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TOPIC - Valence bond theory

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Q Discuss the basic postulates of Valence bond theory of Complexes.

This theory is exclusively used to explain the Stereo-Chemistry and magnetochemistry of Complexes. followings are the main points of this theory.

1. It Concerns itself firstly with the oxidation state of the central metal in Complexes.
2. The electronic Configuration of the central metal in Complexes is then written in that oxidation state.
3. Electron present in inner orbitals of the metals donot participate in bonding with the ligands. Therefore these are not mentioned.
4. The outer orbital of the metal is shown by a box, $\square$
5. The central metal electron in outer orbitals is shown by an arrow - upward ($\uparrow$) or downward ($\downarrow$).
6. The ligand electron is shown by a cross (X)
7. Each ligand donates an electron pair to the metal for the formation of metal (M) - ligand (L) Coordinate bond in Complexes as $M \leftarrow :L$
8. The metal-ligand bond is formed by the overlapping of orbitals. Greater the overlapping, stronger is the bond so formed. for more effective overlap, hybrid orbitals are used in place of pure atomic orbitals.
9. A σ bond is formed by the overlapping of a vacant metal orbital and a filled ligand orbital.
10. A π-bond is formed by the overlapping of filled metal orbital and a vacant ligand orbital.

11 The central metal atom makes available a number of empty orbitals equal to the co-ordination number for the formation of $M \leftarrow :L$ bond.

12 The hybridisation and shape or structure of Complexes are related to the number of ligands s.e co-ordination number of the metal.

No of ligands	Hybridisation	Structure
2	SP	Linear
4	sp^3	Tetrahedral
4	dsp^2	Square planar
6	d^2sp^2 or sp^3d^2	octahedral

13 Ligands donating an electron pair easily to the metal are called strong ligands e.g CN^-, CO, etc and those donating with difficulty are called weak ligands e.g halides H_2O etc.

14 Under the influence of strong ligands, metal electrons are forced to pair up even Contrary to Hund's rule.

15 The magnetic properties of Complexes are governed by the number of unpaired electrons present in electronic Configuration of Complexes. If the Complex has n unpaired electrons, then magnetic moment due to spin only (μ_s) is given as

$$\mu_s = \sqrt{n(n+2)}\ B.M$$

where B.M (Bohr Magneton) is the unit of moment.

Hence Complexes having unpaired electrons are paramagnetic and Complexes having, no unpaired electrons are diamagnetic.