CHEMISTRY

BOOKS - KALYANI CHEMISTRY (ENGLISH)

COORDINATION COMPOUNDS

Example

1. O.N of Fe in $K_4\left[Fe(CN)_6\right]$ is

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2. Find the oxidation number of platinum in $\left[Pt(en)(H_2O)_2(NO_2)(Cl)\right]^{2+}$ ion.

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3. Specify the oxidation number of the metals in the following coordination entities $\left[Co(H_2O)(CN)(en)_2\right]^{2+}$

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4. Calculate the oxidation number of the metals in the following coordination entites $\left[PtCl_4\right]^{2-}$

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5. Specify the oxidation number of the metals in the following coordination entities $\left[Cr(NH_3)_3Cl_3\right]$

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6. Specify the oxidation number of the metals in the following coordination entities $\left[CoBr_2(en)_2\right]^+$

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7. Calculate the oxidation number of the metals in the following coordination entites $K_3\left[Fe(CN)_6\right]$

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8. Give reason for the statement $\left[Ni(CN)_4\right]^{2-}$ is diamagnetic while $\left[NiCl_4\right]^{2-}$ is paramagnetic in nature .

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9. $\left[NiCl_4\right]^{2-}$ is paramagnetic while $\left[Ni(CO)_4\right]$ is diamagnetic though both are tetrahedral Why?

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10. Assertion : $\left[Fe(H_2O)_6\right]^{3+}$ is strongly paramagnetic whereas $\left[Fe(CN)_6\right]^{3-}$ is weakly paramagnetic .

Reason : H_2O is a weak ligand and CN^- is a strong field ligand .

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11. Explain $\left[Co(NH_3)_6\right]^{3+}$ is an inner orbital complex whereas $\left[Ni(NH_3)_6\right]^{2+}$ is an outer orbital complex.

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12. Predict the number of unpaired electrons in the square planar $\left[Pt(CN)_4\right]^{2-}$ ion.

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13. How would you account for the following :

$\left[Fe(CN)_6\right]^{3-}$ is weakly paramagnetic while

$[Fe(CN)_6]^{4-}$ is diamagnetic

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14. How would you account for the following :

$Ni(CO)_4$ possesses tetrahedral geometry while $[Pt(NH_3)_2Cl_2]$ is square planar.

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15. Which of the following complexes has more Δ_O vlaue and why? (i) $Fe(H_2O)_6]^{3+}$ and (ii) $[Fe(CN)_6]^{3-}$.

Also find the number of unpared electrons in them.

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16. A solution of $\left[Ni(H_2O)_6\right]^{2+}$ is green but a solution of $\left[Ni(CN)_4\right]^{2-}$ is colourless Explain.

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17. $\left[Fe(CN)_6\right]^{4-}$ and $\left[Fe(H_2O)_6\right]^{2+}$ show different colours in dilute solution because

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Follow Up Problems

1. What is the coordination number of Co in $\left[Co(NH_3)_6\right]^{3+}$?

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2. What is the coordination number of Co in $\left[Co(en)_3\right]^{3+}$?

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3. What is the coordination number of $\left[Fe(C_2O_4)_3\right]^{3-}$?

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4. What is the coordination number of Fe in $[Fe(\text{edta})]^-$?

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5. Find the oxidation number of Co in $\left[Co(NH_3)_6\right]^{3+}$

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6. Find the oxidation number of Ni in $K_4\left[Ni(CN)_4\right]$

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7. Find the oxidation number of Fe in $\left[Fe(H_2O)_6\right]^{3+}$

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8. Find the oxidation number of Fe in $K_4\left[Fe(CN)_6\right]$

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9. Calculate the oxidation number of the metals in the following coordination entites $\left[Co(CN)(H_2O)(en)_2\right]^{2+}$

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10. Calculate the oxidation number of the metals in the following coordination entites $\left[PtCl_4\right]^{2-}$

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11. Calculate the oxidation number of the metals in the following coordination entites $\left[CrCl_3(NH_3)_3\right]$

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12. Specify the oxidation number of the metals in the following coordination entities $\left[CoBr_2(en)_2\right]^+$

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13. Calculate the oxidation number of the metals in the following coordination entites $K_3\left[Fe(CN)_6\right]$

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14. Give the IUPAC names of the following compound $\left[Co(NH_3)_6\right]Cl_3$

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15. Give the IUPAC names of the following compound $\left[Co(NH_3)_5Cl\right]Cl_2$

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16. Give the IUPAC names of the following compound $\left[Cr(H_2O)_4Cl_2\right]Cl$

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17. Give the IUPAC names of the following compound $K_4\left[Ni(CN)_4\right]$

Watch Video Solution

18. Give the IUPAC names of the following compound $[Co(NH_3)_3(NO_2)_3]$

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19. Give the IUPAC names of the following compound $[Pt(NH_3)_6]Cl_4$

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20. Give the IUPAC names of the following compound $[Cr(NH_3)_3(NO_2)_3]$

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21. Give the IUPAC names of the following compound $[Pt(NH_3)_2]Cl$

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22. Give the IUPAC names of the following compound $[Co(NH_3)_5CO_3]Cl$

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23. Give the IUPAC names of the following compound $[Ag(NH_3)_2]Cl$

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24. Give the IUPAC names of the following compound $\left[CoCl_2(en)_2\right]_2SO_4$

