EXERCISE - O

SINGLE CORRECT TYPE QUESTIONS

Introduction of coordination compounds

1. Which of the following statements is incorrect ?
(A) Coordination compounds and complexes are synonymous terms.
(B) Complexes must give ions in the solution.
(C) Complexes may give ions in the solution or may not give ions in the solution.
(D) Generally complex ion does not dissociate into its component parts even in the solution.

CCC093

2. Which will not give test of all the ions present in it
(A) $K_2Fe_2(SO_4)_4 \cdot 24H_2O$ (B) $(NH_4)_2Fe(SO_4)_2 \cdot 6H_2O$
(C) $K_3[Fe(CN)_6]$ (D) $Fe_2(SO_4)_3$

CCC094

3. The coordination number of Cr in the complex ion $[Cr(H_2O)_6]^{3\oplus}$ is :-
(A) Zero (B) 3 (C) 6 (D) None of these

CCC096

4. The coordination number of cobalt in $[Co(en)_2Br_2]Cl_2$ is :-
(A) 2 (B) 4 (C) 6 (D) 8

CCC098

5. In the coordination compound $K_4[Ni(CN)_4]$, the oxidation state of nickel is –
(A) 0 (B) +1 (C) +2 (D) –1

CCC099

6. Statement-I : $K_2SO_4 . Al_2(SO_4)_3 . 24H_2O$ is a double salt compound.
Because
Statement-II : It ionises to give a complex ion.
These questions contains, Statement-I (assertion) and Statement-II (reason).
(A) Statement-I is True, Statement-II is True ; Statement-II is a correct explanation for Statement-I
(B) Statement-I is True, Statement-II is True ; Statement-II is NOT a correct explanation for Statement-I
(C) Statement-I is True, Statement-II is False.
(D) Statement-I is False, Statement-II is True.

CCC100

7. For the reaction of the type $M + 4L \rightleftharpoons ML_4$
(A) larger the stability constant, lower the proportion of ML_4 that exists in solution.
(B) larger the stability constant, higher the proportion of ML_4 that exists in solution.
(C) smaller the stability constant, higher the proportion of ML_4 that exists in solution.
(D) None of the above

CCC101

8. Ligand in a complex salt are
(A) anions linked by coordinate bonds to a central metal atom or ion
(B) cations linked by coordinate bonds to a central metal or ion
(C) molecules linked by coordinate bonds to a central metal or ion
(D) ions or molecules linked by coordinate bonds to a central atom or ion

CCC106

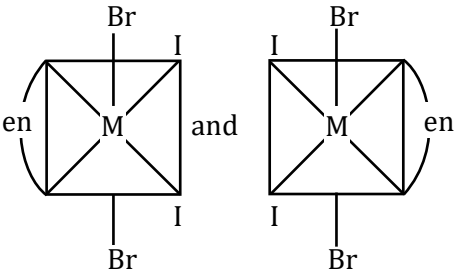
9. The total number of monodentate ligands attached to the central metal ion through coordinate (sigma) bond is called.

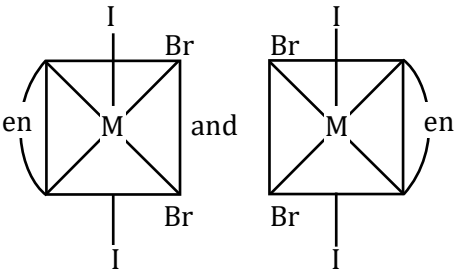
(A) Valency of the metal ion (B) Oxidation state of the metal ion

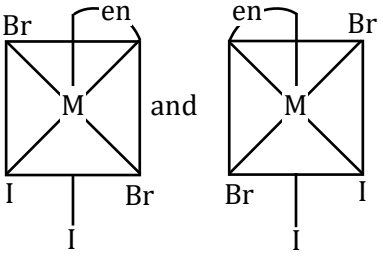
(C) Coordination number of metal ion (D) None of the above

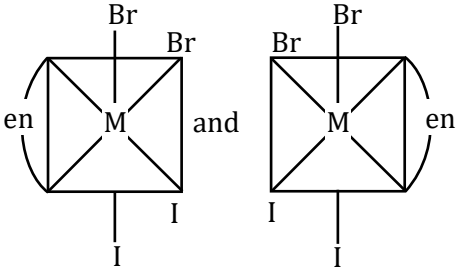
CCC115

10. The complex ion has two optical isomers. Their **CORRECT** configurations are:

(A) 

(B) 

(C) 

(D) 

CCC226

Types of ligands

11. Bidentate ligand is :-

(A) $CN^{\ominus}$ (B) Ethylene diamine (C) $EDTA^{4\ominus}$ (D) $SCN^{\ominus}$

CCC113

12. Which of the following ligand does not act as bidentate ligand

(A) dipy (B) dien (C) $gly^{\ominus}$ (D) $dmg^{\ominus}$

CCC116

13. $\overset{\ominus}{C}N$ is an ambidentate ligand because

(A) it has multiple bonds (B) carbon as a negative charge

(C) it form chelate (D) both C & N can donate lone pair

CCC118

14. Which of the following ligands may be ambidentate ligand –

(A) $NO_2^{\ominus}$ (B) $\overset{\ominus}{S}CN$ (C) Both (A) and (B) (D) None of these

CCC119

15. An ambident ligand is one which

(A) is linked to the metal atom through two donor atom

(B) has two donor atoms, and only one of them has the capacity to form a coordinate bond [or a sigma (σ) bond]

(C) has two donor atoms, but either of the two can form a coordinate bond

(D) forms chelate rings.

CCC122

16. Which of the following does not form a chelate ?
(A) EDTA (B) Oxalate (C) Pyridine (D) Ethylenediamine

CCC124

17. Identify the correct statements for the behaviour of ethane-1, 2-diamine as a ligand.
(i) It is a neutral ligand. (ii) It is a bidentate ligand.
(iii) It is a chelating ligand. (iv) It is a unidentate ligand.
(A) (i), (ii) and (iii) (B) (ii) and (iii)
(C) (iii) and (iv) (D) (i), (iii) and (iv)

CCC125

Wermer's theory

18. Consider the following statements:
According the Werner's theory.
(a) Ligands are connected to the metal ions by covalent bonds.
(b) Secondary valencies have directional properties
(c) Secondary valencies are non-ionisable
(A) a, b and c are correct (B) b and c are correct
(C) a and c are correct (D) a and b are correct

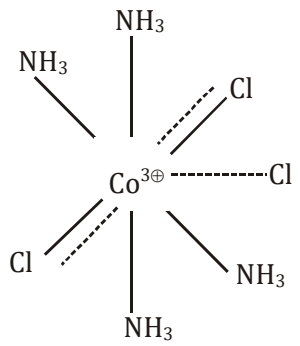
CCC141

19. A complex of platinum, ammonia and chloride produces four ions per molecule in the solution. The structure consistent with the observation is :
(A) $[Pt(NH_3)_4]Cl_4$ (B) $[Pt(NH_3)_2Cl_4]$
(C) $[Pt(NH_3)_5Cl]Cl_3$ (D) $[Pt(NH_3)_4Cl_2]Cl_2$

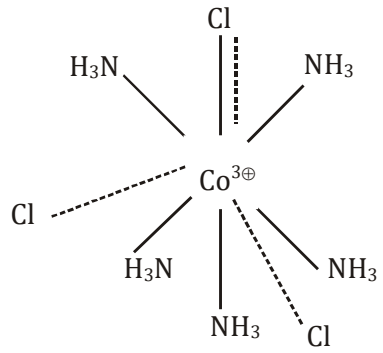
CCC143

20. Which of the following Werner's complex has least electrical conductivity ?

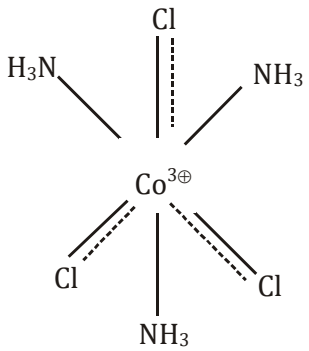
(A)



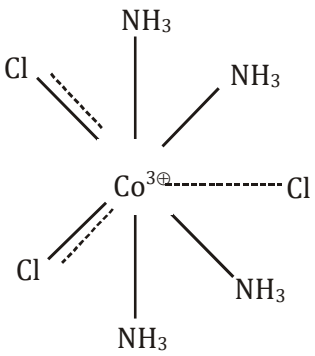
(B)



(C)



(D)



CCC144

21. Which of the following has least conductivity in aqueous solution.
(A) $CoCl_3 . 4NH_3$ (B) $CoCl_3 . 3NH_3$
(C) $CoCl_3 . 5NH_3$ (D) $CoCl_3 . 6NH_3$

CCC145

22. Which gives only 50% mole of AgCl, when reacts with $AgNO_3$:-
(A) $PtCl_2 . 4NH_3$ (B) $PtCl_4 . 5NH_3$
(C) $PtCl_4 . 4NH_3$ (D) $PtCl_4 . 3NH_3$

CCC146

23. Number of electrolytes in the complex $CoCl_3 . 5NH_3$
(A) 3 (B) 2 (C) 4 (D) 5

CCC147

24. A co-ordination complex of cobalt has molecular formula containing five ammonia molecules, one nitro group and two chlorine atoms for one cobalt atom. One mole of this compound produces three mole ions in an aqueous solution. In reacting this solution with excess of silver nitrate solution, two moles of AgCl get precipitated. The ionic formula of this complex would be :-
(A) $[Co(NH_3)_4 . NO_2Cl] . [(NH_3)Cl]$ (B) $[Co(NH_3)_5Cl] . [Cl(NO_2)]$
(C) $[Co(NH_3)_5(NO_2)]Cl_2$ (D) $[Co(NH_3)_5] . [(NO_2)_2Cl_2]$

CCC148

Effective atomic number

25. The EAN of cobalt in the complex ion $[Co(en)_2Cl_2]^{\oplus}$ is :-
(A) 27 (B) 36 (C) 33 (D) 35

CCC154

26. If EAN of a central metal ion $X^{2\oplus}$ in a complex is 34. and atomic number of X is 28. The number of monodentate ligands present in complex are:-
(A) 3 (B) 4 (C) 6 (D) 2

CCC155

27. Which of the following does not obey Sidgwick effective atomic number rule -
(A) $Co_2(CO)_8$ (B) $[Fe(CO)_5]$ (C) $[V(CO)_6]^{\ominus}$ (D) $[Mn(CO)_6]$

CCC156

28. The complex that violates the EAN rule :-
(A) Potassium ferrocyanide (B) Potassium ferricyanide
(C) Tetra carbonyl Nickel (D) Cobalt (III) hexamine chloride

CCC157

29. The EAN of metal atoms in $Fe(CO)_2(NO)_2$ and $Co_2(CO)_8$ respectively are
(A) 34, 35 (B) 34, 36 (C) 36, 36 (D) 36, 35

CCC158

30. Effective atomic number of $Co(CO)_4$ is 35, hence it is less stable. It attains stability by
(A) Oxidation of Co (B) Reduction of Co (C) Dimerization (D) Both (B) & (C)

CCC159

31. Among the following complexes which can act as oxidising agent.
(A) $[Mn(CO)_6]$ (B) $[Mn(CO)_6]^{\oplus}$ (C) $[Mn(CO)_5]^{\ominus}$ (D) $[V(CO)_6]$

CCC160

32. Ligands are neutral or ionic species capable of donating at least one electron pair to central metal. Hence ligands can be of different denticities.

