Exercise-1

Marked Questions may have for Revision Questions.

OBJECTIVE QUESTIONS

Section (A) : General introduction of complex salts and definitions to be used :

A-1. Ethylene diamine is an example of a .... ligand :
(1) monodentate (2) bidentate (3) tridentate (4) hexadentate

A-2. Which of the following represents the monodentate monoanion ligand ?
(1) Carbonato (2) Ammonia (3) Nitrito (4) Oxalato

A-3. The co-ordination number and oxidation number of 'X' in the following compound $[X(SO_4)(NH_3)_5]Cl$ will be:
(1) 10 & 3 (2) 2 & 6 (3) 6 & 3 (4) 6 & 4

A-4. The oxidation state of Fe in brown ring complex $[Fe(H_2O)_5NO]SO_4$ is :
(1) + 1 (2) + 2 (3) + 3 (4) + 4

A-5. All ligands are :
(1) lewis acids (2) lewis bases (3) neutral (4) none

A-6. Which of the following are bidentate monoanion ligands ?
(a) Dimethylglyoximato (b) Oxalato ion (c) Bis(ethane-1,2-diamine)
Select the correct answer using the codes given below :
(1) a only (2) a and c only (3) c only (4) b and c only

A-7. An ambidentate ligand is one which :
(1) is linked to the metal atom at two points.
(2) has two donor atoms but only one of them has the capacity to form a coordinate bond.
(3) has two donor atoms but either of the two can form a coordinate bond.
(4) forms chelate rings.

A-8. Which of the following is not correctly matched ?
(1) NO_2^- – Bidentate ligand (2) Ethylenediamine – Bidentate ligand
(3) SCN^- – Monodentate ligand (4) (CO) – Monodentate ligand

A-9. What is the charge on the complex $[Co(NH_3)Cl(gly)_2]$ formed by Co(III) :
(1) +3 (2) 0 (3) +2 (4) –1

A-10. Consider the following :

	Complex		Coordination number
(A)	$[CuCl_2]^-$	(i)	6
(B)	$Ni(CO)_4$	(ii)	5
(C)	$[PtCl_6]^{4-}$	(iii)	4
(D)	$[Ni(NH_3)_6]^{2+}$	(iv)	2

Proper matching is :
(1) A(i), B(ii), C(iii), D(iv) (2) A(iii), B(iv), C(ii), D(iv)
(3) A(iv), B(iii), C(i), D(i) (4) A(i), B(iii), C(ii), D(iv)

A-11._ Which of the following ligands forms a chelate
(1) Acetate (2) Oxalate (3) Cyanide (4) Ammonia

A-12. _ Oxidation state of nitrogen is incorrectly given for

Compound	*Oxidation state*
(1) $[Co(NH_3)_5Cl]Cl_2$	0
(2) NH_2OH	–1
(3) $(N_2H_5)_2SO_4$	+2
(4) Mg_3N_2	–3

Section (B) : Nomenclature of coordination compounds

B-1. What is the chemical formula of bis(ethane-1,2-diamine)oxalatochromium(III) ?

(1) $[Cr(en)_2(ox)]$ (2) $[Cr(ox)_2(en)]^-$ (3) $[Cr(en)_2(ox)]^+$ (4) $[Cr(en)_2(ox)]^-$

B-2. Trioxalatoaluminate(III) and tetrafluoroborate(III) ions are :

(1) $[Al(C_2O_4)_3]$, $[BF_4]^{3-}$ (2) $[Al(C_2O_4)_3]^{3+}$, $[BF_4]^{3+}$ (3) $[Al(C_2O_4)_3]^{3-}$, $[BF_4]^-$ (4) $[Al(C_2O_4)_3]^{2-}$, $[BF_4]^{2-}$

B-3. The IUPAC name for the coordination compound $Ba[BrF_4]_2$ is:

(1) Barium tetrafluorobromate (V) (2) Barium tetrafluorobromate (III)

(3) Barium bis (tetrafluorobromate) (III) (4) none of these

B-4. The IUPAC name of $[Co(NH_3)_3Br\ Cl(NO_2)]$ will be :

(1) Triamminebromidochloridonitrito-N-cobaltate(III)

(2) Triamminebromidochloridonitrito-N-cobalt(III)

(3) Triamminebromidochloridonitrito-O-cobaltate(III)

(4) Triamminenitrito-O-bromidochloridocobaltate(III)

B-5. The correct IUPAC name of complex, $[Rh(en)_2(ONO)\ (SCN)]\ NO_3$ is :

(1) diethane-1,2-diamine nitrito-O-thiocyanato-S-rhodium (III) nitrate

(2) bis(ethane-1,2-diamine) nitrito-O-thiocyanato-S-rhodium(III) nitrate

(3) bis(ethane-1,2-diamine) nitrito-O-thiocyanato-S-rhodate(III) nitrate

(4) bis(ethane-1,2-diamine) nitrito-N-thiocyanato-N-rhodium(II) nitrate.

B-6. The IUPAC name of the complex ion $[Cr(NO_2)(NH_3)(CN)_4]^{2-}$ is :

(1) amminetetracyanidonitrito-O-chromate (III) (2) amminetetracyanidonitrito-N-chromate(III)

(3) amminetetracyanidonitrito-N-chromium(III) (4) amminetetracyanidonitrito-N-chromate(II)

B-7._ IUPAC name of $[Pt(NH_3)_3(Br)(NO_2)Cl]Cl$ is :

(1) Triamminechlorobromonitroplatinum (IV) chloride

(2) Triamminebromonitrochloroplatinum (IV) chloride

(3) Triamminebromochloronitroplatinum (IV) chloride

(4) Triamminenitrochlorobromoplatinum (IV) chloride

B-8._ IUPAC name of $K_3[Al(C_2O_4)_3]$ is called

(1) Potassium alumino oxalato (2) Potassium aluminium (III) trioxalate

(3) Potassium trioxalato aluminate (III) (4) Potassium trioxalato aluminate (IV)

B-9._ The complex chlorocompound diaquatriammine cobalt (III) chloride is represented as

(1) $[Co(NH_3)_3(H_2O)_3]Cl_2$ (2) $[Co(NH_3)_3(H_2O)_2]Cl_2$

(3) $[CoCl(NH_3)_3(H_2O)_2]Cl_3$ (4) $[CoCl(NH_3)_3(H_2O)_2]Cl_2$

B-10._ The complex compound $[Co(NH_3)_3NO_2ClCN]$ is named as

(1) Chlorocyanonitrotriammine cobalt (III)(2) Nitrochlorocyanotriammine cobalt (III)

(3) Cyanonitrochlorotriammine cobalt (III) (4) Triamminenitrochlorocyano cobalt (III)

B-11._ The oxidation number of *Pt* in $[Pt(C_2H_4)Cl_3]^-$ is

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

B-12._ What is the structural formula of lithium tetrahydridoaluminate

(1) $Al[LiH_4]$ (2) $Al_2[LiH_4]_3$ (3) $Li[AlH_4]$ (4) $Li[AlH_4]_2$

Section (C) : Bonding in coordination compounds :
(Initial bonding theories and EAN rule, Valence bond theory)

C-1. In a complex the correct statements :

(1) primary valency is ionisable (2) primary valency is non-ionisable

(3) secondary valency is ionisable (4) All of these

C-2. According to Werner's theory, the secondary valencies of a central metal atom correspond to its:

(1) oxidation state (2) co-ordination number

(3) any of the two (1) and (2) (4) neither of the two

C-3. EAN of the central metal in the complexes – $K_2[Ni(CN_4)]$, $[Cu(NH_3)_4]SO_4$ and $K_2[PtCl_6]$ are respectively:

(1) 36, 35, 86 (2) 34, 35, 84 (3) 34, 35, 86 (4) 34, 36, 86

C-4. In which of the following pairs of complexes, the central metals/ions do not have same effective atomic number ?

(1) $[Cr(CO)_6]$ and $[Fe(CO)_5]$ (2) $[Cu(CN)_4]^{3-}$ and $[Ni(CO)_4]$

(3) $[Co(NH_3)_6]^{2+}$ and $[Ni(NH_3)_6]^{2+}$ (4) $[V(CO)_6]^{-}$ and $[Co(NO_2)_6]^{3-}$

C-5. In which of the following complexes the valence shell of central metal ion does not have d^6 electronic configuration?

(1) $[Fe(H_2O)_6]^{2+}$ (2) $[Mn(H_2O)_6]^{2+}$ (3) $[Co(H_2O)_6]^{3+}$ (4) $[Ni(H_2O)_6]^{4+}$

C-6. A complex compound which is formed by nitrate and bromide ligands, gives 2 mol precipitate of AgBr, when reacts with $AgNO_3$, the formula of complex is :

(1) $[Co(NH_3)_5(NO_3)]Br_2$ (2) $[Co(NH_3)_5Br]Br(NO_3)$

(3) $[Co(NH_3)_4Br_2]NO_3$ (4) None of these

C-7._ Pick out the complex compound in which the central metal atom obeys EAN rule strictly

(1) $K_4[Fe(CN)_6]$ (2) $K_3[Fe(CN)_6]$ (3) $[Cr(H_2O)_6]Cl_3$ (4) $[Cu(NH_3)_4]SO_4$

C-8._ In the complex $[SbF_5]^{2-}$, sp^3d hydridisation is present. Geometry of the complex is :

(1) Square pyramidal (2) Square bipyramidal (3) Tetrahedral (4) Square

C-9._ The type of hybridization involved in the metal ion of $[Ni(H_2O)_6]^{2+}$ complex is

(1) d^3sp^2 (2) sp^3d^2 (3) sp^3 (4) dsp^2

C-10._ The shape of $[Cu(NH_3)_4]^{2+}$ is square planar, Cu^{2+} in this complex is

(1) sp^3 hybridised (2) dsp^2 hybridised (3) sp^3d hybridized (4) sp^3d^2 hybridized

C-11._ $[Pt(NH_3)_4]Cl_2$ is

(1) Square planar (2) Tetrahedral (3) Pyramidal (4) Pentagonal

C-12._ A co-ordination complex compound of cobalt has the molecular formulae 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 on reacting with excess of $AgNO_3$, AgCl precipitate. The ionic formula for this complex would be :

(1) $[Co(NH_3)_5(NO_2)]Cl_2$ (2) $[Co(NH_3)_5Cl][Cl(NO_2)]$

(3) $[Co(NH_3)_4(NO_2)Cl][(NH_3)Cl]$ (4) $[Co(NH_3)_5][(NO_2)_2Cl_2]$

Section (D) : Crystal field theory & applications of crystal field theory : (Theory Magnetic moment of complex, Color of complex, Stability of complex)

D-1. The outer complexes are generally formed by :
(1) strong ligand (2) weak ligands (3) neutral ligands (4) none

