

1. Why does the absorption spectrum of aqueous $[\text{Ti}(\text{H}_2\text{O})_6]^{+3}$ exhibit a broad band with a shoulder?

- (a) The ground state of $[\text{Ti}(\text{H}_2\text{O})_6]^{+3}$ is jahn teller distorted.
 (b) The excited state of $[\text{Ti}(\text{H}_2\text{O})_6]^{+3}$ is jahn teller distorted.
 (c) $[\text{Ti}(\text{H}_2\text{O})_6]^{+3}$ is a d^2 ion and therefor there are two absorption.
 (d) $[\text{Ti}(\text{H}_2\text{O})_6]^{+3}$ is partially reduce to $[\text{Ti}(\text{H}_2\text{O})_6]^{+2}$ in aqueous solution and two absorption which are closely in energy are observed, one for each species.

2. Which of the following ligands behave as an ambidentate ligand?

- (a) NO_3^- (b) SO_3^{2-} (c) SO_3 (d) ClO_4^-

3. The number of possible isomers for the octahedral complex ion $[\text{Co}(\text{en})\text{Cl}_2\text{Br}_2]^-$ is

- (a) 2 (b) 4 (c) 6 (d) 8

4. For the complex, MX_3Y_3 possessing trigonal prismatic geometry, the number of possible isomers is:

- (a) 2 (b) 3 (c) 4 (d) 6

5. The IUPAC name of $\text{Na}_3[\text{Fe}(\text{CN})_5\text{NO}]$ is:

- (a) Sodium pentacynonitrosyl iron(II)
 (b) Sodium pentacynonitrosonium ferrate (I)
 (c) Sodium nitrosoniumpentacyno ferrate (I)
 (d) Sodium pentacynonitrosyl ferrate(I)

6. The crystal field splitting energy (Δ) for CoCl_6^{4-} is 18000 cm^{-1} . The Δ for CoCl_4^{2-} would be

- (a) 18000 cm^{-1} (b) 16000 cm^{-1} (c) 8000 cm^{-1} (d) 2000 cm^{-1}

7. The complex with maximum CFSE is:

- (a) $[\text{CoCl}_4]^{2-}$ (b) $[\text{Co}(\text{H}_2\text{O})_6]^{+3}$ (c) $[\text{CoF}_3(\text{H}_2\text{O})_3]$ (d) $[\text{CoF}_6]^{3-}$

8. The number of manganese ions in tetrahedral and octahedral sites, respectively in Mn_3O_4 are:

- (a) one Mn^{+2} and two Mn^{+3} (b) one Mn^{+3} and two Mn^{+2}
 (c) two Mn^{+3} and one Mn^{+2} (d) two Mn^{+2} and one Mn^{+3}

9. The magnetic moment of the complex $\text{K}_3[\text{CoF}_6]$ is $5.0 \mu_B$. The total stabilization energy will be:

- (a) $-0.4\Delta_o + P$ (b) $-0.4\Delta_o$ (c) $(a) -2.4\Delta_o + 3P$ (d) $(a) -1.8\Delta_o + 3P$

10. The spinels CoFe_2O_4 and FeFe_2O_4 , respectively are

- (a) inverse and normal (b) normal and normal
 (c) normal and inverse (d) inverse and inverse

11. Arrange the following metal complex in order of their increasing hydration energy:

- (P) $[\text{Mn}(\text{H}_2\text{O})_6]^{+2}$ (Q) $[\text{V}(\text{H}_2\text{O})_6]^{+2}$ (R) $[\text{Ni}(\text{H}_2\text{O})_6]^{+2}$ (S) $[\text{Ti}(\text{H}_2\text{O})_6]^{+2}$
 (a) $P < Q < R < S$ (b) $S < P < Q < R$ (c) $P < Q < S < R$ (d) $S < Q < P < R$

12. The structure of the complexes $[\text{Cu}(\text{NH}_3)_4](\text{ClO}_4)_2$ and $[\text{Cu}(\text{NH}_3)_4](\text{ClO}_4)$ in solution respectively are:

- (a) square planer and tetrahedral (b) Octahedral and square planer
(c) octahedral and trigonal bipyramidal (d) tetrahedral and square planer

13. The CFSE for the following d^3 metal ions (V^{+2} , Cr^{+3} , Mo^{+3}) decrease in the following order:

- (a) $\text{V}^{+2} > \text{Cr}^{+3} > \text{Mo}^{+3}$ (b) $\text{Cr}^{+3} > \text{V}^{+2} > \text{Mo}^{+3}$
(c) $\text{Mo}^{+3} > \text{Cr}^{+3} > \text{V}^{+2}$ (d) $\text{Cr}^{+3} > \text{Mo}^{+3} > \text{V}^{+2}$

