Chapter 19

Coordination Compounds

1. Which of the following has an optical isomer?

   [AIEEE-2009]

   (1) $[Co\,(en)\,(NH_3)_2]^{2+}$ (2) $[Co\,(H_2O)_4\,(en)]^{3+}$

   (3) $[Co\,(en)_2\,(NH_3)_2]^{3+}$ (4) $[Co\,(NH_3)_3\,Cl]^+$

2. Which of the following pairs represents linkage isomers?   **[AIEEE-2009]**

   (1) $[Pd(P\,Ph_3)_2\,(NCS)_2]$ and $[Pd(P\,Ph_3)_2(SCN)_2]$

   (2) $[Co\,(NH_3)_5\,NO_3]SO_4$ and $[Co(NH_3)_5SO_4]\,NO_3$

   (3) $[Pt\,Cl_2(NH_3)_4]Br_2$ and $[PtBr_2(NH_3)_4]Cl_2$

   (4) $[Cu(NH_3)_4]\,[PtCl_4]$ and $[Pt(NH_3)_4]\,[CuCl_4]$

3. Which one of the following has an optical isomer?

   [AIEEE-2010]

   (1) $[Zn(en)_2]^{2+}$ (2) $[Zn(en)(NH_3)_2]^{2+}$

   (3) $[Co(en)_3]^{3+}$ (4) $[Co(H_2O)_4(en)]^{3+}$

4. A solution containing 2.675 g of $CoCl_3.6NH_3$ (molar mass = 267.5 g mol^{-1}) is passed through a cation exchanger. The chloride ions obtained in solution were treated with excess of $AgNO_3$ to give 4.78 g of AgCl (molar mass = 143.5 g mol^{-1}). The formula of the complex is   **[AIEEE-2010]**

   (At. mass of Ag = 108 u)

   (1) $[CoCl(NH_3)_5]Cl_2$ (2) $[Co(NH_3)_6]Cl_3$

   (3) $[CoCl_2(NH_3)_4]Cl$ (4) $[CoCl_3(NH_3)_3]$

5. Among the ligands NH_3, en, CN^- and CO the correct order of their increasing field strength, is

   [AIEEE-2011]

   (1) en < CH$^-$ < NH_3 < CO

   (2) CO < NH_3 < en < CN$^-$

   (3) NH_3 < en < CN$^-$ < CO

   (4) CN$^-$ < NH_3 < CO < en

6. Which one of the following complex ions has geometrical isomers?   **[AIEEE-2011]**

   (1) $[\,Cr\,(NH_3)_4\,(en)\,]^{3+}$

   (2) $[\,Co\,(en)_3\,]^{3+}$

   (3) $[\,Ni\,(NH_3)_5\,Br\,]^+$

   (4) $[\,Co\,(NH_3)_2\,(en)_2\,]^{3+}$

7. Which among the following will be named as dibromidobis (ethylene diamine) chromium (III) bromide?   **[AIEEE-2012]**

   (1) $[Cr\,(en)_2Br_2]Br$ (2) $[Cr\,(en)Br_4]^-$

   (3) $[Cr\,(en)\,Br_2]Br$ (4) $[Cr\,(en)_3]Br_3$

8. Which of the following complex species is not expected to exhibit optical isomerism?

   [JEE (Main)-2013]

   (1) $[Co(en)_3]^{3+}$ (2) $[Co(en)_2Cl_2]^+$

   (3) $[Co(NH_3)_3Cl_3]$ (4) $[Co(en)(NH_3)_2Cl_2]^+$

9. The octahedral complex of a metal ion M^{3+} with four monodentate ligands L_1, L_2, L_3 and L_4 absorb wavelengths in the region of red, green, yellow and blue, respectively. The increasing order of ligand strength of the four ligands is   **[JEE (Main)-2014]**

   (1) $L_4 < L_3 < L_2 < L_1$ (2) $L_1 < L_3 < L_2 < L_4$

   (3) $L_3 < L_2 < L_4 < L_1$ (4) $L_1 < L_2 < L_4 < L_3$

10. The equation which is balanced and represents the correct product(s) is   **[JEE (Main)-2014]**

    (1) $Li_2O + 2KCl \rightarrow 2LiCl + K_2O$

    (2) $[CoCl(NH_3)_5]^+ + 5H^+ \rightarrow Co^{2+} + 5NH_4^+ + Cl^-$

    (3) $[Mg(H_2O)_6]^{2+} + (EDTA)^{4-} \xrightarrow{excess\,NaOH}$ $[Mg(EDTA)]^{2+} + 6H_2O$

    (4) $CuSO_4 + 4KCN \rightarrow K_2[Cu(CN)_4] + K_2SO_4$

11. The number of geometric isomers that can exist for square planar $[Pt(Cl)(py)(NH_3)(NH_2OH)]^+$ is (py = pyridine)   **[JEE (Main)-2015]**

    (1) 2   (2) 3

    (3) 4   (4) 6

12. Which one of the following complexes shows optical isomerism?   **[JEE (Main)-2016]**

    (1) cis$[Co(en)_2Cl_2]Cl$

    (2) trans$[Co(en)_2Cl_2]Cl$

    (3) $[Co(NH_3)_4Cl_2]Cl$

    (4) $[Co(NH_3)_3Cl_3]$

    (en = ethylenediamine)

13. On treatment of 100 mL of 0.1 M solution of $CoCl_3 \cdot 6H_2O$ with excess $AgNO_3$; 1.2×10^{22} ions are precipitated. The complex is **[JEE (Main)-2017]**

    (1) $[Co(H_2O)_6]Cl_3$

    (2) $[Co(H_2O)_5Cl]Cl_2 \cdot H_2O$

    (3) $[Co(H_2O)_4Cl_2]Cl \cdot 2H_2O$

    (4) $[Co(H_2O)_3Cl_3] \cdot 3H_2O$

14. For 1 molal aqueous solution of the following compounds, which one will show the highest freezing point? **[JEE (Main)-2018]**

    (1) $[Co(H_2O)_6]Cl_3$

    (2) $[Co(H_2O)_5Cl]Cl_2 \cdot H_2O$

    (3) $[Co(H_2O)_4Cl_2]Cl \cdot 2H_2O$

    (4) $[Co(H_2O)_3Cl_3] \cdot 3H_2O$

15. The oxidation states of

    Cr in $\left[Cr(H_2O)_6\right]Cl_3, \left[Cr(C_6H_6)_2\right]$, and

    $K_2\left[Cr(CN)_2(O)_2(O_2)(NH_3)\right]$ respectively are

    [JEE (Main)-2018]

    (1) +3, +4 and +6

    (2) +3, +2 and +4

    (3) +3, 0 and +6

    (4) +3, 0 and +4

16. Consider the following reaction and statements

    $[Co(NH_3)_4Br_2]^+ + Br^- \rightarrow [Co(NH_3)_3Br_3] + NH_3$

    (I) Two isomers are produced if the reactant complex ion is a *cis*-isomer

    (II) Two isomers are produced if the reactant complex ion is a *trans*-isomer.

    (III) Only one isomer is produced if the reactant complex ion is a *trans*-isomer.

    (IV) Only one isomer is produced if the reactant complex ion is a *cis*-isomer.

    The correct statements are: **[JEE (Main)-2018]**

    (1) (I) and (II)

    (2) (I) and (III)

    (3) (III) and (IV)

    (4) (II) and (IV)

17. Two complexes $[Cr(H_2O)_6]Cl_3$ (A) and $[Cr(NH_3)_6]Cl_3$ (B) are violet and yellow coloured, respectively. The incorrect statement regarding them is

    [JEE (Main)-2019]

    (1) Δ_0 values of (A) and (B) are calculated from the energies of violet and yellow light, respectively

    (2) Both are paramagnetic with three unpaired electrons

    (3) Δ_0 value for (A) is less than that of (B)

    (4) Both absorb energies corresponding to their complementary colors

18. Homoleptic octahedral complexes of a metal ion 'M³⁺' with three monodentate ligands L_1, L_2 and L_3 absorb wavelengths in the region of green, blue and red respectively. The increasing order of the ligand strength is **[JEE (Main)-2019]**

    (1) $L_1 < L_2 < L_3$

    (2) $L_3 < L_2 < L_1$

    (3) $L_3 < L_1 < L_2$

    (4) $L_2 < L_1 < L_3$

19. The complex that has highest crystal field splitting energy (Δ), is **[JEE (Main)-2019]**

    (1) $[Co(NH_3)_5Cl]Cl_2$

    (2) $K_2[CoCl_4]$

    (3) $K_3[Co(CN)_6]$

    (4) $[Co(NH_3)_5(H_2O)]Cl_3$

20. Wilkinson catalyst is (Et = C_2H_5)

    [JEE (Main)-2019]

    (1) $[(Ph_3P)_3IrCl]$

    (2) $[(Ph_3P)_3RhCl]$

    (3) $[(Et_3P)_3IrCl]$

    (4) $[(Et_3P)_3RhCl]$

21. The total number of isomers for a square planar complex $[M(F)(Cl)(SCN)(NO_2)]$ is

    [JEE (Main)-2019]

    (1) 8

    (2) 12

    (3) 4

    (4) 16

22. The electrolytes usually used in the electroplating of gold and silver, respectively, are

    [JEE (Main)-2019]

    (1) $[Au(CN)_2]^-$ and $[AgCl_2]^-$

    (2) $[Au(NH_3)_2]^+$ and $[Ag(CN)_2]^-$

    (3) $[Au(CN)_2]^-$ and $[Ag(CN)_2]^-$

    (4) $[Au(OH)_4]^-$ and $[Ag(OH)_2]^-$

23. A reaction of cobalt (III) chloride and ethylenediamine in a 1 : 2 mole ratio generates two isomeric products A (violet coloured) and B (green coloured). A can show optical activity, but, B is optically inactive. What type of isomers does A and B represent? **[JEE (Main)-2019]**

    (1) Ionisation isomers

    (2) Coordination isomers

    (3) Geometrical isomers

    (4) Linkage isomers

24. The difference in the number of unpaired electrons of a metal ion in its high spin and low-spin octahedral complexes is two. The metal ion is **[JEE (Main)-2019]**

    (1) Ni^{2+}

    (2) Mn^{2+}

    (3) Fe^{2+}

    (4) Co^{2+}

25. The number of bridging CO ligand(s) and Co-Co bond(s) in $Co_2(CO)_8$, respectively are

   [JEE (Main)-2019]

   (1) 2 and 1
   (2) 0 and 2
   (3) 2 and 0
   (4) 4 and 0

26. The coordination number of Th in $K_4[Th(C_2O_4)_4(OH_2)_2]$ is   **[JEE (Main)-2019]**

   $\left(C_2O_4^{2-} = \text{Oxalato}\right)$

   (1) 10
   (2) 6
   (3) 14
   (4) 8

27. The metal d-orbitals that are directly facing the ligands in $K_3[Co(CN)_6]$ are   **[JEE (Main)-2019]**

   (1) d_{xy}, d_{xz} and d_{yz}
   (2) d_{xz}, d_{yz} and d_{z^2}
   (3) $d_{x^2-y^2}$ and d_{z^2}
   (4) d_{xy} and $d_{x^2-y^2}$

28. The pair of metal ions that can give a spin only magnetic moment of 3.9 BM for the complex $[M(H_2O)_6]Cl_2$, is   **[JEE (Main)-2019]**

   (1) V^{2+} and Co^{2+}
   (2) Co^{2+} and Fe^{2+}
   (3) V^{2+} and Fe^{2+}
   (4) Cr^{2+} and Mn^{2+}

29. $Mn_2(CO)_{10}$ is an organometallic compound due to the presence of   **[JEE (Main)-2019]**

   (1) Mn – C bond
   (2) Mn – Mn bond
   (3) Mn – O bond
   (4) C – O bond

30. The magnetic moment of an octahedral homoleptic Mn(II) complex is 5.9 BM. The suitable ligand for this complex is   **[JEE (Main)-2019]**

   (1) CO
   (2) Ethylenediamine
   (3) NCS^-
   (4) CN^-

31. The correct order of the spin-only magnetic moment of metal ions in the following low-spin complexes, $[V(CN)_6]^{4-}$, $[Fe(CN)_6]^{4-}$, $[Ru(NH_3)_6]^{3+}$ and $[Cr(NH_3)_6]^{2+}$, is   **[JEE (Main)-2019]**

   (1) $V^{2+} > Cr^{2+} > Ru^{3+} > Fe^{2+}$
   (2) $Cr^{2+} > V^{2+} > Ru^{3+} > Fe^{2+}$
   (3) $V^{2+} > Ru^{3+} > Cr^{2+} > Fe^{2+}$
   (4) $Cr^{2+} > Ru^{3+} > Fe^{2+} > V^{2+}$

32. The following ligand is   **[JEE (Main)-2019]**
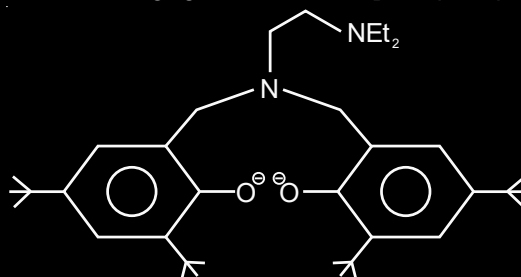
   (1) Tetradentate
   (2) Tridentate
   (3) Bidentate
   (4) Hexadentate

33. The compound that inhibits the growth of tumors is   **[JEE (Main)-2019]**

   (1) cis-$[Pt(Cl)_2(NH_3)_2]$
   (2) trans-$[Pt(Cl)_2(NH_3)_2]$
   (3) cis-$[Pd(Cl)_2(NH_3)_2]$
   (4) trans-$[Pd(Cl)_2(NH_3)_2]$

34. The calculated spin-only magnetic moments (BM) of the anionic and cationic species of $[Fe(H_2O)_6]_2$ and $[Fe(CN)_6]$, respectively, are   **[JEE (Main)-2019]**

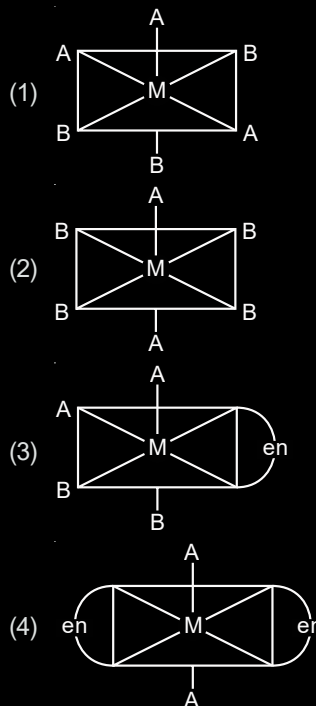   (1) 2.84 and 5.92
   (2) 4.9 and 0
   (3) 0 and 5.92
   (4) 0 and 4.9

35. The number of water molecule(s) not coordinated to copper ion directly in $CuSO_4 \cdot 5H_2O$, is   **[JEE (Main)-2019]**

   (1) 4
   (2) 1
   (3) 2
   (4) 3

36. The one that will show optical activity is (en = ethane-1,2-diamine)   **[JEE (Main)-2019]**

37. The degenerate orbitals of $[Cr(H_2O)_6]^{3+}$ are

[JEE (Main)-2019]

(1) d_{xz} and d_{yz}

(2) $d_{x^2-y^2}$ and d_{xy}

(3) d_{z^2} and d_{xz}

(4) d_{yz} and d_{z^2}

38. The correct statements among I to III are

(I) Valence bond theory cannot explain the color exhibited by transition metal complexes.

(II) Valence bond theory can predict quantitatively the magnetic properties of transition metal complexes.

(III) Valence bond theory cannot distinguish ligands as weak and strong field ones.

