COORDINATION CHEMISTRY

1. The calculated magnetic moments (spin only value) for species $[FeCl_4]^{2-}$, $[Co(C_2O_4)_3]^{3-}$ and MnO_4^{2-} respectively are :
(1) 5.82, 0 and 0 BM
(2) 4.90, 0 and 1.73 BM
(3) 5.92, 4.90 and 0 BM
(4) 4.90, 0 and 2.83 BM

2. The hybridization and magnetic nature of $[Mn(CN)_6]^{4-}$ and $[Fe(CN)_6]^{3-}$, respectively are:
(1) d^2sp^3 and diamagnetic
(2) sp^3d^2 and diamagnetic
(3) d^2sp^3 and paramagnetic
(4) sp^3d^2 and paramagnetic

3. In which of the following order the given complex ions are arranged correctly with respect to their decreasing spin only magnetic moment ?
(i) $[FeF_6]^{3-}$ (ii) $[Co(NH_3)_6]^{3+}$
(iii) $[NiCl_4]^{2-}$ (iv) $[Cu(NH_3)_4]^{2+}$
(1) (i) > (iii) > (iv) > (ii)
(2) (ii) > (iii) > (i) > (iv)
(3) (iii) > (iv) > (ii) > (i)
(4) (ii) > (i) > (iii) > (iv)

4. Given below are two statements :
Statement I :
The identification of Ni^{2+} is carried out by dimethyl glyoxime in the presence of NH_4OH.
Statement II :
The dimethyl glyoxime is a bidentate neutral ligand.
In the light of the above statements, choose the correct answer from the options given below:
(1) Statement I is false but Statement II is true.
(2) Both Statement I and Statement II are false.
(3) Statement I is true but Statement II is false.
(4) Both Statement I and Statement II are true.

5. Number of bridging CO ligands in $[Mn_2(CO)_{10}]$ is _____.

6. The number of stereoisomers possible for $[Co(ox)_2(Br)(NH_3)]^{2-}$ is _____.[ox = oxalate]

7. The equivalents of ethylene diamine required to replace the neutral ligands from the coordination sphere of the trans-complex of $CoCl_3.4NH_3$ is _____. (Round off to the Nearest Integer).

8. Arrange the following metal complex/compounds in the increasing order of spin only magnetic moment. Presume all the three, high spin system.
(Atomic numbers Ce = 58, Gd = 64 and Eu = 63.)
(a) $(NH_4)_2[Ce(NO_3)_6]$ (b) $Gd(NO_3)_3$ and
(c) $Eu(NO_3)_3$
Answer is :
(1) (b) < (a) < (c) (2) (c) < (a) < (b)
(3) (a) < (b) < (c) (4) (a) < (c) < (b)

9. $[Ti(H_2O)_6]^{3+}$ absorbs light of wavelength 498 nm during a d – d transition. The octahedral splitting energy for the above complex is _____ $\times 10^{-19}$ J. (Round off to the Nearest Integer).
$h = 6.626 \times 10^{-34}$ Js; $c = 3 \times 10^8$ ms^{-1}.

10. Match List-I with List-II :

List-I		List-II	
(a)	$[Co(NH_3)_6]$ $[Cr(CN)_6]$	(i)	Linkage isomerism
(b)	$[Co(NH_3)_3$ $(NO_2)_3]$	(ii)	Solvate isomerism
(c)	$[Cr(H_2O)_6]Cl_3$	(iii)	Co-ordination isomerism
(d)	*cis*-$[CrCl_2(ox)_2]^{3-}$	(iv)	Optical isomerism

Choose the correct answer from the options given below
(1) (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)
(2) (a)-(iv), (b)-(ii), (c)-(iii), (d)-(i)
(3) (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)
(4) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

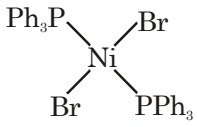
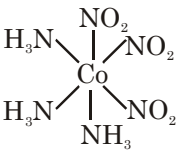
11. On complete reaction of $FeCl_3$ with oxalic acid in aqueous solution containing KOH, resulted in the formation of product A. The secondary valency of Fe in the product A is ____.
(Round off to the Nearest Integer).

