

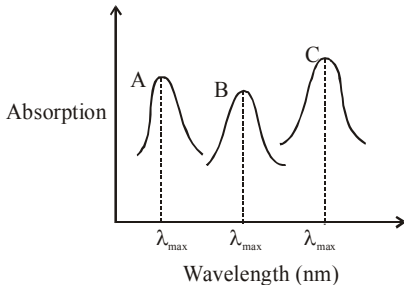
COORDINATION CHEMISTRY

- The theory that can completely/properly explain the nature of bonding in $[\text{Ni}(\text{CO})_4]$ is:
 - Werner's theory
 - Crystal field theory
 - Valence bond theory
 - Molecular orbital theory
- The IUPAC name of the complex $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{NH}_2\text{CH}_3)]\text{Cl}$ is :
 - Diammine (methanamine) chlorido platinum (II) chloride
 - Bisammine (methanamine) chlorido platinum (II) chloride
 - Diamminechlorido (aminomethane) platinum(II) chloride
 - Diamminechlorido (methanamine) platinum (II) chloride
- Among the statements(a)-(d), the incorrect ones are-
 - Octahedral Co(III) complexes with strong field ligands have very high magnetic moments
 - When $\Delta_0 < P$, the d-electron configuration of Co(III) in an octahedral complex is $t_{eg}^4 e_g^2$
 - Wavelength of light absorbed by $[\text{Co}(\text{en})_3]^{3+}$ is lower than that of $[\text{CoF}_6]^{3-}$
 - If the Δ_0 for an octahedral complex of Co(III) is $18,000 \text{ cm}^{-1}$, the Δ_t for its tetrahedral complex with the same ligand will be $16,000 \text{ cm}^{-1}$
 - (a) and (b) only
 - (c) and (d) only
 - (b) and (c) only
 - (a) and (d) only
- The number of possible optical isomers for the complexes MA_2B_2 with sp^3 and dsp^2 hybridised metal atom, respectively, is :

Note : A and B are unidentate neutral and unidentate monoanionic ligands, respectively

 - 0 and 0
 - 0 and 2
 - 0 and 1
 - 2 and 2
- The complex that can show fac-and mer-isomers is :
 - $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$
 - $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$
 - $[\text{Co}(\text{NH}_3)_3(\text{NO}_2)_3]$
 - $[\text{CoCl}_2(\text{en})_2]$
- The volume (in mL) of 0.125 M AgNO_3 required to quantitatively precipitate chloride ions in 0.3 g of $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ is _____.
 $^M[\text{Co}(\text{NH}_3)_6]\text{Cl}_3 = 267.46 \text{ g/mol}$
 $^M\text{AgNO}_3 = 169.87 \text{ g/mol}$
- Among (a) – (d) the complexes that can display geometrical isomerism are :
 - $[\text{Pt}(\text{NH}_3)_3\text{Cl}]^+$
 - $[\text{Pt}(\text{NH}_3)\text{Cl}_5]^-$
 - $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{NO}_2)]$
 - $[\text{Pt}(\text{NH}_3)_4\text{ClBr}]^{2+}$
 - (d) and (a)
 - (a) and (b)
 - (b) and (c)
 - (c) and (d)
- The correct order of the calculated spin-only magnetic moments of complexes (A) to (D) is:
 - $\text{Ni}(\text{CO})_4$
 - $[\text{Ni}(\text{H}_2\text{O})_6]\text{Cl}_2$
 - $\text{Na}_2[\text{Ni}(\text{CN})_4]$
 - $\text{PdCl}_2(\text{PPh}_3)_2$
 - (A) \approx (C) \approx (D) < (B)
 - (A) \approx (C) < (B) \approx (D)
 - (C) < (D) < (B) < (A)
 - (C) \approx (D) < (B) < (A)
- Complexes (ML_5) of metals Ni and Fe have ideal square pyramidal and trigonal bipyramidal geometries, respectively. The sum of the 90° , 120° and 180° L-M L angles in the two complexes is _____.
 - 2.84 BM and $-1.6 \Delta_0$
 - 1.73 BM and $-2.0 \Delta_0$
 - 0 BM and $-2.4 \Delta_0$
 - 5.92 BM and 0
- Complex X of composition $\text{Cr}(\text{H}_2\text{O})_6\text{Cl}_n$ has a spin only magnetic moment of 3.83 BM. It reacts with AgNO_3 and shows geometrical isomerism. The IUPAC nomenclature of X is:
 - Tetraaquadichlorido chromium (III) chloride dihydrate
 - Hexaaqua chromium (III) chloride
 - Dichloridotetraqua chromium (IV) chloride dihydrate
 - Tetraaquadichlorido chromium(IV) chloride dihydrate