D-2. The most stable complex among the following is :
(1) $[NiCl_4]^{2-}$ (2) $[Ni(H_2O)_2Cl_2]$ (3) $[Ni(NH_3)_4]^{2+}$ (4) $[Ni(CN)_4]^{2-}$

D-3. $[Sc(H_2O)_6]^{3+}$ ion is :
(1) coloured and paramagnetic (2) colourless and paramagnetic
(3) colourless and diamagnetic (4) coloured and octahedral

D-4. The geometry and magnetic moment of the complexes $[NiCl_4]^{2-}$ and $[PdCl_4]^{2-}$ respectively are :
(1) tetrahederal, square planar ; 2.83, 0 (2) tetrahedral, tetrahedral ; 2.83, 2.83
(3) square planar, tetrahedral ; 0, 2.83 (4) square planar, square planar : 0, 0

D-5. Which of the following statements is correct with respect to the crystal field theory ?
(1) It considers only the metal ion d–orbitals and gives no consideration at all to other metal orbitals.
(2) It cannot account for the π bonding in complexes.
(3) The ligands are point charges which are either ions or neutral molecules.
(4) All of these

D-6. All the following complex ions are found to be paramagnetic :
P : $[FeF_6]^{3-}$ Q : $[CoF_6]^{3-}$ R : $[V(H_2O)_6]^{3+}$ S : $[Ti(H_2O)_6]^{3+}$
The correct order of their paramagnetic moment (spin only) is :
(1) P > Q > R > S (2) P < Q < R < S (3) P = Q = R = S (4) P > R > Q > S

D-7. In which of the following complex ion, the metal ion will have t_{2g}^6, e_g^0 configuration according to CFT:
(1) $[FeF_6]^{3-}$ (2) $[Fe(CN)_6]^{3-}$ (3) $[Fe(CN)_6]^{4-}$ (4) None of these

D-8. Hybridisation of Fe in $K_3[Fe(CN)_6]$ and $K_4[Fe(CN)_6]$ respectively are :
(1) d^2sp^3 and sp^3d^2 (2) d^2sp^3 and d^2sp^3 (3) sp^3d^2 and sp^3d^2 (4) sp^3d^2 and d^2sp^3

D-9. $[FeF_6]^{3-}$ has Fe atom ---hybridised with unpaired ----electrons :
(1) d^2sp^3, 4 (2) d^2sp^3, 5 (3) sp^3d^2, 5 (4) sp^3d^2, 3

D-10. Hybridisation of $[Ni(NH_3)_6]^{2+}$ and $[Zn(NH_3)_6]^{2+}$ are :
(1) both d^2sp^3 (2) both sp^3d^2
(3) d^2sp^3 and sp^3d^2 respectively (4) sp^3d^2 and d^2sp^3 respectively

D-11._ The number of unpaired electrons in the complex ion $[CoF_6]^{3-}$ is (Atomic no. of Co = 27)
(1) Zero (2) 2 (3) 3 (4) 4

D-12._ Amongst $Ni(CO)_4$, $[Ni(CN)_4]^{2-}$ and $[NiCl_4]^{2-}$
(1) $Ni(CO)_4$ and $[NiCl_4]^{2-}$are diamagnetic and $[Ni(CN)_4]^{2-}$ is paramagnetic
(2) $[NiCl_4]^{2-}$ and $[Ni(CN)_4]^{2-}$ are diamagnetic and $Ni(CO)_4$ is paramagnetic
(3) $Ni(CO)_4$ and $[Ni(CN)_4]^{2-}$ are diamagnetic and $[NiCl_4]^{2-}$ is paramagnetic
(4) $Ni(CO)_4$ is diamagnetic and $[NiCl_4]^{2-}$ and $[Ni(CN)_4]^{2-}$ are paramagnetic

D-13._ The compound which does not show paramagnetism is
(1) $[Cu(NH_3)_4]Cl_2$ (2) $[Ag(NH_3)_2]Cl$ (3) NO (4) NO_2

D-14._ The most stable ion is
(1) $[Fe(OH)_3]^{3-}$ (2) $[Fe(Cl)_6]^{3-}$ (3) $[Fe(CN)_6]^{3-}$ (4) $[Fe(H_2O)_6]^{3+}$

D-15._ The most stable complex among the following is
(1) $K_3[Al(C_2O_4)_3]$ (2) $[Pt(en)_2]Cl_2$ (3) $Ag(NH_3)_2Cl$ (4) $K_2[Ni(EDTA)]$

Section (E) : Isomerism in coordination compounds :

(Structural Isomerism, Stereoisomerism, Geometrical Isomerism, Optical Isomerism)

E-1. $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5SO_4]Br$ are examples of which of the following type of isomerism?

(1) Optical (2) Linkage (3) Coordination (4) Ionization

E-2. Change in composition of co-ordination sphere yields which type of isomers ?

(1) Hydrate (2) Optical (3) Geometrical (4) None of these

E-3. Which of the following cannot show linkage isomerism ?

(1) H_2O (2) CN^- (3) SCN^- (4) NO_2^-

E-4. The number of geometrical isomers of $[Pt(NH_3)_2Cl_2]$ is :

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

E-5. Which of the following complex ions does not show optical activity :

(1) $[PtBrClI(NO_2)(H_2O)NH_3]$ (2) cis$[Co(en)_2Cl_2]^+$

(3) cis$[Co(en)(NH_3)_2Cl_2]^+$ (4) $[Co(NH_3)_4Cl_2]^+$

E-6. Which of the following complex shows ionization isomerism?

(1) $[Cr(NH_3)_6]Cl_3$ (2) $[Cr(en)_2\ ]Cl_2$ (3) $[Cr(en)_3]Cl_3$ (4) $[Co(NH_3)_5Br]SO_4$

E-7. Which kind of isomerism is shown by the complex $[Co(NH_3)_5(ONO)]SO_4$?

1. Ionisation isomerism 2. Linkage isomerism

3. Geometrical isomerism 4. Optical isomerism

(1) 1, 2, 3 and 4 are correct (2) 1, 3 and 4 are correct only

(3) 1 and 2 are correct only (4) 2, 3 and 4 are correct only

E-8._ Which one of the following octahedral complexes will not show geometric isomerism (*A* and *B* are monodentate ligands)

(1) $[MA_5B]$ (2) $[MA_2B_4]$ (3) $[MA_3B_3]$ (4) $[MA_4B_2]$

E-9._ Which would exhibit co-ordination isomerism

(1) $[Cr(NH_3)_6][Co(CN)_6]$ (2) $[Co(en)_2Cl_2]$ (3) $[Cr(NH_3)_6]Cl_3$ (4) $[Cr(en)_2Cl_2]^+$

E-10._ $[Cr(NH_3)_5NO_2]Cl_2$ and $[Co(NH_3)_5(ONO)]Cl_2$ are related to each other as :

(1) Geometrical isomers (2) Optical isomers

(3) Linkage isomers (4) Coordination isomers

E-11._ $[Co(NH_3)_5Br]SO_4$ and $[Co(NO_3)_5SO_4]Br$ are examples of which type of isomerism

(1) Linkage (2) Geometrical (3) Ionization (4) Optical

E-12._ $[Co(NH_3)_4Cl_2]NO_2$ and $[Co(NH_3)_4Cl.NO_2]Cl$ are .... isomers

(1) Geometrical (2) Optical (3) Linkage (4) Ionization

E-13._ Which would exhibit ionisation isomerism

(1) $[Cr(NH_3)_6]Cl_3$ (2) $[Co(NH_3)_5Br]SO_4$ (3) $[Cr(en)_2Cl_2]$ (4) $[Cr(en)_3Cl_3]$

E-14._ $[Ti(H_2O)_6]^{3+}$ is paramagnetic in nature due to

(1) One unpaired e^- (2) Two unpaired e^- (3) Three unpaired e^- (4) No unpaired e^-

E-15._ Which one of the following will not show geometrical isomerism

(1) $[Cr(NH_3)_4Cl_2]Cl$ (2) $[Co(en)_2Cl_2]Cl$ (3) $[Co(NH_3)_5NO_2]Cl_2$ (4) $[Pt(NH_3)_2Cl_2]$

E-16._ Which of the following isomeric pairs shows ionization isomerism

(1) $[Co(NH_3)_6][Cr(CN)_6]$ and $[Cr(NH_3)_6][Co(CN)_6]$

(2) $[Cr(H_2O)_6]Cl_3$ and $[Cr(H_2O)_5Cl]Cl_2.H_2O$

(3) $[Pt(NH_3)_2Cl_2]$ and $[Pt(NH_3)_4][PtCl_4]$

(4) $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5SO_4]Br$

E-17._ The number of isomers possible for square planar complex $K_2[PdClBr_2(SCN)]$ is

(1) 2 (2) 3 (3) 4 (4) 6

Section : (F) Organometallic Compounds

F-1. Which of the following statements are wrong ?

(a) Al_4C_3 is an organometallic compounds

(b) Metal carbonyls are organometallic compounds

(c) TEL is π-bonded organometallic compound

(d) Frankland reagent is π-bonded organometallic compound

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

F-2. Solution of $TiCl_4$ and trialkylaluminium used as a catalyst in polymerisation of olefins is called :

(1) Wilkinson's catalyst (2) Zeigler Natta catalyst

(3) Homogeneous catalyst (4) Grignard reagent

F-3. Which of the following is π-complex?

(1) Trimethyl aluminium (2) Ferrocene

(3) Diethyl zinc (4) Nickel carbonyl

F-4._ Wilkinson's catalyst used as a homogeneous catalyst in the hydrogenation of alkenes contains

(1) Iron (2) Aluminium (3) Rhodium (4) Cobalt

F-5._ Tollen's reagent is

(1) $[Ag(NH_3)_2]^+$ (2) Ag_2O (3) $[Cu(OH)_4]^{2-}$ (4) Cu_2O

F-6._ Which of the following is not considered as an organometallic compound.

(1) Cis-platia (2) Ferrocene (3) Zeise's salt (4) Gringard reagent

Exercise-2

Marked Questions may have for Revision Questions.

OBJECTIVE QUESTIONS

1. Which of the following species in s not expected to be a ligand

(1) NO^+ (2) NH_4^+ (3) $NH_2–NH_3^+$ (4) NO_2^+

2. In $K_4[Fe(CN)_6]$, Fe is in the form of

(1) An atom (2) Neutral complex (3) Cationic complex (4) Anionic complex

3. Which one of the following is not a homoleptic complex ?

(1) $K_2[Ni(CN)_4]$ (2) $[Ni(en)_3](NO_2)_2$ (3) $[NiCl_2(PPh_3)_2]$ (4) $[Ni(H_2O)_6]Cl_2$

4._ The IUPAC name of $[Co(NH_3)_6][Cr(C_2O_4)_3]$ is

(1) Hexaamminecobalt (III) tris (Oxalato) chromate (III)

(2) Hexaamminecobalt (III) tris (Oxalato) chromium (III)

(3) Hexaamminecobalt (II) tris (Oxalato) chromium (III)

(4) Hexaamminecobalt (III) trisoxalatechromium (III)

5. Consider the following statements:

According the Werner's theory.

