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MCQ-Questions & Answers of Coordination Compounds

1. A square planar complex is formed by hybridisation of which atomic orbitals ? (2002)

1) s, p_x, p_y, d_{yz} 2) s, p_x, p_y, $d_{x^2-y^2}$

3) s, p_x, p_y, d_{z^2} 4) s, p_y, p_z, d_{xy}

Ans.(2) A square planer complex is formed by hybridisation of s, p_x, p_y and d_{x2} -d_{y2} atomic orbitals.

2.The type of isomerism present in nitro- pentamine chromium (III) chloride is (2002)
(1)optical 2) linkage
3) ionization 4) polymerisation
Ans.(2) The nitro group can attach to metal through nitrogen as (-$N0_2$) or through oxygen as nitrito (-ONO).

3.CH_3-Mg-Br is an organo metallic compound due to (2002)
(1)Mg-Br bond 2) C-Mg bond
3) C-Br bond 4) C-H bond
Ans.(2)Bond between C atom of organic molecule and metal atom.

4.Most common oxidation states of Ce (cerium) are (2002)
(1)+2, + 3 2) +2, + 4
3) +3, + 4 4) +3, +5
Ans.(3)Common oxidation states of Ce(Cerium) are +3 and + 4.

	Yn^{+3}	< Pm^{+3}	< Ce^{+3}	< La^{+3}
At. nos.	70	61	58	57

This is due to lanthanide contraction.

5.Arrange Ce^{+3}, La^{+3}, Pm^{+3} and Yb^{+3} in increasing order of their ionic radii (2002)
(1)$Yb^{+3} < Pm^{+3} < Ce^{+3} < La^{+3}$
(2)$Ce^{+3} < Yb^{+3} < Pm^{+3} < La^{+3}$
(3)$Yb^{+3} < Pm^{+3} < La^{+3} < Ce^{+3}$
(4)$Pm^{+3} < La^{+3} < Ce^{+3} < Yb^{+3}$
Ans.(1) According to their positions in the periods, these values are in the order :

6. The most stable ion is (2003)

1) $[Fe(OH)_3]^{3-}$ 3) $[Fe(Cl)_6]^{3-}$

3) $[Fe(CN)_6]^{3-}$ 4) $[Fe(H_2O)_6]^{3+}$

Ans.(2) A more basic ligand forms stable bond with metal ion, Cl^- is most basic amongst all.

7.Ammonia forms the complex ion $[Cu(NH_3)_4]^{2+}$with copper ions in alkaline solutions but not in acidic solutions. What is the reason for it ? (2003)
(1)In acidic solutions protons coordinate with ammonia molecules forming NH_4 ions and NH_3 molecules are not available
(2)In alkaline solutions insoluble $Cu(OH)_2$ is precipitated which is soluble in excess of any alkali.
(3)Copper hydroxide is an amphoteric substance
(4)In acidic solutions hydration protects copper ions
Ans.(1) Cu^{2+} forms complex with free NH_y (4)

8.One mole of the complex compound $Co(NH_3)_5C1_3$, gives 3 moles of ions on dissolution in water. One mole of the same complex reacts with two moles of $AgN0_3$ solution to yield two moles of $AgCl_{(s)}$. The structure of the complex is (2003)
(1)$[Co(NH_3)_3Cl_3].2NH_3$
(2)$[Co(NH_3)_4C1_2]C1.NH_3$
(3)$[Co(NH_3)_4C1]C1_2.NH_3$ 4) $[Co(NH_3)_5C1]C1_2$
Ans.

(4) $Co(NH_3)_5Cl_3$ is $[Co(NH_3)_5Cl]^{+2}+2Cl^-$

Structure of complex is $[Co(NH_3)_5\ Cl]Cl_2$

9.In the coordination compound, $K_4[Ni(CN)_4]$, the oxidation state of nickel is (2003)
1)0 2) + 1 3) + 2 4) – l
Ans.

(1) $4(+1) + x + (-1) \times 4 = 0$

$\Rightarrow 4 + x - 4 = 0$ (or) $x = 0$

10.A reduction in atomic size with increase in atomic number is a characteristic of elements of (2003)
(1)d-block 2) f-block
3) radioactive series 4) high atomic masses
Ans.(2) f-block elements show a regular decrease in atomic size due to lanthanide/actinide contraction.

11.The coordination number of central metal atom in a complex is determined by (2004)
(1)The number of ligands around a metal ion bonded by sigma bonds
(2)The number of only anionic ligands bonded to the metal ion
(3)The number of ligands around a metal ion bonded by sigma and pi- bonds both
(4)The number of ligands around a metal ion bonded by pi-bonds
Ans.

(1) Coordination number is 2^0 valency.

12.Which one of the following complexes in an outer orbital complex ? (2004)
(1)$[Fe(CN)_6]^{4-}$ 2) $[Ni(NH_3)_6]^{2+}$
3) $[Co(NH_3)_6]^{3+}$ 4) $[Mn(CN)_6]^{4-}$
Ans.

(2) sp^3d^2

Therefore, outer orbital octahedral complex.

13.Coordination compound have great importance in biological systems. In this context which of the following statements is incorrect ? (2004)
' 1) Chlorophylls are green pigments in plants and contains calcium
(2)Carboxypeptidase – A is an enzyme and contains zinc
(3)Cyanocobalamin is B_{12} and contains cobalt
(4)Haemoglobin is the red pigment of blood and contains iron
Ans.(3)Chlorophyll contains magnesium instead of calcium.

14.Cerium(Z=58)is an important member of the lanthanoids. Which of the following statements about cerium is incorrect ? (2004)
(1)The common oxidation states of cerium are +3 and +4
(2)Cerium (IV) acts as an oxidizing agent
(3)The +4 oxidation state of cerium is not knownin solutions .
(4)The +3 oxidation state of cerium is more stable than the +4 oxidation state
Ans.(3) Oxidation potential of Ce(IV) in aqueous solution is supposed to be -ve i.e. -0.784 V at 25°C.

