Lewis theory of acids – bases :

Acid : which accepts electron pair.

- All electrophiles are Lewis acids
- Lewis acid must contain suitable vacant orbitals.

  Eg: BF_3, BCl_3, $AlCl_3$, H^+, Ag^+ etc.

Base : which donates e^- pair.

- All nucleophiles are Lewis bases
- Lewis base must contain 1 or more lone pairs of electrons.

Eg: $\ddot{N}H_3, \ddot{P}H_3, R-\ddot{N}H_2$,

$\ddot{N}H_2-\ddot{N}H_2, OH^-, Cl^-, H_2\ddot{O}$

Neutralization: It involves formation of coordinate covalent bond by the transfer of e pair form base to acid.

$H_3\ddot{N} + \square BF_3 \rightarrow [H_3N \rightarrow BF_3]$

$H_2\ddot{O} + H^{\oplus} \rightarrow [H_2O-H]^+$ or $H_3O^{\oplus}$

$H_3\ddot{N} + H^{\oplus} \rightarrow [H_3N-H]^+$ or $NH_4^{\oplus}$

$Cl^- + AlCl_3 \rightarrow [Cl-AlCl_3]^-$ or $AlCl_4^-$

- **Types of Lewis acids :**

1) All simple cations :

   Eg : H^+, Ag^+, Li^+, Cu^{2+}, Co^{3+}, Al^{3+} etc.

$$Ag^+ + 2\ddot{N}H_3 \rightarrow [Ag(NH_3)_2]^+$$

2) Electron deficient molecules :

   Eg: BF_3, BCl_3, BBr_3, BI_3, $AlCl_3$, $GaCl_3$ etc.

   $BF_3 < BCl_3 < BBr_3 < BI_3$

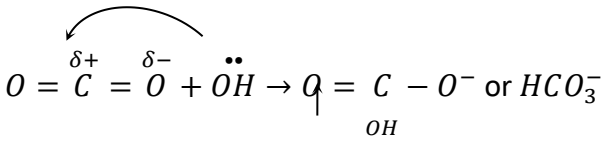
$BF_3 + \ddot{F}^- \rightarrow [F_3B-F]^-$ or BF_4^-

- 3) Molecules which can extend octet configuration:

Eg: SiF_4, $SiCl_4$, $SnCl_4$, SF_4, $SFCl_4$, $TeCl_4$ etc.

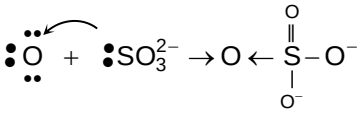
- 4) Molecules with multiple bonds in between atoms of different electronegativities

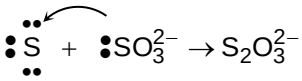
  Eg : CO_2, SO_2, SO_3, NO_2, N_2O_5, Cl_2O_7, P_2O_5



- 5) Molecules in which the central atom with sextet configuration

  Eg : S, O, Se……..





- Types of Lewis bases :

  All simple anions :

  Eg : Cl^-, Br^-,OH^-,CN^-etc.

  $SiCl_4 + 2Cl^- \rightarrow SiCl_6^{2-}$

- Molecules with lone pairs :

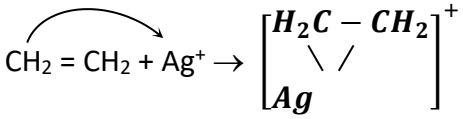
  Eg : $\ddot{N}H_3, \ddot{P}H_3, \ddot{N}_2H_4, R-\ddot{N}H_2, R-\ddot{O}H, H_2\ddot{O}$,

  $R-\ddot{O}-R, R_2\ddot{S}$ etc.

  $\ddot{N}H_3 + H^+ \rightarrow [H_3N \rightarrow H]^+$ or NH_4^+

- Molecular multiple bonds in between similar atoms:

  Eg: $CH_2 = CH_2$, CH≡ CH, pyridine , **:** NO, : CO



Draw backs of Lewis theory :

1) It will not consider popular acids like $HClO_4$, HNO_3, H_2SO_4 as they do not form co-ordinate covalent bond.
2) It fails to explain the catalytic activity of H^+.
3) Lewis acid base neutralisation is very slow as it involves formation of co-ordinate covalent bond but actually neutralisation reactions are very fast.
4) It fails to explain strength of acids and bases.
5) It fails to explain the simple neutralisation reactions where H^+ is involved.

Comparison of acid – base theories :

1) All Arrhenius acids are bronsted lowery acids but all bronsted lowery bases are not Arrhenius bases.

   Eg: $HCl_{(aq)} \rightarrow$ It is Arrhenius acid as it gives H^+ and bronsted lowery acid as it donates proton.

   $NH_3 \rightarrow$ It is bronsted lowery base because it accepts proton but it is not Arrhenius base as it will not give OH^-

- 2) All bronsted lowery bases are Lewis base but Lewis acids need not be bronsted lowery acids.

   Eg: $\ddot{N}H_3$ →It is Bronsted lowery base because it accepts proton and it is Lewis base because it donates e^- pair.

   $BF_3 \rightarrow$ It is Lewis acid as it accepts electron pair but it is not bronsted lowery acid as it will not donate proton.