[JEE (Main)-2019]

(1) (II) and (III) only

(2) (I), (II) and (III)

(3) (I) and (II) only

(4) (I) and (III) only

39. The maximum possible denticities of a ligand given below towards a common transition and inner-transition metal ion, respectively, are
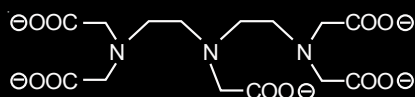
[JEE (Main)-2019]

(1) 6 and 8

(2) 8 and 6

(3) 8 and 8

(4) 6 and 6

40. The species that can have a trans-isomer is :

(en = ethane-1, 2-diamine, ox = oxalate)

[JEE (Main)-2019]

(1) $[Zn(en)Cl_2]$

(2) $[Pt(en)Cl_2]$

(3) $[Cr(en)_2(ox)]^+$

(4) $[Pt(en)_2Cl_2]^{2+}$

41. Three complexes, $[CoCl(NH_3)_5]^{2+}(I)$, $[Co(NH_3)_5H_2O]^{3+}(II)$ and $[Co(NH_3)_6]^{3+}(III)$ absorb light in the visible region. The correct order of the wavelength of light absorbed by them is :

[JEE (Main)-2019]

(1) (I) > (II) > (III)

(2) (II) > (I) > (III)

(3) (III) > (I) > (II)

(4) (III) > (II) > (I)

42. The INCORRECT statement is **[JEE (Main)-2019]**

(1) The spin-only magnetic moments of $[Fe(H_2O)_6]^{2+}$ and $[Cr(H_2O)_6]^{2+}$ are nearly similar.

(2) The gemstone, ruby, has Cr^{3+} ions occupying the octahedral sites of beryl.

(3) The spin-only magnetic moment of $[Ni(NH_3)_4(H_2O)_2]^{2+}$ is 2.83 BM.

(4) The color of $[CoCl(NH_3)_5]^{2+}$ is violet as it absorbs the yellow light.

43. The crystal field stabilization energy (CFSE) of $[Fe(H_2O)_6]Cl_2$ and $K_2[NiCl_4]$, respectively, are

[JEE (Main)-2019]

(1) $-2.4\Delta_o$ and $-1.2\Delta_t$

(2) $-0.6\Delta_o$ and $-0.8\Delta_t$

(3) $-0.4\Delta_o$ and $-0.8\Delta_t$

(4) $-0.4\Delta_o$ and $-1.2\Delta_t$

44. The complex ion that will lose its crystal field stabilization energy upon oxidation of its metal to +3 state is
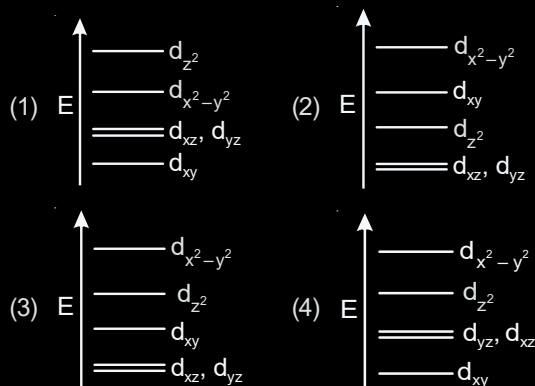

(Phen =

and

ignore pairing energy)
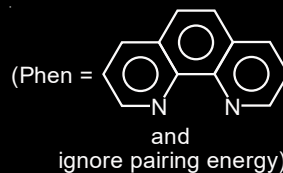
[JEE (Main)-2019]

(1) $[Ni(phen)_3]^{2+}$

(2) $[Co(phen)_3]^{2+}$

(3) $[Zn(phen)_3]^{2+}$

(4) $[Fe(phen)_3]^{2+}$

45. Complete removal of both the axial ligands (along the z-axis) from an octahedral complex leads to which of the following splitting patterns? (relative orbital energies not on scale).

[JEE (Main)-2019]

46. The coordination numbers of Co and Al in $[Co(Cl)(en)_2]Cl$ and $K_3[Al(C_2O_4)_3]$, respectively, are (en = ethane-1, 2-diamine) **[JEE (Main)-2019]**

(1) 3 and 3
(2) 5 and 3
(3) 5 and 6
(4) 6 and 6

47. The IUPAC name of the complex $[Pt(NH_3)_2 Cl(NH_2CH_3)]Cl$ is **[JEE (Main)-2020]**

(1) Diamminechlorido(methanamine)platinum (II) chloride

(2) Diammine(methanamine)chloridoplatinum (II) Chloride

(3) Bisammine(methanamine)chloridoplatinum (II) chloride

(4) Diamminechlorido(aminomethane)platinum (II) chloride

48. The theory that can completely/properly explain the nature of bonding in $[Ni(CO)_4]$ is

[JEE (Main)-2020]

(1) Crystal field theory

(2) Werner's theory

(3) Valence bond theory

(4) Molecular orbital theory

49. Among the statements (a)-(d), the incorrect ones are

(a) Octahedral Co(III) complexes with strong field ligands have very high magnetic moments

(b) When $\Delta_0 < P$, the d-electron configuration of Co(III) in an octahedral complex is $t_{eg}^4 e_g^2$

(c) Wavelength of light absorbed by $[Co(en)_3]^{3+}$ is lower than that of $[CoF_6]^{3-}$

(d) If the Δ_0 for an octahedral complex of Co(III) is 18,000, cm^{-1} the Δ_t for its tetrahedral complex with the same ligand will be 16,000 cm^{-1}

[JEE (Main)-2020]

(1) (c) and (d) only

(2) (a) and (d) only

(3) (a) and (b) only

(4) (b) and (c) only

50. The complex that can show *fac*-and *mer*-isomers is **[JEE (Main)-2020]**

(1) $[CoCl_2(en)_2]$
(2) $[Co(NH_3)_3(NO_2)_3]$
(3) $[Pt(NH_3)_2Cl_2]$
(4) $[Co(NH_3)_4Cl_2]^+$

51. The correct order of the calculated spin-only magnetic moments of complexes (A) to (D) is

(A) $Ni(CO)_4$
(B) $[Ni(H_2O)_6]Cl_2$
(C) $Na_2[Ni(CN)_4]$
(D) $PdCl_2(PPh_3)_2$

[JEE (Main)-2020]

(1) (A) ≈ (C) ≈ (D) < (B)

(2) (C) ≈ (D) < (B) < (A)

(3) (A) ≈ (C) < (B) ≈ (D)

(4) (C) < (D) < (B) < (A)

52. Among (a) – (d), the complexes that can display geometrical isomerism are

(a) $[Pt(NH_3)_3Cl]^+$
(b) $[Pt(NH_3)Cl_5]^-$
(c) $[Pt(NH_3)_2Cl(NO_2)]$
(d) $[Pt(NH_3)_4ClBr]^{2+}$

[JEE (Main)-2020]

(1) (c) and (d)
(2) (a) and (b)
(3) (b) and (c)
(4) (d) and (a)

53. $[Pd(F)(Cl)(Br)(I)]^{2-}$ has n number of geometrical isomers. Then, the spin-only magnetic moment and crystal field stabilisation energy [CFSE] of $[Fe(CN)_6]^{n-6}$, respectively, are

[Note : Ignore the pairing energy]

[JEE (Main)-2020]

(1) 0 BM and $-2.4 \Delta_0$

(2) 5.92 BM and 0

(3) 1.73 BM and $-2.0 \Delta_0$

(4) 2.84 BM and $-1.6 \Delta_0$

54. Complex X of composition $Cr(H_2O)_6Cl_n$ has a spin only magnetic moment of 3.83 BM. It reacts with $AgNO_3$ and shows geometrical isomerism. The IUPAC nomenclature of X is **[JEE (Main)-2020]**

(1) Tetraaquadichlorido chromium(III) chloride dihydrate

(2) Hexaaqua chromium(III) chloride

(3) Tetraaquadichlorido chromium(IV) Chloride dihydrate

(4) Dichloridotetraaqua chromium(IV) chloride dihydrate

55. The correct order of the spin-only magnetic moments of the following complexes is :

(I) $[Cr(H_2O)_6]Br_2$

(II) $Na_4[Fe(CN)_6]$

(III) $Na_3[Fe(C_2O_4)_3](\Delta_0 > P)$

(IV) $(Et_4N)_2[CoCl_4]$ **[JEE (Main)-2020]**

(1) (I) > (IV) > (III) > (II)

(2) (III) > (I) > (IV) > (II)

(3) (II) $\approx$ (I) > (IV) > (III)

(4) (III) > (I) > (II) > (IV)

56. The isomer(s) of $[Co(NH_3)_4Cl_2]$ that has/have a Cl—Co—Cl angle of 90°, is/are **[JEE (Main)-2020]**

(1) cis and trans

(2) meridional and trans

(3) cis only

(4) trans only

57. For octahedral Mn(II) and tetrahedral Ni(II) complexes, consider the following statements:

(I) Both the complexes can be high spin.

(II) Ni(II) complex can very rarely below spin.

(III) With strong field ligands, Mn(II) complexes can be low spin.

(IV) Aqueous solution of Mn(II) ions is yellow in colour.

The correct statements are : **[JEE (Main)-2020]**

(1) (I), (III) and (IV) only

(2) (I) and (II) only

(3) (II), (III) and (IV) only

(4) (I), (II) and (III) only

58. Consider that a d^6 metal ion (M^{2+}) forms a complex with aqua ligands, and the spin only magnetic moment of the complex is 4.90 BM. The geometry and the crystal field stabilization energy of the complex is **[JEE (Main)-2020]**

(1) Tetrahedral and $-1.6\,\Delta_t + 1P$

(2) Octahedral and $-2.4\,\Delta_0 + 2P$

(3) Tetrahedral and $-0.6\,\Delta_t$

(4) Octahedral and $-1.6\,\Delta_0$

59. Simplified absorption spectra of three complexes ((i), (ii) and (iii)) of M^{n+} ion are provided below; their λ_{max} values are marked as A, B and C respectively. The correct match between the complexes and their λ_{max} values is

Wavelength (nm)
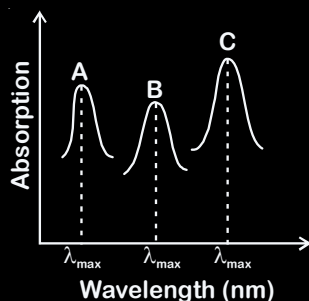
(i) $[M(NCS)_6]^{(-6 + n)}$ (ii) $[MF_6]^{(-6 + n)}$

(iii) $[M(NH_3)_6]^{n+}$

[JEE (Main)-2020]

(1) A-(i), B-(ii), C-(iii)

(2) A-(ii), B-(iii), C-(i)

(3) A-(ii), B-(i), C-(iii)

(4) A-(iii), B-(i), C-(ii)

60. The one that is not expected to show isomerism is **[JEE (Main)-2020]**

(1) $[Pt(NH_3)_2Cl_2]$ (2) $[Ni(NH_3)_4 (H_2O)_2]^{2+}$

(3) $[Ni(en)_3]^{2+}$ (4) $[Ni(NH_3)_2Cl_2]$

61. The electronic spectrum of $[Ti(H_2O)_6]^{3+}$ shows a single broad peak with a maximum at 20,300 cm^{-1}. The crystal field stabilization energy (CFSE) of the complex ion, in kJ mol^{-1}, is

(1 kJ mol^{-1} = 83.7 cm^{-1}) **[JEE (Main)-2020]**

(1) 145.5   (2) 97

(3) 242.5   (4) 83.7

62. The complex that can show optical activity

[JEE (Main)-2020]

(1) cis-$[Fe(NH_3)_2(CN)_4]^-$

(2) trans-$[Cr(Cl_2)(ox)_2]^{3-}$

(3) trans-$[Fe(NH_3)_2(CN)_4]^-$

(4) cis-$[CrCl_2(ox)_2]^{3-}$ (ox = oxalate)

63. The d-electron configuration of $[Ru(en)_3]Cl_2$ and $[Fe(H_2O)_6]Cl_2$, respectively are **[JEE (Main)-2020]**

(1) $t_{2g}^6 e_g^0$ and $t_{2g}^6 e_g^0$ (2) $t_{2g}^6 e_g^0$ and $t_{2g}^4 e_g^2$

(3) $t_{2g}^4 e_g^2$ and $t_{2g}^4 e_g^2$ (4) $t_{2g}^4 e_g^2$ and $t_{2g}^6 e_g^0$

64. Complex A has a composition of $H_{12}O_6Cl_3Cr$. If the complex on treatment with conc. H_2SO_4 loses 13.5% of its original mass, the correct molecular formula of A is **[JEE (Main)-2020]**

[Given : atomic mass of Cr = 52 amu and Cl = 35 amu]

(1) $[Cr(H_2O)_6]Cl_3$

(2) $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$

(3) $[Cr(H_2O)_3Cl_3] \cdot 3H_2O$

(4) $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$

65. The number of isomers possible for $[Pt(en)(NO_2)_2]$ is **[JEE (Main)-2020]**

(1) 3   (2) 1

(3) 4   (4) 2

66. The pair in which both the species have the same magnetic moment (spin only) is

[JEE (Main)-2020]

(1) $[Cr(H_2O)_6]^{2+}$ and $[CoCl_4]^{2-}$

(2) $[Co(OH)_4]^{2-}$ and $[Fe(NH_3)_6]^{2+}$

(3) $[Mn(H_2O)_6]^{2+}$ and $[Cr(H_2O)]^{2+}$

(4) $[Cr(H_2O)_6]^{2+}$ and $[Fe(H_2O)_6]^{2+}$

67. The one that can exhibit highest paramagnetic behaviour among the following is

gly = glycinato; bpy = 2, 2'-bipyridine

[JEE (Main)-2020]

(1) $[Fe(en)(bpy)(NH_3)_2]^{2+}$

(2) $[Pd(gly)_2]$

(3) $[Co(OX)_2(OH)_2]^-$ ($\Delta_0 > P$)

(4) $[Ti(NH_3)_6]^{3+}$

68. The molecule in which hybrid MOs involve only one d-orbital of the central atom is **[JEE (Main)-2020]**

(1) XeF_4 (2) $[Ni(CN)_4]^{2-}$

(3) $[CrF_6]^{3-}$ (4) BrF_5

69. The values of the crystal field stabilization energies for a high spin d^6 metal ion in octahedral and tetrahedral fields, respectively, are

[JEE (Main)-2020]

(1) $-1.6 \Delta_0$ and $-0.4 \Delta_t$

(2) $-2.4 \Delta_0$ and $-0.6 \Delta_t$

(3) $-0.4 \Delta_0$ and $-0.27 \Delta_t$

(4) $-0.4 \Delta_0$ and $-0.6 \Delta_t$

70. Consider the complex ions,

trans-$[Co(en)_2Cl_2]^+$ (A) and cis-$[Co(en)_2Cl_2]^+$ (B).

The correct statement regarding them is

[JEE (Main)-2020]

(1) both (A) and (B) can be optically active.

(2) both (A) and (B) can not be optically active.

(3) (A) can not be optically active, but (B) can be optically active.

(4) (A) can be optically active, but (B) can not be optically active.

71. The species that has a spin-only magnetic moment of 5.9 BM, is (T_d = tetrahedral) **[JEE (Main)-2020]**

(1) $[MnBr_4]^{2-}$ (T_d)

(2) $[NiCl_4]^{2-}$ (T_d)

(3) $Ni(CO)_4$ (T_d)

(4) $[Ni(CN)_4]^{2-}$ (square planar)

72. For a d^4 metal ion in an octahedral field, the correct electronic configuration is **[JEE (Main)-2020]**

(1) $t_{2g}^4 e_g^0$ when $\Delta_0 < P$

(2) $t_{2g}^3 e_g^1$ when $\Delta_0 > P$

(3) $e_g^2 t_{2g}^2$ when $\Delta_0 < P$

(4) $t_{2g}^3 e_g^1$ when $\Delta_0 < P$

73. Complexes (ML_5) of metals Ni and Fe have ideal square pyramidal and trigonal bipyramidal geometries, respectively. The sum of the 90°, 120° and 180° L-M-L angles in the two complexes is _____. **[JEE (Main)-2020]**

74. The oxidation states of iron atoms in compounds (A), (B) and (C), respectively, are x, y and z. The sum of x, y and z is _____.