15.Which one the following has largest number of isomers? (R-= alkyl group, en = ethylenediamine) (2004)
1) $[Ru(NH_3)_4C1_2+]$ 2) $[Co(en)_2Cl_2]^+$
3) $[Ir(PR_3)_2\ H(CO)]^{2+}$ 4) $[Co(NH_3)_5C1]^{2+}$
Ans.(2)Geomerical and optical isomerisum.

16.The correct order of magnetic moments (spin only values in B.M.) among is (2004)
(1)$[MnClJ^{2-} > [CoCl_4]^{-2} > [Fe(CN)_6r$
(2)$[Fe(CN)_6]'^4 > [CoClJ^{2-} > [MnClJ^{2-}$
(3)$[Fe(CN)J^{4-} > [MnClJ^{2-} > [CoClJ^{2-}$
(4)$[MnClJ^{2-} > [Fe(CN)J^{4-} > [CoClJ^{2-}$
Ans.(1) Number of unpaired e" in Mn^{2+} is 5, Co^{2+} is 3 and Fe^{2+} is zero.

17.The oxidation state of Cr in the complex$[Cr(NH_3)_4Cl_2]^+$ is (2005)
(1)+3 2) +2 3) +1 4)0

Ans.

(1) Let oxidation state of Cr in complex

$(Cr(NH_3)_4Cl_2)^+$ is x

$x + 4 \times 0 + 2\times -1 = 1$; $x = +3$

18.Calomel (Hg_2Cl_2) on reaction with ammonium hydroxide gives (2005)

(1)$HgNH_2Cl$ 2) NH_2-Hg-Hg-Cl

3) Hg_20 4) HgO

Ans.(1) Reaction between calomel and ammonia is $Hg_2Cl_2 + 2NH_4OH \rightarrow Hg + Hg(NH_2)C1 + 2H_2$

19.The IUPAC name of the coordination compound $K_3[Fe(CN)_6]$ is (2005)

(1)Potassium hexacyanoferrate (II)

(2)Potassium hexacyanoferrate (III)

(3)Potassium hexacyanoiron (II)

(4)tripotassium hexcyanoiron (II)

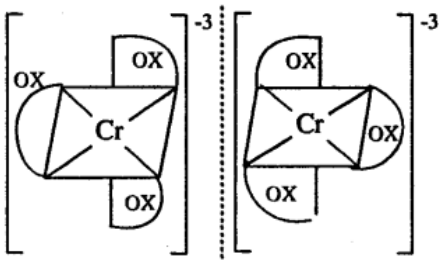
Ans.(2) Complex of Fe^{3+} is ferrate(III).

20.Which of the following compounds shows optical isomerism? (2005)

1) $[Cu(NH_3)_4]^{+2}$ 2) [ZnClJ-^{2}

3) $[Cr(C_20_4)_3]^{-3}$ 4) $[Co(CN)_6]^{-3}$

Ans.(3) The optical isomers are.



21. Which one of the following cyano complexes would exhibit the lowest value of paramagnetic behaviour ? (2005)

1) $[Cr(CN)_6]^{-3}$ 2) $[Mn(CN)_6]^{-3}$

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

Ans.

(4) Co^{3+} has least number of umpaired e^-

22.The value of the 'spin only' magnetic moment for one of the following configurations is 2.84 BM. The correct one is (2005)

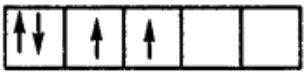
(1)d^4 (in strong ligand filed)

(2)d^4 (in weak ligand field)

(3)d^3 (in weak as well as in strong fields)

(4)d^5 (in strong ligand field)

Ans.

(1)  d^4 in strong field.

So number of unpaired electrons = 2.

23.The IUPAC name for the complex $[Co(N0_2)(NH_3)_5]C1_2$ is (2006)
(1)nitrito-N-pentaamminecobalt (III) chloride
(2)nitrito-N-pentaamminecobalt (II) chloride
(3)pentaammine nitrito-N-cobalt (II) chloride
(4)pentaammine nitrito-N-cobalt (III) chloride
Ans.

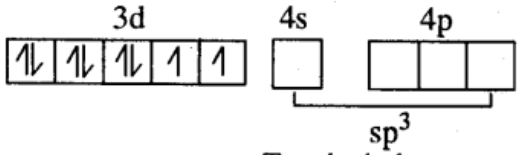
(4) Naming of ligands is in the order :

NH_3 and NO_2^-

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

(2) $_{28}Ni$: ..... $3s^2, 3p^6, 3d^8, 4s^2$

Ni^{2+} has $3s^2, 3p^6, 3d^8$



Tetrahedral geometry

25.In $Fe(CO)_5$, the Fe-C bond possesses (2006)
(1)k -character only
(2)both 0 and n characters
(3)ionic character 4) a -character only…
Ans.(2) Because of back bonding both o and kbonds are present.

26.How many EDTA (ethylenediaminetetraacetic acid) molecules are required to make an octahedral complex with a Ca^{2+} ion ? (2006)
(1)Six 2) Three 3) One 4) Two
Ans.(3) $EDTA^{4-}$ is hexadentate ligand.

27.Lanthanoid contraction is caused due to (2006)
(1)The appreciable shielding on outer electrons by 4f electrons from the nuclear charge
(2)The appreciable shielding on outer electrons by 5d electrons from the nuclear charge
(3)The same effective nuclear charge from Ce to Lu
(4)The imperfect shielding on outer electrons by 4f electrons from the nuclear charge
Ans.(4) Poor slidding by f-electrons.

28.Identify the incorrect statement among the, following (2007)

(1)d-Block elements show irregular and erratic chemical properties among themselves

(2)La and Lu have partially filled d orbitals and no other partially filled orbitals

(3)The chemistry of various lanthanoids is very similar

(4)4f and 5f orbitals are equally shielded

Ans.(4) 4f and 5f belongs to different energy levels, hence the shielding effect is on them is not the same. Shielding of 4f is more than 5f.

