

7/5/20

①

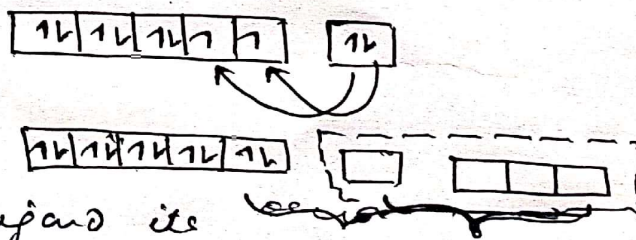
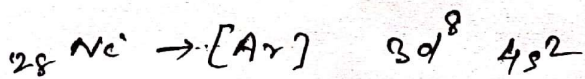
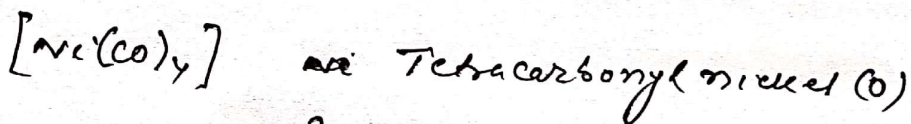
Application of VBT On co-ordination complexes

Structure of Complex with co-ordination no. 4

Complex with co-ordination no. 4 may have either tetrahedral or square planar geometry depend upon the nature of orbitals involved in hybridization.

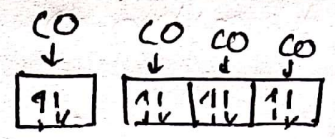
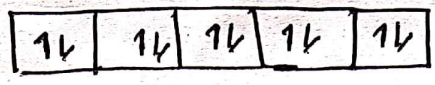
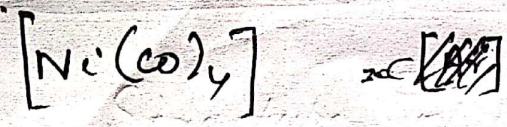
- If One s and three p orbitals are involved in bonding then it will be tetrahedral and hybridization will be  $sp^3$ .
- If One d ( $(n-1)d$ ) orbital, One s and two p orbitals are involved in bonding then geometry will be square planar and hybridization is  $dsp^2$ .

① Tetrahedral complexes :-

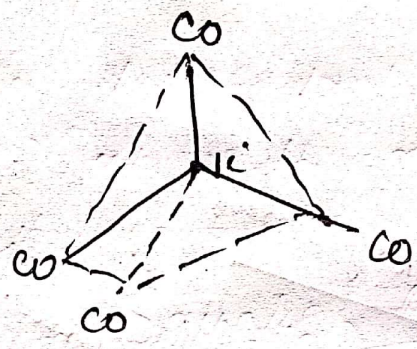


CO is strong ligand its force unpair electron to paired  $sp^3$  hyb.

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$sp^3$ -hyb.



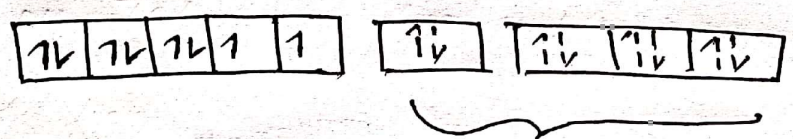
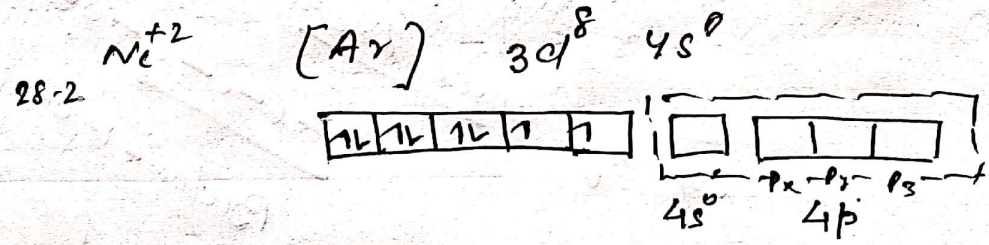
Geometry is tetrahedral  
There is no unpaired electron

2- hence diamagnetic & neutral

ii) Structure of  $[NiCl_4]^{2-}$

Oxidn stat. of Ni =  $x + 4(-1) = -2$   
 $x - 4 = -2$   
 $x = 4 - 2 = +2$

Electronic config. of



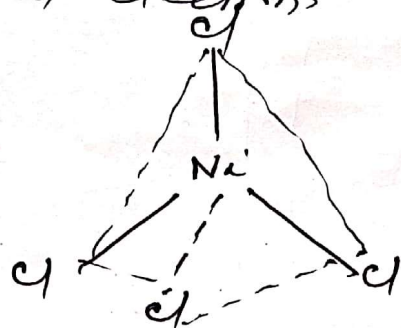
$sp^3$ -hyb.

Explanation:

Since chlorine is weak ligand it can not force to pair up the 3d. electron.

No. of orbitals involve in hyb. One s and three p  
 i.e.  $sp^3$ -hyb.

3) ~~But~~ Geometry is tetrahedral and it will be paramagnetic if it carry two unpaired electrons



Another example of tetrahedral complexes are  $[CuCl_4]^{2-}$ ,  $[Zn(NH_3)_4]^{2+}$  etc.

• In Square planar complexes:  
i.e.  $(dsp^2)$ -hyb.

In such complexes inner d-orbitals involve  $sp^2$  hybridization with co. no. 4. complex, here strong ligands can force unpaired electron of d-orbitals to pair up & make vacant d-orbitals take part in hybridization.

e.g.  $[Ni(CN)_4]^{2-}$  (Tetracyano nickelate II ion)

D. NO. of Ni

$$x + 4(-1) = -2$$

$$x - 4 = -2$$

$$x = +2$$

$Ni^{2+} - [Ar] 3d^8 4s^0$