

Coordination Compounds

- Which of the following has an optical isomer?
[AIEEE-2009]
 (1) $[\text{Co}(\text{en})(\text{NH}_3)_2]^{2+}$ (2) $[\text{Co}(\text{H}_2\text{O})_4(\text{en})]^{3+}$
 (3) $[\text{Co}(\text{en})_2(\text{NH}_3)_2]^{3+}$ (4) $[\text{Co}(\text{NH}_3)_3\text{Cl}]^+$
- Which of the following pairs represents linkage isomers?
[AIEEE-2009]
 (1) $[\text{Pd}(\text{PPh}_3)_2(\text{NCS})_2]$ and $[\text{Pd}(\text{PPh}_3)_2(\text{SCN})_2]$
 (2) $[\text{Co}(\text{NH}_3)_5\text{NO}_3\text{SO}_4]$ and $[\text{Co}(\text{NH}_3)_5\text{SO}_4]\text{NO}_3$
 (3) $[\text{PtCl}_2(\text{NH}_3)_4]\text{Br}_2$ and $[\text{PtBr}_2(\text{NH}_3)_4]\text{Cl}_2$
 (4) $[\text{Cu}(\text{NH}_3)_4]\text{[PtCl}_4]$ and $[\text{Pt}(\text{NH}_3)_4]\text{[CuCl}_4]$
- Which one of the following has an optical isomer?
[AIEEE-2010]
 (1) $[\text{Zn}(\text{en})_2]^{2+}$ (2) $[\text{Zn}(\text{en})(\text{NH}_3)_2]^{2+}$
 (3) $[\text{Co}(\text{en})_3]^{3+}$ (4) $[\text{Co}(\text{H}_2\text{O})_4(\text{en})]^{3+}$
- A solution containing 2.675 g of $\text{CoCl}_3 \cdot 6\text{NH}_3$ (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) $[\text{CoCl}(\text{NH}_3)_5]\text{Cl}_2$ (2) $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$
 (3) $[\text{CoCl}_2(\text{NH}_3)_4]\text{Cl}$ (4) $[\text{CoCl}_3(\text{NH}_3)_3]$
- 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
- Which one of the following complex ions has geometrical isomers ?
[AIEEE-2011]
 (1) $[\text{Cr}(\text{NH}_3)_4(\text{en})]^{3+}$
 (2) $[\text{Co}(\text{en})_3]^{3+}$
 (3) $[\text{Ni}(\text{NH}_3)_5\text{Br}]^+$
 (4) $[\text{Co}(\text{NH}_3)_2(\text{en})_2]^{3+}$
- Which among the following will be named as dibromidobis (ethylene diamine) chromium (III) bromide?
[AIEEE-2012]
 (1) $[\text{Cr}(\text{en})_2\text{Br}_2]\text{Br}$ (2) $[\text{Cr}(\text{en})\text{Br}_4]^-$
 (3) $[\text{Cr}(\text{en})\text{Br}_2]\text{Br}$ (4) $[\text{Cr}(\text{en})_3]\text{Br}_3$
- Which of the following complex species is not expected to exhibit optical isomerism?
[JEE (Main)-2013]
 (1) $[\text{Co}(\text{en})_3]^{3+}$ (2) $[\text{Co}(\text{en})_2\text{Cl}_2]^+$
 (3) $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$ (4) $[\text{Co}(\text{en})(\text{NH}_3)_2\text{Cl}_2]^+$
- 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) $L_1 < L_2 < L_4 < L_3$
- The equation which is balanced and represents the correct product(s) is
[JEE (Main)-2014]
 (1) $\text{Li}_2\text{O} + 2\text{KCl} \rightarrow 2\text{LiCl} + \text{K}_2\text{O}$
 (2) $[\text{CoCl}(\text{NH}_3)_5]^+ + 5\text{H}^+ \rightarrow \text{Co}^{2+} + 5\text{NH}_4^+ + \text{Cl}^-$
 (3) $[\text{Mg}(\text{H}_2\text{O})_6]^{2+} + (\text{EDTA})^{4-} \xrightarrow{\text{excess NaOH}} [\text{Mg}(\text{EDTA})]^{2+} + 6\text{H}_2\text{O}$
 (4) $\text{CuSO}_4 + 4\text{KCN} \rightarrow \text{K}_2[\text{Cu}(\text{CN})_4] + \text{K}_2\text{SO}_4$
- The number of geometric isomers that can exist for square planar $[\text{Pt}(\text{Cl})(\text{py})(\text{NH}_3)(\text{NH}_2\text{OH})]^+$ is (py = pyridine)
[JEE (Main)-2015]
 (1) 2 (2) 3
 (3) 4 (4) 6
- Which one of the following complexes shows optical isomerism?
[JEE (Main)-2016]
 (1) cis $[\text{Co}(\text{en})_2\text{Cl}_2]\text{Cl}$
 (2) trans $[\text{Co}(\text{en})_2\text{Cl}_2]\text{Cl}$
 (3) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$
 (4) $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$
 (en = ethylenediamine)