12. The correct order of the spin-only magnetic moments of the following complexes is :
- (I) $[\text{Cr}(\text{H}_2\text{O})_6]\text{Br}_2$
 (II) $\text{Na}_4[\text{Fe}(\text{CN})_6]$
 (III) $\text{Na}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$ ($\Delta_0 > P$)
 (IV) $(\text{Et}_4\text{N})_2[\text{CoCl}_4]$
- (1) (III) > (I) > (II) > (IV)
 (2) (I) > (IV) > (III) > (II)
 (3) (II) \approx (I) > (IV) > (III)
 (4) (III) > (I) > (IV) > (II)
13. The isomer(s) of $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]$ that has/have a Cl–Co–Cl angle of 90° , is/are :
- (1) meridional and trans
 (2) cis and trans
 (3) trans only
 (4) cis only
14. The species that has a spin only magnetic moment of 5.9 BM, is -
- (1) $\text{Ni}(\text{CO})_4(\text{T}_d)$
 (2) $[\text{MnBr}_4]^{2-}(\text{T}_d)$
 (3) $[\text{NiCl}_4]^{2-}(\text{T}_d)$
 (4) $[\text{Ni}(\text{CN})_4]^{2-}$ (square planar)
15. For a d^4 metal ion in an octahedral field, the correct electronic configuration is :
- (1) $t_{2g}^4 e_g^0$ when $\Delta_0 < P$
 (2) $e_g^2 t_{2g}^2$ when $\Delta_0 < P$
 (3) $t_{2g}^3 e_g^1$ when $\Delta_0 < P$
 (4) $t_{2g}^3 e_g^1$ when $\Delta_0 > P$
16. Considering that $\Delta_0 > P$, the magnetic moment (in BM) of $[\text{Ru}(\text{H}_2\text{O})_6]^{2+}$ would be _____ .
17. Consider the complex ions, *trans*- $[\text{Co}(\text{en})_2\text{Cl}_2]^+$ (A) and *cis*- $[\text{Co}(\text{en})_2\text{Cl}_2]^+$ (B). The correct statement regarding them is :
- (1) both (A) and (B) can be optically active
 (2) both (A) and (B) cannot be optically active
 (3) (A) can be optically active, but (B) cannot be optically active
 (4) (A) cannot be optically active, but (B) can be optically active
18. The total number of coordination sites in ethylenediaminetetraacetate (EDTA^{4-}) is _____.
19. The values of the crystal field stabilization energies for a high spin d^6 metal ion in octahedral and tetrahedral fields, respectively, are :
- (1) $-0.4 \Delta_0$ and $-0.27 \Delta_t$
 (2) $-1.6 \Delta_0$ and $-0.4 \Delta_t$
 (3) $-0.4 \Delta_0$ and $-0.6 \Delta_t$
 (4) $-2.4 \Delta_0$ and $-0.6 \Delta_t$
20. The molecule in which hybrid MOs involve only one d-orbital of the central atom is :-
- (1) $[\text{Ni}(\text{CN})_4]^{2-}$ (2) $[\text{CrF}_6]^{3-}$
 (3) BrF_5 (4) XeF_4
21. The one that can exhibit highest paramagnetic behaviour among the following is :-
 gly = glycinate; bpy = 2, 2'-bipyridine
- (1) $[\text{Pd}(\text{gly})_2]$
 (2) $[\text{Ti}(\text{NH}_3)_6]^{3+}$
 (3) $[\text{Co}(\text{OX})_2(\text{OH})_2]^-$ ($\Delta_0 > P$)
 (4) $[\text{Fe}(\text{en})(\text{bpy})(\text{NH}_3)_2]^{2+}$
22. The crystal Field stabilization Energy (CFSE) of $[\text{CoF}_3(\text{H}_2\text{O})_3]$ ($\Delta_0 < P$) is :-
- (1) $-0.8 \Delta_0$
 (2) $-0.4 \Delta_0 + P$
 (3) $-0.8 \Delta_0 + 2P$
 (4) $-0.4 \Delta_0$
23. The pair in which both the species have the same magnetic moment (spin only) is :
- (1) $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{Cr}(\text{H}_2\text{O})]^{2+}$
 (2) $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{CoCl}_4]^{2-}$
 (3) $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$
 (4) $[\text{Co}(\text{OH})_4]^{2-}$ and $[\text{Fe}(\text{NH}_3)_6]^{2+}$
24. The number of isomers possible for $[\text{Pt}(\text{en})(\text{NO}_2)_2]$ is :
- (1) 3 (2) 2
 (3) 1 (4) 4