$\underset{(A)}{Na_4[Fe(CN)_5(NOS)]} \quad \underset{(B)}{Na_4[FeO_4]} \quad \underset{(C)}{[Fe_2(CO)_9]}$

[JEE (Main)-2020]

75. The total number of coordination sites in ethylenediaminetetraacetate ($EDTA^{4-}$) is ____. **[JEE (Main)-2020]**

76. Considering that $\Delta_0 > P$, the magnetic moment (in BM) of $[Ru(H_2O)_6]^{2+}$ would be _____. **[JEE (Main)-2020]**

77. The volume (in mL) of 0.125 M $AgNO_3$ required to quantitatively precipitate chloride ions in 0.3 g of $[Co(NH_3)_6]Cl_3$ is _____.

$^M[Co(NH_3)_6]Cl_3$ = 267.46 g/mol

$^M AgNO_3$ = 169.87 g/mol **[JEE (Main)-2020]**

78. The number of possible optical isomers for the complexes MA_2B_2 with sp^3 and dsp^2 hybridized metal atom, respectively, is

Note : A and B are unidentate neutral and unidentate monoanionic ligands, respectively.

[JEE (Main)-2020]

(1) 2 and 2   (2) 0 and 2

(3) 0 and 1   (4) 0 and 0

79. The Crystal Field Stabilization Energy

(CFSE) of $[CoF_3(H_2O)_3]$ ($\Delta_0 < P$) is

[JEE (Main)-2020]

(1) $-0.8 \Delta_0$ (2) $-0.8 \Delta_0 + 2P$

(3) $-0.4 \Delta_0$ (4) $-0.4 \Delta_0 + P$

80. The stepwise formation of $[Cu(NH_3)_4]^{2+}$ is given below:

$$Cu^{2+} + NH_3 \xrightleftharpoons{K_1} [Cu(NH_3)]^{2+}$$

$$[Cu(NH_3)]^{2+} + NH_3 \xrightleftharpoons{K_2} [Cu(NH_3)_2]^{2+}$$

$$[Cu(NH_3)_2]^{2+} + NH_3 \xrightleftharpoons{K_3} [Cu(NH_3)_3]^{2+}$$

$$[Cu(NH_3)_3]^{2+} + NH_3 \xrightleftharpoons{K_4} [Cu(NH_3)_4]^{2+}$$
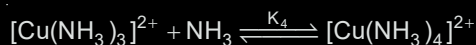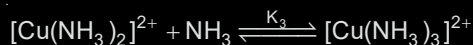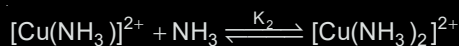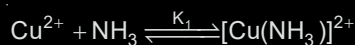
The value of stability constants K_1, K_2, K_3 and K_4 are 10^4, 1.58×10^3, 5×10^2 and 10^2 respectively. The overall equilibrium constants for dissociation of $[Cu(NH_3)_4]^{2+}$ is $x \times 10^{-12}$. The value of x is _____. (Rounded off to the nearest integer)

[JEE (Main)-2021]

81. The calculated magnetic moments (spin only value) for species $[FeCl_4]^{2-}$, $[Co(C_2O_4)_3]^{3-}$ and MnO_4^{2-} respectively are : [JEE (Main)-2021]

(1) 5.82, 0 and 0 BM

(2) 4.90, 0 and 1.73 BM

(3) 5.92, 4.90 and 0 BM

(4) 4.90, 0 and 2.83 BM

82. The hybridization and magnetic nature of $[Mn(CN)_6]^{4-}$ and $[Fe(CN)_6]^{3-}$, respectively are

[JEE (Main)-2021]

(1) d^2sp^3 and paramagnetic

(2) d^2sp^3 and diamagnetic

(3) sp^3d^2 and paramagnetic

(4) sp^3d^2 and diamagnetic

83. In which of the following order the given complex ions are arranged correctly with respect to their decreasing spin only magnetic moment?

(i) $[FeF_6]^{3-}$ (ii) $[Co(NH_3)_6]^{3+}$

(iii) $[NiCl_4]^{2-}$ (iv) $[Cu(NH_3)_4]^{2+}$

[JEE (Main)-2021]

(1) (iii) > (iv) > (ii) > (i)

(2) (ii) > (iii) > (i) > (iv)

(3) (i) > (iii) > (iv) > (ii)

(4) (ii) > (i) > (iii) > (iv)

84. Given below are two statements :

Statement I : The identification of Ni^{2+} is carried out by Dimethylglyoxime in the presence of NH_4OH.

Statement II : The Dimethylglyoxime is a bidentate neutral ligand.

In the light of the above statements, choose the correct answer from the options given below :

[JEE (Main)-2021]

(1) Both Statement I and Statement II are true

(2) Statement I is true but Statement II is false

(3) Both Statement I and Statement II are false

(4) Statement I is false but Statement II is true

85. Number of bridging CO ligands in $[Mn_2(CO)_{10}]$ is _____.

[JEE (Main)-2021]

86. The number of stereoisomers possible for $[Co(ox)_2(Br)(NH_3)]^{2-}$ is _____.

[ox = oxalate] [JEE (Main)-2021]

87. The equivalents of ethylene diamine required to replace the neutral ligands from the coordination sphere of the trans-complex of $CoCl_3 \cdot 4NH_3$ is ___ (Round off to the Nearest Integer).

[JEE (Main)-2021]

88. Arrange the following metal complex/compounds in the increasing order of spin only magnetic moment. Presume all the three, high spin system.

(Atomic numbers Ce = 58, Gd = 64 and Eu = 63.)

(a) $(NH_4)_2[Ce(NO_3)_6]$

(b) $Gd(NO_3)_3$ and

(c) $Eu(NO_3)_3$

[JEE (Main)-2021]

(1) (a) < (c) < (b)

(2) (a) < (b) < (c)

(3) (c) < (a) < (b)

(4) (b) < (a) < (c)

89. $[Ti(H_2O)_6]^{3+}$ absorbs light of wavelength 498 nm during a d – d transition. The octahedral splitting, energy for the above complex is _____ $\times 10^{-19}$ J.

(Round off to the nearest Integer).

$h = 6.626 \times 10^{-34}$ Js; $c = 3 \times 10^8$ ms^{-1}

[JEE (Main)-2021]

90. Match **List-I** with **List-II** :

List-I		List-II	
(a)	$[Co(NH_3)_6][Cr(CN)_6]$	(i)	Linkage isomerism
(b)	$[Co(NH_3)_3(NO_2)_3]$	(ii)	Solvate isomerism
(c)	$[Cr(H_2O)_6]Cl_3$	(iii)	Co-ordination isomerism
(d)	cis-$[CrCl_2(ox)_2]^{3-}$	(iv)	Optical isomerism

Choose the correct answer from the options given below. **[JEE (Main)-2021]**

(1) (a)-(iv), (b)-(ii), (c)-(iii), (d)-(i)

(2) (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)

(3) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

(4) (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)

91. On complete reaction of $FeCl_3$ with oxalic acid in aqueous solution containing KOH, resulted in the formation of product A. The secondary valency of Fe in the product A is _____. (Round off to the Nearest Integer). **[JEE (Main)-2021]**

92. Match **List-I** with **list-II** :

List-I		List-II	
(a)	Chlorophyll	(i)	Ruthenium
(b)	Vitamin - B_{12}	(ii)	Platinum
(c)	Anticancer drug	(iii)	Cobalt
(d)	Grubbs catalyst	(iv)	Magnesium

Choose the **most appropriate** answer from the options given below : **[JEE (Main)-2021]**

(1) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

(2) (a)-(iv), (b)-(ii), (c)-(iii), (d)-(i)

(3) (a)-(iii), (b)-(ii), (c)-(iv), (d)-(i)

(4) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)

93. The correct structures of trans-$[NiBr_2(PPh_3)_2]$ and meridonial-$[Co(NH_3)_3(NO_2)_3]$, respectively

[JEE (Main)-2021]

(1)

(2)

(3)

(4)
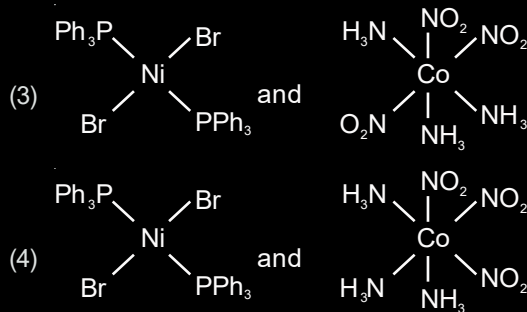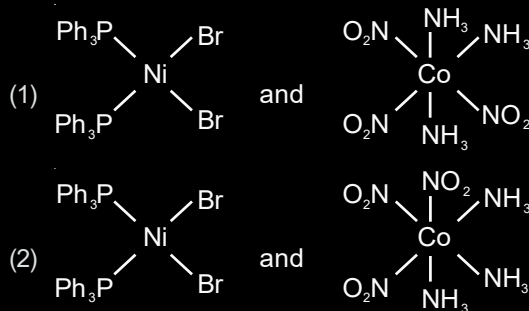
94. The total number of unpaired electrons present in the complex $K_3[Cr(oxalate)_3]$ is _____.

[JEE (Main)-2021]

95. The secondary valency and the number of hydrogen bonded water molecule(s) in $CuSO_4 \cdot 5H_2O$, respectively, are **[JEE (Main)-2021]**

(1) 5 and 1

(2) 6 and 4

(3) 6 and 5

(4) 4 and 1

96. According to the valence bond theory the hybridization of central metal atom is dsp^2 for which one of the following compounds?

[JEE (Main)-2021]

(1) $NiCl_2.6H_2O$

(2) $[Ni(CO)_4]$

(3) $K_2[Ni(CN)_4]$

(4) $Na_2[NiCl_4]$

97. The spin-only magnetic moment value for the complex $[Co(CN)_6]^{4-}$ is _____ BM.

[At. no. of Co = 27] **[JEE (Main)-2021]**

98. The correct order of intensity of colors of the compounds is **[JEE (Main)-2021]**

(1) $[Ni(CN)_4]^{2-} > [NiCl_4]^{2-} > [Ni(H_2O)_6]^{2+}$

(2) $[NiCl_4]^{2-} > [Ni(CN)_4]^{2-} > [Ni(H_2O)_6]^{2+}$

(3) $[Ni(H_2O)_6]^{2+} > [NiCl_4]^{2-} > [Ni(CN)_4]^{2-}$

(4) $[NiCl_4]^{2-} > [Ni(H_2O)_6]^{2+} > [Ni(CN)_4]^{2-}$

99. Spin only magnetic moment of an octahedral complex of Fe^{2+} in the presence of a strong field ligand in BM is **[JEE (Main)-2021]**

(1) 3.46

(2) 2.82

(3) 0

(4) 4.89

100. An aqueous solution of $NiCl_2$ was heated with excess sodium cyanide in presence of strong oxidizing agent to form $[Ni(CN)_6]^{2-}$. The total change in number of unpaired electrons on metal centre is _____. **[JEE (Main)-2021]**

101. The total number of unpaired electrons present in $[Co(NH_3)_6]Cl_2$ and $[Co(NH_3)_6]Cl_3$ is _____.

[JEE (Main)-2021]

102. Which one of the following species responds to an external magnetic field? **[JEE (Main)-2021]**

(1) $[Ni(CN)_4]^{2-}$ (2) $[Fe(H_2O)_6]^{3+}$

(3) $[Co(CN)_6]^{3-}$ (4) $[Ni(CO)_4]$

103. Three moles of AgCl get precipitated when one mole of an octahedral co-ordination compound with empirical formula $CrCl_3.3NH_3.3H_2O$ reacts with excess of silver nitrate. The number of chloride ions satisfying the secondary valency of the metal ion is _____. **[JEE (Main)-2021]**

104. Which one of the following metal complexes is most stable ? **[JEE (Main)-2021]**

(1) $[Co(NH_3)_6]Cl_2$ (2) $[Co(en)(NH_3)_4]Cl_2$

(3) $[Co(en)_2(NH_3)_2]Cl_2$ (4) $[Co(en)_3]Cl_2$

105. The type of hybridisation and magnetic property of the complex $[MnCl_6]^{3-}$, respectively, are

[JEE (Main)-2021]

(1) d^2sp^3 and diamagnetic

(2) sp^3d^2 and diamagnetic

(3) d^2sp^3 and paramagnetic

(4) sp^3d^2 and paramagnetic

106. The number of geometrical isomers found in the metal complexes $[PtCl_2(NH_3)_2]$, $[Ni(CO)_4]$, $[Ru(H_2O)_3Cl_3]$ and $[CoCl_2(NH_3)_4]^+$ respectively, are

[JEE (Main)-2021]

(1) 2, 1, 2, 1   (2) 2, 1, 2, 2

(3) 2, 0, 2, 2   (4) 1, 1, 1, 1

107. The number of geometrical isomers possible in triamminetrinitrocobalt (III) is X and in trioxalatochromate (III) is Y. Then the value of X + Y is _____. **[JEE (Main)-2021]**

108. Given below are two statements :

Statement I : $[Mn(CN)_6]^{3-}$, $[Fe(CN)_6]^{3-}$ and $[Co(C_2O_4)_3]^{3-}$ are d^2sp^3 hybridised.

Statement II : $[MnCl_6]^{3-}$ and $[FeF_6]^{3-}$ are paramagnetic and have 4 and 5 unpaired electrons, respectively.

In the light of the above statements, choose the correct answer from the options given below:

[JEE (Main)-2021]

(1) Both statement I and statement II are true

(2) Statement I is correct but statement II is false

(3) Both statement I and statement II are false

(4) Statement I is incorrect but statement II is true

109. 3 moles of metal complex with formula $Co(en)_2Cl_3$ gives 3 moles of silver chloride on treatment with excess of silver nitrate. The secondary valency of Co in the complex is _____.

(Round off to the Nearest Integer).

[JEE (Main)-2021]

110. The ratio of number of water molecules in Mohr's salt and potash alum is _____ $\times 10^{-1}$. (Integer answer) **[JEE (Main)-2021]**

111. Arrange the following cobalt complexes in the order of increasing Crystal Field Stabilisation Energy (CFSE) value. **[JEE (Main)-2021]**

Complexes :

A. $[CoF_6]^{3-}$ B. $[Co(H_2O)_6]^{2+}$

C $[Co(NH_3)_6]^{3+}$ D. $[Co(en)_3]^{3+}$

Choose the **correct** option :

(1) C < D < B < A   (2) B < C < D < A

(3) A < B < C < D   (4) B < A < C < D

112. Indicate the complex/ complex ion which did not show any geometrical isomerism:

[JEE (Main)-2021]

(1) $\left[Co(NH_3)_4 Cl_2\right]^+$

(2) $\left[Co(CN)_5 (NC)\right]^{3-}$

(3) $\left[CoCl_2 (en)_2\right]$

(4) $\left[Co(NH_3)_3 (NO_2)_3\right]$

113. The overall stability constant of the complex ion $[Cu(NH_3)_4]^{2+}$ is 2.1×10^{13}. The overall dissociation constant is $y \times 10^{-14}$. Then y is _____. (Nearest integer) **[JEE (Main)-2021]**

114. Acidic ferric chloride solution on treatment with excess of potassium ferrocyanide gives a Prussian blue coloured colloidal species. It is :

[JEE (Main)-2021]

(1) $KFe[Fe(CN)_6]$

(2) $K_5Fe[Fe(CN)_6]_2$

(3) $Fe_4[Fe(CN)_6]_3$

(4) $HFe[Fe(CN)_6]$

115. 1 mol of an octahedral metal complex with formula $MCl_3·2L$ on reaction with excess of $AgNO_3$ gives 1 mol of AgCl. The denticity of Ligand L is _____. (Integer answer) **[JEE (Main)-2021]**

116. The number of optical isomers possible for $[Cr(C_2O_4)_3]^{3-}$ is _____. **[JEE (Main)-2021]**

117. The denticity of an organic ligand, biuret is :

[JEE (Main)-2021]

(1) 3

(2) 2

(3) 4

(4) 6

118. Spin only magnetic moment in BM of $[Fe(CO)_4(C_2O_4)]^+$ is : **[JEE (Main)-2021]**

(1) 5.92

(2) 1.73

(3) 1

(4) 0

119. The Crystal Field Stabilization Energy (CFSE) and magnetic moment (spin-only) of an octahedral aqua complex of a metal ion (M^{z+}) are $-0.8\,\Delta_0$ and 3.87 BM, respectively. Identify (M^{z+}) :

[JEE (Main)-2021]

(1) Cr^{3+}

(2) V^{3+}

(3) Mn^{4+}

(4) Co^{2+}

120. The sum of oxidation states of two silver ions in $[Ag(NH_3)_2][Ag(CN)_2]$ complex is _____.

[JEE (Main)-2021]

121. Which one of the following species **doesn't** have a magnetic moment of 1.73 BM (spin only value)?

[JEE (Main)-2021]

(1) $[Cu(NH_3)_4]Cl_2$

(2) CuI

(3) O_2^-

(4) O_2^+

122. In the cobalt-carbonyl complex: $[Co_2(CO)_8]$, number of Co-Co bonds is "X" and terminal CO ligands is "Y". X + Y = _____.