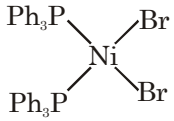
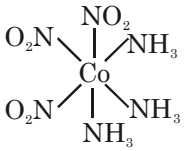
12. Match List-I with List-II

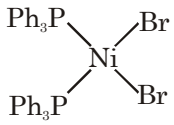
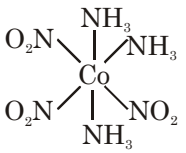
List-I	List-II
(a) Chlorophyll	(i) Ruthenium
(b) Vitamin-B_{12}	(ii) Platinum
(c) Anticancer drug	(iii) Cobalt
(d) Grubbs catalyst	(iv) Magnesium

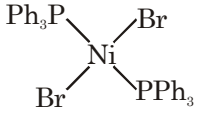
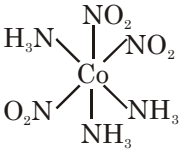
Choose the most appropriate answer from the options given below :
(1) a-iii, b-ii, c-iv, d-i
(2) a-iv, b-iii, c-ii, d-i
(3) a-iv, b-iii, c-i, d-ii
(4) a-iv, b-ii, c-iii, d-i

13. The correct structures of trans-$[NiBr_2(PPh_3)_2]$ and meridonial-$[Co(NH_3)_3(NO_2)_3]$, respectively, are

(1)  and 

(2)  and 

(3)  and 

(4)  and 

14. The total number of unpaired electrons present in the complex $K_3[Cr(oxalate)_3]$ is _____.

15. The secondary valency and the number of hydrogen bonded water molecule(s) in $CuSO_4 \cdot 5H_2O$, respectively, are :

(1) 6 and 4 (2) 4 and 1

(3) 6 and 5 (4) 5 and 1

16. According to the valence bond theory the hybridization of central metal atom is dsp^2 for which one of the following compounds?

(1) $NiCl_2.6H_2O$

(2) $K_2[Ni(CN)_4]$

(3) $[Ni(CO)_4]$

(4) $Na_2[NiCl_4]$

17. The correct order of intensity of colors of the compounds is :

(1) $[Ni(CN)_4]^{2-} > [NiCl_4]^{2-} > [Ni(H_2O)_6]^{2+}$

(2) $[Ni(H_2O)_6]^{2+} > [NiCl_4]^{2-} > [Ni(CN)_4]^{2-}$

(3) $[NiCl_4]^{2-} > [Ni(H_2O)_6]^{2+} > [Ni(CN)_4]^{2-}$

(4) $[NiCl_4]^{2-} > [Ni(CN)_4]^{2-} > [Ni(H_2O)_6]^{2+}$

18. The spin-only magnetic moment value for the complex $[Co(CN)_6]^{4-}$ is _____ BM.
[At. no. of Co = 27]

19. Spin only magnetic moment of an octahedral complex of Fe^{2+} in the presence of a strong field ligand in BM is :

(1) 4.89 (2) 2.82

(3) 0 (4) 3.46

20. Which one of the following species **doesn't** have a magnetic moment of 1.73 BM, (spin only value) ?

(1) O_2^+ (2) CuI

(3) $[Cu(NH_3)_4]Cl_2$ (4) O_2^-

21. An aqueous solution of $NiCl_2$ was heated with excess sodium cyanide in presence of strong oxidizing agent to form $[Ni(CN)_6]^{2-}$. The total change in number of unpaired electrons on metal centre is _____.

22. The total number of unpaired electrons present in $[Co(NH_3)_6]Cl_2$ and $[Co(NH_3)_6]Cl_3$ is

23. Which one of the following species responds to an external magnetic field?

(1) $[Fe(H_2O)_6]^{3+}$ (2) $[Ni(CN)_4]^{2-}$

(3) $[Co(CN)_6]^{3-}$ (4) $[Ni(CO)_4]$

24. Three moles of AgCl get precipitated when one mole of an octahedral co-ordination compound with empirical formula $CrCl_3.3NH_3.3H_2O$ reacts with excess of silver nitrate. The number of chloride ions satisfying the secondary valency of the metal ion is_____ .

25. Which one of the following metal complexes is most stable?

(1) $[Co(en)(NH_3)_4]Cl_2$

(2) $[Co(en)_3]Cl_2$

(3) $[Co(en)_2(NH_3)_2]Cl_2$

(4) $[Co(NH_3)_6]Cl_2$

26. The type of hybridisation and magnetic property of the complex $[MnCl_6]^{3-}$, respectively, are :
(1) sp^3d^2 and diamagnetic
(2) d^2sp^3 and diamagnetic
(3) d^2sp^3 and paramagnetic
(4) sp^3d^2 and paramagnetic

27. The number of geometrical isomers found in the metal complexes $[PtCl_2(NH_3)_2]$, $[Ni(CO)_4]$, $[Ru(H_2O)_3Cl_3]$ and $[CoCl_2(NH_3)_4]^+$ respectively, are :
(1) 1, 1, 1, 1
(2) 2, 1, 2, 2
(3) 2, 0, 2, 2
(4) 2, 1, 2, 1

28. The number of geometrical isomers possible in triamminetrinitrocobalt (III) is X and in trioxalatochromate (III) is Y. Then the value of X + Y is _____.

