

22. Fac-Mer isomerism is associated with which one of the following complexes? (M = central metal)  
 (a)  $[M(AA)_2]$  (b)  $[MA_3B_3]$   
 (c)  $[M(AA)_3]$  (d)  $[MABCD]$   
 (e)  $[MA_4B_2]$  (Kerala PMT 2007)
23. Which of the following can exhibit geometrical isomerism?  
 (a)  $[MnBr_4]^{2-}$  (b)  $[Pt(NH_3)_3Cl]^+$   
 (c)  $[PtCl_2P(C_2H_5)_3]_2$  (d)  $[Fe(H_2O)_5NO]^{2+}$   
 (Odisha JEE 2008)
24. Which one of the following complex ions has geometrical isomers?  
 (a)  $[Co(en)_3]^{3+}$  (b)  $Ni(NH_3)_5Br^+$   
 (c)  $[Co(NH_3)_2(en)_2]^{3+}$  (d)  $[Cr(NH_3)_4(en)]^{3+}$   
 (AIEEE 2011)
25. Which of the following complex species is not expected to exhibit optical isomerism?  
 (a)  $[Co(en)(NH_3)_2Cl_2]^+$   
 (b)  $[Co(en)_3]^{3+}$  (c)  $[Co(en)_2Cl_2]^+$   
 (d)  $[Co(NH_3)_3Cl_3]$  (JEE Main 2013)
26. Which one of the following complexes shows optical isomerism?  
 (a)  $[Co(NH_3)_3Cl_3]$  (b)  $[Co(en)_2Cl_2]Cl$   
 (c) *trans*  $[Co(en)_2Cl_2]Cl$   
 (d)  $[Co(NH_3)_4Cl_2]Cl$  (en = ethylenediamine)  
 (JEE Main 2016)
- IV. Bonding in coordination compounds and stability in aqueous solution**
27. Cobalt (III) chloride forms several octahedral complexes with ammonia. Which of the following will not give test for chloride ions with silver nitrate at 25°C?  
 (a)  $CoCl_3 \cdot 5NH_3$  (b)  $CoCl_3 \cdot 6NH_3$   
 (c)  $CoCl_3 \cdot 3NH_3$  (d)  $CoCl_3 \cdot 4NH_3$   
 (AIPMT 2015)
28. When 0.01 mole of a cobalt complex is treated with excess silver nitrate solution, 4.305 g silver chloride is precipitated. The formula of the complex is  
 (a)  $[Co(NH_3)_3Cl_3]$  (b)  $[Co(NH_3)_5Cl]Cl_2$   
 (c)  $[Co(NH_3)_6]Cl_3$  (d)  $[Co(NH_3)_4Cl_2]NO_3$   
 (e)  $[Co(NH_3)_4Cl_2]Cl$  (Kerala PET 2011)
29. An excess of  $AgNO_3$  is added to 100 mL of 0.01 M solution of dichlorotetraaquachromium (III) chloride. The number of moles of  $AgCl$  precipitated would be:  
 (a) 0.001 (b) 0.002  
 (c) 0.003 (d) 0.01 (AIPMT 2013)
30. A solution containing 0.319 g of  $CrCl_3 \cdot 6H_2O$  was passed through a cation exchange resin and acid coming out of the cation exchange resin required 28.5 mL of 0.125 M NaOH. Determine correct formula of the complex [Mol. wt. of the complex = 266.5]  
 (a)  $[Cr(H_2O)_6]Cl_3$   
 (b)  $[Cr(H_2O)_5Cl]H_2O \cdot Cl_2$   
 (c)  $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$   
 (d)  $[Cr(H_2O)_3Cl_3] \cdot 3H_2O$  (AIIMS 2014)
31. Both  $Co^{3+}$  and  $Pt^{4+}$  have a coordination number of six. Which of the following pair of complexes will show approximately the same electrical conductance for their 0.001 M aqueous solutions?  
 (a)  $CoCl_3 \cdot 4NH_3$  and  $PtCl_4 \cdot 4NH_3$   
 (b)  $CoCl_3 \cdot 3NH_3$  and  $PtCl_4 \cdot 5NH_3$   
 (c)  $CoCl_3 \cdot 6NH_3$  and  $PtCl_4 \cdot 5NH_3$   
 (d)  $CoCl_3 \cdot 6NH_3$  and  $PtCl_4 \cdot 3NH_3$   
 (e)  $CoCl_3 \cdot 5NH_3$  and  $PtCl_4 \cdot 6NH_3$   
 (Kerala PET 2007)
32. The two isomers X and Y with the formula  $Cr(H_2O)_5ClBr_2$  were taken for experiment on depression in freezing point. It was found that one mole of X gave depression corresponding to 2 moles of particles and one mole of Y gave depression due to 3 moles of particles. The structural formulae of X and Y respectively are  
 (a)  $[Cr(H_2O)_5Cl]Br_2$ ,  $[Cr(H_2O)_4Br_2]Cl \cdot H_2O$   
 (b)  $[Cr(H_2O)_5Cl]Br_2$ ,  $[Cr(H_2O)_3ClBr_2] \cdot 2H_2O$   
 (c)  $[Cr(H_2O)_5Br]BrCl$ ,  $[Cr(H_2O)_4ClBr]Br \cdot H_2O$   
 (d)  $[Cr(H_2O)_5Cl]Br_2$ ,  $[Cr(H_2O)_4ClBr]Br \cdot H_2O$   
 (e)  $[Cr(H_2O)_4Br_2]Cl \cdot H_2O$ ,  $[Cr(H_2O)_5Cl]Br_2$   
 (Kerala PET 2008)
33. The correct statement with respect to the complexes  $Ni(CO)_4$  and  $[Ni(CN)_4]^{2-}$  is  
 (a) nickel is in the same oxidation state in both  
 (b) both have tetrahedral geometry  
 (c) both have square planar geometry  
 (d) have square planar and tetrahedral geometry respectively  
 (e) have tetrahedral and square planar geometry respectively (Kerala PET 2011)
34. The complex which has the highest magnetic moment among the following is  
 (a)  $[CoF_6]^{3-}$  (b)  $[Co(NH_3)_6]^{3+}$

