

SOLVED EXAMPLE

Ex.1 NH_2NH_2 although possesses two electron pair for donation but not acts as chelating agent. Why ?

Sol. The co-ordinating by NH_2NH_2 leads to a three member highly unstable strained ring and thus it does not acts as chelating agent.

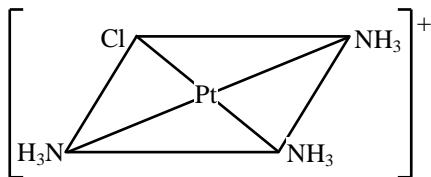
Ex.2 Square planar complexes with co-ordination number four exhibit geometrical isomerism whereas tetrahedral complexes do not. Why ?

Sol. In tetrahedral complexes, the relative position of atoms with respect to each other is same thus these do not show geometrical isomerism. Square planar complexes show cis, trans isomerism.

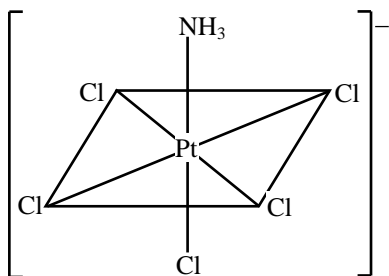
Ex.3 Platinum (II) forms square planar complexes and platinum (IV) gives octahedral complexes. How many geometrical isomers are possible for each of the following complexes ? Describe their structures -

- (A) $[\text{Pt}(\text{NH}_3)_3\text{Cl}]^+$ (B) $[\text{Pt}(\text{NH}_3)\text{Cl}_5]^-$
 (C) $[\text{Pt}(\text{NH}_3)_2\text{ClNO}_2]$ (D) $[\text{Pt}(\text{NH}_3)_4\text{ClBr}]^{2+}$

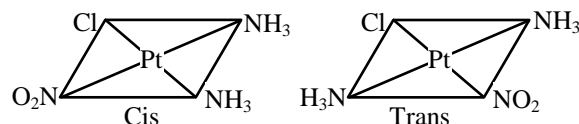
Sol. (i) Square planar complex of the type Ma_3b shows no isomerism.



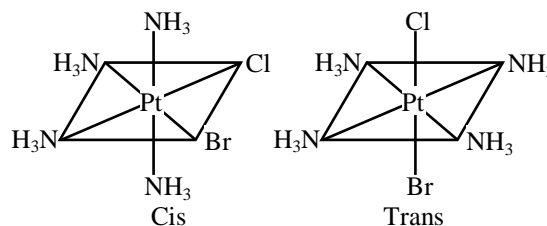
(ii) An octahedral complex of the type Ma_5b shows no isomerism.



(iii) A square planar complex of the type Ma_2bc exists as cis and trans isomers

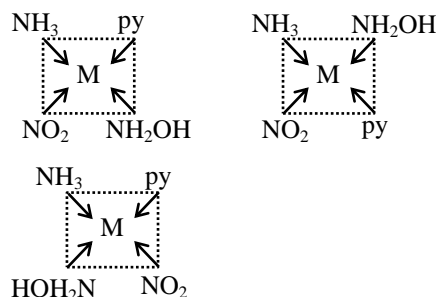


(iv) An octahedral complex of the type Ma_4bc shows cis and trans isomerism.



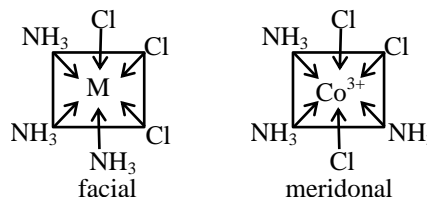
Ex.4 How many geometrical isomers with formula $[\text{MABCD}]$ e.g., $[\text{Pt}(\text{NH}_3)\text{py}(\text{NH}_2\text{OH})\text{NO}_2]^+$ are possible ?

Sol. Three isomers



Ex.5 What are facial meridional isomers ? Explain with examples.

Sol. For the complexes of the type $[\text{Ma}_3\text{b}_3]$ e.g., $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]^{3+}$ and $[\text{Rh}(\text{py})_3\text{Cl}_3]^{3+}$; the isomer is called facial (fac) when all similar ligands occupy same face of an octahedron as shown below. When all similar ligands are not on the same face then isomer is called meridional (mer).

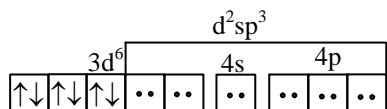


Ex.6 Why does $[\text{CoF}_6]^{3-}$ give a high spin complex ?

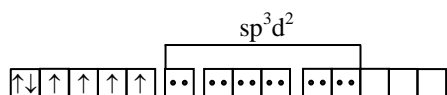
Sol. F^- is weak field ligand so it can not pair up the electrons i.e., why it is high spin complex.

Ex.7 $[\text{Fe}(\text{CN})_6]^{4-}$ is diamagnetic while $[\text{FeF}_6]^{4-}$ is strongly paramagnetic. Why ?

Sol. CN^- is strong field ligand and so it pairs up the electrons leading to the formation of low spin complex which is diamagnetic.



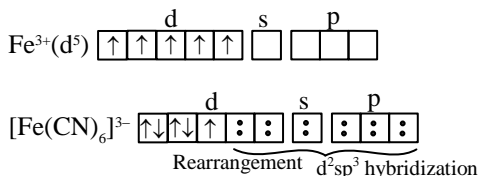
Octahedral, diamagnetic complex F^- is weak field ligand so it forms high spin paramagnetic complex.



Octahedral, paramagnetic complex

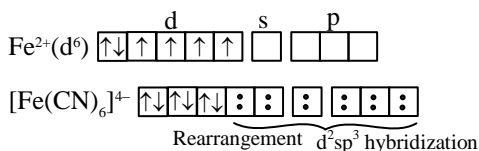
Ex.8 $[\text{Fe}(\text{CN})_6]^{3-}$ is weakly paramagnetic while $[\text{Fe}(\text{CN})_6]^{4-}$ is diamagnetic, why ?

Sol. $[\text{Fe}(\text{CN})_6]^{3-}$ involves d^2sp^3 hybridization



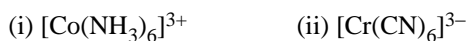
One d-orbital is singly occupied, hence it is weakly paramagnetic in nature.

$[\text{Fe}(\text{CN})_6]^{4-}$ involves also d^2sp^3 hybridization but it has Fe^{2+} ion as central ion.

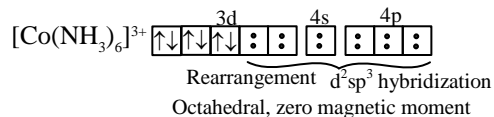
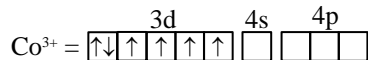


All orbitals are doubly occupied, hence it is diamagnetic in nature.

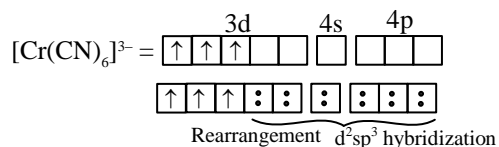
Ex.9 Find out the hybridization, geometry and magnetic moment of the complexes :



Sol. (i) The oxidation state of cobalt in the complex is +3. The electronic configuration of Co^{3+} ions is –



(ii) The oxidation state of chromium in the complex is +3. The electronic configuration of Cr^{3+} ion is –



Octahedral, mag. moment

$$= \sqrt{3 \times (3+2)} = \sqrt{15} = 3.87 \text{ B.M.}$$

Ex.10 The magnetic moment of $[\text{MnCl}_4]^{2-}$ is 5.92 B.M. On the basis of its magnetic moment, write configuration of Mn^{2+} in this complex.

