B.Sc. (Honours) Part-I

Paper-IA

Topic: Lewis Concept

UG

Subject-Chemistry

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Lewis concept

Lewis concept or Electron pair acceptor-donor concept

According to G.N. Lewis, a Lewis acid is an electron pair acceptor and a Lewis base is an electron pair donor.

Lewis acid	Lewis base
Electrophile	Nucleophile
Contain vacant orbitals	Contain lone pair of electrons
Example – BeF_2, BH_3, BF_3 etc.	Example–NH_3, H_2O, H^- etc.

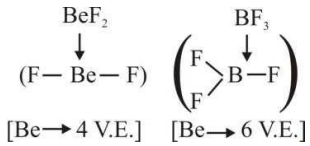
Neutralization reaction according to Lewis concept:

- Lewis acid reacts with Lewis base and forms a compound which is called adduct or complex compound.
- The compound contains (Lewis base – Lewis acid) co-ordinate bond.
- Lewis acid + Lewis base → Adduct
  BF_3 + $:NH_3$ → $[NH_3 \rightarrow BF_3]$

Examples of Lewis acids:

1. Molecules whose central atoms have vacant p-orbital or incomplete octet of electrons in its valence shell.

   Examples –



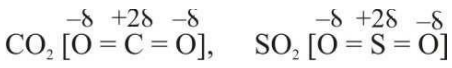
   Lewis system : acid + base → adduct / coordination compound.

2. Molecules whose central atoms have vacant d-orbitals in their valence shell.

   e.g. AlF_3, $AlCl_3$, GeX_4, $TeCl_4$, SF_4, SbF_3 etc.

3. Molecules whose central atom is linked with more electronegative atom by double bonds.

   e.g.



4. Simple cations, with low lying empty orbitals.

e.g. Ag^{+}, Cu^{2+}, Cd^{2+} etc.

5. Elements which have a sextant of electrons in their valence shell.

e.g.  

Examples of Lewis base:

1. Molecules whose central atom has one or more unshared electron pairs (lone pair of electrons), e.g.

e.g.   

2. Molecules containing C = C double bond

3. Halides, e.g. – XeF_2, XeF_4, CsF, $CoCl_2$ etc.

Advantage of Lewis Concept:

1. This concept includes those reactions also in which no protons are involved.
2. It is more significant than Bronsted– Lowry concept because according to this concept, acid-base behavior is independent of solvent's presence or absence.
3. It explains basic properties of metallic oxides and acidic properties of non-metallic oxides.
4. This concept also explains gas phase, high temperature and non-solvent reactions.

Limitations of Lewis Concept:

1. It is not possible to arrange Lewis acids and Lewis bases in order of their acid or base strength.
2. Protonic acids like H_2SO_4 and HCl are not covered under Lewis concept, as they do not establish a covalent bond by accepting a pair of electron.
3. According to this concept, acid-base reaction should be fast but it is not so in actual practice for many reactions due to kinetic factors.
4. The reactions catalyzed by Lewis acids are generally not catalyzed by the protonic acids.