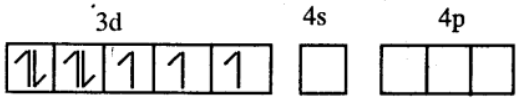
29. Which one of the following has a square planar geometry ? (2007)

1) $[CoCl_4]^{2-}$ 2) $[FeCl_4]^{2-}$

3) $[NiCl_4]^{2-}$ 4) $[PtCl_4]^{2-}$

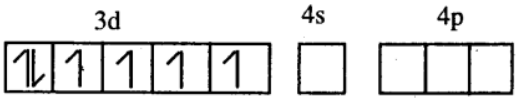
Ans.

(4) $_{27}Co^{2+} - 1s^2 2s^2 2p^6 3s^2 3p^6 3d^7 4s^0$



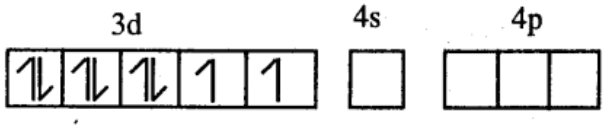
Cl^- is weak field ligand and no pairing up of electrons. Hence it is sp^3 hybridized giving tetrahedral geometry.

$Fe^{2+} - 1s^2 2s^2 2p^6 3s^2 3p^6 3d^7 4s^0$



Due to weak Cl^-, pairing is not observed. So it will be sp^3 hybridized giving tetrahedral geometry.

$Ne^{2+} - 1s^2 2s^2 2p^6 3s^2 3p^6 3d^7 4s^0$



Because Cl^- is weak ligand, pairing is not observed. So it will be sp^3 with tetrahedral geometry.

All the complexes of Pt^{2+} are square planar including those with weak field ligand such as halide ions.

30.The actinoids exhibits more number of oxidation states in general than the lanthanoids. This is because (2007)

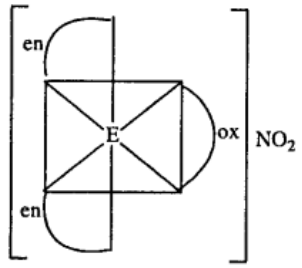
(1)The 5f orbitals are more buried than the 4f orbitals

(2)There is a similarity between 4f and 5f orbitals in their angular part of the wave function
(3)The actinoids are more reactive than the lanthanoids
(4)The 5f orbitals extend further from the nucleus than the 4f orbitals

Ans.(4) The actinoids exhibit more number of oxidation states in general than the lanthanoids. This is because the 5f orbitals extend further from the nucleus than the 4f orbitals.

31.The coordination number and the oxidation state of the element 'E' in the complex $[E(en)_2(C_2O_4)]NO_2$ (where 'en' is ethylene diamine) are, respectively, (2008)
1) 6 and 2 2) 4 and 2 3) 4 and 3 4) 6 and 3

Ans.
(4) Complex is shown as :



Coordination number is = 6 and oxidation number is = +3.

32.Larger number of oxidation states are exhibited by the actinoids than those by the lanthanoids, the main reason being (2008)
(1)4f orbitals more diffused than the 5f orbitals
(2)Lesser energy difference between 5f and 6d than between 4f and 5d orbitals
(3)More energy difference between 5f and 6d than between 4f and 5d orbitals
(4)More reactive nature of the actinoids than the lanthanoids

Ans.(2) Being lesser energy difference between 5f and 6d than 4f and 5d orbitals.

33.In which of the following octahedral complexes of Co (at. no. 27), will be magnitude of A_0 be the highest ? (2008)
1) $[Co(CN)_6]^{3-}$ 2) $[Co(C_2O_4)_3]^{3-}$
3) $[Co(H_2O)_6]^{3+}$ 4) $[Co(NH_3)_6]^{3+}$

Ans.
(1) $CH^{\ominus}$ is stronger ligand hence Δ_0 is highest.

34.Knowing that the chemistry of lanthanoids (Ln) is dominated by its +3 oxidation state, which of the following statements in incorrect?(2009)
(1)Because of the large size of the Ln(III) ions the bonding in its compounds is predominantly ionic in character
(2)The ionic sizes of Ln(III) decreases in general with increasing atomic number

(3)Ln(III) compounds are generally colourless
(4)Ln(III) hydroxides are mainly basic in character

Ans.(3) Ln^{+3} compounds are mostly coloured.

35.Which of the following has an optical isomer?(2009)
1) $[C0(NH_3)_3C1]$\ 2) $[CO(en)(NH_3)_2]^{2+}$
3) $[C0(H_20)_4(en)]^{3+}$ 4) $[CO(en)_2(NH_3)_2]^{3+}$

Ans.(4) It is an octahedral complex of the type $[M(AA)_2X_2]$ where AA is bidentate ligand.

36.In context with the transition elements, which of the following statements is incorrect ?(2009)
(1)In addition to the normal oxidation states, the zero oxidation state is also shown by these elements in complexes
(2)In the highest oxidation states, the transition metal show basic character and form cationic complexes.
(3)In the highest oxidation states of the first five transition elements (Sc to Mn), all the 4s and 3d electrons are used for bonding.
(4)Once the d^3 configuration is exceeded, the tendency to involve all the 3d electrons in bonding decreases.
Ans.(2) In higher oxidation states transition elements show acidic nature.

37.Which of the following pairs represents linkage isomers ? (2009)
(1)$[Cu(NHj)_4][PtCl_4]$ and $[Pt(NH,)_4][CuCl_4]$
(2)$[Pd(PPh_3)_2(NCS)_2]$ and$[Pd(PPh_3)_2(SCN)_2]$
(3)$[CO(NH_3)_5N0_3]S0_4$and $[co(NH_3)_5S0_4]N0_3$
(4)$[PtCl_2(NH_3)_4]Br_2$ and $[PtBr_2(NH_3)_4]C1_2$
Ans.

(2) NCS^- is ambidentate ligand and it can be linked through N (or) S.