14. Which of the following shows NORMAL spinel structure?

- (A) Fe_3O_4 (B) Mn_3O_4 (C) NiAl_2O_4 (D) La_2CuO_4
(a) B and D (b) A and C (c) B only (d) B, C and D

15. On molecular orbital treatment of $[\text{Mn}(\text{CO})_6]^+$, the symmetry of LGO that is NOT sigma-bonding is;

- (a) a_{1g} (b) t_{1g} (c) t_{1u} (d) e_g

16. CFSE of transition metal can be determine by

- (a) IR spectroscopy (b) Microwave spectroscopy
(c) NMR spectroscopy (d) UV spectroscopy

17. The observation of equal Cu-O distance in the hexa-coordinated Cu(II) complex, $\text{K}_2\text{Pb}[\text{Cu}(\text{NO}_2)_6]$ is best understood in term of

- (a) Failure of the Jahn-Teller theorem to predict the structure of this complex
(b) Error in the crystallographic estimate of Cu-O distance
(c) Dynamic Jahn-Teller distortion of the Cu-O bonds
(d) Symmetrical distribution of the nine valence electrons of Cu(II)

18. Stabilisation of highest oxidation states of transition metals by strong electronegative ligands due to

- (a) $d\pi(L) \rightarrow d\pi(M)$ bonding (b) $p\pi(L) \rightarrow d\pi(M)$ bonding
(c) $d\pi(M) \rightarrow p\pi(L)$ bonding (d) $d\pi(M) \rightarrow d\pi(L)$ bonding

19. Which one of the following complex ions shows the minimum intensity of the absorption in the UV-visible region?

- (a) $[\text{Cr}(\text{H}_2\text{O})_6]^{+2}$ (b) $[\text{V}(\text{H}_2\text{O})_6]^{+2}$ (c) $[\text{Mn}(\text{H}_2\text{O})_6]^{+2}$ (d) $[\text{Co}(\text{H}_2\text{O})_6]^{+2}$

20. The complex which exhibits lowest energy electronic absorption band is:

- (a) $[\text{NiCl}_4]^{-2}$ (b) $[\text{Ni}(\text{H}_2\text{O})_6]^{+2}$ (c) $[\text{Ni}(\text{CN})_4]^{-2}$ (d) $[\text{Ni}(\text{CO})_4]$

21. The absorption of $[\text{Co}(\text{NH}_3)_6]^{+2}$ is

- (a) stronger than that of $[\text{Co}(\text{NH}_3)_5\text{Cl}]^+$ and $[\text{MnCl}_4]^{-2}$
(b) weaker than that of $[\text{Co}(\text{NH}_3)_5\text{Cl}]^+$ and $[\text{MnCl}_4]^{-2}$
(c) stronger than that of $[\text{Co}(\text{NH}_3)_5\text{Cl}]^+$ and weaker than $[\text{MnCl}_4]^{-2}$

(d) weaker than that of $[\text{Co}(\text{NH}_3)_5\text{Cl}]^+$ and stronger than $[\text{MnCl}_4]^{-2}$

22. The number of absorption bands observed for $[\text{FeF}_6]^{-3}$ and $[\text{CoF}_6]^{-3}$, respectively are

- (a) 1 and 3 (b) 0 and 1 (c) 0 and 3 (d) 3 and 1

23. The compound which shows M → L charge transfer is

- (a) $\text{K}_2\text{Cr}_2\text{O}_7$ (b) HgO (c) $\text{Ni}(\text{CO})_4$ (d) $[\text{Ni}(\text{H}_2\text{O})_6]^{+2}$

24. The spectroscopic ground state symbol and the total number of electronic transitions of $[\text{Ti}(\text{H}_2\text{O})_6]^{+2}$ are

- (a) ${}^3\text{T}_{1g}$ and 2 (b) ${}^3\text{A}_{2g}$ and 3 (c) ${}^3\text{T}_{1g}$ and 3 (d) ${}^3\text{A}_{2g}$ and 2

25. Ruby has a low concentration of trivalent 3d-metal ion substitution for Al^{+3} in alumina giving initial excitation of the spin-allowed process ${}^4\text{A}_{2g} \rightarrow {}^4\text{T}_{2g}$ and ${}^4\text{A}_{2g} \rightarrow {}^4\text{T}_{1g}$. The 3d-metal ion is:

- (a) $\text{Fe}(\text{III})$ (b) $\text{Cr}(\text{III})$ (c) $\text{Co}(\text{III})$ (d) $\text{Ni}(\text{III})$

26. The ground state term symbol of Ni^{+2} ion is

- (a) ${}^3\text{F}$ (b) ${}^3\text{A}$ (c) ${}^3\text{P}$ (d) ${}^3\text{E}$

27. The bright yellow colour of $[\text{Cu}(\text{phen})_2]^+$ (phen = 1,10-phenanthroline) is due to

- (a) d-d transition (b) π to π^* transition in the phenanthroline ligand
(c) ligand to metal charge transfer (d) metal to ligand charge transfer

28. Which one of the following electronic configuration of an octahedral metal complex will show three spin allowed electronic transitions?