25. Complex A has a composition of $H_{12}O_6Cl_3Cr$. If the complex on treatment with conc. H_2SO_4 loses 13.5% of its original mass, the correct molecular formula of A is :
[Given : atomic mass of Cr = 52 amu and Cl = 35 amu]
- (1) $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$
 - (2) $[Cr(H_2O)_3Cl_3] \cdot 3H_2O$
 - (3) $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$
 - (4) $[Cr(H_2O)_6]Cl_3$
26. The d-electron configuration of $[Ru(en)_3]Cl_2$ and $[Fe(H_2O)_6]Cl_2$, respectively are :
- (1) $t_{2g}^4 e_g^2$ and $t_{2g}^6 e_g^0$
 - (2) $t_{2g}^6 e_g^0$ and $t_{2g}^6 e_g^0$
 - (3) $t_{2g}^6 e_g^0$ and $t_{2g}^4 e_g^2$
 - (4) $t_{2g}^4 e_g^2$ and $t_{2g}^4 e_g^2$
27. The electronic spectrum of $[Ti(H_2O)_6]^{3+}$ shows a single broad peak with a maximum at $20,300\text{ cm}^{-1}$. The crystal field stabilization energy (CFSE) of the complex ion, in kJ mol^{-1} , is :
- (1) 242.5
 - (2) 83.7
 - (3) 145.5
 - (4) 97
28. The complex that can show optical activity is:
- (1) $\text{trans}-[Fe(NH_3)_2(CN)_4]^-$
 - (2) $\text{cis}-[Fe(NH_3)_2(CN)_4]^-$
 - (3) $\text{cis}-[CrCl_2(ox)_2]^{3-}$ (ox = oxalate)
 - (4) $\text{trans}-[Cr(Cl_2)(ox)_2]^{3-}$
29. The one that is not expected to show isomerism is :
- (1) $[Ni(NH_3)_4(H_2O)_2]^{2+}$
 - (2) $[Ni(NH_3)_2Cl_2]$
 - (3) $[Pt(NH_3)_2Cl_2]$
 - (4) $[Ni(en)_3]^{2+}$
30. For octahedral Mn(II) and tetrahedral Ni(II) complexes, consider the following statements:
(I) both the complexes can be high spin
(II) Ni(II) complex can very rarely be low spin.
(III) with strong field ligands, Mn(II) complexes can be low spin.
(IV) aqueous solution of Mn(II) ions is yellow in color.
The correct statements are :
- (1) (I), (III) and (IV) only
 - (2) (II), (III) and (IV) only
 - (3) (I), (II) and (III) only
 - (4) (I) and (II) only
31. Consider that a d^6 metal ion (M^{2+}) forms a complex with aqua ligands, and the spin only magnetic moment of the complex is 4.90 BM. The geometry and the crystal field stabilization energy of the complex is :
- (1) tetrahedral and $-1.6 \Delta_t + 1P$
 - (2) tetrahedral and $-0.6 \Delta_t$
 - (3) octahedral and $-1.6 \Delta_0$
 - (4) octahedral and $-2.4 \Delta_0 + 2P$
32. The oxidation states of iron atoms in compounds (A), (B) and (C), respectively, are x, y and z. The sum of x, y and z is ____.
- $Na_4[Fe(CN)_5NOS]$ $Na_4[FeO_4]$ $[Fe_2(CO)_9]$
(A) (B) (C)
33. Simplified absorption spectra of three complexes (i), (ii) and (iii) of M^{n+} ion are provided below; their λ_{max} values are marked as A, B and C respectively. The correct match between the complexes and their λ_{max} values is :
- 
- (i) $[M(NCS)_6]^{(-6+n)}$
 - (ii) $[MF_6]^{(-6+n)}$
 - (iii) $[M(NH_3)_6]^{n+}$
- (1) A-(ii), B-(i), C-(iii)
 - (2) A-(iii), B-(i), C-(ii)
 - (3) A-(ii), B-(iii), C-(i)
 - (4) A-(i), B-(ii), C-(iii)

SOLUTION

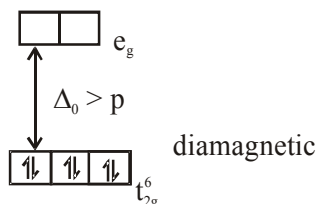
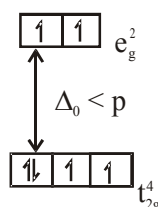
1. NTA Ans. (4)

Sol. In complex $[\text{Ni}(\text{CO})_4]$ decrease in Ni–C bond length and increase in C–O bond length as well as its magnetic property is explained by MOT.