13. On treatment of 100 mL of 0.1 M solution of $\text{CoCl}_3 \cdot 6\text{H}_2\text{O}$ with excess AgNO_3 ; 1.2×10^{22} ions are precipitated. The complex is [JEE (Main)-2017]
- $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_3$
 - $[\text{Co}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2 \cdot \text{H}_2\text{O}$
 - $[\text{Co}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl} \cdot 2\text{H}_2\text{O}$
 - $[\text{Co}(\text{H}_2\text{O})_3\text{Cl}_3] \cdot 3\text{H}_2\text{O}$
14. For 1 molal aqueous solution of the following compounds, which one will show the highest freezing point? [JEE (Main)-2018]
- $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_3$
 - $[\text{Co}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2 \cdot \text{H}_2\text{O}$
 - $[\text{Co}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl} \cdot 2\text{H}_2\text{O}$
 - $[\text{Co}(\text{H}_2\text{O})_3\text{Cl}_3] \cdot 3\text{H}_2\text{O}$
15. The oxidation states of Cr in $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$, $[\text{Cr}(\text{C}_6\text{H}_6)_2]$, and $\text{K}_2[\text{Cr}(\text{CN})_2(\text{O})_2(\text{O}_2)(\text{NH}_3)]$ respectively are [JEE (Main)-2018]
- +3, +4 and +6
 - +3, +2 and +4
 - +3, 0 and +6
 - +3, 0 and +4
16. Consider the following reaction and statements
 $[\text{Co}(\text{NH}_3)_4\text{Br}_2]^+ + \text{Br}^- \rightarrow [\text{Co}(\text{NH}_3)_3\text{Br}_3] + \text{NH}_3$
- Two isomers are produced if the reactant complex ion is a *cis*-isomer
 - Two isomers are produced if the reactant complex ion is a *trans*-isomer.
 - Only one isomer is produced if the reactant complex ion is a *trans*-isomer.
 - Only one isomer is produced if the reactant complex ion is a *cis*-isomer.
- The correct statements are: [JEE (Main)-2018]
- (I) and (II)
 - (I) and (III)
 - (III) and (IV)
 - (II) and (IV)
17. Two complexes $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$ (A) and $[\text{Cr}(\text{NH}_3)_6]\text{Cl}_3$ (B) are violet and yellow coloured, respectively. The incorrect statement regarding them is [JEE (Main)-2019]
- Δ_0 values of (A) and (B) are calculated from the energies of violet and yellow light, respectively
 - Both are paramagnetic with three unpaired electrons
 - Δ_0 value for (A) is less than that of (B)
 - Both absorb energies corresponding to their complementary colors
18. Homoleptic octahedral complexes of a metal ion ' M^{3+} ' 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]
- $\text{L}_1 < \text{L}_2 < \text{L}_3$
 - $\text{L}_3 < \text{L}_2 < \text{L}_1$
 - $\text{L}_3 < \text{L}_1 < \text{L}_2$
 - $\text{L}_2 < \text{L}_1 < \text{L}_3$
19. The complex that has highest crystal field splitting energy (Δ), is [JEE (Main)-2019]
- $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$
 - $\text{K}_2[\text{CoCl}_4]$
 - $\text{K}_3[\text{Co}(\text{CN})_6]$
 - $[\text{Co}(\text{NH}_3)_5(\text{H}_2\text{O})]\text{Cl}_3$
20. Wilkinson catalyst is (Et = C_2H_5) [JEE (Main)-2019]
- $[(\text{Ph}_3\text{P})_3\text{IrCl}]$
 - $[(\text{Ph}_3\text{P})_3\text{RhCl}]$
 - $[(\text{Et}_3\text{P})_3\text{IrCl}]$
 - $[(\text{Et}_3\text{P})_3\text{RhCl}]$
21. The total number of isomers for a square planar complex $[\text{M}(\text{F})(\text{Cl})(\text{SCN})(\text{NO}_2)]$ is [JEE (Main)-2019]
- 8
 - 12
 - 4
 - 16
22. The electrolytes usually used in the electroplating of gold and silver, respectively, are [JEE (Main)-2019]
- $[\text{Au}(\text{CN})_2]^-$ and $[\text{AgCl}_2]^-$
 - $[\text{Au}(\text{NH}_3)_2]^+$ and $[\text{Ag}(\text{CN})_2]^-$
 - $[\text{Au}(\text{CN})_2]^-$ and $[\text{Ag}(\text{CN})_2]^-$
 - $[\text{Au}(\text{OH})_4]^-$ and $[\text{Ag}(\text{OH})_2]^-$
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]
- Ionisation isomers
 - Coordination isomers
 - Geometrical isomers
 - 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]
- Ni^{2+}
 - Mn^{2+}
 - Fe^{2+}
 - Co^{2+}