$[Mn(CO)_5]$ can attain more stability by :

(A) Oxidation of itself (B) Reduction of itself

(C) Dimerization (D) Both (B) and (C)

CCC165

IUPAC Nomenclature of coordination compounds

33. $K_3[Fe(CN)_6]$ is :-

(a) Potassium hexacynoferrate(II) (b) Potassium hexacynoferrate(III)

(c) Potassium ferricyanide (d) Hexacynoferrate(III) potassium

Correct answer is :-

(A) Only (a) and (b) (B) Only (b) and (c) (C) Only (a) and (c) (D) Only (b) and (d)

CCC172

34. The IUPAC name of $Fe(CO)_5$ is

(A) Pentacarbonyl ferrate(0) (B) Pentacarbonyl ferrate(III)

(C) Pentacarbonyliron(0) (D) Pentacarbonyliron(II)

CCC173

35. Give the IUPAC name of the complex compound $[Co(NH_3)_4(H_2O)Br](NO_3)_2$.

(A) BromoaquatetraamineCobalt(III) nitrate

(B) BromoaquatetraaminoCobalt(III) nitrate

(C) BromoaquatetraammineCobaltate(III) nitrate

(D) TetraammineaquabromoCobalt(III) nitrate

CCC176

36. The number of ions formed, when bis(ethane-1,2-diamine)copper(II) sulphate is dissolved in water will be

(A) 1 (B) 2 (C) 3 (D) 4

CCC179

37. The IUPAC name for $[Co(NCS)(NH_3)_5]Cl_2$ is :-

(A) Pentaammine(thiocyanato-N)cobalt(III) chloride

(B) Pentaammine(thiocyanato-S)cobalt(III) chloride

(C) Pentaammine(isothiocyanato-N,S)cobalt(III) chloride

(D) Pentaammine(mercapto-N)cobalt(III) chloride

CCC181

38. The correct IUPAC name of the complex $[Fe(\pi-C_5H_5)_2]$ is

(A) Cyclopentadienyliron(II) (B) Bis(η^5-cyclopentadienyl)iron(II)

(C) Dicyclopentadienylferrate(II) (D) Ferrocene

CCC184

Isomerism

39. The complex, $[Pt(py)(NH_3)BrCl]$ will have how many geometrical isomers ?

(A) 3 (B) 4 (C) 0 (D) 2

CCC188

40. Which of the following complex shows ionization isomerism.
(A) $[Cr(NH_3)_6]Cl_3$ (B) $[Cr(en)_2]Cl_2$ (C) $[Cr(en)_3]Cl_3$ (D) $[CoBr(NH_3)_5]SO_4$
CCC193

41. Find the name of the hydrate isomer of $CrCl_3.6H_2O$, which is having lowest electrical conductivity excluding zero value of conductivity.
(A) Hexaaquachromium(III)chloride
(B) Tetraaquadichloridochromium(III)chloride dihydrate
(C) Pentaaquachloridochromium(III)chloride monohydrate
(D) Triaquatrichloridochromium(III)chloride trihydrate
CCC196

42. Which of the following compound cannot show coordination isomerism?
(A) $[Pt(NH_3)_4][PtCl_4]$ (B) $[Co(NH_3)_4Cl_2]\ [Cr(NH_3)_2(C_2O_4)_2]$
(C) $[Pt(NH_3)_4Cl_2]\ [Pt(SCN)_2Cl_2]$ (D)$[Pt(en)_2]^{2\oplus}$
CCC197

43. The type of isomerism present in pentaamminenitrochromium(III) chloride is :
(A) Coordination (B) linkage
(C) hydrate (D) Coordination position
CCC198

44. The two compounds sulphatopenta-amminecobalt(III) bromide and penta-amminebromo cobalt(III) sulphate represent :
(A) Linkage isomerism (B) Ionisation isomerism
(C) Co-ordination isomerism (D) Hydrate isomerism
CCC199

45. How many coordination isomers of $[Pt(NH_3)_4][PtCl_4]$ show geometrical isomerism.
(A) All (B) One (C) Two (D) None
CCC202

46. Which of the following statements is/are true
(A) In $[PtCl_2(NH_3)_4]^{2\oplus}$ complex ion, the cis-form is optically active, while trans-form is optically inactive
(B) In $[Fe(C_2O_4)_3]^{3\ominus}$, geometrical isomerism does not exist, while optical isomerism exists
(C) $[Mabcd]^{\pm}$ square planar complexes exhibit both optical as well as geometrical isomerism
(D) In $[Mabcd]^{n\pm}$ tetrahedral complexes, optical isomerism cannot be observed
CCC203

47. Which of the following tetrahedral complex has two stereoisomers ?
[M = central atom, a, b, c, d = monodentate ligands]
(A) $[Ma_2B_2]$ (B) $[Ma_2bc]$ (C) $[Mab_2c]$ (D) [Mabcd]
CCC206

48. A co-ordination compound [M abcd] has total two stereoisomers. The expected geometry of this complex is : [M = central atom, a, b, c, d = monodentate ligands]
(A) Square planar (B) octahedral (C) Tetrahedral (D) trigonal bipyramidal
CCC207

49. The number of optical isomers possible for $[Cr(C_2O_4)_3]^{3\ominus}$ is :
(A) Three (B) Two (C) One (D) Four
CCC209

50. Among the following coordination compounds/ ions

(i) $[Fe(CN)_6]^{3\ominus}$ (ii) $[Pt(NH_3)_2Cl_2]$ (iii) $[Co(NH_3)_6]^{3\oplus}$ (iv) $[Cr(H_2O)_6]Cl_3$

Which species exhibit geometrical isomerism ?

(A) (ii) only (B) (i) and (ii) (C) (ii) and (iv) (D) (i) and (iii)

CCC210

51. Which of the following complex produce precipitates with $AgNO_3$ and exist in two geometrical isomeric form

(A) $PtCl_2.4NH_3$ (B) $PtCl_2.3NH_3$ (C) $PtCl_4.4NH_3$ (D) $PtCl_4.2NH_3$

CCC216

52. Which of the following complex shows optical isomerism -

(A) $[Cd(CN)_4]^{2\ominus}$ (B) $[Cr(H_2O)_3Cl_3].3H_2O$

(C) $[Zn(gly)_2]$ (D) $[Ni(dmg)_2]$

CCC218

53. Which of the following can exhibit geometrical isomerism ?

(A) $[MnBr_4]^{2\ominus}$ (B) $[Pt(NH_3)_3Cl]^{\oplus}$ (C) $[PtCl_2(P(C_2H_5)_3)_2]$ (D) $[Fe(H_2O)_5NOS]^{2\oplus}$

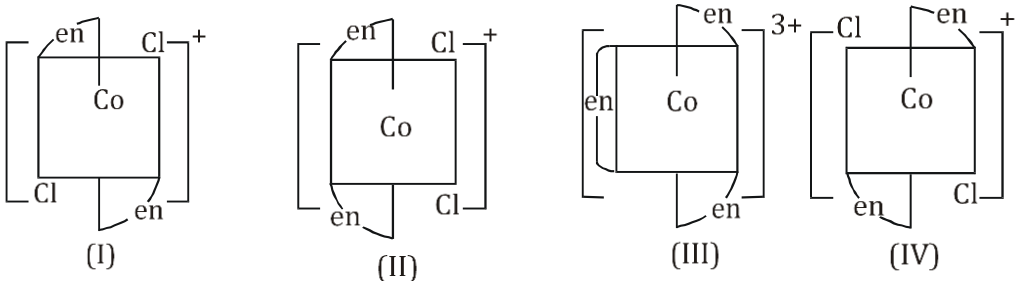
CCC219

54. Find complex which have maximum number of stereoisomers -

(A) $[Ma_3b_3]$ (B) $[Ma_3b_2c]$ (C) $[Ma_2b_2c_2]$ (D) $[M(AA)a_2b_2]$

CCC222

55. Which of the following ions are optically active ?



(A) I only (B) II only (C) II and III (D) IV only

CCC223

Valence bond theory and crystal field theory

56. The geometry of $[Ni(CO)_4]$ and $[Ni(PPh_3)_2Cl_2]$ are

(A) both square planar (B) tetrahedral and square planar

(C) both tetrahedral (D) None of these

CCC233

57. Which of the following complexes has square planar structure ?

(A) $[Ni(CO)_4]$ (B) $[Ni(CN)_4]^{2\ominus}$ (C) $[Ni(Cl)_4]^{2\ominus}$ (D) $[Zn(NH_3)_4]^{2\oplus}$

CCC237

58. Which of the following will show optical isomerism but not geometrical isomerism.

(A) $[Cr(Cl_3)_3(NH_3)_3]$ (B) $K_3[Fe(C_2O_4)_3]$

(C) $[CoCl_2(en)_2]^{\oplus}$ (D) $[CoBrCl(Ox)_2]^{3\ominus}$

CCC242

59. Which of the following is diamagnetic and sp^3 hybridised -

(A) $[NiCl_4]^{2\ominus}$ (B) $[Ni(CN)_4]^{4\ominus}$ (C) $[Ni(CN)_4]^{2\ominus}$ (D) $[NiCl_2(PPh_3)_2]$

CCC248

60. Identify tetrahedral species which has maximum magnetic moment value :
(A) $[CuCl_4]^{2\ominus}$ (B) $[CoCl_4]^{2\ominus}$ (C) $[FeCl_4]^{2\ominus}$ (D) $[AlCl_4]^{\ominus}$

CCC249

61. For which of the following types of d^n configuration, the number of unpaired electrons in octahedral complexes remains same irrespective of the ligand field strength.
(A) d^3 (B) d^4 (C) d^5 (D) d^6

CCC251

62. The magnetic moment of $[NiX_4]^{2\ominus}$ ion is found to be zero. Then the metal of the complex ion is (X = monodentate anionic ligand).
(A) sp^3 hybridised (B) spd^2 hybridised (C) dsp^2 hybridised (D) d^2sp hybridised

CCC255

63. Which one of the following complex is an outer orbital complex -
(A) $[Ni(H_2O)_6]^{2\oplus}$ (B) $[Fe(H_2O)_5NO]SO_4$ (C) $[Fe(NH_3)_6]^{2\oplus}$ (D) All of these