29. Given below are two **statements** :
Statement I : $[Mn(CN)_6]^{3-}$, $[Fe(CN)_6]^{3-}$ and $[Co(C_2O_4)_3]^{3-}$ are d^2sp^3 hybridised.
Statement II : $[MnCl_6]^{3-}$ and $[FeF_6]^{3-}$ are paramagnetic and have 4 and 5 unpaired electrons, respectively.
In the light of the above statements, choose the **correct** answer from the options given below :
(1) **Statement I** is correct but **statement II** is false
(2) Both **statement I** and **statement II** are false
(3) **Statement I** is incorrect but **statement II** is true
(4) Both **statement I** and **statement II** are are true

30. 3 moles of metal complex with formula $Co(en)_2Cl_3$ gives 3 moles of silver chloride on treatment with excess of silver nitrate. The secondary valency of Co in the complex is _____. (Round off to the nearest integer)

31. Which one of the following complexes is violet in colour?
(1) $[Fe(CN)_6]^{4-}$
(2) $[Fe(SCN)_6]^{4-}$
(3) $Fe_4[Fe(CN_6)]_3 \cdot H_2O$
(4) $[Fe(CN)_5NOS]^{4-}$

32. Indicate the complex/complex ion which did not show any geometrical isomerism :
(1) $[CoCl_2(en)_2]$ (2)$[Co(CN)_5(NC)]^{3-}$
(3) $[Co(NH_3)_3(NO_2)_3]$ (4) $[Co(NH_3)_4Cl_2]^+$

33. Arrange the following Cobalt complexes in the order of increasing Crystal Field Stabilization Energy (CFSE) value.
Complexes :
$[\underset{A}{CoF_6}]^{3-}, [\underset{B}{Co(H_2O)_6}]^{2+}, [\underset{C}{Co(NH_3)_6}]^{3+}$
and $[Co(en)_3]^{3+}$
Choose the **correct** option :
(1) A < B < C < D (2) B < A < C < D
(3) B < C < D < A (4) C < D < B < A

34. 1 mol of an octahedral metal complex with formula $MCl_3 \cdot 2L$ on reaction with excess of $AgNO_3$ gives 1 mol of AgCl. The denticity of Ligand L is _____ . (Integer answer)

35. The number of optical isomers possible for $[Cr(C_2O_4)_3]^{3-}$ is _____.

36. The denticity of an organic ligand, biuret is :
(1) 2 (2) 4 (3) 3 (4) 6

37. Spin only magnetic moment in BM of $[Fe(CO)_4(C_2O_4)]^+$ is :
(1) 5.92 (2) 0 (3) 1 (4) 1.73

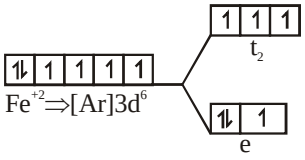
38. The Crystal Field Stabilization Energy (CFSE) and magnetic moment (spin-only) of an octahedral aqua complex of a metal ion (M^{z+}) are –0.8 Δ_0 and 3.87 BM, respectively. Identify (M^{Z+}) :
(1) V^{3+} (2) Cr^{3+} (3) Mn^{4+} (4) Co^{2+}

39. The sum of oxidation states of two silver ions in $[Ag(NH_3)_2]$ $[Ag(CN)_2]$ complex is _____.

SOLUTION

1. Official Ans. by NTA (2)

Sol. (i) $[FeCl_4]^{-2} \Rightarrow$

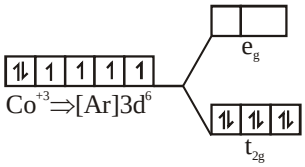


$\mu = \sqrt{n(n+2)}$ BM

$= \sqrt{4(4+2)}$ BM

$= \sqrt{24}$ BM $\Rightarrow 4.90$ BM

(ii) $[Co(C_2O_4)_3]^{-3}$



$\mu = 0$

(iii) MnO_4^{-2}

$Mn^{+6} \Rightarrow [Ar]3d^1$ $\mu = \sqrt{n(n+2)}$ BM

$= \sqrt{1(1+2)}$ BM

$= \sqrt{3}$ BM $\Rightarrow 1.73$ BM

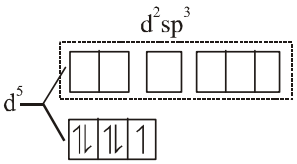
2. Official Ans. by NTA (3)

Sol. $[Mn(CN)_6]^{4-}$

Mn^{+2} d^5

CN^- – SFL

$\Delta_0 > P$



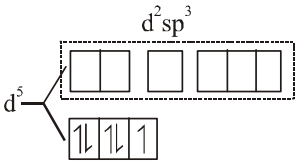
∴ hybridisation is d^2sp^3 and due to presence of unpaired e^- complex is paramagnetic in nature

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

Fe^{+3} d^5

CN^- – SFL

$\Delta_0 > P$

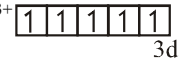


∴ hybridisation is d^2sp^3 and due to presence of unpaired e^- complex paramagnetic in nature

3. Official Ans. by NTA (1)

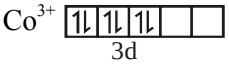
Sol. Complex

(i) $[FeF_6]^{3-}$ $Fe^{3+} \Rightarrow [Ar]3d^5, F^-$ is WFL



$n = 5$, $\mu = \sqrt{35}$ B.M.

