INORGANIC CHEMISTRY

B.Sc - Part - II, Group - B - 3

Sidgwick Theory

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Paper-III

Lecture Notes Series

Sidgwick Theory

When werner put forward his Co-ordination Theory, Electronic theory of valency was un-known. But later on it was considered very important to bring werner theory of co-ordi-nation compounds into line with the electronic concept of valency.

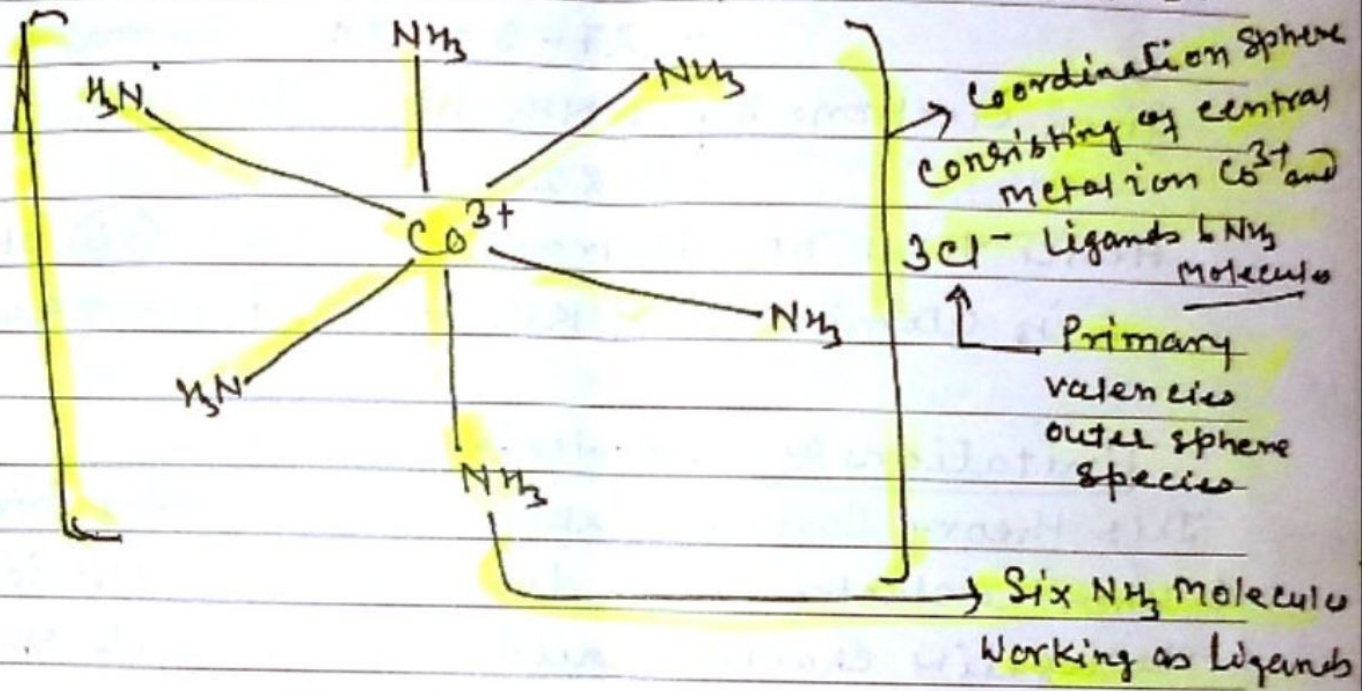
In 1927 Sidgwick made notable contribution in this field. According to Sidgwick all neutral molecules or anions which were capable of being co-ordinated to the central metal ion have atoms without least one unshared (lone) pair of electrons in their valency shells.

The auxiliary valence of the central metal ion, arises by the donation of electron pairs by such atoms to the central metal ion, dificient in electrons.

This give rise to a new type of covalent bonding in which the paired electrons of the bonds are furnished by one and only one of the atoms concerned, the atom (or the ion) furnishing the electron is called the donor and the ion accepting the electron is called acceptor.

Nobody can hurt me without my permission.

Hence in Cobalt amine complex $[CoCl_3 \cdot 6NH_3]$, Cobaltic ion (central ion) accepts 12 electrons from six ammonia molecules (Nitrogen atom) has one unshared Electron Pairs ie Loan Pair of electron, which is donated. The structure of this complex shown below.



Therefore a metal coordination compounds may be defined as

" A compound formed between a metal ion and Ligands, each capable of existing independently through electron pairs using electron from the ligands.

Sidgwick Explaind the stability of the complexes by the fact that central atom or ion acquire the same effective atomic number as the next inert gas.

Notes

For Example.

$[Co(NH_3)_6]^{3+}$

In complex $[Co(NH_3)_6]^{3+}$ oxidation of Co is +3.

Atomic no of Co is 27

Loss of electron in formation of Co^{+3} ion
$= 27 - 3 = 24$

Given electrons by 6 NH_3 Ligands
$= 6 \times 2 = 12$

Hence total no electrons $= 24 + 12 = 36$ It is atomic no of Kr. which is an inert gas.

Limitations of Sigdwick's Theory

This theory Can not Explain the following Points.

1. When the electron Pairs donated to Cobaltic ion. the negative charge Should be accumulate on Cobaltic ion.
2. The electrons donate by the neutral molecules (eg H_2O, NH_3) to the central metal ion belong to the $2s^2$ Pairs which have no bonding characteristics and to Excite them to a higher Level would require more energy than is usually available in bond formation.
3. Cobaltic ion accepts 12 electrons while It does not have completely equivalent orbitals to get the electrons.
4. It does not explain the directional nature of the bonds.