CCC256

64. The number of unpaired electrons calculated in $[Co(NH_3)_6]^{3\oplus}$ and $[CoF_6]^{3\ominus}$ are :
(A) 4 and 4 (B) 0 and 2 (C) 2 and 4 (D) 0 and 4

CCC264

65. In an octahedral crystal field, the t_{2g} orbitals are
(A) Raised in energy by 0.4 Δ_O (B) Lowered in energy by 0.4 Δ_O
(C) Raised in energy by 0.6 Δ_O (D) Lowered in energy by 0.6 Δ_O

CCC266

66. $[NiF_6]^{2\ominus}$ is :
(A) Paramagnetic (B) high spin
(C) Diamagnetic (D) tetrahedral

CCC268

67. $[M(C_2O_4)_3]^{x\ominus}$ is diamagnetic when $M^{n\oplus}$ ion is :
(A) $Co^{3\oplus}$ (B) $Co^{2\oplus}$ (C) $Ni^{2\oplus}$ (D) $Fe^{2\oplus}$

CCC269

68. The number of unpaired electron in $[AuCl_4]^{\ominus}$ is :
(A) 0 (B) 1 (C) 2 (D) 4

CCC280

69. $[PdCl_4]^{2\ominus}$ is :
(A) Tetrahedral, 2 unpaired e^-s. (B) Square planar, paramagnetic
(C) Square planar, diamagnetic (D) Tetra hedral, diamagnetic

CCC281

CFSE and colour in coordination compounds

70. Crystal field stabilisation energy of a complex is affected by :
(A) Ligand strength (B) Oxidation Number of central atom
(C) Coordination number (D) All of these

CCC296

71. Δ_O is maximum for which of the following given complex?
(A) $[Co(H_2O)_3F_3]$ (B) $[Co(NH_3)_6]^{3\oplus}$
(C) $[Co(H_2O)_6]^{3\oplus}$ (D) $[Co(NH_3)_4]^{3\oplus}$

CCC297

72. Select the correct general order of comparison :
(A) $\Delta_t > \Delta_{sp} > \Delta_O$ (B) $\Delta_{sp} > \Delta_O > \Delta_t$
(C) $\Delta_{sp} > \Delta_t > \Delta_O$ (D) $\Delta_O > \Delta_{sp} > \Delta_t$

CCC298

73. CFSE in d^3, octahedral is :
(A) $-1.2\ \Delta_O$ (B) $-0.8\ \Delta_O$
(C) $+0.6\ \Delta_O$ (D) $-2.4\ \Delta_O$

CCC299

74. Among the following species the one which causes the highest CFSE, Δ_O as a ligand is :-
(A) $CN^{\ominus}$ (B) NH_3 (C) CO (D) $F^{\ominus}$

CCC301

75. If $\lambda_{absorbed}$ for d-d transition is in order $[Ti(X)_6]^{3\oplus} > [Ti(Y)_6]^{3\oplus} > [Ti(Z)_6]^{3\oplus}$.
Select correct order of strength of ligands (X, Y, Z are monodentate ligand)-
(A) Z > Y > X (B) X > Y > Z (C) Z > X > Y (D) Not predictable

CCC303

76. Which of the following complex is coloured and diamagnetic –
(A) $MnO_4^{2\ominus}$ (B) $[Ni(H_2O)_6]^{2\oplus}$ (C) $[CrCl_6]^{3\ominus}$ (D) $CrO_4^{2\ominus}$

CCC304

77. Which of the following compound is not coloured ?
(A) $Na_2[CuCl_4]$ (B) $Na_2[CdCl_4]$ (C) $K_4[Fe(CN)_6]$ (D) $K_3[Fe(CN)_6]$

CCC307

78. Given the following data about the absorption maxima of several complex ions, what is the order of $\triangle_0$ for these ions.

Compound	λ_{max}
I. $[CrCl_6]^{3\ominus}$	758
II. $[Cr(NH_3)_6]^{3\oplus}$	465
III. $[Cr(H_2O)_6]^{3\oplus}$	694

(A) $\triangle_O$ (I) < $\triangle_O$ (II) < $\triangle_O$ (III) (B) $\triangle_O$ (II) < $\triangle_O$ (III) < $\triangle_O$ (I)
(C) $\triangle_O$ (I) < $\triangle_O$ (III) < $\triangle_O$ (II) (D) $\triangle_O$ (III) < $\triangle_O$ (II) < $\triangle_O$ (I)

CCC308

Synergez bonding

79. Statement-1 : In Zeise's salt C – C bond order regarding ethylene molecule is less than two.
Statement-2 : Ethylene accepts electron pair from filled d-orbital of $Pt^{2\oplus}$ into its vacant bonding M.O.
(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.
(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.
(C) Statement-1 is true, statement-2 is false.
(D) Statement-1 is false, statement-2 is true.

CCC120

80. Which of the following complex has highest M – C bond order ?
(A) $[Mn(CO)_6]^{\oplus}$ (B) $[V(CO)_6]^{\ominus}$ (C) $[Cr(CO)_6]$ (D) $[Ti(CO)_6]^{2\ominus}$

CCC135

81. Which of the following order is correct for the IR vibrational frequency of CO.
(A) $[Fe(CO)_4]^{2\ominus} < [Co(CO)_4]^{\ominus} < [Ni(CO)_4]$
(B) $[Fe(CO)_4]^{2\ominus} > [Co(CO)_4]^{\ominus} > [Ni(CO)_4]$
(C) $[Fe(CO)_4]^{2\ominus} > [Co(CO)_4]^{\ominus} < [Ni(CO)_4]$
(D) $[Fe(CO)_4]^{2\ominus} < [Co(CO)_4]^{\ominus} > [Ni(CO)_4]$

CCC137

82. Which of the following complex has highest C–O bond length ?
(A) $[Ni(CO)_3(PF_3)]$ (B) $[Ni(CO)_4]$
(C) $[Ni(CO)_3(PMe_3)]$ (D) None of these

CCC138

83. Ligands are neutral or ionic species capable of donating at least one electron pair to central metal. Hence ligands can be of different denticities.
Which of the following complexes follow Sidgwick EAN rule ?
(A) $[Fe(\eta^5 - C_5H_5)_2]$ (B) $K[PtCl_3(\eta^2 - C_2H_4)]$
(C) $[V(CO)_6]$ (D) $[Mn(CO)_6]$

CCC166

Organometallic compounds and application of coordination complexes

84. Which one of the following coordination compounds is used to inhibit the growth of tumours ?
(A) Trans-platin (B) EDTA complex of calcium
(C) $[(Ph_3P)_3RhCl]$ (D) Cis-platin

CCC283

85. The compound used in the treatment of lead poisoning is :
(A) D-penicillamine (B) desferrioxime B
(C) Cis-platin (D) EDTA

CCC284

86. Coordination compounds have great importane in biological system. In this context which of the following statements is incorrect.
(A) Cyanocobalamin is B_{12} and contains cobalt
(B) Haemoglobin is the red pigment of blood and contains iron
(C) Chlorophylls are green pigments in plants and contain calcium
(D) Carboxypeptidase – A is an enzyme and contains zinc.

CCC285

87. The compound Na_2IrCl_6 reacts with triphenylphosphine in diethyleneglycol in an atmosphere of CO to give $[IrCl(CO)(PPh_3)_2]$, known as 'Vaska's compound'. (Atomic number of Ir = 77) Which of the following statements is correct?
(A) The IUPAC name of the complex is carbonylchloridobis (triphenylphosphine) iridium(III)
(B) The hybridisation of the metal ion is sp^3
(C) The magnetic moment (spin only) of the complex is zero
(D) The complex shows geometrical as well as ionization isomerism

CCC289

MULTIPLE CORRECT QUESTIONS

Introduction of coordination compounds

88. Which is TRUE about metal complex ?

(A) Central metal acts as lewis acid

(B) Ligands acts lewis base

(C) It will give test of all individual entities in aqueous solution

(D) The coordinate bonds are present in the metal complex

CCC108

Types of complexes

89. Which of the following complexes is/are an example of heteroleptic complex ?

(A) $[Co(NO_2)_3(NH_3)_3]$ (B) $K_3[CrCl_6]$

(C) $[Co(NH_3)_3Cl_3]$ (D) $[Cr(C_2O_4)_3]^{3\ominus}$

CCC110

Isomerism

90. Select which Square planar complex (es) cannot show optical isomerism : -

(A) $[Pt(bn)_2]^{2\oplus}$ (B) $[Pt(en)_2]^{2\oplus}$ (C) $[PtCl_2(NH_3)_2]^0$ (D) $[Pt(gly)_2]^0$

CCC212

91. Which of the following exhibit geometrical isomerism (M stands for a metal, and a and b are achiral ligands) ?

(A) Ma_2b_2 (Sq. Pl.) (B) Ma_4b_2 (C) Ma_5b (D) Ma_6

CCC240

92. Which of the following will have two stereoisomeric forms?

(A) $[Cr(NO_3)_3(NH_3)_3]$ (B) $K_3[Fe(C_2O_4)_3]$

(C) $[CoCl_2(en)_2]^{\oplus}$ (D) $[CoBrCl(Ox)_2]^{3\ominus}$

CCC241

Valence bond theory and crystal field theory

93. Which of the following statement(s) is/are correct?

(A) $Ni(CO)_4$ is diamagnetic and sp^3 hybridized.

(B) Complex $[Cu(CN)_4]^{3-}$ is paramagnetic and Cu^{2+} ion is dsp^2 hybridized.

(C) $[MnBr_4]^{2-}$ ion is paramagnetic and sp^3 hybridized.

(D) Vaska's catalyst, that is, $[IrCl(CO)(PPh_3)_2]$ is diamagnetic and Ir^+ ion is dsp^2 hybridized.

CCC321

94. In case of $[Mn(NH_3)_6]^{2+}$

(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_{x^2} and d_{xy}.

