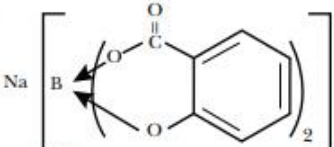


Coordination Compounds

SINGLE CORRECT CHOICE TYPE QUESTIONS

- Which of the following is the correct match between IUPAC name and complex?
 (A) Hexa- μ -acetato(O,O')- μ_4 -oxido-tetra-beryllium(II) : $[Be_4O(CH_3COO)_6]$
 (B) μ -amido-decaamminecobalt(III) nitrate: $[(NH_3)_5CoNH_2Co(NH_3)_5](NO_3)_3$
 (C) Pentaamminechloridoplatinum (IV) ammine-pentachloridoplatinate (IV): $[Pt(NH_3)_5Cl][PtCl_5(NH_3)]$
 (D) Hydrogen hexfluoridosilicate (IV) acid: $H_2[SiF_6]$
- Which of the following options represents the oxidation state of Co and Cr in the given complex? $[Co(NH_3)_4(NO_2)_2][Cr(NH_3)_3(NO_2)_3]$
 (A) 2, 3 (B) 3, 2
 (C) 3, 3 (D) 2, 2
- Which of the following complexes does not show optical activity?
 (A) $[Co(EDTA)]^-$ (B) $[Pt(bn)_2]^{2+}$
 (C) $[Pt(pn)_2]^{2+}$ (D) $[Pt(en)_2]^{2+}$
- Which of the following is not correctly matched? (P : Pairing energy)
 (A) $[Co(H_2O)_6]^{3+}$: $\Delta_o < P$: Paramagnetic
 (B) $[NiF_6]^{2-}$: $\Delta_o < P$: Diamagnetic
 (C) $[RhF_6]^{3-}$: $\Delta_o > P$: Diamagnetic
 (D) $[Fe(NH_3)_6]^{2+}$: $\Delta_o < P$: Paramagnetic
- What is the difference in the EAN value of metal in the complexes sodium pentacyanonitrosylferrate (II) and pentaamminecyanocobalt (II) ion?
 (A) 1 (B) 2
 (C) Cannot be predicted (D) None of these
- Which of the following statements is incorrect?
 (A) According to Werner's coordination theory, secondary valencies of central metal atom is fixed towards a particular ligand.
 (B) C_2H_4 and NO act as non-classical ligand.
 (C) The bond order of O_2 is 2 and it is colourless gas and paramagnetic in nature.
 (D) In PF_3 , the P-F bond order decreases when PF_3 forms complex with a metal and shows synergic bonding.
- Which of the following statements is incorrect?
 (A) $[Fe(EDTA)]^-$ is diamagnetic and optically active.
 (B) Nitro triacetate(nta^{3-}) is tetradentate ligand.
 (C) $[Mn(CO)_5]$ gets stabilized through dimerization.
 (D) $[Mn(CO)_5]$ gets stabilized by reduction.
- Which of the following complex has low spin?
 (A) $K_2[Fe(CN)_6]$
 (B) $K_3[Fe(CN)_6]$
 (C) $K_3[Co(ox)_3]$
 (D) All of these
- Which of the following complex is optically inactive but its other geometrical isomer is optically active?
 (A) *trans*-tetraaquadichloridocobalt (III) nitrate
 (B) *mer*-triaquatrifluoridocobalt (III)
 (C) *trans*-diamminebis (ethane 1, 2 diamine) cobalt (III) chloride
 (D) *trans*-diamminedichloridoplatinum (II)
- Which of the following complexes is colourless?
 (A) MnO_4^-
 (B) $[Ni(H_2O)_6]^{2+}$
 (C) $[Cu(CH_3CN)_4]^+$
 (D) $[Cr(H_2O)_6]^{3+}$
- The correct statement is
 (A) $[NiCl_4]^{2-}$ is sp^3 hybridized and paramagnetic in nature.
 (B) $[PtCl_4]^{2-}$ is dsp^2 hybridized and paramagnetic in nature.
 (C) $[Ni(CO)_4]$ is dsp^2 hybridized and diamagnetic in nature.
 (D) $[Co(H_2O)_6]^{3+}$ is sp^3d^2 hybridized and diamagnetic in nature.
- Which of the following complex is most stable?
 (A) $[Co(H_2O)_6]Cl_3$
 (B) $K_3[Co(CN)_6]$
 (C) $K_3[Co(ox)_3]$
 (D) $K_3[CoF_6]$
- The geometries of $[Co(CO)_4]^-$ and $[Cd(CN)_4]^{2-}$ are
 (A) both square planar.
 (B) both tetrahedral.
 (C) tetrahedral and square planar, respectively.
 (D) square planar and tetrahedral, respectively.
- Which of the following species exists as optically inactive form?
 (A) $[Fe(en)_3]Cl_3$
 (B) $[RhCl(PPh_3)(CO)(H_2O)]$
 (C) $[Pd(en)_2Cl_2]$
 (D) 
- Which of the following ligands can act as chelating agent but does not have a chiral centre?
 (A) nta^{3-} (B) bn
 (C) pn (D) None of these
- Which type of isomerism may be shown by the complex $[Ru(NH_3)_4(H_2O)(S_2O_3)]NO_3$?
 (A) Ionization isomerism
 (B) Linkage isomerism
 (C) Geometrical isomerism
 (D) All of these
- Select correct statement about this complex $[Pt(ox)(py)_2(O_2)(H_2O)]$
 (A) Oxidation state of O_2 is -1.
 (B) EAN of Pt is 86.
 (C) Complex will show geometrical as well as optical isomerism.
 (D) Both (B) and (C).

