SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

Coordination Compounds

1. Write the correct IUPAC name of $Hg\left[Co\left(SCN\right)_4\right]$

1) Mercury (I) tetracyanatocobaltate (III)

2) Mercury (I) tetrathiocyanato – s – cobaltate

3) Tetrathiocyanato – s – cobaltate (III) Mercury

4) Mercury (I) Tetrathiocyanato – s- cobaltate

Which of the following is the correct order of increasing tendency to gain electrons

1) I < II < III < IV 2) IV < II < III < I 3) I < III < II < IV 4) IV < I < II < III

2. $\left[Ag(NH_3)_2\right]\left[Ag\left(CN\right)_2\right]$ is named as

1) Dicyanidoargentate (I) diamminesilver (I)

2) dicyanidosilver (I) diamminesilver

3) diamminesilver (I) Dicyanidoargentate (I)

4) diamminesilver (II) Dicyanidoargentate(III) chloride

3. Which of the following is the correct formula for Tetrammineaquachloridocobalt

1) $\left[Co\left(NH_3\right)_4\left(H_2O\right)Cl\right]Cl_2$ 2) $\left[Co\left(NH_3\right)_4\left(H_2O\right)Cl\right]^{+3}Cl_2$

3) $\left[Co\left(NH_3\right)_4\left(H_2O\right)Cl\right]^{-3}Cl_2$ 4) $\left[Co\left(NH_3\right)_4\left(H_2O\right)Cl_3\right]$

4. IUPAC name of $\left[Pt\left(NH_3\right)_2Cl.\left(NO_2\right)\right]$ is

1) Diamminechloronitrito-N-platinate (II) 2) Diamminechloridonitrito-N- platinum (II)

3) platinum diaminechloronitrite 4) Chloronitrito – N – animineplatinum (II)

5. The Co –ordination number of metal M in a complex having formula MCl_34H_2O is 6 and there is no molecule of hydration in it. The volume of 0.2M $AgNO_3$ Solution needed to precipitate the free chloride ions in 400 ml of 0.02 M complex is

1) 10 ml 2) 20 ml 3) 30 ml 4) 40 ml

6. An excess of $AgNO_3$ Solution is added to 100 ml of a 0.4 M chloridopenta aquachromium (III) chloride The number of millimoles of AgCl precipitated would be …

1) 80 2) 30 3) 40 4) 10

7. **A coordination compound has the formula** $CoCl_3.4NH_3$ It does not liberate NH_3 but precipitates Cl^- ions as AgCl which of the following is its structural formula

1) $\left[Co(NH_3)_4\,Cl_2\right]Cl$ 2) $\left[Co(NH_3)_4\,Cl_3\right]$

3) $\left[Co(NH_3)_2\,Cl_3\right](NH_3)_2$ 4) $\left[Co(NH_3)_3\,Cl_3\right]NH_3$

8. The Coordination number of a central metal atom of a Complex is

1) The number of only anionic ligands bounded to the metal ion.

2) The number of ligands around a metal ion bounded by π bonds

3) The number of σ bonds between ligands and central metal atom

4) The number of ligands around a metal ion bounded of σ and π bonds both

9. **Find the secondary valency of following compounds .** a) $PdCl_2.4NH_3$ gives 2 moles AgCl

b) $CoCl_3.4NH_3$ gives 1 moles AgCl c) $NiCl_2.6H_2O$ gives 2 moles AgCl

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

10. **Which of the following gives yellow colour**

1) $\left[CoCl_2(NH_3)_4\right]^+Cl^-$ 2) $\left[CoCl_2(NH_3)_3\right]^{+2}\;2Cl^-$

3) $\left[CoCl_3(NH_3)_3\right]NH_3$ 4) $Co(CO)_y$

11. **A Compound is made by mixing cobalt (III) nitrite and potassium nitrite solutions in the ratio of 1 : 3 The aqueous solution of the compound showed 4 particles per molecule whereas molar conductivity reveals the presence of six electrical charges the formula of the compound is :**

1) $Co(No_2)_3.2KNO_2$ 2) $Co(NO_2)3KNO_3$

3) $K_3\left[Co(NO_2)_6\right]$ 4) $K\left[Co(NO_2)_4\right]$

12. **Following Sidwik's rule of EAN,** $Co(CO)_y$ will be

1) $Co(CO)_3$ 2) $Co_2(CO)_{10}$

3) $Co_2(CO)_8$ 4) $Co_2(CO)_4$

13. **How many geometrical isomers are formed by the complex** $\left[Pt(H_2O)(NH_3)BrI\right]$