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25. Give the IUPAC names of the following compound $\left[Co(NH_3)_4Cl(NO_2)\right]NO_3$

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26. Give the IUPAC names of the following compound $K_3\left[Ir(C_2O_4)_3\right]$

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27. Give the IUPAC names of the following compound

$Hg[Co(SCN)_4]$

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28. Give the IUPAC names of the following compound

$[Pt(NH_3)_4Cl_2]$ $[PtCl_4]$

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29. Give the IUPAC names of the following compound

$Na_2[CrF_4O]$

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30. Using IUPAC norms write the systematic names of the $\left[Co(NH_3)_6\right]Cl_3$

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31. Using IUPAC norms write the systematic names of the $\left[Pt(NH_3)_4Cl(NO_2)\right]Cl$

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32. Using IUPAC norms write the systematic names of the $\left[Ti(H_2O)_6\right]^{3+}$

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33. Using IUPAC norms write the systematic names of the $[Co(NH_3)_4Cl(NO_2)]Cl$

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34. Using IUPAC norms write the systematic names of the $[Mn(H_2O)_6]^{2+}$

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35. Using IUPAC norms write the systematic names of the $[NiCl_4]^{2-}$

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36. Using IUPAC norms write the systematic names of the $[Ni(NH_3)_6]Cl_2$

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37. Using IUPAC norms write the systematic names of the $[Co(en)_3]^{3+}$

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38. Give the structural formula of the potassium tetrafluoridoborate (III).

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39. Give the structural formula of the potassium pentachloridonitridoosmate(VI)

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40. Give the structural formula of the bis(ethylenediamine)difluoridocobalt(III)-perchlorate

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41. Give the structural formula of the tetraamminedichloridocobalt(III) hexacyanido-chromate(III)

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42. Give the structural formula of the diamminesilver(I)sulfate

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43. Give the structural formula of the iron(III)hexacyanidoferrate(II)

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44. Give the structural formula of the pentaamminechromium(III) uhydroxopentaamminechromium(III)chloride

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45. Give the structural formula of the sodium hexafluoridosilicate(IV)

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46. Give the structural formula of the

(i) chlorido triphenyl phosphine platinum(II)-4

(ii) dichlorido chlorido triphenyl phosphine platinum(II)

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47. Give the structural formula of the dodecacarbonyltrimanganese(0)

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48. Give the structural formula of the bis(cyclopentadienyl)iron(II)

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49. Give the structural formula of the tetrapyridineplatinum(II)tetrachlorido-platinate(II)

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50. Give the structural formula of the di(benzene)chromium(0)

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51. Give the structural formula of the sodium di(thiosulfato argentate(I)

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52. Give the structural formula of the lithium tetrahydridoaluminate(III)

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53. Give the structural formula of the tetramminechromium(III)-4-amido-uhydroxotetraaquacobalt(III) nitrate

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54. Using IUPAC norms write the formula for the Tetrahydroxozincate(II)

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55. Using IUPAC norms write the formula for the Potassium tetrachloridopalladate(II)

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56. Using IUPAC norms write the formula for the Diamminedichloridoplatinum(II)

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57. Using IUPAC norms write the formula for the Potassium tetracyanidonickelate(II)

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58. Using IUPAC norms write the formula for the Pentaamminenitrito-0-cobalt(III)ion

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59. Using IUPAC norms write the formulae for the following:

(i) Hexaamminecobalt (III) sulphate.

(ii) Potassium trioralatochromate (III).

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60. Using IUPAC norms write the formula for the Potassium trisoxalato)chromate(III)

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61. Using IUPAC norms write the formula for the Hexaammineplatium(IV) ion

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62. Using IUPAC norms write the formula for the Tetrabromidocuprate(II)ion

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63. Using IUPAC norms write the formula for the Pentaamminenitrito-N-cobalt(III)ion

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64. How many geometrical isomers are possible in the following coordination entities ?

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

(ii) $\left[Co(NH_3)_3Cl_3\right]$

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65. How many geometrical isomers are possible in the following coordination entities ?

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

(ii) $\left[Co(NH_3)_3Cl_3\right]$

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66. Draw the structures of optical isomers of:

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

(ii) $\left[PtCl_2(en)_2\right]^{2+}$

(iii) $\left[Cr(NH_3)_2Cl_2(en)\right]^{+}$

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67. Draw the structures of optical isomers of:

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

(ii) $[PtCl_2(en)_2]^{2+}$

(iii) $[Cr(NH_3)_2Cl_2(en)]^{+}$

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68. Draw the structures of optical isomers of:

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

(ii) $[PtCl_2(en)_2]^{2+}$

(iii) $[Cr(NH_3)_2Cl_2(en)]^{+}$

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69. Write all the geometrical isomers of $[Pt(NH_3)(Br)(Cl)(py)]$ and how many of these will exhibit optical isomers ?