Sol. For an atom/ion

$$\text{Magnetic moment } (\mu) = \sqrt{n(n+2)}$$

(n = No. of unpaired electrons)

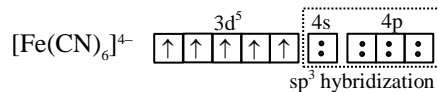
Given that $\mu = 5.92 \text{ B.M.}$

$$\therefore 5.92 = \sqrt{n(n+2)}$$

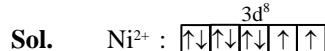
or $n = 5$

Thus in this complex Mn contains five unpaired electrons and so its possible configuration may be Mn^{2+} in $[\text{MnCl}_4]^{2-} = [\text{Ar}] 3d^5 4s^0$

so hybridisation of Mn^{2+} in the given complex must be sp^3 .



Ex.11 All the octahedral complexes of Ni^{2+} are outer orbital complexes, why ?



Thus only one 3d-orbital is available electrons pair up due to strong field ligand. Therefore, d^2sp^3 hybridisation is not possible. Only sp^3d^2 is possible which represents outer complex.

Ex.21 The order of stability of complexes of ion Cu^{+2} , Ni^{+2} , Mn^{+2} and Fe^{+2} decreases in the order -

- (A) $\text{Cu}^{+2} > \text{Ni}^{+2} > \text{Fe}^{+2} > \text{Mn}^{+2}$
- (B) $\text{Mn}^{+2} > \text{Ni}^{+2} > \text{Cu}^{+2} > \text{Fe}^{+2}$
- (C) $\text{Ni}^{+2} > \text{Cu}^{+2} > \text{Fe}^{+2} > \text{Mn}^{+2}$
- (D) $\text{Fe}^{+2} > \text{Ni}^{+2} > \text{Cu}^{+2} > \text{Mn}^{+2}$

Sol. [A] The order of stability of the complexes of some of the ions carrying the same charge but differing in ionic radii decrease as the ionic radii increase.

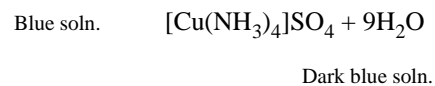
ion	Cu^{+2} ,	Ni^{+2} ,	Fe^{+2} ,	Mn^{+2}
Ionic radii	0.69	0.78	0.83	0.91

The complexes of Cu^{+2} are most stable while Mn^{+2} is least stable.

Ex.22 A blue solution of copper sulphate becomes darker when treated with excess of ammonia. This is because –

- (A) ammonia molecules replace water molecules in the solution
- (B) ammonia is stronger ligand than water
- (C) ammonia forms a stable complex ion $[\text{Cu}(\text{NH}_3)_4]^{2+}$ with Cu^{2+} ions
- (D) All are correct

Sol.[D] $[\text{Cu}(\text{H}_2\text{O})_4]\text{SO}_4 \cdot \text{H}_2\text{O} + 4\text{NH}_4\text{OH} \longrightarrow$



LEVEL # 1

Questions
based on

Coordination Compound and Terminology

- Q.1** Which of the following is not a double salt but is a complex salt –
 (A) $\text{KCl.MgCl}_2 \cdot 6\text{H}_2\text{O}$
 (B) $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
 (C) $\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$
 (D) $4\text{KCN} \cdot \text{Fe}(\text{CN})_2$
- Q.2** The solution of the complex $[\text{Cu}(\text{NH}_3)_4] \text{SO}_4$ in water –
 (A) Will give the tests of Cu^{2+} ions
 (B) Will give the tests of NH_3
 (C) Will give the tests of SO_4^{2-} ions
 (D) Will not give the tests of any of the above species
- Q.3** The donor atoms in EDTA are –
 (A) Two N and Two O
 (B) Two N and four O
 (C) Four N and Two O
 (D) Three N and three O
- Q.4** Which of the following ligands is not a chelating agent –
 (A) EDTA (B) en
 (C) Oxalate (D) Pyridine
- Q.5** The co-ordination number of Cr in the complex ion $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ is –
 (A) Zero (B) 3
 (C) 6 (D) None of these
- Q.6** The oxidation number of platinum in $[\text{Pt}(\text{NH}_3)_5 \text{Cl}]\text{Cl}_3$ is –
 (A) 2 (B) 3
 (C) 4 (D) 6
- Q.7** An ambidentate ligand is one which –
 (A) is linked to the metal atom at two points
 (B) has two donor atoms but only one of them has the capacity to form a coordinate bond
 (C) Has two donor atoms but either of the two can form a co-ordinate bond
 (D) forms chelate rings
- Q.8** Coordination number and oxidation number of Cr in $\text{K}_3[\text{Cr}(\text{C}_2\text{O}_4)_3]$ are, respectively –
 (A) 4 and + 2 (B) 6 and + 3
 (C) 3 and + 3 (D) 3 and 0
- Q.9** All ligands are –
 (A) Lewis acid (B) Lewis base
 (C) Neutral (D) None of these
- Q.10** In SCN ligand if N is attached to central atom, the name of ligand is –
 (A) Thiocyanato-N (B) Cyanato-N
 (C) Thiocyanato-S (D) Cyanato-S
- Q.11** In $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$ the co-ordination number of cobalt is –
 (A) 4 (B) 6
 (C) 2 (D) 7
- Q.12** Bidentate ligand is –
 (A) CN^- (B) Ethylene diamine
 (C) EDTA (D) SCN^-
- Q.13** The neutral ligand is –
 (A) Chloro (B) Hydroxo
 (C) Ammine (D) Oxalato
- Q.14** Glycinato ligand is –
 (A) $\text{CH}_2 \begin{array}{l} \nearrow \ddot{\text{N}}\text{H}_2 \\ \searrow \text{COO}^- \end{array}$
 (B) Bidentate ligand
 (C) Two donor sites N and O^-
 (D) All of these
- Q.15** In the complex $[\text{Co}(\text{NH}_3)_6]^{3+}$ the species acting as Lewis acid and Lewis bases are respectively –
 (A) Co^{2+} , NH_3 (B) NH_3 , Co
 (C) Co^{3+} , NH_3 (D) NH_3 , Co^{3+}
- Q.16** Triphenyl phosphine is –
 (A) Neutral and monodentate ligand
 (B) Neutral and tridentate ligand
 (C) Uninegative and unidentate ligand
 (D) Trinegative and tridentate ligand
- Q.17** The coordination number and oxidation number of the central metal ion in the complex $[\text{Pt}(\text{en})_2]^{+2}$ is –
 (A) C.N. = 2, O.N. = +2
 (B) C.N. = 6, O.N. = +4
 (C) C.N. = 4, O.N. = +4
 (D) C.N. = 4, O.N. = +2

- Q.18** The addition compounds, which retain their identity in solution are called –
 (A) Double salts
 (B) Complex compounds
 (C) Coordination compounds
 (D) (B) and (C) both
- Q.19** The total number of Ligands attached to the central metal ion through coordinate bond is called –
 (A) Valency of the metal ion
 (B) Oxidation state of the metal ion
 (C) Coordination number of metal ion
 (D) None of the above
- Q.20** The co-ordination number of a metal in co-ordination compound is –
 (A) Same as primary valency
 (B) Sum of primary and secondary valencies
 (C) Same as secondary valency
 (D) None of the above
- Q.21** The co-ordination number and oxidation number of X in the compound $[X(SO_4)(NH_3)_5]$ will be –
 (A) 10 and +3 (B) 1 and +6
 (C) 6 and +4 (D) 6 and +2
- Q.22** To form a coordination bond, one needs a ligand. Which of the following species cannot be a ligand –
 (i) NH_4^+ (ii) NO^+
 (iii) $C_5H_5\ddot{N}$
 (A) i only (B) i & ii only
 (C) i & iii only (D) i, ii & iii only
- Q.23** The co-ordination number of cobalt in $[Co(en)_2Br_2]Cl_2$ is –
 (A) 2 (B) 4
 (C) 6 (D) 8
- Q.24** In which of the following complexes Ni metal is in highest oxidation state –
 (A) $Ni(CO)_4$
 (B) K_2NiF_6
 (C) $[Ni(NH_3)_6](BF_4)_2$
 (D) $K_4[Ni(CN)_6]$