CCC322

95. Which of the following complexes is/are square planar?

(A) $[Ag\ F_4]^-$ (B) $[AuCl_4]^-$ (C) $[NiCl_2(PPh_3)_2]$ (D) $[NiCl_2(Pme_3)_2]$

CCC323

CFSE and colour in coordination compounds

96. Select the correct stability order for the following complexes.

(A) $[Cu(trien)]^{2\oplus} > [Cu(en)_2]^{2\oplus} > [Cu(NH_3)_4]^{2\oplus}$

(B) $[Ir(H_2O)_6]^{3\oplus} > [Rh(H_2O)_6]^{3\oplus} > [Co(H_2O)_6]^{3\oplus}$

(C) $[Cr(NH_3)_6]^{3\oplus} > [Cr(NH_3)_6]^{2\oplus} > [Cr(NH_3)_6]^{\oplus}$

(D) $[Cu(CO)_4]^{2\oplus} > [Cu(H_2O)_4]^{2\oplus} > [Cu(NH_3)_4]^{2\oplus}$

CCC313

Synergez bonding

97. Which of the following chemical species can act as non-classical ligand(s)

(A) CO (B) C_2H_4 (C) $NO^{\oplus}$ (D) PR_3

CCC130

98. Which of the following pairs of compounds has the same EAN value but does not obey Sidgwick EAN rule?

(A) $Fe(CO)_5$, $Ni(CO)_4$

(B) $[Fe(NH_3)_6]^{2+}$, $[Cr(C_2O_4)_3]^{3-}$

(C) $[Fe(H_2O)_5NO]^{2+}$, $[Mn(CO)_6]$

(D) $[Ti(CO)_6]$, $[Mn(C_2O_4)_3]^{3-}$

CCC324

METRIX MATCH TYPE

Types of ligands

99. Match the List with multiple options

List-I	**List-II**
(P) Ethane 1, 2 diamine	(1) Chelating agent
(Q) $SCN^{\ominus}$	(2) Ambidentate
(R) $CO_3^{2\ominus}$	(3) Flexidentate
(S) $NO_2^{\ominus}$	(4) Tridentate

Code :

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

CCC128

Valence bond theory and crystal field theory

Answer Q.100, Q.101 by appropriately matching the information given in the three columns of the following table.

For the following complexes in Column-I, match the correct properties with Column-II and Column-III according to the questions asked.

Column-I	**Column-II** **Hybridisation**	**Column-III** **Magnetic moment value in B.M.**
(I) $[Co(H_2O)_3F_3]$	(i) sp^3	(p) 2.8
(II) $[NiF_6]^{2\ominus}$	(ii) dsp^2	(q) 5.92
(III) $Na_2[NiCl_4]$	(iii) sp^3d^2	(r) 0
(IV) $K_2[Ni(CN)_4]$	(iv) d^2sp^3	(s) 4.9

100. Which is the only correct combination?

(A) I, (iv), (r) (B) II, (i), (q) (C) IV, (ii), (p) (D) IV, (ii), (r)

CCC259

101. Which is the only incorrect combination ?

(A) IV, (ii), (r) (B) II, (iii), (p) (C) II, (iv), (r) (D) III, (i), (p)

CCC260

Table for Question 102 to 104

Complex		Oxidation state of central metal atom or ion		Ligand (s) present	
(1)	Ferrocene	(P)	0	(i)	$C_5H_5^{\ominus}$
(2)	Potassium ferrocynide	(Q)	+1	(ii)	$NO^{\oplus}$
(3)	Sodium nitroprusside	(R)	+2	(iii)	$CN^{\ominus}$
(4)	Zeise's salt	(S)	+3	(iv)	$Cl^{\ominus}$

102. Which of the following matching is INCORRECT : -

(A) (1),(R),(i) (B) (2), (R), (iii)

(C) (3), (R), (ii) and (iii) (D) (4), (S), (iv)

CCC189

103. Select INCORRECT combination for complex given : -

(A) Complex having platinum = R, (iv)

(B) Neutral / uncharged complex = R, (i)

(C) Complex which have η^2 – bonded ligand = R, (i)

(D) Sandwich complex = R, (i)

CCC190

104. Which of the following complex having π-acid ligand (s) : -

(A) 1,2,3,4 (B) 1, 2, 3 (C) 1, 2 (D) 1, 4

CCC191

COMPREHENSION TYPE QUESTIONS

Passage for Questions 105-107

The magnetic moment for two complexes of empirical formula $Ni(NH_3)_4\ (NO_3)_2\ .\ 2H_2O$ is zero and 2.84 BM respectively. The second complex is not a neutral complex.

105. The number of water molecules of crystallization are respectively

(A) zero, two. (B) zero, zero. (C) two, zero. (D) two, two.

CCC325

106. The correct formula and geometry of the first complex is

(A) $[Ni(H_2O)_2\ (NO_3)_2] \cdot 4NH_3$; tetrahedral.

(B) $[Ni(NH_3)_4]\ (NO_3)_2 \cdot 2H_2O$; tetrahedral.

(C) $[Ni(NH_3)_4]\ (NO_3)_2 \cdot 2H_2O$; square planar.

(D) $[Ni(NH_3)_4\ (H_2O)_2]\ (NO_3)_2$; octahedral

CCC326

107. 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.

CCC327

Passage for Questions 108-110

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

108. $[CoCl_2(NH_3)_4]^+ + Cl^- \rightarrow [CoCl_3(NH_3)_3] + NH_3$ 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.

CCC328

109. When 0.1 mol of $CoCl_3(NH_3)_5$ 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

CCC329

110. Due to the presence of ambidentate ligands coordination compounds show isomerism, palladium complexes of the type $[Pd(C_6H_5)_2(SCN)_2]$ and $[Pd(C_6H_5)_2(NCS)_2]$ are
(A) linkage isomers.
(B) coordination isomers.
(C) ionisation isomers.
(D) geometrical isomers.

CCC330

EXERCISE - S

Types of ligands

1. Find the number of complex(es) which have at least one five member chelate ring formed by two carbon atoms, two nitrogen atoms and one central metal.

(I) $[Co\ (EDTA)]^{\ominus}$ (II) $[Co(en)_3]^{3\oplus}$ (III) $[Co\ (Gly)_3]^0$ (IV) $[Co\ (bipy)_3]^{3\oplus}$

(V) $[Co(oxalate)_3]^{3\ominus}$ (VI) $[Co\ (dien)(NH_3)_3]^{3\oplus}$

CCC132

Effective atomic number

2. Determine the effective atomic number of the metal atom in $K_3[Cr(C_2O_4)_3]$

CCC170

Isomerism

3. Find the number of optically active isomers for $[Pd(en)_2(NH_3)(H_2O)]^{4\oplus}$ cation.

CCC244

4. Number of possible Geometrical Isomers of $[PtFClBrI(H_2O)(NH_3)]$

CCC246

5. Find the maximum number of atoms lying in one plane for $[Cr(CN)_6]^{3\ominus}$

CCC243

6. The number of coordination isomers possible for:

(a) $[Pt(NH_3)_4\ Cl][PtCl_4]$ is _____.

(b) $[Pt(NH_3)_4\ Cl_2][Pt(CN)_4]$ is _____.

(c) $[Fe(NH_3)_6]^{3+}\ [Cr(C_2O_4)_3]^{3-}$ is _____.

(d) $[Pt(NH_3)_4]^{2+}[CuCl_4]^{2-}$ is _____.

(e) $[Pt(NH_3)_3\ Cl]_2\ [Pt(SCN)_4]$ is _____.

CCC331

Valence bond theory and crystal field theory

7. Suppose we replace all the fluoride and water ligands from $[CoF_3(H_2O)_3]$ 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

CCC332

8. The number of unpaired electrons in the t_{2g} set of d orbitals in the complex $[Co(H_2O)_3F_3]$ is _____.

CCC333

CFSE and colour in coordination compounds

9. Find the number of complexes in which stability constant value is greater than the stability constant value of $[FeF_6]^{3-}$.

$[Fe(CN)_6]^{3-}$, $[Fe(ox)_3]^{3-}$, $[Fe(NH_3)_6]^{3+}$,

$[Fe(H_2O)_6]^{3+}$, $[Fe(en)_3]^{3+}$

CCC334

Synergez bonding

10. Find the number of ligands which behave predominantly as π-donor ligand (as well as non-classical ligand)

$C_2H_4, C_6H_6, NO^{\oplus}, NO, CO, NH_3, NH_2^{\ominus}, H_2O, OH^{\ominus}$

CCC133

11. Find the EAN value of central atom of $[Fe(\pi - C_4H_4)(CO)_3]$

CCC171

EXERCISE - JEE (Main) PYQ

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

(1) $[Co(NH_3)_4Cl_2]Cl$ (2) $[Co(NH_3)_3Cl_3]$

(3) cis$[Co(en)_2Cl_2]Cl$ (4) trans$[Co(en)_2Cl_2]Cl$

(en = ethylenediamine)

CCC033

2. The pair having the same magnetic moment is :-

[At. No.: Cr = 24, Mn = 25, Fe = 26, Co = 27] **[JEE (Main) 2016]**

(1) $[CoCl_4]^{2\ominus}$ and $[Fe(H_2O)_6]^{2\oplus}$ (2) $[Cr(H_2O)_6]^{2\oplus}$ and $[CoCl_4]^{2\ominus}$

(3) $[Cr(H_2O)_6]^{2\oplus}$and $[Fe(H_2O)_6]^{2\oplus}$ (4) $[Mn(H_2O)_6]^{2\oplus}$ and $[Cr(H_2O)_6]^{2\oplus}$

CCC034

3. Identify the **CORRECT** trend given below :

(Atomic No.= Ti : 22, Cr : 24 and Mo : 42) **[JEE (Main) 2016 Online]**

(1) Δ_O of $[Cr(H_2O)_6]^{2\oplus} < [Mo(H_2O)_6]^{2\oplus}$ and Δ_O of $[Ti(H_2O)_6]^{3\oplus} < [Ti(H_2O)_6]^{2\oplus}$

(2) Δ_O of $[Cr(H_2O)_6]^{2\oplus} < [Mo(H_2O)_6]^{2\oplus}$ and Δ_O of $[Ti(H_2O)_6]^{3\oplus} > [Ti(H_2O)_6]^{2\oplus}$

(3) Δ_O of $[Cr(H_2O)_6]^{2\oplus} > [Mo(H_2O)_6]^{2\oplus}$ and Δ_O of $[Ti(H_2O)_6]^{3\oplus} > [Ti(H_2O)_6]^{2\oplus}$

(4) Δ_O of $[Cr(H_2O)_6]^{2\oplus} > [Mo(H_2O)_6]^{2\oplus}$ and Δ_O of $[Ti(H_2O)_6]^{3\oplus} < [Ti(H_2O)_6]^{2\oplus}$

CCC035

4. $[Co_2(CO)_8]$ displays :- **[JEE (Main) 2017 Online]**

(1) no Co-Co bond, four terminal CO and four bridging CO

(2) one Co-Co bond, six terminal CO and two bridging CO

(3) no Co–Co bond, six terminal CO and two bridging CO

(4) one Co-Co bond, four terminal CO and four bridging CO

CCC036

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

(1) $[Co(H_2O)_4Cl_2]Cl.2H_2O$ (2) $[Co(H_2O)_3Cl_3].3H_2O$

(3) $[Co(H_2O)_6]Cl_3$ (4) $[Co(H_2O)_5Cl]Cl_2.H_2O$

CCC037

6. The oxidation states of Cr in $[Cr(H_2O)_6]Cl_3$, $[Cr(C_6H_6)_2]$, and $K_2[Cr(CN)_2(O)_2(O_2)(NH_3)]$ respectively are : **[JEE (Main) 2018 Offline]**