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

14. **The complexes** $\left[Pt\left(NH_3\right)_4\right]\left[PtCl_6\right]$ and $\left[Pt\left(NH_3\right)_4 Cl_2\right]\left[PtCl_4\right]$ are :

1) Ionisation isomers 2) Co –ordination isomers

3) Linkage isomers 4) Optical isomers

15. **Which of the following complexes show geometrical as well as optical isomerism ?**

$a)\left[Cr\left(Ox\right)_3\right]^{3-}$ $b)\left[Rh\left(en\right)_2 Cl_2\right]^{+}$ $c)\left[Co\left(NH_3\right)_2\left(Cl\right)_2\left(en\right)\right]^{+}$

1) a Only 2) a and b only

3) b and c only 4) All a, b, c

16. **Which of the following octahedral complex does not show geometrical isomerism (X and Y are monodentate ligands)**

1) $\left[MX_3Y_3\right]$ 2) $\left[MX_4Y_2\right]$ 3) $\left[MX_5Y\right]$ 4) $\left[MX_2Y_4\right]$

17. **Facial meridional isomers is associated with which one of the following complex ?**

1) $\left[M\left(XX\right)_2\right]$ 2) $\left[MX_3Y_3\right]$ 3) MXYZW 4) $\left[M\left(XX\right)_3\right]$

18. **Which of the following is not optical active ?**

1) Trans - $\left[FeBr_2\left(en\right)_2\right]^{+}$ 2) CiS - $\left[FeBr_2\left(en\right)_2\right]^{+}$

3) $\left[Co\left(en\right)_3\right]^{+3}$ 4) $\left[Cr\left(OX\right)_3\right]^{3-}$

19. **Which of the following has the largest number of isomers ?**

1) $\left[Cr\left(en\right)_2 Cl_2\right]^{+}$ 2) $\left[Cr\left(NH_3\right)_5 Cl\right]^{+2}$

3) $\left[Ru\left(NH_3\right)_4 Cl_2\right]^{+}$ 4) $\left[Ir\left(PR_3\right)_2 H\left(CO\right)\right]^{2+}$

20. **Which of the following Complexes is expected to exhibit optical isomerism ?**

1) Trans - $\left[M\left(aa\right)_2 b_2\right]$ 2) Cis - $\left[M\left(aa\right)_2 b_2\right]$ 3) Ma_3b_3 4) Ma_4b_2

21. **You are given the following two complex's X and Y which are isomers of each X is** $Hg\left[Co\left(SCN\right)_4\right]$ It is further given that paramagnetic moment of x is found to be more than Y. Than which of the following is correct

1) Anion of X will be tetrahedral and that of Y will be square planar

2) Anion of X will be square planar but that of Y will be tetrahedral

3) Both the anions will be tetrahedral

4) Both the anions will be Square planar

22. All the following complexes show a decreases in their weights when placed in a magnetic balance Then which of these has squar planar geometry

1) $K\left[AgF_4\right]$ 2) $Ni\left(CO\right)_4$ 3) $Na_2\left[Zn\left(CN\right)_4\right]$ 4) None of these

23. In which of the following configurations will there be the possibility of both para and diamagnetism, depending on the nature of the ligands ?

1) d^7 2) d^3 3) d^6 4) d^5

24. Match list A and B

List-A	List – B
1. Tetrahedral	$a,\left[Ni\left(CN\right)_4\right]^{2-}$
2. Octahedral	$b,\left[Ag\left(NH_3\right)_2\right]^{+}$
3. square planar	$c,\left[Fe\left(CO_5\right)\right]$
4. Trigonal bipyramidal	$d,\left[Cr\left(en\right)_2 Cl_2\right]^{+}$
5. Linear	$e,\left[NiCl_4\right]^{2-}$

1). 1 –e : 2 – d : 3 – c : 5 – a 2) 1 – d : 2 – C : 4 – e : 5 –a

3) 1 –e ; 2 –d ; 3 –a ; 5 –b 4) 1 –e ; 2 –d ; 3 –b ; 4 –c ; 5 –a

25. The magnetic moment of $\left[Mn\left(CN\right)_6\right]^{3-}$ is 2.8 BM and that of $\left[MnBr\right]^{2-}$ is 5.9 BM. The hybridization and geometric of these complex ions