Questions
based on

Werner's Theory

- Q.25** When $AgNO_3$ is added to a solution of $Co(NH_3)_5Cl_3$, the precipitate of $AgCl$ shows two ionisable chloride ions. This means –
 (A) Two chlorine atoms satisfy primary valency and one secondary valency
 (B) One chlorine atom satisfies primary as well as secondary valency
 (C) Three chlorine atoms satisfy primary valency
 (D) Three chlorine atoms satisfy secondary valency
- Q.26** A co-ordination complex of cobalt has molecular formula containing five ammonia molecules, one nitro group and two chlorine atoms for one cobalt atom. One mole of this compound produces three mole ions in an aqueous solution. In reacting this solution with excess of silver nitrate solution, two moles of $AgCl$ get precipitated. The ionic formula of this complex would be –
 (A) $[Co(NH_3)_4.NO_2Cl].[NH_3Cl]$
 (B) $[Co(NH_3)_5Cl].[Cl(NO_2)]$
 (C) $[Co(NH_3)_5(NO_2)]Cl_2$
 (D) $[Co(NH_3)_5].[NO_2)_2Cl_2]$
- Q.27** Which of the following complex will give white precipitate with barium chloride solution –
 (A) $[Cr(NH_3)_5Cl]SO_4$ (B) $[Cr(NH_3)SO_4]Cl$
 (C) $[Co(NH_3)_6]Br_3$ (D) None of these
- Q.28** Which isomer of $CrCl_3.6H_2O$ is dark green in colour and forms one mole of $AgCl$ with excess of $AgNO_3$ solution –
 (A) $[Cr(H_2O)_6]Cl_3$
 (B) $[Cr(H_2O)_5Cl]Cl_2.H_2O$
 (C) $[Cr(H_2O)_4Cl_2]Cl.2H_2O$
 (D) $[Cr(H_2O)_3Cl_3].3H_2O$
- Q.29** Give the correct increasing order of electrical conductivity of aqueous solutions of following complex entities –
 I. $[Pt(NH_3)_6]Cl_4$ II. $[Cr(NH_3)_6]Cl_3$
 III. $[Co(NH_3)_4Cl_2]Cl$ IV. $K_2[PtCl_6]$
 (A) III < IV < II < I (B) IV < II < III < I
 (C) II < I < IV < III (D) I < II < IV < III

- Q.30** The complex $[\text{Cr}(\text{H}_2\text{O})_4\text{Br}_2]\text{Cl}$ in its aqueous solution gives test for –
 (A) Cl^- ion
 (B) Br^- ion
 (C) Both Cl^- and Br^- ions
 (D) Neither Cl^- nor Br^- ions

- Q.31** When potassium hexachloroplatinate (II) is dissolved in water. The solution –
 (A) Contains 6 ions per molecule
 (B) Reacts with AgNO_3 to give 6 moles of AgCl
 (C) Does not contain any Cl^- ion
 (D) Contains K^+ , Pt^{4+} and Cl^- ions

- Q.32** The fraction of chlorine precipitated by AgNO_3 solution from $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$ is –
 (A) $1/2$ (B) $2/3$
 (C) $1/3$ (D) $1/4$

- Q.33** Which of the following has the highest molar conductivity in solution –
 (A) $[\text{Pt}(\text{NH}_3)_6]\text{Cl}_4$ (B) $[\text{Pt}(\text{NH}_3)_5\text{Cl}]\text{Cl}_3$
 (C) $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}_2$ (D) $[\text{Pt}(\text{NH}_3)_3\text{Cl}_3]\text{Cl}$

- Q.34** The number of ions given by $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ in aqueous solution is –
 (A) 2 (B) 3
 (C) 1 (D) 4

- Q.35** The no. of ions given by $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}_2$ in aqueous solution is –
 (A) 2 (B) 3
 (C) 4 (D) 5

- Q.36** Which of the following is non-ionizable –
 (A) $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$ (B) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$
 (C) $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_3$ (D) $[\text{Co}(\text{NH}_3)_6]\text{Cl}_2$

- Q.37** A complex of platinum, ammonia and chlorine produces four ions per molecule in the solution. The structure consistent with the observation is –
 (A) $[\text{Pt}(\text{NH}_3)_4]\text{Cl}_4$ (B) $[\text{Pt}(\text{NH}_3)_2\text{Cl}_4]$
 (C) $[\text{Pt}(\text{NH}_3)_5\text{Cl}]\text{Cl}_3$ (D) $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}_2$

- Q.38** Match List I with List II and select the correct answer using the codes given below the lists –
 List I (Equivalent) List II
 conductance (Formula)
 (1) 229 (i) $[\text{Pt}(\text{NH}_3)_5\text{Cl}]\text{Cl}_3$
 (2) 97 (ii) $[\text{Pt}(\text{NH}_3)_3\text{Cl}_3]\text{Cl}$

- (3) 404 (iii) $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}_2$
 (4) 523 (iv) $[\text{Pt}(\text{NH}_3)_6]\text{Cl}_4$

Code :

- | | | | | |
|-----|-----|-----|-----|-----|
| | (1) | (2) | (3) | (4) |
| (A) | iii | i | i | iii |
| (B) | i | iv | iii | ii |
| (C) | ii | iii | iv | i |
| (D) | iii | ii | i | iv |

- Q.39** The complex $\text{CoCl}_3 \cdot 5\text{NH}_3$ in aqueous solution ionizes to give a total number of ions equal to –
 (A) 0 (B) 2
 (C) 3 (D) 4

Questions
based on

IUPAC Nomenclature

- Q.40** The correct name of the compound $[\text{Cu}(\text{NH}_3)_4](\text{NO}_3)_2$, according to IUPAC system is –
 (A) Cuprammonium nitrate
 (B) Tetraamine copper (II) dinitrate
 (C) Tetraammine copper (II) nitrate
 (D) Tetraammine copper (I) dinitrate
- Q.41** The IUPAC name of $[\text{CoCl}(\text{NO}_2)(\text{en})_2]\text{Cl}$ is –
 (A) Chloronitro bis (ethylene diammine) cobalt (III) chloride
 (B) Chloronitro bis (ethylene diammine) cobalt (II) chloride
 (C) Chloro bis (ethylene diammine) nitro cobalt (III) chloride
 (D) Bis (ethylene diammine) chloronitro cobalt (III) chloride
- Q.42** IUPAC name of $[\text{Pt}(\text{NH}_3)_3(\text{Br})(\text{NO}_2)\text{Cl}]\text{Cl}$ is –
 (A) Triamminechlorobromonitroplatinum (IV) chloride
 (B) Triamminebromonitrochloroplatinum (IV) chloride
 (C) Triamminebromochloronitroplatinum (IV) chloride
 (D) Triamminenitrochlorobromoplatinum (IV) chloride
- Q.43** The correct name of $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2][\text{PtCl}_4]$ is –
 (A) Tetraammine dichloro platinum (IV) tetrachloroplatinate (II)
 (B) Dichloro tetra ammine platinum (IV) tetrachloro platinate (II)
 (C) Tetrachloro platinum (II) tetraammine platinate (IV)
 (D) Tetrachloro platinum (II) dichloro tetraamine platinate (IV)

Q.44 The complex compound $[\text{Co}(\text{NH}_3)_3\text{NO}_2\text{ClCN}]$ is named as –
 (A) TriammineChlorocyanonitro cobalt (III)
 (B) Nitrochlorocyanotriammine cobalt (III)
 (C) Cyanonitrochlorotriammine cobalt (III)
 (D) Triamminenitrochlorocyano cobalt (III)