[JEE (Main)-2022]

123. Transition metal complex with highest value of crystal field splitting (Δ_0) will be

[JEE (Main)-2022]

(1) $[Cr(H_2O)_6]^{3+}$

(2) $[Mo(H_2O)_6]^{3+}$

(3) $[Fe(H_2O)_6]^{3+}$

(4) $[Os(H_2O)_6]^{3+}$

124. If $[Cu(H_2O)_4]^{2+}$ absorbs a light of wavelength 600 nm for d-d transition, then the value of octahedral crystal field splitting energy for $[Cu(H_2O)_6]^{2+}$ will be _____ $\times 10^{-21}$ J. [Nearest integer]

(Given : h = 6.63×10^{-34} Js and c = 3.08×10^8 ms^{-1})

[JEE (Main)-2022]

125. Amongst $FeCl_3.3H_2O$, $K_3[Fe(CN)_6]$ and $[Co(NH_3)_6]Cl_3$, the spin-only magnetic moment value of the inner-orbital complex that absorbs light at shortest wavelength is_____B.M. [nearest integer] **[JEE (Main)-2022]**

126. The spin-only magnetic moment value of an octahedral complex among $CoCl_3·4NH_3$, $NiCl_2·6H_2O$ and $PtCl_4·2HCl$, which upon reaction with excess of $AgNO_3$ gives 2 moles of AgCl is _____ B.M. (Nearest Integer) **[JEE (Main)-2022]**

127. Reaction of $[Co(H_2O)_6]^{2+}$ with excess ammonia and in the presence of oxygen results into a diamagnetic product. Number of electrons present in t_{2g}-orbitals of the product is _____.

[JEE (Main)-2022]

128. Which of the following will have maximum stabilization due to crystal field?

[JEE (Main)-2022]

(1) $[Ti(H_2O)_6]^{3+}$

(2) $[Co(H_2O)_6]^{2+}$

(3) $[Co(CN)_6]^{-3}$

(4) $[Cu(NH_3)_4]^{2+}$

129. Arrange the following coordination compounds in the increasing order of magnetic moments. (Atomic numbers: Mn = 25; Fe = 26)

(1) $[FeF_6]^{3-}$

(2) $[Fe(CN)_6]^{3-}$

(3) $[MnCl_6]^{3-}$ (high spin)

(4) $[Mn(CN)_6]^{3-}$

Choose the correct answer from the options given below: **[JEE (Main)-2022]**

(1) 1 < 2 < 4 < 3

(2) 2 < 4 < 3 < 1

(3) 1 < 3 < 4 < 2

(4) 2 < 4 < 1 < 3

130. Given below are two statements:

Statement I: $[Ni(CN)_4]^{2-}$ is square planar and diamagnetic complex, with dsp^2 hybridization for Ni but $[Ni(CO)_4]$ is tetrahedral, paramagnetic and with sp^3-hybridization for Ni.

Statement II: $[NiCl_4]^{2-}$ and $[Ni(CO)_4]$ both have same d-electron configuration, have same geometry and are paramagnetic.

In light of the above statements, choose the **correct** answer from the options given below :

[JEE (Main)-2022]

(1) Both Statement I and Statement II are true

(2) Both Statement I and Statement II are false

(3) Statement I is correct but Statement II is false

(4) Statement I is incorrect but Statement II is true

131. Number of complexes which will exhibit synergic bonding amongst, $[Cr(CO)_6]$, $[Mn(CO)_5]$ and $[Mn_2(CO)_{10}]$ is _____. **[JEE (Main)-2022]**

132. $[Fe(CN)_6]^{4-}$

$[Fe(CN)_6]^{3-}$

$[Ti(CN)_6]^{3-}$

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

$[Co(CN)_6]^{3-}$

Among the given complexes, number of paramagnetic complexes is_____. **[JEE (Main)-2022]**

133. (a) $CoCl_3 \cdot 4 NH_3$, (b) $CoCl_3 \cdot 5NH_3$, (c) $CoCl_3 \cdot 6NH_3$ and (d) $CoCl(NO_3)_2 \cdot 5NH_3$. Number of complex(es) which will exist in cis-trans form is/are_____.

[JEE (Main)-2022]

134. Given below are two statements.

Statement-I: In $CuSO_4 \cdot 5H_2O$, Cu-O bonds are present.

Statement-II: In $CuSO_4 \cdot 5H_2O$, ligands coordinating with Cu(II) ion are O-and S-based ligands.

In the light of the above statements, choose the correct answer from the options given below:

[JEE (Main)-2022]

(1) Both Statement-I and Statement-II are correct

(2) Both Statement-I and Statement-II are incorrect

(3) Statement-I is correct but Statement-II is incorrect

(4) Statement-I is incorrect but Statement-II is correct.

135. Spin only magnetic moment of $[MnBr_6]^{4-}$ is _____B.M. [round off to the closest integer]

[JEE (Main)-2022]

136. For the reaction given below:

$CoCl_3 \cdot xNH_3 + AgNO_3 (aq) \rightarrow$
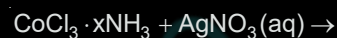
If two equivalents of AgCl precipitate out, then the value of x will be_____. **[JEE (Main)-2022]**

137. Consider the following metal complexes:

$[Co(NH_3)_6]^{3+}$

$[CoCl(NH_3)_5]^{2+}$

$[Co(CN)_6]^{3-}$

$[Co(NH_3)_5(H_2O)]^{3+}$
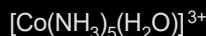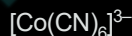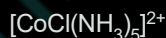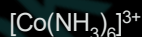
The spin-only magnetic moment value of the complex that absorbs light with shortest wavelength is _____ B.M. (Nearest integer)

[JEE (Main)-2022]

138. The correct order of energy of absorption for the following metal complexes is

A : $[Ni(en)_3]^{2+}$, B : $[Ni(NH_3)_6]^{2+}$, C : $[Ni(H_2O)_6]^{2+}$

[JEE (Main)-2022]

(1) C < B < A   (2) B < C < A

(3) C < A < B   (4) A < C < B

139. The difference between spin only magnetic moment value of $[Co(H_2O)_6]Cl_2$ and $[Cr(H_2O)_6]Cl_3$ is _____. **[JEE (Main)-2022]**

140. The metal complex that is diamagnetic is (Atomic number : Fe, 26; Cu, 29) **[JEE (Main)-2022]**

(1) $K_3[Cu(CN)_4]$ (2) $K_2[Cu(CN)_4]$

(3) $K_3[Fe(CN)_4]$ (4) $K_4[FeCl_6]$

141. The conductivity of a solution of complex with formula $CoCl_3(NH_3)_4$ corresponds to 1 : 1 electrolyte, then the primary valency of central metal ion is _____

[JEE (Main)-2022]

142. Low oxidation state of metals in their complexes are common when ligands : **[JEE (Main)-2022]**

(1) Have good π-accepting character

(2) Have good σ-donor character

(3) Are having good π-donating ability

(4) Are having poor σ-donating ability

143. Total number of relatively more stable isomer(s) possible for octahedral complex $[Cu(en)_2(SCN)_2]$ wiil be _____. **[JEE (Main)-2022]**

144. Match **List-I** with **List-II**

List-I (Complex)	List-II (Hybridization)
A. $Ni(CO)_4$	I. sp^3
B. $[Ni(CN)_4]^{2-}$	II. sp^3d^2
C. $[Co(CN)_6]^{3-}$	III. d^2sp^3
D. $[CoF_6]^{3-}$	IV. dsp^2

Choose the correct answer from the options given below: **[JEE (Main)-2022]**

(1) A-IV, B-I, C-III, D-II (2) A-I, B-IV, C-III, D-II

(3) A-I, B-IV, C-II, D-III (4) A-IV, B-I, C-II, D-III

145. $[Fe(CN)^6]^{3-}$ should be an inner orbital complex. Ignoring the pairing energy, the value of crystal field stabilization energy for this complex is (–) _____ Δ_0. (Nearest integer) **[JEE (Main)-2022]**

146. Octahedral complexes of copper(II) undergo structural distortion (Jahn-Teller). Which one of the given copper(II) complexes will show the maximum structural distortion?

(en – ethylenediamine; H_2N-CH_2-CH_2-NH_2)

[JEE (Main)-2022]

(1) $[Cu(H_2O)_6]SO_4$

(2) $[Cu(en)(H_2O)_4]SO_4$

(3) cis-$[Cu(en)_2Cl_2]$

(4) trans-$[Cu(en)_2Cl_2]$

147. Sum of oxidation state (magnitude) and coordination number of cobalt in $Na[Co(bpy)Cl_4]$ is_____.

(Given : bpy =)

[JEE (Main)-2022]

148. Match **List-I** with **List-II** :

List-I		List-II
(A) $[PtCl_4]^{2-}$	(I)	sp^3d
(B) BrF_5	(II)	d^2sp^3
(C) PCl_5	(III)	dsp^2
(D) $[Co(NH_3)_6]^{3+}$	(IV)	sp^3d^2

Choose the **most appropriate** answer from the options given below. **[JEE (Main)-2022]**

(1) (A)-(II), (B)-(IV), (C)-(I), (D)-(III)

(2) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

(3) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

(4) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)

❏ ❏ ❏

Coordination Compounds

1. Answer (3)
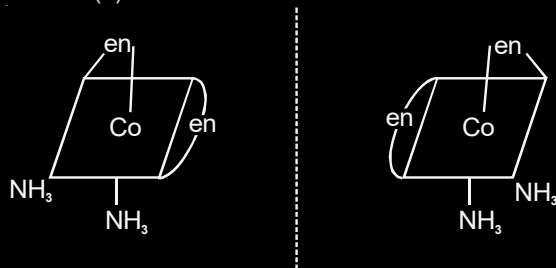
2. Answer (1)

SCN^- is an ambidentate ligand.

3. Answer (3)
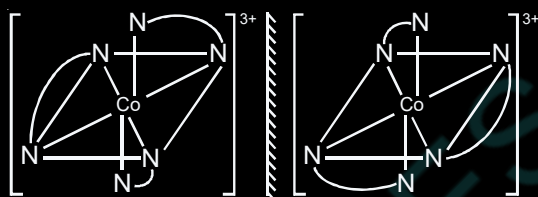
Optically active

Exist as enantiomeric pair $\left[Co(en)_3\right]^{3+}$

4. Answer (2)

Moles of complex = $\dfrac{2.675}{267.5}=0.01$

Moles of AgCl precipitated = $\dfrac{4-78}{143.5}=0.033$

It means $3Cl^-$ are released by one molecule of complex

∴ $[Co(NH_3)_6]Cl_3$

5. Answer (3)

$\xrightarrow[\text{Field strength}]{NH_3<en<CN^-<CO}$ Strong field ligand
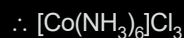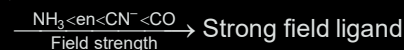
6. Answer (4)

$\left[Co(NH_3)_2(en)_2\right]^{3+}$ will exhibit geometrical isomerism ($\left[Ma_2(A-A)_2\right]^{\pm n}$ type complex).

7. Answer (1)

8. Answer (3)

$[Co(NH_3)_3Cl_3]$ has two geometrical isomers, namely fac. and mer. Both of them have a plane of symmetry. So, they are not expected to show optical isomerism.

fac.   mer.
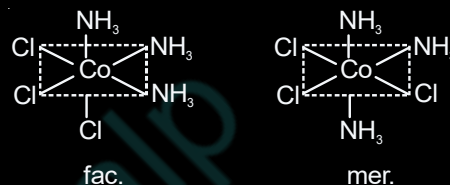
9. Answer (2)

The energy of red light is less than that of violet light. So energy order is

Red < Yellow < Green < Blue

The complex absorbs lower energy light lower will be its strength. So order of ligand strength is

$L_1 < L_3 < L_2 < L_4$

10. Answer (2)

The complex

$[CoCl(NH_3)_5]^+$ decomposes under acidic medium, so

$[CoCl(NH_3)_5]^+ + 5H^+ \rightarrow Co^{2+} + 5NH_4^+ + Cl^-$
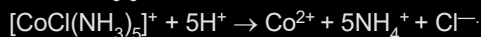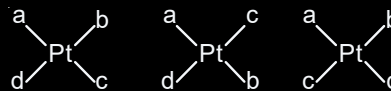
11. Answer (2)

as per question a = Cl, b = py, c = NH_3 and d = NH_2OH are assumed.

12. Answer (1)
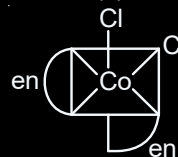
has no plane of symmetry, so it is optically active.

13. **Answer (2)**

Millimoles of $AgNO_3 = \dfrac{1.2 \times 10^{22}}{6 \times 10^{23}} \times 1000 = 20$

Millimoles of $CoCl_3 \cdot 6H_2O = 0.1 \times 100 = 10$

∴ Each mole of $CoCl_3 \cdot 6H_2O$ gives two chloride ions.

∴ $[Co(H_2O)_5Cl]Cl_2 \cdot H_2O$
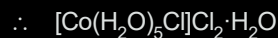
14. **Answer (4)**

The solution which shows maximum freezing point must have minimum number of solute particles.

(1) $[Co(H_2O)_6]Cl_3 \rightarrow [Co(H_2O)_6]^{3+} + 3Cl^-$, i = 4

(2) $[Co(H_2O)_5Cl]Cl_2 \cdot H_2O$

$\rightarrow [Co(H_2O)_5Cl]^{2+} + 2Cl^-$, i = 3

(3) $[Co(H_2O)_4Cl_2]Cl \cdot 2H_2O$

$\rightarrow [Co(H_2O)_4Cl_2]^+ + Cl^-$, i = 2

(4) $[Co(H_2O)_3Cl_3] \cdot 3H_2O \rightarrow [Co(H_2O)_3Cl_3]$, i = 1
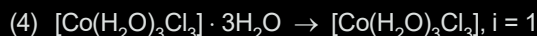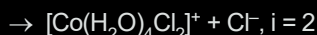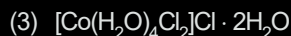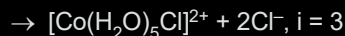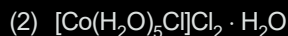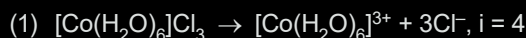
So, solution of 1 molal $[Co(H_2O)_3Cl_3] \cdot 3H_2O$ will have minimum number of particles in aqueous state.

Hence, option (4) is correct.