(1) Ligands are connected to the metal ions by ionic bonds.

(2) Secondary valencies have directional properties

(3) Secondary valencies are nonionisable

Of these statements:

(1) 1, 2 and 3 are correct (2) 2 and 3 are correct

(3) 1 and 3 are correct (4) 1 and 2 are correct

6. The two isomers X and Y with the formula $Cr(H_2O)_5ClBr_2$ were taken for experiment on depression in freezing point. It was found that one mole of X gave depression corresponding to 2 moles of particles and one mole of Y gave depression due to 3 moles of particles. The structural formulae of X and Y respectively are.

(1) $[Cr(H_2O)_5Cl]Br_2$, $[Cr(H_2O)_4Br_2]Cl.\ H_2O$ (2) $[Cr(H_2O)_4Br_2]Cl.H_2O$,$[Cr(H_2O)_5Cl]Br_2$

(3) $[Cr(H_2O)_5Br]BrCl$, $[Cr(H_2O)_4ClBr]Br.H_2O$ (4) $[Cr(H_2O)_5Cl]Br_2$, $[Cr(H_2O)_3ClBr_2].2H_2O$

7. In Tollen’s reagent, the oxidation number, co-ordination number and effective atomic number of central metal ion are respectively [atomic number of Ag - 47] :

(1) +1, 2, 50 (2) +1, 2, 51 (3) 2, +1, 50 (4) +1, 1, 50

8. The number of d-electrons in $[Cr(H_2O)_6]^{3+}$ [atomic number of Cr = 24] is :

(1) 2 (2) 3 (3) 4 (4) 5

9. Chromium hexacarbonyl is an octahedral compound invoving

(1) sp^3d^2 (2) dsp^2 (3) d^2sp^3 (4) dsp^3

10. Which of the following molecules is not tetrahedral

(1) $[Pt(en)_2]^{2+}$ (2) $[Ni(CO)_4]$ (3) $[Zn(NH_3)_4]^{2+}$ (4) $[NiCl_4]^{2–}$

11. Type of isomerism shown by complex $[Co(NH_3)_5NO_2]Cl$ is :

(1) linkage and geometrical (2) linkage only

(3) linkage and ionisation (4) ionisation only

12. $[Co(NH_3)_5NO_2]Cl_2$ and $[Co(NH_3)_5(ONO)]Cl_2$ are related to each other as
(1) Geometrical isomers (2) Optical isomers
(3) Linkage isomers (4) Coordination isomers

13. Which of the following compounds show optical isomerism ?
1. cis-$[Co(NH_3)_4Cl_2]^+$ 2. trans-$[Co(en)_2Cl_2]^+$ 3. cis-$[Co(en)_2Cl_2]^+$ 4. $[Co(en)_3]^{3+}$
Select the correct answer using the codes given below :
(1) 1 and 2 (2) 2 and 3 (3) 3 and 4 (4) 1, 3 and 4

14. Which of the following isomerisms is/are shown by the complex $[CoCl_2(OH_2)_2(NH_3)_2]Br$?
(1) Ionization (2) Geometrical (3) optical (4) All of these

15. In which of the following organometallic compound metal carbon bond has partial bond character ?
(1) $[Fe(\eta^5{-}C_5H_5)_2]$ (2) $K[PtCl_3(\eta^2{-}C_2H_4)]$ (3) $[Co(CO)_5NH_3]^{2+}$ (4) (2) and (3) both

16. Atomic number of Cr and Fe are respectively 24 and 26, which of the following is paramagnetic with the spin of electron ?
(1) $[Cr(CO)_6]$ (2) $[Fe(CO)_5]$ (3) $[Fe(CN)_6]^{4-}$ (4) $[Cr(NH_3)_6]^{3+}$

17. The hypothetical complex chloro diaquatriammine cobalt (III) chloride can be represented as :
(1) $[CoCl(NH_3)_3(H_2O)_2]Cl_2$ (2) $[Co(NH_3)_3(H_2O)Cl_3]$
(3) $[Co(NH_2)_3(H_2O)_2Cl]$ (4) $[Co(NH_3)_3(H_2O)_3]Cl_3$

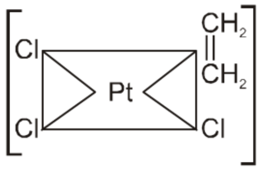
18. According to IUPAC nomenclature, sodium nitroprusside is named as :
(1) Sodium nitroferricyanide
(2) Sodium nitroferrocyanide
(3) Sodium pentacyanonitrosoniumferrate (II)
(4) Sodium pentacyano nitrosylferrate (III)

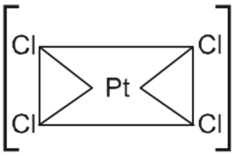
19. The number of unpaired electrons in the complex ion $[CoF_6]^{3-}$ is : (At number Co = 27)
(1) 3 (2) 2 (3) 4 (4) 0

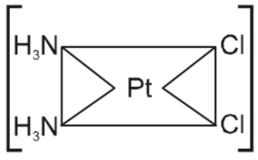
20. Among the following which is not the π-bonded organometallic compound ?
(1) $K[PtCl_3(\eta^2 - C_2H_4)]$ (2) $Fe(\eta^5 - C_5H_5)_2$ (3) $Cr(\eta^6 - C_6H_6)_2$ (4) $(CH_3)_4Sn$

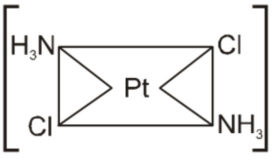
21. Which of the following coordination compounds would exhibit optical isomerism ?
(1) Pentaamminenitrocobalt (III) iodide
(2) Diamminedichloroplatinum (II)
(3) Trans-dicyanobis (ethylenediamine) chromium (III) chloride
(4) Tris-(ethylenediamine) cobalt (III) bromide

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

(1)


(2)


(3)


(4)


23. Which of the following does not have a metal-carbon bond ?
(1) $Al(OC_2H_5)_3$ (2) C_2H_5MgBr (3) $K[Pt(C_2H_4)Cl_3]$ (4) $Ni(CO)_4$

24. CN^- is strong field ligand. This is due to the fact that

(1) it carries negative charge (2) it is a pseudohalide

(3) it can accept electrons from metal species (4) it forms high spin complexes with metal species

25. Considering H_2O as a weak field ligand, the number of unpaired electrons in $[Mn(H_2O)_6]^{2+}$ will be :
(Atomic no. of Mn = 25)

(1) 3 (2) 5 (3) 2 (4) 4

26. Among $[Ni(CO)_4]$, $[Ni(CN)_4]^{2-}$, $[NiCl_4]^{2-}$ species, the hybridisation states of the Ni atom are, respectively (At number of Ni = 28)

(1) sp^3, dsp^2, dsp^2 (2) sp^3, dsp^2, sp^3 (3) sp^3, sp^3, dsp^2 (4) dsp^2, sp^3, sp^3

27. Which one of the following is an inner orbital complex as well as diamagnetic in behaviour ?
[Atomic No. Zn = 30, Cr = 24, Co = 27, Ni = 28]

(1) $[Zn(NH_3)_6]^{2+}$ (2) $[Ni(NH_3)_6]^{2+}$ (3) $[Cr(NH_3)_6]^{3+}$ (4) $[Co(NH_3)_6]^{3+}$

28. $[Co(NH_3)_4(NO_2)_2]Cl$ exhibits :

(1) Ionization isomerism, gemetrical isomerism and optical isomerism

(2) linkage isomerism, geometrical isomerism and optical isomerism

(3) linkage isomerism, ionization isomerism and optical isomerism

(4) linkage isomerism, ionization isomerism and geometrical isomerism

29. Copper sulphate dissolves in excess of KCN give ?

(1) $[Cu(CN)_4]^{2-}$ (2) $Cu(CN)_2$ (3) CuCN (4) $[Cu(CN)_4]^{3-}$

30. $[Cr(H_2O)_6]Cl_3$ (at. no. of Cr = 24) has a magnetic moment of 3.83 B.M. The correct distribution of 3d electrons in the Chromium of the complex is :

(1) $3d^1_{xy}, 3d^1_{yz}, 3d^1_{xz}$ (2) $3d^1_{xy}, 3d^1_{yz}, 3d^1_{z^2}$ (3) $3d^1_{(x2-y2)}, 3d^1_{z^2}, 3d^1_{xz}$ (4) $3d^1_{xy}, 3d^1_{(x2-y2)}, 3d^1_{yz}$

31. Which of the following will give a pair of enantiomorphs ?

(1) $[Pt(NH_3)_4][PtCl_6]$ (2) $[Co(NH_3)_4Cl_2]NO_2$ (3) $[Cr(NH_3)_6][Co(CN)_6]$ (4) $[Co(en)_2Cl_2]Cl$

32. Which of the following complexes exhibits the highest paramagnetic behaviour ?
where, gly = glycine, en = ethylenediamine and bipy = bipyridyl)
(At no Ti = 22, V = 23, Fe = 26, Co = 27)

(1) $[V(gly)_2(OH)_2(NH_3)_2]^+$ (2) $[Fe(en)(bpy)(NH_3)_2]^{2+}$ (3) $[Co(OX)_2(OH)_2]^-$ (4) $[Ti(NH_3)_6]^{3+}$

33. In which of the following coordination entities the magnitude of Δ_0 (Crystal field stabilization energy in octahedral field) will be maximum?
(At No Co = 27)

(1) $[Co(H_2O)_6]^{3+}$ (2) $[Co(NH_3)_6]^{3+}$ (3) $[Co(CN)_6]^{3-}$ (4) $[Co(C_2O_4)_3]^{3-}$

34. Which of the following complex ions is expected to absorb visible light?

(At. no Zn = 30, Sc = 21, Ti = 22, Cr = 24)

(1) $[Sc(H_2O)_3(NH_3)_3]^{3+}$ (2) $[Ti(en)_2(NH_3)_2]^{4+}$ (3) $[Cr(NH_3)_6]^{3+}$ (4) $[Zn(NH_3)_6]^{2+}$

35. The existance of two different coloured complexes with the composition of $[Co(NH_3)_4Cl_2]^+$ is due to

(1) linkage isomerism (2) geometrical isomerism

(3) coordination isomerism (4) ionization isomerism

36. The d-electron configurations of Cr^{2+}, Mn^{2+}, Fe^{2+} and Co^{2+} are d^4, d^5, d^6 and d^7 respectively. Which one of the following will exhibit minimum paramagnetic behaviour ?