25. The number of bridging CO ligand(s) and Co-Co bond(s) in $\text{Co}_2(\text{CO})_8$, 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 $\text{K}_4[\text{Th}(\text{C}_2\text{O}_4)_4(\text{OH}_2)_2]$ is

[JEE (Main)-2019]

- $(\text{C}_2\text{O}_4^{2-} = \text{Oxalato})$
 (1) 10 (2) 6
 (3) 14 (4) 8

27. The metal d-orbitals that are directly facing the ligands in $\text{K}_3[\text{Co}(\text{CN})_6]$ 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 $[\text{M}(\text{H}_2\text{O})_6]\text{Cl}_2$, 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. $\text{Mn}_2(\text{CO})_{10}$ 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^-

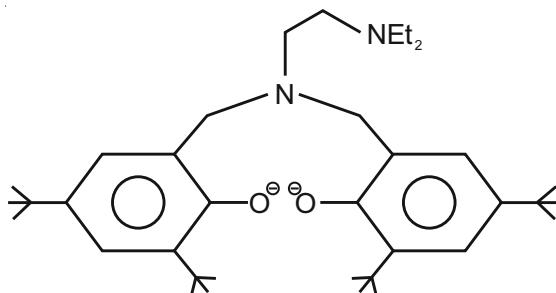
31. The correct order of the spin-only magnetic moment of metal ions in the following low-spin complexes, $[\text{V}(\text{CN})_6]^{4-}$, $[\text{Fe}(\text{CN})_6]^{4-}$, $[\text{Ru}(\text{NH}_3)_6]^{3+}$ and $[\text{Cr}(\text{NH}_3)_6]^{2+}$, is

[JEE (Main)-2019]

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

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- $[\text{Pt}(\text{Cl})_2(\text{NH}_3)_2]$ (2) trans- $[\text{Pt}(\text{Cl})_2(\text{NH}_3)_2]$
 (3) cis- $[\text{Pd}(\text{Cl})_2(\text{NH}_3)_2]$ (4) trans- $[\text{Pd}(\text{Cl})_2(\text{NH}_3)_2]$

34. The calculated spin-only magnetic moments (BM) of the anionic and cationic species of $[\text{Fe}(\text{H}_2\text{O})_6]_2^-$ and $[\text{Fe}(\text{CN})_6]^+$, 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

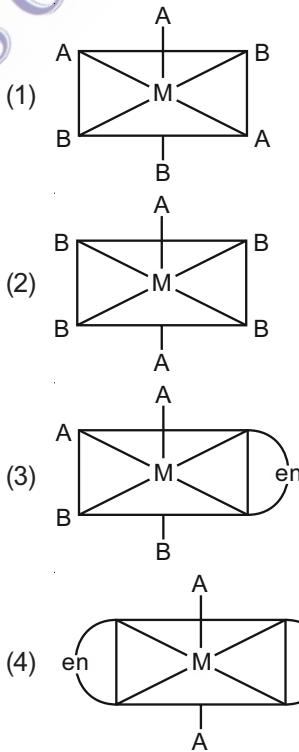
35. The number of water molecule(s) not coordinated to copper ion directly in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, is

