1. Why does the absorption spectrum of aqueous \([\text{Ti(H}_2\text{O)}_6]^{3+}\) exhibit a broad band with a shoulder?
(a) The ground state of \([\text{Ti(H}_2\text{O)}_6]^{3+}\) is john teller distorted.
(b) The excited state of \([\text{Ti(H}_2\text{O)}_6]^{3+}\) is john teller distorted.
(c) \([\text{Ti(H}_2\text{O)}_6]^{3+}\) is a d^2 ion and therefore there are two absorption.
(d) \([\text{Ti(H}_2\text{O)}_6]^{3+}\) is partially reduced to \([\text{Ti(H}_2\text{O)}_6]^{2+}\) 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 \([\text{Co(en)Cl}_2\text{Br}_2]^–\) is
(a) 2  (b) 4  (c) 6  (d) 8

4. For the complex, MX$_3$Y$_3$ possessing trigonal prismatic geometry, the number of possible isomers is:
(a) 2  (b) 3  (c) 4  (d) 6

5. The IUPAC name of Na$_3$[Fe(CN)$_5$NO] is:
(a) Sodium pentacyanonitrosyl iron(II)
(b) Sodium pentacyanonitrosonium ferrate (I)
(c) Sodium nitrosoniumpentacyano ferrate (I)
(d) Sodium pentacyanonitrosyl ferrate(I)

6. The crystal field splitting energy (\(\Delta\)) for CoCl$_6^{4–}$ is 18000 cm$^{-1}$. The \(\Delta\) 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) \([\text{Co(H}_2\text{O)}_6]^{13}^+\)  (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$_3$O$_4$ are:
(a) one Mn$^{+2}$ and two Mn$^{+3}$  (b) one Mn$^{+3}$ and two Mn$^{+2}$
(c) two Mn$^{+2}$ and one Mn$^{+3}$  (d) two Mn$^{+2}$ and one Mn$^{+3}$

9. The magnetic moment of the complex 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) \(-2.4\Delta_o + 3P\)  (d) \(-1.8\Delta_o + 3P\)

10. The spinels CoFe$_2$O$_4$ and FeFe$_2$O$_4$, 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) \([\text{Mn(H}_2\text{O)}_6]^{3+}\)  (Q) \([\text{V(H}_2\text{O)}_6]^{3+}\)  (R) \([\text{Ni(H}_2\text{O)}_6]^{3+}\)  (S) \([\text{Ti(H}_2\text{O)}_6]^{3+}\)
(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 \([\text{Cu(NH}_3]_4\text{][ClO}_4]_2\) and \([\text{Cu(NH}_3]_4\text{][ClO}_4]_2\) 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 (\(V^{2+}, \text{ Cr}^{3+}, \text{ Mo}^{3+}\)) decrease in the following order:
(a) \(V^{2+} > \text{ Cr}^{3+} > \text{ Mo}^{3+}\)   (b) \(\text{ Cr}^{3+} > V^{2+} > \text{ Mo}^{3+}\)
(c) \(\text{ Mo}^{3+} > \text{ Cr}^{3+} > V^{2+}\)   (d) \(\text{ Cr}^{3+} > \text{ Mo}^{3+} > V^{2}\)

14. Which of the following shows NORMAL spinel structure?
(A) \(\text{Fe}_3\text{O}_4\)          (B) \(\text{Mn}_3\text{O}_4\)        (C) \(\text{NiAl}_2\text{O}_4\)     (D) \(\text{La}_2\text{CuO}_4\)
(a) B and D          (b) A and C       (c) B only          (d) B, C and D

15. On molecular orbital treatment of \([\text{Mn(CO)}_6]^+\), 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, \(\text{K}_2\text{Pb[Cu(NO}_2]_6}\) 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) Dymanic 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) \(\text{dπ}_\text{L} \rightarrow \text{dπ}_\text{M}\) bonding   (b) \(\text{pπ}_\text{L} \rightarrow \text{dπ}_\text{M}\) bonding
(c) \(\text{dπ}_\text{M} \rightarrow \text{pπ}_\text{L}\) bonding   (d) \(\text{dπ}_\text{M} \rightarrow \text{dπ}_\text{L}\) bonding