18. Select the incorrect statement about metal carbonyl complex compounds.

(A) Metal-carbon bonds in metal carbonyls possess both σ and π character.
 (B) Due to synergic, bonding metal-carbon bond becomes weak.
 (C) Due to synergic bonding carbon-oxygen bond strength decreases.
 (D) In metal carbonyls the extent of synergic bonding will increase with increase in negative charge on central metal ion.

19. In which of the following complexes, spin only magnetic moment is independent of the nature of ligand? (L = monodentate ligand)

(A) $[\text{NiL}_4]$ (B) $[\text{CoL}_6]$

(C) $[\text{FeL}_6]$ (D) $[\text{CrL}_6]$

20. Match the complexes with their characteristics.

Column-I	Column-II
(P) $[\text{Ni}(\text{CN})_2]^{2-}$	(1) Spin magnetic moment = $\sqrt{8}$ BM
(Q) $\text{Fe}(\text{CO})_5$	(2) sp^3 hybridized state of central metal
(R) $[\text{MnBr}_4]^{2-}$	(3) dsp^2 hybridized state of central metal
(S) $[\text{Ni}(\text{NH}_3)_6]^{2+}$	(4) Trigonal bipyramidal complex

Code:

	P	Q	R	S
(A)	3	4	1	2
(B)	3	4	2	1
(C)	1	4	3	2
(D)	2	4	3	1

21. Which of the following statements is correct for the complex $[\text{Fe}(\text{H}_2\text{O})_5\text{NO}]\text{SO}_4$?

(A) The EAN value of Fe in this complex depends on the charge of NO ligand.
 (B) The EAN value of Fe in this complex does not depend on the charge of NO ligand.
 (C) The hybridization of the central atom is d^2sp^3 .
 (D) It is paramagnetic with $\mu = 1.73$ B.M.

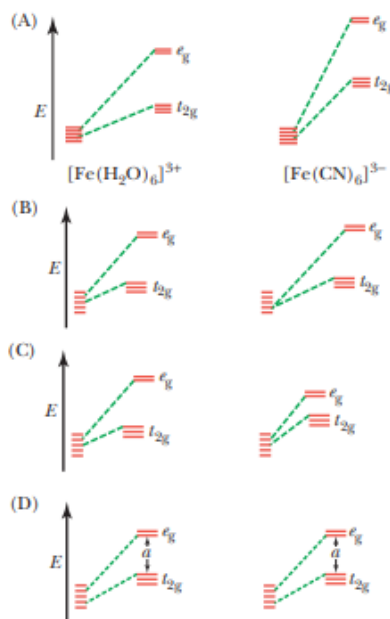
22. The EAN value of $[\text{Ti}(\sigma\text{-C}_5\text{H}_5)_2(\pi\text{-C}_5\text{H}_5)_2]^0$ is

(A) 32
 (B) 33
 (C) 34
 (D) 35

23. Which of the following ligands can show linkage isomerism?

(A) NO
 (B) NH_3
 (C) NO_3^-
 (D) None of these.

24. Which of the splitting patterns is correct for $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{Fe}(\text{CN})_6]^{3-}$ respectively?



25. In $[\text{isothiocyanatothiocyanato}(1\text{-diphenylphosphino-3-dimethylaminopropane})\text{palladium(II)}]$, the Pd-NCS combination is linear while the Pd-SCN combination is bent with the $\angle \text{Pd-S-C}$ of 107.3° . Predict the structure adopted for SCN^- group in this complex.

(A) $\text{S}-\text{C}\equiv\text{N}$:
 (B) $\text{S}=\text{C}=\text{N}$
 (C) Hybrid of (A) and (B).
 (D) Cannot be predicted.

26. Choose the correct order for Δ_o for the following complexes.

I: $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ II: $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$
 III: $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ IV: $[\text{Fe}(\text{CN})_6]^{3-}$

(A) $\text{I} < \text{II} < \text{III} < \text{IV}$
 (B) $\text{I} < \text{III} < \text{II} < \text{IV}$
 (C) $\text{I} < \text{II} = \text{III} < \text{IV}$
 (D) $\text{I} < \text{II} < \text{IV} < \text{III}$

27. $[\text{Fe}(\text{H}_2\text{O})_4(\text{CN})_2]$ is the empirical formula of a compound which has a magnetic moment corresponding to $2\frac{3}{2}$ unpaired electrons per iron. The best possible formula of the compound is

(A) $[\text{Fe}(\text{H}_2\text{O})_4(\text{CN})_2]_2[\text{Fe}(\text{H}_2\text{O})_4(\text{CN})_2]$
 (B) $[\text{Fe}(\text{H}_2\text{O})_6][\text{Fe}(\text{H}_2\text{O})_2(\text{CN})_4]$
 (C) $[\text{Fe}(\text{H}_2\text{O})_6]_2[\text{Fe}(\text{CN})_6]$
 (D) None of these.

28. Which of the following statements is true for the compounds: $[\text{CoF}_6]^{3-}$ (I) and $[\text{NiF}_6]^{2-}$ (II)?

(A) Both I and II are paramagnetic.
 (B) Both I and II are diamagnetic.
 (C) I is paramagnetic while II is diamagnetic.
 (D) I is diamagnetic while II is paramagnetic.