(1) $[Mn(H_2O)_6]^{2+}$ (2) $[Fe(H_2O)_6]^{2+}$ (3) $[Co(H_2O)_6]^{2+}$ (4) $[Cr(H_2O)_6]^{2+}$

(At, nos. Cr = 24, Mn = 25, Fe = 26, Co = 27)

37. An excess of $AgNO_3$ is added to 100 mL of a 0.01M solution of dichlorotetraaquachromium (III) chloride. The number of moles of AgCl precipitated would be :

(1) 0.002 (2) 0.003 (3) 0.01 (4) 0.001

38. Among the following complexes the one which shows Zero crystal field stabilizations energy (CFSE)

(1) $[Nn(H_2O)_6]^{3+}$ (2) $[Fe(H_2O)_6]^{3+}$ (3) $[Co(H_2O)_6]^{2+}$ (4) $[Co(H_2O)_6]^{3+}$

39. Cobalt (III) chloride forms several octahedral complexes with ammonia. Which of the following will not give test for chloride ions with silver nitrate at 25°C ?

(1) $CoCl_3 \cdot 4NH_3$ (2) $CoCl_3 \cdot 5NH_3$ (3) $CoCl_3 \cdot 6NH_3$ (4) $CoCl_3 \cdot 3NH_3$

40. Which of these statements about $[Co(CN)_6]^{3-}$ is true ?

(1) $[Co(CN)_6]^{3-}$ has four unpaired electrons and will be in a low-spin configuration.

(2) $[Co(CN)_6]^{3-}$ has four unpaired electrons and will be in a high-spin configuration.

(3) $[Co(CN)_6]^{3-}$ has no unpaired electrons and will be in a high-spin configuration.

(4) $[Co(CN_6)]^{3-}$ has no unpaired electrons and will be in a low-spin configuration.

41. The geometry of $[Ni(CN)_4]^{2-}$ and $[NiCl_4]^{2-}$ ions are :

(1) Tetrahedral (2) Square planar

(3) Square planar and tetrahedral respectively (4) Tetrahedral and square planar respectively

42. $EDTA^{4-}$ has co-ordination number :

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

43. In $CuSO_4.5H_2O$ copper is co-ordinated to :

(1) five water molecules (2) four water molecules

(3) one sulphate ion (4) one water molecule

44. $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5SO_4]Br$ are examples of which of the following type of isomerism ?

(1) Linkage (2) Geometrical (3) Ionization (4) Optical isomerism

45. EAN of iron in $K_4[Fe(CN)_6]$ is :

(1) 36 (2) 34 (3) 38 (4) 40

46. Given the molecular formula of the hexacoordinated complexes is :

(1) $CoCl_3.6NH_3$ (2) $CoCl_3.5H_2O$ (3) $CoCl_3.4NH_3$

If the number of co-ordinated NH_3 molecules in (1), (2) and (3) respectively are 6, 5 and 4, the primary valency in (1), (2) and (3) are :

(1) 6,5,4 (2) 3,2,1 (3) 0,1,2 (4) 3,3,3

47. The IUPAC name of $K_2[Cr(CN)_2O_2(O)_2(NH_3)]$ is :

(1) Potassium amminedicyanodioxoperoxochromate(VI)

(2) Potassium amminecyanoperoxodioxochromium(IV)

(3) Potassium amminecyanoperoxodioxochromium(V)

(4) Potassium amminecyanoperoxodioxochromatic(IV)

48. The IUPAC name of the compound $[CuCl_2(CH_3NH_2)_2]$ is :

(1) dichloro bis (dimethyl amine) copper (II) (2) dichlorobis(methylamine)copper(II)

(3) dimethyl amine copper (II) chloride (4) bis (dimethy amine) copper (II) chloride.

49. Which of the following species represents the example of dsp^2 hybridisation ?

(1) $[Fe(CN)_6]^{3-}$ (2) $[Ni(CN)_4]^{2-}$ (3) $[Ag(CN)_2]^{-}$ (4) $[Co(CN)_6]^{3-}$

50. In the spectrochemical series, the magnitude of the crystal field splitting is maximum for which ion ?

(1) Cl^- (2) F^- (3) NO_2^- (4) CN^-

51. What is the EAN of nickel in $Ni(CO)_4$?

(1) 38 (2) 30 (3) 36 (4) 32

52. The increasing order of the crystal field splitting power of some common ligands is :

(1) $H_2O < OH^- < Cl^- < F^- < CN^-$ (2) $H_2O < Cl^- < OH^- < F^- < CN^-$

(3) $CN^- < H_2O < OH^- < F^- < Cl^-$ (4) $Cl^- < F^- < OH^- < H_2O < CN^-$

53. Which of the following can exhibit geometrical isomerism ?

(1) $[MnBr_4]^{2-}$ (2) $[Pt(NH_3)_3Cl]^+$ (3) $[PtCl_2\{P(C_2H_5)_3\}_2]$ (4) $[Fe(H_2O)_5NO]^{2+}$

54. **Assertion :** In complex, $[Co(NH_3)_5(CO_3)]Cl$, the oxidation state of cobalt is +3.

Reason : Carbonate ligand is a monodentate bivalent anion.

(1) Both assertion and reason are correct, and the reason is the correct explanation for the assertion

(2) Both assertion and reason are correct, but the reason is not the correct explanation for the assertion

(3) The assertion is incorrect, but the reason is correct

(4) Both are assertion and reason are incorrect

55. **Assertion :** The species $[CuCl_4]^{2-}$ exists but $[CuI_4]^{2-}$ does not.
Reason : $[NiCl_2(PPh_3)_2]$ have tetrahedral geometry.
(1) Both assertion and reason are correct, and the reason is the correct explanation for the assertion
(2) Both assertion and reason are correct, but the reason is not the correct explanation for the assertion
(3) The assertion is incorrect, but the reason is correct
(4) Both are assertion and reason are incorrect

Exercise-3

PART - I : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

OFFLINE JEE-MAIN

1. The most stable ion is : **[AIEEE 2002, 3/225]**
(1) $[Fe(OH)_5]^{3-}$ (2) $FeCl_6]^{3-}$ (3) $[Fe(CN)_6]^{3-}$ (4) $[[Fe(H_2O)_6]^{3+}$

2. The type of isomerism present in nitropentaamminechromium(III) chloride is : **[AIEEE 2002, 3/225]**
(1) optical (2) linkage (3) ionization (4) polymerization

3. One mole of $Co(NH_3)_5Cl_3$ gives 3 moles of ions on dissolution in water. One mole of this reacts with two moles of $AgNO_3$ to give two moles of AgCl. The complex is : **[AIEEE 2003, 3/225]**
(1) $[Co(NH_3)_4Cl_2]Cl.NH_3$ (2) $[Co(NH_3)_4Cl]Cl_2.NH_3$
(3) $[Co(NH_3)_5Cl]Cl_2$ (4) $[Co(NH_3)_3Cl_3].2NH_3$

4. Ammonia forms the complex $[Cu(NH_3)_4]^{2+}$ with copper ions in alkaline solution but not in acid solution. The reason for it is : **[AIEEE 2003, 3/225]**
(1) in alkaline solution $Cu(OH)_2$ is precipitated which is soluble in excess of alkali.
(2) copper hydroxide is amphoteric.
(3) in acidic solution hydration protects Cu^{2+} ions.
(4) in acidic solution protons coordinates with ammonia molecule forming NH_4^+ ions and NH_3 molecules are not available.

5. In the coordination compound $K_4[Ni(CN)_4]$, the oxidation state of nickel is : **[AIEEE 2004, 3/225]**
(1) – 1 (2) 0 (3) + 1 (4) + 2

6. The co-ordination number of a central metal atom in a complex is determined by : **[AIEEE 2004, 3/225]**
(1) the number of only anionic ligands bonded to metal ion
(2) the number of ligands around a metal ion bonded by pi bonds
(3) the number of ligands around a metal ion bonded by sigma and pi bonds
(4) the number of ligands around a metal ion bonded by sigma bonds

7. Which one is an outer orbital complex ? **[AIEEE 2004, 3/225]**
(1) $[Ni(NH_3)_6]^{2+}$ (2) $[Mn(CN)_6]^{4-}$ (3) $[Co(NH_3)_6]^{3+}$ (4) $[Fe(CN)_6]^{4-}$

8. Co-ordination compounds have great importance in biological systems. In this context, which statement is incorrect ? **[AIEEE 2004, 3/225]**
(1) Carboxypeptidase–A is an enzyme and contains zinc.
(2) Haemoglobin is the red pigment of blood and contains iron.
(3) Cyanocobalmin is B_{12} and contains cobalt.
(4) Chlorophylls are green pigments in plants and contain calcium.

9. Which one has largest number of isomers ? **[AIEEE 2004, 3/225]**
(1) $[Co(en)_2Cl_2]^+$ (2) $[Co(NH_3)_5Cl]^{2+}$ (3) $[Ir(PhR_3)_2H(CO)]^{2+}$ (4) $[Ru(NH_3)_4Cl_2]^+$

10. The correct order of magnetic moments (only spin value in BM) among is : **[AIEEE 2004, 3/225]**
(1) $Fe(CN)_6^{4-} > [CoCl_4]^{2-} > [MnCl_4]^{2-}$ (2) $[MnCl_4]^{2-} > [Fe(CN)_6]^{4-} > [CoCl_4]^{2-}$
(3) $[Fe(CN)_6]^{4-} > [MnCl_4]^{2-} > [CoCl_4]^{2-}$ (4) $[MnCl_4]^{2-} > [CoCl_4]^{2-} > [Fe(CN)_6]^{4-}$

11. The oxidation state of Cr in $[Cr(NH_3)_4Cl_2]^+$ is : **[AIEEE 2005, 1½/225]**
(1) 0 (2) +1 (3) +2 (4) +3

12. The IUPAC name of $K_3[Fe(CN)_6]$ is : **[AIEEE 2005, 3/225]**
(1) Potassium hexacyanoferrate(II) (2) Potassium hexacyanoferrate(III)
(3) Potassium hexacyanoiron(II) (4) Tripotassium hexacyanoiron(II)

13. Which of the following will show optical isomerism ? **[AIEEE 2005, 3/225]**
(1) $[Cu(NH_3)_4]^{2+}$ (2) $[ZnCl_4]^{2-}$ (3) $[Cr(C_2O_4)_3]^{3-}$ (4) $[Co(CN)_6]^{3-}$

14. Which one of the following complexes would exhibit the lowest value of paramagnetic behaviour ? **[AIEEE 2005, 3/225]**
(1) $[Co(CN)_6]^{3-}$ (2) $[Fe(CN)_6]^{3-}$ (3) $[Mn(CN)_6]^{3-}$ (4) $[Cr(CN)_6]^{3-}$