**ANSWERS**

22. (b) 23. (c) 24. (c) 25. (d) 26. (b) 27. (c) 28. (c) 29. (a) 30. (a) 31. (c)  
 32. (e) 33. (e)



- (c)  $[\text{Ni}(\text{NH}_3)_4]^{2+}$  (d)  $[\text{Ni}(\text{CN})_4]^{2-}$   
(e)  $[\text{Fe}(\text{CN})_6]^{4-}$  (Kerala PET 2011)
35. Amongst  $[\text{Ni}(\text{CO})_4]$ ,  $[\text{Ni}(\text{CN})_4]^{2-}$  and  $[\text{NiCl}_4]^{2-}$   
(a)  $[\text{Ni}(\text{CO})_4]$  and  $[\text{NiCl}_4]^{2-}$  are diamagnetic and  $[\text{Ni}(\text{CN})_4]^{2-}$  is paramagnetic  
(b)  $[\text{NiCl}_4]^{2-}$  and  $[\text{Ni}(\text{CN})_4]^{2-}$  are diamagnetic and  $[\text{Ni}(\text{CO})_4]$  is paramagnetic  
(c)  $[\text{Ni}(\text{CO})_4]$  and  $[\text{Ni}(\text{CN})_4]^{2-}$  are diamagnetic and  $[\text{NiCl}_4]^{2-}$  is paramagnetic  
(d)  $[\text{Ni}(\text{CO})_4]$  is diamagnetic and  $[\text{NiCl}_4]^{2-}$  and  $[\text{Ni}(\text{CN})_4]^{2-}$  are paramagnetic.
36. Among  $[\text{Ni}(\text{CO})_4]$ ,  $[\text{Ni}(\text{CN})_4]^{2-}$ ,  $[\text{NiCl}_4]^{2-}$  species, the hybridisation states at the Ni atom are, respectively  
(a)  $sp^3$ ,  $dsp^2$ ,  $dsp^2$  (b)  $sp^3$ ,  $dsp^2$ ,  $sp^3$   
(c)  $sp^3$ ,  $sp^3$ ,  $dsp^2$  (d)  $dsp^2$ ,  $sp^3$ ,  $sp^3$   
(Atomic number of Ni = 28) (IIT 2008, AMU Engg. 2011)
37. The hybridization involved in the complex  $[\text{Ni}(\text{CN})_4]^{2-}$  is (At. No. of Ni = 28)  
(a)  $d^2sp^2$  (b)  $d^2sp^3$   
(c)  $dsp^2$  (d)  $sp^3$  (RE-AIPMT 2015)
38. Which of the following complexes are not correctly matched with the hybridisation of their central metal ion?  
(i)  $[\text{Ni}(\text{CO})_4]$   $sp^3$  (ii)  $[\text{Ni}(\text{CN})_4]^{2-}$   $sp^3$   
(iii)  $[\text{CoF}_6]^{3-}$   $d^2sp^3$  (iv)  $[\text{Fe}(\text{CN})_6]^{3-}$   $sp^3d^2$   
Select the correct answer using the codes given below:  
(a) (i) and (ii) (b) (i) and (iii)  
(c) (ii) and (iv) (d) (i), (iii) and (iv)  
(e) (ii), (iii) and (iv)
39. Which of the following complex exhibits the highest paramagnetic behaviour?  
(a)  $[\text{V}(\text{gly})_2(\text{OH})_2(\text{NH}_3)_2]^+$   
(b)  $[\text{Fe}(\text{en})(\text{bpy})(\text{NH}_3)_2]^{2+}$   
(c)  $[\text{Co}(\text{OX})_2(\text{OH})_2]^{2-}$  (d)  $[\text{Ti}(\text{NH}_3)_6]^{3+}$   
where gly = glycine, en = ethylene diamine and bpy = bipyridyl moieties (At Nos. Ti = 22, V = 23, Fe = 26, Co = 27) (AIPMT 2008)
40. The pair having the same magnetic moment is [At. No. Cr = 24, Mn = 25, Fe = 26, Co = 27]  
(a)  $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$  and  $[\text{CoCl}_4]^{2-}$   
