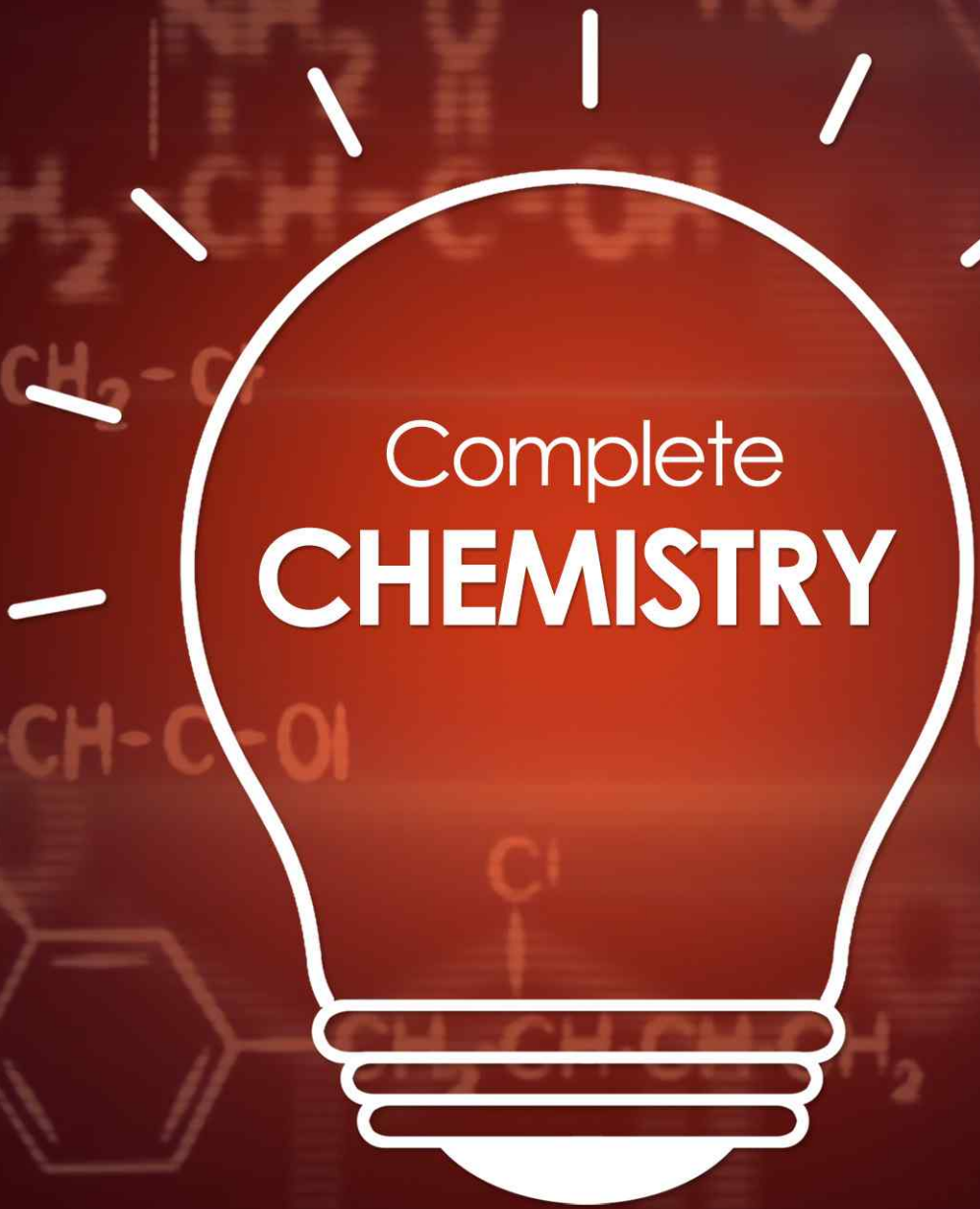
misostudy.com
smart learning



Complete CHEMISTRY

IIT-JEE · NEET · CBSE eBOOKS

CLASS 11&12th

CLASS 11th

Ionic Equilibrium

01. Arrhenius Concept (1887)

(i) According to this concept all substances which give H^+ ions, when dissolved in water are called **Acids**.

(ii) Those which ionise in water to furnish OH^- ions are called **Bases**.
e.g.