- (a) $(t_{2g})^1$ (b) $(t_{2g})^3$ (c) $(t_{2g})^3(e_g)^2$ (d) $(t_{2g})^6(e_g)^3$

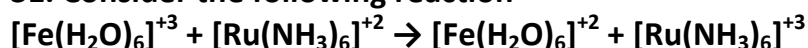
29. The red colour of oxyhemoglobin is mainly due to the

- (a) d-d transition (b) π to π^* transition in the Heme ring
(c) ligand to metal charge transfer (d) metal to ligand charge transfer

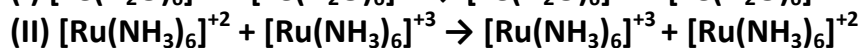
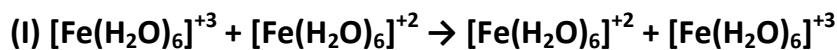
30. In the iso-electronic series VO_4^{-3} , CrO_4^{-2} and MnO_4^- , all members have intense charge transfer transitions. The incorrect statement is:

- (a) CT transitions are attributed to excitations of electrons from ligand(σ) to metal (e)
(b) MnO_4^- exhibit charge transfer at shortest wavelength among the three
(c) The wavelengths of transitions increase in the order $\text{VO}_4^{-3} < \text{CrO}_4^{-2} < \text{MnO}_4^-$
(d) The charge in metal nucleus increase in the order $\text{VO}_4^{-3} < \text{CrO}_4^{-2} < \text{MnO}_4^-$

31. Consider the following reaction



For this cross reaction, the self exchange reaction are



The rate constant for the self exchange reaction (I) and (II) are observed to $4.0 \text{ Lmol}^{-1} \text{ s}^{-1}$ and $4.0 \times 10^3 \text{ Lmol}^{-1} \text{ s}^{-1}$ respectively and the equilibrium constant(K) for the cross reaction is 2×10^{11} . The rate constant for the reaction will be:

- (a) 2.0×10^2 (b) 5.6×10^7 (c) 2.9×10^7 (d) 7.8×10^4

32. What will be the calculated magnetic moment of Pr^{+3}

- (a) 0.8 BM (b) 2.9 BM (c) 6.1 BM (d) 3.58 BM

33. For tetrahedral complex, $[\text{CoCl}_4]^{-2}$, the calculated and experimental magnetic moments are 3.87 and 4.5 BM. The experimental value is high due to

- (a) weak orbital coupling
 (b) strong orbital coupling
 (c) Temperature independent paramagnetism
 (d) Antiferromagnetic exchange interaction

34. For high spin octahedral complex of Mn^{+2} , which ground state is ${}^6\text{A}_{1g}$. The μ_{eff} magnetic moment is

- (a) 5.9 BM (b) 6.43 BM (c) 4.85 BM (d) 1.41 BM

35. The actual magnetic moment shows a large deviation from the spin-only formula in the case of

- (a) Ti^{+3} (b) V^{+3} (c) Gd^{+3} (d) Sm^{+3}

36. The experimental magnetic moment of $\text{K}_3[\text{Fe}(\text{CN})_6]$ is $2.3 \mu_B$ and is attributable to the

- (a) spin only value of a low spin Fe
 (b) Spin only value of a high spin Fe
 (c) low spin Fe with orbital contribution
 (d) high spin Fe with Orbital contribution

37. Red β -ketoenolate complex of Ni(II) is diamagnetic. The red complex turns bluish-green in the presence of water or amine and become paramagnetic. Which of the following structure is formed during the reaction?

- (a) Tetrahedral (b) square planar
 (c) Dodecahedral (d) Octahedral

38. The complex that is expected to show orbital contribution to overall magnetic moment is

- (a) $[\text{Cr}(\text{CN})_6]^{-3}$ (b) $[\text{Co}(\text{H}_2\text{O})_6]^{+2}$ (c) $[\text{Ni}(\text{en})_3]^{+2}$ (d) $[\text{Cu}(\text{NH}_3)_6]^{+2}$