(b)  $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$  and  $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$   
(c)  $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$  and  $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$   
(d)  $[\text{CoCl}_4]^{2-}$  and  $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$  (JEE Main 2016)
41. Among  $[\text{Ni}(\text{CO})_4]$ ,  $[\text{NiCl}_4]^{2-}$ ,  $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$ ,  $\text{Na}_3[\text{CoF}_6]$ ,  $\text{Na}_2\text{O}_2$  and  $\text{CsO}_2$ , the total number of paramagnetic compounds is  
(a) 2 (b) 3  
(c) 4 (d) 5 (JEE Advanced 2016)
42. Hybridization, shape and magnetic moment of  $\text{K}_3[\text{Co}(\text{CO}_3)_3]$  is  
(a)  $d^2sp^3$ , octahedral, 4.9 B.M.  
(b)  $sp^3d^2$ , octahedral, 4.9 B.M.  
(c)  $dsp^2$ , square planar, 4.9 B.M.  
(d)  $sp^3$ , tetrahedral, 4.9 B.M. (Odisha JEE 2008)
43. Which one of the following is an outer orbital complex and exhibits paramagnetic behaviour?  
(a)  $[\text{Ni}(\text{NH}_3)_6]^{2+}$  (b)  $[\text{Zn}(\text{NH}_3)_6]^{2+}$   
(c)  $[\text{Cr}(\text{NH}_3)_6]^{3+}$  (d)  $[\text{Co}(\text{NH}_3)_6]^{3+}$  (AIPMT Prelim 2012)
44. Consider the following complex ions, P, Q and R.  
 $\text{P} = [\text{FeF}_6]^{3-}$ ,  $\text{Q} = [\text{V}(\text{H}_2\text{O})_6]^{2+}$  and  $\text{R} = [\text{Fe}(\text{H}_2\text{O})_6]^{2+}$   
The correct order of the complex ions, according to their spin only magnetic moment (in B.M.) is  
(a)  $\text{R} < \text{Q} < \text{P}$  (b)  $\text{Q} < \text{R} < \text{P}$   
(c)  $\text{R} < \text{P} < \text{Q}$  (d)  $\text{Q} < \text{P} < \text{R}$  (JEE Advanced 2013)
45. The spin only magnetic moment value (in Bohr magneton units) of  $\text{Cr}(\text{CO})_6$  is  
(a) 0 (b) 2.84  
(c) 4.90 (d) 5.92 (IIT 2009)
46. A magnetic moment of 1.73 BM will be shown by one among the following:  
(a)  $[\text{Cu}(\text{NH}_3)_4]^{2+}$  (b)  $[\text{Ni}(\text{CN})_4]^{2-}$   
(c)  $\text{TiCl}_4$  (d)  $[\text{CoCl}_6]^{4-}$  (AIPMT 2013)
47. Which one of the following is wrongly matched?  
(a)  $[\text{Cu}(\text{NH}_3)_4]^{2+}$  – square planar  
(b)  $[\text{Ni}(\text{CO})_4]$  – neutral ligand  
(c)  $[\text{Fe}(\text{CN})_6]^{3-}$  –  $sp^3d^2$   
(d)  $[\text{Co}(\text{en})_3]^{3+}$  – follows EAN rule (Karnataka CET 2010)
48. Geometrical shapes of the complexes formed by the reaction of  $\text{Ni}^{2+}$  with  $\text{Cl}^-$ ,  $\text{CN}^-$  and  $\text{H}_2\text{O}$ , respectively, are