1) SP^3d^2 Octahedral and dsp^2 tetrahedral 2) d^2sp^3 Octahedral and dSP^2 square planar

3) d^2sp^3 Octahedral and sp^3 tetrahedral 4) sp^3d^2 Octahedral and sp^3 square planar

26. The CFSE for octahedral $\left[CoCl_6\right]^4$ is 18,000 cm^{-1} The CFSE for tetrahedral $\left[COCl_4\right]^{2-}$ will be

1) 18,000 cm^{-1} 2) 1,000 cm^{-1} 3) 8,000 cm^{-1} 4) 20,000 cm^{-1}

27. The hybridisation involved in $\left[Co\left(C_2O_4\right)_3\right]^{3-}$ is :

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

28. The Increasing order of Crystal field Splitting strength of the given ligand is :

1) $CO < CN^- < NH_3 < H_20 < F^- < Cl^-$ 2) $Cl^- < F^- < H_2O < NH_3 < CN^- < CO$

3) $F^- < Cl^- < NH_3 < CN^- < H_2O < CO$ 4) $NH_3 < Cl^- < CN^- < F^- < CO < H_2O$

29. **If** $\Delta_0 < P$, The correct electronic configuration for d^5 system will be

1) $t_{2g}^5\ e_g^0$ 2) $t_{2g}^3 e_g^2$ 3) $t_{2g}^1 e_g^4$ 4) $t_{2g}^4 e_g^1$

30. **In crystal field splitting in octahedral complexes, the energy order of d – orbitals is :**

1) $e_g > t_{2g}$ 2) $t_{2g} > eg$ 3) $dxy > dx^2 - y^2$ 4) $dy^3 > dzx$

31. **The Complex** $\left[M\left(NH_3\right)_6\right]^{2+}$ absorbs energy corresponding to 'x' nm. Which Wavelength in nm is $\left[M\left(NH_3\right)_4\right]^{2+}$ (tetrahedral) likely to be absorbed ?

1) $\frac{4}{9}\times$ 2) $\frac{9}{4}\times$ 3) $3\times$ 4) $3.75\times$

32. **Among the following which one causes the highest CFSE,** Δ_0 as a ligand is : -

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

33. **Which one of the following complexes will most likely absorb visible light ?**

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

34. **The species that is both paramagnetic and coloured is**

1) $\left[MnO_4\right]^{2-}$ 2) CrO_2Cl_2 3) $k_4\left[V\left(CN\right)_6\right]$ 4) $\left(VO_4\right)^{3-}$

35. **The Non – existent metal carbonyl among the following is**

1) $Cr\left(CO\right)_6$ 2) $Mn\left(CO\right)_5$ 3) $\left[Ni\left(CO\right)_4\right]$ 4) $\left[Fe\left(CO\right)_5\right]$

Numerical Value Questions

36. The Possible number of Optical isomers in $\left[Cr\left(en\right)_2 Cl_2\right]^+$ is

37. The total number of possible Coordinate isomer for the given compound $\left[Pt\left(NH_4\right)Br_2\right]\left[PtBr_4\right]$ is

38. EAN of Fe in $\left[Fe\left(C_2O_4\right)_3\right]^{3-}$ is

39. How many unpaired electrons are present in eg orbital pf MnO_4^-

40. Give the number of ligands which are non – classical ligand and π donor as well as π acceptor ligand

$CO, PH_3, PF_3, C_3H_5^-, C_5H_5^-$

KEY

1) 2	**2)** 3	**3)** 1	**4)** 2	**5)** 4	**6)** 1	**7)** 1	**8)** 3	**9)** 1	**10)** 4
11) 3	**12)** 3	**13)** 1	**14)** 2	**15)** 3	**16)** 3	**17)** 2	**18)** 1	**19)** 1	**20)** 2
21) 1	**22)** 1	**23)** 3	**24)** 3	**25)** 3	**26)** 3	**27)** 4	**28)** 2	**29)** 2	**30)** 1
31) 2	**32)** 4	**33)** 1	**34)** 1	**35)** 2	**36)** 3	**37)** 4	**38)** 35	**39)** 0	**40)** 2

Solution

1. Conceptual

2. Conceptual

3. Conceptual

4. Conceptual

5. Molecule has the formula = $\left[M\left(H_2O\right)_4 Cl_2\right]Cl$

   $\left[M\left(H_2O\right)_4 Cl_2\right]Cl + AgNO_3 \rightarrow AgCl + \left[M\left(H_2O\right)_4 Cl_2\right]NO_3$ Complex given = 400 ml of 0.02 M = 8