19. Which one of the following complex ions shows the minimum intensity of the absorption in the UV-visible region?
(a) \([\text{Cr(H}_2\text{O)}_6]^{2+}\)          (b) \([\text{V(H}_2\text{O)}_6]^{2+}\)       (c) \([\text{Mn(H}_2\text{O)}_6]^{2+}\)     (d) \([\text{Co(H}_2\text{O)}_6]^{2+}\)

20. The complex which exhibits lowest energy electronic absorption band is:
(a) \([\text{NiCl}_4]^{2-}\)          (b) \([\text{Ni(H}_2\text{O)}_4]^{2-}\)       (c) \([\text{Ni(CN)}_4]^{2-}\)     (d) \([\text{Ni(CO)}_4]^{2-}\)

21. The absorption of \([\text{Co(NH}_3]_5\text{Cl}]^+\) is
(a) stronger than that of \([\text{Co(NH}_3]_5\text{Cl}]^+\) and \([\text{MnCl}_4]^{2-}\)
(b) weaker than that of \([\text{Co(NH}_3]_5\text{Cl}]^+\) and \([\text{MnCl}_4]^{2-}\)
(c) stronger than that of \([\text{Co(NH}_3]_5\text{Cl}]^+\) and weaker 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 \(M \rightarrow L\) charge transfer is
(a) \(\text{K}_2\text{Cr}_2\text{O}_7\)    (b) \(\text{HgO}\)    (c) \(\text{Ni(CO)}_4\)    (d) \([\text{Ni(H}_2\text{O)}_6]^2\)

24. The spectroscopic ground state symbol and the total number of electronic transitions of \([\text{Ti(H}_2\text{O)}_6]^{2+}\) 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 \(\text{Al}^{3+}\) in alumina giving initial excitation of the spin-allowed process \(^4\text{A}_{2g} \rightarrow ^4\text{T}_{1g}\) and \(^4\text{A}_{2g} \rightarrow ^4\text{T}_{1g}\). The 3d-metal ion is:
(a) \(\text{Fe(III)}\)    (b) \(\text{Cr(III)}\)    (c) \(\text{Co(III)}\)    (d) \(\text{Ni(III)}\)

26. The ground state term symbol of \(\text{Ni}^{12+}\) ion is
(a) \(^3\text{F}\)    (b) \(^3\text{A}\)    (c) \(^3\text{P}\)    (d) \(^3\text{E}\)

27. The bright yellow colour of \([\text{Cu(phen)}_2]^+\) (phen = 1,10- phanthroline) is due to
(a) d-d transition    (b) \(\pi\) to \(\pi^*\) transition in the phanthroline 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) \((\text{t}_{2g})^1\)    (b) \((\text{t}_{2g})^3\)    (c) \((\text{t}_{2g})^3(\text{e}_g)^2\)    (d) \((\text{t}_{2g})^6(\text{e}_g)^3\)

29. The red colour of oxyhemoglobin is mainly due to the
(a) d-d transition    (b) \(\pi\) to \(\pi^*\) transition in the Heme ring
(c) ligand to metal charge transfer    (d) metal to ligand charge transfer

30. In the iso-electronic series \(\text{VO}_4^{-3}, \text{CrO}_4^{-2}\) and \(\text{MnO}_4^{-}\), all members have intanse charge transfer transitions. The incorrect statement is:
(a) CT transitions are attributed to excitations of electrons from ligand(\(\sigma\)) to metal (e)
(b) \(\text{MnO}_4^{-}\) 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
\([\text{Fe(H}_2\text{O)}_6]^{3+} + [\text{Ru(NH}_3)_6]^{2-} \rightarrow [\text{Fe(H}_2\text{O)}_6]^{1+} + [\text{Ru(NH}_3)_6]^{3-}\)
For this cross reaction, the self exchange reaction are
(I) \([\text{Fe(H}_2\text{O)}_6]^{3+} + [\text{Fe(H}_2\text{O)}_6]^{2+} \rightarrow [\text{Fe(H}_2\text{O)}_6]^{+2} + [\text{Fe(H}_2\text{O)}_6]^{+3}\)