ANSWERS

34. (a) 35. (c) 36. (b) 37. (c) 38. (e) 39. (c) 40. (b) 41. (b) 42. (b) 43. (a)  
44. (b) 45. (a) 46. (a) 47. (c)



9/104

- (a) Octahedral, tetrahedral and square planar  
(b) Tetrahedral, square planar and octahedral  
(c) Square planar, tetrahedral and octahedral  
(d) Octahedral, square planar and octahedral

(IIT 2011)

49. Among the following complexes (K-P)  
 $K_3[Fe(CN)_6]$  (K),  $[Co(NH_3)_6]Cl_3$  (L),  
 $Na_3[Co(oxalate)_3]$  (M),  $[Ni(H_2O)_6]Cl_2$  (N),  
 $K_2[Pt(CN)_4]$  (O) and  $[Zn(H_2O)_6](NO_3)_2$  (P)  
the diamagnetic complexes are  
(a) K, L, M, N (b) K, M, O, P  
(c) L, M, O, P (d) L, M, N, O

(IIT 2011)

50. Which of the following facts about the complex  
 $[Cr(NH_3)_6]Cl_3$  is wrong?

- (a) The complex is paramagnetic  
(b) The complex is an outer orbital complex  
(c) The complex gives white precipitate with silver nitrate solution  
(d) The complex involves  $d^2sp^3$  hybridization and is octahedral in shape.