39. The correct order of the lability of the complexes is

- (a) $[\text{Sr}(\text{H}_2\text{O})_6]^{+2} > [\text{Ca}(\text{H}_2\text{O})_6]^{+2} > [\text{Mg}(\text{H}_2\text{O})_6]^{+2}$
(b) $[\text{Mg}(\text{H}_2\text{O})_6]^{+2} > [\text{Ca}(\text{H}_2\text{O})_6]^{+2} > [\text{Sr}(\text{H}_2\text{O})_6]^{+2}$
(c) $[\text{Sr}(\text{H}_2\text{O})_6]^{+2} > [\text{Mg}(\text{H}_2\text{O})_6]^{+2} > [\text{Ca}(\text{H}_2\text{O})_6]^{+2}$
(d) $[\text{Mg}(\text{H}_2\text{O})_6]^{+2} > [\text{Sr}(\text{H}_2\text{O})_6]^{+2} > [\text{Ca}(\text{H}_2\text{O})_6]^{+2}$

40. The rate of water exchange in hexaaqua ions follow the order

- (a) $\text{Mn}^{+2} < \text{V}^{+2} < \text{Ni}^{+2} < \text{Cu}^{+2}$ (b) $\text{Mn}^{+2} < \text{Ni}^{+2} < \text{V}^{+2} < \text{Cu}^{+2}$
(c) $\text{V}^{+2} < \text{Ni}^{+2} < \text{Cu}^{+2} < \text{Mn}^{+2}$ (d) $\text{V}^{+2} < \text{Ni}^{+2} < \text{Mn}^{+2} < \text{Cu}^{+2}$

41. The base hydrolysis of Co(III) complexes containing amine ligand is expected to proceed by

- (a) SN^2 mechanism through TBP intermediate
(b) SN^1CB mechanism through TBP intermediate
(c) SN^1CB mechanism through Heptacoordinated intermediate
(d) SN^1CB mechanism through square pyramidal intermediate

42. Hexa coordinated water molecules of a Cd(II) complexes can be successively replaced by Br^- finally to result in $[\text{CdBr}_4]^{-2}$. In this process, the fourth equilibrium constant is observed to be higher than the third one, because:

- (a) equilibrium constant for the third step is always the highest
(b) three molecules of H_2O are released during the fourth step
(c) the aqua-Cd(II) species is octahedral
(d) an anion (Br^-) replaced a neutral (H_2O) molecule from the coordination sphere.

43. The most suitable route to prepare the trans-isomer of $[\text{PtCl}_2(\text{NH}_3)(\text{PPh}_3)]$ is:

- (a) $[\text{PtCl}_4]^{-2}$ with PPh_3 followed by reaction with NH_3
(b) $[\text{PtCl}_4]^{-2}$ with NH_3 followed by reaction with PPh_3
(c) $[\text{Pt}(\text{NH}_3)_4]^{+2}$ with HCl followed by reaction with PPh_3
(d) $[\text{Pt}(\text{NH}_3)_4]^{+2}$ with PPh_3 followed by reaction with HCl

44. Consider the following reactions

1. $[\text{Cr}(\text{H}_2\text{O})_6]^{+2} + [\text{CoCl}(\text{NH}_3)_5]^{+2} \rightarrow [\text{Co}(\text{NH}_3)_5(\text{H}_2\text{O})]^{+2} + [\text{CrCl}(\text{H}_2\text{O})_5]^{+2}$
2. $[\text{Fe}(\text{CN})_6]^{-4} + [\text{Mo}(\text{CN})_8]^{-3} \rightarrow [\text{Fe}(\text{CN})_6]^{-3} + [\text{Mo}(\text{CN})_8]^{-4}$

Which one of the following is the correct statement?

- (a) Both involve an inner sphere mechanism
(b) Both involve an outer sphere mechanism
(c) Reaction 1 follow inner sphere and reaction 2 follow outer sphere mechanism.
(d) Reaction 2 follow inner sphere and reaction 1 follow outer sphere mechanism.

45. An ion M^{+2} forms the complexes $[\text{M}(\text{H}_2\text{O})_6]^{+2}$, $[\text{M}(\text{en})_3]^{+2}$ and $[\text{MBr}_6]^{-2}$, match the complex with appropriate colour

- (a) green, blue and red (b) green, red and blue

- (c) blue, red and green (d) red, blue and green

46. The acid catalysed hydrolysis of trans-[Co(en)₂AX]⁺ⁿ can give cis-product due to the formation of

- (a) square pyramidal intermediate
 (b) trigonal bipyramidal intermediate
 (c) pentagonal bipyramidal intermediate
 (d) face capped octahedral intermediate

47. The d-d transition in an octahedral [NiX₆]⁺² complex is

- (a) Laporte forbidden but spin allowed
 (b) Laporte allowed but spin forbidden
 (c) Laporte allowed and spin allowed
 (d) Laporte forbidden and spin forbidden