29. The correct order of C-C bond length in the following compounds is:

(I) C_2F_4 (II) C_2H_4 (III) $[\text{PtCl}_3(\text{C}_2\text{H}_4)]^-$
 (A) $\text{I} > \text{II} > \text{III}$
 (B) $\text{I} < \text{II} < \text{III}$
 (C) $\text{I} > \text{III} > \text{II}$
 (D) $\text{I} > \text{II} = \text{III}$

30. Which of the following statements is incorrect?
 (A) CN^- is a weaker π -acceptor than CO
 (B) The Fe – C bond length is more in $[\text{Fe}(\text{CN})_6]^{4-}$ as compared to that in $[\text{Fe}(\text{CN})_6]^{3-}$
 (C) The Fe – C bond length is less in $[\text{Fe}(\text{CN})_6]^{4-}$ as compared to that in $[\text{Fe}(\text{CN})_6]^{3-}$
 (D) The $d_{\text{Fe-O}}$ [in $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$] < $d_{\text{Fe-O}}$ [in $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$]
31. The V–C distances in $\text{V}(\text{CO})_6$ and $[\text{V}(\text{CO})_6]^-$ are respectively (in pm)
 (A) 200, 200 (B) 193, 200
 (C) 200, 193 (D) 193, 193
32. Which of the following complexes contains a cationic ligand?
 (A) $[\text{Ni}(\eta^5\text{-C}_5\text{H}_5)_2]^+$
 (B) $[\text{V}(\eta^6\text{-C}_7\text{H}_8)(\eta^7\text{-C}_7\text{H}_7)]^+$
 (C) $[\text{Fe}(\text{CO})_2(\text{NO})_2]^0$
 (D) None of these.
33. Which of the following compounds can show *cis-trans* isomerism?
 (A) $[\text{Ni}(\eta^3\text{-C}_3\text{H}_5)_2]^0$ (B) $[\text{Zn}(\text{gly})_2]^0$
 (C) $[\text{Pd}(\text{acac})_2]^0$ (D) None of these.
34. Which among the following statements is correct regarding the bonding of Pt and C_2H_4 in Zeise's salt?
 (I) It involves σ -donation from the π -orbital of alkene into vacant metal hybrid orbital.
 (II) It involves π -donation from the π -orbital of alkene into vacant metal hybrid orbital.
 (III) It involves π -back donation from the filled metal d -orbital (or hybrid) into the vacant antibonding orbital of alkene.
 (A) I, II and III (B) I and III
 (C) II and III (D) III only
35. Which of the following compounds is resolvable into d or l forms?
 (A) $[\text{Zn}(\text{acac})_2]^0$ (B) $[\text{B}(\text{C}_6\text{H}_5)_3]^0$
 (C) $[\text{B}(\text{C}_6\text{H}_5)_3\text{CH}_3]^0$ (D) $[\text{PdCl}_2(\text{en})]^0$

MULTIPLE CORRECT CHOICE TYPE QUESTIONS

1. Which of the following bidentate ligand(s) has similar donor atoms?
 (A) py (B) bn
 (C) en (D) gly⁻
2. Consider the formation of the following metal carbonyl complex.