   Milli moles = 8×10^{-3} moles

   Molarity of $AgNO_3 = 0.2M$

   So, volume required can be calculated as

   $$0.2 = \frac{8\times10^{-3}}{V\left(L\right)} = 4\times10^{-2}L = 40ml$$

6) 100 ML 0.4 M Solution means 0.04 moles of Complex $\left(\because \frac{100}{1000}\times0.4 = 0.04\right)$

   $\left[Cr\left(H_2O\right)_5 Cl\right]Cl_2$ has two ionisable Cl^-

   $\therefore 0.04$ Moles of the Complex precipitated the $\therefore 0.04\times2$ moles of AgCl

   $\therefore$ milli moles of $AgCl$ precipitated = 80

7) Counter ion gives precipitation

8) Conceptual

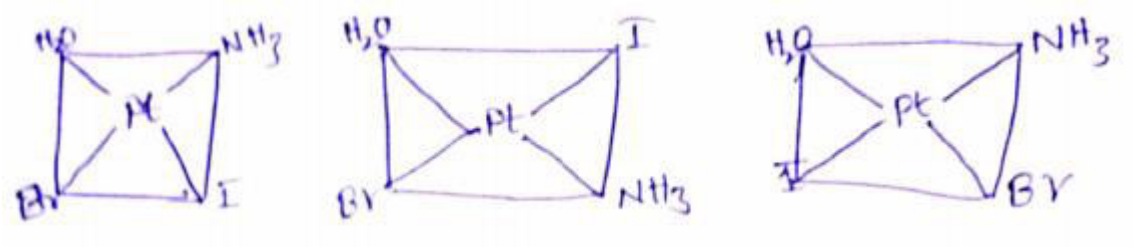
9) Counter ions gives precipitation and remaining ligands gives secondary valence

10) Conceptual

11) Conceptual

12) EAN = Atomic no – Oxidation sate + $2\times$ Coordination number

13)

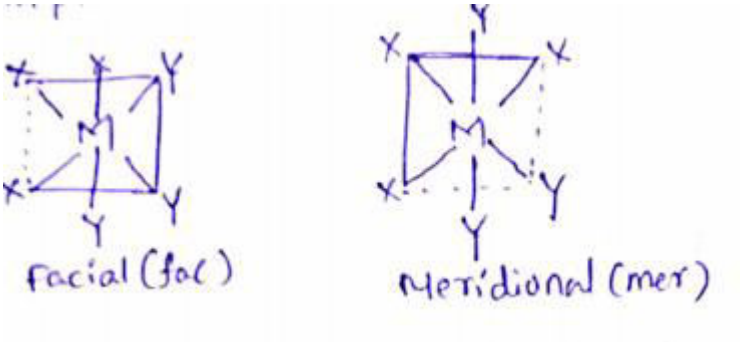


14) Conceptual

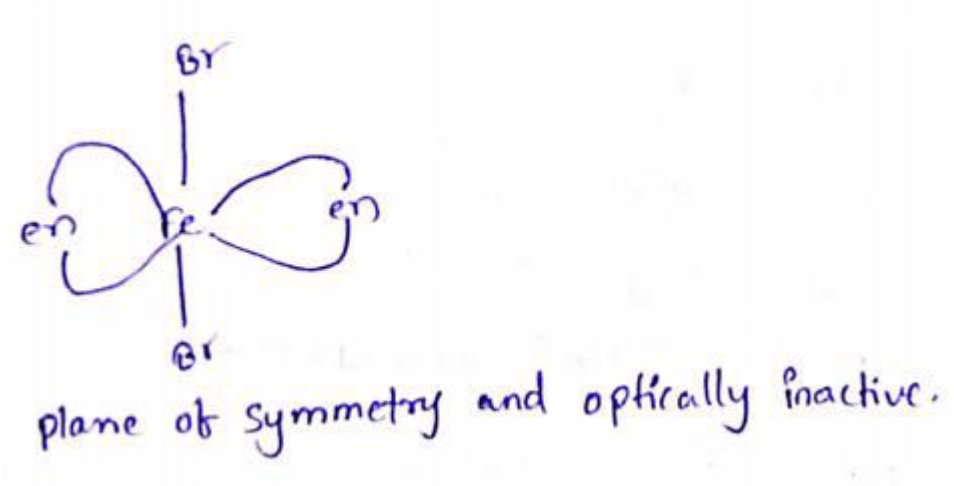
15) Conceptual

16) Conceptual

17)

