Coordination Compounds

Que 1: The crystal field splitting energy (Δ_o) for $[CoCl_6]^{4-}$ is 18000cm^{-1}. Calculate the (Δ_t) for $[CoCl_4]^{2-}$? ***Marks :(2)***

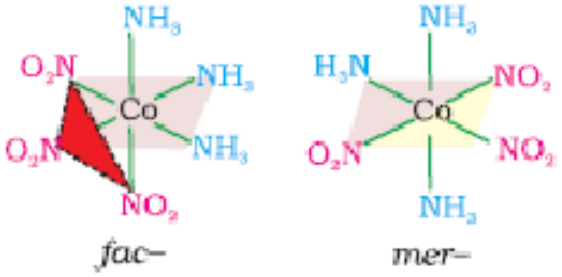
Ans: In both the complexes cobalt is in +2 oxidation state. But the first one is octahedral and other a tetrahedral complex.

$\Delta_t = 4/9\ \Delta_0$,

$\Delta_t = 4/9 \times 18000 = 8000\ cm^{-1}$

Que 2: Draw the structure of $[Co(NH_3)_3(NO_2)_3]$ and Identify the type of geometrical isomerism that can be exhibited by this complex ***Marks :(3)***

Ans:



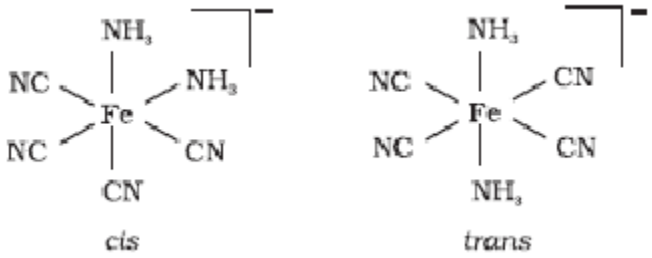
fac-and mer – isomerism

Que 3: Coordination compounds exhibit cis-trans isomerism.

(a) Draw the structure of cis and trans isomer of $[Fe(NH_3)_2(CN)_4]^-$

(b) In the above example which isomer is optically active? Explain? ***Marks :(4)***

Ans: (a)



(b) cis-isomer is optically active, because it is chiral.

Que 4: Write the molecular formulae of following complexes ?

(a) Potassium hexacyanoferrate (III)

(b) Dichloridobis(ethylenediamine)cobalt(III)chloride ***Marks :(2)***

Ans: (a)$K_3[Fe(CN)_6]$

(b) $[CoCl_2(en)_2]Cl$

Que 5: Which of following transition metal ion is expected to give coloured solution.

(a) Zn^{2+} (b) Cu^{+} (c) Ti^{3+} (d) Ti^{4+} ***Marks :(1)***

Ans: (c) Ti^{3+}

Que 6: The platinum complex used to inhibit the growth of tumor is: ***Marks :(1)***

Ans: Cisplatin {cis-[$PtCl_2(NH_3)_2$] }

Que 7: Write the electronic configuration of d^6 state in high spin octahedral complex according to crystal field theory? ***Marks :(1)***

Ans: $t_{2g}^4 e_g^2$

Que 8: Which of the following complex exist in fac- and mer- isomeric forms ***Marks :(1)***

a) [$Cr(H_2O)_4Cl_2]^+$

b) [$Co(en)_2Br_2$] Cl

c) [Pt $(NH_3)_3Cl_3$] Cl

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

Ans: c) [Pt $(NH_3)_3Cl_3$] Cl

Que 9: What is spectrochemical series? ***Marks :(2)***

Ans: It is the series of ligands arranged in the increasing order of their field strength or crystal field splitting energy.

Que 10: Which of the following complex exhibit geometrical isomerism? ***Marks :(1)***

a) [Ni Cl_2 $Br_2]^{2-}$

b) [$Co(NH_3)_5Cl$]$^{-}$

c) $[Co(en)_2Cl_2]^+$

d) $[Fe(H_2O)_5Cl]SO_4$

Ans: c) [$Co(en)_2Cl_2$]$^+$

Que 11: Write all possible structural isomers of the following complex and give IUPAC names ***Marks :(3)***

$[Pt(NH_3)_4Cl_2]$ Br_2

Ans: 1. $[Pt(NH_3)_4Cl_2]$ Br_2 Tetraamine dichloride platinum(IV) bromide.

