

**COORDINATION COMPOUND**

- The metal d-orbitals that are directly facing the ligands in  $K_3[Co(CN)_6]$  are :
  - $d_{xz}$ ,  $d_{yz}$  and  $d_{z^2}$
  - $d_{xy}$ ,  $d_{xz}$  and  $d_{yz}$
  - $d_{xy}$  and  $d_{x^2-y^2}$
  - $d_{x^2-y^2}$  and  $d_{z^2}$
- $Mn_2(CO)_{10}$  is an organometallic compound due to the presence of :
  - Mn – Mn bond
  - Mn – C bond
  - Mn – O bond
  - C – O bond
- The pair of metal ions that can give a spin only magnetic moment of 3.9 BM for the complex  $[M(H_2O)_6]Cl_2$ , is :
  - $Cr^{2+}$  and  $Mn^{2+}$
  - $V^{2+}$  and  $Co^{2+}$
  - $V^{2+}$  and  $Fe^{2+}$
  - $Co^{2+}$  and  $Fe^{2+}$
- The magnetic moment of an octahedral homoleptic Mn(II) complex is 5.9 BM. The suitable ligand for this complex is :
  - $CN^-$
  - $NCS^-$
  - CO
  - ethylenediamine
- The coordination number of Th in  $K_4[Th(C_2O_4)_4(OH_2)_2]$  is :-  
( $C_2O_4^{2-}$  = Oxalato)
  - 6
  - 10
  - 14
  - 8
- The number of bridging CO ligand (s) and Co-Co bond (s) in  $Co_2(CO)_8$ , respectively are :-
  - 0 and 2
  - 2 and 0
  - 4 and 0
  - 2 and 1
- The total number of isomers for a square planar complex  $[M(F)(Cl)(SCN)(NO_2)]$  is :
  - 12
  - 8
  - 16
  - 4
- Wilkinson catalyst is :
  - $[(Ph_3P)_3RhCl]$  (Et =  $C_2H_5$ )
  - $[Et_3P)_3IrCl]$
  - $[Et_3P)_3RhCl]$
  - $[Ph_3P)_3IrCl]$
- Two complexes  $[Cr(H_2O)_6]Cl_3$  (A) and  $[Cr(NH_3)_6]Cl_3$  (B) are violet and yellow coloured, respectively. The incorrect statement regarding them is :
  - $\Delta_0$  value of (A) is less than that of (B).
  - $\Delta_0$  value of (A) and (B) are calculated from the energies of violet and yellow light, respectively
  - Both absorb energies corresponding to their complementary colors.
  - Both are paramagnetic with three unpaired electrons.
- The highest value of the calculated spin only magnetic moment (in BM) among all the transition metal complexes is :
  - 5.92
  - 3.87
  - 6.93
  - 4.90
- The complex that has highest crystal field splitting energy ( $\Delta$ ), is :
  - $K_3[Co(CN)_6]$
  - $[Co(NH_3)_5(H_2O)]Cl_3$
  - $K_2[CoCl_4]$
  - $[Co(NH_3)_5Cl]Cl_2$
- The difference in the number of unpaired electrons of a metal ion in its high-spin and low-spin octahedral complexes is two. The metal ion is :
  - $Fe^{2+}$
  - $Co^{2+}$
  - $Mn^{2+}$
  - $Ni^{2+}$
- A reaction of cobalt(III) chloride and ethylenediamine in a 1 : 2 mole ratio generates two isomeric products A (violet coloured) B (green coloured). A can show optical activity, B is optically inactive. What type of isomers does A and B represent ?
  - Geometrical isomers
  - Ionisation isomers
  - Coordination isomers
  - Linkage isomers



25. The species that can have a trans-isomer is :

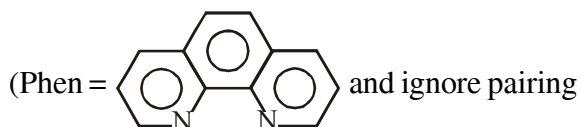
- (en = ethane-1, 2-diamine, ox = oxalate)  
 (1)  $[\text{Pt}(\text{en})\text{Cl}_2]$  (2)  $[\text{Cr}(\text{en})_2(\text{ox})]^+$   
 (3)  $[\text{Zn}(\text{en})\text{Cl}_2]$  (4)  $[\text{Pt}(\text{en})_2\text{Cl}_2]^{2+}$

26. Three complexes,  
 $[\text{CoCl}(\text{NH}_3)_5]^{2+}$  (I),  
 $[\text{Co}(\text{NH}_3)_5\text{H}_2\text{O}]^{3+}$  (II) and  
 $[\text{Co}(\text{NH}_3)_6]^{3+}$  (III)

absorb light in the visible region. The correct order of the wavelength of light absorbed by them is :