38.A solution containing 2.675 g of $CoCl_3.6NH_3$ (molar mass = 267.5g mol'^1) is passed through a cation exchanger. The chloride ions obtained in solution were treated with excess of $AgN0_3$ to give 4.78g of AgCl (molar mass = 143.5 g mol^{-1}). The formula of the complex is (At. Mass of Ag = 108u) (2010)
1) $[Co(NH_3)_6]C1_3$ 2) $[CoC1_2(NH_3)JC1$
' 3) $[CoC1_3(NH_3)_3]$ 4) $[CoC1(NH_3)_5]C1_2$
Ans.

(1) $CoCl_3.6NH_3 \rightarrow xCl^- \xrightarrow{AgNO_3} x\ AgCl\downarrow$

$n(A\ gCl) = xn\ (CoCl_3.6NH_3)$

$\frac{4.78}{143.5} = x\frac{2.675}{267.5}$ (or) $x = 2$

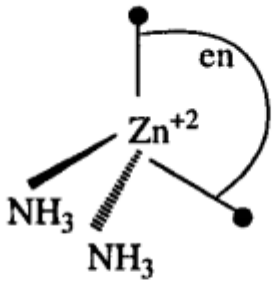
The complex is $[Co(NH_3)_6]Cl_3$

39.Which one of the following has an optical isomer? (en = ethylenediamine) (2010)

(1)[Zn(en) $(NH_3)_2]^{2+}$ 2) $[Co(en)_3]^{3+}$
3)$[Co(H_20)_4(en)]^{3+}$ 4) $[Zn(en)_2]^{2+}$
Ans.

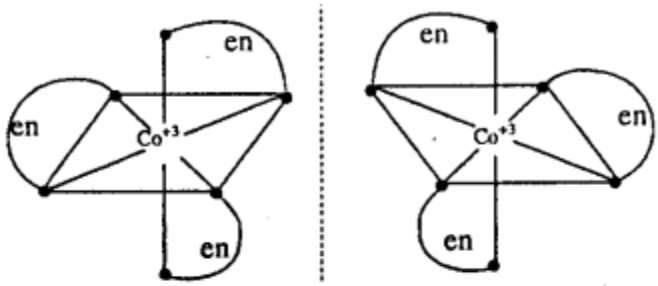
(2)

1)



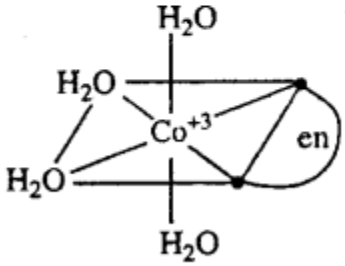
Tetrahedral with a plane of symmetry.
No optical isomer

2)



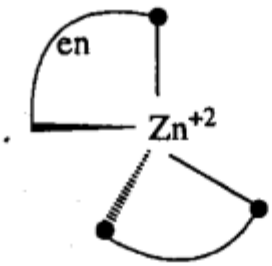
Optical isomers.
Non superimpossible miner images

3)



Horizontal plane is plane of symmetry.
No optical isomer

4)



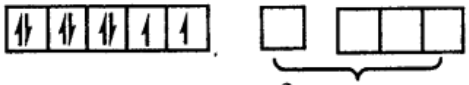
Tetrahedral with a plane of symmetry.
No optical isomer

40.The magnetic moment (spin only) of $[NiClJ^{2]-}$is (2011)
1) 2.82 BM 2) 1.41 BM
(3)82 BM 4) 5.46 BM
Ans.

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

Ni^{+2} : $3d^8\ 4s^0$

Cl^- is a weak ligand have no pairing of non bonding electrons takes place



sp^3-hybridisation

Number of unpaired electrons, n = 2

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

$= \sqrt{2(2+2)} = 2.82$BM

41.Which of the following facts about the complex $[Cr(NH_3)_6]Cl_3$ is wrong ? (2011)
(1)The complex is an outer orbital complex
(2)The complex gives white precipitate with silver nitrate solution.
(3)The complex involves d^2sp^3 hybridisation and is octahedral in shape
(4)The complex is paramagnetic
Ans.

(1) $[Cr(NH_3)_6]Cl_3$

NH_3 acts as strong ligand

Configuration of $Cr^{+3} = 3d^3 4s^0$

d^2sp^3

It is inner orbital complex.

42.In context of the lanthanoids, which of the following statements is not correct ? (2011)
(1)Because of similar properties the separation of lanthanoids is not easy
(2)Availability of 4f electrons results in the formation of compounds in + 4 state for all the members of the series
(3)There is a gradual decrease in the radii of the members with increasing atomic number in the series
(4)All the members exhibit + 3 oxidation state
Ans.(2) All the Lanthanides can not form + 4 oxidation state.

43.Which among the following will be named as dibromidohis (ethylenediamine) chromium (m) bromide ? (2012)

1) $[Cr(en)_3]Br_{33}$ 2) $[Cr(en)_2Br_2]Br$
3) [Cr(en)BrJ- 4) $[Cr(en)Br_2]Br$
Ans.

(2) $[Cr(en)_2Br_2]Br$ 'en' is ethylenediamine

There are two 'en's. Hence –bis

Dibromidobis (ethylenediamine) chromium (III) bromide.

44.Which of the following complex species is not expected to exhibit optical isomerism ? (2013)
1) $[Co(en)_3]^{3+}$ 2) $[Co(en)_2C/_2]^+$
3) $[Co(NH_3)C/_3]$ 4) $[Co(en)(NH_3)_2C/_2]^+$
Ans.(3) $[Co(NH_3)_3C/_3]$ do not exhibit optical isomers but othee exhibit.

45.Which of the following arrangements does not represent the correct order of the property stated against it ? (2013)
(1)V^{2+}< CF^+ < Mn^{2+} < Fe^{2+} :Paramagnetic behaviour
(2)Ni^{2+} < Co^{2+} < Fe^{2+} < Mn^{2+} : Ionic size
(3)Co^{3+} < Fe^{3+} < Cr^{3+} < Sc^{3+} :Stability in aqueous solution
(4)Sc < Ti < Cr < Mn :Number of oxidation states
Ans.

