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7/5/20

B.Sc-III (Hons)

Part-2

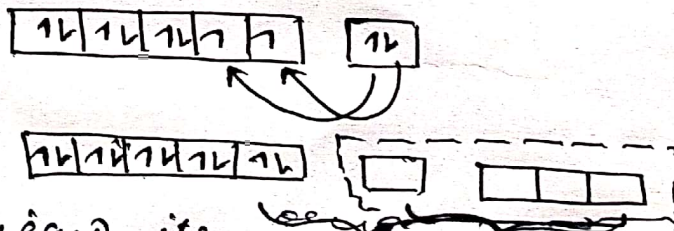
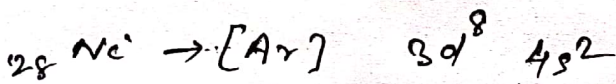
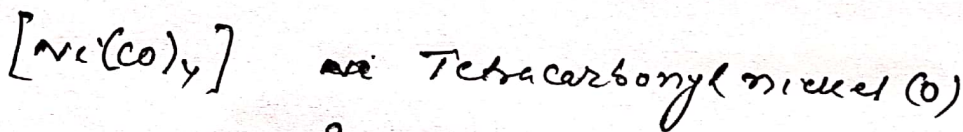
# Application of VBT On Co-ordination complexes

## 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.

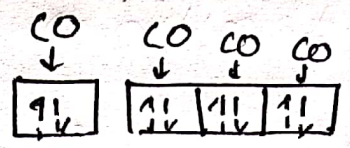
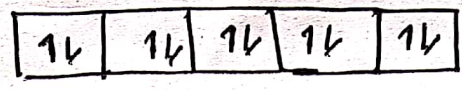
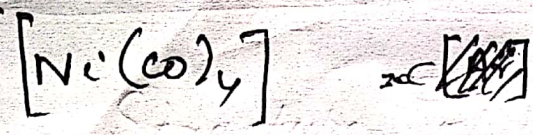
- If One s and three p orbitals are involved in bonding then it will be tetrahedral and hybridization will be  $sp^3$ .
- If 2. One d ( $(n-1)d$ ) orbital, One ns and two np-orbitals are involved in bonding then geometry will be square planar. and hybridization is  $dsp^2$

### ① Tetrahedral complexes :-

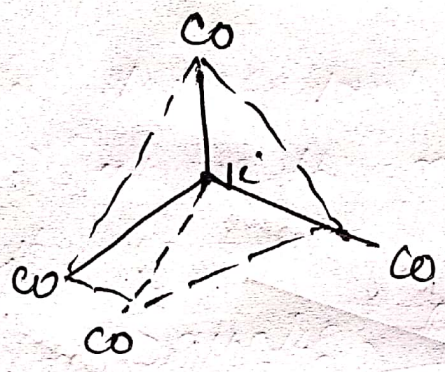


CO is strong ligand its force unpair electron to paired  $sp^3$  hyb.  
up.





$sp^3$ -hyb.



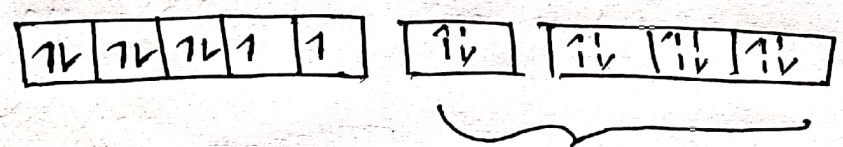
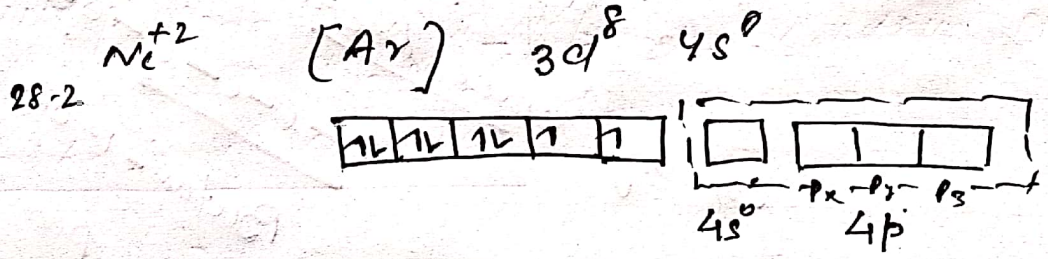
Geometry is tetrahedral  
There is no unpaired electron

∴ hence diamagnetic & neutral

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

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

Electronic config. of



Explanation:

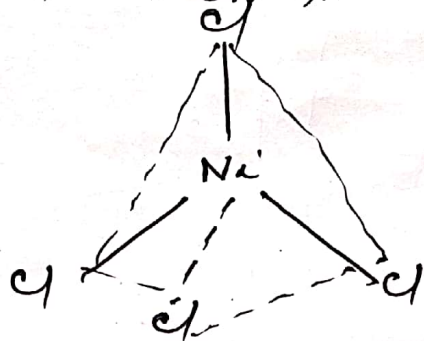
Since chlorine is weak ligand it can not force to pair up the 3d electrons.

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

$sp^3$ -hyb.



3) ~~But~~ Geometry is ~~of~~ 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 a hybridization with co. no. 4. complexes. here strong ligands can force unpaired electron of  $d$ -orbitals to pair up & more vacant  $d$ -orbitals take part in hybridization.

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

D. NO. of Ni

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

$$x - 4 = -2$$

$$x = +2$$

Ni<sup>2+</sup> - [Ar] 3d<sup>8</sup> 4s<sup>0</sup>