2. NTA Ans. (4)

3. NTA Ans. (4)

Sol. (a) Co^{3+} (with strong field ligands)

(b) If $\Delta_0 < p$;

(c) Splitting power of ethylenediamine (en) is greater than fluoride (F^-) ligand therefore more energy absorbed by $[\text{Co}(\text{en})_3]^{3+}$ as compared to $[\text{CoF}_6]^{3-}$.

So wave length of light absorbed by $[\text{Co}(\text{en})_3]^{3+}$ is lower than that of $[\text{CoF}_6]^{3-}$

$$(d) \Delta_t = \frac{4}{9} \Delta_0$$

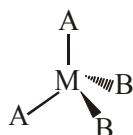
so if $\Delta_0 = 18,000 \text{ cm}^{-1}$

$$\Delta_t = \frac{4}{9} \times 18000 = 8000 \text{ cm}^{-1}$$

Statement (a) and (d) are incorrect.

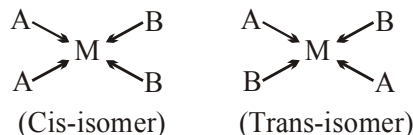
4. NTA Ans. (1)

Sol. (a) If the complex MA_2B_2 is sp^3 hybridised then the shape of this complex is tetrahedral this structure is optically inactive due to the presence of plane of symmetry.



Optical isomers = 0

(b) If the complex MA_2B_2 is dsp^2 hybridised then the shape of this complex is square planar.

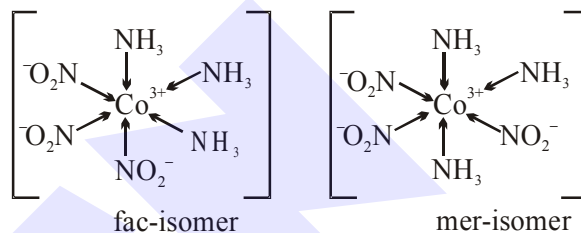
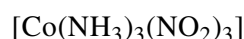


Both isomers are optically inactive due to the presence of plane of symmetry.

Optical isomers = 0

5. NTA Ans. (3)

Sol. $[\text{Ma}_3\text{b}_3]$ type complex shows fac and mer isomerism.



6. NTA Ans. (26.60 to 27.00)

Sol. Number of moles of Cl^- precipitated in $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$ is equal to number of moles of AgNO_3 used.

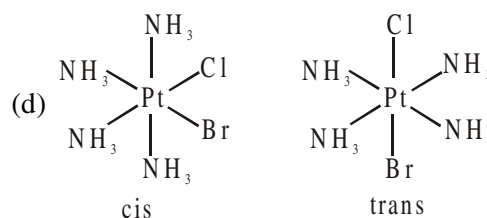
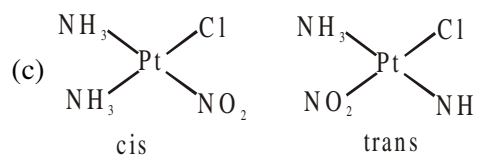
$$\frac{0.3}{267.46} \times 3 = \frac{0.125 \times V}{1000}$$

where V is volume of AgNO_3 (in mL)

$$V = 26.92 \text{ mL}$$

7. NTA Ans. (4)

Sol. $[\text{Pt}(\text{NH}_3)_3\text{Cl}]^+$ & $[\text{Pt}(\text{NH}_3)\text{Cl}_5]^-$ does not show geometrical isomerism



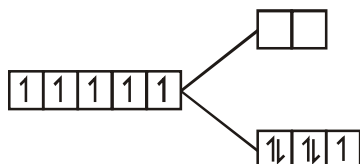
8. NTA Ans. (1)