Magnetic moment = $\sqrt{n(n+2)}$, where n is number of unpaired electrons.

46. 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 (2014)

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

Ans.(3) Order of wavelength of colours Red > Yellow > Green > Blue

48. Match the catalysts to the correct processes

Catalyst	Process	(2015)
A) $TiCl_3$	i) Wacker process	
B) $PdCl_2$	ii) Ziegler-Natta polymeron	
C) $CuCl_2$	iii) Contact process	
D) V_2O_5	iv) Deacon's process	

1) A – (iii), B – (ii), C – (iv), D – (i)

2) A – (ii), B – (i), C – (iv), D – (iii)

3) A – (ii), B – (iii), C – (iv), D – (i)

4) A – (iii), B – (i), C – (ii), D – (iv)

Ans.

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

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

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

Ans.(2)Two bidentate and two monodentative – ligands are present.

(2)

$TiCl_3$ – Ziegler - Natta polymeron

$PdCl_2$ - Wacker process

$CuCl_2$ - Deacon's process

V_2O_5 - Contact process

50. The color of $KMnO_4$ is due to (2015)

1) M $\rightarrow$ L charge transfer transition

2) d $\rightarrow$ d transition

3) L $\rightarrow$ M charge transfer transition

4) $\sigma \rightarrow \sigma^*$ transition

Ans.(3) Change transfer from oxygen to manganese

51. Which of the following compounds is not colored yellow ? (2015)

1) $Zn_2[Fe(CN)_6]$ 2) $K_3[Co(NO_2)_6]$

3) $(NH_4)_3[As(Mo_3O_{10})_4]$

4) $BaCrO_4$

Ans. (1) Ferrocyanide is blue.

1.

The _____ sphere is enclosed in brackets in formulas for complex species, and it includes the central metal ion plus the coordinated groups.
(a) ligand
(b) donor
(c) oxidation
(d) coordination
(e) chelating

2.

In coordination chemistry, the **donor atom** of a ligand is
(a) a Lewis acid.
(b) the counter ion
(c) the central metal atom.
(d) the atom in the ligand that shares an electron pair with the metal.
(e) the atom in the ligand that accepts a share in an electron pair from the metal.

3.

Consider the coordination compound, $Na_2[Pt(CN)_4]$. The Lewis acid is
(a) $[Pt(CN)_4]^{2-}$
(b) Na^+
(c) Pt
(d) Pt^{2+}
(e) CN^-

4.

Consider the coordination compound, $K_2[Cu(CN)_4]$. A coordinate covalent bond exists between
(a) K^+ and CN^-
(b) Cu^{2+} and CN^-
(c) K^+ and $[Cu(CN)_4]^{2-}$
(d) C and N in CN^-
(e) K^+ and Cu^{2+}

5.

Given the list of ligands and their corresponding names, choose the pair that disagree.

	LIGAND NAME
(a) OH^-	hydroxo
(b) CN^-	cyanide
(c) Cl^-	chloro
(d) H_2O	aqua
(e) NH_3	ammine

6.

Select the **correct** IUPAC name for: $[FeF_4(OH_2)_2]^-$
(a) diaquatetrafluoroiron(III) ion
(b) diaquatetrafluoroferrate(III) ion

(c) diaquatetrafluoroiron(I) ion
(d) diaquatetrafluoroferrate(I) ion
(e) none of these

7.

Select the **correct** IUPAC name for: $[Co(NH_3)_6]^{2+}$
(a) hexammoniacobaltate(II) ion
(b) hexaamminecobaltate(II) ion
(c) hexammoniacobalt(II) ion
(d) hexaamminecobalt(II) ion
(e) hexammoniacobalt ion

8.

Which name-formula combination is NOT correct?

	FORMULA	NAME
(a)	$[Co(NH_3)_4(OH_2)I]SO_4$	tetraammineaquaiodocobalt(III) sulfate
(b)	$K[Cr(NH_3)_2Cl_4]$	potassium diamminetetrachlorochromate(III)
(c)	$[Mn(CN)_5]^{2-}$	pentacyanomanganate(II) ion
(d)	$[Ni(CO)_4]$	tetracarbonylnickel(0)
(e)	$Ca[PtCl_4]$	calcium tetrachloroplatinate(II)

9.

What is the oxidation number of the central metal atom in the coordination compound

$[Pt(NH_3)_3Cl]Cl$?

(a) -1
(b) 0
(c) +1
(d) +2
(e) +3

10.

(Valance Bond Theory) Magnetic measurements indicate that $[Co(OH_2)_6]^{2+}$ has 3 unpaired electrons. Therefore, the hybridization of the metal's orbitals in $[Co(OH_2)_6]^{2+}$ is:
(a) sp^3
(b) sp^2d
(c) dsp^2
(d) sp^3d^2
(e) d^2sp^3

11.

Which one of the following complexes can exhibit geometrical isomerism?
(a) $[Pt(NH_3)_2Cl_2]$ (square planar)
(b) $[Zn(NH_3)_2Cl_2]$ (tetrahedral)
(c) $[Cu(NH_3)_4]^{2+}$ (square planar)
(d) $[Co(NH_3)_5Cl]^{2+}$ (octahedral)
(e) $[Cu(CN)_2]^-$ (linear)

12.

A molecule that cannot be superimposed on its mirror image is said to exhibit which of the following?
(a) geometrical isomerism
(b) optical isomerism
(c) linkage isomerism
(d) reactive isomerism
(e) coordination isomerism

13.

In which one of the following species does the transition metal ion have d^3 electronic configuration?
(a) $[Cr(NH_3)_6]^{3+}$
(b) $[Co(OH_2)_6]^{2+}$
(c) $[CoF_6]^{3-}$
(d) $[Fe(CN)_6]^{3-}$
(e) $[Ni(OH_2)_6]^{2+}$

14.