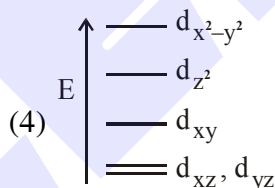
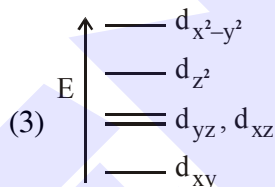
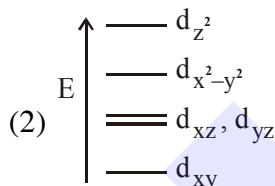
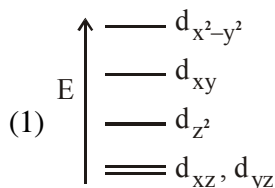
- (1) (III) > (I) > (II) (2) (I) > (II) > (III)  
 (3) (II) > (I) > (III) (4) (III) > (II) > (I)

27. The complex ion that will lose its crystal field stabilization energy upon oxidation of its metal to +3 state is



- (1)  $[\text{Fe}(\text{phen})_3]^{2+}$  (2)  $[\text{Zn}(\text{phen})_3]^{2+}$   
 (3)  $[\text{Ni}(\text{phen})_3]^{2+}$  (4)  $[\text{Co}(\text{phen})_3]^{2+}$

28. Complete removal of both the axial ligands (along the z-axis) from an octahedral complex leads to which of the following splitting patterns? (relative orbital energies not on scale).





11. Ans. (1)

As complex  $K_3[Co(CN)_6]$  have  $CN^-$  ligand which is strongfield ligand amongst the given ligands in other complexes.

12. Ans. (2)

13. Ans. (1)

14. Ans.(1)

(1) EDTA (ethylene diamine tetra acetate) is used for lead poisoning

(2) Cis platin is used as a anti cancer drug

(3) D-penicillamine is used for copper poisoning

(4) desferrioxime B is used for iron poisoning

15. Ans.(3)

en and  $C_2O_4^{2-}$  are bidentate ligand. So coordination number of  $[Co(Cl)(en)_2]Cl$  is 5 and  $K_3[Al(C_2O_4)_3]$  is 6.

16. Ans.(1)

$[Fe(H_2O)_6]Cl_2$ ,  $Fe^{2+} \rightarrow 3d^6 \rightarrow (t_{2g})^4(e_g)^2$

C.F.S.E. =  $4 \times (-0.4\Delta_0) + 2 \times 0.6\Delta_0 = -0.4\Delta_0$

$K_2[NiCl_4]$ ,  $Ni^{2+} \rightarrow 3d^8 \rightarrow (e)^4(t_2)^4$

C.F.S.E. =  $4 \times (-0.6\Delta_t) + 4 \times (0.4\Delta_t) = -0.8\Delta_t$

17. Ans.(3)

(1)  $[Fe(H_2O)_6]^{2+}$ ,  $Fe^{2+} \rightarrow 3d^6 \rightarrow 4$  unpaired electron

$[Cr(H_2O)_6]^{2+}$ ,  $Cr^{2+} \rightarrow 3d^4 \rightarrow 4$  unpaired electron

(2)  $[Ni(NH_3)_4(H_2O)_2]^{2+} = Ni^{2+} \rightarrow 3d^8 \rightarrow 2$  unpaired electron

$\mu_m = 2.83$  B.M

(3) In gemstone, ruby has  $Cr^{3+}$  ion occupying the octahedral sites of aluminium oxide ( $Al_2O_3$ ) normally occupied by  $Al^{3+}$  ion.

(4) Complimenry color of violet is yellow

18. Ans.(1)

Towards common transition element and inner transition metal ion given ligand can have maximum denticities of 6 and 8 respectively.

19. Ans.(2)

cis- $[PtCl_2(NH_3)_2]$  is used in chemotherapy to inhibits the growth of tumors.

20. Ans.(3)

Donating atoms are both nitrogen & oxygen.

Correct option : (3)

21. Ans.(1)

According to question all the complexes are low spin.

Complex	Configuration	No. of unpaired electrons
$[V(CN)_6]^{4-}$	$t_{2g}^3 e_g^0$	3
$[Cr(NH_3)_6]^{2+}$	$t_{2g}^4 e_g^0$	2
$[Ru(NH_3)_6]^{3+}$	$t_{2g}^5 e_g^0$	1
$[Fe(CN)_6]^{4-}$	$t_{2g}^6 e_g^0$	0

Correct option : (1)

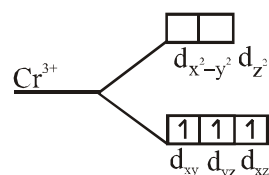
22. Ans.(Bonus)