2. $[Pt(NH_3)_4ClBr]BrCl$ Tetraamine bromide chloride platinum(IV) Bromo chloride

3. $[Pt(NH_3)_4Br_2]Cl_2$ tetraamine bromide platinum(IV) chloride

Que 12: Write IUPAC names of the following complexes ***Marks :(3)***

a) $[Pt(NH_3)_2Cl(NO_2)]$

b) $K_3[Cr(C_2O_4)_3]$

c) $[CoCl_2(en)_2]Cl$

Ans: a) Diamine chloride nitrito-N-platinum(II)

b) Potassium trioxalato chromate(III)

c) Dichoridobis(ethane-1,2-diamine)cobalt(III) chloride

Que 13: Define homoleptic and heteroleptic complexes. Give example for each. ***Marks :(3)***

Ans: Complexes containing only one type of ligands are known as homoleptic complexes

Eg: $[Co(NH_3)_6]Cl_3$, $K_2[Ni(CN)_4]$

Complexes containing more than one kind of ligands are known as heterolytic complexes

Eg: $[Co(NH_3)_3Cl_3]$, $[Fe(H_2O)_4Cl_2]Cl$

Que 14: What is an ambident ligand ? Give examples. ***Marks :(2)***

Ans: Unidentate ligand which can ligate through two different atoms is known as ambident ligand

Eg. CN^- and NC^-

SCN^{--} and NCS^{--}

NO_2^- and ONO^-

Que 15: Write the postulates of Werner's theory of complexes ***Marks :(4)***

Ans: 1. In coordination compounds, metals shows two type of valances -primary valence and secondary valence

2. Primary valences are normally ionisable but secondary valences are nonionisable

3. Primary valences are satisfied by negative ions while secondary valences are satisfied by neutral molecules or -ve ions

4. Secondary valences are equal to coordination number and is fixed for a metal

5. Secondary valences are directional and determines the geometry of the complexes

Que 16: What is chelate ligand ? ***Marks :(2)***

Ans: Certain bidentate or polydentate ligand when connected to same central metal ion or atom forms ring or closed structure. Such ligands are called chelating ligand

Que 17: The spin only magnetic moment of $[MnCl_4]^{2-}$ is 5.9 BM. Predict the geometry of the complex ion ? ***Marks :(3)***

Ans: Since the coordination number of Mn^{2+} ion in the complex ion is 4, it will

be either tetrahedral (sp^3 hybridisation) or square planar (dsp^2 hybridisation).

But the fact that the magnetic moment of the complex ion is 5.9 BM hence there should be 5 unpaired electrons. It should be tetrahedral in shape rather than square planar because of the presence of five unpaired electrons in the d orbitals.

Que 18: How many ions are produced from the complex $[Co(NH_3)_6]Cl_2$ in solution? ***Marks :(1)***

A) 6 **B) 4** **C) 3** **D) 2**

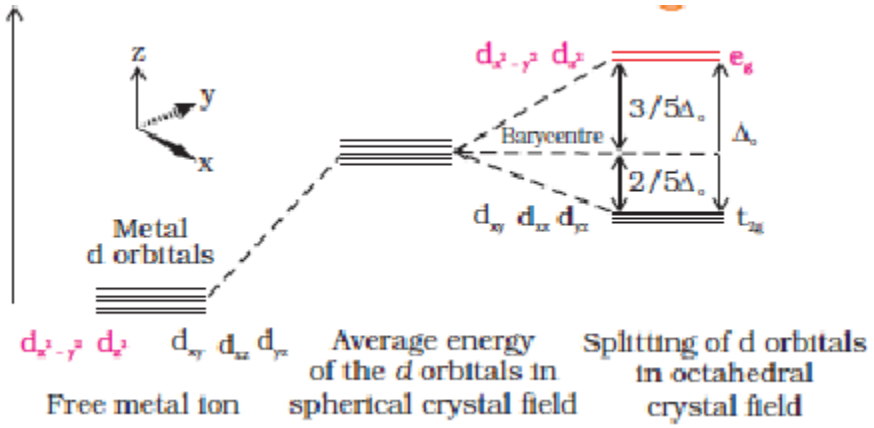
Ans: 3

Que 19: (a)Represent diagrammatically the crystal field splitting in octahedral complexes.

(b)Write octahedral splitting electronic configuration of d^5 state, in presence of weak field ligands?

(c) Find the magnetic moment of above electronic configuration ***Marks :(4)***

Ans: (a)



(b) $t_{2g}^3\ e_g^2$

(c) Magnetic moment =√(n(n+2))BM = √(5(5-2))BM = √(15) = 3.87 BM.

Que 20: What is Wilkinson catalyst? Give its use ? ***Marks :(2)***

Ans: $[Rh(Ph_3P)_3Cl]$ is known as Wilkinson catalyst. It is used as the catalyst for the hydrogenation of alkenes. $[RhCl(Ph_3P)_3]$,