$$\text{Ni} + 4\text{CO} \rightarrow [\text{Ni}(\text{CO})_4]$$

carbon
(Y)
monoxide

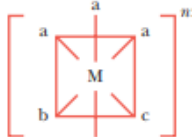
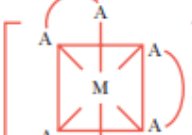
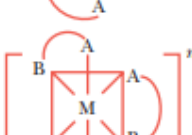
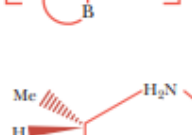
 Select the correct statement(s) about compound Y.
 (A) Compound Y has no counter ion.
 (B) Four monodentate uninegative ligands are connected with central metal ion.
 (C) This compound produces two ions in its aqueous solution.
 (D) Total number of electrons remains the same during the formation of compound Y.
3. Which of the following statement(s) is/are correct?
 (A) $\text{Ni}(\text{CO})_4$ is diamagnetic and sp^3 hybridized.
 (B) Complex $[\text{Cu}(\text{CN})_4]^{3-}$ is paramagnetic and Cu^{2+} ion is dsp^2 hybridized.
 (C) $[\text{MnBr}_4]^{2-}$ ion is paramagnetic and sp^3 hybridized.
 (D) Vaska's catalyst, that is, $[\text{IrCl}(\text{CO})(\text{PPh}_3)_2]$ is diamagnetic and Ir^+ ion is dsp^2 hybridized.
4. Which of the following chemical species can act a non-classical ligand(s)?
 (A) CO (B) C_2H_4
 (C) NO^+ (D) PR_3
5. Which of the following is/are characteristic of ferrocene?
 (A) Cyclopentadienyl act as a π -donor ligand.
 (B) Fe is in (+2) oxidation state.
 (C) It is organometallic compound.
 (D) It has a metal–carbon bond.
6. Which of the following chemical species is/are diamagnetic as well as coloured?
 (A) Hexafluoridoferrate(III) ion
 (B) Permanganate ion
 (C) Brown ring complex
 (D) Chromate ion
7. In case of $[\text{Mn}(\text{NH}_3)_6]^{2+}$
 (A) relation in between Δ_0 and P is $\Delta_0 < P$.
 (B) two unpaired electrons are present in axial d -orbital of Mn^{2+} .
 (C) hybridization of central metal atom of complex is d^2sp^3 .
 (D) d -orbitals involved in hybridization of central atom are d_{xz} and d_{yz} .
8. $[\text{Pt}(\text{NH}_3)_4][\text{PtCl}_3(\text{NH}_3)_2]$ is the polymerization isomer of which of the following compounds?
 (A) *cis* - $[\text{PtCl}_2(\text{NH}_3)_2]$
 (B) *trans* - $[\text{PtCl}_2(\text{NH}_3)_2]$
 (C) $[\text{Pt}(\text{NH}_3)_3\text{Cl}][\text{PtCl}_4]$
 (D) None of these.
9. Which of the following types of isomerism is/are possible for the compound $[\text{Co}(\text{Cl})(\text{en})_2(\text{NH}_2\text{-C}_6\text{H}_4\text{-Me})]\text{Cl}_2$?
 (A) Geometrical isomerism
 (B) Linkage isomerism
 (C) Optical isomerism
 (D) Ligand isomerism
10. Which of the following pairs of compounds has the same EAN value but does not obey Sidgwick EAN rule?
 (A) $\text{Fe}(\text{CO})_5$, $\text{Ni}(\text{CO})_4$
 (B) $[\text{Fe}(\text{NH}_3)_6]^{2+}$, $[\text{Cr}(\text{C}_2\text{O}_4)_3]^{3-}$
 (C) $[\text{Fe}(\text{H}_2\text{O})_5\text{NO}]^{2+}$, $[\text{Mn}(\text{CO})_6]$
 (D) $[\text{Ti}(\text{CO})_6]$, $[\text{Mn}(\text{C}_2\text{O}_4)_3]^{3-}$
11. Which of the following statements is/are correct for ferrocene?
 (A) The dipole moment of the eclipsed form of ferrocene is zero.
 (B) The dipole moment of the staggered form of ferrocene is non-zero.
 (C) All C atoms are equidistant from Fe^{2+} ion.
 (D) Synergic bonding takes place in the π^* orbital of C atoms.

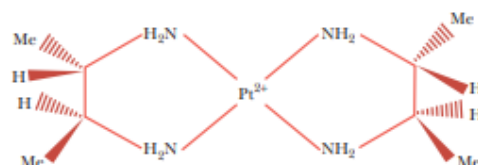
12. Which of the following IUPAC names is/are correct for the complex $[\text{Co}(\text{NH}_3)_2(\text{tn})(\sigma\text{-C}_3\text{H}_5)_2]\text{NO}_3$?
- (A) Diallyldiamminetrimethylenediaminecobalt (III) nitrate.
 (B) 1,3-Diaminopropanediamminediallylcobalt (III) nitrate
 (C) Diammine-1,3-diaminopropanedicyclopropyl cobalt (III) nitrate.
 (D) Diallyldiammine-1,3-diaminopropanecobalt (III) nitrate.
13. A complex compound consists of 1 mole of Co^{3+} ion, 6 moles of NH_3 , 6 moles of NO_2^- and 1 mole of Cr^{3+} ion. The complex has neither the highest value nor the lowest value of electrical conductivity. The possible formulae for the complex is/are
- (A) $[\text{Cr}(\text{NH}_3)_5(\text{NO}_2)][\text{Co}(\text{NH}_3)(\text{NO}_2)_5]$
 (B) $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{NO}_2)_6]$
 (C) $[\text{Cr}(\text{NH}_3)_4(\text{NO}_2)_2][\text{Co}(\text{NH}_3)_2(\text{NO}_2)_4]$
 (D) $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)][\text{Cr}(\text{NH}_3)(\text{NO}_2)_5]$
14. Which of the following complexes is/are square planar?
- (A) $[\text{AgF}_4]^-$
 (B) $[\text{AuCl}_4]^-$
 (C) $[\text{NiCl}_2(\text{PPh}_3)_2]$
 (D) $[\text{NiCl}_2(\text{PMe}_3)_2]$
15. Choose the correct statement(s) from the following:
- (A) Monovalent silver complexes (coordination number 2) are diamagnetic.
 (B) Bivalent silver complexes (coordination number 4 and 6) are paramagnetic with $\mu = 1.73 \text{ BM}$.
 (C) Trivalent silver complexes (coordination number 4) are diamagnetic.
 (D) AgO is diamagnetic.

16. Which of the following complexes have geometrical isomers that are optically inactive due to the presence of centre of symmetry?

- (A) $[\text{Pt}(\text{bn})_2]^{2+}$
 (B) $[\text{Fe}(\text{gly})_3]^0$
 (C) $[\text{Cr}(\text{H}_2\text{O})_3\text{Cl}_3]^0$
 (D) $[\text{Pd}(\text{NH}_2 - \text{CH}(\text{CH}_3) - \text{CO}_2)_2]^0$

17. Which of the following complexes is/are optically inactive due to the presence of plane of symmetry?

- (A) 
 (B) 
 (C) 
 (D) 



COMPREHENSION TYPE QUESTIONS

Passage 1: For Questions 1–2

Isomers in coordination chemistry include many types. In structural isomers hydrate or solvent isomers, ionization isomers and coordination isomers have same overall formula but have different ligands attached to the central atom or ion.

The terms linkage isomerism or ambidentate isomerism are used for cases of bonding through different atoms of the same ligand.