Q.45 The IUPAC name of $\text{K}_2[\text{Cr}(\text{CN})_2\text{O}_2(\text{O})_2(\text{NH}_3)]$ is –
 (A) Potassiumamminedicyanodioxoperoxo chromate (VI)
 (B) Potassiumamminecyanoperoxodioxo chromium (VI)
 (C) Potassiumamminecyanoperoxodioxo chromium (VI)
 (D) Potassiumamminecyanoperoxodioxo chromate (IV)

Q.46 The IUPAC name $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$ is –
 (A) Hexaammine cobalt (III) hexacyanochromate (III)
 (B) Hexacyanochromium cobalt hexaammine (VI)
 (C) Hexaammine cobalt (III) hexacyanochromium (VI)
 (D) Hexacyanochromium (III) hexaammine cobalt (III)

Q.47 The IUPAC name for $[\text{Co}(\text{NCS})(\text{NH}_3)_5]\text{Cl}_2$ is –
 (A) Pentaammine (thiocyanato-N) cobalt (III) chloride
 (B) Pentaammine (thiocyanato-S) cobalt (III) chloride
 (C) Pentaamine (isothiocyanato-N,S) cobalt (III) chloride
 (D) Pentaammine (mercapto-N) cobalt (III) chloride

Q.48 The IUPAC name for $\text{K}_2[\text{OsCl}_5\text{N}]$ is –
 (A) Potassium pentachloroazidoosmate (VIII)
 (B) Potassium pentachloroazidoosmate (VI)
 (C) Potassium pentachloronitridoosmate (VI)
 (D) Potassium nitroosmate (III)

Q.49 The formula of the complex tris (ethylene diamine) cobalt (III) sulphate is –
 (A) $[\text{Co}(\text{en})_2\text{SO}_4]$ (B) $[\text{Co}(\text{en})_3\text{SO}_4]$
 (C) $[\text{Co}(\text{en})_3]\text{SO}_4$ (D) $[\text{Co}(\text{en})_3]_2(\text{SO}_4)_3$

Q.50 The IUPAC name of $\text{Fe}(\text{CO})_5$ is –
 (A) Pentacarbonyl ferrate (0)
 (B) Pentacarbonyl Ferrate (III)
 (C) Pentacarbonyl Iron (0)
 (D) Pentacarbonyl Iron (II)

Q.51 $\text{K}_3[\text{Fe}(\text{CN})_6]$ is –
 (a) Potassium hexacynoferrous (III)
 (b) Potassium hexacynoferrate (III)
 (c) Potassium ferricyanide
 (d) Hexa cyno ferrate (III) potassium
 Correct answer is –
 (A) Only (a) and (b) (B) Only (b) and (c)
 (C) Only (a) and (c) (D) Only (b) and (d)

Q.52 The IUPAC name of the complex $[\text{CrCl}_2(\text{H}_2\text{O})_4]\text{NO}_3$ is –
 (A) Dichlorotetraaquachromium (III) nitrate
 (B) Tetraaquadichlorochromium (III) nitrate
 (C) Chromium tetra aqua dichloro nitrate
 (D) Dichlorotetraaquachromium nitrate

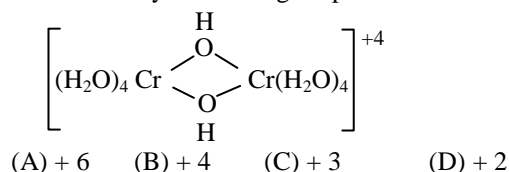
Q.53 In brown ring complex compound $[\text{Fe}(\text{H}_2\text{O})_5\text{NO}]\text{SO}_4$, the oxidation state of Fe is –
 (A) + 2 (B) + 3 (C) + 4 (D) + 1

Q.54 Give the IUPAC name of the complex compound $[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})\text{Br}](\text{NO}_3)_2$ –
 (A) BromoaquatetraamineCobalt (III) nitrate
 (B) BromoaquatetraaminoCobalt (III) nitrate
 (C) BromoaquatetraammineCobaltate (III) nitrate
 (D) TetraammineaquabromoCobalt (III) nitrate

Q.55 The chloro-bis (ethylenediamine) nitro cobalt (III) ion is –
 (A) $[\text{Co}(\text{NO}_2)_2(\text{en})_2\text{Cl}]^+$
 (B) $[\text{CoCl}(\text{NO}_2)_2(\text{en})_2]^+$
 (C) $[\text{Co}(\text{NO}_2)\text{Cl}(\text{en})_2]^+$
 (D) $[\text{Co}(\text{en})\text{Cl}_2(\text{NO}_2)_2]^-$

Q.56 Which of the following statement is incorrect about $[\text{Fe}(\text{H}_2\text{O})_5\text{NO}]\text{SO}_4$ –
 (A) It gives brown ring test for nitrates
 (B) Oxidation state of Fe is + 1
 (C) It exhibits geometrical isomerism
 (D) Charge on NO is +1

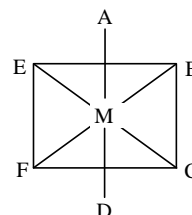
Q.57 What is the oxidation number of chromium in the dimeric hydroxo bridged species



- Q.58** Which of the following is pair of ionization isomers –
 (A) $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$ and $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$
 (B) $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2 \cdot \text{H}_2\text{O}$ and $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl} \cdot 2\text{H}_2\text{O}$
 (C) $[\text{Co}(\text{NH}_3)_6]\text{Cr}(\text{CN})_6$ and $[\text{Cr}(\text{NH}_3)_6][\text{Co}(\text{CN})_6]$
 (D) $\text{cis-}[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ and $\text{trans-}[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
- Q.59** In coordination compounds, the hydrate isomers differ –
 (A) In the number of water molecules of hydration only
 (B) In the number of water molecules only present as ligands
 (C) Both (A) and (B)
 (D) In their coordination number of the metal atom
- Q.60** The complex ions $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]^{2+}$ and $[\text{Co}(\text{NH}_3)_5(\text{ONO})]^{2+}$ are called –
 (A) Ionization isomers
 (B) Linkage isomers
 (C) Coordination isomers
 (D) Hydrate isomers
- Q.61** Geometrical isomerism in coordination compounds is exhibited by –
 (A) Square planar and tetrahedral complexes
 (B) Square planar and octahedral complexes
 (C) Tetrahedral and octahedral complexes
 (D) Square planar, tetrahedral and octahedral complexes
- Q.62** Which of the following is not optically active –
 (A) $[\text{Co}(\text{en})_3]^{3+}$ (B) $[\text{Cr}(\text{ox})_3]^{3-}$
 (C) $\text{cis-}[\text{CoCl}_2(\text{en})_2]^+$ (D) $\text{trans-}[\text{CoCl}_2(\text{en})_2]^+$
- Q.63** Which one of the following octahedral complexes will not show geometrical isomerism (A and B are monodentate ligands) –
 (A) $[\text{MA}_5\text{B}]$ (B) $[\text{MA}_2\text{B}_4]$
 (C) $[\text{MA}_3\text{B}_3]$ (D) $[\text{MA}_4\text{B}_2]$
- Q.64** Which would exhibit co-ordination isomerism –
 (A) $[\text{Cr}(\text{NH}_3)_6][\text{Co}(\text{CN})_6]$
 (B) $[\text{Co}(\text{en})_2\text{Cl}_2]^+$
 (C) $[\text{Cr}(\text{NH}_3)_6]\text{Cl}_3$
 (D) $[\text{Cr}(\text{en})_2\text{Cl}_2]^+$

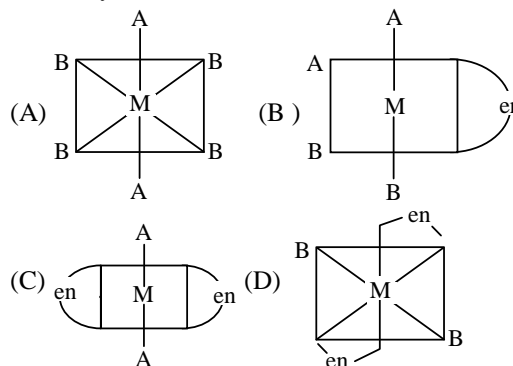
- Q.65** $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$ and $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{Br}$ are isomers –
 (A) Linkage (B) Geometrical
 (C) Ionization (D) Optical