(Valence Bond Theory) The coordination complex, $[Cu(OH_2)_6]^{2+}$ has one unpaired electron. Which of the following statements are **true**?
(1) The complex is octahedral.
(2) The complex is an outer orbital complex.
(3) The complex is d^2sp^3 hybridized.
(4) The complex is diamagnetic.
(5) The coordination number is 6.
(a) 1, 4
(b) 1, 2, 5
(c) 2, 3, 5
(d) 2, 3
(e) 4, 5

15.

(Crystal Field Theory) Which one of the following statements is **FALSE**?
(a) In an octahedral crystal field, the d electrons on a metal ion occupy the e_g set of orbitals before they occupy the t_{2g} set of orbitals.
(b) Diamagnetic metal ions cannot have an odd number of electrons.
(c) Low spin complexes can be paramagnetic.
(d) In high spin octahedral complexes, Δ_{oct} is less than the electron pairing energy, and is relatively very small.
(e) Low spin complexes contain strong field ligands.

16.

(Crystal Field Theory) When the valence d orbitals of the central metal ion are split in energy in an octahedral ligand field, which orbitals are raised **least** in energy?
(a) d_{xy} and d_{x2-y2}
(b) d_{xy}, d_{xz} and d_{yz}

(c) d_{xz} and d_{yz}
(d) d_{xz}, d_{yz} and d_{z2}
(e) d_{x2-y2} and d_{z2}

17.

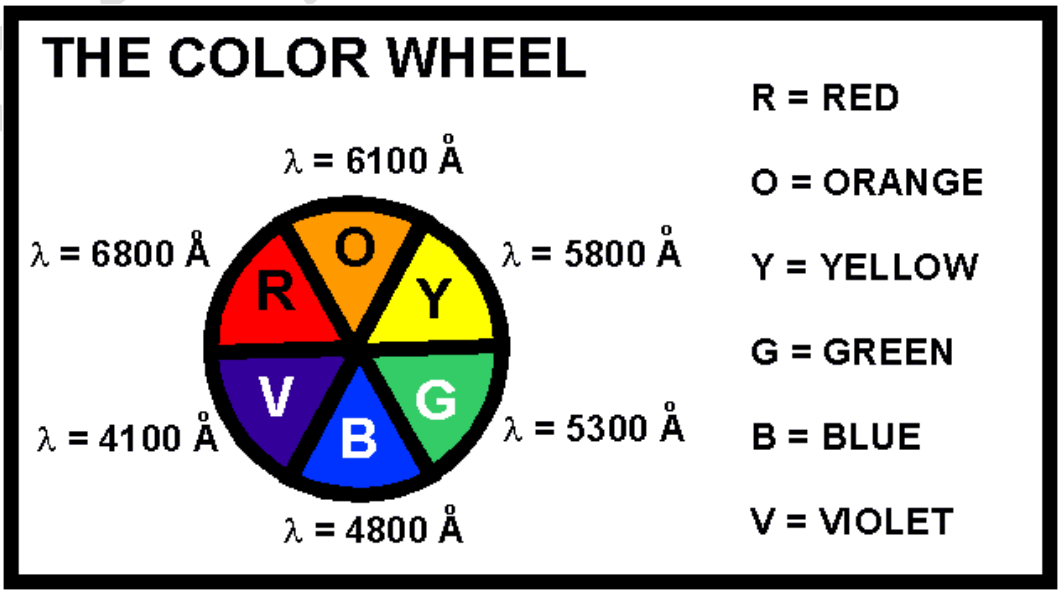
(Crystal Field Theory) How many unpaired electrons are there in a strong field iron(II) octahedral complex?
(a) 0
(b) 1
(c) 2
(d) 4
(e) 6

18.

(Crystal Field Theory) Consider the complex ion $[Mn(OH_2)_6]^{2+}$ with 5 unpaired electrons. Which response includes all the following statements that are **true**, and no false statements?
I. It is diamagnetic.
II. It is a low spin complex.
III. The metal ion is a d^5 ion.
IV. The ligands are weak field ligands.
V. It is octahedral.
(a) I, II
(b) III, IV, V
(c) I, IV
(d) II, V
(e) III, IV

19.

(Crystal Field Theory) Consider the violet-colored compound, $[Cr(OH_2)_6]Cl_3$ and the yellow compound, $[Cr(NH_3)_6]Cl_3$. Which of the following statements is false?



(a) Both chromium metal ions are paramagnetic with 3 unpaired electrons.
(b) Δ_{oct} for $[Cr(NH_3)_6]^{3+}$ is calculated directly from the energy of yellow light.
(c) Δ_{oct} for $[Cr(OH_2)_6]^{3+}$ is less than Δ_{oct} for $[Cr(NH_3)_6]^{3+}$.
(d) A solution of $[Cr(OH_2)_6]Cl_3$ transmits light with an approximate wavelength range of 4000 - 4200 angstroms.
(e) The two complexes absorb their complementary colors.

20.

(Crystal Field Theory) Strong field ligands such as CN^-:
(a) usually produce high spin complexes and small crystal field splittings.
(b) usually produce low spin complexes and small crystal field splittings.
(c) usually produce low spin complexes and high crystal field splittings.
(d) usually produce high spin complexes and high crystal field splittings.
(e) cannot form low spin complexes.

Answers:

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

Question 1:

Write down the molecular formulae of the following co-ordination compounds.

(i) Hexaammine iron (III) nitrate

(ii) Ammonium tetrachlorocuprate (II)

(iii) Sodium monochloropentacyanoferrate (III)

(iv) Potassium hexafluorocabaltate (III)

Solution:

(i) $[Fe(NH_3)_6](NO_3)_3$
(ii) $(NH_4)_2[CuCl_4]$
(iii) $Na_3[FeCl.(CN)_5]$
(iv) $K_3[CoF_6]$

Question 2:

Write the IUPAC names of following compounds?