(ii) $[Co(NH_3)_6]^{3+} \Rightarrow Co^{3+}[Ar]3d^6$, NH_3 is SFL

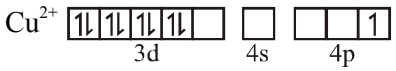


$n = 0$, $\mu = 0$

(iii) $[NiCl_4]^{2-}$ $Ni^{2+} \Rightarrow [Ar]3d^8$, $Cl^- \rightarrow$ WFL

$n = 2$, $\mu = \sqrt{8}$ B.M.

(iv) $[Cu(NH_3)_4]^{2+}$ $Cu^{2+} \Rightarrow [Ar]\ 3d^9$, $NH_3 \rightarrow$ SFL



$n = 1$, $\mu = \sqrt{3}$ B.M.

Thus correct order of spin only magnetic moment is (i) > (iii) > (iv) > (ii)

4. Official Ans. by NTA (3)

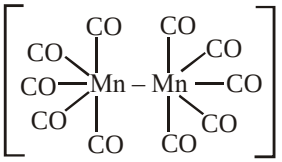
Sol. Neutral dimethyl glyoxime does not act as ligand.

When Ni^{2+} reacts with dimethyl glyoxime in presence of NH_4OH, it produce dimethyl glyoximate then it form rozy red ppt.

$$Ni^{2+}_{(aq)} + 2dmg^- \rightarrow \underset{\text{Rosy red ppt.}}{[Ni(dmg)_2]}$$

5. Official Ans. by NTA (0)

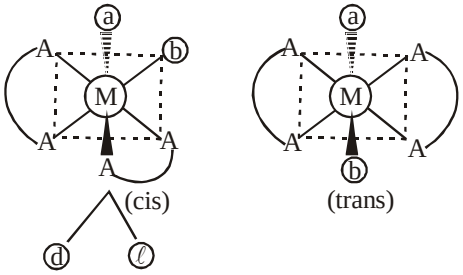
Sol. $Mn_2(CO)_{10}$ structure is



Zero bridging CO ligands are present

6. Official Ans by NTA (3)

Sol. Total number of stereoisomers in $[Co(ox)_2Br(NH_3)]^{2\Theta}$ i.e. $\simeq [M(AA)_2ab]^{2-}$



→ cis is optically active isomers and trans is optically inactive isomer

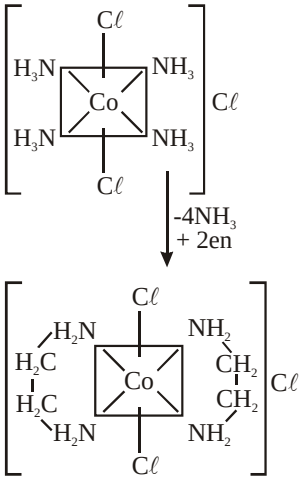
→ Hence total isomers is = 3

7. Official Ans. by NTA (2)

Sol. trans - $CoCl_3.4NH_3$

or

trans-$[Co(NH_3)_4Cl_2]C\ell$



As we know that ethylene diamine is a bidentate ligand and ammonia is a mono dentate ligand.

It means overall two ethylene diamine is required to replace the all neutral ligands (four ammonia) from the coordination sphere of this complex.

8. Official Ans. by NTA (4)

Sol. (a) $_{58}Ce \rightarrow [Xe]4f^2\ 5d^0\ 6s^2$

In complex $Ce^{4+} \rightarrow [Xe]\ 4f^0\ 5d^0\ 6s^0$

there is no unpaired electron so $\mu_m = 0$

(b) $_{64}Gd^{3+} \rightarrow [Xe]4f^7\ 5d^0\ 6s^0$

contain seven unpaired electrons so,

$\mu_m = \sqrt{7(7+2)} = \sqrt{63}$ B.M.

(c) $_{63}Eu^{3+} \rightarrow [_{54}Xe]4f^6\ 5d^0\ 6s^0$

contain six unpaired electron

so, $\mu_m = \sqrt{6(6+2)} = \sqrt{48}$ B.M.