- Q.66** A complex shown below –

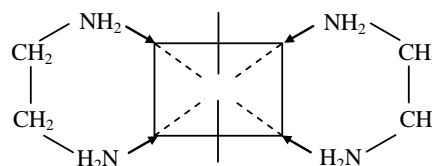


- (A) Optical isomerism only
 (B) Geometrical isomerism only
 (C) Both optical and geometrical isomerism
 (D) None

- Q.67** The phenomenon of optical activity will be shown by –



- Q.68** A square planar complex represented as it will show which isomerism –

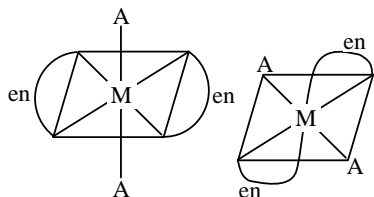


- (A) Geometrical isomerism
 (B) Optical isomerism
 (C) Linkage isomerism
 (D) None

- Q.69** Cis-trans-isomerism is found in square planar complexes of the molecular formula (a and b are monodentate ligands) –
 (A) Ma_4 (B) Ma_3b
 (C) Ma_2b_2 (D) Mab_3

- Q.70** Out of the following which will not show geometrical isomerism –
 (A) $[\text{Pt}(\text{NH}_3)_2(\text{H}_2\text{O})_2]^{2+}$
 (B) $[\text{Cr}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$
 (C) $[\text{Co}(\text{en})_2\text{Cl}_2]\text{Cl}$
 (D) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$

Q.71 The complexes given below are –



- (A) Geometrical isomers (B) Position isomers
(C) Optical isomers (D) Identical

Q.72 Theoretically the No. of geometrical isomers expected for octahedral complex $[Mabcdef]$ is –

- (A) Zero (B) 30
(C) 15 (D) 9

Questions
based on

Valence Bond Theory

Q.73 The complex ion $[Cu(NH_3)_4]^{2+}$ is –

- (A) Tetrahedral and paramagnetic
(B) Tetrahedral and diamagnetic
(C) Square planar and paramagnetic
(D) Square planar and diamagnetic

Q.74 The complex ions $[Fe(CN)_6]^{3-}$ and $[Fe(CN)_6]^{4-}$ –

- (A) Are both octahedral and paramagnetic
(B) Are both octahedral and diamagnetic
(C) Have same structure but different magnetic character
(D) Have different structures but same magnetic character

Q.75 Which of the following contains one unpaired electron in the 4p orbitals –

- (A) $[Cu(NH_3)_2]^+$ (B) $[Cu(NH_3)_4]^{2+}$
(C) $[Cu(CN)_4]^{3-}$ (D) $[Ni(CN)_4]^{2-}$

Q.76 Which complex has square planar structure –

- (A) $Ni(CO)_4$ (B) $[NiCl_4]^{2-}$
(C) $[Ni(H_2O)_6]^{2+}$ (D) $[Cu(NH_3)_4]^{2+}$

Q.77 Which is correct in the case of $[Fe(CN)_6]^{4-}$ complex –

- (A) Diamagnetic (B) Octahedral
(C) d^2sp^3 -hybridisation (D) All are correct

Q.78 Complexes with CN^- ligands are usually –

- (A) High spin complexes
(B) Low spin complexes
(C) Both (A) and (B)
(D) None of these

Q.79 Which order is correct in spectrochemical series of ligands –

- (A) $Cl^- < F^- < C_2O_4^{2-} < NO_2^- < CN^-$
(B) $CN^- < C_2O_4^{2-} < Cl^- > NO_2^- < F^-$
(C) $C_2O_4^{2-} < F^- < Cl^- > NO_2^- < CN^-$
(D) $F^- < Cl^- < NO_2^- < CN^- < C_2O_4^{2-}$

Q.80 The complex ion $[Cu(NH_3)_4]^{2+}$ has –

- (A) The tetrahedral configuration with one unpaired electron configuration
(B) Square planar configuration with one unpaired electron
(C) Tetrahedral configuration with all electrons paired
(D) Square planar configuration with all electrons paired

Q.81 Hexafluorocobaltate(III) ion is found to be high spin complex, the probable hybrid state of cobalt in it is –

- (A) d^2sp^3 (B) sp^3
(C) sp^3d (D) sp^3d^2

Questions
based on

Crystal Field Theory

Q.82 In an octahedral crystal field, the t_{2g} orbitals are –

- (A) Raised in energy by $0.4 \Delta_0$
(B) Lowered in energy by $0.4 \Delta_0$
(C) Raised in energy by $0.6 \Delta_0$
(D) Lowered in energy by $0.6 \Delta_0$

Q.83 If $\Delta_0 < P$, the correct electronic configuration for d^4 system will be –

- (A) $t_{2g}^4 e_g^0$ (B) $t_{2g}^3 e_g^1$
(C) $t_{2g}^0 t_g^4$ (D) $t_{2g}^2 e_g^2$

Q.84 Match List-I (Complex ions) with List-II (Number of Unpaired Electrons) and select the correct answer using the codes given below the lists –

List - I
(Complex ions)

List - II
(Number of Unpaired Electrons)

(1) $[\text{CrF}_6]^{4-}$

(i) One

(2) $[\text{MnF}_6]^{4-}$

(ii) Two

(3) $[\text{Cr}(\text{CN})_6]^{4-}$

(iii) Three

(4) $[\text{Mn}(\text{CN})_6]^{4-}$

(iv) Four

(v) Five

Code :

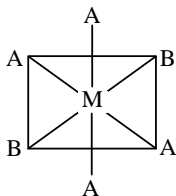
	1	2	3	4
(A)	(iv)	(i)	(ii)	(v)
(B)	(ii)	(v)	(iii)	(i)
(C)	(iv)	(v)	(ii)	(i)
(D)	(ii)	(i)	(iii)	(v)

Q.85 For the $t_{2g}^6 e_g^2$ system, the value of magnetic moment (μ) is –

(A) 2.83 B.M. (B) 1.73 B.M.
(C) 3.87 B.M. (D) 4.92 B.M.