(a) $\underset{\text{(Acid)}}{HA} \overset{H_2O}{\rightleftharpoons} H^+ + A^-$

(b) $\underset{\text{(Base)}}{BOH} \overset{H_2O}{\rightleftharpoons} B^+ + OH^-$

Limitations of Arrhenius concept:

(i) Applicable only to aqueous solution. Dry HCl shall not act as an acid.
(ii) The concept does not explain acidic or basic properties in non aqueous solvents.
(iii) It fails to explain acidic character of no protic compound viz. SO_2,NO_2,CO_2,P_2O_5
(iv) It fails to explain the basic nature of compounds viz. NH3, Na_2CO_3
(v) It fails to explain the acidic nature of certain salts in water e.g. $AlCl_3$, $FeCl_3$

Basicity or protocity of an Acid:

It is the number of H^+ ions furnished by a molecule of an acid. An acid may be classified according to its basicity. Thus we may have,

(i) Mono basic or Mono protic acids like HCl, HNO_3CH_3COOH,HCN etc.
(ii) Dibasic or Diprotic acids like, H_2SO_4, H_2CO_3, H_2BO_3, etc.
(iii) Tribasic or Triprotic acids like H_3PO_4, H_3AsO_4, etc.

Acidity or Hydroxity of a Base

It may be defined as the number of OH^- ions furnished by a molecular of base. A base can be,

(i) Mono acidic or monohydroxic like NaOH, NH_4OH, AgOH etc.
(ii) Diacidic or dihydroxic like $Ba(OH)_2$, $Mg(OH)_2$, $Ca(OH)_2$, $Sr(OH)_2$ etc.
(iii) Triacidic or trihydroxic like $Fe(OH)_3$, $Al(OH)_3$ etc.

Strength of Acid or Base:

(i) Strength of Acid or Base depends on the extent of its ionisation. Hence equilibrium constant K_a or K_b respectively of the following equilibria give a quantitative measure of the strength of acid or base.

(a) $HA \overset{H_2O}{\rightleftharpoons} H^+ + A^- \; ; \; K_a = \dfrac{[H^+][A^-]}{[HA]}$

(b) $BOH \overset{H_2O}{\rightleftharpoons} B^+ + OH^- \; ; \; K_b = \dfrac{[B^+][OH^-]}{[BOH]}$

(ii) The larger the value of Ka or kb, the more complete the ionisation, the higher the concentration of H_3O^+ or OH^- and stronger is the acid or base.

02. Bronsted Lowery Concept (1923)

In 1923, a more general concept of acids and bases was introduced by Bronsted & Lowery. According to Bronsted-Lowery definition

(i) An acid is a substance that accepts a proton and

(ii) A base is a substance that accepts a proton.

(iii) In a typical acid- base reaction,

$$HX + B \rightleftharpoons X^- + HB^+$$

Here HX being a proton donor is an Acid and B being a proton acceptor is a Base in the forward reaction,

(iv) In the backward reaction HB^+ being a proton donor is an acid and X^- being a proton donor acceptor is a base

e.g.	Acid		Base		Conjugate acid		Conjugate base
(b)	HCL	+	H_2O	$\rightleftharpoons$	H_3O^+	+	Cl^-
(a)	HSO_4^-	+	NH_3	$\rightleftharpoons$	NH_4^+	+	SO_4^{2-}
(c)	NH_4^+	+	H_2O	$\rightleftharpoons$	H_3O^+	+	NH_3

Conjugate

Conjugate

Classification of Bronsted-Lowery Acid & Bases:

Bronsted-Lowery acids and bases can be

(i) Molecular

(ii) Cationic

(iii) Anionic

Type	Acid	Base
Molecular	HCl, HNO_3, $HClO_4$,	NH_3, N_2H_4, Amines
	H_2SO_4, H_3PO_4	H2O, Alocohol, Ethers
	CH_3COOH, HBr,	
	H_2O etc.	
Cationic	NH_4^+, $N_2H_5^+$, PH_4^+,	$[Fe(H_2O)_5OH]^{2+}$
	Na^+, Ba^{2+} (All cation)	$[Al(H_2O)_5OH]^{2+}$
	$[Fe(H_2O)_6]^{3+}$	
	$[Al(H_2O)_6]^{3+}$	
Anionic	HS^-, HSO_3-	
	H_2PO4^-, HSO_4^-,	Cl^-, Br^-, OH^-
	HCO_3^-, $HOPO_4^{2-}$,	HSO_4^- CN^-, CO_3^{2-}
	all amphiprotic anions	SO_4^{2-}, NH_2^-, CH_3COO^-

Classification of Solvents:

Protonic or protic solvents :

(i) They are characterized by the presence of transferable hydrogen and the formation of "Onium" ions. Autoionisation taking place in them.

(a) $H_2O + H_2O \rightleftharpoons H_3O^+ + OH^-$

(b) $NH_3 + NH_3 \rightleftharpoons NH_4^+ + NH_2^-$

(c) $3HX \rightleftharpoons H_2X + HX_2^-$

(d) $2H_2SO_4 \rightleftharpoons H_3SO_4^+ + HSO_4^-$