48. For which pair of the complexes is the order of values of Δ_o correct?

- (a) [Fe(CN)₆]⁻⁴ > [Fe(CN)₆]⁻³ (b) [CrF₆]⁻³ > [Cr(CN)₆]⁻³
 (c) [Cr(OH₂)₆]⁺² > [Cr(OH₂)₆]⁺³ (d) [Rh(NH₃)₆]⁺³ > [Co(NH₃)₆]⁺³

49. The reaction of [PtCl₄]⁻² with NH₃ (reaction 1) and of [PtCl₄]⁻² with [NO₂]⁻ followed by NH₃ (reaction 2) are ways of preparing:

- (a) 1. Trans-[PtCl₂(NH₃)₂]; 2. Trans-[PtCl₂(NH₃)(NO₂)]⁻
 (b) 1. cis-[PtCl₂(NH₃)₂]; 2. Trans-[PtCl₂(NH₃)(NO₂)]⁻
 (c) 1. Trans-[PtCl₂(NH₃)₂]; 2. cis-[PtCl₂(NH₃)(NO₂)]⁻
 (d) 1. cis-[PtCl₂(NH₃)₂]; 2. cis-[PtCl₂(NH₃)(NO₂)]⁻

50. Which of the following Beryllium complex is stable?

- (a) [Be(η⁵-Cp)₂] (b) [Be(η²-Cp)(η¹-Cp)]
 © [Be(η¹-Cp)(η³-Cp)] (d) [Be(η¹-Cp)(η⁵-Cp)]

51. Which of the following complex do not obey 18 electron rule

- (a) [CpRu(Cl)(CO)(PPh₃)] (b) [W(CO)₃(SiMe₃)(Cl)(NCMe)₂]
 (c) [IrCl₃(PPh₃)₂(AsPh₂)]⁻ (d) [As(N)Br₂(PMe₃)(NMe₂)]⁻

52. What charge could be necessary for the following complex to obey 18 electron rule? [(η⁵-Cp)Fe(CO)₂(PhC₂H)^z

- (a) z = 0 (b) z = +1 (c) z = -1 (d) z = +3

53. Organometallic compound [Mo(Cp)₂(CO)₂] follow 18 electron rule, the hapticity of two Cp groups are

- (a) η³, η³ (b) η⁵, η⁵ (c) η³, η⁵ (d) η¹, η⁵

54. The bonding in cyclopentadienyl in $\text{Ti}(\text{Cp})_4$ is such that

- (a) all Cp rings are pentahapto
- (b) one Cp ring is pentahepto and other three rings are monohepto
- (c) two Cp rings are monohepto and other two rings are pentahepto
- (d) All Cp rings are monohepto

55. Correct order for the decreasing order of $\nu_{\text{C-O}}$ stretching frequency

(1) $[\text{Mn}(\text{CO})_6]^+$ (2) CO (3) $\text{H}_3\text{O}^+ \leftarrow \text{CO}$ (4) $[\text{V}(\text{CO})_6]^-$

- (a) $4 > 1 > 2 > 3$
- (b) $3 > 2 > 1 > 4$
- (c) $2 > 3 > 1 > 4$
- (d) $2 > 1 > 4 > 3$

56. The total number of metal – metal bonds and metal – metal bond per metal in the following complex is respectively



- (a) 2 and 2
- (b) 3 and 2
- (c) 3 and 1
- (d) 3 and 3

57. The number of M – M bonds and bridging CO in $\text{Fe}_3(\text{CO})_{12}$ respectively are

- (a) 3 and 5
- (b) 3 and 2
- (c) 2 and 3
- (d) 3 and 1

58. $[\text{Ru}_5\text{N}(\text{CO})_{14}]^-$ is belongs to

- (a) hypercloso
- (b) closo
- (c) nido
- (d) arachano

59. $[\text{Cr}(\text{CO})_5]^-$ is isolobal with

- (a) CH_3^-
- (b) CH_3^+
- (c) CH_3
- (d) CH^-

60. $\text{C}_2\text{B}_9\text{H}_{12}^-$ and B_6H_{10} is classified as

- (a) arachano and nido
- (b) nido and closo
- (c) nido and arachano
- (d) nido and nido

61. Which one of the following metal fragments, $d^n - \text{ML}_m$ is isolobal with CH?

- (a) $d^7 - \text{ML}_5$
- (b) $d^8 - \text{ML}_4$
- (c) $d^9 - \text{ML}_3$
- (d) $d^5 - \text{ML}_6$

62. The values of CO stretching frequencies of (1) $\text{Ni}(\text{CO})_4$, (2) $\text{Ni}(\text{CO})_3(\text{PMe}_3)$, (3) $\text{Ni}(\text{CO})_2(\text{PMe}_3)_2$ follow the trend