15. The value of 'spin only' magnetic moment for one of the following configurations is 2.84 BM. The correct one is: **[AIEEE 2005, 4½/225]**
(1) d^4 (in strong field ligand) (2) d^4 (in weak field ligand)
(3) d^3 (in weak as well as strong field ligand) (4) d^5 (in strong field ligand)

16. Nickel (Z = 28) combines with a uninegative monodentate ligand X^- to form a paramagnetic complex $[NiX_4]^{2-}$ The number of unpaired electron(s) in the nickel and geometry of this complex ion are, respectively : **[AIEEE 2006, 3/165]**
(1) one, tetrahedral (2) two, tetrahedral (3) one, square planar (4) two, square planar

17. The IUPAC name for the complex $[Co(NO_2)(NH_3)_5]Cl_2$ is : **[AIEEE 2006, 3/165]**
(1) Nitrito-N-pentaamminecobalt(III) chloride (2) Nitrito-N-pentaamminecobalt(II) chloride
(3) Pentaamminenitrito-N-cobalt(II) chloride (4) Pentaamminenitrito-N-cobalt(III) chloride

18. In $Fe(CO)_5$, the Fe–C bond possesses : **[AIEEE 2006, 3/165]**
(1) π-character only (2) both σ and π characters
(3) ionic character only (4) σ-character only

19. How many EDTA (ethylenediaminetetraacetic acid) molecules are required to make an octahedral complex with a Ca^{2+} ion ? **[AIEEE 2006, 3/165]**
(1) Six (2) Three (3) One (4) Two

20. The 'spin only' magnetic moment (in units of Bohr magneton, μ_B) of Ni^{2+} in aqueous solution would be (atomic number Ni = 28) **[AIEEE 2006, 3/165]**
(1) 2.84 (2) 4.80 (3) 0 (4) 1.73

21. Which one of the following has a square planar geometry? **[AIEEE 2007, 2/120]**
(1) $[NiCl_4]^{2-}$ (2) $[PtCl_4]^{2-}$ (3) $[CoCl_4]^{2-}$ (4) $[FeCl_4]^{2-}$
(At. no. Co = 27, Ni = 28, Fe = 26, Pt = 78)

22. The coordination number and the oxidation state of the element 'E' in the complex $[E(en)_2(C_2O_4)]\ NO_2$ (when 'en' is ethylene diamine) are, respectively, **[AIEEE 2008, 3/105]**
(1) 4 and 2 (2) 4 and 3 (3) 6 and 3 (4) 6 and 2

23. In which of the following octahedral complexes of Co (at no. 27), will the magnitude of Δ_0 be the highest? **[AIEEE 2008, 3/105]**
(1) $[Co(C_2O_4)_3]^{3-}$ (2) $[Co(H_2O)_6]^{3+}$ (3) $[Co(NH_3)_6]^{3+}$ (4) $[Co(CN)_6]^{3-}$

24. Which of the following has an optical isomer ? **[AIEEE 2009, 4/144]**
(1) $[Co\,(en)\,(NH_3)_2]^{2+}$ (2) $[Co(H_2O)_4\,(en)]^{3+}$ (3) $[Co\,(en)_2\,(NH_3)_2]^{3+}$ (4) $[Co\,(NH_3)_3\,Cl]^+$

25. Which of the following pairs represents linkage isomers ? **[AIEEE 2009, 4/144]**
(1) $[Pd(PPh_3)_2(NCS)_2]$ and $[Pd(PPh_3)_2(SCN)_2]$ (2) $[Co(NH_3)_5NO_3]SO_4$ and $[Co(NH_3)_5(SO_4)]NO_3$
(4) $[PtCl_2(NH_3)_4Br_2$ and $[Pt\ Br_2(NH_3)_4]Cl_2$ (4) $[Cu(NH_3)_4]\ [PtCl_4]$ and $[Pt(NH_3)_4\ [CuCl_4]$

26. A solution containing 2.675 g of $CoCl_3.6NH_3$ (molar mass = 267.5 g mol^{-1}) is passed through a cation exchanger. The chloride ions obtained in solution were treated with excess of $AgNO_3$ to give 4.78 g of AgCl (molar mass = 143.5 g mol^{-1}). The formula of the complex is (At. mass of Ag = 108 u)

[AIEEE 2010, 8/144]

(1) $[Co(NH_3)_6]Cl_3$ (2) $[CoCl_2(NH_3)_4]Cl$ (3) $[CoCl_3(NH_3)_3]$ (4) $[CoCl(NH_3)_5]Cl_2$

27. Which one of the following has an optical isomer ? **[AIEEE 2010, 4/144]**

(1) $[Zn(en)(NH_3)_2]^{2+}$ (2) $[Co(en)_3]^{3+}$ (3) $[Co(H_2O)_4(en)]^{3+}$ (4) $[Zn(en)_2]^{2+}$

(en = ethylenediamine)

28. Which of the following facts about the complex $[Cr(NH_3)_6]Cl_3$ is **wrong** ? **[AIEEE 2011, 4/144]**

(1) The complex involves d^2sp^3 hybridisation and is octahedral in shape.

(2) The complex is paramagnetic.

(3) The complex is an outer orbital complex.

(4) The complex gives white precipitate with silver nitrate solution.

29. The magnetic moment (spin only) of $[NiCl_4]^{2-}$ is : **[AIEEE 2011, 4/144]**

(1) 1.82 BM (2) 5.46 BM (3) 2.82 BM (4) 1.41 BM

30. Which among the following will be named as dibromidobis (ethylene diamine) chromium (III) bromide? **[AIEEE 2012, 4/144]**

(1) $[Cr(en)_3]Br_3$ (2) $[Cr(en)_2Br_2]Br$ (3) $[Cr(en)Br_4]^-$ (4) $[Cr(en)Br_2]Br$

31. Which of the following complex species is not expected to exhibit optical isomerism ? **[JEE(Main) 2013, 4/120]**

(1) $[Co(en)_3]^{3+}$ (2) $[Co(en)_2Cl_2]^+$ (3) $[Co(NH_3)_3Cl_3]$ (4) $[Co(en)(NH_3)_2Cl_2]^+$

32. The octahedral complex of a metal ion M^{3+} with four monodentate ligands L_1, L_2, L_3 and L_4 absorb wavelengths in the region of red, green, yellow and blue, respectively. The increasing order of ligand strength of the four ligands is : **[JEE(Main) 2014, 4/120]**

(1) $L_4 < L_3 < L_2 < L_1$ (2) $L_1 < L_3 < L_2 < L_4$ (3) $L_3 < L_2 < L_4 < L_1$ (4) $L_1 < L_2 < L_4 < L_3$

33. The number of geometric isomers that can exist for square planar $[Pt(Cl)(py)(NH_3)(NH_2OH)]^+$ is (py = pyridine): **[JEE(Main) 2015, 4/120]**

(1) 2 (2) 3 (3) 4 (4) 6

34. The pair having the same magnetic moment is : [At. No.: Cr = 24, Mn = 25, Fe = 26, Co = 27] **[JEE(Main) 2016, 4/120]**

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

(3) $[CoCl_4]^{2-}$ and $[Fe(H_2O)_6]^{2+}$ (4) $[Cr(H_2O)_6]^{2+}$ and $[CoCl_4]^{2-}$

35. Which one of the following complexes shows optical isomerism ? **[JEE(Main) 2016, 4/120]**

(1) *cis*$[Co(en)_2Cl_2]Cl$ (2) *trans*$[Co(en)_2Cl_2]Cl$

(3) $[Co(NH_3)_4Cl_2]Cl$ (4) $[Co(NH_3)_3Cl_3]$

(en = ethylenediamine)

36. 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, 4/120]**

(1) $[Co(H_2O)_3Cl_3].3H_2O$ (2) $[Co(H_2O)_6]Cl_3$

(3) $[Co(H_2O)_5Cl]Cl_2.H_2O$ (4) $[Co(H_2O)_4Cl_2]Cl.2H_2O$

ONLINE JEE-MAIN

1. An octahedral complex of Co^{3+} is diamagnetic. The hybridisation involved in the formation of the comlex is: **[JEE(Main) 2014 Online (09-04-14), 4/120]**

(1) sp^3d^2 (2) dsp^2 (3) d^2sp^3 (4) sp^3d

2. The correct statement about of the magnetic prperties of $[Fe(CN)_6]^{3-}$ and $[FeF_6]^{3-}$ is : (Z = 26)
[JEE(Main) 2014 Online (09-04-14), 4/120]

(1) both are paramagnetic
(2) both are diamagnetic
(3) $[Fe(CN)_6]^{3-}$ is diamagnetic, $[FeF_6]^{3-}$ is paramagnetic.
(4) $[Fe(CN)_6]^{3-}$ is paramagnetic, $[FeF_6]^{3-}$ is diamagnetic.

3. Which of the following name formula combinations is not correct ?
[JEE(Main) 2014 Online (11-04-14), 4/120]

	Formula	**Name**
(1)	$K_2[Pt(CN)_4]$	Potasium tetracyanoplatinate (II)
(2)	$[Mn(CN)_5]^{2-}$	Pentacyanomagnate (II) ion
(3)	$K[Cr(NH_3)_2Cl_4]$	Potassium diammine tetrachlorochromate (III)
(4)	$[Co(NH_3)_4(H_2O)I]SO_4$	Tetraammine aquaiodo cobalt (III) sulphate

4. Consider the coordination compound, $[Co(NH_3)_6]Cl_3$. In the formation of the complex, the species which acts as the Lewis acid is : **[JEE(Main) 2014 Online (11-04-14), 4/120]**

(1) $[Co(NH_3)_6]^{3+}$ (2) Cl^- (3) Co^{3+} (4) NH_3

5. Among the following species the one which causes the highest CFSE, Δ_0 as a ligand is :
[JEE(Main) 2014 Online (12-04-14), 4/120]

(1) CN^- (2) NH_3 (3) F^- (4) CO

6. Which one of the following complexes will most likely absorb visible light ?
(At nos. Sc = 21, Ti = 22, V = 23, Zn = 30)
[JEE(Main) 2014 Online (12-04-14), 4/120]

(1) $[Sc(H_2O)_6]^{3+}$ (2) $[Ti(NH_3)_6]^{4+}$ (3) $[V(NH_3)_6]^{3+}$ (4) $[Zn(NH_3)_6]^{2+}$

7. An octahedral complex with molecular composition $M.5NH_3.Cl.SO_4$ has two isomers, A and B. The solution of A gives a white precipitate with $AgNO_3$ solution and the solution of B gives white precipitate with $BaCl_2$ solution. The type of isomerism exhibited by the complex is:
[JEE(Main) 2014 Online (19-04-14), 4/120]