(II) \([\text{Ru(NH}_3)_6]^{2+} + [\text{Ru(NH}_3)_6]^{3+} \rightarrow [\text{Ru(NH}_3)_6]^{+3} + [\text{Ru(NH}_3)_6]^{2+}\)

The rate constant for the self exchange reaction (I) and (II) are observed to 4.0 Lmol\(^{-1}\) s\(^{-1}\) and 4.0*10\(^3\) Lmol\(^{-1}\) 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 \(\mu_{\text{eff}}\) 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 K\(_3[\text{Fe(CN)}_6]\) 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 spn Fe
(c) low spin Fe with orbital contribution
(d) high spin Fe with Orbital contribution

37. Red \(\beta\)-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) \([\text{Cr(CN)}_6]^3-\)   (b)\([\text{Co(H}_2\text{O)}_6]^{2+}\)   (c)\([\text{Ni(en)}_3]^{2+}\)   (d)\([\text{Cu(NH}_3)_6]^{2+}\)
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) \(\text{SN}_2\) mechanism through TBP intermediate
(b) \(\text{SN}_1\)CB mechanism through TBP intermediate
(c) \(\text{SN}_1\)CB mechanism through Heptacoordinated intermediate
(d) \(\text{SN}_1\)CB 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\(_2\)O are released during the fourth step
(c) the aqua-Cd(II) species is octahedral
(d) an anion (Br\(^-\)) replaced a neutral (H\(_2\)O) 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. \([\text{Cr}(\text{H}_2\text{O})_6]^{2+} + [\text{CoCl}((\text{NH}_3)_3)]^{2-} \rightarrow [\text{Co}((\text{NH}_3)_3(\text{H}_2\text{O}))]^{2+} + [\text{CrCl}(\text{H}_2\text{O})_3]^{-2}\)
2. \([\text{Fe(CN)}_6]^{3-} + [\text{Mo(CN)}_8]^{-3} \rightarrow [\text{Fe(CN)}_6]^{3-} + [\text{Mo(CN)}_8]^{-4}\)
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
46. The acid catalysed hydrolysis of trans-[Co(en)₂AX]⁺⁺ 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 Δₒ 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)₅(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)]⁺
(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 heptacity of two Cp groups are
(a) η³, η³        (b) η⁵, η⁵        (c) η³, η⁵        (d) η¹, η⁵
54. The bonding in cyclopentadienyl in Ti(Cp)₄ is such that
(a) all Cp rings are pentahapto
(b) one Cp ring is pentaheptao and other three ring are monoheptao
(c) two Cp ring are monoheptao and other two ring are pentaheptao
(d) All Cp rings are monoheptao

55. Correct order for the decreasing order of ν_{C=O} stretching frequency
(1) [Mn(CO)₆]^+  (2) CO  (3) H₂O ← CO  (4) [V(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
(CO)₂[CPCo]₃(PPh₃)
(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 Fe₃(CO)₁₂ respectively are
(a) 3 and 5  (b) 3 and 2  (c) 2 and 3  (d) 3 and 1

58. [Ru₅N(CO)₁₄]⁻ belongs to
(a) hypercloso  (b) closo  (c) nido  (d) arachano

59. [Cr(CO)₅]⁻ is isolobal with
(a) CH₃⁻  (b) CH₃⁺  (c) CH₄⁻  (d) CH⁻

60. C₂B₉H₁₂⁻ and B₆H₁₀ 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, dⁿ – MLₘ is isolobal with CH?
(a) d⁷-ML₅  (b) d⁸-ML₄  (c) d⁹-ML₃  (d) d¹⁻ML₆

