

# Atomic Energy Central School, Indore

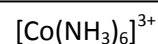
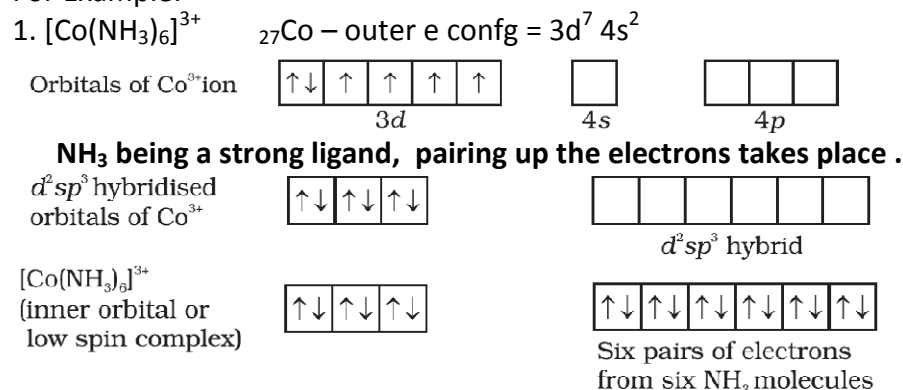
Class XII Chemistry CO-ORDINATION COMPOUNDS Handout 4/6

## Bonding in Coordination Compounds

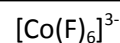
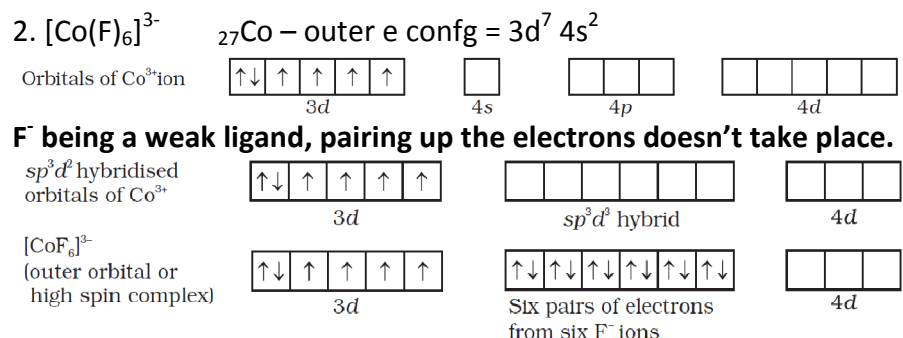
### Valence Bond Theory

According to this theory, the metal atom or ion under the influence of ligands can use its  $(n-1)d$ ,  $ns$ ,  $np$  or  $ns$ ,  $np$ ,  $nd$  orbitals for hybridization to yield a set of equivalent orbitals of definite geometry such as tetrahedral ( $sp^3$ ), square planar ( $dsp^2$ ), pentagonal bipyramidal ( $dsp^3$ ) or octahedral ( $d^2sp^3/sp^3d^2$ ). These hybridised orbitals are allowed to overlap with ligand orbitals that can donate electron pairs for bonding. This is illustrated by the following examples.

For Example:



1. As inner d orbitals are used in  $d^2sp^3$ , it is an **inner orbital complex**
2. As the e- are paired, it is called a **low spin or spin paired complex**
3. As the e- are paired, it is **diamagnetic** in nature.



1. As outer d orbitals are used in  $sp^3d^2$ , it is an **outer orbital complex**
2. As the e- are not paired, it is called a **high spin or spin free complex**
3. As the e- are not paired, it is **paramagnetic** in nature.

### Limitations of Valence Bond Theory

- (i) It involves a number of assumptions.
- (ii) It does not give quantitative interpretation of magnetic data.
- (iii) It does not explain the colour exhibited by coordination compounds.
- (iv) It does not give a quantitative interpretation of the thermodynamic or kinetic stabilities of coordination compounds.
- (v) It does not make exact predictions regarding the tetrahedral and square planar structures of 4-coordinate complexes.
- (vi) It does not distinguish between weak and strong ligands.