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70. How many isomers are possible for the following coordination compound ? $\left[CoCl_2(en)_2\right]^+$

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71. Indicate the types of isomerism exhibited by the following complexes and draw the structures of these isomers $K\left[Cr(H_2O)_2(C_2O_4)_2\right]$

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72. Indicate the types of isomerism exhibited by the following complexes and draw the structures of these isomers $\left[Co(en)_3\right]Cl_3$

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73. Indicate the type of isomerism exhibited by the following complexes and draw the structures for these isomers:

(i) $K\left[Cr(H_2O)_2(C_2O_4)_2\right.$

(ii) $\left[Co(en)_3\right]Cl_3$

(iii) $\left[Co(NH_3)_5(NO_2)\right](NO_3)_2$

(iv) $[Pt(NH_3)(H_2O)Cl_2]$

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74. Indicate the type of isomerism exhibited by the following complexes and draw the structures for these isomers:

(i) $K\left[Cr(H_2O)_2(C_2O_4)_2\right.$

(ii) $\left[Co(en)_3\right]Cl_3$

(iii) $\left[Co(NH_3)_5(NO_2)\right](NO_3)_2$

(iv) $[Pt(NH_3)(H_2O)Cl_2]$

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75. Give evidence that $\left[Co(NH_3)_5Cl\right]SO_4$ and $\left[Co(NH_3)_5SO_4\right]CL$ are

ionization isomers.

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76. Draw structures of geometrical isomers of $\left[Fe(NH_3)_2(CN)_4\right]^-$.

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77. Write the number of ions in the solution of following complexes $K_4\left[Fe(CN)_6\right]$

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78. Write the number of ions in the solution of following complexes $\left[Ag(NH_3)_2\right]Cl$

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79. Write the number of ions in the solution of following complexes $\left[Pt(NH_3)_4\right]\left[PtCl_4\right]$

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80. Find the oxidation state, type of hybridization and geometry of the following complexes.

$\left[Ni(CN)_4\right]^{2-}$

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81. Find the oxidation state, type of hybridization and geometry of the following complexes.

$[MnCl_4]^{2-}$

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82. Experimentally determined magnetic susceptibility results of $(NiCl_4)^{2-}$ ion correspond to the presence of two unpaired electrons. Predict the type of hybridization and geometry of this complex.

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83. Explain the geometry and magnetic character of complex $\left[Cr(NH_3)_6\right]^{3+}$.

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84. Predict the number of unpaired electrons in $\left[Cr(H_2O)_6\right]^{2+}$

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85. Predict the number of unpaired electrons in $\left[Cr(CN)_6\right]^{4-}$

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86. With the help of crystal field theory, predict the number of unpaired electrons in $\left[Fe(H_2O)_6\right]^{2+}$

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87. With the help of crystal field theory, predict the number of unpaired electrons in $\left[Fe(CN)_6\right]^{4-}$

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88. Give the oxidation state, d-orbital occupation and coordination number of the central metal ion in the following complexes: $K_3\left[Co(C_2O_4)_3\right]$

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89. Give the oxidation state, d-orbital occupation and coordination number of the central metal ion in the following complexes: $cis - \left[Cr(en)_2Cl_2\right]Cl$

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90. Give the oxidation state, d-orbital occupation and coordination number of the central metal ion in the following complexes: $(NH_4) - 2[CoF_4]$

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91. Give the oxidation state, d-orbital occupation and coordination number of the central metal ion in the following complexes: $\left[Mn(H_2O)_6\right]SO_4$

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92. Write down the IUPAC name for each of the following complexes and indicate the oxidation state, electronic configuration and coordination number. Also give stereochemistry and magnetic moment of the complex $K\left[Cr(H_2O)_2(C_2O_4)_2\right].3H_2O$

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93. Write down the IUPAC name for each of the following complexes and indicate the oxidation state, electronic configuration and coordination number. Also give stereochemistry and magnetic moment of the complex $CrCl_3(py)_3$

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94. Write down the IUPAC name for each of the following complexes and indicate the oxidation state, electronic configuration and coordination number. Also give stereochemistry and magnetic moment of the complex $K_4[Mn(CN)_6]$

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95. Write down the IUPAC name for each of the following complexes and indicate the oxidation state, electronic configuration and coordination number. Also give stereochemistry and magnetic moment of the complex $\left[Co(NH_3)_5Cl\right]Cl_2$

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96. Write down the IUPAC name for each of the following complexes and indicate the oxidation state, electronic configuration and coordination number. Also give stereochemistry and magnetic moment of the complex $Cs[FeCl_4]$

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97. Amongst the following ions which one has the highest magnetic moment value?

(i) $\left[Cr(H_2O)_6\right]^{3+}$

(ii) $\left[Fe(H_2O)_6\right]^{2+}$

(iii) $\left[Zn(H_2O)_6\right]^{2+}$

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98. Amongst the following ions which one has the highest magnetic moment value?

(i) $\left[Cr(H_2O)_6\right]^{3+}$

(ii) $\left[Fe(H_2O)_6\right]^{2+}$

(iii) $\left[Zn(H_2O)_6\right]^{2+}$

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99. Amongst the following ions which one has the highest magnetic moment value?

(i) $\left[Cr(H_2O)_6\right]^{3+}$

(ii) $\left[Fe(H_2O)_6\right]^{2+}$

(iii) $\left[Zn(H_2O)_6\right]^{2+}$

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100. What will be the correct order for the wavelengths of absorption in the visible region for the following:

$\left[Ni(NO_2)_6\right]^{4-}$, $\left[Ni(NH_3)_6\right]^{2+}$, $\left[Ni(H_2O)_6\right]^{2+}$?

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Exercise Part I Objective Questions

1. Fill in the blanks by choosing the appropriate word/words from those given in the brackets: (double salts, complex compounds, uni, bi, six, four, three, coordination, linkage, imperfect, perfect, normal, penetrating, central ion, chelating, Werner, Pauling)

A complex ion contains a metal atom or ion which is known as.....