1. Which of the following is not correctly matched against indicated isomerism?
- (A) $[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})\text{Cl}]\text{Br}_2$: Ionization isomerism
 (B) $[\text{Rh}(\text{PPh}_3)_2(\text{CO})(\text{NCS})_2]$: Linkage isomerism
 (C) $[\text{Pt}(\text{NH}_3)_4][\text{PtCl}_4]$: Coordination isomerism
 (D) $[\text{Zn}(\text{gly})_2]$ tetrahedral : Geometrical isomerism
2. Ma_3b_3 complex has two geometrical forms: facial and meridional. Then which of the following statement is incorrect?
- (A) In facial isomers, three same ligands occupy adjacent positions on octahedron face.
 (B) In meridional isomers, same ligands are present at 90° and 180° angles.
 (C) In facial isomers, same ligands are present only at 90° angle.
 (D) Both isomers (facial and meridional) are optically active.

Passage 2: For Questions 3–5

The magnetic moment for two complexes of empirical formula $\text{Ni}(\text{NH}_3)_4(\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$ is zero and 2.84 BM respectively. The second complex is not a neutral complex.

3. The number of water molecules of crystallization are respectively
- (A) zero, two.
 (B) zero, zero.
 (C) two, zero.
 (D) two, two.
4. The correct formula and geometry of the first complex is
- (A) $[\text{Ni}(\text{H}_2\text{O})_2(\text{NO}_3)_2] \cdot 4\text{NH}_3$; tetrahedral.
 (B) $[\text{Ni}(\text{NH}_3)_4](\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$; tetrahedral.
 (C) $[\text{Ni}(\text{NH}_3)_4](\text{NO}_3)_2 \cdot 2\text{H}_2\text{O}$; square planar.
 (D) $[\text{Ni}(\text{NH}_3)_4(\text{H}_2\text{O})_2](\text{NO}_3)_2$; octahedral.
5. Which of the following statements are true for the second complex?
- (A) It has the EAN value of 36.
 (B) It can show optical isomerism.
 (C) It cannot show geometrical isomerism.
 (D) It produces three-fold freezing point depression.

Passage 3: For Questions 6–8

Some ligands not only donate their lone pair to the central metal atom but also accept the electron cloud from the central metal atom. This is known as synergic bonding.

- In which of the following cases is the bond energy of C – O bond minimum?
(A) Free CO molecule.
(B) Terminal CO group in a complex.
(C) Doubly bridging CO in a complex.
(D) Triply bridging CO in a complex.
- Select the correct order for the stretching frequencies of C – O bond the following compounds.
(I) $\text{fac-Mo(CO)}_3(\text{PF}_3)_3$ (II) $\text{fac-Mo(CO)}_3(\text{PCl}_3)_3$
(III) $\text{fac-Mo(CO)}_3(\text{PMe}_3)_3$
(A) $\text{I} < \text{II} < \text{III}$. (B) $\text{I} > \text{II} > \text{III}$.
(C) $\text{I} = \text{II} = \text{III}$. (D) $\text{II} > \text{I} > \text{III}$.
- In which of the following complexes is the bond order of C – O bond minimum?
(A) $[\text{Mn(CO)}_6]^+$ (B) $[\text{Cr(CO)}_6]$
(C) $[\text{Ti(CO)}_6]^{2-}$ (D) $[\text{V(CO)}_6]^-$

Passage 4: For Questions 9–11

The series $[\text{CoCl}_2(\text{NH}_3)_{6-n}]\text{Cl}_n$ gives rise to 4, 3, 2, and zero ions in solution respectively, for $n = 0, 1, 2$, and 3.

- For which value of n is the electrical conductivity of the complex maximum?
(A) 0 (B) 1
(C) 2 (D) 3
- For which value of n will the complex not show optical isomerism?
(A) 1 (B) 2
(C) 3 (D) All of these
- For which value of n , the complex will show minimum freezing point depression?
(A) 0 (B) 3
(C) 2 (D) 1

Passage 5: For Questions 12–13

Synergic bond is a type of back bonding.

- Which of the following has higher stretching frequency for C–O bond?
(A) $[\text{Ni(CO)}_3\text{PF}_3]$
(B) $[\text{Ni(CO)}_3(\text{PMe}_3)]$
(C) Both have equal stretching frequency.
(D) None of these.
- Which of the following has higher multiple bond character in M–C bond?
(A) $[\text{Ni(CO)}_4]$
(B) $[\text{Co(CO)}_4]^-$
(C) $[\text{Fe(CO)}_4]^{2-}$
(D) (B) and (C) both have equal bond character in M–C bond.

Passage 6: For Questions 14–16

Coordination number of a central atom is its inherent property and has no role on its isomerism.

- $[\text{CoCl}_2(\text{NH}_3)_4]^+ + \text{Cl}^- \rightarrow [\text{CoCl}_3(\text{NH}_3)_3] + \text{NH}_3$
If in the above reaction two isomers of the product are obtained, which is true for the initial (reactant) complex?
(A) compound is in *cis* form.
(B) compound is in *trans* form.
(C) compound is in both (*cis* and *trans*) forms.
(D) cannot be predicted.
- When 0.1 mol of $\text{CoCl}_2(\text{NH}_3)_5$ is treated with excess of AgNO_3 , 0.2 mol of AgCl are obtained. The conductivity of solution will correspond to (cation : anion)
(A) 1 : 3 electrolyte
(B) 1 : 2 electrolyte
(C) 1 : 1 electrolyte
(D) 3 : 1 electrolyte
- Due to the presence of ambidentate ligands coordination compounds show isomerism, palladium complexes of the type $[\text{Pd}(\text{C}_6\text{H}_5)_2(\text{SCN})_2]$ and $[\text{Pd}(\text{C}_6\text{H}_5)_2(\text{NCS})_2]$ are
(A) linkage isomers.
(B) coordination isomers.
(C) ionisation isomers.
(D) geometrical isomers.