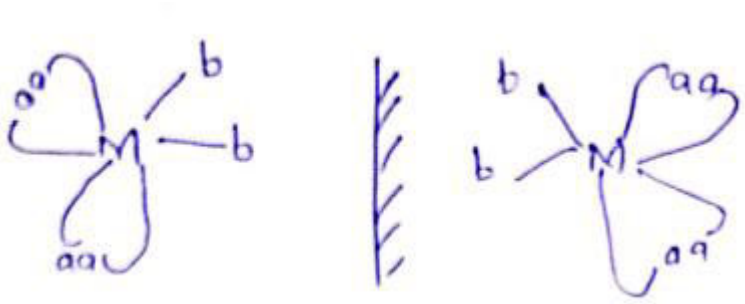


18)



19) $\left[CO(on)_2\,Cl_2\right]^+$ shows geometrical as well optical isomerism

20)



21) $X : Hg\left[Co(SCN)_4\right]$ $\qquad$ $Y : \left[Co(NCS)_4\right]$

$Co^{+2}\ is\ sp^3$ $\qquad$ $Co^{+2}\ is\ dsp^2$

Paramagnetic = (3e) $\qquad$ Paramagnetic = (1e)

22) $K\left[AgF_4\right]$ is square planer because Ag (II) is $4d^8$ and complex is diamagnetic

23) Strong field ligand $d^6 = t_{2g}^{2.2.2}\ eg^{0.0}$ – diamagnetic

Weak field ligand $d^6 = t_{2g}^{2.1.1}\ eg^{1.1}$ – paramagnetic

24) $\left[Ni(CN)_4\right]^{2-} - dsp^2$ – square planer

$\left[Ag(NH_3)\right]^{+} - sp$ – linear

$\left[Fe(CO)_5\right] - dsp^3$ – trigonal bipyramidal

$\left[Cr(en)_2 Cl_2\right]^{+} - dsp^3$ – Octahedral

$\left[NiCl_4\right]^{2-} - sp^3$ – tetrahedral

25) $\left[Mn(CN)_6\right]^{3-}$: $Mn^{+3} = 3d^4 4S^0 = t_{2g}^{2,1,1}\ eg^{0,0} = d^2 sp^3$ hybridised number of unpaired electrons = 2

Magnetic momentum = $\mu_B = \sqrt{2\times 4}\ BM = 2.8\ BM$

$\left[MnBr_4\right]^{2-} : Mn^{+2} = 3d^5 4S^0 = eg^{1,1} t_{2g}^{1,1,1} = sp^3$ hybridised

Number of unpaired electrons = 5

$\mu_B = \sqrt{5\times 7} = 5.9\ BM$

26) $\Delta_t = \frac{4}{9}\Delta_0$

$\Delta_0 = 18,000\ cm^{-1}$

$$\Delta_t = \frac{4}{9}\Delta_0 = \frac{4}{9} \times 18,000\, cm -^1$$

$$4 \times 2,000\, CM^{-1} = 8,000^{\,cm-1}$$

27) $C_2O_4 \rightarrow$ strong field ligand

28) Conceptual

29) If $\Delta_0 < p$ electronic configuration follows hunds rule

30) Conceptual

31) $\Delta_t = \frac{4}{9}\Delta_0$

$$\frac{hc}{\lambda} = \frac{hc}{x} \times \frac{4}{9} \Rightarrow \lambda = \frac{9}{4}x$$

32) $CO > CN^- > NH_3 > F^-$ Field strength increase Δ_0 value

33) Absorption of visible light α number of unpaired electrons

34) $\left[MnO_4\right]^{2-}$; Mn is in + 6 Oxidation state

E.C: $\left[Ar\right]^{18} 8d^1 4S^0$ As it contains one unpaired electron it is paramagnetic and green coloured because

d – d transition in visible region $\left[TiCl_4\right]^{2-}$, $\left[VO_4\right]^{3-}$ and CrO_2Cl_2 are diamagnetic

35. $Mn(CO)_5$ does not obey EAN rule

36) Conceptual

37) Conceptual

38) Conceptual

39) Conceptual

40) Conceptual