Hence, order of spin only magnetic movement

$\boxed{b > c > a}$

9. Official Ans. by NTA (4)

Sol. $\lambda_{absorbed} = 498$ nm (given)

The octahedral spilitting energy

$$\Delta_0 \text{ or } E = \frac{hc}{\lambda} = \frac{6.626\times10^{-34}\times3\times10^{8}}{498\times10^{-9}}$$

$= 0.0399 \times 10^{-17}$ J

$= 3.99 \times 10^{-19}$ J

$= 4.00 \times 10^{-19}$ J (round off)

10. Official Ans. by NTA (1)

Sol.	**Complex**	**Type of Isomerism**
(a)	$[Co(NH_3)_6]\ [Cr(CN)_6]$	Co-ordination isomerism
(b)	$[Co(NH_3)_3\ (NO_2)_3]$	Linkage isomerism
(c)	$[Cr(H_2O)_6]Cl_3$	Solvate isomerism
(d)	*cis*-$[CrCl_2(ox)_2]^{3-}$	Optical isomerism

11. Official Ans. by NTA (6)

Sol. $Fe^{3+} + 3K^{+} + 3C_2O_4^{2-} \rightarrow K_3[Fe(C_2O_4)_3]$

(A)

Secondary valency of Fe in 'A' is 6.

12. Official Ans. by NTA (2)

Sol. Chlorophyll is a coordination compound of magnesium.

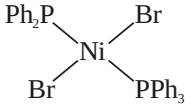
Vitamin B-12, cyanocobalamine is a coordination compound of cobalt.

Cisplatin is used as an anti-cancer drug and is a coordination compound of platinum.

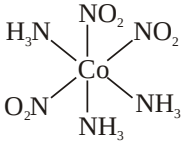
Grubbs catalyst is a compound of Ruthenium.

13. Official Ans. by NTA (4)

Sol. trans-$[Ni\ Br_2(PPh_3)_2]$ is



meridional - $[Co(NH_3)_3(NO_2)_3]$ is



14. Official Ans. by NTA (3)

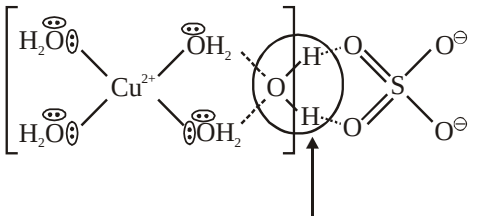
Sol. $K_3[Cr(oxalate)_3]$

Chromium is in +3 oxidation state.

Number of unpaired electrons in Cr^{+3} will be 3.

15. Official Ans. by NTA (2)

Sol.



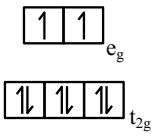
Hydrogen bonded water molecule = 1
Secondary valency = 4

16. Official Ans. by NTA (2)

Sol. (1) $NiCl_2.6H_2O$

$Ni^{+2} \rightarrow [Ar]_{18}3d^8 4s^0$

C.N. = 6 octahedral splitting



Hybridisation sp^3d^2

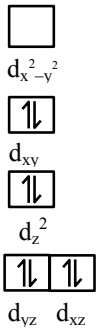
(2) $K_2[Ni(CN)_4]$

C.N. 4

$Ni^{+2} \rightarrow [Ar]_{18}3d^8 4s^0$

$CN^- \rightarrow$ Strong field ligand

Square planar splitting

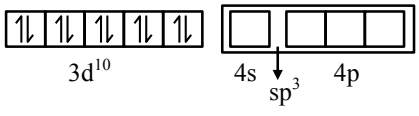


Hybridisation dsp^2

(3) $Ni(CO)_4$

CO - Strong field ligand

$Ni \rightarrow [Ar]_{18}$



Hybridisation

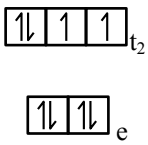
(4) $Na_2[NiCl_4]$

$Ni \rightarrow [Ar]_{18}3d^8 4s^0$

$Cl^{\ominus} \rightarrow$ weak field ligand

C.N. 4

tetrahedral splitting



Hybridisation sp^3

17. Official Ans. by NTA (3)

Sol. $[NiCl_4]^{2-} > [Ni(H_2O)_6]^{2+} > [Ni(CN)_4]^{2-}$

Splitting energy order $\Delta_t < \Delta_0 < \Delta_{sq}$

absorbed energy order $[NiCl_4]^{2-} < [Ni(H_2O)_6]^{2+} < [Ni(CN)_4]^{2-}$

intensity of colour of compound $[NiCl_4]^{2-} > [Ni(H_2O)_6]^{2+} > [Ni(CN)_4]^{2-}$