(1) +3, +2, and +4 (2) +3, 0, and +6

(3) +3, 0, and +4 (4) +3, +4, and +6

CCC038

7. Consider the following reaction and statements :

$[Co(NH_3)_4Br_2]^{\oplus}\ Br^{\ominus} \rightarrow [Co(NH_3)_3Br_3] + NH_3$

(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 Offline]**

(1) (I) and (III) (2) (III) and (IV) (3) (II) and (IV) (4) (I) and (II)

CCC039

8. The total number of possible isomers for square-planar $[Pt(Cl)(NO_2)(NO_3)(SCN)]^{2\ominus}$ is :-

[JEE (Main) 2018 Online]

(1) 16 (2) 8 (3) 24 (4) 12

CCC040

9. The correct order of spin-only magnetic moments among the following is :

(Atomic number : Mn = 25, Co = 27, Ni= 28, Zn = 30) **[JEE (Main) 2018 Online]**

(1) $[ZnCl_4]^{2\ominus} > [NiCl_4]^{2\ominus} > [CoCl_4]^{2\ominus} > [MnCl_4]^{2\ominus}$

(2) $[CoCl_4]^{2\ominus} > [MnCl_4]^{2\ominus} > [NiCl_4]^{2\ominus} > [ZnCl_4]^{2\ominus}$

(3) $[MnCl_4]^{2\ominus} > [CoCl_4]^{2\ominus} > [NiCl_4]^{2\ominus} > [ZnCl_4]^{2\ominus}$

(4) $[NiCl_4]^{2\ominus} > [CoCl_4]^{2\ominus} > [MnCl_4]^{2\ominus} > [ZnCl_4]^{2\ominus}$

CCC041

10. The correct combination is **[JEE (Main) 2018 Online]**

(1) $[Ni(CN)_4]^{2\ominus}$ – tetrahedral ; $[Ni(CO)_4]$ – paramagnetic

(2) $[NiCl_4]^{2\ominus}$– paramagnetic ; $[Ni(CO)_4]$ – tetrahedral

(3) $[NiCl_4]^{2\ominus}$ – diamagnetic ; $[Ni(CO)_4]$ – square – planar

(4) $[NiCl_4]^{2\ominus}$– square – planar ; $[Ni(CN)_4]^{2\ominus}$ – paramagnetic

CCC042

11. 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 value of (A) is less than that of (B).

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

(3) Both absorb energies corresponding to their complementary colors.

(4) Both are paramagnetic with three unpaired electrons.

CCC044

12. 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 $t_{2g}^4 e_g^2$

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

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

CCC045

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

(1) $[Co(en)(NH_3)_4]Cl_2$ (2) $[Co(en)_3]Cl_2$

(3) $[Co(en)_2(NH_3)_2]Cl_2$ (4) $[Co(NH_3)_6]Cl_2$

CCC046

14. 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]**

CCC047

15. Arrange the following Cobalt complexes in the order of increasing Crystal Field Stabilization Energy (CFSE) value. **[JEE (Main) 2021]**

Complexes : $\underset{A}{\left[CoF_6\right]^{3\ominus}}$, $\underset{B}{\left[Co(H_2O)_6\right]^{2\oplus}}$, $\underset{C}{\left[Co(NH_3)_6\right]^{3\oplus}}$ and $\underset{D}{\left[Co(en)_3\right]^{3\oplus}}$

Choose the correct option :

(1) A < B < C < D (2) B < A < C < D (3) B < C < D < A (4) C < D < B < A

CCC048

16. 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

CCC049

17. 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; $H_2N\text{-}CH_2\text{-}CH_2\text{-}NH_2$) **[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-$[Cu(en)_2Cl_2]$

CCC050

18. The set which does not have ambidentate ligand(s) is **[JEE (Main) 2023]**

(1) $C_2O_4^{2-}$, ethylene diammine, H_2O (2) $EDTA^{4-}$, NCS^-, $C_2O_4^{2-}$

(3) NO_2^-, $C_2O_4^{2-}$, $EDTA^{4-}$ (4) $C_2O_4^{2-}$, NO_2^-, NCS^-

CCC316

19. Which of the following complex has a possibility to exist as meridional isomer? **[JEE (Main) 2023]**

(1) $[Co(NH_3)_3(NO_2)_3]$ (2) [Co (en)$_3$]

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

CCC317

20. The ratio of spin-only magnetic moment values $\mu_{eff}[Cr(CN)_6]^{3-} / \mu_{eff}[Cr(H_2O)_6]^{3+}$ is _____.

[JEE (Main) 2023]

CCC318

EXERCISE - JEE (Advanced) PYQ

1. Consider the following complex ions P, Q and R,
P = $[FeF_6]^{3\ominus}$, **Q** = $[V(H_2O)_6]^{2\oplus}$ and **R** = $[Fe(H_2O)_6]^{2\oplus}$
The correct order of the complex ions, according to their spin-only magnetic moment values (in B.M.) is - **[JEE (Advanced) 2013]**
(A) R < Q < P (B) Q < R < P (C) R < P < Q (D) Q < P < R
CCC071

2. The pair(s) of coordination complex/ion exhibiting the same kind of isomerism is(are) – **[JEE (Advanced) 2013]**
(A) $[Cr(NH_3)_5Cl]Cl_2$ and $[Cr(NH_3)_4Cl_2]Cl$ (B) $[Co(NH_3)_4Cl_2]^{\oplus}$ and $[Pt(NH_3)_2(H_2O)Cl]^{\oplus}$
(C) $[CoBr_2Cl_2]^{2\ominus}$ and $[PtBr_2Cl_2]^{2\ominus}$ (D) $[Pt(NH_3)_3(NO_3)]$ Cl and $[Pt(NH_3)_3Cl]$ Br
CCC072

3. $EDTA^{4\ominus}$ is ethylenediaminetetraacetate ion. The total number of N–Co–O bond angles in $[Co(EDTA)]^{1\ominus}$ complex ion is **[JEE (Advanced) 2013]**
CCC073

4. Match each coordination compound in List-I with an appropriate pair of characteristics from List-II and select the correct answer using the code given below the lists. **[JEE (Advanced) 2014]**
{en = $H_2NCH_2CH_2NH_2$ ' atomic numbers ; Ti = 22 ; Cr = 24 ; Co = 27 ; Pt = 78}

List-I	**List-II**
(P) $[Cr(NH_3)_4Cl_2]Cl$	(1) Paramagnetic and exhibits ionisation isomerism
(Q) $[Ti(H_2O)_5Cl](NO_3)_2$	(2) Diamagnetic and exhibits cis-trans isomerism
(R) $[Pt(en)(NH_3)Cl]NO_3$	(3) Paramagnetic and exhibits cis-trans isomerism
(S) $[Co(NH_3)_4(NO_3)_2]NO_3$	(4) Diamagnetic and exhibits ionisation isomerism

Code :

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

CCC074

5. For the octahedral complexes of $Fe^{3\oplus}$ in $SCN^{\ominus}$ (thiocyanato – S)and in $CN^{\ominus}$ ligand environments, the difference between the spin only magnetic moments in Bohr magnetons (when approximated to the nearest integer) is : [Atomic number of Fe = 26] **[JEE (Advanced) 2015]**
CCC075

6. In the complex acetylbromidodicarbonylbis (triethyl phosphine)iron(II), the number of Fe–C bond(s) is- **[JEE (Advanced) 2015]**
CCC076

7. Among the complex ions,
$[Co(NH_2 - CH_2 - CH_2 - NH_2)_2Cl_2]^{\oplus}$, $[CrCl_2(C_2O_4)_2]^{3\ominus}$, $[Fe(H_2O)_4(OH)_2]^{\oplus}$, $[Fe(NH_3)_2(CN)_4]^{\ominus}$, $[Co(NH_2\text{-}CH_2\text{-}CH_2\text{-}NH_2)_2(NH_3)Cl]^{2\oplus}$ and $[Co(NH_3)_4(H_2O)Cl]^{2\oplus}$, the number of complex ion(s) that show(s) cis-trans isomerism is - **[JEE (Advanced) 2015]**
CCC077

8. Among $[Ni(CO)_4]$, $[NiCl_4]^{2\ominus}$, $[Co(NH_3)_4Cl_2]Cl$, $Na_3[CoF_6]$, Na_2O_2 and CsO_2, the total number of paramagnetic compounds is - **[JEE(Advance) 2015]**

(A) 2 (B) 3 (C) 4 (D) 5

CCC078

9. The number of geometric isomers possible for the complex $[CoL_2Cl_2]^{\ominus}$ $(L = H_2NCH_2CH_2O^{\ominus})$ is **[JEE (Advanced) 2016]**

CCC079

10. The geometries of the ammonia complexes of $Ni^{2\oplus}$, $Pt^{2\oplus}$ and $Zn^{2\oplus}$, respectively, are : **[JEE (Advanced) 2016]**

(A) octahedral, square planar and tetrahederal

(B) square planar, octahederal and tetrahederal

(C) tetrahederal, square planar and octahederal

(D) octahedral, tetrahedral and square planar

CCC080

11. Addition of excess aqueous ammonia to a pink coloured aqueous solution of $MCl_2 . 6H_2O$ (X) and NH_4Cl gives an octahedral complex Y in the presence of air. In aqueous solution, complex Y behaves as 1 : 3 electrolyte. The reaction of X with excess HCl at room temperature results in the formation of a blue coloured complex Z. The calculated spin only magnetic moment of X and Z is 3.87 B.M., whereas it is zero for complex Y.