LEVEL # 2

- Q.1** Which of the following is an outer orbital complex –
 (A) $[\text{Fe}(\text{CN})_6]^{3-}$ (B) $[\text{Fe}(\text{CN})_6]^{4-}$
 (C) $[\text{FeF}_6]^{3-}$ (D) $[\text{Cr}(\text{CN})_6]^{3-}$
- Q.2** Which of the following complexes has the least molar conductivity in the solution –
 (A) $\text{CoCl}_3 \cdot 3\text{NH}_3$ (B) $\text{CoCl}_3 \cdot 4\text{NH}_3$
 (C) $\text{CoCl}_3 \cdot 5\text{NH}_3$ (D) $\text{CoCl}_3 \cdot 6\text{NH}_3$
- Q.3** The number of geometrical isomers for $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ is –
 (A) Two (B) One
 (C) Three (D) Four
- Q.4** The geometry of some complex ions are given against them –
 (1) $[\text{Ag}(\text{NH}_3)_2]^+$ – Linear
 (2) $[\text{MnCl}_4]^{2-}$ – Tetrahedral
 (3) $[\text{Cu}(\text{NH}_3)_4]^{2+}$ – Square planar
 (4) $[\text{Ni}(\text{CN})_4]^{2-}$ – square planar
 The correct match is –
 (A) 1 and 4 (B) 1, 2 and 3
 (C) 1, 3 and 4 (D) 1, 2, 3 and 4
- Q.5** Which one is the most likely structure of $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$ if $1/3$ of total chlorine of the compound is precipitated by adding AgNO_3 to its aqueous solution –
 (A) $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$
 (B) $[\text{Cr}(\text{H}_2\text{O})_3\text{Cl}_3] \cdot (\text{H}_2\text{O})_3$
 (C) $[\text{CrCl}_2(\text{H}_2\text{O})_4]\text{Cl} \cdot 2\text{H}_2\text{O}$
 (D) $[\text{CrCl}(\text{H}_2\text{O})_5]\text{Cl}_2 \cdot \text{H}_2\text{O}$
- Q.6** Aqua-regia reacts with Pt to yield –
 (A) $\text{Pt}(\text{NO}_3)_4$ (B) H_2PtCl_6
 (C) PtCl_4 (D) PtCl_2
- Q.7** The complex ion which has no 'd' electrons in the central metal atom is –
 (A) $[\text{MnO}_4]^-$ (B) $[\text{Co}(\text{NH}_3)_6]^{3+}$
 (C) $[\text{Fe}(\text{CN})_6]^{3-}$ (D) $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$
- Q.8** The complex that violates the EAN rule –
 (A) Potassium ferrocyanide
 (B) Potassium ferricyanide
 (C) Tetra carbonyl Nickel
 (D) Cobalt (III) hexamine chloride
- Q.9** $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ ion has d-electrons equal to –
 (A) 2 (B) 3 (C) 4 (D) 5
- Q.10** $[(\text{C}_6\text{H}_5)_2\text{Pd}(\text{SCN})_2]$ and $[(\text{C}_6\text{H}_5)_2\text{Pd}(\text{NCS})_2]$ are –
 (A) Linkage isomers
 (B) Co-ordination isomers
 (C) Ionisation isomers
 (D) Geometrical isomers
- Q.11** Which one of the following pairs of isomers and types of isomerism are correctly matched –
 (a) $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]\text{Cl}_2$ and $[\text{Co}(\text{NH}_3)_5(\text{ONO})]\text{Cl}_2$Linkage
 (b) $[\text{Cu}(\text{NH}_3)_4](\text{PtCl}_4)]$ and $[\text{Pt}(\text{NH}_3)_4][\text{CuCl}_4]$co-ordination
 (c) $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]$ Br₂ and $[\text{Pt}(\text{NH}_3)_4\text{Br}_2]\text{Cl}_2$Ionization
 Select the correct answer using the codes given below –
 (A) b and c (B) a, b and c
 (C) a and c (D) a and b
- Q.12** Match List I with List II and Select the correct answer using the codes given below the lists –
List-1 Complex ions
List-2 Magnetic Moment in Bohr Magneton
 a. $[\text{Fe}(\text{CN})_6]^{4-}$ 1. 1.73
 b. $[\text{Fe}(\text{CN})_6]^{3+}$ 2. 5.93
 c. $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ 3. 0.00
 d. $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ 4. 2.83
 e. $[\text{FeF}_6]^{3-}$ 5. 3.88
Code:
- | | a | b | c | d | e |
|-----|---|---|---|---|---|
| (A) | 1 | 2 | 3 | 4 | 5 |
| (B) | 3 | 1 | 5 | 4 | 2 |
| (C) | 2 | 3 | 4 | 5 | 1 |
| (D) | 4 | 5 | 1 | 2 | 3 |
- Q.13** Correct formula of diammine silver (I) chloride is –
 (A) $\text{Ag}(\text{NH}_3)\text{Cl}$ (B) $\text{Ag}(\text{NH}_2)\text{Cl}$
 (C) $[\text{Ag}(\text{NH}_3)_2]\text{Cl}$ (D) $\text{Ag}(\text{NH}_2)_2\text{Cl}$
- Q.14** The formula of sodium nitroprusside is –
 (A) $\text{Na}_4[\text{Fe}(\text{CN})_5\text{NOS}]$
 (B) $\text{Na}_2[\text{Fe}(\text{CN})_5\text{NO}]$
 (C) $\text{NaFe}[\text{Fe}(\text{CN})_6]$
 (D) $\text{Na}_2[\text{Fe}(\text{CN})_6\text{NO}_2]$

- Q.15** The isomer  Can be marked as –
 (A) Dextro isomer (B) Laevo isomer
 (C) Cis isomer (D) Trans isomer

- Q.16** The formula of potassiumdicyano bis (oxalato) nickelate (II) is –
 (A) $K_4[Ni(CN)_2(Ox)_2]$
 (B) $K_3[Ni_2(CN)_2(Ox)_2]$
 (C) $K[Ni(CN)(Ox)_2]$
 (D) $K_2[Ni(CN)_2(Ox)_2]$

- Q.17** The secondary valency of copper in cuprammonium ion is –
 (A) + 4 (B) 4 (C) + 2 (D) – 4

- Q.18** The complex diaquatrimmine chlorocobalt (III) chloride is represented as –
 (A) $[Co(NH_3)_3(H_2O)_3]Cl_2$
 (B) $[Co(NH_2)_3(H_2O)_2]Cl_2$
 (C) $[CoCl(NH_3)_3(H_2O)_2]Cl_3$
 (D) $[CoCl(NH_3)_3(H_2O)_2]Cl_2$

- Q.19** Match List-I with List-II and select the correct answer using codes given below the lists –

List-I	List-II
Metal ions	Magnetic moment(B.M.)
(1) Cr^{3+}	i. $\sqrt{35}$
(2) Fe^{2+}	ii. $\sqrt{30}$
(3) Ni^{2+}	iii. $\sqrt{24}$
(4) Mn^{2+}	iv. $\sqrt{15}$
	v. $\sqrt{8}$

code :

(1)	(2)	(3)	(4)
(A) i	iii	v	iv
(B) ii	iii	v	i
(C) iv	iii	v	i
(D) iv	v	iii	i

- Q.20** The species having tetrahedral shape is –
 (A) $[PdCl_4]^{2-}$ (B) $[Ni(CN)_4]^{2-}$
 (C) $[Pd(CN)_4]^{2-}$ (D) $[NiCl_4]^{2-}$

- Q.21** In nitroprusside ion the iron and NO exist as Fe^{II} and NO^+ rather than Fe^{III} and NO. These forms can be differentiated by –
 (A) Estimating the concentration of iron
 (B) Measuring the concentration of CN^-
 (C) Measuring the solid state magnetic moment
 (D) Thermally decomposing the compound

- Q.22** Which of the following complexes are paramagnetic in nature –
 $[Fe(CN)_6]^{3-}$ $[Fe(CN)_6]^{4-}$ $[CoF_6]^{3-}$ $Ni(CO)_4$
 I II III IV
 (A) Only I (B) I and II
 (C) I and III (D) III and IV

- Q.23** Among the complex ions given below which is/are outer-orbitals complex –
 $[Co(CN)_6]^{4-}$ $[Fe(H_2O)_6]^{2+}$ $[FeF_6]^{3-}$ $[CoF_6]^{3-}$
 I II III IV
 (A) II, III, IV (B) II, III only
 (C) I, IV only (D) II only

- Q.24** In which of following pairs of species the number of unpaired electrons are same –
 (A) $[CoF_6]^{3-}$, $[FeF_6]^{3-}$
 (B) $[Fe(CN)_6]^{3-}$, $[Fe(CN)_6]^{4-}$
 (C) $[Fe(CN)_6]^{3-}$, $[Ni(CN)_4]^{2-}$
 (D) $[CoF_6]^{3-}$, $[Fe(H_2O)_6]^{2+}$

- Q.25** Match List I with List II and select the correct answer using the codes given below the lists –

List I	List II
(1) Muscle contraction	i. Zinc
(2) Blue-green algae	ii. Cobalt
(3) Carboxypeptidase	iii. Calcium
(4) Cyanocobalamine	iv. Molybdenum

Code :