18. Official Ans. by NTA (2)

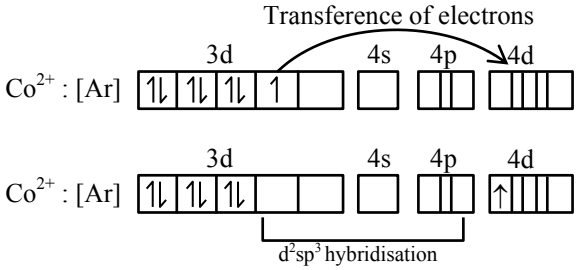
Sol. $[Co(CN)_6]^{4-}$

$x + 6 \times (-1) = -4$

$\boxed{x = +2}$

Co^{2+} : [Ar] $3d^7$

and CN^- is a strong field ligand which can pair electron of central atom.



It has one unpaired electron (n) in 4d-subshell.

So spin only magnetic moment (μ)

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

where n = number of unpaired electrons.

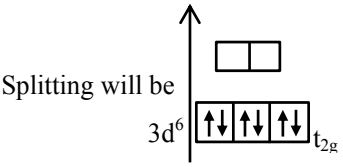
$\mu = \sqrt{3}$ B.M

$\boxed{\mu = 1.73\,BM}$

19. Official Ans. by NTA (3)

Sol. In presence of SFL $\Delta_0 > P$ means pairing occurs therefore

For $Fe^{+2} \rightarrow 3d^6$



$\therefore$ No of unpaired e^- (s) = 0

$\therefore \mu = \sqrt{n(n+2)}\,BM = 0$

[n = No of unpaired e^-(s)]

In $NiCl_2$ Ni^{+2} is having configuration $3d^8$

$\therefore$ Number of unpaired electron = 2

After formation of oxidised product $[Ni(CN)_6]^{-2}$ Ni^{+4} is obtained

$Ni^{+4} \Rightarrow 3d^6$ and CN^- is strong field ligand

$\therefore$ number of unpaired electrons = 0

$\therefore$ The charge is 2 – 0 = 2

20. Official Ans. by NTA (2)

Sol. Species must not contain single unpaired

(1) $O_2^+ \rightarrow$

$\sigma_{1s}^2 < \sigma_{1s}^{*2} < \sigma_{2s}^2 < \sigma_{2s}^{*2} < \sigma_{2pz}^2 < \pi_{2px}^2 = \pi_{2py}^2 < \pi_{2px}^{*1} = \pi_{2py}^*$

unpaired $e^- = 1 \therefore \mu = 1.73$ BM

(1) $Cu^+I^- Cu^+ \rightarrow [Ar]3d^{10} \therefore$ unpaired $e^- = 0$

$I^- \rightarrow [Xe] \therefore$ unpaired $e^- = 0$

therefore $\mu = 0$

3. $[Cu(NH_3)_4]Cl_2$

$Cu \rightarrow [A]\ 3d^3 \therefore$ unpaired $= 1 \therefore \mu = 1.73$ BM

4. $O_2^- \rightarrow d$

$\sigma_{1s}^2 < \sigma_{1s}^{*2} < \sigma_{2s}^2 < \sigma_{2s}^{*2} < \sigma_{2px}^2 < \pi_{2px}^2 = \pi_{2py}^2 < \pi_{2px}^{*1} = \pi_{2py}^*$

$(11e^-)$

$\therefore$ unpaired $\therefore \mu = 1.73$ BM

21. Official Ans. by NTA (2)

Sol. $[Ni(CN)_6]^{2-}$

$Ni^{+4} \rightarrow d^6$ strong field ligand

↑↓	↑↓	↑↓		

Pairing will be there zero unpaired electron

$NiCl_2 \rightarrow Ni^{2+} \rightarrow d^8$

↑↓	↑↓	↑↓	↑	↑

$\rightarrow$ two unpaired e^-

Change = 2

22. Official Ans. by NTA (1)

Sol. $[Co(NH_3)_6]Cl_2$

Co^{2+} : $[Ar]3d^7 4s^0 4p^0$

For this complex Δ_0 < P.E., so pairing of electron does not take place.

sp^3d^2 hybridisation

Total 3 unpaired electrons are present.

$[Co(NH_3)_6]Cl_3$

Co^{3+} : $[Ar]\ 3d^6\ 4s^0\ 4p^0$

d^2sp^3 hybridisation

NH_3 acts as SFL because Δ_0 > P.E.

So here all electrons becomes paired.