- (a) $1 > 2 > 3$
- (b) $3 > 2 > 1$
- (c) $1 > 3 > 2$
- (d) $2 > 3 > 1$

63. Using the wade rules, the structure of $\text{B}_{10}\text{C}_2\text{H}_{12}$ can be predicted. The structure and the number of isomers of $\text{B}_{10}\text{C}_2\text{H}_{12}$ respectively are

- (a) nido and two
- (b) closo and three
- (c) nido and three
- (d) closo and two

64. The bond order of metal-metal bonds in $[\text{Re}_2\text{Cl}_8]^{2-}$, $[\text{Re}_2\text{Cl}_6\{\text{P}(\text{C}_2\text{H}_5)_3\}_2]$ and $[\text{Re}_2\text{Cl}_4\{\text{P}(\text{C}_2\text{H}_5)\text{Ph}_2\}_4]$ respectively are

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

65. Statement: The characteristic spectroscopic feature of the quadruply bonded $[\text{Re}_2\text{Cl}_8]^{-2}$ is a strong royal blue colour

Reason: this is due to an absorption band in visible region due to excitation of an Electron from $\sigma^2 \pi^2 \delta^2$ ground state to $\sigma^2 \pi^2 \delta^1 \delta^{*1}$ excited state

Assertion: This transition is quantum mechanically allowed

- (a) Both Reason and Assertion are correct
 (b) Both reason and assertion are wrong
 (c) Reason is correct but assertion is wrong
 (d) Reason is wrong but assertion is right

66. The reaction of $[\eta^5\text{CpFe}(\text{CH}_3)(\text{CO})_2]$ with PPh_3 results in

- (a) $[\eta^5\text{CpFe}(\text{CH}_3)(\text{CO})(\text{PPh}_3)] + \text{CO}$ (b) $[\eta^1\text{CpFe}(\text{CH}_3)(\text{CO})_2(\text{PPh}_3)]$
 (c) $[\eta^5\text{Cp}(\text{COCH}_3)(\text{PPh}_3)] + \text{CO}$ (d) $[\eta^5\text{Cp}(\text{COCH}_3)(\text{CO})(\text{PPh}_3)]$

67. The product of the reaction between $\text{CH}_3\text{Mn}(\text{CO})_5$ and ^{13}CO is

- (a) $(\text{CH}_3^{13}\text{CO})\text{Mn}(\text{CO})_5$ (b) $(\text{CH}_3\text{CO})\text{Mn}(\text{CO})_4(^{13}\text{CO})$
 (c) $(^{13}\text{CH}_3\text{CO})\text{Mn}(\text{CO})_5$ (d) $\text{CH}_3\text{Mn}(\text{CO})_4$

68. On reducing $\text{Fe}_3(\text{CO})_{12}$ with excess Na a carbonylate ion is formed. The ion is isoelectronic and isostructural with

- (a) $[\text{Mn}(\text{CO})_5]^-$ (b) $[\text{Mn}(\text{CO})_5]^+$ (c) $[\text{Ni}(\text{CO})_4]$ (d) $[\text{V}(\text{CO})_6]^-$

69. $\text{Mn}_2(\text{CO})_{10} \xrightarrow{\text{Na}}$ (A) $\xrightarrow{\text{Allyl bromide}}$ (B) the B is

- (a) $[\eta^1\text{-C}_3\text{H}_5]\text{Mn}(\text{CO})_4]$ (b) $[(\eta^3\text{-C}_3\text{H}_5)\text{Mn}(\text{CO})_4]$
 (c) $[(\text{C}_4\text{H}_5\text{O})\text{Mn}(\text{CO})_5]$ (d) $[(\eta^1\text{-C}_3\text{H}_5)\text{Mn}(\text{CO})_4]$

70. The usual form of the experimental rate law for substitution in square planer complex of Pt(II) contains two terms:

$$\text{Rate} = K_1[\text{PtL}_3\text{X}] + K_2[\text{PtL}_3\text{X}][\text{Y}]$$

Where $[\text{PtL}_3\text{X}]$ is starting complex and Y is the entering group. The reason of two term rate law is that

- (a) There are competitive associative and dissociative pathway
 (b) there are two competing dissociative pathways
 (c) the solvent enters in the rate determining step, and then two competing fast steps follow
 (d) the solvent competes with Y in the rate determining step

71. Which statement about trans effect and trans influence is correct?

- (a) the trans influence is a ground state effect, whereas trans effect has a kinetic origin.
 (b) the trans effect is a ground state effect, whereas trans influence has a kinetic origin.
 (c) Both the trans effect and trans influence are ground state effects

(d) Rate of substitution is effected by trans effect but have nothing to do with trans influence of ligand.