	(1)	(2)	(3)	(4)
(A)	iv	iii	i	ii
(B)	iii	iv	ii	i
(C)	iv	iii	ii	i
(D)	iii	iv	i	ii

- Q.26** In electroplating of copper, $K[Ag(CN)_2]$ is used instead of $AgNO_3$. The reason is –
 (A) A thin layer of Ag is formed on Cu
 (B) More voltage is required
 (C) Ag^+ ions are completely removed from solution
 (D) less availability of Ag^+ ions, as Cu cannot displace Ag from $[Ag(CN)_2]^-$ ion

- Q.27** A reagent used for identifying nickel ion is –
 (A) Potassium ferrocyanide
 (B) Phenolphthalein
 (C) Dimethyl glyoxime
 (D) EDTA

- Q.28** Name the metal M which is extracted on the basis of following reactions –
 $4M + 8CN^- + 2H_2O + O_2 \rightarrow 4[M(CN)_2]^- + 4OH^-$
 $2[M(CN)_2]^- + Zn \rightarrow [Zn(CN)_4]^{2-} + 2M$
 (A) Nickel (B) Silver
 (C) Copper (D) Mercury

LEVEL # 3

- Q.1** How many H-bonds are present in the complex entity formed by Ni^{2+} and dmg ligands –
 (A) 2 (B) 3
 (C) 4 (D) None
- Q.2** Which of the following has highest magnetic moment –
 (A) $[\text{FeF}_6]^{3-}$ (B) $[\text{Co}(\text{NH}_3)_6]^{3+}$
 (C) $[\text{Fe}(\text{CN})_6]^{4-}$ (D) $[\text{Mn}(\text{CN})_6]^{4-}$
- Q.3** The stability constant of the complexes formed by a metal ion (M^{2+}) with NH_3 , CN^- , H_2O and en are of the order 10^{11} , 10^{27} , 10^{15} and 10^8 respectively. Then –
 (A) en is the strongest ligand
 (B) CN^- is the strongest ligand
 (C) The strength of the ligands has not relationship with given values
 (D) all ligands are equally strong
- Q.4** In metal carbonyls, there is –
 (A) No π bond between CO and metal atom
 (B) Only σ bond between metal atom and CO molecules
 (C) One σ and one π bond (back-donation) between metal atom and CO molecules
 (D) The metal-carbon bonds does not exist at all
- Q.5** Aqueous solution of Ni^{2+} contains $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ and its magnetic moment is 2.83 BM. When ammonia is added in it, comment on the magnetic moment of solution –
 (A) It will remain same
 (B) It increases from 2.83 BM
 (C) It decreases from 2.83 BM
 (D) It cannot be predicated theoretically
- Q.6** Which statement is incorrect –
 (A) $\text{Ni}(\text{CO})_4$ – Tetrahedral, paramagnetic
 (B) $[\text{Ni}(\text{CN})_4]^{2-}$ – Square planar, diamagnetic
 (C) $\text{Ni}(\text{CO})_4$ – Tetrahedral, diamagnetic
 (D) $[\text{NiCl}_4]^{2-}$ – Tetrahedral, paramagnetic
- Q.7** The number of unpaired electrons in the complex ion $[\text{CoF}_6]^{3-}$ is –
 (A) 4 (B) 0
 (C) 2 (D) 3
- Q.8** The correct order for the wavelength of absorption in the visible region is –
 (A) $[\text{Ni}(\text{NO}_2)_6]^{4-} < [\text{Ni}(\text{NH}_3)_6]^{2+} < [\text{Ni}(\text{H}_2\text{O})_6]^{2+}$
 (B) $[\text{Ni}(\text{NO}_2)_6]^{4-} < [\text{Ni}(\text{H}_2\text{O})_6]^{2+} < [\text{Ni}(\text{NH}_3)_6]^{2+}$
 (C) $[\text{Ni}(\text{H}_2\text{O})_6]^{4-} < [\text{Ni}(\text{NH}_3)_6]^{2+} < [\text{Ni}(\text{NO}_2)_6]^{4-}$
 (D) $[\text{Ni}(\text{NH}_3)_6]^{2+} < [\text{Ni}(\text{H}_2\text{O})_6]^{2+} < [\text{Ni}(\text{NO}_2)_6]^{4-}$
- Q.9** How many isomer are theoretically possible for the formula $[\text{Pt}(\text{py})(\text{NH}_3)(\text{NO}_2)\text{Cl Br I}]$ –
 (A) 3 (B) 4
 (C) 8 (D) 15
- Q.10** Which one of the following statements is incorrect –
 (A) Greater the stability constant of a complex ion, greater is its stability
 (B) Greater the charge on the central metal ion, greater is the stability of the complex.
 (C) Greater is the basic character of the ligand, the greater is the stability of the complex
 (D) Chelate complexes have low stability constant
- Q.11** In which pair of complex entities given below the EAN of metal atom/ion is same –
 (A) $[\text{Ni}(\text{en})_2]^{2+}$, $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$
 (B) $[\text{Fe}(\text{CN})_6]^{3-}$, $[\text{Co}(\text{CN})_6]^{3-}$
 (C) $[\text{Ni}(\text{CO})_4]$, $[\text{Fe}(\text{CN})_6]^{4-}$
 (D) $[\text{Ni}(\text{en})_2]^{2+}$, $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$
- Q.12** Which of the following complex has highest stability at 298 K –
 (A) $[\text{CdCl}_4]^{2-}$ (B) $[\text{CdBr}_4]^{2-}$
 (C) $[\text{CdI}_4]^{2-}$ (D) $[\text{Cd}(\text{CN})_4]^{2-}$
- Q.13** The complex salt having the molecular composition $[\text{Co}(\text{NO}_2)(\text{SCN})(\text{en})_2] \text{ Br}$ exhibits-
 (A) Cis-Trans isomerism only
 (B) Linkage only
 (C) Ionisation only
 (D) All the above
- Q.14** Which of the following is a high-spin complex–
 (A) $[\text{Co}(\text{NH}_3)_6]^{3+}$ (B) $[\text{Fe}(\text{CN})_6]^{4-}$
 (C) $[\text{CoF}_6]^{3-}$ (D) $[\text{Fe}(\text{CN})_6]^{3-}$

Q.15 The IUPAC name for $[(\text{NH}_3)_5 \text{Cr}-\text{OH}-\text{Cr}(\text{NH}_3)_5]^{5+}$ is –

- (A) μ -hydroxo-bis (pentaammine dichromium) (V+) ion
 (B) μ -hydroxo-bis (decaammine dichromium) (V+) ion
 (C) μ -hydroxo-bis- (octaammine chromium) (V+) ion
 (D) μ -hydroxo-bis (pentammine chromium) (III) ion

Q.16 Which of the following statements is correct –

- (A) The $[\text{Ni}(\text{CN})_4]^{2-}$ ion has tetrahedral geometry and is diamagnetic
 (B) The $[\text{Ni}(\text{CN})_4]^{2-}$ ion has a square-planar geometry and is paramagnetic
 (C) The $[\text{Ni}(\text{CN})_4]^{2-}$ ion has a square-planar geometry and is diamagnetic
 (D) The $[\text{Cu}(\text{NH}_3)_4]^{2+}$ ion has a tetrahedral geometry and is diamagnetic

Q.17 How many geometrical isomers are possible for the square-planar complex $[\text{Pt}(\text{NO}_2)(\text{py})(\text{NH}_3)(\text{NH}_2\text{OH})] \text{NO}_2^-$

- (A) 4 (B) 5
 (C) 8 (D) 3

Q.18 When the d-orbitals involved in the hybridisation are inner (n-1) d-orbitals; the complex formed are referred to as –

- (A) High spin complexes
 (B) Low spin complexes
 (C) Zero spin complexes
 (D) Positive spin complexes

