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quantization



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is broken and new hybrid orbitals are formed. Hence we can get 4 or 6 or higher equivalent orbitals according to the number of vacant orbitals. Here different type of hybridisation have been discussed with their characteristics.

Important Feature of valence bond

Theory.

(i) The central metal atom or ion provides hybrid orbitals as required by the ligands i.e. coordination no to form complex.

(ii) Each ligand has at least one s-orbitals having the pair of electrons.

(iii) The lone pair of electrons of the ligand overlap with the empty hybrid orbital of the metal ions or atoms.

(iv) If d-orbitals are involved in the hybridisation that may be either inner viz (n-1) d-orbitals or the outer viz (n)-orbitals.

The complexes formed in these two ways are known as low spin and high spin complexes respectively.

(v) If complex does not contain unpaired electron is called diamagnetic while the complex having one or more unpaired electron is called paramagnetic while

Illustration :- We discuss valence bond theory by taking some examples of metal co-ordination compounds. In these cases the orbitals are designated by squares and electrons are indicated by arrows.

In transition metal atoms d-electrons levels are partly filled, hence it is the number of d-electron in the central atom (forming complex) that determines the possible modes of hybridisation and the shape of the complex (Octahedral, Square Planar or tetrahedral)

In complex formation Hund's rule of maximum multiplicity is strictly followed i.e. as many orbitals are singly occupied as possible before any pairing occurs. In complex formation redistribution of electrons and orbital pairing takes place. In this way some orbitals are vacated and made available for hybridisation.

1. Octahedral complexes

Such complexes are most common and have been studied most extensively. Let us consider the formation of $[Fe(en)_6]^{4-}$

complex ion. The electronic configuration of Fe atom is $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^6, 4s^2$ or the ferrous ion or the ferrous ion (Fe^{2+}) has $3d^6$ configuration.

S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
						1	2	3	4	5	6	7	8	9	10	11	12	13	14	
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31				

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When six



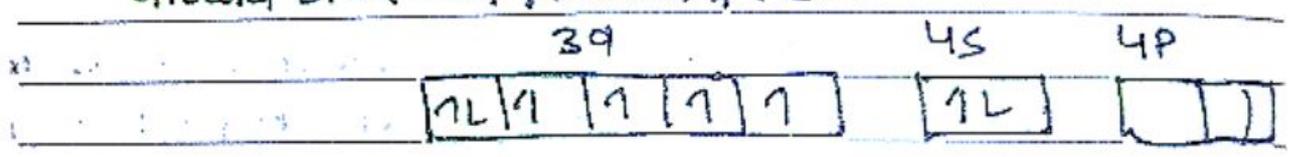
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CN⁻ ions approach to Ferrrous ion to form [Fe(CN)₆]⁴⁻ complex ion.

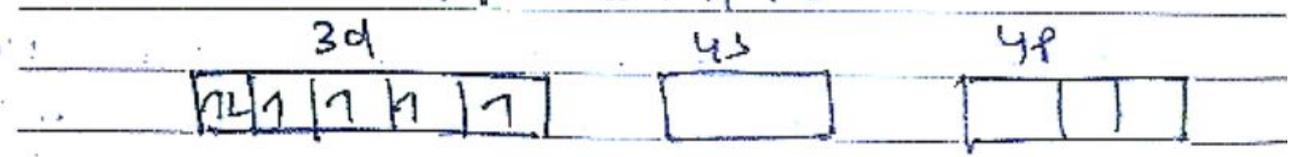
The Pairing of electrons takes place (since CN⁻ ion is a strong ligand hence pairing is possible) in this way two empty orbitals are available for hybridisation.

Now d²sp² hybridisation takes place in the Ferrrous ion which provides six equivalent d²sp² hybrid orbitals to form [Fe(CN)₆]⁴⁻ ion as shown below.

Ground state configuration of Fe -



Ground state configuration of Fe²⁺



Due to strong ligand 3d electrons paired opposite hunds rule.