[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 $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ 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}

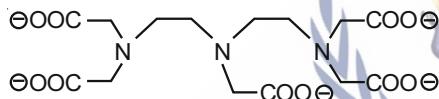
38. The correct statements among I to III are

- (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) $[\text{Zn}(\text{en})\text{Cl}_2]$ (2) $[\text{Pt}(\text{en})\text{Cl}_2]$
 (3) $[\text{Cr}(\text{en})_2(\text{ox})]^+$ (4) $[\text{Pt}(\text{en})_2\text{Cl}_2]^{2+}$

41. Three complexes, $[\text{CoCl}(\text{NH}_3)_5]^{2+}$ (I), $[\text{Co}(\text{NH}_3)_5\text{H}_2\text{O}]^{3+}$ (II) and $[\text{Co}(\text{NH}_3)_6]^{3+}$ (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 $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ are nearly similar.

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

(3) The spin-only magnetic moment of $[\text{Ni}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$ is 2.83 BM.

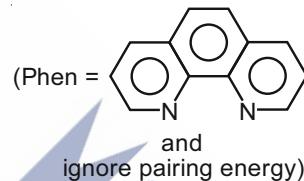
(4) The color of $[\text{CoCl}(\text{NH}_3)_5]^{2+}$ is violet as it absorbs the yellow light.

43. The crystal field stabilization energy (CFSE) of $[\text{Fe}(\text{H}_2\text{O})_6]\text{Cl}_2$ and $\text{K}_2[\text{NiCl}_4]$, 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

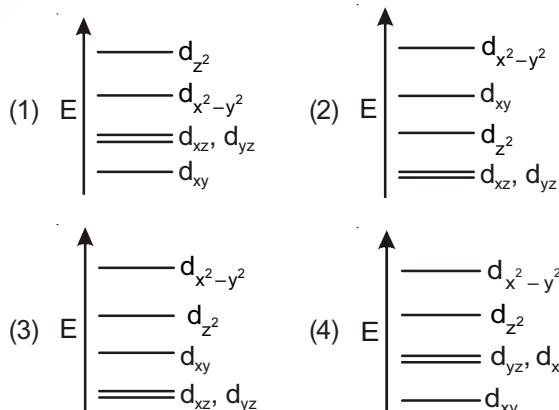


[JEE (Main)-2019]

- (1) $[\text{Ni}(\text{phen})_3]^{2+}$ (2) $[\text{Co}(\text{phen})_3]^{2+}$
 (3) $[\text{Zn}(\text{phen})_3]^{2+}$ (4) $[\text{Fe}(\text{phen})_3]^{2+}$