15. **Answer (3)**

$\left[Cr(H_2O)_6\right]Cl_3 \Rightarrow x + 0 \times 6 - 1 \times 3 = 0$

$\therefore x = +3$

$\left[Cr(C_6H_6)_2\right] \Rightarrow x + 2 \times 0 = 0$

$x = 0$

$K_2\left[Cr(CN)_2(O_2)(O_2)NH_3\right]$
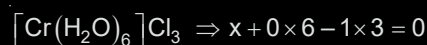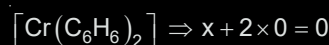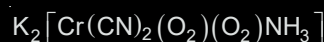
$\Rightarrow 1 \times 2 + x - 1 \times 2 - 2 \times 2 - 2 \times 1 = 0$

$\Rightarrow x - 6 = 0$

$x = +6$

16. **Answer (2)**

cis-isomer

+Br⁻ ↓

fac-   mer-
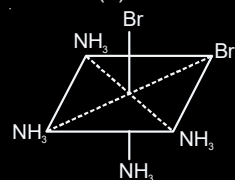
(2 isomer)

trans   Mer (1 isomer)
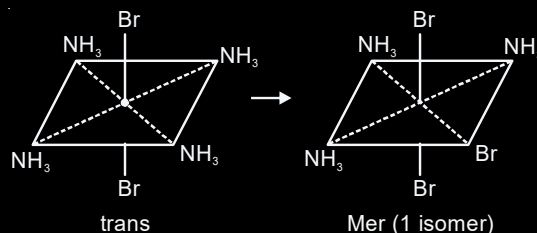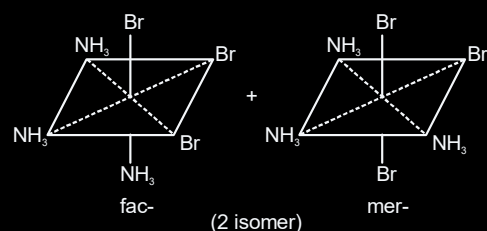
So option (2) is correct.

17. **Answer (1)**

$Cr^{3+} : 3d^3$

3d

$\left[Cr(H_2O)_6\right]^{3+}$:
(A)

3d   4s   4p d^2sp^3 hybridisation

$\left[Cr(NH_3)_6\right]^{3+}$:
(B)

3d   4s   4p d^2sp^3 hybridisation
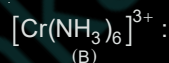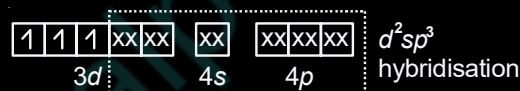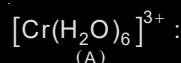
Both (A) and (B) are paramagnetic with 3 unpaired electrons each. The splitting energy (Δ_0) values of (A) and (B) are calculated from the wavelengths of light absorbed and not from the wavelengths of light emitted. H_2O is a weak field ligand causing lesser splitting than NH_3 which is relatively stronger field ligand.

18. **Answer (3)**

Greater the energy or lesser the wavelength of light absorbed, greater is the ligand strength

Energy : Blue > Green > Red
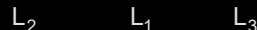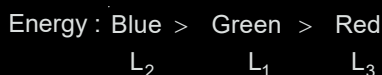
$\qquad$ L_2 $\qquad$ L_1 $\qquad$ L_3

So, ligand strength : $L_2 > L_1 > L_3$

19. **Answer (3)**

For the same metal ion, greater the co-ordination number and greater the strength of the ligands, greater is the value of crystal field splitting energy

$^-CN > NH_3 > H_2O > Cl^-$
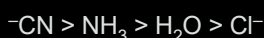
20. Answer (2)

Wilkinson's catalyst is $[Rh(PPh_3)_3]Cl$

21. Answer (2)
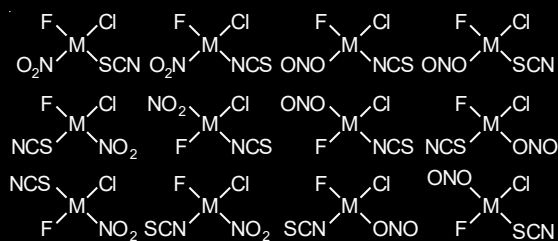
∴ Answer is 12.

22. Answer (3)

$[Au(CN)_2]^-$ and $[Ag(CN)_2]^-$ are used in the electroplating of Au and Ag respectively.

23. Answer (3)

$[CoCl_6]^{3-}$ + 2(en) $\longrightarrow$ $[CoCl_2(en)_2]^+$

(1 : 2 mole ratio)   (cis-trans isomer)
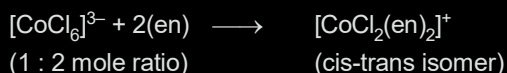
A - optically active (cis-isomer)

B - optically inactive (trans isomer)

24. Answer (4)

$Ni^{2+} = |Ar|\ 4s^0\ 3d^8$

3 d^8 4 s   4 p
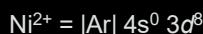
No of unpaired electron remain two with S.F.L or W.F.L

$Mn^{2+} = |Ar|\ 4s°\ 3d^5$

 → 5 unpaired electron with W.F.L

$Fe^{2+} = |Ar|\ 4s°\ 3d^6$

 → 4 unpaired electron with W.F.L

$Co^{2+} = |Ar|\ 4s^0\ 3d^7$

 → 3 unpaired electron with W.F.L

→ 1 unpaired electron with S.F.L
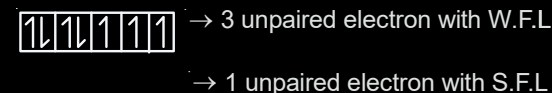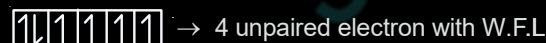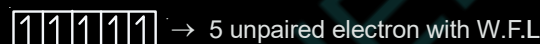
25. Answer (1)

Structure of $Co_2(CO)_8$

26. Answer (1)

$K_4[Th(C_2O_4)_4(OH_2)_2]$
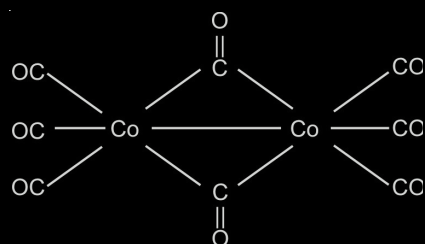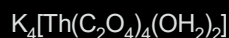
$C_2O_4^{2-}$ is bidentate ligand and H_2O is monodentate ligand.

∴ Co-ordination no. of Th = 2 × 4 + 2 = 10

27. Answer (3)

$K_3[Co(CN)_6]$
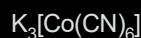
During splitting in octahederal co-ordination entities, $d_{x^2-y^2}$ and d_{z^2} orbitals point towards the direction of ligands (i.e. they experience more repulsion and their energy is raised)

28. Answer (1)

μ = 3.9 BM

So, the central metal ion has 3 unpaired electrons.

∴ Configuration is either d^3 or d^7 as H_2O is a weak field ligand.

V^{2+} has d^3 configuration.

Co^{2+} has d^7 configuration.

29. Answer (1)

It is organometallic compound due to presence of Mn – C bond.

30. Answer (3)

Electronic configuration of Mn^{2+} is

$Mn^{+2} : 3d^5$
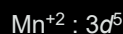
It has 5 unpaired electrons which corresponds to magnetic moment of $\sqrt{35}$ = 5.9 BM. This shows that the homoleptic complex of Mn^{2+} has only weak field ligands and that is NCS^-. The remaining three ligands are strong field ligands.

31. Answer (1)

		No. of unpaired electrons
$[V(CN)_6]^{4-}$	V^{+2}	3
$[Ru(NH_3)_6]^{3+}$	Ru^{+3}	1
$[Fe(CN)_6]^{4-}$	Fe^{+2}	0
$[Cr(NH_3)_6]^{2+}$	Cr^{+2}	2

∴ Order of spin magnetic moment

$V^{2+} > Cr^{2+} > Ru^{3+} > Fe^{2+}$

32. Answer (1)

It has four lone pairs.

Denticity is 4.

33. **Answer (1)**

Cis-platin is used as an anti-cancer drug.

Cis [$PtCl_2(NH_3)_2$]

$$\begin{bmatrix} Cl & & NH_3 \\ & Pt & \\ Cl & & NH_3 \end{bmatrix}$$

34. **Answer (4)**

[$Fe(H_2O)_6]_2$]   [$Fe(CN)_6$]
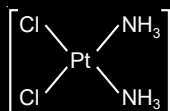
[$Fe(H_2O)_6]^{2+}$ [$Fe(CN)_6]^{4-}$
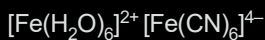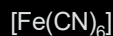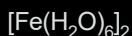
4 unpaired   no unpaired electron

electrons $\mu = 0$

$\mu = 4.9$

35. **Answer (2)**

In $CuSO_4 \cdot 5H_2O$, four H_2O molecules are directly coordinated to the central metal ion while one H_2O molecule is hydrogen bonded.

36. **Answer (3)**
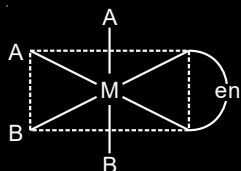
has no plane of symmetry or centre of symmetry, hence it is optically active.

37. **Answer (1)**

Cr^{3+} has d^3 configuration and forms an octahedral inner orbitals complex.

The set of degenerate orintals are (d_{xy}, d_{yz} and d_{xz}) and ($d_{x^2-y^2}$ and d_{z^2}).

38. **Answer (4)**

Valence bond theory cannot predict quantitatively the magnetic properties of transition metal complex.

39. **Answer (1)**

The maximum possible denticities of the given ligand towards transition metal ion is 6 and towards inner transition metal ion is 8.

40. **Answer (4)**
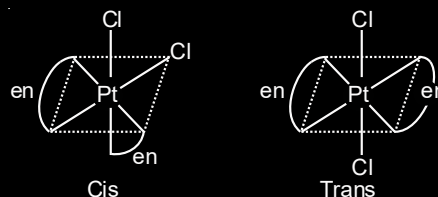
Cis   Trans

Cis-trans isomerism is possible with [$Pt(en)_2Cl_2]^{2+}$. [$Cr(en)_2Ox]^+$ shows optical isomerism but not geometrical isomerism. The other two complexes, i.e. [$Pt(en)Cl_2$] and [$Zn(en)Cl_2$] do not show stereoisomerism.

41. **Answer (1)**

In a co-ordination compound, the strong field ligand causes higher splitting of the d-orbitals. Wavelength of the energy absorbed by the co-ordination compound is inversely proportional to ligand field strength of the given co-ordination compound. The decreasing order of ligand field strength is $NH_3 >$ $H_2O > Cl$. Therefore decreasing order of wavelength absorbed is (I) > (II) > (III).

42. **Answer (2)**

Ruby is aluminium oxide (Al_2O_3) containing about $0.5 - 1\%$ Cr^{3+} ions which are randomly distributed in the position normally occupied by Al^{3+} ions.

43. **Answer (3)**

[$Fe(H_2O)_6]^{2+}$ $t_{2g}^4 e_g^2$ CFSE = $-0.4\Delta_0$

[$NiCl_4]^{2-}$ $e^4 t_2^4$ CFSE = $-0.8\Delta_t$

44. **Answer (4)**

$Ni^{2+}(d^8) \longrightarrow Ni^{3+}(d^7)$
$t_{2g}^6 e_g^2 \qquad\qquad t_{2g}^6 e_g^1$

$Co^{2+}(d^7) \longrightarrow Co^{3+}(d^6)$
$t_{2g}^6 e_g^1 \qquad\qquad t_{2g}^6 e_g^0$

$Zn^{2+}(d^{10}) \longrightarrow Zn^{2+}(d^9)$
$t_{2g}^6 e_g^4 \qquad\qquad t_{2g}^6 e_g^3$

$Fe^{2+}(d^6) \longrightarrow Fe^{3+}(d^5)$
$t_{2g}^6 e_g^0 \qquad\qquad t_{2g}^5 e_g^0$
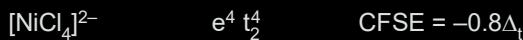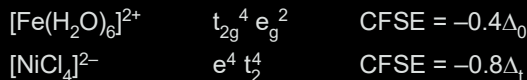
So, only Fe^{2+} will lose crystal field stabilisation upon oxidation to +3, others will gain crystal field stabilisation.

45. **Answer (2)**

The field becomes square planar and the order of energy is $d_{x^2-y^2} > d_{xy} > d_{z^2} > d_{zx} = d_{yz}$.

46. Answer (3)

$[Co(en)_2Cl]Cl$
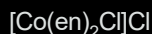
Cl⁻ - monodentate ligand

en - bidentate ligand

∴ Co-ordination No. of Co = (2 × 2) + 1 = 5

$K_3[Al(C_2O_4)_3]$
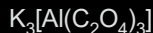
$C_2O_4^{2-}$ - bidentate ligand

∴ Co-ordination No. of Al = 2 × 3 = 6

47. Answer (1)

The IUPAC name is Diamminechlorido (methanamine)platinum(II) chloride

48. Answer (4)

CFT assumes that the ligands are point charges and it follows that anionic ligands should exert the greatest splitting effect. Further it does not take into account the covalent character of bonding which exists between the metal and the carbon atom of the carbonyl. The M – C σ bond is formed by the donation of lone pair of electrons on the carbonyl carbon into a vacant orbital of the metal and the M-C π bond is formed by the donation of a pair of electrons from a filled d-orbital of metal into vacant antibonding π∗ orbital of carbon monoxide.

So, MOT explains the bonding in $Ni(CO)_4$.

49. Answer (2)

(a) Co^{3+} with strong field complex forms low magnetic moment complex

(b) If Δ_0 < P configuration of Co^{3+} will be $t_g^6 e_g^2$

(c) CFSE of $[Co(en)_3]^{3+}$ is more than $[CoF_6]^{3-}$

⇒ $\lambda_{absorbed}$ of $[Co(en)_3]^{3+}$ is less than $[CoF_6]^{3-}$

(d) $\Delta_t = \dfrac{4}{9}\Delta_0 = \dfrac{4}{9} \times 18000 = 8000 \text{ cm}^{-1}$

Hence, (a) and (d) are incorrect

50. Answer (2)

$[Co(NH_3)_3(NO_2)_3]$ will show *fac* and *mer* isomers

51. Answer (1)

		Number of unpaired electrons	μ
(A) $Ni(CO)_4$	Ni = $3d^8 4s^2$ (SFL)	0	0
(B) $[Ni(H_2O)_6]Cl_2$	$Ni^{+2} = 3d^8$ (WFL)	2	$\sqrt{8}$ BM
(C) $Na_2[Ni(CN)_4]$	$Ni^{+2} = 3d^8$ (SFL)	0	0
(D) $PdCl_2(PPh_3)_2$	$Pd^{+2} = 4d^8$	0	0

Correct order of the calculated spin only magnetic moments of complexes A to D is

(A) ≈ (C) ≈ (D) < B

52. Answer (1)

$\underset{(c)}{[Pt(NH_3)_2Cl(NO_2)]}$ and $\underset{(d)}{[Pt(NH_3)_4ClBr]^{+2}}$

can display geometrical isomerism

(c)

$$\underset{(cis)}{\begin{array}{c} H_3N \\ H_3N \end{array}}Pt\begin{array}{c} Cl \\ NO_2 \end{array} \quad \underset{(trans)}{\begin{array}{c} H_3N \\ O_2N \end{array}}Pt\begin{array}{c} Cl \\ NH_3 \end{array}$$

(square planar complex)

(d)

$$\underset{(cis)}{\begin{array}{c} NH_3 \\ H_3N-Pt-Cl \\ H_3N \quad Br \\ NH_3 \end{array}} \quad \underset{(trans)}{\begin{array}{c} Cl \\ H_3N-Pt-NH_3 \\ H_3N \quad NH_3 \\ Br \end{array}}$$

(octahedral complex)
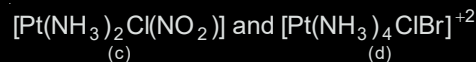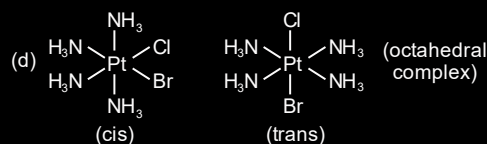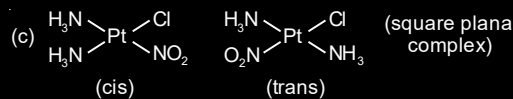
53. Answer (3)

Complex $[Pd(F)(Cl)(Br)(I)]^{2-}$ (square planar geometry)- has 3 geometrical isomers.

