Co-ordination Compounds

Weightage = 9 Marks 3 Marks – 3Q

ONE MARK QUESTIONS

1. What is the IUPAC of $K_2[Zn(OH)_2]$?
   Ans :Potassium tetrahydroxidozincate(II)
2. Write formula for the mercurytetrathiocyanatocobaltate(III)
   Ans : $Hg[Co(SCN)_4]$
3. How many Cl^-ions can be precipitated as AgCl. by adding excess of aqueous $AgNO_3$ solution into one mole of $[Co(NH_3)_6]Cl_3$?
   Ans : Three(3) ions or three or 3
4. What is the value of co-ordination number of Fe in$[FeCl_2(en)_2]Cl$?
   Ans : 6

TWO MARK QUESTIONS :

5. What is an ambidentate ligand? Give an example.
   Ans :Ligand which can ligate through two different atoms to central metal atom/ion is known as ambidentate ligand.

   Ex : Nitrito-N and Nitrito-O OR NO^-_2OR Thiocyanate and Isothiocyanate OR SCN^- and NCS^- (any one)
6. What is Chelating ligand? Give an example.
   Ans : When a didentate or polydentate ligand uses two or more donor atoms to bind single central metal metal atom/ ion is known as cheating ligand.
   Example : ethane 1-2 diamine (en), ethylenediaminetetraacetate($EDTA^{4-}$)ion, oxalate ($C_2O_4^{2-}$) etc. (any one)
7. What are homoleptic complexes? Give an example.
   Ans : Complexes in which a central metal atom /ion is bound to more than one kind of donor groups are known as heteroleptic complexes.
   Example :$[Ti(H_2O)_6]^{3+}$, $[Co(CN)_6]^{3-}$, $[Cu(H_2O)_4]^{2+}$, $[Ni(CN)_4]^{2-}$, $[NiCl_4]^{2-}$, $[Co(en)_3]^{3+}$ etc
8. What are heteroleptic complexes? Give an example.
   Ans :Complexes in which a central metal atom /ion is bound to more than one kind of donor groups are known as heteroleptic complexes.
   Example : $[CoCl.CN.NO_2(NH_3)_3]$, $[Co(NH_3)5(NO_2)]Cl_2$. $[Co(NH_3)_5(NH_3)_5(ONO)]Cl_2$etc
9. Mention any two postulates of Werner's theory of co-ordination compound.
   Ans :
   i) The central metal atom or ion in a complex posseses two types of valences(linkages) Namely a) Primary valency b) Secondary valency
   ii) Primary valency is ionisable and secondary valency is non ionisablle.
   iii) Primary valency is satisfied only by anions.(negatively charged ions) and secondary valency is satisfied by either anions or neutral moleculesor both.
   iv) The primary valency corresponds to the oxidation state of central metal and the secondary valency corresponds to the co-ordination number of the metal(remains fixed for a metal)

   v) The secondary valences are directional. Hence they show isomerism.

vi) The primary valency of the metal is variable. The secondary valency has a fixed value.

10. Draw energy level diagram for the splitting of d-orbitals in an octahedral crystal field.

Ans :

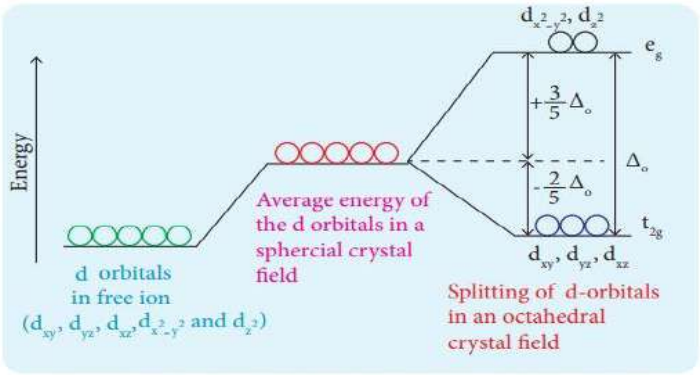


Figure: 5.10 - Crystal field splitting in octahedral field

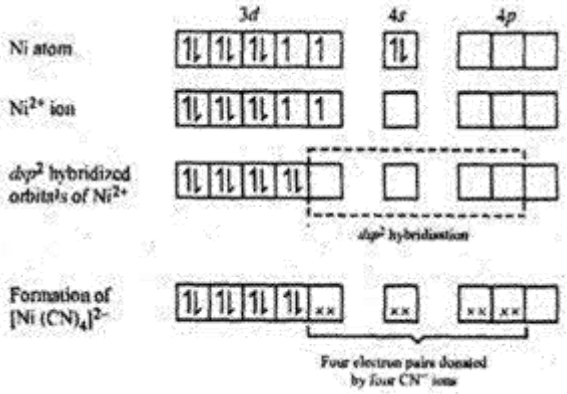
THREE MARKS QUESTIONS :

11. On the basis of Valence Bond Theory (VBT), Account for hybridisation, geometry and magnetic property of $[Ni(CN)_4]^{2-}$ complex ion. (Z for Ni is 28)