72. Which statement is incorrect about electron transfer mechanism?

- (a) electron transfer may occur by an outer sphere or inner sphere mechanism depending on the system
- (b) Long range electron transfer such as in cytochromes are most likely to occur by outer sphere mechanism
- (c) Marcus-hush theory applies to inner sphere mechanism
- (d) In the inner sphere mechanism, electron transfer between two metal centres involve a bridging ligand.

73. In the base catalysed substitution of Cl^- by $[\text{OH}]^-$ in $[\text{Co}(\text{NH}_3)_5\text{Cl}]^{+2}$ under strongly basic condition, the first step in the mechanism is

- (a) conversion of an ammine to amido ligand
- (b) substitution of Cl^- by OH^-
- (c) dissociation of Cl^- to give 5 coordinated intermediate
- (d) association of OH^- to give 7 coordinated intermediate

74. The number of radial nodes possessed by 4f atomic orbital is

- (a) 0 (b) 1 (c) 3 (d) 4

75. Which statement best describes the electronic spectra of lanthanoids?

- (a) Absorption due to 4f-4f transitions are, in theory forbidden, but nonetheless give rise to intense absorption
- (b) Absorption due to 4f-4f transition are sharp, those assigned to 4f-5d transitions are broad.
- (c) Absorption due to 4f-4f transition are broad, those assigned to 4f-5d transitions are sharp.
- (d) When a Ln^{+3} ion form a complex, absorption due to 4f-4f transitions undergo significant shift, the magnitude depending on the ligand.

76. Which statement is incorrect about lanthanoids metal?

- (a) Each metal react with dilute acid to release H_2
- (b) Eu and Yb dissolve in liq. NH_3 to give Eu^{+3} and Yb^{+3} respectively
- (c) Reaction between Ln and H_2 give hydride of formula LnH_2 or LnH_3
- (d) The chemistry of lanthanoid is dominated by the +3 oxidation state

77. The ground state term of Eu^{+3} is

- (a) ${}^7\text{F}_0$ (b) ${}^7\text{F}_6$ (c) ${}^3\text{F}_0$ (d) ${}^3\text{F}_6$

78. Which statement is incorrect

- (a) On standing in air, $\text{Ce}(\text{OH})_4$ slowly convert to $\text{Ce}(\text{OH})_3$

- (b) Dissolving $\text{Lu}(\text{OH})_3$ in hot concentrated NaOH leads to the formation of $\text{Na}_3[\text{Lu}(\text{OH})_6]$
(c) $\text{La}(\text{OH})_3$ react with CO_2 to give lanthanum carbonate
(d) $\text{La}(\text{OH})_3$ is a strong base

79. When uranium is heated with Cl_2 , Which combination of products is most likely?

- (a) UCl_2 and UCl_4
(b) UCl_3 , UCl_4 and UCl_5
(c) UCl_4 and UCl_6
(d) UCl_4 , UCl_5 and UCl_6

80. Which of the following series contains only paramagnetic metal ions?

- (a) La^{+3} , Sm^{+3} , Ce^{+3} (b) Sm^{+3} , Ho^{+3} , Lu^{+3}
(c) Ce^{+3} , Eu^{+3} , Yb^{+3} (d) La^{+3} , Gd^{+3} , Eu^{+3}

81. Which statement is incorrect about $[\text{PuO}_2]^{+2}$ and $[\text{PuO}_2]^+$?

- (a) Under aqueous condition of same pH, $[\text{PuO}_2]^{+2}$ is more stable with respect to reduction than $[\text{UO}_2]^{+2}$
(b) In aqueous solution $[\text{PuO}_2]^{+2}$ is thermodynamically unstable with respect to disproportionation
(c) In $[\text{PuO}_2]^+$ and $[\text{PuO}_2]^{+2}$, Pu is in oxidation state +5 and +6 respectively.
(d) Hydrolysis of aqueous $[\text{PuO}_2]^+$ and $[\text{PuO}_2]^{+2}$ leads to acidic solution

82. Which reaction is likely to give the stated organometallic compound as the final product? [$\text{Cp}^* = \text{C}_5\text{Me}_5$]

- (a) $\text{UCl}_4 + 2\text{K}_2[\text{C}_8\text{H}_8] \rightarrow \text{U}(\eta^8\text{-C}_8\text{H}_8)_2$
(b) $\text{U}(\text{BH}_4)_4 + 2\text{KCp}^* \rightarrow (\eta^5\text{-Cp}^*)_2\text{U}(\eta^3\text{-BH}_4)_2$
(c) $\text{ThCl}_4 + 2\text{NaCp} \rightarrow (\eta^5\text{-Cp})_2\text{ThCl}_2$
(d) $(\eta^5\text{-Cp}^*)_2\text{ThCl}_2 + 2\text{Li}(\text{CH}=\text{CH}_2)_2 \rightarrow (\eta^5\text{-Cp}^*)_2\text{Th}(\text{CH}=\text{CH}_2)_2$