(1) Linkage isomerism (2) Ionisation isomerism
(3) Coordinate isomerism (4) Geometrical isomerism

8. Nickel (Z = 28) combines with a uninegative monodenate ligand to form a diamagnetic complex $[NiL_4]^{2-}$. The hybridisation involved and the number of unpaired electrons present in the complex are respectively:
[JEE(Main) 2014 Online (19-04-14), 4/120]

(1) sp^3, two (2) dsp^2, zero (3) dsp^2, one (4) sp^3, zero

9. The correct statement on the isomerism associated with the following complex ions,
[JEE(Main) 2015 Online (10-04-15), 4/120]
(a) $[Ni(H_2O)_5NH_3]^{2+}$, (b) $[Ni(H_2O)_4(NH_3)_2]^{2+}$ and (c) $[Ni(H_2O)_3(NH_3)_3]^{2+}$ is :
(1) (a) and (b) show only geometrical isomerism.
(2) (b) and (c) show geometrical and optical isomerism
(3) (b) and (c) show only geometrical isomerism
(4) (a) and (b) show geometrical and optical isomerism

10. Which molecule/ion among the following cannot act as a ligand in complex compounds?
[JEE(Main) 2015 Online (10-04-15), 4/120]

(1) CH_4 (2) CN^- (3) Br^- (4) CO

11. Which of the following complex ions has electrons that are symmetrically filled in both t_{2g} and e_g orbitals?
[JEE(Main) 2015 Online (11-04-15), 4/120]

(1) $[FeF_6]^{3-}$ (2) $[Mn(CN)_6]^{4-}$ (3) $[CoF_6]^{3-}$ (4) $[Co(NH_3)_6]^{2+}$

12. Identify the correct trend given below: (Atomic No.: Ti = 22, Cr = 24 and Mo = 42)
[JEE(Main) 2016 Online (09-04-16), 4/120]

(1) Δ_o of $[Cr(H_2O)_6]^{2+} < [Mo(H_2O)_6]^{2+}$ and Δ_o of $[Ti(H_2O)_6]^{3+} < [Ti(H_2O)_6]^{2+}$

(2) Δ_o of $[Cr(H_2O)_6]^{2+} > [Mo(H_2O)_6]^{2+}$ and Δ_o of $[Ti(H_2O)_6]^{3+} > [Ti(H_2O)_6]^{2+}$

(3) Δ_o of $[Cr(H_2O)_6]^{2+} > [Mo(H_2O)_6]^{2+}$ and Δ_o of $[Ti(H_2O)_6]^{3+} < [Ti(H_2O)_6]^{2+}$

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

13. Which one of the following complexes will consume more equivalents of aqueous solution of $Ag(NO_3)$?
[JEE(Main) 2016 Online (09-04-16), 4/120]

(1) $Na_3[CrCl_6]$ (2) $[Cr(H_2O)_5Cl]Cl_2$ (3) $[Cr(H_2O)_6]Cl_3$ (4) $Na_2[CrCl_5(H_2O)]$

14. Which of the following is an example of homoleptic complex ?
[JEE(Main) 2016 Online (09-04-16), 4/120]

(1) $[Co(NH_3)_4Cl_2]$ (2) $[Co(NH_3)_6]Cl_3$ (3) $[Co(NH_3)_5Cl]Cl_2$ (4) $[Pt(NH_3)_2Cl_2]$

15. sp^3d^2 hybridization is **not** displayed by : **[JEE(Main) 2017 Online (08-04-17), 4/120]**

(1) PF_5 (2) SF_6 (3) $[CrF_6]^{3-}$ (4) BrF_5

16. $[Co_2(CO)_8]$ displays : **[JEE(Main) 2017 Online (09-04-17), 4/120]**

(1) one 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, four terminal CO and four bridging CO

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

PART - II : JEE (ADVANCED) / IIT-JEE PROBLEMS (PREVIOUS YEARS)

1. The species having tetrahedral shape is : **[JEE 2004(S), 3/84]**

(A) $[PdCl_4]^{2-}$ (B) $[Ni(CN)_4]^{2-}$ (C) $[Pd(CN)_4]^{2-}$ (D) $[NiCl_4]^{2-}$

2. The spin magnetic moment of cobalt in the compound, Hg $[Co(SCN)_4]$ is : **[JEE 2004(S), 3/84]**

(A) $\sqrt{3}$ (B) $\sqrt{8}$ (C) $\sqrt{15}$ (D) $\sqrt{24}$

3. Which kind of isomerism is exhibited by octahedral $[Co(NH_3)_4Br_2]Cl$? **[JEE–2005(S), 3/84]**

(A) Geometrical and ionization (B) Geometrical and optical

(C) Optical and ionization (D) Geometrical only

4. The bond length in CO is 1.128 Å. What will be the bond length of CO in $Fe(CO)_5$?**[JEE–2006, 5/184]**

(A) 1.158 Å (B) 1.128 Å (C) 1.178 Å (D) 1.118 Å

5. Among the following metal carbonyls, the C–O bond order is lowest in : **[JEE–2007, 3/162]**

(A) $[Mn(CO)_6]^+$ (B) $[V(CO)_6]^-$ (C) $[Cr(CO)_6)]$ (D) $[Fe(CO)_5]$

6. The IUPAC name of $[Ni(NH_3)_4][NiCl_4]$ is : **[JEE–2008, 3/163]**

(A) Tetrachloronickel(II) tetraamminenickel (II) (B) Tetraamminenickel(II) tetrachloronickel (II)

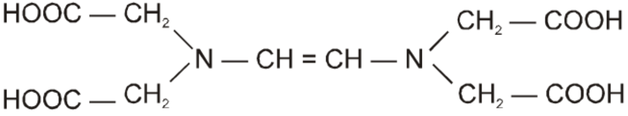
(C) Tetraamminenickel(II) tetrachloronickelate (II) (D) Tetraamminenickel(II) tetrachloronickelate (0)

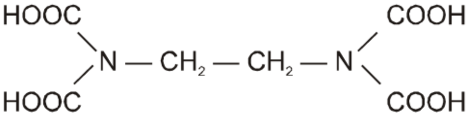
7. Both $[Ni(CO)_4]$ and $[Ni(CN)_4]^{2-}$ are diamagnetic. The hybridisation of nickel in these complexes, respectively, are : **[JEE–2008, 3/163]**

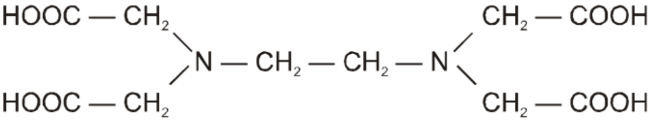
(A) sp^3, sp^3 (B) sp^3, dsp^2 (C) dsp^2, sp^3 (D) dsp^2, sp^2

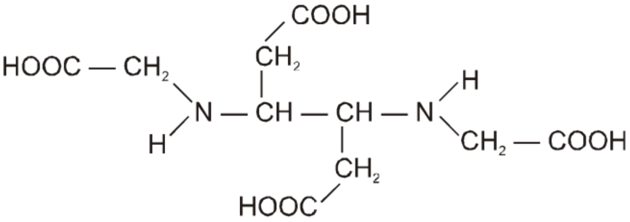
8. The spin only magnetic moment value (in Bohr magneton units) of $Cr(CO)_6$ is : **[JEE–2009, 3/160]**
(A) 0 (B) 2.84 (C) 4.90 (D) 5.92

9. The correct structure of ethylenediaminetetraacetic acid (EDTA) is : **[JEE–2010, 3/163]**

(A)


(B)


(C)


(D)


10. The ionization isomer of $[Cr(H_2O)_4Cl\ (NO_2)]Cl$ is : **[JEE–2010, 3/163]**
(A) $[Cr(H_2O)_4(O_2N)]Cl_2$ (B) $[Cr(H_2O)_4Cl_2](NO_2)$
(C) $[Cr(H_2O)_4Cl(ONO)]Cl$ (D) $[Cr(H_2O)_4Cl_2(NO_2)].H_2O$

11. The complex showing a spin-only magnetic moment of 2.82 B.M. is : **[JEE–2010, 5/163]**
(A) $Ni(CO)_4$ (B) $[NiCl_4]^{2-}$ (C) $Ni(PPh_3)_4$ (D) $[Ni(CN)_4]^{2-}$

12. Geometrical shapes of the complexes formed by the reaction of Ni^{2+} with Cl^-, CN^- and H_2O, respectively, are **[JEE–2011, 3/160]**
(A) octahedral, tetrahedral and square planar (B) tetrahedral, square planar and octahedral
(C) square planar, tetrahedral and octahedral (D) octahedral, square planar and octahedral

13. Among the following complexes (K–P), $K_3[Fe(CN)_6]$ (K), $[Co(NH_3)_6]Cl_3$ (L), $Na_3[Co(oxalate)_3]$ (M), $[Ni(H_2O)_6]Cl_2$ (N), $K_2[Pt(CN)_4]$ (O) and $[Zn(H_2O)_6](NO_3)_2$ (P)
the diamagnetic complexes are : **[JEE–2011, 3/160]**
(A) K, L, M, N (B) K, M, O, P (C) L, M, O, P (D) L, M, N, O

14. As per IUPAC nomenclature, the name of the complex $[Co(H_2O)_4(NH_3)_2]Cl_3$ is : **[JEE–2012, 3/143]**
(A) Tetraaquadiaminecobalt (III) chloride (B) Tetraaquadiamminecobalt (III) chloride
(C) Diaminetetraaquacobalt (III) chloride (D) Diamminetetraaquacobalt (III) chloride

15. $NiCl_2\ \{P\ (C_2H_5)_2\ (C_6H_5)\}_2$ exhibits temperature dependent magnetic behaviour (paramagnetic/ diamagnetic) . the coordination geometries of Ni^{2+} in the paramagnetic and diamagnetic states are respectively **[JEE–2012, 3/143]**
(A) tetrahedral and tetrahedral (B) square planar and square planar
(C) tetrahedral and square planar (D) square planar and tetrahedral

16. Consider the following complex ions, P, Q and R. **[JEE(Advanced) 2013, 2/120]**
$P = [FeF_6]^{3-}$, $Q = [V(H_2O)_6]^{2+}$ and $R = [Fe(H_2O)_6]^{2+}$.