Ans : Hybridisation : dsp^2

Geometry : Square planar

Magnetic property : Diamagnetic

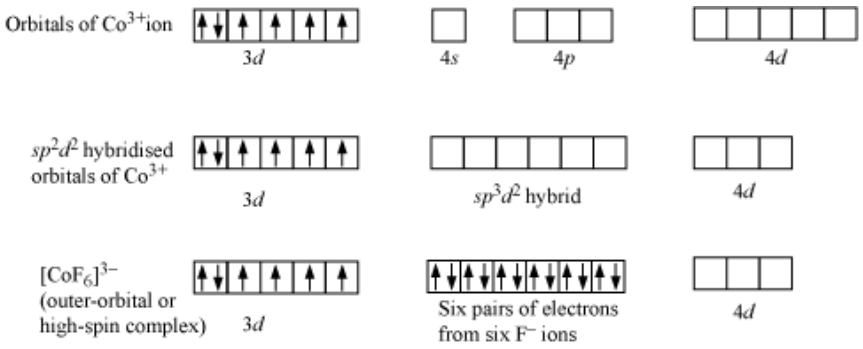


12. Using valence bond theory explain geometry hybridisation and magnetic property of $[CoF_6]^{3-}$.(Given atomic number of Co is 27)

Ans : Hybridisation : sp^3d^2

Geometry :Octahedral

Magnetic property : Paramagnetic



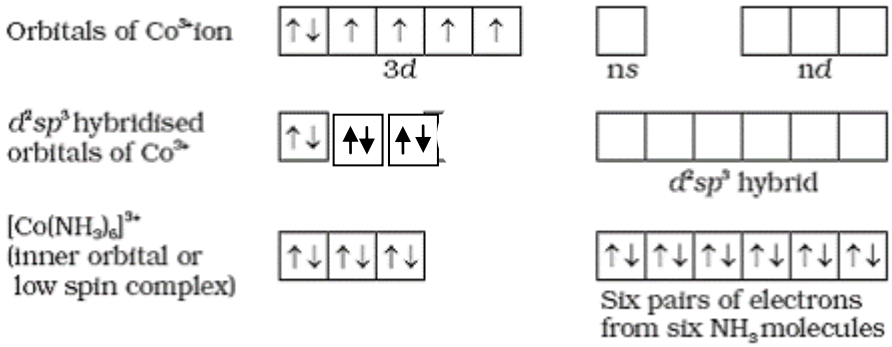
Complexes hybridisation according to valence bond theory

13. Using valence bond theory explain geometry hybridization and magnetic property of $[Co(NH_3)_6]^{3-}$ (Given atomic number of Co is 27)

Ans : Hybridisation : d^2sp^3

Geometry : Octahedral

Magnetic property :Diamagnetic

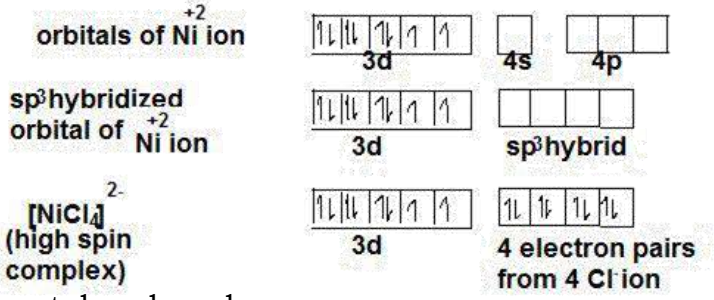


14. On the basis of valence bond theory (VBT), Account for hybridisation, geometry and magnetic property of $[NiCl_4]^{2-}$Complex ion (Z for Ni is 28)

Ans : Hybridisation : sp^3

Geometry :Tetrahedral

Magnetic property :Paramagnetic



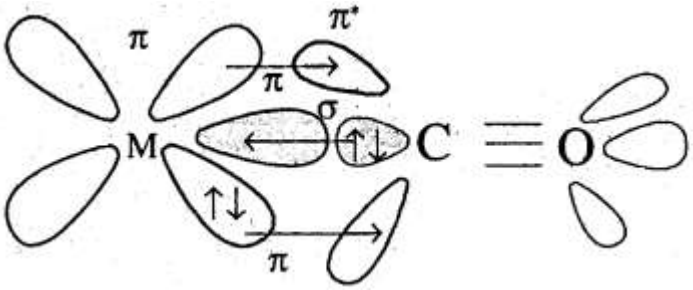
15. Discuss the nature of bonding in metal carbonyl.

Ans : In metal carbonyl : The metal-carbon bond posses both σ and π-character.

The metal-carbon σ bond is fomed by the donation of lone pair of electrons on the carbonyl carbon into vacant orbitals of metal.

The metal-carbon π- bond is formed by the donation of a pair of electrons from a filled d-orbital of metal into the vacant antibonding π* orbital of CO

The metal to ligand bonding creates a synergic effect which strengthens the bond between CO and metal.



16. What is Crystal Field Splitting Energy? Name two factors on which Crystal Field splitting energy depends.

Ans : The energy separation in the splitting of the degenerated levels due to presence of ligands in a definite geometry is known as Crystal-Field Splitting energy.

OR

The difference in energy between the two sets of degenerate orbitals during crystal field splitting is called as Crystal-Field Splitting Energy.

The crystal field splitting energy depends on :

1. Field produced by the ligand. (Strength of ligand)
2. Charge on the metal ion.

17. Define spectrochemical series

A series of ligands arranged is the increasing order of their ligand field strength is called spectrochemical series.