ASSERTION-REASONING TYPE QUESTIONS

In the following set of questions, a Statement I is given and a corresponding Statement II is given below it. Mark the correct answer as:

- (A) If both Statement I and Statement II are true and Statement II is the correct explanation of Statement I.
(B) If both Statement I and Statement II are true but Statement II is not the correct explanation for Statement I.
(C) If Statement I is true but Statement II is false.
(D) If Statement I is false but Statement II is true.

- Statement I:** Only *cis* $\text{Pt}(\text{NH}_3)_2\text{Cl}_2$ reacts with oxalic acid ($\text{H}_2\text{C}_2\text{O}_4$) to form $[\text{PtCl}_2(\text{ox})]^{2-}$ not the *trans* isomer.

Statement II: The oxalate ion is a bidentate ligand which occupies adjacent positions only.

- Statement I:** Under the strong field ligand only, the degeneracy of the *d*-orbital is lost.

Statement II: After splitting of the *d*-orbitals also, Hund's rule is not violated anywhere.

- Statement I:** NO is $3e^-$ -donor.

Statement II: The antibonding electron of NO is very much susceptible to donate apart from its lone pair.

- Statement I:** Dithiooxalate is bidentate ambidentate ligand.

Statement II: At a time either two S atoms or two O atoms act as donor atoms.

- Statement I:** PF_3 is weakest donor as well as weakest acceptor compared to PMe_3 in synergic bonding.

Statement II: Me group is having +I effect while F atom is having –I effect.

- Statement I:** SnCl_2 does not act as ligand but SnCl_3 acts as good ligand.

Statement II: On addition of Cl^- to SnCl_2 , the orbital containing the lone pair acquires less *s*-character.

7. Statement I: $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ is more acidic compared to $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$.

Statement II: Both are inner orbital complexes.

8. Statement I: Under the influence of a strong field ligand, d^7 -system will have only one unpaired electron either in coordination number six or four.

Statement II: $t_{2g}^6 e_g^1$ is the electronic configuration for both cases.

9. Statement I: CdS is yellow coloured.

Statement II: The $d-d$ transition does not take place in this compound.

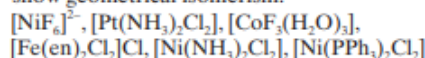
10. Statement I: $[\text{Co}(\text{en})_2(\text{NH}_3)\text{Br}]\text{SO}_4$ has lower electrical conductivity as compared to $[\text{Co}(\text{en})_2(\text{NH}_3)\text{SO}_4]\text{Br}$.

Statement II: Both the ions produce the same number of ions in solution.

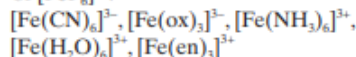
INTEGER ANSWER TYPE QUESTIONS

The answer to each of the following questions is a non-negative integer.

1. Find the number of diamagnetic complexes which show geometrical isomerism.



2. Find the number of complexes in which stability constant value is greater than the stability constant value of $[\text{FeF}_6]^{3-}$.



3. Suppose we replace all the fluoride and water ligands from $[\text{CoF}_3(\text{H}_2\text{O})_3]$ by oxalate ligand without changing the oxidation state and coordination number of central metal atom or ion. Predict the number of parameters among following which increase in the newly formed complex.

- (I) Δ_0
 (II) Number of t_{2g} electrons
 (III) Number of e_g electrons
 (IV) Number of stereoisomers
 (V) Number of geometrical isomers
 (VI) EAN value

4. The number of coordination isomers possible for:

- (a) $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2][\text{PtCl}_4]$ is _____.
 (b) $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2][\text{Pt}(\text{CN})_4]$ is _____.
 (c) $[\text{Fe}(\text{NH}_3)_6]^{3+}[\text{Cr}(\text{C}_2\text{O}_4)_3]^{3-}$ is _____.
 (d) $[\text{Pt}(\text{NH}_3)_4]^{2+}[\text{CuCl}_4]^{2-}$ is _____.
 (e) $[\text{Pt}(\text{NH}_3)_3\text{Cl}][\text{Pt}(\text{SCN})_4]$ is _____.

5. The possible number of stereoisomers for the formula $[\text{Ma}_3\text{b}_2]^{n\pm}$ is _____.

6. The number of stereoisomers, optically active isomers and geometrical isomers for the complex $[\text{Co}(\text{en})(\text{pn})(\text{NO}_2)_2]^+$ is _____, _____ and _____ respectively.

7. If CFSE increases by 30% and 40% respectively for Co^{3+} to Rh^{3+} and for Rh^{3+} to Ir^{3+} , then the total increase in CFSE for Ir^{3+} with respect to Co^{3+} is _____%.

