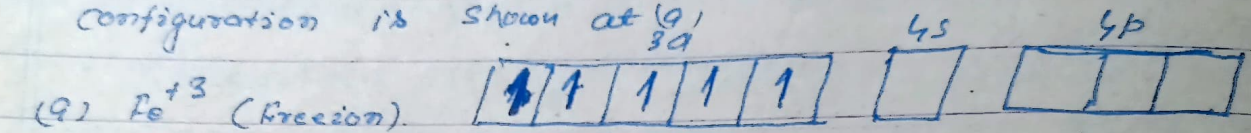
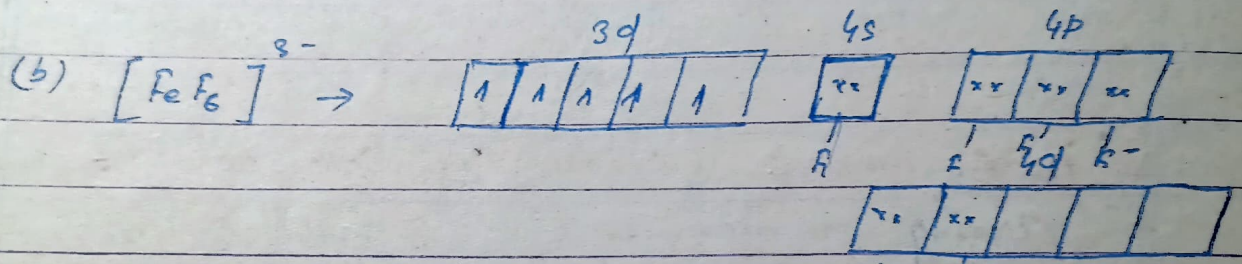
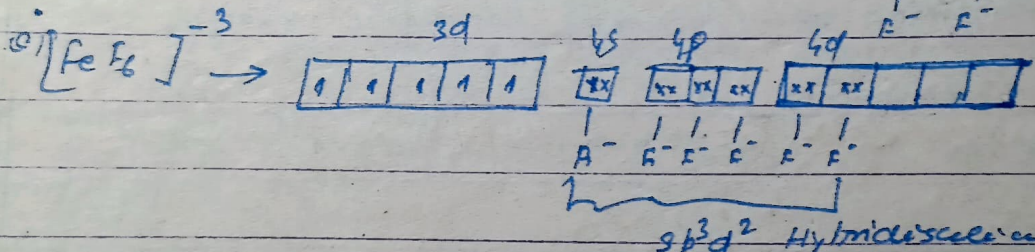
Let us consider how Valence Bond Theorem is used to Explain the formation of Outer orbital Octahedral Complex:—

HEXA Fluro ferric III ion, $[FeF_6]^{3-}$ →

In this Complex ion is present as Fe^{+3} where valence - shell configuration is shown at (a)







Physical measurment shows that $[FeF_6]^{3-}$ ion has Paramagnetic character corresponding to the presence of 5 unpaired Electrons in 3d orbitals

To account for the Paramagnetic character of the ion. Huggin assumed that the d-orbitals involved in the hybridisation process to form Six(6) Octahedral hybrids are not 3d orbitals but are 4d orbitals So that one 4s and three 4p and two 4d orbitals were mixed to give Six equivalent sp^3d^2 hybrids orbitals. which are vaccant and there for accept Six lone pair donated by six ligands (F^- ion) to form $[FeF_6]^{3-}$ ion

Thus this sp^3d^2 hybridisation keeps the 3d-electrons unpaired which explains the Paramagnetic character of the complex ion.

The complexes like $[FeF_6]^{3-}$ are called outer orbital complexes (Taube). Since d-orbitals involved in octahedral hybridisation scheme are from the same main level as the s and p orbitals. In general outer orbitals complexes involve ns, np and nd orbitals in sp^3d^2 Hybridisation scheme. Outer orbital complexes are called High spin (orgel) and spin free (Nyholm) complexes.

The outer orbital complexes has greater number of unpaired electron. Other example of such type of complexes are.

$[Ni^{II}(NH_3)_6]^{2+}$, $[Cr(H_2O)_6]^{2+}$, $[Fe(H_2O)_4]^{3+}$, $[Cu(NH_3)_6]^{+}$

$[CoF_6]^{3-}$, $[Fe^{II}(NH_3)_6]^{2+}$, $[Cu(NH_3)_6]^{2+}$ etc.

Tetrahedral Complexes :⟶

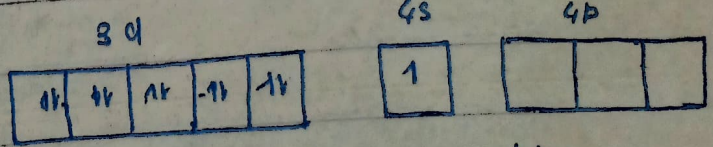
Tetrahedral complexes result of sp^3 Hybridisation.