83. The reaction of $(\eta^6\text{-C}_7\text{H}_8)\text{Mo}(\text{CO})_3$ with $[\text{PPh}_3\text{C}][\text{BF}_4]$ results in

- (a) proton abstraction and formation of $[(\eta^7\text{-C}_7\text{H}_7)\text{Mo}(\text{CO})_3]^-$
(b) proton abstraction and formation of $[(\eta^5\text{-C}_7\text{H}_7)\text{Mo}(\text{CO})_3]^-$
(c) hydride abstraction and formation of $[(\eta^7\text{-C}_7\text{H}_7)\text{Mo}(\text{CO})_3]^+$
(d) hydride abstraction and formation of $[(\eta^5\text{-C}_7\text{H}_7)\text{Mo}(\text{CO})_3]^+$

84. Which of the following statement is correct about the metal bound arene ring in $(\eta^6\text{-C}_6\text{H}_6)\text{Cr}(\text{CO})_3$?

- (a) The metal-bound arene ring is more susceptible to attack by electrophiles than free C_6H_6 .
(b) The metal-bound arene ring is more susceptible to attack by nucleophile than free C_6H_6 .

91. In the Tennessee-Eastman acetic anhydride process, the catalyst is cis- $[\text{Rh}(\text{CO})_2\text{I}_2]^-$. Which sequence of steps best describes the primary catalytic cyclic?
 (a) Oxidative addition of MeI and loss of CO; Me migration; addition of 2 CO; elimination of MeC(O)I
 (b) Oxidative addition of MeI; Me migration; addition of CO; elimination of MeC(O)I
 (c) Loss of CO; oxidative elimination of MeI; Me migration; addition of 2 CO; elimination of MeC(O)I
 (d) Oxidative addition of MeI; CO migration to the Me group; CO addition; elimination of MeC(O)I

92. In the hydrogenation of alkene using Wilkinson's catalyst, the active catalyst is $\text{RhCl}(\text{PPh}_3)_2$ [or $\text{RhCl}(\text{PPh}_3)_2(\text{solvent})$]. The first step in the catalytic cycle is
 (a) alkene coordination (b) oxidative addition of H_2
 (c) loss of PPh_3 (d) loss of Cl^-

93. In the solid state structure of EtMgBr etherate, the Mg centre are
 (a) linear (b) bent
 (c) trigonal planer (d) tetrahedral

94. Which statement about organoaluminium compounds is incorrect
 (a) Dimers of AlMe_3 possess delocalised Al – C – Al bonding interaction
 (b) The bonding in $\text{Al}_2\text{Me}_4\text{Cl}_2$ can be describe in terms of a localised scheme
 (c) In $\text{Al}_2\text{Ph}_4(\mu\text{-C}\equiv\text{CPh})_2$, the bridge bond can be described in a similar way to $\text{Al}_2\text{Me}_4(\mu\text{-Ph})_2$
 (d) $\text{Al}_2\{\text{CH}(\text{SiMe}_3)_2\}_4$ contains an Al – Al bond

95. Structurally Nickelocene is similar to ferrocene. Nickelocene attains stability due to the formation of
 (a) a monocation (b) a dication (c) a monoanion (d) a dianion

96. The incorrect statement about Zeise's salt
 (a) Zeise's salt is diamagnetic
 (b) The oxidation state of Pt in Zeise's salt is +2
 (c) All the Pt-Cl bond lengths in Zeise's salt are equal
 (d) C – C bond length of ethylene moiety is longer than that of free ethylene molecule.

97. The correct statement about metallocenes is
 (a) Cp_2Fe metal ligand bond in strong in comparision to $\text{Cp}_2\text{Fe}^{+2}$
 (b) $\text{Cp}_2\text{Fe}^{+2}$ metal ligand bond is strong in comparision to Cp_2Fe
 (c) Cp_2Co metal ligand bond is strong in comparism to Cp_2Co^+
 (d) None of these

98. Which of the following metallocenes is readily oxidized

- (a) Cp_2Co (b) Cp_2Co^+ (c) Cp_2Fe (d) None of these

99. The byproduct formed in the characteristic reaction of $(\text{CO})_5\text{Cr} = \text{C}(\text{OMe})(\text{Me})$ with MeNH_2 is

- (a) CO (b) MeOH (c) MeCHO (d) MeCONH_2

100. The catalyst and Co-catalyst used in the Wacker process, respectively are

- (a) PdCl_2 and Cu (b) CuCl_2 and $[\text{PdCl}_4]^{-2}$
(c) Pd and CuCl (d) $[\text{PdCl}_4]^{-2}$ and CuCl_2

RAJSI