Sol. $[\text{Ni}(\text{CO})_4]$ $\mu_m = 0 \text{ B.M.}$
 $[\text{Ni}(\text{H}_2\text{O})_6]\text{Cl}_2$ $\mu_m = 2.8 \text{ B.M.}$
 $\text{Na}_2[\text{Ni}(\text{CN})_4]$ $\mu_m = 0 \text{ B.M.}$
 $[\text{PdCl}_2(\text{PPh}_3)_2]$ $\mu_m = 0 \text{ B.M.}$
 $A \approx C \approx D < B$

9. NTA Ans. (20)

10. NTA Ans. (2)

Sol. $[\text{Pb}(\text{F})(\text{Cl})(\text{Br})(\text{I})]^{2-}$ have three geometrical isomer so formula for $[\text{Fe}(\text{CN})_6]^{n-6}$ is $[\text{Fe}(\text{CN})_6]^{3-}$ and CFSE for this complex is $\text{Fe}^{3+} \Rightarrow 3d^5 4s^0$



$$\text{Magnetic Moment} = \sqrt{3} = 1.73 \text{ B.M}$$

$$\text{CFSE} = [(-0.4 \times 5) + (0.6 \times 0)] \Delta_0 = -2.0 \Delta_0$$

11. NTA Ans. (1)

Sol. $\text{Cr}(\text{H}_2\text{O})_6 \text{Cl}_n$

if magnetic moment is 3.83 BM then it contain three unpaired electrons. It means chromium in +3 oxidation state so molecular formula is $\text{Cr}(\text{H}_2\text{O})_6 \text{Cl}_3$

\therefore This formula have following isomers

(a) $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$: react with AgNO_3 but does not show geometrical isomerism.

(b) $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2 \cdot \text{H}_2\text{O}$ react with AgNO_3 but does not show geometrical isomerism.

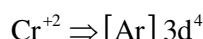
(c) $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl} \cdot 2\text{H}_2\text{O}$ react with AgNO_3 & show geometrical isomerism.

(d) $[\text{Cr}(\text{H}_2\text{O})_3\text{Cl}_3] \cdot 3\text{H}_2\text{O}$ does not react with AgNO_3 & show geometrical isomerism.

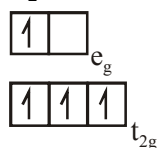
$[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl} \cdot 2\text{H}_2\text{O}$ react with AgNO_3 & show geometrical isomerism and it's IUPAC nomenclature is Tetraaquadichlorido chromium (III) Chloride dihydrate.

12. NTA Ans. (2)

Sol. I $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$



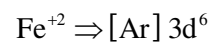
$\text{H}_2\text{O} \rightarrow$ Weak field ligand



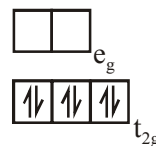
Unpaired $e^- = 4$

$$\text{Magnetic moment} = \sqrt{24} \text{ BM} = 4.89 \text{ BM}$$

II $[\text{Fe}(\text{CN})_6]^{4-}$



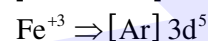
$\text{CN}^- \rightarrow$ Strong field ligand



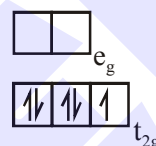
Unpaired $e^- = 0$

$$\text{Magnetic moment} = 0 \text{ BM} = 0 \text{ BM}$$

III $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$



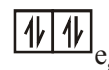
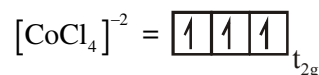
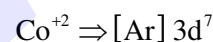
As $\Delta_0 > P$



Unpaired $e^- = 1$

$$\text{Magnetic moment} = \sqrt{3} \text{ BM} = 1.73 \text{ BM}$$

IV $(\text{Et}_4\text{N})^+ [\text{CoCl}_4]^{2-}$



Unpaired electrons = 3

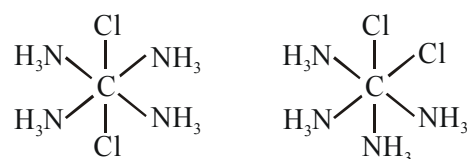
$$\text{Magnetic moment} = \sqrt{15} \text{ BM} = 3.87 \text{ BM}$$

Hence order of magnetic moment is

I > IV > III > II

13. NTA Ans. (4)

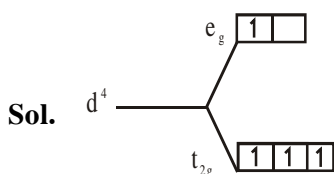
Sol. $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]$ has 2 geometrical isomers



trans
cis isomer has $\text{Cl}-\text{Co}-\text{Cl}$ angle of 90°

14. Official Ans. by NTA (2)

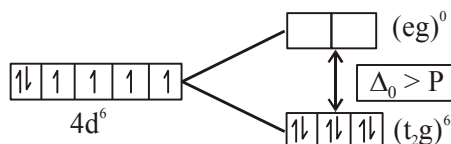
15. Official Ans. by NTA (3)



back pairing is not possible because pairing energy $> \Delta_0$.