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2. Fill in the blanks by choosing the appropriate word/words from those given in the brackets: (double salts, complex compounds, uni, bi, six, four, three, coordination, linkage, imperfect, perfect, normal, penetrating, central ion,

chelating, Werner, Pauling)

The addition compounds which retain their identity in solution are called.....

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3. Fill in the blanks by choosing the appropriate word/words from those given in the brackets: (double salts, complex compounds, uni, bi, six, four, three, coordination, linkage, imperfect, perfect, normal, penetrating, central ion, chelating, Werner, Pauling)

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

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4. Fill in the blanks by choosing the appropriate word/words from those given in the brackets: (double salts, complex compounds, uni, bi, six, four, three, coordination, linkage, imperfect, perfect, normal, penetrating, central ion, chelating, Werner, Pauling)

In the complex ion, $[Fe(\mathrm{edta})]^{-}$, the C.N. and the O.N. of the central metal ion Fe are ..... and ..... respectively.

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5. Fill in the blanks by choosing the appropriate word/words from those given in the brackets: (double salts, complex compounds, uni, bi, six, four, three, coordination, linkage, imperfect, perfect, normal, penetrating, central ion,

chelating, Werner, Pauling)

$[Cr(NH_3)_6][Co(CN)_6]$ exhibits .....isomerism.

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6. Fill in the blanks by choosing the appropriate word/words from those given in the brackets: (double salts, complex compounds, uni, bi, six, four, three, coordination, linkage, imperfect, perfect, normal, penetrating, central ion, chelating, Werner, Pauling)

Complexes such as $K_4[Fe(CN)_6]$ in which the complex ion is quite stable and almost undissociated in solution are called ..... or ..... complexes.

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7. Fill in the blanks by choosing the appropriate word/words from those given in the brackets: (double salts, complex compounds, uni, bi, six, four, three, coordination, linkage, imperfect, perfect, normal, penetrating, central ion, chelating, Werner, Pauling)

Polydentate ligands are also called.... ligands.

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8. Fill in the blanks by choosing the appropriate word/words from those given in the brackets: (double salts, complex compounds, uni, bi, six, four, three, coordination, linkage, imperfect, perfect, normal, penetrating, central ion, chelating, Werner, Pauling)

A bridging ligand must contain atleast.....electron pairs for coordination.

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9. Fill in the blanks by choosing the appropriate word/words from those given in the brackets: (double salts, complex compounds, uni, bi, six, four, three, coordination, linkage, imperfect, perfect, normal, penetrating, central ion, chelating, Werner, Pauling)

Mode of attachment of ligand to metal atom gives rise to .....isomerism.

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10. Fill in the blanks by choosing the appropriate word/words from those given in the brackets: (double salts, complex compounds, uni, bi, six, four, three, coordination, linkage, imperfect, perfect, normal, penetrating, central ion, chelating, Werner, Pauling)

Valence bond theory for bonding in complexes was given by.....

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11. Correct the following statements by changing the under lined part of the sentence (Do not change the whole sentence)

Mohr's salt is a coordination compound.

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12. Correct the following statements by changing the under lined part of the sentence (Do not change the whole sentence)

$C\overline{N}$ is a chelating ligand.

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13. Correct the following statements by changing the under lined part of the sentence (Do not change the whole sentence)

The coordination number of Co in $\left[Co(en)_3\right]^{3+}$ is 3.

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14. Correct the following statements by changing the under lined part of the sentence (Do not change the whole sentence)

The oxidation number of Ni in $\left[K_4\left[Ni(CN)_4\right]\right.$ is 2.

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15. Correct the following statements by changing the under lined part of the sentence (Do not change the whole sentence)

According to latest IUPAC recommendations, the ligand F is named as fluoride.

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16. Correct the following statements by changing the under lined part of the sentence (Do not change the whole sentence)

$[CO(NH_3)_6][Cr(CN)_6]$ and $[Cr(NH_3)_6][CO(CN)_6]$ are linkage isomers.

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17. Correct the following statements by changing the under lined part of the sentence (Do not change the whole sentence)

Octahedral complexes of the type MA_6 and MA_5B show geomertical isomerism.

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18. Correct the following statements by changing the under lined part of the sentence (Do not change the whole sentence)

The complex $\left[Co(NH_3)_5Cl\right]Cl_2$ in aqueous solution gives three Cl^- ions.

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19. Correct the following statements by changing the under lined part of the sentence (Do not change the whole sentence)

Greater the value of the dissociation constant K, greater will be the stability of the complex.

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20. Correct the following statements by changing the under lined part of the sentence (Do not change the whole sentence)

$[Fe(CN)_6]^{3-}$ is an inner-orbital complex having two unpaired electrons.

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21. Correct the following statements by changing the under lined part of the sentence (Do not change the whole sentence)

In a coordination complex, donation of electron pair takes place from the central metal atom to the ligands.