∴ $[Fe(CN)_6]^{3-6} = [Fe(CN)_6]^{-3}$

O.S. of Fe = +3

∴ No. of unpaired e⁻s in Fe^{+3} = 1

$Fe^{+3} = 3d^5$

∴ E.C. according to CFT = $t_{2g}^5 e_g^0$

∴ Spin only magnetic moment

$= \sqrt{1(1+2)} = \sqrt{3} = 1.73$ BM

∴ CFSE $= -4\Delta_0 \times 5 = -2\Delta_0$

54. Answer (1)

Complex : $Cr(H_2O)_6Cl_n$
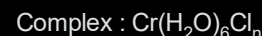
Spin only magnetic moment = $\sqrt{n(n+2)}$ BM

$= \sqrt{3.8}$ BM

n = no. of unpaired electrons

∴ n = 3

∴ Cr is in +3 oxidation state

∵ Complex shows geometrical isomerism and also reacts with $AgNO_3$

∴ Complex $[Cr(H_2O)_4Cl_2]Cl·2H_2O$
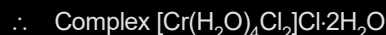
IUPAC Name : Tetraaquadichloridochromium(III) chloride dihydrate

55. Answer (1)

$Na_4[Fe(CN)_6] \rightarrow$ diamagnetic (μ = 0)

$[Cr(H_2O)_6]Br_2 \rightarrow$ Paramagnetic (μ = $\sqrt{24}$ BM)

$(NEt_4)_2[CoCl_4] \rightarrow$ Paramagnetic (μ = $\sqrt{15}$ BM)

$Na_3[Fe(C_2O_4)_3] \rightarrow$ Paramagnetic (μ = $\sqrt{3}$ BM)

56. Answer (3)

cis-isomer
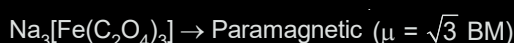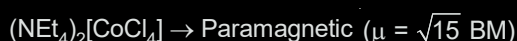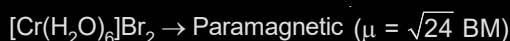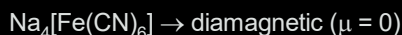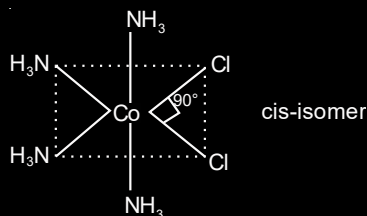
57. Answer (4)

- Both complex can be high spin
- Tetrahedral complex are generally high spin complex with any ligand is present
- Aqueous solution of Mn^{2+} ions is pink in colour
- Mn^{2+} + SFL → low spin complex

58. Answer (3)

Spin only magnetic moment = 4.9 = $\sqrt{n(n+2)}$

From this, n = 4 (unpaired electrons)

In case of d^6 having 4 unpaired electrons.

We have 2 possibilities.

For octahderal   For tetrahedral
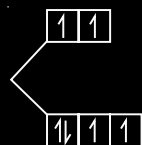
CFSE = $-0.4\,\Delta_0$ CFSE = $-0.6\,\Delta_t$

So, option (3) is correct.

59. Answer (4)

$(\lambda_{max})_C > (\lambda_{max})_B > (\lambda_{max})_A$

From spectrochemical series

   $F^- < NCS^- < NH_3$
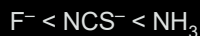
$\Rightarrow$ A - iii, B - i, C - ii

60. Answer (4)
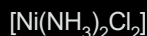
$[Ni(NH_3)_2Cl_2]$

$Ni^{2+} \rightarrow d^8$ sp^3 hybridisation

                    Tetrahedral complex

$[Ni(NH_3)_2Cl_2] \rightarrow$ cannot show isomerism.

$[Pt(NH_3)_2Cl_2] \rightarrow dsp^2 \rightarrow$ shows geometrical

                              isomerism

$[Ni(NH_3)_4(H_2O)_2]^{2+} \rightarrow$ Octahedral $\rightarrow$ show

                         geometrical isomerism

$[Ni(en)_3]^{2+} \rightarrow$ Octahedral $\rightarrow$ shows optical

                         isomerism

61. Answer (2)

$[Ti(H_2O)_6]^{3+}$ $Ti^{3+} \rightarrow d^1$
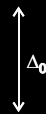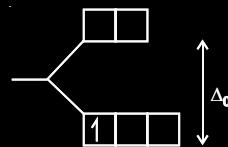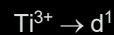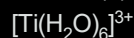
Δ_0 = 20300 cm^{-1}

For octahedral

CFSE = $-0.4\,\Delta_0$ = -0.4×20300 = -8120 cm^{-1}

CFSE (in kJ) = $\dfrac{8120}{83.7}$ = 97 kJ / mol

62. Answer (4)

cis-$[CrCl_2(ox)_2]^{3-}$

$\downarrow$
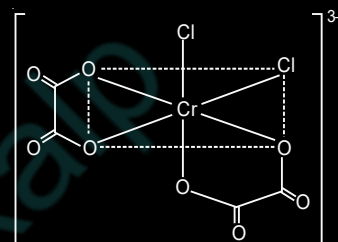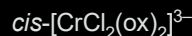
does not have symmetry, so, optically active.

cis-$[Fe(NH_3)_2(CN)_4]^-$, trans-$[CrCl_2(ox)_2]^{3-}$,

trans-$[Fe(NH_3)_2(CN)_4]^-$
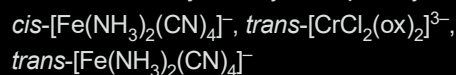
have plane of symmetry.

So, optically inactive.

63. Answer (2)

$[Ru(en)_3]Cl_2$ d^6

(low spin)
(because of higher Zeff)

$[Fe(H_2O)_6]Cl_2$ d^6

(high spin)
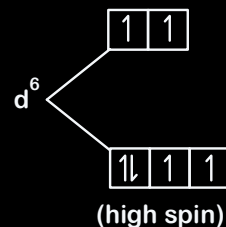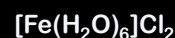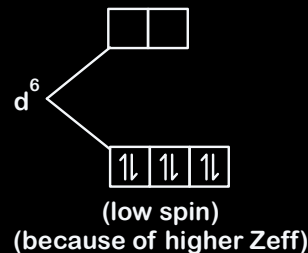
64. Answer (2)

13.5% of $H_{12}O_6Cl_3Cr$ is equal to 36 (approx.)

∴ around two moles of water are lost during heating.

∴ Formula of complex could be

$[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$

65. Answer (1)
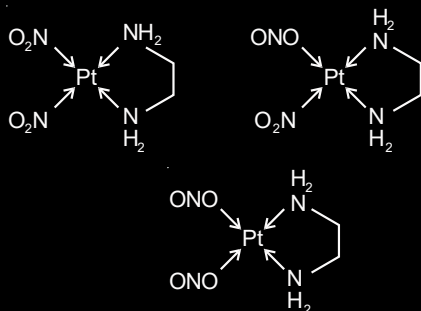
Total 3 geometrical isomers are possible.

66. Answer (4)

Species with same number of unpaired electrons have equal magnetic moment

Complex	(n)
$[Cr(H_2O)_6]^{2+}$	4
$[Fe(H_2O)_6]^{2+}$	4
$[CoCl_4]^{2-}$	3
$[Co(H_2O)_6]^{2+}$	3
$[Mn(H_2O)_6]^{2+}$	5
$[Fe(NH_3)_6]^{2+}$	4

67. Answer (3)

		No. of unpaired electrons
$[Fe(en)(bpy)(NH_3)_2]^{2+}$	: $Fe^{2+} - 3d^6$	0
$[Pd(gly)_2]$	: $Pd^{2+} - 3d^8$	0
$[Co(OX)_2(OH)_2]^-$	: $Co^{5+} - 3d^4$	2
$[Ti(NH_3)_6]^{3+}$	: $Ti^{3+} - 3d^1$	1

∴ $[Co(OX)_2(OH)_2]^-$ exhibits highest paramagnetic behaviour.

68. Answer (2)

$XeF_4 = sp^3d^2$

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

$[CrF_6]^{3-} = d^2sp^2$

$BrF_5 = sp^3d^2$
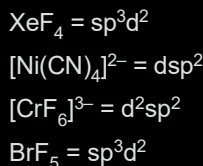
69. Answer (4)

Crystal field stabilization energy (CFSE) for high spin d^6 metal ion

In octahedral
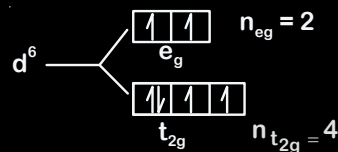
$CFSE = \left[-0.4n_{t_{2g}} + 0.6n_{e_g}\right]\Delta_0$

$= [-0.4 \times 4 + 0.6 \times 2]\Delta_0$

$= -0.4\ \Delta_0$

In tetrahedral fields

$CFSE = \left(-0.6\ n_{eg} + 0.4n_{t_{2g}}\right)\Delta_t$

$= (-0.6 \times 3 + 0.4 \times 3)\Delta_t$

$= (-1.8 + 1.2)\Delta_t$

$= -0.6\ \Delta_t$

70. Answer (3)

trans-$[Co(en)_2Cl_2]^+$ (A) contain a plane of symmetry. It cannot be optically active. Whereas, (B) cis-$[Co(en)_2Cl_2]^+$ does not contain any plane of symmetry. The compound (B) is optically active.

71. Answer (1)

$[MnBr_4]^{2-} \Rightarrow Mn^{2+} \Rightarrow d^5(Td)$

$d^5(Td)$ is high spin complex

$\mu = \sqrt{5(5+2)} = 5.91\,B.M.$

72. Answer (4)

If $\Delta_0 > P$ then for $d^4 \Rightarrow t_{2g}^4\ e_g^0$

If $\Delta_0 < P$ then for $d^4 \Rightarrow t_{2g}^3\ e_g^1$

73. Answer (20.00)

(Trigonal bipyramidal)

$\angle 120° = 3,\ \angle 90° = 6,\ \angle 180° = 1$ Total $= 10$
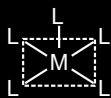
(Square pyramidal)

$\angle 90° = 8, \angle 180° = 2 \Rightarrow$ Total = 10

Total number of 180°, 90° and 120° L-M-L bond angles = 10 + 10 = 20

74. Answer (6)

$Na_4[Fe(CN)_5(NOS)]^{4-}$
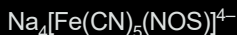
Let the O.S. of Fe be x

OS of CN = –1

OS of NOS = –1

$\therefore$ x + 5(–1) + (–1) = –4 $\Rightarrow$ x = +2

$Na_4[FeO_4]^{4-}$
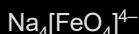
Let O.S. of Fe be y

$\therefore$ y + 4(–2) = –4 $\Rightarrow$ y = +4

$[Fe_2(CO)_9]$
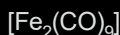
Let O.S. of Fe be z

2(z) + 9(0) = 0 $\Rightarrow$ z = 0

x + y + z = 2 + 4 + 0 = 6

75. Answer (6.00)

$[EDTA]^{4-}$ is ethylenediaminetetraacetate anion.

It has six co-ordination sites.
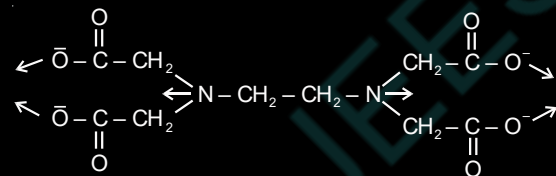
It has six co-ordination sites.

76. Answer (0.00)

As $\Delta_0 > P$

$\therefore$ Pairing of e⁻s will take place

$Ru^{2+}(Z = 44) = [Kr]4d^6$
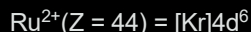
No. of unpaired e⁻s = 0

$\therefore$ Magnetic moment = 0 B.M

77. Answer (26.92)

Number of moles of the given complex,

$= \dfrac{0.3}{267.46}$

Number of moles of Cl⁻ ions = $\dfrac{0.3 \times 3}{267.46}$

Moles of Ag⁺ ions needed to ppt. Cl⁻ = $\dfrac{0.3 \times 3}{267.46}$

Let the volume of 0.125 M $AgNO_3$ needed by V ml.

$\dfrac{0.125 \times V}{1000} = \dfrac{0.3 \times 3}{267.46}$

V = 26.92 ml

78. Answer (4)

$[MA_2B_2]$

Tetrahedral   Square planar
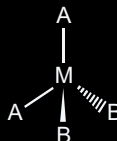
has plane of   planar
symmetry
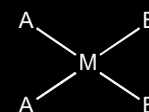
Total number of optical isomer is zero in both the cases.

79. Answer (3)

$[CoF_3(H_2O)_3] \Rightarrow Co^{3+} \Rightarrow d^6$ or $t_{2g}^4 e_g^2$

CFSE = $[-4 \times 0.4 + 2 \times 0.6]\Delta_0 + 0$

= $-0.4 \Delta_0$
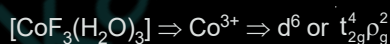
80. Answer (1)

K_f of $[Cu(NH_3)_4]^{2+} = K_1 \cdot K_2 \cdot K_3 \cdot K_4$

$\therefore$ Dissociation constant of $[Cu(NH_3)_4]^{2+} = \dfrac{1}{k_f}$

$= \dfrac{1}{10^4 \times 1.58 \times 10^3 \times 5 \times 10^2 \times 10^2}$

$= \dfrac{1}{7.9} \times 10^{-11}$

= 1.26 × 10⁻¹²

≈ 1 × 10⁻¹²

81. Answer (2)
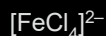
$[FeCl_4]^{2-}$ Fe²⁺ + Weak ligand   n = 4
              (High spin complex)   μ = 4.9 BM
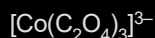
$[Co(C_2O_4)_3]^{3-}$ Co³⁺ + Strong field   n = 0
              (Low spin complex)   μ = 0 BM

MnO_4^{2-} Mn⁺⁶   n = 1
              (Low spin complex)   μ = 1.73 BM

(n is number of unpaired electron and μ is spin only magnetic moment)

82. Answer (1)
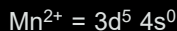
$[Mn(CN)_6]^{4-}$

$Mn^{2+} = 3d^5\ 4s^0$

^-CN is a strong field ligand

∴ Pairing will occur

d^2sp^3
Paramagnetic

$[Fe(CN)_6]^{3-}$

$Fe^{3+} = 3d^5\ 4s^0$
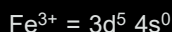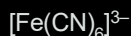
CN^- is a strong field ligand

∴ Pairing will occur

d^2sp^3
Paramagnetic

83. Answer (3)

		Unpaired e⁻ (n)
(i) FeF_6^{3-}	Fe^{3+} (W.F.L)	5
(ii) $[Co(NH_3)_6]^{3+}$	Co^{3+} (S.F.L)	0
(iii) $[NiCl_4]^{2-}$	Ni^{2+} (W.F.L)	2
(iv) $[Cu(NH_3)_4]^{2+}$	Cu^{2+}	1

$\mu = \sqrt{n(n+2)}$ B.M

So, correct order of spin only magnetic moment is

(ii) < (iv) < (iii) < (i)

84. Answer (2)
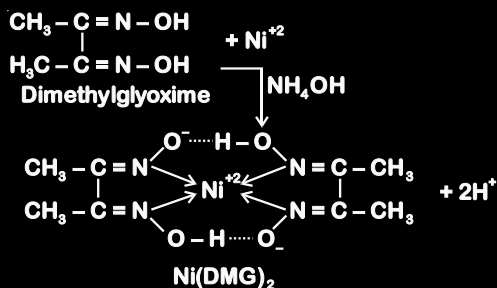
Identification of Ni^{+2} is carried out by dimethyl glyoxime in presence of NH_4OH

85. Answer (0)

$[Mn_2(CO)_{10}]$
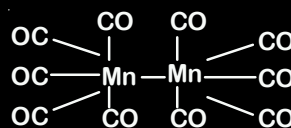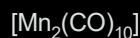
∴ No. of bridging CO ligands = 0

86. Answer (3)

Total number of stereoisomers possible for $[Co(OX)_2Br(NH_3)]^{2-}$ is 3.
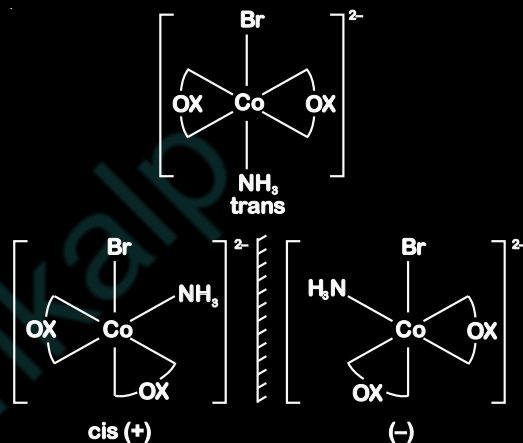
87. Answer (2)

$CoCl_3 \cdot 4NH_3 \Rightarrow$ trans-complex means octahedral with one Cl^- out of the coordination sphere i.e., $[Co(NH_3)_4Cl_2]Cl$. NH_3 are neutral ligands. Each ethylene diamine replaces two ammines ligands. So two ethylene diamine are required to replace all neutral monodentate (NH_3) ligands.