Complex is  $[Fe(H_2O)_6]_2 [Fe(CN)_6]$

Complex ion	Configuration	No. of unpaired electrons	Magnetic moment
$[Fe(H_2O)_6]^{2+}$	$t_{2g}^4 e_g^2$	4	4.9 BM
$[Fe(CN)_6]^{4-}$	$t_{2g}^6 e_g^0$	0	0

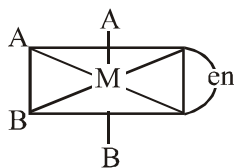
23. Ans.(3)

Degenerate orbitals of  $[Cr(H_2O)_6]^{3+}$



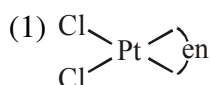
Hence according to the options given, degenerate orbitals are  $d_{xz}$  &  $d_{yz}$

24. Ans.(3)

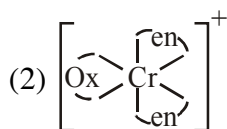


This structure does not contain plane of symmetry hence it is optically active, rest of all options has plane of symmetry and they are optically inactive.

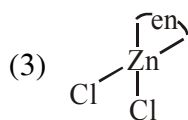
25. Ans.(4)



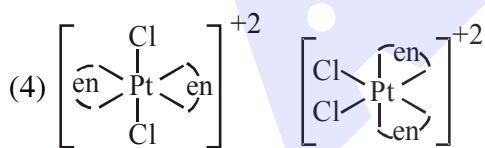
no trans isomer possible because bidentate ligand will be co-ordinating only at  $90^\circ$  angle in square planar complex



no trans isomer possible



$sp^3$  hybridized so no trans possible



trans and cis both are possible

26. Ans.(2)

A complex having strong field ligand has tendency to absorb light of highest energy.

Among the three complexes.

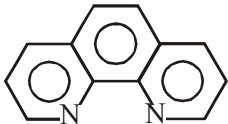
$[\text{Co}(\text{NH}_3)_6]^{+3}$  will absorb radiation of highest energy and least wavelength.

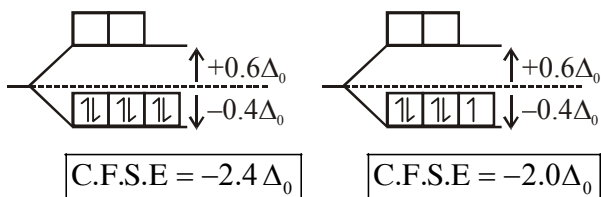
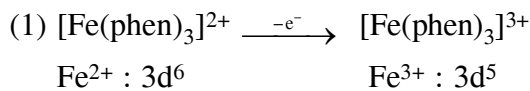
$[\text{Co}(\text{NH}_3)_5\text{H}_2\text{O}]^{+3}$  has field weaker than the above compound and therefore absorb radiation of lesser energy and more wavelength.

$[\text{CoCl}(\text{NH}_3)_5]^{+2}$  has the weakest field and therefore will absorb light of least energy and highest wavelength.

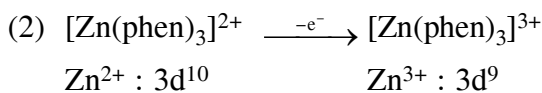
Strength of ligand  $\text{NH}_3 > \text{H}_2\text{O} > \text{Cl}$ .

27. Ans.(1)

Phen =  is a strong field symmetrical bidentate ligand.

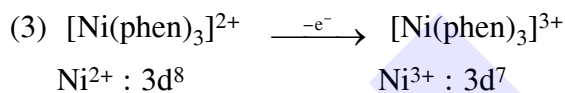


By oxidation of  $\text{Fe}^{2+}$  into  $\text{Fe}^{3+}$ , the CFSE value decrease.



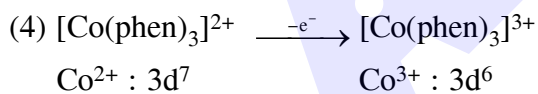
$\text{C.F.S.E} = 0$                        $\text{C.F.S.E} = -0.6 \Delta_0$

By oxidation of  $\text{Zn}^{2+}$  into  $\text{Zn}^{3+}$ , the CFSE value increase.



$\text{C.F.S.E} = -1.2 \Delta_0$                        $\text{C.F.S.E} = -1.8 \Delta_0$

by oxidation of  $\text{Ni}^{2+}$  into  $\text{Ni}^{3+}$ , the CFSE value increase.



$\text{C.F.S.E} = -1.8 \Delta_0$                        $\text{C.F.S.E} = -2.4 \Delta_0$

by oxidation of  $\text{Co}^{2+}$  into  $\text{Co}^{3+}$ , the CFSE value increase.

28. Ans.(1)

If both ligands present along z-axis removed from octahedral field and converted into square planar field, then