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22. Match the following:

1. $[Ni(CN)_4]^{2-}$	(a) Werner's theory
2. $Ni(CO)_4$	(b) Octahedral
3. $[Co(NH_3)_6]^{3+}$	(c) Square planar
4. Coordination compounds	(d) Hexadentate
5. EDTA	(e) Tetrahedral
6. $[Co(NH_3)_6][Cr(CN)_6]$	(f) Geometrical isomerism
7. $[Co(NH_3)_4Cl_2]$	(g) Coordination isomerism

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Exercise Part I Objective Questions Multiple Choice Questions

1. Out of the following, the compound which is not a coordination compound is :

A. $\left[Co(NH_3)_4Cl_2\right]^+$

B. $\left[FeSO_4(NH_4)_2SO_4.6H_2O\right.$

C. $K_3Fe(CN)_6$

D. $K_4Fe(CN)_6$

Answer: B

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2. Hexadentate ligand out of the following is :

A. $C_2O_4^{2-}$

B. EDTA

C. $NH_2CH_2CH_2NH_2$

D. NO_2^-

Answer: B

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3. The coordination number (C.N.) and oxidation number (O.N.) of central metal atom in the complex $K_3\left[Fe(CN)_6\right]$ is :

A. C.N. = 3, O.N. = +3

B. C.N. = 6, O.N. = +6

C. CN. =6, ON =+3

D. CN. =3, ON. =+6.

Answer: C

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4. The ligand which is not chelating is :

A. EDTA

B. $C_2O_4^{2-}$

C. CH_3COO^-

D. $en.$

Answer: C

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5. The ligand S^{2-} is named in coordination compounds as :

A. thio

B. sulfide

C. sulfido

D. none of these.

Answer: C

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6. In complex compounds, the ligand ONO^- is named as:

A. nitrato

B. nitrito

C. nitro

D. none of these.

Answer: B

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7. According to IUPAC system, the name of the complex, $\left[Co(en)_2Cl(ONO)\right]^+$ is :

A. Chloronitrodi(ethylenediamine)cobalt(III) ion

B. Chloridobis(ethylenediamine) nitrito-O-cobalt(III) ion

C. Chlorobis(ethylenediamine)nitrocobalt (III) ion

D. Nitrochlorobis (ethylenediamine)cobalt(III) ion

Answer: B

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8. The compound which exhibits linkage isomerism is :

A. $\left[Cr(NH_3)_6\right]^{3+}$

B. $\left[Co(NH_3)_6\right]^{3+}$

C. $\left[Co(NH_3)_5NO_2\right]Cl_2$

D. $\left[Pt(NH_3)_2Cl_2\right]$

Answer: C

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9. The comopound which exhibits coordination isomerism is:

A. $\left[Pt(NH_3)_2Cl_2\right]$

B. $K_3[Fe(CN)_6]$

C. $K_4[Fe(CN)_6]$

D. $[Cr(NH_3)_6][Co(CN)_6]$

Answer: D

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10. The complex trioxalatochromate (III) ion exhibits

A. optical isomerism

B. ionization isomerism

C. geometrical isomerism

D. linkage isomerism.

Answer: A

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11. The valence bond theory for complexes was put forward by

A. Werner

B. de Broglie

C. H-Bethe

D. Linus Pauling

Answer: D

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12. Octahedral complexes involve the type of hybridization as

A. sp^3

B. dsp^2

C. d^2sp^3

D. sp^3d

Answer: C

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13. The shape and magnetic property of $\left[Cr(NH_3)_6\right]^{3+}$ ion is :

A. octahedral, paramagnetic

B. octahedral, diamagnetic

C. square planar, paramagnetic

D. square planar, diamagnetic

Answer: A

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14. In $NI(CO)_4$, electron configuration and the oxidation state of Ni are

A. $3d^8 4s^2, 0$

B. $3d^{10}, 0$

C. $3d^8, +2$

D. none of these

Answer: A

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15. The name of the complex $\left[Pt(NH_3)_6\right]Cl_4$ is

A. hexaammineplatinum (IV) chloride

B. hexaammineplatinum (II) chloride

C. tetrachlorohexaammineplatinum (IV)

D. tetrachlorohexaammineplatinum (II).

Answer: A

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16. Bidentate ligand out of the following is :

A. EDTA

B. Ethylenediamine

C. Acetate

D. Pyridine

Answer: B

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17. Which of the following complexes formed by Cu^{2+} ions is most stable ?

A. $Cu^{2+} + 4NH_3 \Leftrightarrow \left[Cu(NH_3)_4\right]^{2+}, \log K = 11.6$

B. $Cu^{2+} + 4CN^- \Leftrightarrow \left[Cu(CN)_4\right]^{2-}, \log K = 27.3$

C. $Cu^{2+} + 2en \Leftrightarrow \left[Cu(en)_2\right]^{2+}, \log K = 15.4$

D. $Cu^{2+} + 4H_2O \Leftrightarrow \left[Cu(H_2O)_4\right]^{2+}, \log K = 8.9$

Answer: B

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18. The colour of the coordination compounds depends on the crystal field splitting . What will be the correct order of absorption of wavelength of light in the visible region for the complexes , $\left[Co(NH_3)_6\right]^{3+}, \left[Co(CN)_6\right]^{3-}, \left[Co(H_2O)_6\right]^{3+}$?