88. Answer (1)

(a) $(NH_4)_2 [Ce(NO_3)_6]$

  $Ce^{+4} = 4f^0$ (diamagnetic)

(b) $Gd(NO_3)_3$

  $Gd^{+3} = 4f^7$

  $\mu = \sqrt{7(7+2)}\ =\ \sqrt{63}$ B.M.

(c) $Eu(NO_3)_3$

  $Eu^{+3} = 4f^6$
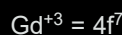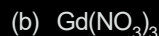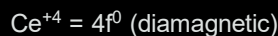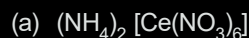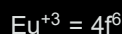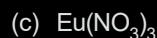
  $\mu = \sqrt{6(6+2)}\ =\ \sqrt{48}$ B.M.

∴ Order of spin only magnetic moment

= b > c > a

89. Answer (04)

Octahedral splitting energy = $\dfrac{hc}{\lambda}$

$= \dfrac{6.626 \times 10^{-34} \times 3 \times 10^{8}}{498 \times 10^{-9}}$

= 3.99 × 10⁻¹⁹ J

$\approx 4 \times 10^{-19}$

90. Answer (2)

(a) $[Co(NH_3)_6][Cr(CN)_6]$ → (iii) Coordination isomerism

(b) $[Co(NH_3)_3(NO_2)_3]$→ (i) Linkage isomerism

(c) $[Cr(H_2O)_6]Cl_3$ → (ii) Solvate isomerism

(d) cis-$[CrCl_2(ox)_2]^{3-}$ (iv) Optical isomerism

91. Answer (6)

$FeCl_3$ + oxalic acid $\xrightarrow{\text{KOH}}$ $\left[Fe(C_2O_4)_3\right]^{3-}$
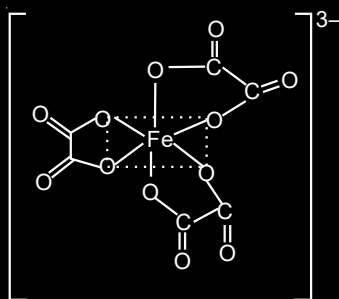
Coordination number = 6

Secondary valency is 6

92. Answer (1)

Chlorophyll - Mg

Vitamin - B_{12} - Co

Anticancer drug - Pt

93. Answer (3)
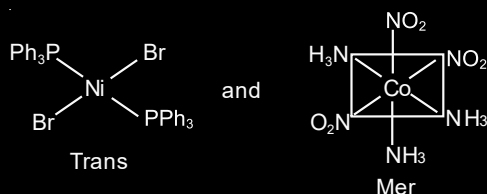
94. Answer (03)

$K_3[Cr(oxalate)_3]$

Oxidation state of Cr = +3

Electronic configuration of Cr^{+3} = [Ar] $3d^3$

∴ Number of unpaired electrons = 3

95. Answer (4)

Out of five H_2O molecules, four H_2O are the part of secondary valency and one H_2O is H-bonded.

96. Answer (3)

$K_2[Ni(CN)_4]$ → d^8 + strong field ligand
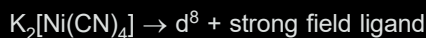
Ni^{2+}
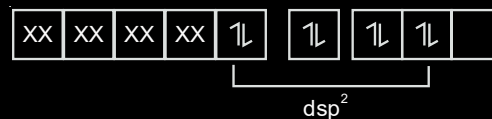
97. Answer (2)

CN^- is strong field ligand and cause pairing of electrons.
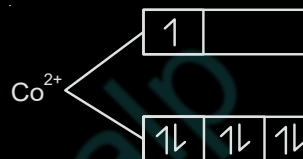
Spin only magnetic moment $(\mu) = \sqrt{n(n+2)}$ BM

$\mu = \sqrt{3} = 1.732$ BM

98. Answer (4)

Order of Intensity of colour is

$[NiCl_4]^{2-}$	>	$[Ni(H_2O)_6]^{2+}$	>	$[Ni(CN)_4]^{2-}$
→ d^8		d^8		d^8
→ Tetrahedral		Octahedral		Diamagnetic
→ High spin		High spin		
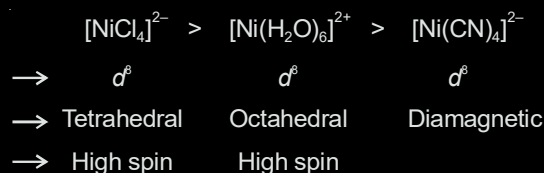
99. Answer (3)

The electronic configuration of Fe^{2+} is $3d^6 4s^0$. In presence of strong field ligand (L^{-1}) resulting in the formation of inner orbital octahedral complex the electronic configuration of Fe^{2+} would be

$[FeL_6]^{4-}$: $t_{2g}^6 e_g^o$

Magnetic moment, $\mu = 0$

d^2sp^3 hybridisation

100. Answer (2)

$NiCl_2(aq) \rightarrow [Ni(H_2O)_6]Cl_2$

$\quad\quad\quad\quad H_2O$: weak field ligand

$[Ni(H_2O)_6]Cl_2 \xrightarrow[\text{(excess)}]{\text{NaCN}} [Ni(CN)_6]^{2-}$

$Ni^{2+} \rightarrow sp^3d^2$ $\quad\quad\quad Ni^{4+} \rightarrow d^2sp^3$
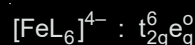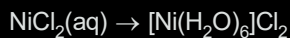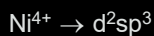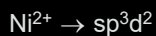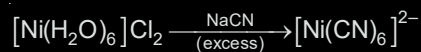
unpaired electrons $\quad\quad\quad d^6$

$\quad\quad = 2$ $\quad\quad\quad\quad$ number of unpaired

$\quad\quad\quad\quad\quad\quad\quad\quad$ electrons = 0

∴ Total change in number of unpaired electrons = 2
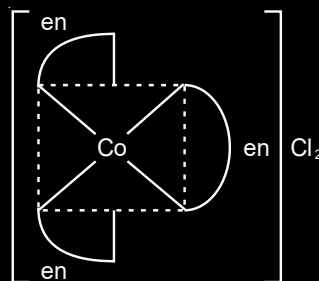
101. Answer (1)
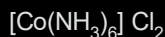
$[Co(NH_3)_6]Cl_2$

Co^{2+} • NH_3 is a strong field ligand

$\quad\quad$ • Pairing will occur

$Co^{2+} = 3d^7\ t_{2g}^6 \quad$ eg^1 $\quad$ 5s
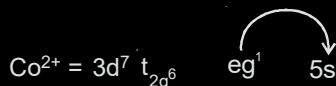
e⁻ from the eg orbital will get excited to 5s orbital hence the hybridisation will be d^2sp^3 with one unpaired e⁻

$[Co(NH_3)_6]Cl_3$ – d^2sp^3 hybridised with no unpaired e⁻

102. Answer (2)

CN⁻ and CO are strong field ligands and causes pairing of electrons. Whereas H_2O is weak field ligand so do not cause pairing, generally.
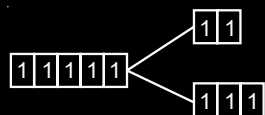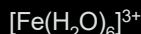
$[Fe(H_2O)_6]^{3+}$

So, $[Fe(H_2O)_6]^{3+}$ is paramagnetic. In the rest of the complexes no unpaired electron is present hence they are diamagnetic. Paramagnetic substances get weakly attracted by external magnetic field whereas diamagnetic gets weakly repelled.

103. Answer (0)

$[Cr(NH_3)_3(H_2O)_3]Cl_3 + AgNO_3$

$\quad\quad \longrightarrow 3AgCl(s) + [Cr(NH_3)_3(H_2O)_3](NO_3)_3$
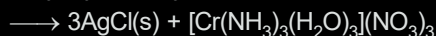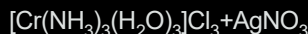
None of the chloride ion is directly bonded to metal ion. Hence number of chloride ions satisying the secondary valence of the metal ion is zero.

104. Answer (4)

Cyclic complexes, called chelates, are generally more stable than open chain complexes. Chelates having more number of cyclic rings are more stable than those having less number of cyclic rings.

∴ Of the given complexes $[Co(en)_3]Cl_2$ is most stable

105. Answer (4)

$[MnCl_6]^{3-} \Rightarrow Mn^{3+}$ with weak field ligand
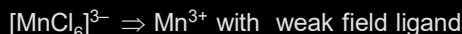
$\quad\quad\quad\quad\quad \Rightarrow$ high spin complex

Hence, it is sp^3d^2 with paramagnetic character.

106. Answer (3)

$[Pt\,Cl_2(NH_3)_2]$

$[Ni(CO)_4]$

$[Ru(H_2O)_3\,Cl_3]$

$[CoCl_2(NH_3)_4]^+$
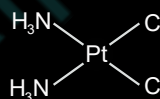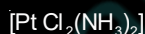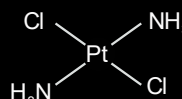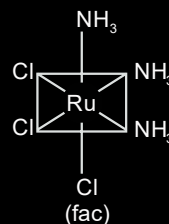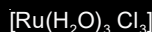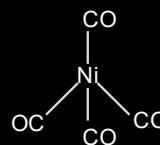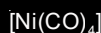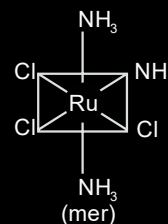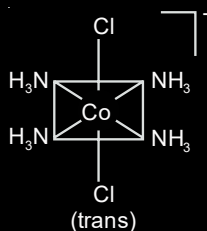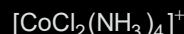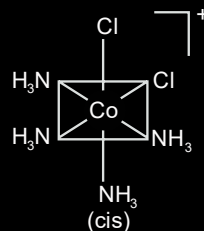
107. Answer (2)

Triamminetrinitrocobalt (III) $[Co(NH_3)_3(NO_2)_3]$

Trioxalatochromate (III) $[Co(ox)_3]^{3-}$

fac

mer

$x = 2$

$y = 0$

108. Answer (1)

$[Mn(CN)_6]^{3-}$

$Mn^{3+} \longrightarrow 3d^4 4s^0$

CN^- is a strong field ligand.

d^2sp^3

$[Co(C_2O_4)_3]^{3-} \longrightarrow d^2sp^3$ (0 unpaired electron)

$[Fe(CN)_6]^{3-} \longrightarrow d^2sp^3$ (1 unpaired electron)

Cl^- and F^- are weak field.

So, $[MnCl_6]^{3-} \longrightarrow sp^3d^2$ (4 unpaired electron)

$[FeF_6]^{3-} \longrightarrow sp^3d^2$ (5 unpaired electron)
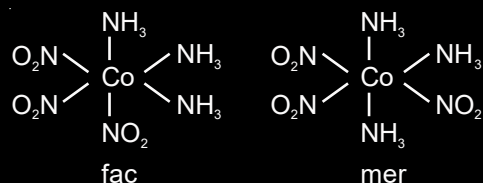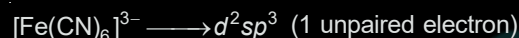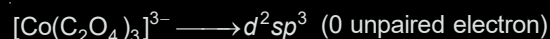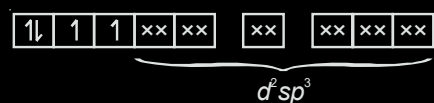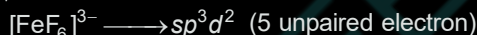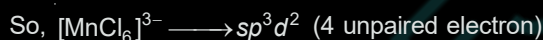
109. Answer (6)

Each mole of complex gives one mole of AgCl. Which indicates two chloride ions present in coordination sphere. So, the complex is $[Co(en)_2Cl_2]Cl$ having a coordination number of 6. Secondary valency is equal to the coordination number.

110. Answer (5)

Mohr salt $(NH_4)_2Fe(SO_4)_2 \cdot 6H_2O$

Potash alum $KAl(SO_4)_2 \cdot 12H_2O$

Ratio $= \dfrac{6}{12} = 0.5 = 5 \times 10^{-1}$

111. Answer (4)

CFSE value increases as the strength of the ligand increases also with increase in positive charge of central atom. According to spectrochemical series, the order of ligand strength is en > NH_3 >

$H_2O > F^-$. So, the CFSE value of the given complexes should be A < B < C < D. But as complex A contain cobalt in +3 OS. So A > B. Final order is B < A < C < D

112. Answer (2)

$[Co(CN)_5(NC)]^{3-}$ can not show geometrical isomerism

113. Answer (5)

$Cu^{2+} + 4NH_3 \rightleftharpoons [Cu(NH_3)_4]^{2+}$ $\quad K_S = 2.1 \times 10^{13}$

$[Cu(NH_3)_4]^{2+} \rightleftharpoons Cu^{2+} + 4NH_3$ $\quad K_d = \dfrac{1}{K_s}$
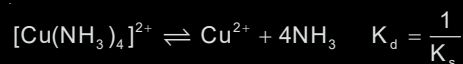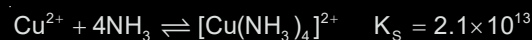
$K_d = \dfrac{1}{K_s} = \dfrac{10^{-13}}{2.1} = 4.76 \times 10^{-14}$

So nearest integer is 5.

