{+2} + 2Cl^{-}$$

Solvation

Solvation describes the interaction of solute molecules and solvent. The strength and nature of this interaction influence many properties of the solute, including solubility, reactivity, and color, as well as influence the properties of the solvent such as the viscosity and density.

Solvation involves bond and forces formation, hydrogen bonding, and van der Waals forces.

Solvation of a solute by water is called hydration.

Conjugate acid and Conjugate base

Conjugate base: is the species formed when and acid loses a proton (H(+

$$H_3O^+ \leftrightarrow H_2O + H^+$$

H_2O is a conjugate base of H_3O^+

$CH_3COOH \leftrightarrow CH_3COO^- + H^+$

CH_3COO^- is a conjugate base of acetic acid

Conjugate acid: is the species formed when a base accept a proton (H^+)

$NH_3 + H^+ \leftrightarrow NH^{+4}$ (NH^{+4} is a conjugate acid of ammonia)

Amphiprotic compounds:- These compounds act as an acid in the presence of base and as base in the presence of an acid

$$CH_3OH + NH_3 \leftrightarrow CH_3O^- + NH^{+4}$$

$$CH_3OH + HNO_3 \leftrightarrow CH_3OH_2^+ + NO^{-3}$$

Amphiprotic Solvents:- solvents act as an acid in the presence of base and as base in the presence of an acid.

$$H_2O + H^+ \leftrightarrow H_3O^+$$

$$H_2O + NH_3 \leftrightarrow NH_4 + OH^-$$

Acid Base Theories:-

1-Arrhenius theory (The theory of H^+ and OH^-)

Acid :- is any compound which ionize (partially or completely) to give H^+

$HCl \rightarrow H^+ + Cl^-$

$CH_3COOH \leftrightarrow CH_3COO^- + H^+$

Base :- is any compound which ionize (partially or completely) to give OH^-

$NaOH \rightarrow Na^+ + OH^-$

$NH_4OH \leftrightarrow NH_4^+ + OH^-$

The **disadvantage** of Arrhenius theory

This theory applicable for aqueous media only and not applicable for organic media

2-Bronshted – Lowry Theory (The theory of give and accept H^+)

Acid :- is any compound which ionize (partially or completely) to give (proton) H^+

$HCl \rightarrow H^+ + Cl^-$

$CH_3COOH \leftrightarrow CH_3COO^- + H^+$

Base :- is any compound which accept H^+

$NH_3 + H^+ \leftrightarrow NH_4^+$

$H_2O + H^+ \leftrightarrow H_3O^+$

Disadvantage / Advantage

The theory is applicable for aqueous and organic solvent. But isn't applicable for non-ionized solvent dioxane, hexane, ccl_4 carbon tetra chloride.

3-Lewis Theory (The theory of give and accept electron pair)

Acid :- any compound which accept electron pair

Base :- any compound which give electron pair

$H_2O + H^+ \rightarrow H_3O^+$

Base acid

$NH_3 + H_3O^+ \leftrightarrow NH_4^+$

Base acid

$ALCl_3 + OR_2 \rightarrow R_2OALCl_3$

Acid base

(Aluminum chloride) ether R-O-R

Lewis Theory give an explanation for organic compound and the effect of solvent.