A. $[Co(CN)_6]^{3-} > [Co(NH_3)_6]^{3+} > [Co(H_2O)_6]^{3+}$

B. $[Co(NH_3)_6]^{3+} > [Co(H_2O)_6]^{3+} > [Co(CN)_6]^{3-}$

C. $[Co(H_2O)_6]^{3+} > [Co(H_2O)_6]^{3+} > [Co(CN)_6]^{3-}$

D. $[Co(CN)_6]^{3-} > [Co(H_2O)_6]^{3+} > [Co(CN)_6]^{3+}$

Answer: C

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19. When 1 mol $CrCl_3 \cdot 6H_2O$ is treated with excess of $AgNO_3$, 3 mol of AgCl are obtained . The formula of the complex is

A. $[CrCl_3(H_2O)_3] . 3H_2O$

B. $[CrCl_2(H_2O)_4]Cl.2H_2O$

C. $\left(CrCl(H_2O)_5\right]Cl_2H_2O$

D. $\left[Cr(H_2O)_6Cl_3.\right.$

Answer: B

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20. When 1 mol $CrCl_3 \cdot 6H_2O$ is treated with excess of $AgNO_3$, 3 mol of AgCl are obtained . The formula of the complex is

A. $\left[CrCl_3(H_2O)_3\right] . 3H_2O$

B. $\left[CrCl_2(H_2O)_4\right]Cl. 2H_2O$

C. $\left(CrCl(H_2O)_5\right]Cl_2. H_2O$

D. $\left[Cr(H_2O)_6Cl_3.\right.$

Answer: D

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21. The correct IUPAC name of $\left[Pt(NH_3)_2Cl_2\right]$ is

A. diamminedichloridoplatinum (II)

B. diammincdichloridoplatinum (IV)

C. diamminedichloridoplatinum (0)

D. dichloridodiammineplatinum (IV)

Answer: A

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22. The stabilisation of coordination compounds due to chelation is called the chelate effect . Which of the following is the most stable complex species ?

A. $\left[Fe(CO)_5\right]$

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

C. $\left[Fe(C_2O_4)_3\right]^{3-}$

D. $\left[Fe(H_2O)_6\right]^{3+}$

Answer: C

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23. Indicate the complex ion which shows geometrical isomerism.

A. $\left[Cr(H_2O)_4Cl_2\right]^+$

B. $\left[Pt(NH_3)_3Cl\right]$

C. $\left[Co(NH_3)_6\right]^{3+}$

D. $\left[Co(CN)_5(NC)\right]^{3+}$

Answer: A

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24. The CFSE for octahedral $[CoCl_6]^{4-}$ is $18,000cm^{-1}$. The CFSE for tetrahedral $[CoCl_4]^{2-}$ will be

A. $18,000cm^{-1}$

B. $16,000cm^{-1}$

C. $8,000cm^{-1}$

D. $20,000 cm^{-1}$

Answer: C

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25. Due to the presence of ambidentate ligands coordination compounds show isomerism. Palladium comples of the type $\left[Pd(C_6H_5)_2(SCN)_2\right]$ and $\left[Pd(C_6H_5)_2(NCS)_2\right]$ are

A. linkage isomers

B. coordination isomers

C. ionization isomers

D. geometrical isomers.

Answer: A

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26. The compounds $\left[Co(SO_4)(NH_3)_5\right]Br$ and $\left[Co(SO_4)(NH_3)_5\right]Cl$ represent

A. linkage isomerism

B. ionization isomerism

C. coordination isomerism

D. no isomerism.

Answer: D

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27. A chelating agent has two or more than two donor atoms to bind to a single metal ion. Which of the following is not a chelating agent ?

A. Thiosulfato

B. Oxalato

C. Glycinato

D. Ethane-1, 2-diamine

Answer: A

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28. Which of the following species is not expected to be a ligand ?

A. NO

B. NH_4^+

C. $NH_2CH_2CH_2NH_2$

D. CO

Answer: B

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29. What kind of isomerism exists between $[Cr(H_2O)_6]Cl_3$ (violet) and $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$ (greyish - green) ?

A. Linkage isomerism

B. Solvate isomerism

C. Ionization isomerism

D. Coordination isomerism.

Answer: B

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30. IUPAC name of $\left[Pt(NH_3)_2Cl(NO_2)\right]$ is

A. Platinum diaminechloronitrite

B. Chloronitrito-N-ammineplatinum (II)

C. Diamminechloridonitrito-N-platinum (II)

D. Diamminechloronitrito-N-platinate (II).

Answer: C

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Exercise Part Ii Descriptive Questions Very Short Answer Type Questions

1. Give an example of a double salt.

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2. Give two examples for neutral didentate ligands.

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3. Give one example of a positive ligand.

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4. Give one example of a hexadentate ligand.

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5. How many moles of AgCl will be precipitated when an excess of $AgNO_3$ is added to a molar solution of $\left[CrCl(H_2O)_5\right]Cl_2$?

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6. What is the coordination number of central metal ion in $\left[Fe(C_2O_4)_3\right]^{3-}$?

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7. What is a bidentate ligand ? Give one example.

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8. Give one example of chelate complex.

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9. What is the oxidation state of $Niin(Ni(CO))_4$?

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10. What is meant by unidentate, didentate and ambidentate ligands? Give two examples for each.

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11. Write IUPAC name of $K_3\left[Fe(CN)_6\right]$

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12. Write down the IUPAC name for each of the following complex:

$K_3\left[Fe(CN)_5NO\right]$

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13. The correct IUPAC name of $\left[Pt(NH_3)_2Cl_2\right]$ is

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14. Write the name of $\left[Co(NH_3)_4(H_2O)_2\right]Cl_3$.

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15. Write IUPAC name of the complex $\left[Pt(NH_3)_4\right]\left[NiCl_4\right]$.

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16. Write the IUPAC name of $Fe_4\left[Fe(CN)_6\right]_3$.