8. The hapticity of the organic ligand in the following complex is _____.



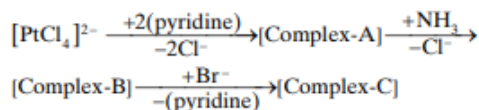
9. The coordination number of the central atom in $[\text{Co}(\text{NH}_3)_4\text{SO}_4]\text{NO}_3$ is _____.

10. The number of optically active isomers for the complex of formula $[\text{Ma}_2\text{b}_2\text{cd}]$ is _____.

11. The number of unpaired electrons in the t_{2g} set of d orbitals in the complex $[\text{Co}(\text{H}_2\text{O})_3\text{F}_3]$ is _____.

12. The number of unpaired electrons present in $[\text{NiF}_6]^{2-}$ is _____.

13. The sum of stereoisomers of complex-A, complex-B and complex-C in following reaction is _____.



MATRIX-MATCH TYPE QUESTIONS

In each of the following questions, statements are given in two columns, which have to be matched. The statements in Column I are labelled as (A), (B), (C) and (D),

while those in Column II are labelled as (P), (Q), (R), (S) and (T). Any given statement in Column I can have correct matching with *one or more* statements in Column II.

1. Match the processes with their respective characteristics.

Column-I	Column-II
(A) $[\text{CoCl}_6]^{3-} \rightarrow [\text{Co(en)}_2\text{Cl}_2]^+$	(P) Change in number of geometrical isomers
(B) $[\text{Fe(EDTA)}]^- \rightarrow [\text{Fe(en)}_3]^{+3}$	(Q) Change in number of stereoisomers
(C) $[\text{Pt(NH}_3)_4]^{+2} \rightarrow [\text{Pt(ONO)}_4]^{2-}$	(R) EAN value does not change
(D) $[\text{Co(H}_2\text{O)}_6]\text{Cl}_3 \rightarrow [\text{Co(H}_2\text{O)}_3\text{Cl}_3] \cdot 3\text{H}_2\text{O}$	(S) Change in number of structural isomers
	(T) Change in magnitude of Δ

2. Match the metal complex type with the properties.

Column I	Column II
(A) $[\text{M(AA)abcd}]^{n\pm}$	(P) All geometrical isomers are optically active.
(B) $[\text{M(AB)}_2\text{a}_2\text{b}_2]^{n\pm}$	(Q) The number of stereoisomers is four.
(C) $[\text{M(AB)}_3]^{n\pm}$	(R) The number of geometrical isomers is four.
(D) $[\text{Ma}_2\text{b}_2\text{cd}]^{n\pm}$	(S) The number of optically active isomers is four.

4. Match the processes carried out with the changes observed.

Column I	Column II
(A) $[\text{M(AB)}_3\text{b}]^{n\pm} \xrightarrow{-a/+b} [\text{M(AB)}_2\text{a}_2\text{b}_2]^{n\pm}$	(P) The number of pairs of enantiomers is increased by one.
(B) $[\text{M(AB)}_2\text{abc}]^{n\pm} \xrightarrow{-c/+b} [\text{M(AB)}_2\text{a}_2\text{b}_2]^{n\pm}$	(Q) The number of geometrical isomers in the final product is four.
(C) $[\text{Ma}_3\text{b}_2\text{c}]^{n\pm} \xrightarrow{-b/+d} [\text{Ma}_3\text{bcd}]^{n\pm}$	(R) The number of stereoisomers is increased to double of the original or decreased to half of the original.
(D) $[\text{M(AA)}_3\text{b}]^{n\pm} \xrightarrow{-a/+b} [\text{M(AA)}_2\text{a}_2\text{b}_2]^{n\pm}$	

5. Match the complex compounds with the properties not depicted by them.

Column I	Column II
(A) $[\text{Fe(CO)}_4]^{2-}$	(P) Hybridization is dsp^2 .
(B) $[\text{Pt(NH}_3)_2\text{Cl}_2]$	(Q) Hybridization is sp^3 .
(C) $[\text{Pt(bn)}_2]^{2+}$	(R) Exhibits geometrical isomerism.
(D) $[\text{Zn(gly)}_2]^0$	(S) Low spin complex.
	(T) Exhibits optical isomerism.

6. Match the pair of complex compounds with the properties that are different in them.

Column I	Column II
(A) $[\text{Mn(NH}_3)_6]\text{SO}_4$ and $[\text{Co(H}_2\text{O)}_6]\text{Cl}_3$	(P) Hybridization.
(B) $(\text{NH}_4)_2[\text{PtCl}_4]$ and $\text{K}_2[\text{NiCl}_4]$	(Q) Magnetic moment value.
(C) $\text{K}_4[\text{Fe(CN)}_5\text{O}_2]$ and $\text{K}_4[\text{Fe(CN)}_6]$	(R) Magnetic behaviour.
	(S) Electrical conductivity with significant change.

3. Match the complex compounds with their properties.

Column I	Column II
(A) $[\text{CoF}_3(\text{H}_2\text{O})_3]^0$	(P) Diamagnetic and low spin complex.
(B) $[\text{Cr(C}_2\text{O}_4)_3]^{3-}$	(Q) Paramagnetic and outer orbital complex.
(C) $[\text{AuCl}_4]^-$	(R) Paramagnetic but inner orbital complex.
(D) $[\text{Fe(CN)}_6]^{3-}$	(S) Diamagnetic and high spin complex.
	(T) Paramagnetic and low spin complex.