62. The values of CO stretching frequencies of (1) Ni(CO)₄, (2) Ni(CO)₃(PMe₃), (3) Ni(CO)₂(PMe₃)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 B₁₀C₂H₁₂ can be predicted. The structure and the number of isomers of B₁₀C₂H₁₂ 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 [Re₂Cl₆]²⁻, [Re₂Cl₆{P(C₂H₅)₃}₂] and [Re₂Cl₄{P(C₂H₅)Ph₂}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 \([\eta^5\text{CpFe(CH}_3](\text{CO})_2]\) with PPh\(_3\) results in

(a) \([\eta^3\text{CpFe(CH}_3](\text{CO})(\text{PPh}_3)] + \text{CO}\)
(b) \([\eta^3\text{CpFe(CH}_3](\text{CO})_2(\text{PPh}_3)]\)
(c) \([\eta^5\text{Cp(COCH}_3](\text{PPh}_3)] + \text{CO}\)
(d) \([\eta^5\text{Cp(COCH}_3](\text{CO})(\text{PPh}_3)]\)

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

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

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

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

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

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

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 [OH\(^-\)]\(^+\) in [Co(NH\(_3\))\(_5\)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 redial 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) \(^7\)!F\(_{0}\)     (b) \(^7\)!F\(_{6}\)     (c) \(^3\)!F\(_{0}\)     (d) \(^3\)!F\(_{6}\)

78. Which statement is incorrect
(a) On standing in air, Ce(OH)\(_3\) slowly convert to Ce(OH)\(_3\)
(b) Dissolving Lu(OH)_3 in hot concentrated NaOH leads to the formation of Na_3[Lu(OH)_6]
(c) La(OH)_3 react with CO_2 to give lanthanum carbonate
(d) La(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 [PuO_2]^{2-} and [PuO_2]^+?
(a) Under aqueous condition of same pH, [PuO_2]^{2-} is more stable with respect to reduction than [UO_2]^{2+}
(b) In aqueous solution [PuO_2]^{2-} is thermodynamically unstable with respect to disproportionation
(C) In [PuO_2]^+ and [PuO_2]^{2-}, Pu is in oxidation state +5 and +6 respectively.
(d) Hydrolysis of aqueous [PuO_2]^{2-} and [PuO_2]^+ leads to acidic solution

82. Which reaction is likely to give the stated organometallic compound as the final product? [Cp* = C_5Me_5]
(a) UCl_4 + 2K_2[C_8H_8] → U(η^8-C_8H_8)_2
(b) U(BH_4)_4 + 2KCp* → (η^5-Cp*)_2U(η^3-BH_4)_2
(c) ThCl_4 + 2NaCp → (η^5-Cp)_2ThCl_2
(d) (η^7-Cp^+)_2ThCl_2 + 2Li(CH=CH_2)_2 → (η^5-Cp^+)_2Th(CH=CH_2)_2

83. The reaction of (η^6-C_7H_8)Mo(CO)_3 with [PPh_3Cl][BF_4] results in
(a) proton abstraction and formation of [(η^7-C_7H_7)Mo(CO)_3]^-
(b) proton abstraction and formation of [(η^5-C_7H_7)Mo(CO)_3]^-
(c) hydride abstraction and formation of [(η^7-C_7H_7)Mo(CO)_3]^+
(d) hydride abstraction and formation of [(η^5-C_7H_7)Mo(CO)_3]^+

84. Which of the following statement is correct about the metal bound arene ring in (η^6-C_6H_6)Cr(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 nucleophiles than free C_6H_6.
(c) The metal-bound ring readily undergoes addition reaction, whereas free C₆H₆ does not
(d) The metal-bound arene ring is less susceptible to attack by nucleophile than free C₆H₆.