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17. Write IUPAC name of $K_2[PdCl_4]$

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18. Write the formula of pentamminechloridoplatinum (IV) chloride.

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19. Write the formula of tetraamminedichloridochromium(III) chloride.

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20. Write IUPAC name of $\left[CoCl_2(NH_3)_4\right]^+$.

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21. Write IUPAC name of $\left[Co(NH_3)_5ONO\right]Cl_2$.

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22. Name the following complex using IUPAC norms: $\left[Co(en)_2(ONO)Cl\right]Cl$

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23. Write IUPAC name of the complex: $\left[Cr(H_2O)_5Cl\right]Cl_2$

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24. Write IUPAC name of the complex: $Na_3\left[Cr(OH)_2F_4\right]$

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25. Write IUPAC name of the complex : $[Co_3(NH_3)_5SCN]Cl$

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26. Give the IUPAC name of $(NH_4)_3[Co(ONO)_6]$

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27. Write the IUPAC name of $[Ni(H_2O)_6](ClO_4)_2$

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28. Write the formula of hexaquairon(II) sulfate.

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29. Write the formula of potassium hexacyanidoferrate (III) .

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30. Write the formula of hexaammineplatinum (IV) chloride

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31. Using IUPAC norms write the formulae for the following:

(a) Potassium trioxalatoaluminate (III)

(b) Dichloridobis (ethane-1,2-diamine)cobalt(III)

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32. Illustrate the geometrical isomers of $\left[Pt(NH_3)_4Cl_2\right]^{2+}$.

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33. Name the isomerism shown by $\left[Cr(H_2O)_5(NCS)\right]^{2+}$

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34. Write IUPAC name of $Na_3\left[Co(NO_2)_6\right]$

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35. Name the ionization isomer of $\left[Cr(H_2O)_5Br\right]SO_4$.

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36. Why does a tetrahedral complex of the type $[MA_2B_2]$ not show geometrical isomerism ?

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37. What is the coordination number of the metal atom if its geometry is (i) square planar (ii) octahedral?

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38. What is the coordination number of the metal atom if its! geometry is tetrahedral?

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39. What type of isomerism is shown by $\left[Co(NH_3)_5\right]SO_4$ and $\left[Co(NH_3)_5SO_4\right]Br$?

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40. Name the type of isomerism shown by the pair of co-ordination compounds:

$\left[Co(NH_3)_5NO_2\right]Cl_2$ and $\left[Co(NH_3)_5ONO\right]Cl_2$

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41. What type of isomerism is shown by $[Co(\text{edta})]^{-1}$ and $\left[Co(en)_3\right]^{3+}$?

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42. (i) What type of isomerism is shown by the complex $\left[Co(NH_3)_6\right]\left[Cr(CN)_6\right)]$?

(ii) Why a solution of $\left[Ni(H_2O)_6\right]^{2+}$ is colored while a solution of $\left[Ni(CN)_4\right]^{2-}$ colourless ? (At. No. of Ni = 28)

(iii) Write the IUPAC name of the following complex : $\left[Co(NH_3)_5(CO)\right]Cl_3$

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43. $[Co(NH_3)_5SO_4]Br$ gives yellow precipitate with $AgNO_3$ solution while $[Co(NH_3)_5Br]SO_4$ does not why ?

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44. Why does ammonia readily form a complex while ammonium ion does not?

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45. If the geometry of $[PtCl_4]^{2-}$ -is square planar, which orbitals are involved in bonding?

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46. What happens when silver sulfide is shaken with NaCN solution?

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47. How many ions are produced from the complex $Co(NH_3)_4Cl_2$ in solution ?

(i) 6 (ii) 4 (iii) 3 (iv) 2

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48. Name the metal present in haemoglobin.

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49. Name the central element present in chlorophyll.

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50. What are the most important coordination numbers encountered in coordination compounds ?

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51. Name the compound used to determine the hardness of water.

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52. How many coordination sites are there in ethylenediamine,

$$\begin{array}{l} CH_2NH_2 \\ | \\ CH_2NH_2 \end{array}$$

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53. Write the number of types of valencies present for metals in complexes according to Werner.

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54. What are primary and secondary valencies according to modern concept?

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55. Name a neutral ligand.

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56. What is cis-platin?

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57. Name the metal present in B-12.

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58. Name two factors which influence the stability of a complex.

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59. The magnitude of CFSE (Crystal Field Splitting Energy , Δ_0) can be related to the configuration of d-orbitals in a coordination entity as

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60. How does the magnitude of Δ_o decide the actual configuration of d-orbitals in a coordination entity.

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61. Only transition elements are known to form carbonyls. Why?

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62. Why does precipitate of AgCl dissolve in ammonia solution?

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63. What happens when photographic plate is developed with hypo?

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64. Name the electrolyte (complex) used in electroplating objects by silver.

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65. What happens when excess of ammonia is added to copper sulfate solution ?

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66. What is Nessler's reagent? How is it prepared ?

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67. Name the type of isomerism when ambidentate ligands are attched to central metal ion. Give two examples of ambidentate ligands.

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Exercise Part Ii Descriptive Questions Short Answer Questions

1. Define double salts and coordinate compounds. Distinguish them with suitable examples.

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2. Define ligand, coordination number and complex ion. Give two examples in each case.

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3. Define and explain the term coordination sphere.