23. Official Ans. by NTA (1)

Sol. 1. $[\overset{+3}{Fe}(H_2O)_6]^{3+}$

Fe^{3+} : $[Ar]3d^5$

Hybridisation : sp^3d^2

Magnetic nature : Paramagnetic (so this complex response to external magnetic field)

2. $[Ni(CN)_4]^{2-}$

Ni^{2+} : $[Ar]3d^8$

Hybridisation : dsp^2

Magnetic nature : diamagnetic

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

Co^{3+} : $[Ar]3d^6$

Hybridisation : d^2sp^3

Magnetic nature : diamagnetic

4. $[Ni(CO)_4]$

Ni : $[Ar]\ 3d^8\ 4s^2$

Hybridisation : sp^3

Magnetic nature : diamagnetic

24. Official Ans. by NTA (0)

Sol. Mole of AgCl precipitated is equal the mole of Cl^- present in ionization sphere.

$[Cr(H_2O)_3(NH_3)_3]Cl_3 \rightarrow [Cr(H_2O)_3(NH_3)_3]^{3+} + 3Cl^-$

1 mole 1 mole 3 mole

$AgNO_3$ (Excess) $\downarrow$

AgCl (3mole)

Since none of Cl^- is present in the co-ordination sphere. Therefore answer is zero.

25. Official Ans. by NTA (2)

Sol. Complex $[Co(en)_3]Cl_2$ is most stable complex among the given complex compounds because more number of chelate rings are present in this complex as compare to others.

(1) $[Co(en)(NH_3)_4]Cl_2$ 1 chelate ring

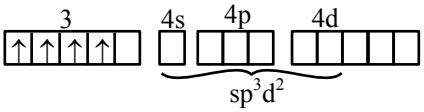
(2) $[Co(en)_3]Cl_2$ 3 chelate ring

(3) $[Co(en)_2(NH_3)_2]Cl_2$ 2 chelate ring

(4) $[Co(NH_3)_6]Cl_2$ 0 chelate ring

26. Official Ans. by NTA (4)

Sol. $[MnCl_6]^{3-}$

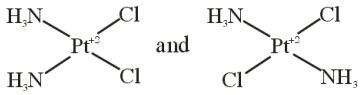
$Mn^{3+} \rightarrow [Ar]$ 

Paramagnetic and having 4 unpaired electrons.

27. Official Ans. by NTA (3)

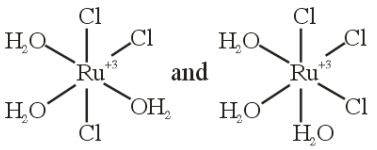
Sol.

$[PtCl_2(NH_3)_2]$

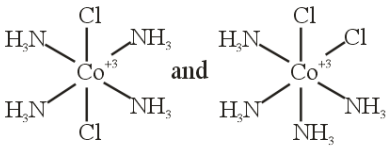
 and 2 Geometrical isomers

$[Ni(CO)_4]$ → All ligands are same — Zero Geometrical isomers

$[Ru(H_2O)_3Cl_3]$

 and 2 Geometrical isomers

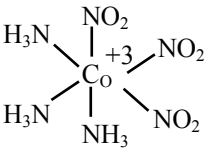
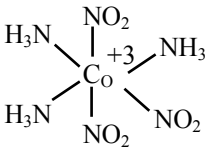
$[CoCl_2(NH_3)_4]^+$

 and 2 Geometrical isomers

28. Official Ans. by NTA (2)

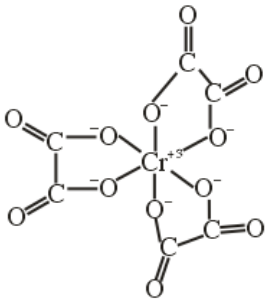
Sol. Triamminetrinitrocobalt(III) → $[Co(NO_2)_3(NH_3)_3]$

trioxalatochromate(III) ion → $[Cr(C_2O_4)_3]^{3-}$ $[Co(NO_2)_3(NH_3)_3]$

 & 

Two geometrical isomers (X)

$[Cr(C_2O_4)_3]^{3-}$



Zero geometrical isomer (Y)

X + Y = 2 + 0 = 2.0

29. Official Ans. by NTA (4)

Sol. $\left[Mn(CN)_6\right]^{3-}$ $\left[Fe(CN)_6\right]^{3-}$

$\left[Co(C_2O_4)_3\right]^{3-}$

⇓

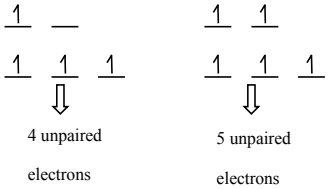
Mn^{3+} CN^- Fe^{3+}, CN^- Co3+, $C_2O_4^{2-}$

d^4 configuration, SFL d^5 configuration, SFL d^6 configuration, Chelating ligand

⇒ All will have larger splitting hence d^2sp^3 hybridisation

$\left[MnCl_6\right]^{3-}$ and $\left[FeF_6\right]^{3-}$

d^4 configuration, Cl^- WFL — d^5 configuration, F^- WFL



30. Official Ans. by NTA (6)

Sol. $3\left[Co(en)_2Cl_2\right]C\ell + AgNO_3 \underset{\text{(excess)}}{\rightarrow} 3AgCl \underset{\text{(white ppt.)}}{}$

Secondary valency of Co = 6 (C. N.)