114. Answer (1)

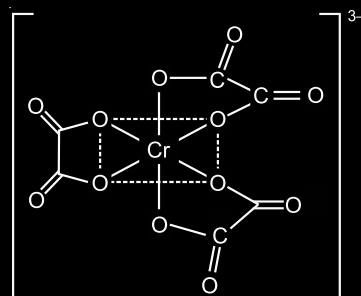$FeCl_3 + K_4[Fe(CN)_6] \longrightarrow \underset{\text{(Prussian blue)}}{KFe[Fe(CN)_6]} + 3KCl$

115. Answer (2)

1 mol of octahedral complex $MCl_3 2L$ on reaction with $AgNO_3$ gives 1 mol of AgCl
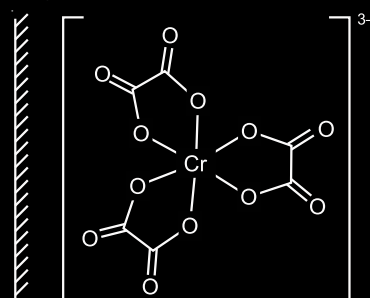
∴ Formula of complex is $[MCl_2 2L]Cl$

Since co-ordination number of M is 6, the denticity of L must be 2.
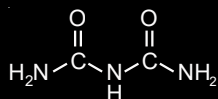
116. Answer (2)
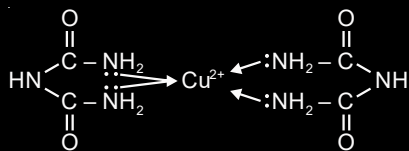

Complex is optically active

117. Answer (2)

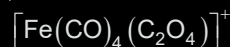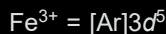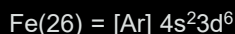Biuret ligand is

It forms complexes like

118. Answer (2)

$$\left[Fe(CO)_4(C_2O_4)\right]^+$$

oxidation state of iron in the given compound is

$X + 0 - 2 = +1$

$x = +3$

$Fe(26) = [Ar]\, 4s^2 3d^6$

$Fe^{3+} = [Ar]3d^5$

It is a low spin complex because of four strong CO ligand. So number of unpaired electron is 1.

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

$$= \sqrt{1(1+2)} = \sqrt{3} = 1.73 \text{ B.M.}$$

119. Answer (4)

$Co^{2+} = [Ar]\, 3d^7\, 4s^\circ$

in $[Co(H_2O)_6]^{2+}$, H_2O will behave as weak field ligand

$Co^{2+} = t_2g^5,\ eg^2$
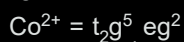
$CFSE = (-0.4 \times 5 + 2 \times 0.6)\,\Delta_0$

$\quad\quad = -0.8\,\Delta_0$
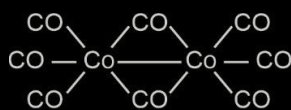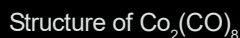
Co^{2+} has 3 unpaired e^-, $\mu = 3.87$ BM

120. Answer (2)

$[Ag(NH_3)_2]^+\,[Ag(CN)_2]^-$
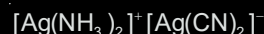
Oxidation state of Ag in both ions is +1.

121. Answer (2)

$[Cu(NH_3)_4]Cl_2$: Cu^{2+} : 1 unpaired electron; $\mu = 1.73$ BM

CuI : Cu^+ : No unpaired electron ; $\mu = 0$

O_2^- :   1 unpaired electron; $\mu = 1.73$ BM

O_2^+ :   1 unpaired electron; $\mu = 1.73$ BM

122. Answer (7)

Structure of $Co_2(CO)_8$
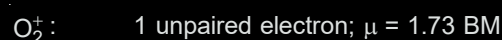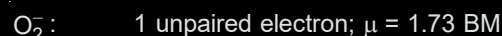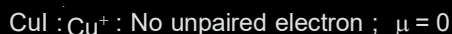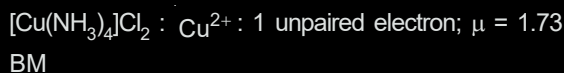

Number of Co – Co bonds = 1 = X

Number of terminal CO ligands = 6 = Y

$\therefore$ X + Y = 1 + 6 = 7

123. Answer (4)

Crystal field splitting (Δ_0) for octahedral complexes depends on oxidation state of the metal as well as to which transition series the metal belongs. For the same oxidation state, the crystal field splitting (Δ_0) increases as we move from $3d \to 4d \to 5d$. Cr^{3+} and Fe^{3+} belong to $3d$ series, Mo^{3+} belongs to $4d$ series and Os^{3+} belongs to $5d$ series. Therefore crystal field splitting (Δ_0) is highest for $[Os(H_2O)_6]^{3+}$.

124. Answer (765)

$[Cu(H_2O)_4]^{2+}$ is tetrahedral
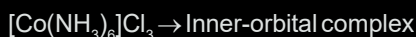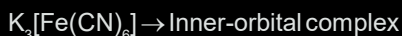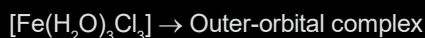
$[Cu(H_2O)_6]^{2+}$ is octahedral
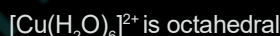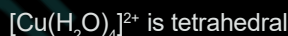
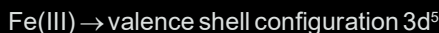$$\therefore\ \Delta_t = \frac{4}{9} \times \Delta_0$$

$$\Delta_t = \frac{6.63 \times 10^{-34} \times 3.08 \times 10^8}{600 \times 10^{-9}}$$

$$\Delta_0 = \frac{9}{4} \times \frac{6.63 \times 10^{-34} \times 3.08 \times 10^8}{600 \times 10^{-9}} \approx 765 \times 10^{-21}\ \text{J}$$
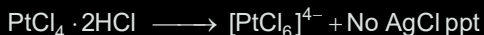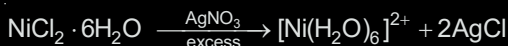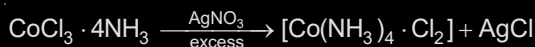
125. Answer (2)

$[Fe(H_2O)_3Cl_3] \to$ Outer-orbital complex

$K_3[Fe(CN)_6] \to$ Inner-orbital complex

$[Co(NH_3)_6]Cl_3 \to$ Inner-orbital complex

Since CN^- is a strong field ligand than NH_3. Hence $K_3[Fe(CN)_6]$ is the inner-orbital complex that absorbs light at shortest wavelength.

$Fe(III) \to$ valence shell configuration $3d^5$

Since CN^- will do pairing, so unpaired electron = 1

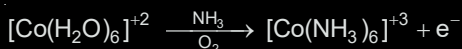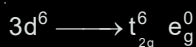$$\mu = \sqrt{1(1+2)} = \sqrt{3}\ \text{BM} \approx 2\ \text{BM}$$

126. Answer (3)

$$CoCl_3 \cdot 4NH_3 \xrightarrow[\text{excess}]{AgNO_3} [Co(NH_3)_4 \cdot Cl_2] + AgCl$$

$$NiCl_2 \cdot 6H_2O \xrightarrow[\text{excess}]{AgNO_3} [Ni(H_2O)_6]^{2+} + 2AgCl$$

$$PtCl_4 \cdot 2HCl \longrightarrow [PtCl_6]^{4-} + \text{No AgCl ppt}$$

$$[Ni^{+2}(H_2O)_6] = d^8 = t2_g^6 \ e_g^2 = 2 \text{ unpaired electrons}$$

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

$$= 2\sqrt{8} \approx 3$$

127. Answer (6)

$$[Co(H_2O)_6]^{+2} \xrightarrow[O_2]{NH_3} [Co(NH_3)_6]^{+3} + e^-$$

$$Co^{+3} \longrightarrow 3d^6$$

NH_3 is a strong field ligand.

$$3d^6 \longrightarrow t_{2g}^6 \ e_g^0$$

128. Answer (3)

The given complexes are:

$$[Ti(H_2O)_6]^{3+}, [Co(H_2O)_6]^{2+}, [Co(CN)_6]^{-3}, [Cu(NH_3)_4]^{2+}$$
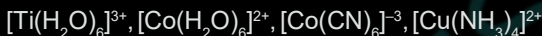
CN^- is the strongest ligand among the given complexes CFSE value for the $[Co(CN)_6]^{-3}$ complex will be highest as it has d^6 configuration with a CFSE value of $-2.40\,\Delta_0 + 2P$, where P represents pairing energy and Δ_0 represents splitting energy in octahedral field.

The value of Δ_0 is high for cyanide complexes.

129. Answer (2)

Coordination Compound	Number of unpaired e⁻ (n)	Magnetic moment (μ) (B.M)
A $[FeF_6]^{3-} - d^5$	5	5.91
B $[Fe(CN)_6]^{3-} - d^5$	1	1.73
C $[MnCl_6]^{3-} - d^4$	4	4.89
D $[Mn(CN)_6]^{3-} - d^4$	2	2.82

Hence, correct order of magnetic moment is 2 < 4 < 3 < 1

130. Answer (2)

$[Ni(CN)_4]^{2-}$ is square planar and diamagnetic with $\mu = 0$

its hybridisation is dsp^2

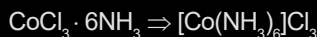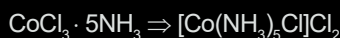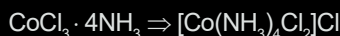$Ni(CO)_4$ is tetrahedral but diamagnetic.

131. Answer (3)

CO ligand shows synergic bonding, so all complexes can show synergic bonding.

132. Answer (2)

	Valence shell configuration	Magnetic nature
$[Fe(CN)_6]^{4-}$	$3d^6$ (Pairing)	Diamagnetic
$[Fe(CN)_6]^{3-}$	$3d^5$ (Pairing)	Paramagnetic
$[Ti(CN)_6]^{3-}$	$3d^1$	Paramagnetic
$[Ni(CN)_4]^{2-}$	$3d^8$ (Pairing)	Diamagnetic
$[Co(CN)_6]^{3-}$	$3d^6$ (Pairing)	Diamagnetic

133. Answer (1)

$$CoCl_3 \cdot 4NH_3 \Rightarrow [Co(NH_3)_4Cl_2]Cl$$

$$CoCl_3 \cdot 5NH_3 \Rightarrow [Co(NH_3)_5Cl]Cl_2$$
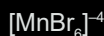
$$CoCl_3 \cdot 6NH_3 \Rightarrow [Co(NH_3)_6]Cl_3$$

Only $[Co(NH_3)_4Cl_2]$ can show geometrical isomerism. Hence can exist in cis-trans form.

134. Answer (3)

Statement I is true but statement II is false. Only oxygen atom forms Co-ordinate bond with Cu^{+2} in $CuSO_4.5H_2O$

135. Answer (6)

$[MnBr_6]^{-4}$

$x - 6 = -4$

$x = +2$ \qquad $Mn = 3d^5 4s^2$

$Mn^{+2} = 3d^5 4s^0$

$n = 5$

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

$$= \sqrt{35} \approx 6 \text{ B.M.}$$

136. Answer (5)

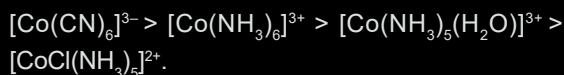$$[CoCl(NH_3)_5]Cl_2 \xrightarrow{AgNO_3} 2AgCl\downarrow$$
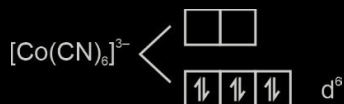
$x = 5$

137. Answer (0)

In all complexes, Co is present in +3 oxidation state and all complexes are low spin or inner orbital complex.

Stronger the ligand, higher the crystal field splitting.

So, order of crystal field splitting is

$[Co(CN)_6]^{3-} > [Co(NH_3)_6]^{3+} > [Co(NH_3)_5(H_2O)]^{3+} > [CoCl(NH_3)_5]^{2+}$.

Shortest wavelength is shown by complex having maximum crystal field splitting.

$[Co(CN)_6]^{3-}$
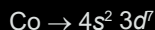

d^6

Spin only magnetic moment $= \sqrt{0(0+2)} = 0$ B.M

138. Answer (1)

Stronger is ligand attached to metal ion, greater will be the splitting between t_2g and eg (hence greater will be ΔU), $\therefore$ greater will be absorption of energy.
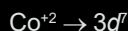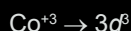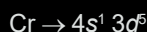
Hence correct order

$[Ni(en)_3]^{2+} > [Ni(NH_3)_6]^{2+} > [Ni(H_2O)_6]^{2+}$

139. Answer (0)

$Co \rightarrow 4s^2\, 3d^7$

H_2O is weak field ligand.

$Co^{+2} \rightarrow 3d^7$

$n = 3$ $\mu_1 = \sqrt{n(n+2)}$

                     $= \sqrt{15}$ B.M.

$Cr \rightarrow 4s^1\, 3d^5$

$Co^{+3} \rightarrow 3d^6$
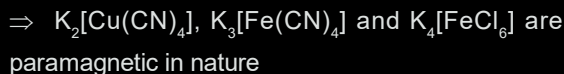
$n = 3$ $\mu_2 = \sqrt{15}$ B.M.

$\mu_1 - \mu_2 = 0$

140. Answer (1)

$\Rightarrow$ $K_3[Cu(CN)_4]$ is diamagnetic

$Cu(I) \Rightarrow d^{10}$ configuration $\Rightarrow$ No unpaired electrons.

$\Rightarrow$ $K_2[Cu(CN)_4]$, $K_3[Fe(CN)_4]$ and $K_4[FeCl_6]$ are paramagnetic in nature
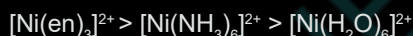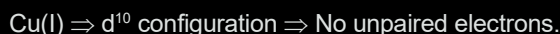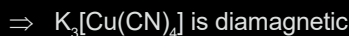
141. Answer (3)

In 1 : 1 type of electrolyte the ions have +1 and –1 charge on them

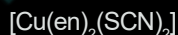$\therefore$ Possible compound is $\rightarrow [Co(NH_3)_4Cl_2]^+Cl^-$
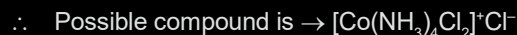
Oxidation state of central atom represents the total number of primary valency
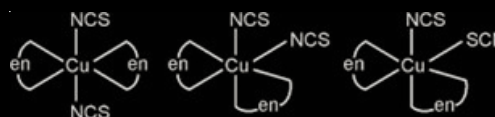
$\therefore$ Primary valency will be 3.

142. Answer (1)

Ligands like :CO, are sigma donor and π-acceptor and they make stronger bond with lower oxidation state metal ion, in this case back bonding is more effective
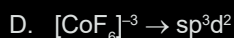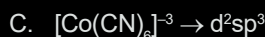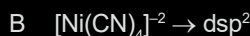
143. Answer (3)

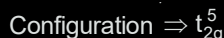$[Cu(en)_2(SCN)_2]$

Total isomers

144. Answer (2)

A. $Ni(CO)_4 \rightarrow sp^3$

B $[Ni(CN)_4]^{-2} \rightarrow dsp^2$

C. $[Co(CN)_6]^{-3} \rightarrow d^2sp^3$

D. $[CoF_6]^{-3} \rightarrow sp^3d^2$

145. Answer (2)

In $[Fe(CN)^6]^{3-}$, Fe is present in (+3) oxidation state Fe(III) $\Rightarrow$ inner orbital complex $\Rightarrow d^5$ (with pairing)

Configuration $\Rightarrow t_{2g}^5$

CFSE $= 5 \times \dfrac{-2}{5}\Delta_0 = -2\Delta_0$

146. **Answer (4)**

John teller distortion: Any non-linear compound remove its degeneracy to attain the stability.

Extent of John teller distortion depends upon metal ion as well as nature of ligand.

Stronger the ligand, more will be the John Teller distortion and more will be the stability.

Hence Trans $[Cu(en)_2Cl_2]$ will exhibit maximum John Teller distortion.

147. **Answer (9)**

Na $[Co(bpy)Cl_4]$

Oxidation state of cobalt = + 3

Coordination number of cobalt = 6

[As bpy is bidentate]

So, sum = 9

148. **Answer (2)**

Complex/compound	Hybridisation of central atoms
(A) $[PtCl_4]^{-2}$	(III) dsp^2
(B) BrF_5	(IV) sp^3d^2
(C) PCl_5	(I) sp^3d
(D) $[Co(NH_3)_6]^{+3}$	(II) d^2sp^3

Hence, the most appropriate answer is given in option (2)

❑ ❑ ❑