SOLUTION TEST-A

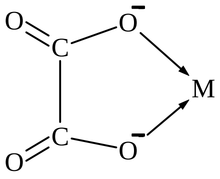
1. $[Co(NH_3)_6]^{3+}$ d^2sp^3, $t_{2g^6}\ e_g^{\,o}$ no unpaired electron

$[Cr(CN)_6]^{3-}$ d^2sp^3, $t_{2g^3}\ e_g^{\,o}$ three unpaired electron

$[Fe(CN)_6]^{3-}$ d^2sp^3, $t_{2g^5}\ e_g^{\,o}$ one unpaired electron

$[Fe(en)_3]^{3+}$ d^2sp^3 $t_{2g^5}\ e_g^{\,o}$ one unpaired electron

The correct answer is (i)

2. $C_2O_4^{2-}$  is a didentate ligand.

The correct answer is (iii)

3. $$\underset{\text{Cation}}{Fe^{2+}} \quad \underset{\text{Anion}}{[Fe(CN)_6]^{3-}} \longrightarrow \overset{II}{Fe_3}[\overset{III}{Fe}(CN)_6]_2$$

The correct answer is (iv)

4. All Cr^{3+} ion octahedral complexes are paramagnetic with three unpaired electrons and $t_{2g}3$ electronic configuration irrespective of the ligand present.

The correct answer is (iv)

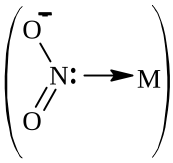
5. $Ni(CO)_4$ and $[Co(CO)_4]^-$ are isoelectronic, isostructural with metal sp^3 hybridised and both the complexes are diamagnetic. Also both these complexes have metal-CO back bonding.

The correct answer is (ii)

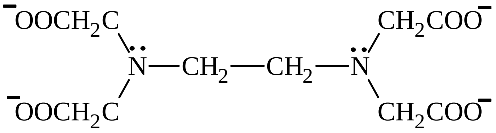
6. Pentaamminesulphatochromium (III) bromide.

7. It is a series in which the ligands have been arranged in order of their increasing ligand field strength or crystal field stabilisation energy.

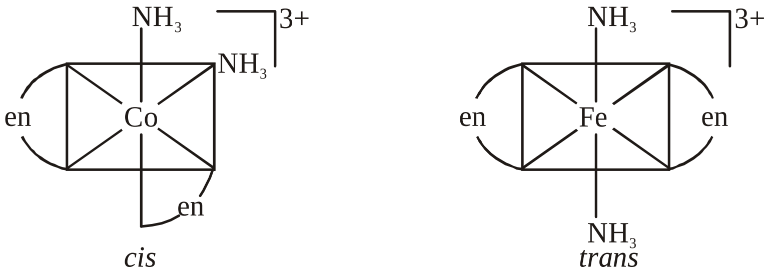
8. (i) Ligands having the same molecular formula but different atoms through which the coordinate bond is being formed with the metal are called ambident ligands.

Examples: nitrito-O ($ONO^- \rightarrow M$) and nitrito-N 

(ii) Ethylenediaminetetracetato

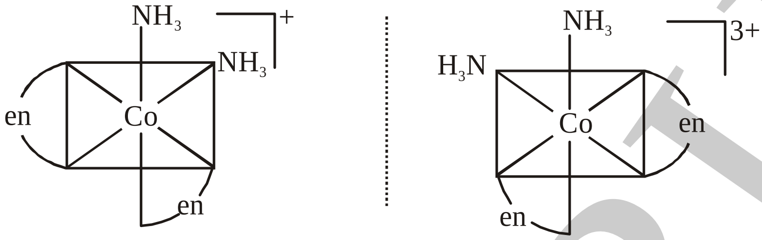


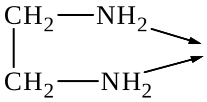
9. $[Co(NH_3)_2(en)_2]^{3+}$



cis *trans*

The cis isomer also shows optional isomerism



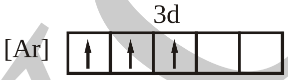
where en = 

10. (i) $Na_2\,[Zn\,(CN)_4]$

(ii)

	Primary Valencies		Secondary Valencies
•	These are ionizable	•	These are non-ionizable
•	These are satisfied by anions.	•	These are satisfied by ligand
•	These are variable	•	These are fixed
•	These valencies determine the charge on the complex	•	These valencies determines the coordination number and the geometry

11. (i) $\overset{(III)}{[Cr(H_2O)_6]^{3+}}$ $Cr^{3+} : [Ar]3d^3$

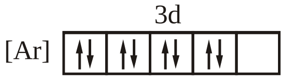


$\mu = \sqrt{n(n+2)}$

$\mu = \sqrt{3(3+2)} = \sqrt{15} = 3.87\ \text{BM}$

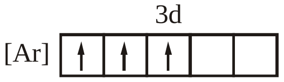
Geometry : Octahedral

(ii) $\overset{(II)}{[Ni(CN)_4]^{2+}}$ $Ni^{2+} = [Ar]3d^8$ [CN⁻ is a strong field ligand]



$\mu = 0$ (no unpaired e⁻)

(iii) $\overset{(III)}{[Cr(CN)_6]^{3-}}$ $Cr^{3+} : [Ar]3d^3$



$\mu = \sqrt{3(3+2)} = \sqrt{15} = 3.87\ \text{BM}$

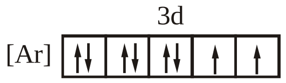
Geometry : Octahedral

12. (i) 'en' or ethane-1, 2-diamine is a didentate ligand and results in the formation of cyclic complex called **chelate** $[Co(en)_3]^{3+}$ while $[Co(NH_3)]^{3+}$ is an open complex. Hence, $[Co(en)_3]^{3+}$ is more stable than $[Co(NH_3)_6]^{3+}$.