31. Official Ans. by NTA (4)

Sol. (1) $[Fe(CN)_6]^{4-} \rightarrow$ Pale yellow solution
(2) $[Fe(SCN)_6]^{4-} \rightarrow$ Blood red colour
(3) $Fe_4[Fe(CN_6)]_3 \cdot H_2O \rightarrow$ Prussian blue
(4) $[Fe(CN)_5NOS]^{4-} \rightarrow$ Violet colour

32. Official Ans. by NTA (2)

Sol. (1) $[CoCl_2(en)_2]$ show
Cis-trans isomerism
(2) $[Co(CN)_5(NC)]^{-3}$ can't
Show G.I.
(3) $[Co(NH_3)_3(NO_2)_3]$
Show fac & mer isomerism
(4) $[Co(NH_3)_4Cl_2]^{\oplus}$ show cis & trans isomerism

33. Official Ans. by NTA (2)

Sol. (i) CFSE $\propto$ charge or oxidation no. of central metal ion.
(ii) CFSE $\propto$ strength of ligand
en > NH_3 > H_2O > F^-
$\therefore$ order of CFSE

$$[\overset{III}{Co}(en)_3]^{+3} > \overset{III}{Co}(NH_3)_6]^{+3} > [\overset{III}{CoF_6}]^{-3} > [\overset{II}{Co}(H_2O)_6]^{+2}$$

34. Official Ans. by NTA (2)

Sol. $MCl_3.2L$ octahedral

$$\underset{1\,mole}{MCl_3.2L} \xrightarrow{Ex.AgNO_3} 1\,mole\,of\,AgCl$$

Its means that one Cl^- ion present in ionization sphere.

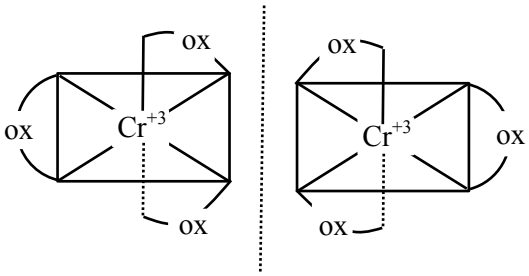
$\therefore$ formula = $[MCl_2L_2]Cl$

For octahedral complex coordination no. is 6

$\therefore$ L act as bidentate ligand

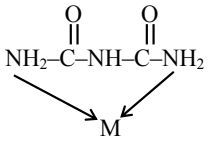
35. Official Ans. by NTA (2)

Sol. The number of optical isomers for $[Cr(C_2O_4)_3]^{3-}$ is two.



36. Official Ans. by NTA (1)

Sol.

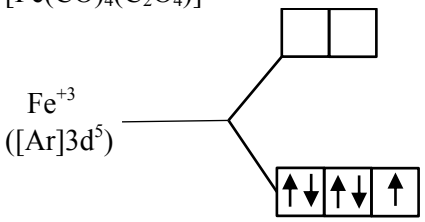


Biuret :- Bidentate ligand

The denticity of organic ligand is 2.

37. Official Ans. by NTA (4)

Sol. $[Fe(CO)_4(C_2O_4)]^+$



One unpaired electron
Spin only magnetic moment
$= \sqrt{3}$ B.M. $= 1.73$ BM

38. Official Ans. by NTA (4)

Sol. $V^{3+} \Rightarrow$ $\square\,\square_{e_g}$ $= 2 \times 0.4\ \Delta_0$

$1\,1\,\square_{t_{2g}}$ $= -0.8\ \Delta_0$

$= 2$ unpaired e^-

$\mu = 2.89$ Bm

$Co^{2+} \Rightarrow$ $1\,1_{e_g}$ $[2 \times 0.6\ \Delta_0 - 5 \times 0.4\ \Delta_0]$

$= -0.8\ \Delta_0$

$\overset{\downarrow\uparrow}{1}\,\overset{\downarrow\uparrow}{1}\,1_{t_{2g}}$ 3 unpaired $e^- \Rightarrow \mu = 3.87$ BM

hence d^7 configuration is of Co^{2+} Ans.

39. Official Ans. by NTA (2)

Sol. $\underset{+1}{[Ag(NH_3)_2]^+}$ $\underset{+1}{[Ag(CN)_2]^-}$