(AIEEE 2011)

51. Which of these statements about  $[Co(CN)_6]^{3-}$  is true?

- (a)  $[Co(CN)_6]^{3-}$  has four unpaired electrons and will be in a high-spin configuration  
(b)  $[Co(CN)_6]^{3-}$  has no unpaired electrons and will be in a high-spin configuration  
(c)  $[Co(CN)_6]^{3-}$  has no unpaired electrons and will be in a low-spin configuration  
(d)  $[Co(CN)_6]^{3-}$  has four unpaired electrons and will be in a low-spin configuration

(AIPMT 2015)

52. Which of the following complex has minimum magnitude of  $\Delta_0$ ?

- (a)  $[Cr(CN)_6]^{3-}$  (b)  $[Co(NH_3)_6]^{3+}$   
(c)  $[CoCl_6]^{3-}$  (d)  $[Cr(H_2O)_6]^{3+}$

(DPMT 2010, Karnataka CET 2015)

53. Crystal field stabilization energy for high spin  $d^4$  octahedral complex is

- (a)  $-0.6 \Delta_0$  (b)  $-1.8 \Delta_0$   
(c)  $-1.6 \Delta_0 + P$  (d)  $-1.2 \Delta_0$

(AIPMT Prelim 2010)

54. Low spin complex of  $d^6$ -cation in an octahedral field will have the following energy:

- (a)  $-\frac{2}{5} \Delta_0 + 2P$  (b)  $-\frac{2}{5} \Delta_0 + P$

- (c)  $-\frac{12}{5} \Delta_0 + P$  (d)  $-\frac{12}{5} \Delta_0 + 3P$

(AIPMT Main 2012)

55. Which of the following is diamagnetic in nature?

- (a)  $Co^{3+}$ , octahedral complex with weak field ligands  
(b)  $Co^{3+}$ , octahedral complex with strong field ligand  
(c)  $Co^{2+}$  in tetrahedral complex  
(d)  $Co^{2+}$  in square planar complex

(DPMT 2010)

56. In spectrochemical series, chlorine is above water i.e.,  $Cl > H_2O$ , this is due to

- (a) Good  $\pi$ -acceptor properties of Cl  
(b) Strong  $\sigma$ -donor and good  $\pi$ -acceptor properties of Cl  
(c) Good  $\pi$ -donor properties of Cl  
(d) Larger size of Cl than  $H_2O$

(DCE 2009)

57. The magnitude of crystal field stabilization energy (CFSE or  $\Delta_f$ ) in tetrahedral complexes is considerably less than in the octahedral field. Because

- (a) There are only four ligands instead of six so the ligand field is only  $2/3$  the size hence the  $\Delta_f$  is only  $2/3$  the size  
(b) The direction of the orbitals does not coincide with the direction of the ligands. This reduces the crystal field stabilization energy ( $\Delta_f$ ) by further  $2/3$ .  
(c) Both points (a) and (b) are correct.  
(d) Both points (a) and (b) are wrong.

(DPMT 2009)

58. Which of the following complex ions is expected to absorb visible light?

- (a)  $[Ti(en)_2(NH_3)_2]^{4+}$  (b)  $[Cr(NH_3)_6]^{3+}$   
(c)  $[Zn(NH_3)_6]^{2+}$   
(d)  $[Sc(H_2O)_3(NH_3)_3]^{3+}$   
[At. No. Zn = 30, Sc = 21, Ti = 22, Cr = 24]

(AIPMT 2009)

59. Which of the following compounds is not yellow coloured?

- (a)  $(NH_4)_3[As(Mo_3O_{10})_4]$   
(b)  $BaCrO_4$  (c)  $Zn_2[Fe(CN)_6]$   
(d)  $K_3[Co(NO_2)_6]$

(JEE Main 2015)

60. Which of the following is high spin complex?

- (a)  $[CoCl_6]^{3-}$  (b)  $[FeF_6]^{3-}$   
(c)  $[Co(NH_3)_6]^{2+}$  (d) All of these

## ANSWERS

48. (b) 49. (c) 50. (b) 51. (c) 52. (c) 53. (a) 54. (d) 55. (b) 56. (c) 57. (c)  
58. (b) 59. (c) 60. (d)