(i) $[CoBr(NH_3)_5]SO_4$
(ii) $[Fe(NH_3)_6][Cr(CN)_6]$
(iii) $[Co(SO_4)(NH_3)_5]^+$
(iv) $[Fe(OH)(H_2O)_5]^{2+}$

Solution:

(i) Pentaamminebromocobalt (III) sulphate

(ii) Hexaammineiron (III) hexacyanochromate (III)

(iii) Pentaammine sulphate cobalt (III) ion

(iv) Pentaaquahydroxoiron (III) ion

Question 3:
Write down the IUPAC name of the complex $K_4[Fe(CN)_6]$.
Solution:
Firstly the +ve part should be named followed by the negative part in which the name of the ligand should be given in alphabetical order with the metal in the negative part ending in - ate (oxidation state in parenthesis) Thus the name is Potassiumhexacyano - C-ferrate (II). Hyphen C is shown to indicate CN^- bonded via carbon

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Question 4:
Write down the IUPAC name of $K_2[Fe(NC)_3Cl_2(NH_3)_2]$.
Solution:
The positive part is named first followed by the negative part. In the negative part the names are written in alphabetical order followed by metal. So the name is Potassiumdiamminedichlorotricyano-N- ferrate (III).

Question 5:
Write the IUPAC name of $[Co(NH_3)_4(NO_2)_2]Cl$
S**olution:**
In the earlier two examples the negative part was the complex part while in this case the positive part is the complex. So it is named first with ligands in alphabetical order followed by metal (but not ending in –ate as the metal belong to the positive part of the complex). This is followed by the negative part.So the name is Tetraamminedinitrocobalt (III) chloride.

Question 6:
Write down the IUPAC name of $[Co(NH_3)_2Cl(en)_2]Cl_2$
S**olution:**
The approach is same as the earlier one with the exception that in case of -en which is actually ethylene diammine the term bis – comes to indicate two – en groups instead of – bi. The name is Diamminechlorobis (ethylene diamine) cobalt(III) chloride.

Question 7:
Write IUPAC name of $[Pt(Py)_4][PtCl_4]$.
S**olution:**
Here both the positive and negative part has the same metal. Procedure is same as earlier for the IUPAC name. Tetrapyridineplatinum(II) tetrachloroplatinate(II).

Question 8:
Write the IUPAC name of $[Fe(NH_3)_4O_2C_2O_4]Cl$
Solution:
In this charge on the complex part is +1. The ligand oxalato has a charge of –2, so iron should be in +3 state meaning O_2 to be neutral. Now had O_2 been superoxo (O_2^-) or peroxo (O_2^{--}) the negative charge of the ligands should have been –3 and –4 respectively. In that case Iron has to be +4 and +5 which is not possible. So O_2 will behave as a neutral ligand and IUPAC name is Tetraammineoxalatodioxygeniron (III) chloride.

Question 9:
Amongst $Ni(CO)_4$, $[Ni(CN)_4]^{2-}$ and $NiCl_4^{2-}$
(a) $Ni(CO)_4$ and $NiCl_4^2$ are diamagnetic and $[Ni(CN)_4]^{2-}$ is paramagnetic
(b) $[NiCl_4]^{2-}$ and $[Ni(CN)_4]^{2-}$ are diamagnetic and $Ni(CO)_4$ is paramagnetic
(c) $Ni(CO)_4$ and $[Ni(CN)_4]^{2-}$ are diamagnetic and $[NiCl_4]^{2-}$ is paramagnetic
(d) $Ni(CO)_4$ is diamagnetic and $[NiCl_4]^{2-}$ and $[Ni(CN)_4]^{2-}$ are paramagnetic
Solution:
In $Ni(CO)_4$, Ni has $3d^{10}$ configuration, diamagnetic.
In $[Ni(CN)_4]^{2-}$, Ni has $3d^8$ configuration but due to strong ligand field, all the d-electrons are spin paired giving dsp^2 hybridization, diamagnetic.
In $[NiCl_4]^{2-}$, Ni has $3d^8$ configuration and there is two unpaired electrons (weak chloride ligand do not pair up d-electrons) hence, paramagnetic.

Question 10:
Among the following ions, which one has the highest paramagnetism ?
(a) $[Cr(H_2O)_6]^{3+}$
(b) $[Fe(H_2O)_6]^{2+}$
(c) $[Cu(H_2O)_6]^{2+}$
(d) $[Zn(H_2O)_6]^{2+}$
Solution:
Fe in $[Fe(H_2O)_6]^{2+}$ has maximum (four) unpaired electrons, has highest paramagnetism.

1. When 0.1 mol $CoCl_3(NH_3)_5$ is combined with excess $AgNO_3$, then 0.2 mol AgCl is obtained. The conductivity of the solution suits the

a. 1:3 electrolyte
b. 1:1 electrolyte
c. 3:1 electrolyte
d. 1:2 electrolyte

Answer: (d)

2. A chelating agent has two or more than two donor atoms to bind to a single metal ion. Which of the following is not a chelating agent?

a. Thiosulphato
b. Oxalato
c. Glycinato
d. Ethane-1,2-diamine

Answer: (a)

3. IUPAC name of $[Pt(NH_3)_2Cl(NO_2)]$ is

a. Platinum diamminechloronitrite

b. Chloronitrito-N-ammineplatinum (II)
c. Diamminechloridonitrito-N-platinum (II)
d. Diamminechloronitrito-N-plantinate (II)

Answer: (c)

4. In the complex $[E(en)_2(C_2O_4)]NO_2$ (where (en) is ethylenediamine) _____are the coordination number and the oxidation state of the element 'E' respectively.

a. 6 and 2
b. 2 and 2
c. 4 and 3
d. 6 and 3

Answer: (d)

5. The sum of coordination number and oxidation number of the metal M in the complex $[M(en)_2(C_2O_4)]Cl$ (where (en) is ethylenediamine) is

a. 9
b. 6
c. 7
d. 8

Answer: (a)

6. Some salts containing two different metallic elements give test for only one of them in solution, such salts are

a. double salts
b. normal salts
c. complex salts
d. None of these

Answer: (c)

7. An example of a sigma bonded organometallic compound is

a. Grignard reagent
b. Ferrocene
c. Cobaltocene
d. Ruthenocene

Answer: (a)

8. Iron carbonyl, $Fe(CO)_5$ is

a. Tetranuclear
b. Mononuclear
c. Dinuclear
d. Trinuclear

Answer: (b)

9. The type of isomerism shown by the complex $[CoCl_2(en)_2]$ is

a. Geometrical isomerism
b. Coordination isomerism
c. Linkage isomerism
d. Ionization isomerism

Answer: (a)

10. Which of the following elements do not form a complex with EDTA?

a. Ca
b. Mg
c. Be
d. Sr

Answer: (c)

Question 1

Which one of the following complex ions has geometrical isomers?