(ii) In $[Sc(H_2O)_6]^{3+}$, Sc^{3+} has an electronic configuration of $[Ar]3d^0$. Due to the absence of any unpaired e^-, the $[Sc(H_2O)_6]^{3+}$ is repelled by magnetic field.

(iii) $[Pt(NH_3)_6]Cl_4$ has more number of primary valencies and gives more number of ions in solution than $[Pt(NH_3)_4]Cl_2$. Hence, $[Pt(NH_3)_6]Cl_4$ is more electrically conducting than $[Pt(NH_3)_4]Cl_2$.

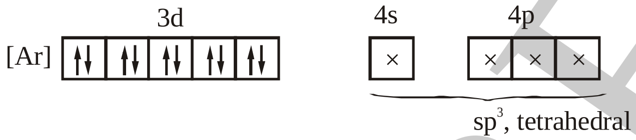
13. (i) $[NiCl_4]^{2-}$ Ni^{2+}: $[Ar]3d^8$



Ni → sp^3, tetrahedral

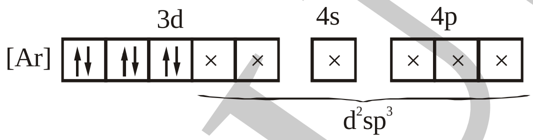
Due to the presence of two unpaired electrons, $[NiCl_4]^{2-}$ is paramagnetic. In $Ni(CO)_4$, a CO is a strong field ligand, all electron are pair up and no unpaired electron left. Hence, $Ni(CO)_4$ is diamagnetic

$Ni(CO)_4$, Ni^0: [Ar] $3d^8$ $4s^2$.



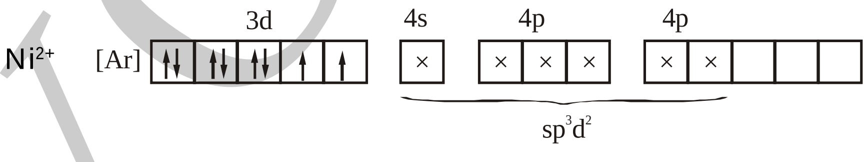
(ii) Due to high charge density of Co^{3+} and strong field nature of NH_3, all six electron in Co^{3+} will pair up to give t_{2g}^{6} and form an inner orbital complex with hybridisation d^2sp^3.

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

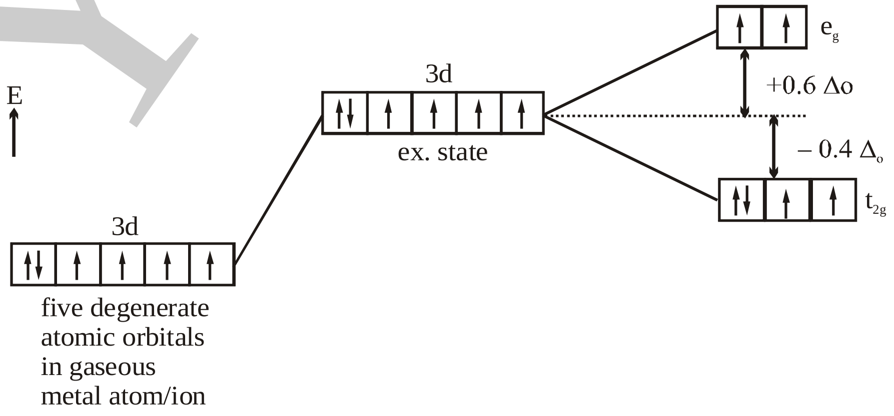


In $[Ni(NH_3)_6]^{2+}$ Ni^{2+}: $[Ar]3d^8$

Due to less charge density of Ni^{2+}, the two elecron remains unpaired in 3d and Ni uses all orbitals from the outer shell, hence outer orbital complex,

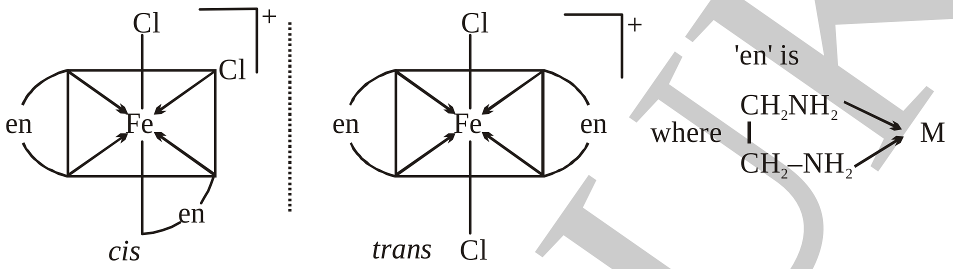


14. (a)



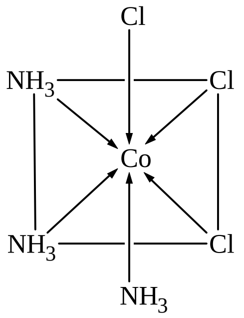
(b) Crystal field splitting energy depends on
  (i) nature of the ligand
  (ii) nature of the metal atom i.e. its charge to radius ratio.

10. (a) (i) Dichloridobis (ethane-1, 2-diamine) iron (III)
  (ii) d^2sp^3
  (iii) Octahedral
  (iv) attracted by magnetic field
  (v)

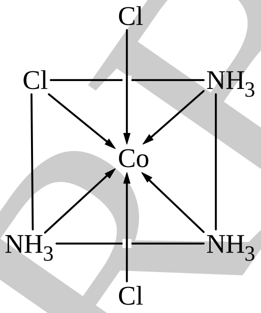


  (vi) Yes, complex will slow optical isomerism

(b)



Facial



Meridional