The correct order of the complex ions, according to their spin-only magnetic moment values (in B.M.) is

(A) R < Q < P (B) Q < R < P (C) R < P < Q (D) Q < P < R

17. 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, 3/120]**

{en = $H_2NCH_2CH_2NH_2$; atomic numbers : Ti = 22; Cr = 24; Cp = 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. Diamagentic and exhibits *cis-trans* isomerism
R. $[Pt(en)(NH_3)Cl]NO_3$	3. Paramagentic and exhibits *cis-trans* isomerism
S. $[Co(NH_3)_4(NO_3)_2]NO_3$	4. Diamagentic and exhibits ionisation isomerism

Code :

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

18. Among $[Ni(CO)_4]$, $[NiCl_4]^{2-}$, $[Co(NH_3)_4Cl_2]Cl$, $Na_3[CoF_6]$, Na_2O_2 and CsO_2, the total number of paramagnetic compounds is : **[JEE(Advanced) 2016, 3/124]**

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

19. The geometries of the ammonia complexes of Ni^{2+}, Pt^{2+} and Zn^{2+}, respectively, are **[JEE(Advanced) 2016, 3/124]**

(A) octahedral, square planar and tetrahedral (B) square planar, octahedral and tetrahedral

(C) tetrahedral, square planar and octahedral (D) octahedral, tetrahedral and square planar

20. 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**. **[JEE(Advanced) 2017, 3/124]**

Among the following options, which statement(s) is (are) correct ?

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

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

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

(D) **Z** is a tetrahedral complex

Answers

EXERCISE - 1

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

EXERCISE 2

1.	(2)	**2.**	(4)	**3.**	(3)	**4.**	(1)	**5.**	(2)
6.	(2)	**7.**	(1)	**8.**	(2)	**9.**	(3)	**10.**	(1)
11.	(3)	**12.**	(3)	**13.**	(3)	**14.**	(4)	**15.**	(4)
16.	(4)	**17.**	(1)	**18.**	(3)	**19.**	(3)	**20.**	(4)
21.	(4)	**22.**	(3)	**23.**	(1)	**24.**	(3)	**25.**	(2)
26.	(2)	**27.**	(4)	**28.**	(4)	**29.**	(4)	**30.**	(1)
31.	(4)	**32.**	(3)	**33.**	(3)	**34.**	(3)	**35.**	(2)
36.	(3)	**37.**	(4)	**38.**	(2)	**39.**	(4)	**40.**	(4)
41.	(3)	**42.**	(4)	**43.**	(2)	**44.**	(3)	**45.**	(1)
46.	(4)	**47.**	(1)	**48.**	(2)	**49.**	(2)	**50.**	(4)
51.	(3)	**52.**	(4)	**53.**	(3)	**54.**	(1)	**55.**	(2)

EXERCISE - 3

PART - I

OFFLINE JEE-MAIN

1.	(3)	**2.**	(2)	**3.**	(3)	**4.**	(4)	**5.**	(2)
6.	(4)	**7.**	(1)	**8.**	(4)	**9.**	(1)	**10.**	(4)
11.	(4)	**12.**	(2)	**13.**	(3)	**14.**	(1)	**15.**	(1)
16.	(2)	**17.**	(4)	**18.**	(2)	**19.**	(3)	**20.**	(1)
21.	(2)	**22.**	(3)	**23.**	(4)	**24.**	(3)	**25.**	(1)
26.	(1)	**27.**	(2)	**28.**	(3)	**29.**	(3)	**30.**	(2)
31.	(3)	**32.**	(2)	**33.**	(2)	**34.**	(1)	**35.**	(1)
36.	(3)								

ONLINE JEE-MAIN

1.	(3)	**2.**	(1)	**3.**	(2)	**4.**	(3)	**5.**	(4)
6.	(3)	**7.**	(2)	**8.**	(2)	**9.**	(3)	**10.**	(1)
11.	(1)	**12.**	(4)	**13.**	(3)	**14.**	(2)	**15.**	(1)
16.	(2)								

PART - II

1.	(D)	**2.**	(C)	**3.**	(A)	**4.**	(A)	**5.**	(B)
6.	(C)	**7.**	(B)	**8.**	(A)	**9.**	(C)	**10.**	(B)
11.	(B)	**12.**	(B)	**13.**	(C)	**14.**	(D)	**15.**	(C)
16.	(B)	**17.**	(B)	**18.**	(B)	**19.**	(A)	**20.***	(ACD)

Additional Problems For Self Practice (APSP)

PART - I : PRACTICE TEST PAPER

This Section is not meant for classroom discussion. It is being given to promote self-study and self testing amongst the Resonance students.

Max. Marks : 120 **Max. Time : 1 Hr.**

Important Instructions

1. The test is of **1 hour** duration.

2. The Test Booklet consists of **30** questions. The maximum marks are **120.**

3. Each question is allotted **4 (four)** marks for correct response.

4. Candidates will be awarded marks as stated above in Instructions No. 3 for correct response of each question. **¼ (one fourth)** marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.

5. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instructions 4 above.

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1. In which of the following complexes the nickel metal is in highest oxidation state ?

(1) $Ni(CO)_4$ (2) K_2NiF_6 (3) $[Ni(NH_3)_6](BF_4)_2$ (4) $K_4[Ni(CN)_6]$

2. The EAN of platinum in potassium hexachloroplatinate (IV) is :

(1) 46 (2) 86 (3) 36 (4) 84

3. The IUPAC name of $K_2[Cr(CN)_2O_2(O)_2(NH_3)]$ is :

(1) Potassium amminedicyanodioxoperoxochromate(VI)
(2) Potassium amminecyanoperoxodioxochromium(VI)
(3) Potassium amminedicyanoperoxooxochromium(VI)
(4) Potassium amminecyanodiperoxodioxochromate(VI)

4. Which one of the following high-spin complexes has the largest CFSE (Crystal field stabilization energy) ?

(1) $[Mn(H_2O)_6]^{2+}$ (2) $[Cr(H_2O_6)]^{2+}$ (3) $[Mn(H_2O)_6]^{3+}$ (4) $[Cr(H_2O)_6]^{3+}$

5. Which of the following complex will show optical activity ?

(1) trans$[Co(NH_3)_4Cl_2]^+$ (2) $[Cr(H_2O)_6]^{3+}$
(3) cis$[Co(NH_3)_2(en)_2]^{3+}$ (4) trans$[Co(NH_3)_2(en)_2]^{3+}$

6. Which kind of isomerism is shown by the complex $[Co(NH_3)_5(ONO)]SO_4$?

1. Ionisation isomerism 2. Linkage isomerism
3. Geometrical isomerism 4. Optical isomerism
(1) 1, 2, 3 and 4 are correct (2) 1, 3 and 4 are correct only
(3) 1 and 2 are correct only (4) 2, 3 and 4 are correct only

7. Which of the following statements is correct for complex $[Cr(NH_3)(CN)_4(NO)]^{2-}$ (given that n = 1)?

(1) It is d^2sp^3 hybridised .
(2) It is heteroleptic complex and its aqueous solution is coloured
(3) The chromium is in +I oxidation state
(4) All of these.

8. Consider the following statements:

S_1 : $[Cr(NH_3)_6]^{3+}$ is a inner orbital complex with crystal field stabilization energy equal to – 1.2 Δ_o

S_2 : The complex formed by joining the CN^- ligands to Fe^{3+} ion has theoretical value of 'spin only' magnetic moment equal to 1.73 B.M.

S_3 : $Na_2S + Na_2[Fe(CN)_5NO] \longrightarrow Na_4[Fe(CN)_5NOS]$, In reactant and product the oxidation states of iron are same
and arrange in the order of true/false.

(1) F T F (2) T T F (3) T T T (4) F F F

9. Which of the following statements is false ?

(1) Complex of Pt(+II) and Au(+III) are square planar-including those with weak field ligands such as halide ions.

(2) In tetrahedral complex, the t_{2g} orbitals are nearer to the direction of the ligands.

(3) For d^o, d^5 and d^{10} arrangements the CFSE is zero in both octahedral and tetrahedral complexes with weak field ligands.

(4) None.

10. If excess of $AgNO_3$ solution is added to 100 mL of a 0.024 M solution of dichlorobis(ethylenediamine)cobalt (III) chloride. How many moles of AgCl be precipitated ?

(1) 0.0012 (2) 0.0016 (3) 0.0024 (4) 0.0048

11. A complex of certain metal has the magnetic moment of 4.91 BM whereas another complex of the same metal with same oxidation state has zero magnetic moment. The metal ion could be :

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

12. Oxidation number of Fe in violet coloured complex $Na_4[Fe(CN)_5(NOS)]$ is :

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

13. Aqueous solution of nickel sulphate on treating with pyridine and then adding a solution of sodium nitrite gives dark blue crystals of :

(1) $[Ni(py)_4]SO_4$ (2) $[Ni(py)_2(NO_2)_2]$ (3) $[Ni(py)_4](NO_2)_2$ (4) $[Ni(py)_3(NO_2)]_2SO_4$

14. The IUPAC name of $[Co(NH_3)_6][Cr(C_2O_4)_3]$ is :

(1) Hexaamminecobalt(III) tris(oxalato)chromate(III)

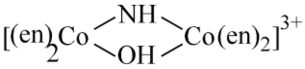
(2) Hexaamminecobalt(III) tris(oxalato)chromium(III)

(3) Hexaamminecobalt(II) tris(oxalato)chromium(III)

(4) Hexaamminecobalt(III) trioxalatechromium(III)

15. In the compound lithiumtetrahydroaluminate, the ligand is :

(1) H^+ (2) H (3) H^- (4) None of these

16. The oxidation number of Co in the complex ion  $\left[(en)_2Co\begin{smallmatrix}NH\\OH\end{smallmatrix}Co(en)_2\right]^{3+}$ is :

(1) +2 (2) +3 (3) +4 (4) +6

17. The magnitude of crystal field stabilisation energy (CFSE of Δ_t) in tetrahedral complexes is considerably less than that in the octahedral field. Because

(1) There are only four ligands instead of six so the ligand field is only 2/3 in tetrahedral complex

(2) The direction of the orbitals does not coincide with the direction of the ligands. This reduces the crystal field stabilization energy (Δ) by further 2/3

(3) Both points (1) and (2) are correct

(4) Both points (1) and (2) are wrong

18. Other than the X-ray diffractions, how could be the following pairs of isomers be distinguished from one another by; $[Cr(NH_3)_6]\ [Cr(NO_2)_6]$ and $[Cr(NH_3)_4(NO_2)_2]\ [Cr(NH_3)_2(NO_2)_4]$.

(1) cryoscopic method (2) measurement of molar conductance
(3) measuring magnetic moments (4) observing their colours

19. $[Fe(en)_2(H_2O)_2]^{2+}$ + en → complex(X). The correct statement about the complex (X) is :
(1) it is a low spin complex. (2) it is diamagnetic.
(3) it shows geometrical isomerism. (4) (1) and (2) both.

20. Which of the following pairs will show the same magnetic moment ('spin only')?
(1) $[Cr(H_2O)_6]^{3+}$ and $[Fe(H_2O)_5NO]^{2+}$ (2) $[Mn(CN)_6]^{4-}$ and $[Fe(CN)_6]^{3-}$
(3) $[Ni(CO)_4]$ and $[Zn(NH_3)_4]^{2+}$ (4) All of these.