85. A fisher carbine contains all but one of the following. Which is the odd one out
(a) an M=C bond
(b) A nucleophilic carbon centre
(c) A low oxidation state metal centre
(d) A heteroatom attached to the metal bound carbon atom

86. Which statement about ferrocene is incorrect?
(a) I₂ oxidised ferrocene to give diamagnetic cation.
(b) The ligands in ferrocene undergo the electrophilic substitution with RCOCl in the presence of lewis acid.
(c) The Fe centre in ferrocene can be protonated by treatment with conc. H₂SO₄.
(d) In the gas phase, the C₆H₅ rings in ferrocene are eclipsed.

87. Which compound most likely to undergo oxidative addition of H₂?
(a) Fe(CO)₅
(b) RhCl(PPh₃)₃
(c) [RhI₂(CO)₂]⁻
(d) [HFe(CO)₄]⁻

88. Which statement about (η⁵-C₅)₂Fe₂(CO)₄ is incorrect?
(a) Cis and Trans isomers exist and are both present in solution at 298 K
(b) The Fe₂ unit is supported by two bridging CO ligands.
(c) Reaction with Na produces [(η⁵-C₅)Fe(CO)₂]⁻.
(d) Reaction with Br₂ give [(η⁵-C₅)FeBr₂(CO)₂]

89. Consider the compound (C₈H₈)Ru(CO)₃. Which is likely to be the best description of the C₈H₈ ligand?
(a) It is bounded in an η⁸- manner to the Ru atom and one ¹H NMR signal is observed over a range of temperatures.
(b) It is bounded in an η⁴- manner to the Ru atom and one ¹H NMR signal is observed in the limiting high temperature spectrum.
(c) It is bounded in an η₃- manner to the Ru atom and one ¹H NMR signal is consistent with a stereochemically non-rigid molecule.
(d) It is bounded in an η¹- manner to the Ru atom and one ¹H NMR signal is consistent with a static structure.

90. The conversion of Mn₂(CO)₉(PPh₂H) to Mn₂(CO)₈(μ-PPh₂)(μ-H) is best described in terms of loss of CO in association with
(a) an oxidative addition
(b) a substitution reaction
(c) α-H abstraction
(d) β-H elimination
91. In the Tennessee-Eastman acetic anhydride process, the catalyst is cis-[Rh(CO)₂I₂]. 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 RhCl[PPh₃]₂ [or RhCl(PPh₃)₂(solvent)]. The first step in the catalytic cycle is
(a) alkene coordination    (b) oxidative addition of H₂
(c) loss of PPh₃           (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 AlMe₃ possess delocalised Al – C – Al bonding interaction
(b) The bonding in Al₂Me₂Cl₂ can be describe in terms of a localised scheme
(c) In Al₂Ph₄(μ-C≡CPh)₂, the bridge bond can be described in a similar way to Al₂Me₄(μ-Ph)₂
(d) Al₂{CH(SiMe₃)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 metalloccenes is
(a) Cp₂Fe metal ligand bond in strong in comparison to Cp₂Fe⁺²
(b) Cp₂Fe⁺² metal ligand bond is strong in comparison to Cp₂Fe
(c) Cp₂Co metal ligand bond is strong in comparison to Cp₂Co⁺
(d) None of these
98. Which of the following metallocenes is readily oxidized
(a) Cp₂Co     (b) Cp₂Co⁺    (c) Cp₂Fe      (d) None of these

99. The byproduct formed in the characteristic reaction of (CO)₂Cr = C(OMe)(Me) with MeNH₂ is
(a) CO        (b) MeOH    (c) MeCHO     (d) MeCONH₂

100. The catalyst and Co-catalyst used in the Wacker process, respectively are
(a) PdCl₂ and Cu  (b) CuCl₂ and [PdCl₄]⁻²
(c) Pd and CuCl  (d) [PdCl₄]⁻² and CuCl₂