Among the following options, which statements is(are) **CORRECT** ? **[JEE (Advanced) 2017]**

(A) The hybridization of the central metal ion in Y is d^2sp^3

(B) Z is tetrahedral complex

(C) Addition of silver nitrate to Y gives only two equivalents of silver chloride

(D) When X and Z are in equilibrium at 0°C, the colour of the solution is pink

CCC081

12. The correct statement(s) regarding the binary transition metal carbonyl compounds is (are) (Atomic numbers : Fe = 26, Ni = 28) **[JEE (Advanced) 2018]**

(A) Total number of valence shell electrons at metal centre in $Fe(CO)_5$ or $Ni(CO)_4$ is 16

(B) These are predominantly low spin in nature

(C) Metal - carbon bond strengthens when the oxidation state of the metal is lowered

(D) The carbonyl C–O bond weakens when the oxidation state of the metal is increased

CCC082

13. The correct option(s) regarding the complex $[Co(en)(NH_3)_3(H_2O)]^{3\oplus}$:- $(en = H_2NCH_2CH_2NH_2)$ is (are) **[JEE (Advanced) 2018]**

(A) It has two geometrical isomers

(B) It will have three geometrical isomers if bidentate 'en' is replaced by two cyanide ligands

(C) It is paramagnetic

(D) It absorbs light at longer wavelength as compared to $[Co(en)(NH_3)_4]^{3\oplus}$

CCC083

14. Match each set of hybrid orbitals from LIST-I with complex (es) given in LIST-II.

LIST-I	LIST-II
(P) dsp^2	(1) $[FeF_6]^{4\ominus}$
(Q) sp^3	(2) $[Ti(H_2O)_3Cl_3]$
(R) sp^3d^2	(3) $[Cr(NH_3)_6]^{3\oplus}$
(S) d^2sp^3	(4) $[FeCl_4]^{2\ominus}$
	(5) $Ni(CO)_4$
	(6) $[Ni(CN)_4]^{2\ominus}$

The correct option is :- **[JEE (Advanced) 2018]**

(A) P → 5; Q → 4,6; R → 2,3; S → 1 (B) P → 5,6; Q → 4; R → 3; S → 1,2

(C) P → 6; Q → 4,5; R → 1; S → 2,3 (D) P → 4,6; Q → 5,6; R → 1,2; S → 3

CCC084

15. Among the species given below, the total number of diamagnetic species is___.

H atom, NO_2 monomer, $O_2^{\ominus}$ (superoxide), dimeric sulphur in vapour phase,

Mn_3O_4, $(NH_4)_2[FeCl_4]$, $(NH_4)_2[NiCl_4]$, K_2MnO_4, K_2CrO_4 **[JEE (Advanced) 2018]**

CCC085

16. Total number of cis N–Mn–Cl bond angles (that is, Mn–N and Mn–Cl bonds in cis positions) present in a molecule of cis-$[Mn(en)_2Cl_2]$ complex is ___ (en = $NH_2CH_2CH_2NH_2$)

[JEE (Advanced) 2019]

CCC086

17. Choose the correct statement(s) among the following : **[JEE (Advanced) 2020]**

(A) $[FeCl_4]^{\ominus}$ has tetrahedral geometry.

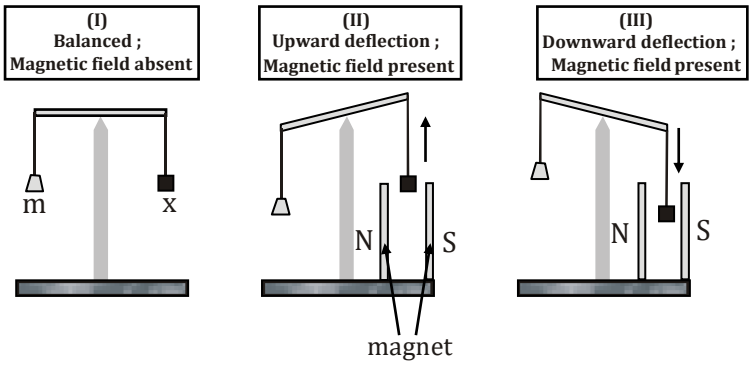
(B) $[Co(en)(NH_3)_2Cl_2]^{\oplus}$ has 2 geometrical isomers.

(C) $[FeCl_4]^{\ominus}$ has higher spin – only magnetic moment than $[Co(en)(NH_3)_2Cl_2]^{\oplus}$.

(D) The cobalt ion in $[Co(en)(NH_3)_2Cl_2]$| has sp^3d^2 hybridization.

CCC087

18. In an experiment, m grams of a compound X (gas/liquid/solid) taken in a container is loaded in a balance as shown in figure **I** below. In the presence of a magnetic field, the pan with **X** is either deflected upwards (figure **II**), or deflected downwards (figure **III**), depending on the compound **X**. Identify the correct statement (s) **[JEE (Advanced) 2020]**



(A) If X is $H_2O(l)$, deflection of the pan is upwards.

(B) If X is $K_4[Fe(CN)_6](s)$, deflection of the pan is upwards.

(C) If X is $O_2(g)$, deflection of the pan is downwards.

(D) If X is $C_6H_6(l)$, deflection of the pan is downwards.

CCC088

19. The pair(s) of complexes wherein both exhibit tetrahedral geometry is(are)
(Note: py = pyridine **[JEE (Advanced) 2021]**
Given: Atomic numbers of Fe, Co, Ni and Cu are 26, 27, 28 and 29, respectively)

(A) $[FeCl_4]^-$ and $[Fe(CO)_4]^{2\ominus}$
(B) $[Co(CO)_4]^{\ominus}$ and $[CoCl_4]^{2\ominus}$
(C) $[Ni(CO)_4]$ and $[Ni(CN)_4]^{2\ominus}$
(D) $[Cu(py)_4]^{\oplus}$ and $[Cu(CN)_4]^{3\ominus}$

CCC089

20. The total number of possible isomers for $[Pt(NH_3)_4Cl_2]Br_2$ is _____ **[JEE (Advanced) 2021]**

CCC090

21. The calculated spin only magnetic moments of $[Cr(NH_3)_6]^{3\oplus}$ and $[CuF_6]^{3\ominus}$ in BM, respectively, are
(Atomic numbers of Cr and Cu are 24 and 29, respectively) **[JEE (Advanced) 2021]**

(A) 3.87 and 2.84
(B) 4.90 and 1.73
(C) 3.87 and 1.73
(D) 4.90 and 2.84

CCC091

22. LIST-I contains metal species and LIST-II contains their properties.

LIST-I	**LIST-II**
(I) $[Cr(CN)_6]^{4\ominus}$	(P) t_{2g} orbitals contain 4 electrons
(II) $[RuCl_6]^{2\ominus}$	(Q) μ(spin-only) = 4.9 BM
(III) $[Cr(H_2O)_6]^{2\oplus}$	(R) low spin complex ion
(IV) $[Fe(H_2O)_6]^{2\oplus}$	(S) metal ion in +4 oxidation state
	(T) d^4 species

[Given : Atomic number of Cr = 24, Ru = 44, Fe = 26] **[JEE (Advanced) 2022]**
Metal each metal species in LIST-I with their properties in LIST-II, and choose the correct option

(A) I → R, T; II → P, S; III → Q, T; IV → P, Q
(B) I → R, S; II → P, T; III → P, Q; IV → Q, T
(C) I → P, R; II → R, S; III → R, T; IV → P, T
(D) I → Q, T; II → S, T; III → P, T; IV → Q, R

CCC092

23. Match the electronic configurations in List-I with appropriate metal complex ions in List-II and choose the correct option.
[Atomic Number: Fe = 26, Mn = 25, Co = 27] **[JEE (Advanced) 2023]**

List-I		**List-II**	
(P)	$t_{2g}^6 e_g^0$	(1)	$[Fe(H_2O)_6]^{2+}$
(Q)	$t_{2g}^3 e_g^2$	(2)	$[Mn(H_2O)_6]^{2+}$
(R)	$e^2 t_2^3$	(3)	$[Co(NH_3)_6]^{3+}$
(S)	$t_{2g}^4 e_g^2$	(4)	$[FeCl_4]^-$
		(5)	$[CoCl_4]^{2-}$

(A) P → 1; Q → 4; R → 2; S → 3
(B) P → 1; Q → 2; R → 4; S → 5
(C) P → 3; Q → 2; R → 5; S → 1
(D) P → 3; Q → 2; R → 4; S → 1

CCC319

24. The complex(es), which can exhibit the type of isomerism shown by $[Pt(NH_3)_2Br_2]$, is(are)
[en = $H_2NCH_2CH_2NH_2$] **[JEE (Advanced) 2023]**

(A) $[Pt(en)(SCN)_2]$
(B) $[Zn(NH_3)_2Cl_2]$
(B) (C) $[Pt(NH_3)_2Cl_4]$
(D) $[Cr(en)_2(H_2O)(SO_4)]^+$

CCC320

JEE (Main) Practice Paper

SECTION-A

- This section contains **TWENTY** questions.
- Each question has **FOUR** options (1), (2), (3) and (4). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :

Full Marks : +4, if only the bubble corresponding to the correct option is darkened.

Zero Marks : 0, if none of the bubbles is darkened.

Negative Marks : –1 in all other cases

---

1. Some salts although containing two different metallic elements give test for one of them in solution. Such salts are

(1) complex salt (2) double salt (3) normal salt (4) none of these

CCC001

2. Aqueous solution of $FeSO_4$ gives tests for both $Fe^{2\oplus}$ and $SO_4^{2\ominus}$ but after addition of excess of KCN, solution ceases to give test for $Fe^{2\oplus}$. This is due to the formation of

(1) the double salt $FeSO_4.2KCN.6H_2O$ (2) $Fe(CN)_3$

(3) the complex ion $[Fe(CN)_6]^{4\ominus}$ (4) the complex ion $[Fe(CN)_6]^{3\ominus}$

CCC002

3. Diethylene triamine is:

(1) Chelating agent (2) Polydentate ligand

(3) Tridentate ligand (4) All of these

CCC003

4. In the co-ordination compound $Na_4[Fe(CN)_5NOS]$ oxidation state of Fe is -

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

CCC004

5. Which of the following order is correct for the IR vibrational frequency of CO.

(1) $[Fe(CO)_4]^{2\ominus} < [Co(CO)_4]^{\ominus} < [Ni(CO)_4]$ (2) $[Fe(CO)_4]^{2\ominus} > [Co(CO)_4]^{\ominus} > [Ni(CO)_4]$

(3) $[Fe(CO)_4]^{2\ominus} > [Co(CO)_4]^{\ominus} < [Ni(CO)_4]$ (4) $[Fe(CO)_4]^{2\ominus} < [Co(CO)_4]^{\ominus} > [Ni(CO)_4]$

CCC005

6. Which of the following obey Sidgwick EAN rule ?

(1) Wilkinson catalyst (2) cis-platin

(3) Brown ring complex (4) Prussian blue

CCC006

7. The formula of the complex tris(ethylenediamine)cobalt(III)-sulphate is

(1) $[Co(en)_2SO_4]$ (2) $[Co(en)_3SO_4]$ (3) $[Co(en)_3]SO_4$ (4) $[Co(en)_3]_2(SO_4)_3$

CCC007

8. Which of the following statement is **INCORRECT** regarding the following compound $[Pt(NH_3)_4]$ $[PtCl_4]$

(1) It is the polymerisation isomer of $[Pt(NH_3)_3Cl_3]$

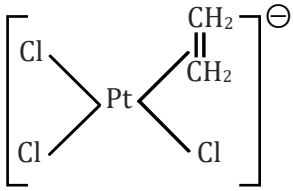
(2) E.A.N. of cationic part is equal to that of anionic part

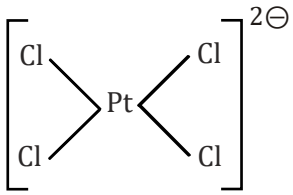
(3) It is the co-ordination isomer of $[Pt(NH_3)_3Cl]$ $[Pt(NH_3)Cl_3]$

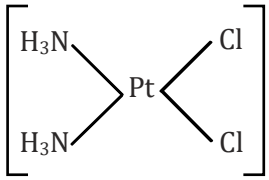
(4) Synergic bonding is not involved in the complex

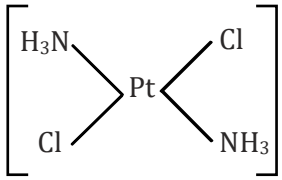
CCC008

9. Which of the following is considered to be an anticancer species ?

(1) 

(2) 

(3) 

(4) 

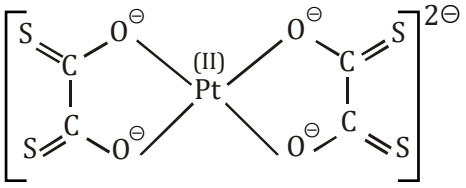
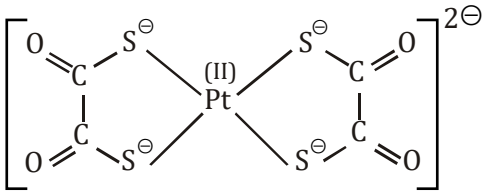
CCC009

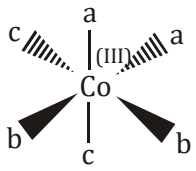
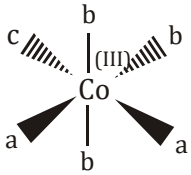
10. Which of the following complex show cis-trans isomerism.