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 $[\text{Co}(\text{Cl})(\text{en})_2]\text{Cl}$ and $\text{K}_3[\text{Al}(\text{C}_2\text{O}_4)_3]$, 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 $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{NH}_2\text{CH}_3)]\text{Cl}$ is [JEE (Main)-2020]
- Diamminechlorido(methanamine)platinum (II) chloride
 - Diammine(methanamine)chloridoplatinum (II) Chloride
 - Bisamine(methanamine)chloridoplatinum (II) chloride
 - Diamminechlorido(aminomethane)platinum (II) chloride
48. The theory that can completely/properly explain the nature of bonding in $[\text{Ni}(\text{CO})_4]$ is [JEE (Main)-2020]
- Crystal field theory
 - Werner's theory
 - Valence bond theory
 - Molecular orbital theory
49. Among the statements (a)-(d), the incorrect ones are
- Octahedral Co(III) complexes with strong field ligands have very high magnetic moments
 - When $\Delta_0 < P$, the d-electron configuration of Co(III) in an octahedral complex is $t_{eg}^4 e_g^2$
 - Wavelength of light absorbed by $[\text{Co}(\text{en})_3]^{3+}$ is lower than that of $[\text{CoF}_6]^{3-}$
 - 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]
- (c) and (d) only
 - (a) and (d) only
 - (a) and (b) only
 - (b) and (c) only
50. The complex that can show *fac*-and *mer*-isomers is [JEE (Main)-2020]
- $[\text{CoCl}_2(\text{en})_2]$
 - $[\text{Co}(\text{NH}_3)_3(\text{NO}_2)_3]$
 - $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
 - $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$
51. The correct order of the calculated spin-only magnetic moments of complexes (A) to (D) is [JEE (Main)-2020]
- $\text{Ni}(\text{CO})_4$
 - $[\text{Ni}(\text{H}_2\text{O})_6]\text{Cl}_2$
 - $\text{Na}_2[\text{Ni}(\text{CN})_4]$
 - $\text{PdCl}_2(\text{PPh}_3)_2$
- [JEE (Main)-2020]
- $(\text{A}) \approx (\text{C}) \approx (\text{D}) < (\text{B})$
 - $(\text{C}) \approx (\text{D}) < (\text{B}) < (\text{A})$
 - $(\text{A}) \approx (\text{C}) < (\text{B}) \approx (\text{D})$
 - $(\text{C}) < (\text{D}) < (\text{B}) < (\text{A})$
52. Among (a) – (d), the complexes that can display geometrical isomerism are [JEE (Main)-2020]
- $[\text{Pt}(\text{NH}_3)_3\text{Cl}]^+$
 - $[\text{Pt}(\text{NH}_3)\text{Cl}_5]^-$
 - $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{NO}_2)]$
 - $[\text{Pt}(\text{NH}_3)_4\text{ClBr}]^{2+}$
- (c) and (d)
 - (a) and (b)
 - (b) and (c)
 - (d) and (a)
53. $[\text{Pd}(\text{F})(\text{Cl})(\text{Br})(\text{I})]^{2-}$ has n number of geometrical isomers. Then, the spin-only magnetic moment and crystal field stabilisation energy [CFSE] of $[\text{Fe}(\text{CN})_6]^{n-6}$, respectively, are [Note : Ignore the pairing energy] [JEE (Main)-2020]
- 0 BM and $-2.4 \Delta_0$
 - 5.92 BM and 0
 - 1.73 BM and $-2.0 \Delta_0$
 - 2.84 BM and $-1.6 \Delta_0$
54. Complex X of composition $\text{Cr}(\text{H}_2\text{O})_6\text{Cl}_n$ 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]
- Tetraaquadichlorido chromium(III) chloride dihydrate
 - Hexaaqua chromium(III) chloride
 - Tetraaquadichlorido chromium(IV) Chloride dihydrate
 - Dichloridotetraqua chromium(IV) chloride dihydrate
55. The correct order of the spin-only magnetic moments of the following complexes is :
- $[\text{Cr}(\text{H}_2\text{O})_6]\text{Br}_2$
 - $\text{Na}_4[\text{Fe}(\text{CN})_6]$
 - $\text{Na}_3[\text{Fe}(\text{C}_2\text{O}_4)_3](\Delta_0 > P)$
 - $(\text{Et}_4\text{N})_2[\text{CoCl}_4]$
- [JEE (Main)-2020]
- $(\text{I}) > (\text{IV}) > (\text{III}) > (\text{II})$
 - $(\text{III}) > (\text{I}) > (\text{IV}) > (\text{II})$
 - $(\text{II}) \approx (\text{I}) > (\text{IV}) > (\text{III})$
 - $(\text{III}) > (\text{I}) > (\text{II}) > (\text{IV})$

56. The isomer(s) of $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]$ 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 be low spin.
- (III) With strong field ligands, Mn(II) complexes can be low spin.
- (IV) Aqueous solution of Mn(II) ions is yellow in colour.

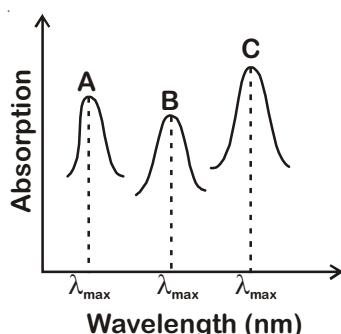
The correct statements are : [JEE (Main)-2020]

- (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



- (i) $[\text{M}(\text{NCS})_6]^{(-6+n)}$
 - (ii) $[\text{MF}_6]^{(-6+n)}$
 - (iii) $[\text{M}(\text{NH}_3)_6]^{n+}$
- [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) $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
- (2) $[\text{Ni}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$
- (3) $[\text{Ni}(\text{en})_3]^{2+}$
- (4) $[\text{Ni}(\text{NH}_3)_2\text{Cl}_2]$