16. Official Ans. by NTA (00)

Sol. Magnetic moment (in B.M.) of $[\text{Ru}(\text{H}_2\text{O})_6]^{2+}$ would be; while considering that $\Delta_0 > P$, $\text{Ru}_{(44)}$; $[\text{Kr}]4d^75s^1$ (in ground state)
 \Rightarrow In $\text{Ru}^{2+} \Rightarrow 4d^6 \Rightarrow (t_{2g})^6(eg)^0$

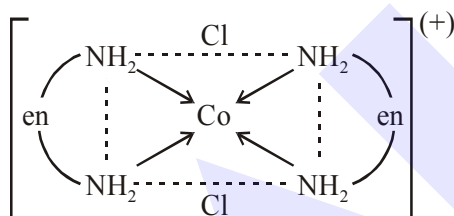


\Rightarrow Here number of unpaired electrons in $\text{Ru}^{2+} = (t_{2g})^6(eg)^0 = 0$ and Hence

$$\mu_m = \sqrt{n(n+2)} \text{B.M.} = \boxed{0 \text{ B.M.}}$$

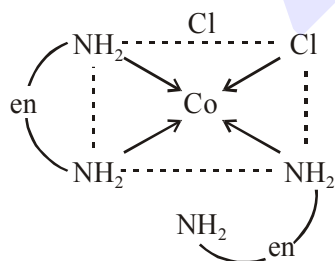
17. Official Ans. by NTA (4)

Sol. (A) *trans*- $[\text{Co}(\text{en})_2\text{Cl}_2]^+$



\Rightarrow (A) is trans form and shows plane of symmetry which is optically inactive (not optically active)

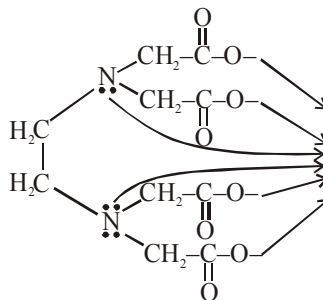
(B) *cis*- $[\text{Co}(\text{en})_2\text{Cl}_2]^+$



\Rightarrow (B) is cis form and does not show plane of symmetry, hence it is optically active.

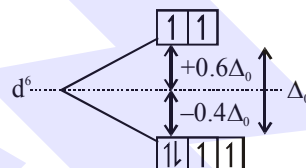
18. Official Ans. by NTA (6)

Sol. EDTA^{4-} is hexadentate ligand, so its donation sites are six.



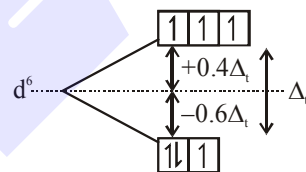
19. Official Ans. by NTA (3)

Sol. For high spin octahedral field



$$\text{CFSE} = (4)(-0.4\Delta_0) + 2(0.6\Delta_0) = -0.4\Delta_0$$

For high spin tetrahedral field



$$\text{CFSE} = 3(-0.6\Delta_t) + 3(0.4\Delta_t) = -0.6\Delta_t$$

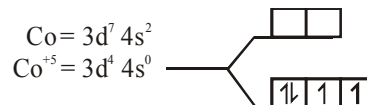
20. Official Ans. by NTA (1)

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

dsp^2 hybridisation.

21. Official Ans. by NTA (3)

Sol. $[\text{Co}(\text{OX})_2(\text{OH})_2]^-$ $\Delta_0 > P$ [S.F.L.]



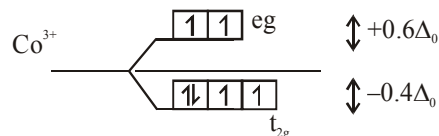
It has highest number of unpaired e-s. so it is most paramagnetic.