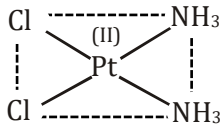
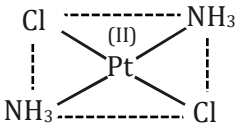
(1) $[Pt(NH_3)_4]^{2\oplus}$ (2) $[Zn(Cl_4)]^{2\ominus}$ (3) $[Zn(NH_3)_2Cl_2]$ (4) $[Pt(NH_3)_2Cl_2]$

CCC010

11. Identify the pair of complex which are stereoisomer of each other -

(1)  and 

(2)  and 

(3)  and 

(4) All of the above

CCC011

12. Find the complex which have maximum number of stereoisomers -

(1) $[Ma_2b_2cd]$ (2) $[Ma_2bcde]$ (3) $[M(AA)b_2c_2]$ (4) $[M(AB)_2c_2]$

CCC012

13. Both geometrical and optical isomerism shown by :-

(1) $[Co(en)_2Cl_2]^{\oplus}$ (2) $[Co(NH_3)_5Cl]^{2\oplus}$

(3) $[Co(NH_3)_4Cl_2]^{\oplus}$ (4) $[Cr(ox)_3]^{3\ominus}$

CCC013

14. Which of the following is an outer orbital complex ?

(1) $[Fe(CN)_6]^{4\ominus}$ (2) $[Mn(CN)_6]^{4\ominus}$ (3) $[Cr(NH_3)_6]^{3\oplus}$ (4) $[Ni(NH_3)_6]^{2\oplus}$

CCC014

15. The geometry of $[Co(CO)_4]^{\ominus}$ and $[Cd(CN)_4]^{2\ominus}$ are
(1) both square planar
(2) both tetrahedral
(3) tetrahedral and square planar, respectively
(4) square planar and tetrahedral, respectively.

CCC015

16. $\left[Fe(en)_2(H_2O)_2\right]^{2\oplus} + en \longrightarrow$ complex (X). the correct statement about the complex (X) is
(1) it is a high spin complex
(2) it is diamagnetic
(3) it shows geometrical isomerism
(4) it is outer orbital complex

CCC016

17. The tetrahedral $[CoI_4]^{2\ominus}$ and square planar $[PdBr_4]^{2\ominus}$ complex ions are respectively
(1) low spin, high spin
(2) high spin, low spin
(3) both low spin
(4) both high spin

CCC017

18. In which of the following pair of complexes stability of first complex is more than the second one.
(1) $K_4[Fe(CN)_6], K_3[Fe(CN)_6]$
(2) $[Co(NH_3)_6]^{3\oplus}, [Co(CN)_6]^{3\ominus}$
(3) $[Co(en)_3]^{3\oplus}, [Co(NH_3)_6]^{3\oplus}$
(4) $[Co(en)_3]^{3\oplus}, [Co(EDTA)]^{\ominus}$

CCC018

19. Which of the following compound shows colour ?
(1) $K_2Cr_2O_7$ (2) $[Ti(H_2O)_6]^{4\oplus}$ (3) $ZnSO_4$ (4) $CdCl_2$

CCC019

20. Which one of the following species does not represent cationic species of vanadium formed in aqueous solution
(1) $VO_2^{\oplus}$ (2) $VO^{2\oplus}$ (3) $[V(H_2O)_6]^{3\oplus}$ (4) $VO_2^{2\oplus}$

CCC020

SECTION-B

- This section will have **10 questions**. Candidate can choose to attempt any 5 questions out of these 10 questions. In case if candidate attempts more than 5 questions, first 5 attempted questions will be considered for marking.
- The answer to each question is a **NUMERICAL VALUE.**
- For each question, enter the correct numerical value (Answer should be rounded off to the nearest integer).
- Answer to each question will be evaluated according to the following marking scheme:
  Full Marks : +4, if only correct answer is given.
  Zero Marks : 0, if no answer is given.
  Negative Marks :-1 for incorrect answer

---

1. Give the co-ordination number of La in the compound $Na[La\ EDTA\ (H_2O)_4].3H_2O$
(Here $EDTA^{4\ominus}$ show it's maximum denticity.)

CCC021

2. Number of moles of AgCl obtained when one mole of complex $PtCl_4.3NH_3$ is react with excess of $AgNO_3$.

CCC022

3. Find the value of E.A.N of $[Pd(CO)_4]^{2\oplus}$ (atomic number = 46) :

CCC023

4. Find number of Co–N linkage in,
"Pentaamminecobalt(III)–μ–amidodiamminetriaquacobalt(III) chloride"

CCC024

5. Find out the total number of geometrical isomers of $[Co(H_2O)_3Cl_3]$.

CCC025

6. Find the number of optically active isomers for $[Pd(en)_2(NH_3)(H_2O)]^{4\oplus}$ cation.

CCC026

7. A co-ordination compound have magnetic moment 5.92 B.M. Find out the number of unpaired electron(s) in the compound.

CCC027

8. Among the following complexes, how many have 'spin only' magnetic moment of 2.83 B.M. ?
$[Ni(CO)_4], [Ni(CN)_4]^{2\ominus}, [NiCl_2(PPh_3)_2], [NiCl_4]^{2\ominus}, [NiF_6]^{2\ominus}, [NiF_6]^{4\ominus}$

CCC028

9. Find the total number of complexes or compounds are coloured :-
$[Ti(NH_3)_6]^{4\oplus}, CuCl_2, [Cu(CH_3CN)_4]BF_4, CuCl, VOCl_2, MnO_4^{\ominus}$

CCC029

10. Number of unpaired electrons in t_{2g} orbital of cobalt in $[CoF_6]^{3\ominus}$.

CCC030

JEE (Advanced) Practice Paper

SECTION–I

- This section contains **FOUR** questions.
- Each question has FOUR options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories:

Full Marks : +3, if only the bubble corresponding to the correct option is darkened.
Zero Marks : 0, if none of the bubbles is darkened.
Negative Marks : –1 in all other cases

---

1. In the co-ordination species, $[M(N_2H_5)_2Cl_2]ClO_4$ the oxidation number and co-ordination number of central atom are respectively :

(A) +3 and 4 (B) +1 and 6 (C) +1 and 4 (D) +3 and 6

CCC051

2. As per IUPAC nomenclature, the name of the complex $[Co(H_2O)_4(NH_3)_2]Cl_3$ is :

(A) Tetraaquadiaminecobalt(III) chloride

(B) Tetraaquadiamminecobalt(III) chloride

(C) Diaminetetraaquacobalt(II) chloride

(D) Diamminetetraaquacobalt(III) chloride

CCC052

3. The coordination number of $Ni^{2\oplus}$ is 4.

$NiCl_2$ + KCN (excess) → A (cyano complex)

$NiCl_2$ + KCl (excess) → B (chloro complex)

The hybridization of A and B are

(A) dsp^2, sp^3 (B) sp^3, sp^3 (C) dsp^2, dsp^2 (D) sp^3d^2, d^2sp^3

CCC053

4. **Statement-1**: $[Ti(H_2O)_6]^{3\oplus}$ is coloured while $[Sc(H_2O)_6]^{3\oplus}$ is colourless.

Statement-2: d–d transition is not possible in $[Sc(H_2O)_6]^{3\oplus}$ because no d-electron is present while possible for $Ti^{3\oplus}$ having d^1 system.

(A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.

(B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.

(C) Statement-1 is true, statement-2 is false.

(D) Statement-1 is false, statement-2 is true.

CCC054

SECTION-II

- This section contains **FIVE** questions.
- Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose the correct option(s) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks	: +4, if only (all) the correct option(s) is (are) chosen.
Partial Marks	: +3 If all the four options are correct but ONLY three options are chosen.
Partial Marks	: +2 If three or more options are correct but ONLY two options are chosen, both of which are correct options.
Partial Marks	: +1 If two or more options are correct but ONLY one option is chosen and it is a correct option.
Zero Marks	: 0 If none of the options is chosen (i.e. the question is unanswered).
Negative Marks	: –2 In all other cases.

For Example : If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in –2 marks.

---

5. Which of the following statement(s) is/are **INCORRECT**

(A) In $[CoBrCl(en)_2]^{\oplus}$ geometrical isomerism exists, while optical isomerism does not exist

(B) Potassium aquadicyanidosuperoxidoperoxidochromate(III) is IUPAC name for $K_2[Cr(CN)_2O_2(O_2)(H_2O)]$

(C) There are 3 geometrical isomers and 15 stereoisomers possible for $[Pt(NO_2)(NH_3)(NH_2OH)(py)]^+$ and $[PtBr\ Cl\ I\ (NO_2)(NH_3)(py)]$ respectively

(D) cis and trans forms are not diastereomers of each other

CCC055

6. Which of the following compound(s) show(s) optical isomerism.

(A) $[Pt(bn)_2]^{2\oplus}$ (B) $[CrCl_2(en)_2]^{\oplus}$ (C) $[Co(en)_3]\ [CoF_6]$ (D) $[Zn(gly)_2]$

CCC056

7. Which of the following statement(s) is (are) **CORRECT** ?

(A) The oxidation state of iron in sodium nitroprusside $Na_2[Fe(CN)_5(NO)]$ is +II.

(B) $[Ag(CN)_2]^{\ominus}$ is linear in shape.

(C) In $[Fe(H_2O)_6]^{3\oplus}$, Fe is d^2sp^3 hybridized.

(D) In $Ni(CO)_4$, the oxidation state of Ni is zero.