7. Match the pair of complex compounds with the properties that are same in them.

Column I	Column II
(A) $[\text{Ti(H}_2\text{O)}_6]^{3+}$ and $[\text{Mn(NH}_3)_6]^{2+}$	(P) Hybridization.
(B) $[\text{AuCl}_4]^-$ and $[\text{PdCl}_4]^{2-}$	(Q) Magnetic moment value.
(C) $[\text{Fe(DMG)}_2]^0$ and $\text{Ni(DMG)}_2]^0$	(R) EAN value.
(D) $[\text{Fe(CO)}_5]^0$ and $[\text{Ni(CO)}_4]^0$	(S) Shape.

8. Match the coordination complex with the number of isomers formed.

Column I	Column II
(A) $[M(AB)_3]^{nz}$	(P) Complex having two optically active isomers.
(B) $[Ma_2b_2c_2]^{nz}$	(Q) Complex having four stereoisomers.
(C) $[M(AA)a_2b_2]^{nz}$	(R) Complex having odd number of geometrical isomers.
(D) $[Ma_3bcd]^{nz}$	(S) Complex having even number of geometrical isomers.
	(T) All geometrical isomerism are not optically active.

9. Match the complex with its property.

Column I	Column II
(A) $[Co(C_2O_4)_3]^{3-}$	(P) High-spin complex.
(B) $[CoF_6]^{3-}$	(Q) Low-spin complex.
(C) $[Ni(NH_3)_6]^{2+}$	(R) Zero electron in e_g set of orbital.
(D) $[Cr(CN)_6]^{3-}$	(S) Paramagnetic behaviour.
	(T) d^2sp^3 hybridization.

ANSWERS

Single Correct Choice Type Questions

- | | | | | |
|--------|---------|---------|---------|---------|
| 1. (A) | 8. (D) | 15. (A) | 22. (C) | 29. (B) |
| 2. (B) | 9. (C) | 16. (D) | 23. (A) | 30. (B) |
| 3. (D) | 10. (C) | 17. (D) | 24. (A) | 31. (C) |
| 4. (A) | 11. (A) | 18. (B) | 25. (A) | 32. (B) |
| 5. (A) | 12. (B) | 19. (D) | 26. (B) | 33. (A) |
| 6. (D) | 13. (B) | 20. (B) | 27. (C) | 34. (B) |
| 7. (A) | 14. (B) | 21. (B) | 28. (C) | 35. (C) |

Multiple Correct Choice Type Questions

- | | | | | |
|-----------------------|-----------------------|-------------------|------------------------|--------------|
| 1. (B), (C) | 5. (A), (B), (C), (D) | 9. (A), (C), (D) | 13. (A), (D) | 17. (A), (D) |
| 2. (A), (D) | 6. (B), (D) | 10. (C), (D) | 14. (A), (B), (D) | |
| 3. (A), (C), (D) | 7. (A), (B) | 11. (A), (C), (D) | 15. (A), (B), (C), (D) | |
| 4. (A), (B), (C), (D) | 8. (A), (B), (C) | 12. (A), (C), (D) | 16. (A), (D) | |

Comprehension Type Questions

- | | | | |
|--------|--------|---------|---------|
| 1. (D) | 5. (D) | 9. (A) | 13. (C) |
| 2. (D) | 6. (D) | 10. (D) | 14. (A) |
| 3. (C) | 7. (B) | 11. (B) | 15. (B) |
| 4. (C) | 8. (C) | 12. (A) | 16. (A) |

Assertion-Reasoning Type Questions

- | | | | | |
|--------|--------|--------|--------|---------|
| 1. (A) | 3. (A) | 5. (D) | 7. (C) | 9. (B) |
| 2. (D) | 4. (A) | 6. (A) | 8. (C) | 10. (D) |

Matrix-Match Type Questions

- | | | | |
|---|---|---|------------------------------------|
| 1. (A) \rightarrow (P), (Q), (R), (T) | (C) \rightarrow (P) | 6. (A) \rightarrow (P), (Q), (R), (S) | (D) \rightarrow (P), (S), (T) |
| (B) \rightarrow (R), (T) | (D) \rightarrow (T), (R) | (B) \rightarrow (P), (Q), (R) | |
| (C) \rightarrow (R), (S), (T) | | (C) \rightarrow (Q), (R) | 9. (A) \rightarrow (Q), (R), (T) |
| (D) \rightarrow (P), (Q), (R), (T) | 4. (A) \rightarrow (P), (Q) | | (B) \rightarrow (P), (S) |
| | (B) \rightarrow (Q), (R) | 7. (A) \rightarrow (S) | (C) \rightarrow (S) |
| 2. (A) \rightarrow (P) | (C) \rightarrow (P), (Q) | (B) \rightarrow (P), (Q), (S) | (D) \rightarrow (R), (S), (T) |
| (B) \rightarrow (R), (S) | (D) \rightarrow (P), (R) | (C) \rightarrow (P), (Q), (S) | |
| (C) \rightarrow (P), (Q), (S) | 5. (A) \rightarrow (P), (R), (S), (T) | (D) \rightarrow (Q), (R) | |
| (D) \rightarrow (S) | (B) \rightarrow (Q), (T) | | |
| 3. (A) \rightarrow (Q) | (C) \rightarrow (Q) | 8. (A) \rightarrow (Q), (S) | |
| (B) \rightarrow (R) | (D) \rightarrow (P), (R), (S) | (B) \rightarrow (P), (R), (T) | |
| | | (C) \rightarrow (P), (Q), (R), (T) | |