22. Official Ans. by NTA (4)

Official Ans. by ALLEN (2, 4)

Sol. $[\text{CoF}_3(\text{H}_2\text{O})_3]$ $\Delta_0 < P$

Means all ligands behaves as weak field ligands



$$= [-0.4 \times 4 + 0.6 \times 2] \Delta_0$$

$$= [-1.6 + 1.2] \Delta_0$$

$$= [-0.4 \Delta_0]$$

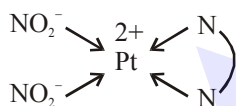
23. Official Ans. by NTA (3)

Sol.	Complex	e ⁻ configuration	no. of unpaired e ⁻
	[Mn(H ₂ O) ₆] ²⁺	$\uparrow\uparrow$ eg	5
	WFL	$\uparrow\uparrow\uparrow\uparrow$ t _{2g}	
	[Cr(H ₂ O) ₆] ²⁺	\uparrow eg	4
	WFL	$\uparrow\uparrow\uparrow$	
	[CoCl ₄] ²⁻	$\uparrow\uparrow\uparrow$ t ₂	3
	Tetrahedral	$\uparrow\downarrow\uparrow\downarrow$ e	
	[Fe(H ₂ O) ₆] ²⁺	$\uparrow\uparrow$ eg	4
	WFL	$\uparrow\downarrow\uparrow\downarrow$ t _{2g}	
	[Co(OH) ₄] ²⁻	$\uparrow\uparrow\uparrow$ t ₂	3
	WFL	$\uparrow\downarrow\uparrow\downarrow$ e	
	Tetrahedral	$\uparrow\uparrow$	4
	[Fe(NH ₃) ₆] ²⁺	$\uparrow\downarrow\uparrow\downarrow$	

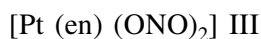
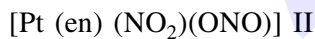
Thus complex [Cr(H₂O)₆]²⁺ and [Fe(H₂O)₆]²⁺ have same no. of unpaired e⁻ and hence same magnetic moment (spin only).

24. Official Ans. by NTA (1)

Sol. [Pt(en)(NO₂)₂] ⇒ does not show G.I. as well as optical isomerism.



This complex will have three linkage isomers as follows :-



25. Official Ans. by NTA (3)

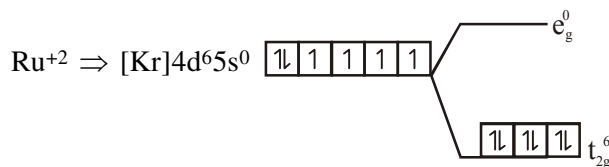
Sol. % mass of water

$$= \frac{x \times 18}{(12 + 6 \times 16 + 35 \times 3 + 52)} \times 100 = 13.5$$

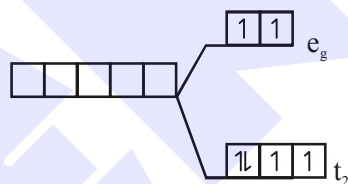
$$\Rightarrow x = \frac{265 \times 13.5}{18 \times 100} \approx 2$$

26. Official Ans. by NTA (3)

Sol. [Ru(en)₃]Cl₂ Ru ⇒ 4d series
en ⇒ chelating ligand
CN = 6, octahedral splitting hence large splitting of d-subshell



[Fe(H₂O)₆]Cl₂ ⇒ H₂O ⇒ Weak filled ligand
Fe²⁺ ⇒ [Ar] 3d⁶4s⁰
less splitting
CN = 6 octahedral splitting



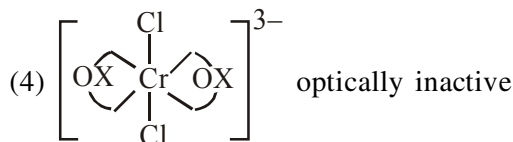
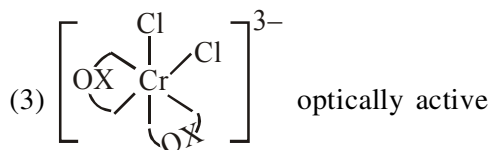
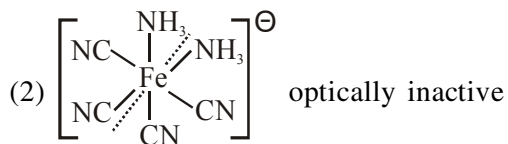
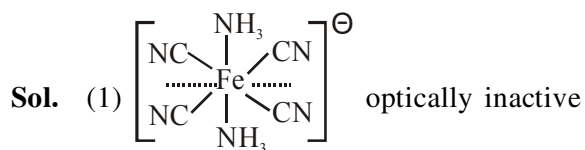
27. Official Ans. by NTA (4)

Sol. CFSE = 0.4 Δ₀

$$= 0.4 \times \frac{20300}{83.7}$$

$$= 97 \text{ kJ/mol}$$

28. Official Ans. by NTA (3)



29. Official Ans. by NTA (2)

Sol. $[\text{Ni}(\text{NH}_3)_2\text{Cl}_2]$ is tetrahedral complex, therefore does not show geometrical and optical isomerism.