A $[Cr(NH_3)_4(en)]^{3+}$
B $[Co(en)_3]^{3+}$
C $[Ni(NH_3)_5Br]^{+}$
D $[Co(NH_3)_2(en)_2]^{3+}$

Question 2

Which one of the following cyano complexes would exhibit the lowest value of paramagnetic behaviour?

(At. No. Cr = 24, Mn = 25, Fe = 26, Co = 27)

A $[Cr(CN)_6]^{3-}$
B $[Mn(CN)_6]^{3-}$
C $[Fe(CN)_6]^{3-}$

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

Question 3

Which one of the following has a square planar geometry? (At. Nos. Co = 27, Ni = 28, Fe = 26, Pt = 78)

A $[CoCl_4]^{2-}$
B $[FeCl_4]^{2-}$
C $[NiCl_4]^{2-}$
D $[PtCl_4]^{2-}$

Question 4

Which one of the following has an optical isomer? (en = ethylenediamine)

A $[Zn(en)(NH_3)_2]^{2+}$
B $[Co(en)_3]^{3+}$
C $[Co(H_2O)_4(en)]^{3+}$
D $[Zn(en)_2]^{2+}$

Question 5

Which kind of isomerism is exhibited by octahedral $Co(NH_3)_4BrCl$?

A Geometrical and ionisation
B Geometrical and optical
C Optical and ionisation
D Geometrical only

Question 6

Which of the following compounds shows optical isomerism?

A $[Cu(NH_3)_4]^{2+}$
B $[ZnCl_4]^{2-}$
C $[Cr(C_2O_4)_3]^{3-}$
D $[Co(CN)_6]^{3-}$

Question 7

Which of the following facts about the complex $[Cr(NH_3)_6]Cl_3$ is wrong?

A The complex gives white precipitate with silver nitrate solution
B The complex involves d^2sp^3 hybridization and is

octahedral in shape

C The complex is paramagnetic

D The complex is an outer orbital complex

Question 8

Which of the following has an optical isomer?

A $[Co(NH_3)_3\,Cl]^+$

B $[Co(en)\,(NH_3)_2]^{2+}$

C $[Co(H_2O)_4\,(en)]^{3+}$

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

Question 9

Which of the following pairs represents linkage isomers?

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

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

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

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

Question 10

Which of the following statements is incorrect?

A In $K_4\,[Fe(CN)_6]$, the ligand has satisfied both primary and secondary valencies of ferrous ion.

B In $[Cu(NH_3)_4]SO_4$, the ligand has satisfied only the secondary valency of copper.

C In $K_3[Fe(CN)_6]$, the ligand has satisfied only the secondary valency of ferric ion.

D In $K_3[Fe(CN)_6]$, the ligand has satisfied both primary and secondary valencies of ferric ion.

Question 1

The volume (in mL) of 0.1 M $AgNO_3$ required for complex precipitation of chloride ions present in 30 mL of 0.01 M solution of $[Cr(H_2O)_5Cl]Cl_2$, as silver chloride is close to

A 3

B 4

C 5

D 6

Question 2

Total number of geometrical isomers for the complex $[RhCl(CO)(PPh_3)(NH_3)]$is

A 1
B 2
C 3
D 4

Question 3

The oxidation state of iron in K_4 [Fe $(CN)_6$] is

A 1
B 2
C 3
D 4

Question 4

The pair of compounds having metals in their highest oxidation state is

A MnO_2, $FeCl_3$
B $[MnO_4]^-$, CrO_2Cl_2
C $[Fe(CN)_6]^{3-}$, $[Co(CN)_3]$
D $[NiCl_4]^{2-}$, $[CoCl_4]^-$

Question 5

The spin only magnetic moment value (in Bohr magneton units) of $Cr(CO)_6$ is

A 0
B 2.84
C 4.90
D 5.92

Question 6

The value of the 'spin only' magnetic moment for one of the following configurations is 2.84 BM. The correct one is

A d^4 (in strong ligand filed)
B d^4 (in weak ligand field)

C d^3 (in weak as well as in strong fields)
D d^5 (in strong ligand field)

Question 7

When EDTA solution is added to Mg^{2+} ion solution, then which of the following statements is not true?

A four coordinate sites of Mg^{2+} are occupied by EDTA and remaining two sites are occupied by water molecules
B All six coordinate sites of Mg^{2+} are occupied
C pH of the solution is decreased
D Colorless $[Mg–EDTA]^{2–}$ chelate is formed

Question 8

Which complex can not ionize in solution?

A $[Pt(NH_3)_6]\,Cl_4$
B $K_2[pt(F_6)]$
C $K_4[Fe(CN)_6]$
D $[CoCl_3(NH_3)_3]$

Question 9

Which compound is zero valent metal complex?

A $[Cu(NH_3)_4]SO_4$
B $[Pt(NH_3)_2Cl_2]$
C $[Ni(CO)_4]$
D $K_3[Fe(CN)_6]$

Question 10

Which has maximum paramagnetic character?

A $[Fe(CN)_6]^{4-}$
B $[Cu(H_2O)_4]^{2+}$
C $[Cu(NH_3)_4]^{2+}$
D $[Mn\ (H_2O)_6]^{2+}$