Q.19 Extraction of metals of other processes is through the complex formation –

I : cyanide process

II : Mond's process

III : Photographic fixing process

Complexes formed in these methods are –

- | | | |
|-------------------------------------|--|--|
| I | II | III |
| (A) $[\text{Ag}(\text{NH}_3)_2]^+$ | $\text{Ni}(\text{CO})_4$ | $[\text{Ag}(\text{CN})_2]^-$ |
| (B) $[\text{Cd}(\text{CN})_4]^{2-}$ | $\text{Ni}(\text{CO})_4$ | $[\text{Ag}(\text{S}_2\text{O}_3)_2]^{3-}$ |
| (C) $[\text{Ag}(\text{CN})_2]^-$ | $\text{Ni}(\text{CO})_4$ | $[\text{Ag}(\text{S}_2\text{O}_3)_2]^{3-}$ |
| (D) $[\text{Ag}(\text{CN})_2]^-$ | $[\text{Ag}(\text{S}_2\text{O}_3)_2]^{3-}$ | $\text{Ni}(\text{CO})_4$ |

Q.20 Co-ordination isomerism is caused interchange of ligand between the –

- (A) Complex cation and complex anion
 (B) Inner sphere and outer sphere
 (C) Low oxidation and higher oxidation states
 (D) cis and trans structure

Q.21 What is the magnetic moment of $\text{K}_3[\text{FeF}_6]^-$

- (A) 3.87 BM (B) 4.98 BM
 (C) 5.91 BM (D) 6.92 BM

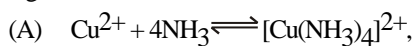
Q.22 Which of the following complex is an outer orbital complex –

- (A) $[\text{Ni}(\text{NH}_3)_6]^{2+}$ (B) $[\text{Mn}(\text{CN})_6]^{4-}$
 (C) $[\text{Co}(\text{NH}_3)_6]^{3+}$ (D) $[\text{Fe}(\text{CN})_6]^{4-}$

Q.23 Which one of the following is expected to exhibit optical isomerism [en = ethylenediamine] –

- (A) Trans- $[\text{Co}(\text{en})_2\text{Cl}_2]$ (B) Cis- $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
 (C) Cis- $[\text{Co}(\text{en})_2\text{Cl}_2]$ (D) Trans- $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$

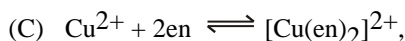
Q.24 From the stability constant (hypothetical values) given below, predict which is the strongest ligand –



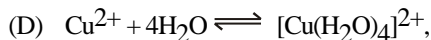
$(K = 4.5 \times 10^{11})$



$(K = 2.0 \times 10^{27})$

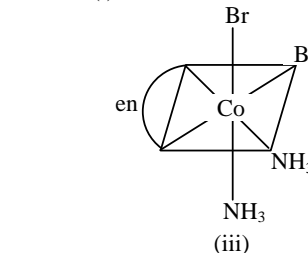
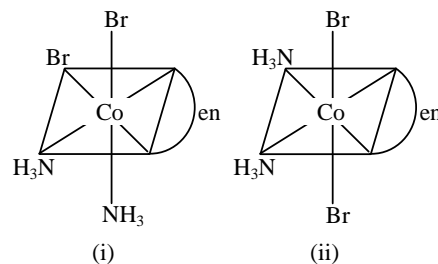


$(K = 3.0 \times 10^{15})$



$(K = 9.5 \times 10^8)$

Q.25 Three arrangements are shown for the complex, $[\text{Co}(\text{en})(\text{NH}_3)_2\text{Br}_2]^+$. Which one is the wrong statement –



- (A) I and II are geometrical isomers
 (B) II and III are optical isomers
 (C) I and III are optical isomers
 (D) II and III are geometrical isomers

- Q.26** Which statement is wrong –
 (A) All the octahedral complexes of Ni^{2+} are outer orbitals complexes.
 (B) $(\text{SCN})^-$ shows linkage isomerism in coordination compounds.
 (C) All ligands are Lewis bases.
 (D) NH_4^+ ion can act as a ligand

- Q.27** The most probable formula of prussian blue is –
 (A) $\text{Fe}_3[\text{Fe}(\text{CN})_6]_2$ (B) $\text{Fe}_2[\text{Fe}(\text{CN})_6]_3$
 (C) $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$ (D) $\text{Fe}_3[\text{Fe}(\text{CN})_6]_4$

- Q.28** Which of the following is a π -acid ligand –
 (A) NH_3
 (B) CO
 (C) F^-
 (D) $\text{H}_2\text{N}-\text{CH}_2-\text{CH}_2-\text{NH}_2$

Passage - 1

Two types of magnetic behaviour are found in substances :

(a) Diamagnetism and (b) Paramagnetism

Diamagnetic substances are those which are repelled by an applied magnetic field. Such substances have no unpaired electron. Paramagnetic substances are those which are attracted by an applied magnetic field. Transition metals and many of their compounds show paramagnetic behaviour where unpaired electrons are present. The magnetic moment arises from the spin and orbital motions in ions or molecules. Magnetic moment of n unpaired electrons is given as,

$$\mu = \sqrt{n(n+2)} \text{ Bohr Magnetons}$$

Magnetic moment increases as the number of unpaired electrons increases.

- Q.29** In 3d series, the maximum magnetic moment is shown by –
 (A) Sc (At. no. 21) (B) V (23)
 (C) Cr (24) (D) Fe (26)
- Q.30** Which among the following ions has maximum value of magnetic moment –
 (A) Cu^{2+} (B) Mn^{2+}
 (C) Cr^{2+} (D) Ti^{2+}
- Q.31** Increasing value of magnetic moments of –
 (I) $[\text{Fe}(\text{CN})_6]^{4-}$ (II) $[\text{Fe}(\text{CN})_6]^{3-}$
 (III) $[\text{Cr}(\text{NH}_3)_6]^{3+}$ (IV) $[\text{Ni}(\text{H}_2\text{O})_4]^{+2}$ is –
 (A) $\text{I} < \text{II} < \text{III} < \text{IV}$ (B) $\text{IV} < \text{III} < \text{II} < \text{I}$
 (C) $\text{II} < \text{III} < \text{I} < \text{IV}$ (D) $\text{I} < \text{II} < \text{IV} < \text{III}$

- Q.32** Magnetic moment of $[\text{Ni}(\text{CN})]^{2-}$ is zero but that of $[\text{Ni}(\text{H}_2\text{O})_4]^{2+}$ is 2.83 B.M. It is because of –
 (A) CN^- is a strong ligand making two unpaired electrons in Ni^{2+} to pair up, while in $[\text{Ni}(\text{H}_2\text{O})_4]^{2+}$ two electrons remain unpaired as H_2O is a weak ligand
 (B) different oxidation state of Ni in two complexes
 (C) both (A) and (B)
 (D) none of the above

- Q.33** Magnetic moments of Cr ($Z = 24$), Mn^+ ($Z = 25$) and Fe^{2+} ($Z = 26$) are x , y and z respectively. Which of the following order is correct ?
 (A) $x < y < z$ (B) $x = y < z$
 (C) $z < x = y$ (D) $x = y = z$

ANSWER KEY

LEVEL # 1

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	D	C	B	D	C	C	C	B	B	A	B	B	C	D	C	A	D	D	C	C
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	D	A	C	B	A	C	A	C	A	A	C	B	A	D	B	A	C	D	C	C
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	C	C	A	A	A	A	A	C	D	C	B	B	D	D	C	C	C	A	C	B
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans.	B	D	A	A	C	C	B	D	C	B	D	C	C	C	B	D	D	B	A	B
Ques.	81	82	83	84	85															
Ans.	D	B	B	C	A															

LEVEL # 2

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	C	A	A	D	C	B	A	B	B	A	B	B	C	B	D	A	B	D	C	D
Ques.	21	22	23	24	25	26	27	28												
Ans.	C	C	A	D	D	D	C	B												

LEVEL # 3

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	A	A	B	C	A	A	A	A	D	D	C	D	D	C	D	C	D	B	C	A
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33							
Ans.	C	A	C	B	B	D	C	B	C	B	D	A	C							