$[\text{Ni}(\text{NH}_3)_2\text{Cl}_2]$ does not show structural isomerism

$[\text{Ni}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$ & $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ show geometrical isomerism

$[\text{Ni}(\text{en})_3]^{2+}$ show optical isomerism

30. Official Ans. by NTA (3)

Sol. (I) Under weak field ligand, octahedral Mn(II) and tetrahedral Ni(II) both the complexes are high spin complex.

(II) Tetrahedral Ni(II) complex can very rarely be low spin because square planar (under strong ligand) complexes of Ni(II) are low spin complexes.

(III) With strong field ligands Mn(II) complexes can be low spin because they have less number of unpaired electron (unpaired electron = 1)

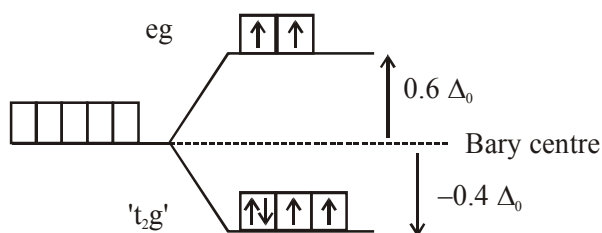
While with weak field ligands Mn(II) complexes can be high spin because they have more number of unpaired electron (unpaired electron = 5)

(IV) Aqueous solution of Mn(II) ions is pink in colour.

31. Official Ans. by NTA (2)

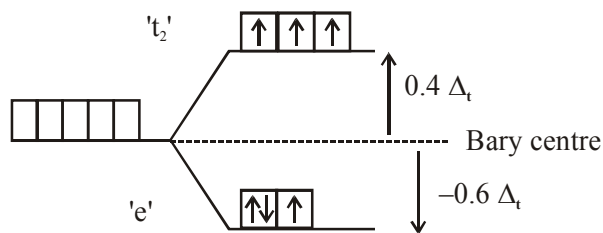
Sol. If spin only magnetic moment of the complex is 4.90 BM, it means number of unpaired electrons should be 4.

(A) In octahedral complex : $[\text{M}(\text{H}_2\text{O})_6]^{2+}$
 d^6



$$\text{C.F.S.E.} = (-0.4 \Delta_0) \times 4 + (+0.6 \Delta_0) \times 2 + 0 \times P = -0.4 \Delta_0$$

(B) In tetrahedral complex : $[\text{M}(\text{H}_2\text{O})_4]^{2+}$
 d^6



$$\text{C.F.S.E.} = (-0.6 \Delta_t) \times 3 + (+0.4 \Delta_t) \times 3 + 0 \times P = -0.6 \Delta_t$$

32. Official Ans. by NTA (6)

Sol. (A) $\text{Na}_4[\text{Fe}(\text{CN})_5(\text{NOS})]$
 $(+1)4 + x + (-1)5 + (-1)1 = 0$

$$x = +2$$

(B) $\text{Na}_4[\text{FeO}_4]$
 $(+1)4 + y + (-2)4 = 0$

$$y = +4$$

(C) $[\text{Fe}_2(\text{CO})_9]$

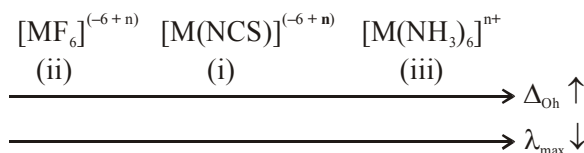
$$2z + 0 \times 9 = 0$$

$$z = 0$$

$$\text{so } (x + y + z) = +2 + 4 + 0 = 6$$

33. Official Ans. by NTA (2)

Sol. Strength of ligand $\text{F}^- < \text{NCS}^- < \text{NH}_3$



As given in graph : $A < B < C$ (λ_{max})

∴ Correct matching is A-(iii), B-(i), C-(ii)