21. What will be the theoretical value of 'spin only' magnetic moment when $Fe(SCN)_3$ reacts with a solution containing F^- ions to yield a colourless complex ?
(1) 2.83 B.M. (2) 3.87 B.M. (3) 5.92 B.M. (4) 1.73 B.M.

22. Which of the following statements about $Fe(CO)_5$ is correct?
(1) It is paramagnetic and high spin complex (2) It is diamagnetic and high spin complex
(3) It is diamagnetic and low spin complex (4) It is paramagnetic and low spin complex

23. The crystal field-splitting for Cr^{3+} ion in octahedral field changes for ligands I^-, H_2O, NH_3, CN^- and the increasing order is :
(1) $I^- < H_2O < NH_3 < CN^-$ (2) $CN^- < I^- < H_2O < NH_3$
(3) $CN^- < NH_3 < H_2O < I^-$ (4) $NH_3 < H_2O < I^- < CN^-$

24. Which of the following complex ion is not expected to absorb visible light
(1) $[Ni(H_2O)_6]^{2+}$ (2) $[Zn (NH_3)_4]^{2+}$ (3) $[Cr(NH_3)_6]^{3+}$ (4) $[Fe(H_2O)_6]^{2+}$

25. Of the following complex ions, the one that probably has the largest overall formation constant, K_f, is :
(1) $[Co(NH_3)_6]^{3+}$ (2) $[Co(H_2O)_6]^{3+}$ (3) $[Co(NH_3)_2(H_2O)_4]^{3+}$ (4) $[Co(en)_3]^{3+}$

26. The correct structure of $Fe(CO)_5$ is :
(1) octahedral (2) tetrahedral (3) square pyramidal (4) trigonal bipyramidal

27. Arrange the following in order of decreasing number of unpaired electrons ?
I : $[Fe(H_2O)_6]^{2+}$ II : $[Fe(CN)_6]^{3-}$ III : $[Fe(CN)_6]^{4-}$ IV : $[Fe(H_2O)_6]^{3+}$
(1) IV, I, II, III (2) I, II, III, IV (3) III, II, I, IV (4) II, III, I, IV

28. Match **List-I** (Complexes) with **List-II** (Hybridization) of central atom and select the correct answer using the codes given below the lists :

	List-I		**List-II**
A	$Ni(CO)_4$	1.	sp^3
B	$[Ni(CN)_4]^{2-}$	2.	dsp^2
C	$[Fe(CN)_6]^{4-}$	3.	sp^3d^2
D	$[MnF_6]^{4-}$	4.	d^2sp^3

Code:

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

29. Which of the following complexes shows ionization isomerism ?
(1) $[Cr(NH_3)_6]Cl_3$ (2) $[Cr(en)_2]Cl_2$ (3) $[Cr(en)_3]Cl_3$ (4) $[Co(NH_3)_5Br]SO_4$

30. Coordination number of Ni in $[Ni(C_2O_4)_3]^{4-}$ is :
(1) 3 (2) 6 (3) 4 (4) 2

Practice Test (JEE-Main Pattern)

OBJECTIVE RESPONSE SHEET (ORS)

Que.	1	2	3	4	5	6	7	8	9	10

Ans.										
Que.	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Ans.										
Que.	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Ans.										

PART - II : PRACTICE QUESTIONS

1. A co-ordination complex has the formula $PtCl_4.2KCl$. Electrical conductance measurements indicate the presence of three ion in one formula unit. Treatment with $AgNO_3$ produces no precipitate of AgCl. What is the co-ordination number of Pt in this complex ?

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

2. Which of the following complexes produces three moles of silver chloride when its one mole is treated with excess of silver nitrate ?

(1) $[Cr(H_2O)_3Cl_3]$ (2) $[Cr(H_2O)_4Cl_2]Cl$ (3) $[Cr(H_2O)_5Cl]Cl_2$ (4) $[Cr(H_2O)_6]Cl_3$

3. The number of chloride ions which would be precipitated when one mole of the complex $PtCl_4.4NH_3$ is treated with silver nitrate is:(here coordination number of platinum is 6).

(1) four (2) one (3) three (4) two

4. From the stability constant (hypothetical values), given below, predict which is the most stable complex ?

(1) $Cu^{2+} + 4NH_3$ $[Cu(NH_3)_4]^{2+}$, $\longrightarrow$ $K = 4.5 \times 10^{11}$

(2) Cu^{2+} $4CN^-$ $[Cu(CN)_4]^{3-}$, $\longrightarrow$ $K = 2.0 \times 10^{27}$

(3) $Cu^{2+} + 2en$ $[Cu(en)_2]^{2+}$, $\longrightarrow$ $K = 3.0 \times 10^{15}$

(4) $Cu^{2+} + 4H_2O$ $[Cu(H_2O)_4]^{2+}$, $\longrightarrow$ $K = 9.5 \times 10^{8}$

5. What is wrong about the compound $K[Pt(\eta^2\text{–}C_2H_4)Cl_3]$?

(1) It is called Zeise's salt. (2) It is π bonded complex.
(3) Oxidation number of Pt is +4. (4) Four ligands surround the platinum atom.

6. Diethylenetriamine is:

(1) chelating agent (2) tridentate neutral molecule
(3) tridentatemonoanion (4) (1) and (2) both

7. In $K_4[Fe(CN)_6]$, Fe is in the form of

(1) An atom (2) Neutral complex (3) Cationic complex (4) Anionic complex

8. An ion M^{2+}, form the complexes $[M(H_2O)_6]^{2+}$, $[M(en)_3]^{2+}$ and $[MBr_6]^{4-}$.

(1) Green, blue & Red (2) Blue, Red & Green (3) Green, Red & Blue (4) Red, Blue & Green

9. Consider the following statements:
According the Werner's theory.
(a) Ligands are connected to the metal ions by ionic bonds.
(b) Secondary valencies have directional properties
(c) Secondary valencies are nonionisable

Of these statements:
(1) a, b and c are correct (2) b and c are correct (3) a and c are correct (4) a and b are correct

10. Crystal field stabilization energy for high spin d^4 octahedral complex is :
(1) $-0.6\ \Delta_0$ (2) $-1.8\ \Delta_0$ (3) $-1.6\ \Delta_0 + P$ (4) $-1.2\ \Delta_0$

11. Which one of the following will be able to show cistrans isomerism ?
(1) Ma_3b (2) $M(AA)_2$ (3) M(AB)(CD) (4) Ma_4

12. Which of the following compounds show optical isomerism ?
a. cis-$[Co(NH_3)_4Cl_2]^+$ b. trans-$[Co(en)_2Cl_2]^+$ c. cis-$[Co(en)_2Cl_2]^+$ d. $[Co(en)_3]^{3+}$
Select the correct answer using the codes given below :
(1) a and b (2) b and c (3) c and d (4) a, c and d

13. Which of the following pairs of name and formula of complexes, is incorrect ?
(1) Tetramminecopper(II) sulphate............. $[Cu(NH_3)_4]SO_4$
(2) Diamminesilver(I) chloride .... $[Ag(NH_3)_2]Cl$
(3) Potassium hexacyanidoferrate (III) .... $K_3[Fe(CN)_6]$
(4) Potassium amminepentachloridoplatinate (IV) .... $K[Pt(NH_3)Cl_5]$

14. Which of the following statements is incorrect ?
(1) $Ni(CO)_4$ —— Tetrahedral, paramagnetic (2) $Ni(CN)_4]^{2-}$ —— Square planar, diamagnetic
(3) $Ni(dmg)_2$ —— Square planar, diamagnetic (4) $[NiCl_4]^{2-}$ —— Tetrahedral, paramagnetic

15. Which of the following are π-bonded organometallic compounds ?
(1) Ferrocene (2) Diethyl zinc (3) Ethylmagnesium iodide (4) None of these

16. 50 ml of 0.2 M solution of a compound with empirical formula $CoCl_3.4NH_3$ on treatment with excess of $AgNO_3$(aq) yields 1.435 g of AgCl. Ammonia is not removed by treatment with concentrated H_2SO_4. The formula of the compound is:
(1) $Co(NH_3)_4Cl_3$ (2) $[Co(NH_3)_4Cl_2]Cl$ (3) $[Co(NH_3)_4Cl_3$ (4) $[CoCl_3(NH_3)]NH_3$

17. Which of the following statements is not true?
(1) $MnCl_4^{-}$ ion has tetrahedral geometry and is paramagnetic.
(2) $[Mn(CN)_6]^{2-}$ ion has octahedral geometry and is paramagnetic.
(3) $[Cu(CN)_4]^{3-}$ has square planar geometry and is diamagnetic.
(4) $[Ni(Ph_3P)_2Br_3]$ has trigonal bipyramidal geometry and is paramagnetic.

18. Which of the following statements is correct with respect to the metal carbonyls of Ist transition series?
(1) As M–Cπ bonding increases, the C–O bond length increases.
(2) As positive charge on the central metal atom increases, the C–O bond length increases.
(3) As electron density on the central metal atom increases, the C–O bond length increases.
(4) (1) and (3) both.

19. Which of the following statements is/are incorrect for the complex $[Cr(H_2O)_6]Cl_3$?
(1) It has a magnetic moment of 3.83 BM.
(2) The distribution of 3d electrons is $3dxy^1$, $3dyz^1$, $3dzx^1$
(3) The ligand has satisfied both primary and secondary valencies of chromium.
(4) None of these

20. The number of unpaired electrons present in $[NiF_6]^{2-}$
(1) 0 (2) 1 (3) 2 (4) 3

APSP Answers

PART - I

1.	(2)	**2.**	(2)	**3.**	(1)	**4.**	(4)	**5.**	(3)
6.	(3)	**7.**	(4)	**8.**	(3)	**9.**	(4)	**10.**	(3)
11.	(3)	**12.**	(2)	**13.**	(3)	**14.**	(1)	**15.**	(1,3)
16.	(2)	**17.**	(3)	**18.**	(2)	**19.**	(4)	**20.**	(4)
21.	(3)	**22.**	(3)	**23.**	(1)	**24.**	(2)	**25.**	(4)
26.	(4)	**27.**	(1)	**28.**	(4)	**29.**	(4)	**30.**	(2)

PART - II

1.	(2)	**2.**	(4)	**3.**	(4)	**4.**	(2)	**5.**	(C)
6.	(4)	**7.**	(4)	**8.**	(3)	**9.**	(2)	**10.**	(1)
11.	(3)	**12.**	(3)	**13.**	(3)	**14.**	(1)	**15.**	(1)
16.	(2)	**17.**	(3)	**18.**	(4)	**19.**	(3)	**20.**	(1)