61. The electronic spectrum of $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ shows a single broad peak with a maximum at $20,300 \text{ cm}^{-1}$. The crystal field stabilization energy (CFSE) of the complex ion, in kJ mol^{-1} , is

- (1) $1 \text{ kJ mol}^{-1} = 83.7 \text{ cm}^{-1}$ [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*- $[\text{Fe}(\text{NH}_3)_2(\text{CN})_4]^-$
- (2) *trans*- $[\text{Cr}(\text{Cl}_2)(\text{ox})_2]^{3-}$
- (3) *trans*- $[\text{Fe}(\text{NH}_3)_2(\text{CN})_4]^-$
- (4) *cis*- $[\text{CrCl}_2(\text{ox})_2]^{3-}$ (ox = oxalate)

63. The d-electron configuration of $[\text{Ru}(\text{en})_3]\text{Cl}_2$ and $[\text{Fe}(\text{H}_2\text{O})_6]\text{Cl}_2$, 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 $\text{H}_{12}\text{O}_6\text{Cl}_3\text{Cr}$. 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) $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$
- (2) $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl} \cdot 2\text{H}_2\text{O}$
- (3) $[\text{Cr}(\text{H}_2\text{O})_3\text{Cl}_3] \cdot 3\text{H}_2\text{O}$
- (4) $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2 \cdot \text{H}_2\text{O}$

65. The number of isomers possible for $[\text{Pt}(\text{en})(\text{NO}_2)_2]$ 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]

 - $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{CoCl}_4]^{2-}$
 - $[\text{Co}(\text{OH})_4]^{2-}$ and $[\text{Fe}(\text{NH}_3)_6]^{2+}$
 - $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{Cr}(\text{H}_2\text{O})]^{2+}$
 - $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$

67. The one that can exhibit highest paramagnetic behaviour among the following is
gly = glycinate; bpy = 2, 2'-bipyridine
[JEE (Main)-2020]

 - $[\text{Fe}(\text{en})(\text{bpy})(\text{NH}_3)_2]^{2+}$
 - $[\text{Pd}(\text{gly})_2]$
 - $[\text{Co}(\text{OX})_2(\text{OH})_2]^-$ ($\Delta_0 > P$)
 - $[\text{Ti}(\text{NH}_3)_6]^{3+}$

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

 - XeF_4
 - $[\text{Ni}(\text{CN})_4]^{2-}$
 - $[\text{CrF}_6]^{3-}$
 - 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]

 - $-1.6 \Delta_0$ and $-0.4 \Delta_t$
 - $-2.4 \Delta_0$ and $-0.6 \Delta_t$
 - $-0.4 \Delta_0$ and $-0.27 \Delta_t$
 - $-0.4 \Delta_0$ and $-0.6 \Delta_t$

70. Consider the complex ions,
trans- $[\text{Co}(\text{en})_2\text{Cl}_2]^+$ (A) and cis- $[\text{Co}(\text{en})_2\text{Cl}_2]^+$ (B).
The correct statement regarding them is
[JEE (Main)-2020]

 - both (A) and (B) can be optically active.
 - both (A) and (B) can not be optically active.
 - (A) can not be optically active, but (B) can be optically active.
 - (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]**

 - $[\text{MnBr}_4]^{2-}$ (T_d)
 - $[\text{NiCl}_4]^{2-}$ (T_d)
 - $\text{Ni}(\text{CO})_4$ (T_d)
 - $[\text{Ni}(\text{CN})_4]^{2-}$ (square planar)

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

 - $t_{2g}^4 e_g^0$ when $\Delta_0 < P$
 - $t_{2g}^3 e_g^1$ when $\Delta_0 > P$
 - $e_g^2 t_{2g}^2$ when $\Delta_0 < P$
 - $t_{2g}^3 e_g^1$ 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 _____.
 $\text{Na}_4[\text{Fe}(\text{CN})_5(\text{NOS})]$ (A) $\text{Na}_4[\text{FeO}_4]$ (B) $[\text{Fe}_2(\text{CO})_9]$ (C)
[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 $[\text{Ru}(\text{H}_2\text{O})_6]^{2+}$ 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 $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ is _____.
 $M[\text{Co}(\text{NH}_3)_6]\text{Cl}_3 = 267.46 \text{ g/mol}$
 $M\text{AgNO}_3 = 169.87 \text{ g/mol}$ **[JEE (Main)-2020]**