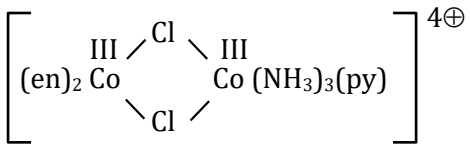
CCC057

8. Which of the following complexes exhibit colour due to d–d transition (t_{2g}–e_g transition).

(A) $[Ti(H_2O)_6]^{3\oplus}$ (B) $[MnO_4]^{\ominus}$ (C) $[CrO_4]^{2\ominus}$ (D) $[Fe(H_2O)_3Cl_3]$

CCC058

9. Select type of isomerism in :



(A) Linkage isomerism (B) Optical isomerism

(C) Geometrical isomerism (D) Co-ordination position isomer

CCC059

SECTION–III

- This section contains **TWO** questions.
- Each question has **matching lists**. The codes for the lists have choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct
- For each question, marks will be awarded in one of the following categories :

Full Marks : +3, if only the bubble corresponding to the correct option is darkened.

Zero Marks : 0, if none of the bubbles is darkened.

Negative Marks : –1 in all other cases.

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10. Match the list.

List-I	**List-II**
(P) $[Cr(H_2O)_4Br_2]^{\oplus}$	(1) Paramagnetic in nature.
(Q) $[Cu(NH_2CH_2CH_2NH_2)(CN)_2Cl_2]^{2\ominus}$	(2) Geometrical isomerism is exhibited.
(R) $[Pt(ox)_2]^{2\ominus}$	(3) Central atom in d^2sp^3 hybridisation
(S) $[Fe(OH)_4]^{\ominus}$	(4) Linkage isomerism is exhibited.
	(5) Complex having symmetrical bidented ligand.

(A) P → 1,2,3; Q → 1,2,4,5; R → 5; S → 1 (B) P → 1,2,3,4; Q → 1,2; R → 1,2,3; S → 3,4

(C) P → 2,3,4,5; Q → 1,5; R → 1,2,3; S → 3,4 (D) P → 3; Q → 4,5; R → 1; S → 1,2,3

CCC060

11. Match the List-I with List-II :

List-I	**List-II**
(P) $EDTA^{4\ominus}$	(1) N-donor atom
(Q) en	(2) Chelate ligand with same donor site
(R) $gly^{\ominus}$	(3) Bidentate with different donor atom
(S) amide	(4) Hexadentate

Code :

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

CCC061

SECTION–IV

- This section contains **A** question of matching type.
- This section contains **One** table (having 3 columns and 4 rows)
- Based on table, there are **THREE** questions
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :

Full Marks : +3 If only the bubble corresponding to the correct option is darkened.
Zero Marks : 0 If none of the bubbles is darkened.
Negative Marks : –1 In all other cases

Answer Q.12, Q.13 and Q.14 by appropriately matching the information given in the three columns of the following table.

The following column I, II, III represent the different type of observations based on CFT in complex compounds.

Answer the questions that follow

Column-I - Crystal field stablization energy (CFSE) (neglecting PE in all cases)

Column-II - Electronic configuration

Column-III - Type of complex

Column – I CFSE (neglecting PE in all cases)	**Column - II** Electronic Configuration	**Column - III** Type of Complex
(I) $-0.4\ \Delta_o$	(i) t_{2g}^5, e_g^0	(P) High spin & Paramagnetic
(II) $-2.0\ \Delta_o$	(ii) t_{2g}^4, e_g^0	(Q) Low spin & Paramagnetic
(III) $-2.4\ \Delta_o$	(iii) t_{2g}^6, e_g^0	(R) High spin & Diamagnetic
(IV) $-1.2\ \Delta_o$	(iv) t_{2g}^4, e_g^2	(S) Low spin & Diamagnetic

12. For sodium nitroprusside complex the only **CORRECT** combination is

(A) (III), (iv), (Q) (B) (III), (iii), (S)
(C) (III), (iii), (R) (D) (II), (iii), (Q)

CCC062

13. For $[Co(H_2O)_3F_3]$ complex the only **CORRECT** combination is.

(A) (I), (iv), (Q) (B) (II), (iv), (S)
(C) (III), (ii), (R) (D) (I), (iv), (P)

CCC063

14. For $[Mn(CN)_6]^{4\ominus}$ complex the only **CORRECT** combination is.

(A) (IV), (i), (S) (B) (II), (i), (R)
(C) (I), (i), (S) (D) (II), (i), (Q)

CCC064

SECTION–V

- This section contains **ONE** paragraphs.
- Based on each paragraph, there are **THREE** questions.
- Each question has **FOUR** options (A), (B), (C) and (D) **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :

Full Marks : +3 If only the bubble corresponding to the correct answer is darkened.

Zero Marks : 0 In all other cases.

Comprehension (15 to 17)

Complex compounds are molecular compounds which retain their identities even when dissolved in water. They do not give all the simple ions in solution but instead furnish complex ions with complicated structures. The complex compounds are often called coordination compounds because certain groups called ligands are attached to the central metal ion by coordinate or dative bonds. Coordination compounds exhibit isomerism, both structural and stereoisomerism. The structure, magnetic property, colour and electrical properties of complexes are explained by various theories.

15. Arrange the following compounds in order of their Molar conductance:

(I) $K[Co(NO_2)_4(NH_3)_2]$ (II) $[Cr(ONO)_3(NH_3)_3]$

(III) $[Cr(NO_2)(NH_3)_5]_3[Co(NO_2)_6]_2$ (IV) $Mg[Cr(NO_2)_5(NH_3)]$

(A) II < I < IV < III (B) I < II < III < IV

(C) II < I < III < IV (D) IV < III < II < I

CCC065

16. The oxidation number and coordination number of chromium in the following complex is $[Cr(C_2O_4)_2(NH_3)_2]^{1\ominus}$

(A) O.N. = + 4, C.N. = 4 (B) O.N. = +3, C.N. = 4

(C) O.N. = – 1, C.N. = 4 (D) O.N. = + 3, C.N. = 6

CCC066

17. In which of the following pairs, both the complexes have the same geometry but different hybridisation

(A) $[NiCl_4]^{2\ominus}$, $[Ni(CN)_4]^{2\ominus}$ (B) $[CoF_6]^{3\ominus}$, $[Co(NH_3)_6]^{3\oplus}$

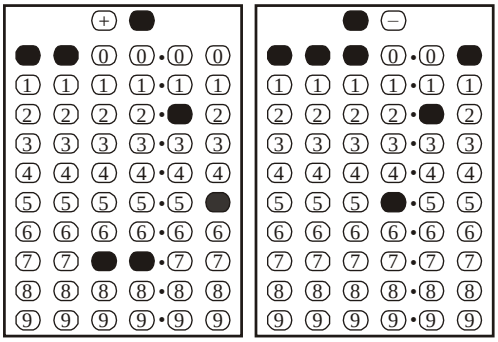
(C) $[Ni(CO)_4]$, $[Ni(CN)_4]^{2\ominus}$ (D) $[Cu(NH_3)_4]^{2\oplus}$, $[Ni(NH_3)_6]^{2\oplus}$

CCC067

SECTION-VI

- This section contains **THREE** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. 6.25, 7.00, –0.33, –.30, 30.27, –127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct) by darken the corresponding bubbles in the ORS.

  For Example : If answer is –77.25, 5.2 then fill the bubbles as follows.



- Answer to each question will be evaluated according to the following marking scheme:

  Full Marks : +3 If ONLY the correct numerical value is entered as answer.

  Zero Marks : 0 In all other cases.

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18. Find out the ratio of number of 'p' electrons to 'd' electrons, in the metal ion of complex $[MCl_4]^{2\ominus}$ if EAN (effective atomic number) of metal in complex is 35.

CCC068

19. Find the total number of linkage isomer in $K_4[Fe(CN)_6]$.

CCC069

20. "Crystal field splitting energy" (CFSE = "Δ_O") for $[Ti(H_2O)_6]^{3\oplus}$ is 242 KJ/mol. Then the "Crystal field stabilisation energy" (CFSE) in KJ/mol will be

CCC070

ANSWER KEY

EXERCISE - O

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	B	C	C	C	A	C	B	D	C	D
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	B	B	D	C	C	C	A	B	C	C
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	B	D	A	C	B	B	D	B	C	D
Que.	31	32	33	34	35	36	37	38	39	40
Ans.	D	D	B	C	D	B	A	B	A	D
Que.	41	42	43	44	45	46	47	48	49	50
Ans.	B	D	B	B	D	B	D	C	B	A
Que.	51	52	53	54	55	56	57	58	59	60
Ans.	C	C	C	C	C	C	B	B	B	C
Que.	61	62	63	64	65	66	67	68	69	70
Ans.	A	C	D	D	B	C	A	A	C	D
Que.	71	72	73	74	75	76	77	78	79	80
Ans.	B	B	A	C	A	D	B	C	C	D
Que.	81	82	83	84	85	86	87	88	89	90
Ans.	A	C	A	D	D	C	C	ABD	AC	BCD
Que.	91	92	93	94	95	96	97	98	99	100
Ans.	AB	AB	ACD	AB	ABD	ABC	ABCD	CD	B	D
Que.	101	102	103	104	105	106	107	108	109	110
Ans.	B	D	C	A	C	C	D	A	B	A

EXERCISE - S

Que.	1	2	3	4	5	6
Ans.	4	33	2	15	9	(a) 4, (b) 9, (c) 4, (d) 4, (e) 5
Que.	7	8	9	10	11	
Ans.	2	2	5	2	36	

EXERCISE - JEE (Main) PYQ

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	3	3	2	2	4	2	1	4	3	2
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	2	4	2	2	2	1	1	1	1	1

EXERCISE - JEE (Advanced) PYQ

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	B	BD	8	B	4	3	6	B	5	A
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	ABD	BC	ABD	C	1	6	AC	ABC	ABD	6
Que.	21	22	23	24						
Ans.	A	A	D	CD						

JEE (Main) Practice Paper

	Q.	1	2	3	4	5	6	7	8	9	10
Section-A	A.	1	3	4	2	1	4	4	1	3	4
	Q.	11	12	13	14	15	16	17	18	19	20
	A.	3	2	1	4	2	2	2	3	1	4
Section-B	Q.	1	2	3	4	5	6	7	8	9	10
	A.	10	1	52	9	2	2	5	3	3	2

JEE (Advanced) Practice Paper

Section-I	Q.	1	2	3	4	
	A.	C	D	A	A	
Section-II	Q.	5	6	7	8	9
	A.	ABCD	ABCD	ABD	AD	BCD
Section-III	Q.	10	11			
	A.	A	D			
Section-IV	Q.	12	13	14		
	A.	B	D	D		
Section-V	Q.	15	16	17		
	A.	A	D	B		
Section-VI	Q.	18	19	20		
	A.	1.33	7.00	–96.80		