Examples of tetrahedral complexes are $[CuCl_4]^{3-}$, $[ZnCl_4]^{-2}$

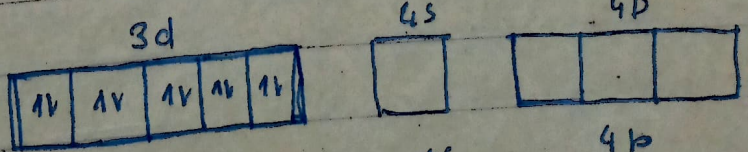
$[Zn(NH_3)_4]^{2+}$, $[Zn(H_2O)_4]^{2+}$, $[Ni(CO)_4]$ $[Ni(NH_3)_4]^{2+}$

(i) Formation of $[CuCl_4]^{3-}$ complex ion

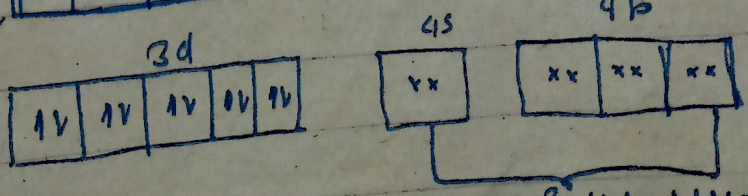
(a) Cu (atom in free state) :→ $3d^{10}4s^1$ / $3d^9 4s^2$ (wrong)



(b) Cu^+ ion →



(c) $[CuCl_4]^{3-}$ →



Formation of $[CuCl_4]^{3-}$ by sp^3 Hybridisation. In the Complex $[CuCl_4]^{3-}$ ion, Copper is as Cu^{+} ion. Its Valence shell Configuration is shown at (b).

It has one vaccent 4s-orbital and three vaccent 4P-orbitals.

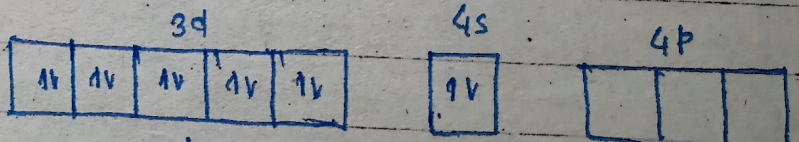
These orbitals hybridise to give four equivalent sp^3 hybride orbitals directed toward 4 corners of a regular tetrahedron. Since these hybride orbitals are vaccant so they accept lone pair of electrons from Cl^- ligands resulting in the formation of $[CuCl_4]^{-3}$ ion.

Since there is no unpaired electron in the Complex. So, it is diamagnetic.

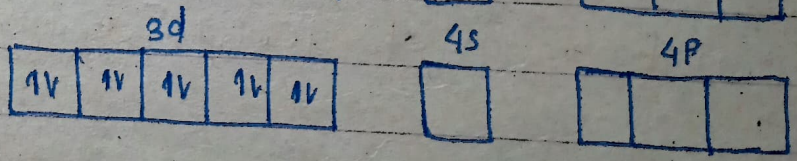
IN Complex ion $[ZnCl_4]^{-2}$ →

(a) $Zn \rightarrow 1s^2 2s^2 p^6 3s^2 p^6 d^{10} 4s^2$

$3d^{10} 4s^2$



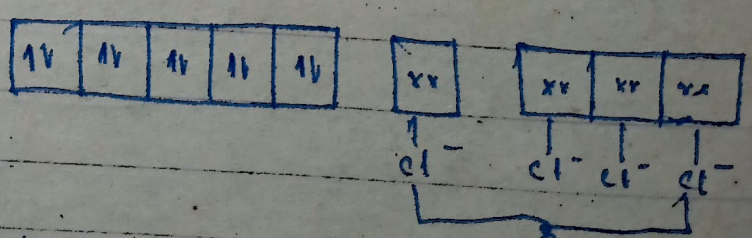
(b) Zn^{+2}



(c) On combining with 4 Cl^- ion

One Cl^- ion contains 2 electron in it

$[ZnCl_4]^{2-}$



This Complex has not any unpaired electron, Hence it is diamagnatic.

sp^3 Hybridisation

Square Planer Complexes:→

Squre Planer Complexes are the result of dsp^2 hybridisation this thype of hybridisation involves due to mixing of one d, one s and two p orbitals, resulting the formation of foure equivalent hybride orbitals which are planer and mutually at right angles pointing towards the fore Corners of a squre planer Complexes.

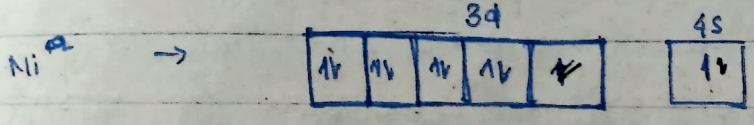
Example of Squre Planer Complexes are

$[Ni(CN)_4]^{2-}$, $[Cu(CN)_4]^{2-}$, $[Cu(NH_3)_4]^{2+}$, $[PtCl_4]^{2-}$ $[PdCl_4]^{2-}$

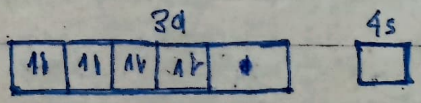
formation of some Complexe ion have been illustrated below:—

(a) $[Ni(CN)_4]^{2-}$.

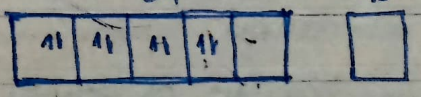
Ni — $1s^2 2s^2 p^6 3s^2 p^6 d^8 4s^2$



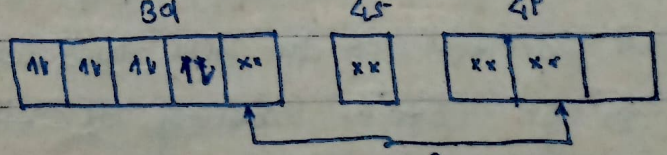
(a) Ni^{+2} →



(b) Ni^{+2} ion in $[Ni(CN)_4]^{2-}$ →



(c) $[Ni(CN)_4]^{-2}$ →



Since there is no unpaired electron, in Complex. ion. so it is Diamagnetic.