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4. Write the IUPAC name of the following compound. $Na_3[AlF_6]$

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5. Write the IUPAC name of the following compound. $[Pt(NH_3)_4][PtCl_4]$

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6. Find the coordination number and oxidation state of the metal in the following complex compounds. $K[BF_4]$

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7. Find the coordination number and oxidation state of the metal in the following complex compounds. $K_3[Fe(C_2O_4) - 3]$

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8. Find the coordination number and oxidation state of the metal in the following complex compounds. $\left[Co(en)_3\right]^{3+}$

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9. Define a hexadentate ligand and give one example of it. How is it used to measure the hardness of water ?

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10. What is meant by the chelate effect? Give an example.

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11. Write the formulas of the following coordination compounds Tetraamminediaquacobalt(III) chloride

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12. Write the formulas for the following coordination compounds:

(i) Tetraamminediaquacobalt(III) chloride (ii) Potassium tetracyanidonickelate(II) (iii) hane–1,2–diamine) chromium(III) chloride (iv) Amminebromidochloridonitrito-N-platinate(II) (v) Dichloridobis(ethane–1,2–diamine)platinum(IV) nitrate (vi) Iron(III) hexacyanidoferrate(II)

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13. Write the formulas for the following coordination compounds:

(i) Tetraamminediaquacobalt(III) chloride (ii) Potassium tetracyanidonickelate(II) (iii) hane–1,2–diamine) chromium(III) chloride (iv) Amminebromidochloridonitrito-N-platinate(II) (v) Dichloridobis(ethane–1,2–diamine)platinum(IV) nitrate (vi) Iron(III) hexacyanidoferrate(II)

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14. Write the formulas of the following coordination compounds Amminebromidochloridonitrito-N-platinate(II)

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15. Write the formulas of the following coordination compounds Dichloridobisethane-1,2-diamineplatinum(IV) nitrate

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16. Write the formulas for the following coordination compounds:

(i) Tetraamminediaquacobalt(III) chloride (ii) Potassium tetracyanidonickelate(II) (iii) hane–1,2–diamine) chromium(III) chloride (iv) Amminebromidochloridonitrito-N-platinate(II) (v) Dichloridobis(ethane–1,2–diamine)platinum(IV) nitrate (vi) Iron(III) hexacyanidoferrate(II)

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17. Give the IUPAC names of the following compound $\left[Co(NH_3)_6\right]Cl_3$

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18. Write down the IUPAC name for each of the following complexes and indicate the oxidation state, electronic configuration and coordination number. Also give stereochemistry and magnetic moment of the complex $\left[Co(NH_3)_5Cl\right]Cl_2$

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19. Write IUPAC name for each of the following complexes :

(i) $\left[Ni(NH_3)_6\right]Cl_2$

(ii) $K_3\left[Fe(CN)_6\right]$

(iii) $\left[Co(en)_3\right]^{3+}$

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20. Write IUPAC names of the following coordination compounds $K_3\left[Fe(C_2O_4)_3\right]$

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21. Write IUPAC name of $K_2[PdCl_4]$

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22. Write IUPAC names of the following coordination compounds $\left[Pt(NH_3)_2Cl(NH_2CH_3)\right]Cl$

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23. List various types of isomerism possible for coordination compounds, giving an example of each.

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24. What are the linkage and ionisation isomerisms? Give one example in each case.

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25. What are coordination isomers and optical isomers. Explain with atleast one example.

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26. Explain geometrical isomerism with the help of suitable example.

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27. Give IUPAC name of the $\left[Cu(NH_3)_4\right]SO_4$

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28. Give IUPAC name of the $\left[Ag(NH_3)_2\right]Cl$

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29. What is the IUPAC name of complex $\left[Ni(NH_3)_6\right]Cl_2$?

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30. What type of isomerism is shown by $\left[Co(NH_3)_4Cl_2\right]^+$. Write the possible structures and state of hybridization of the central metal atom.

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31. Describe the postulates of Werner's coordination theory.

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32. A cyclic complex ion is more stable than an open one. Explain.

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33. Consider the complex ion, $\left[Co(NH_3)_3(H_2O)_2Cl\right]^+$ and answer the following :

Write the geometry of the complex ion.

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34. Consider the complex ion, $\left[Co(NH_3)_3(H_2O)_2Cl\right]^+$ and answer the following :

Identify the ligand's formula and the charge on each one of them.

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35. Write the postulates or salient features of valence bond theory. Using this theory deduce the structure of $\left[Cu(NH_3)_4\right]^{2+}$. Is it paramagnetic or diamagnetic ?

(Z for Ni=28).

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36. Using valence bond theory, explain the geometry of nickel carbonyl. Why is it not paramagnetic ?

(Z for Ni = 28).

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37. Explain that $K_4Fe(CN)_6$ is diamagnetic while $K_3Fe(CN)_6$ is paramagnetic.

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38. Why $Ni(CO_2)_4$ is tetrahedral while $\left[Ni(CN)_4\right]^{2-}$ is square planar?

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39. Describe the nature of bonding in metal carbonyls.

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40. Using the valence bond theory, predict the shape and magnetic behaviour of $\left[Cr(NH_3)_5Cl\right]^{2+}$ ion.

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41. Among $\left[Ag(NH_3)_2\right]Cl$, $\left[Ni(CN)_4\right]^{2-}$ and $[CuCl_4]^{2-}$ which has square planar geometry?

(Atomic number of Ag=47, Ni = 28, Cu= 29).

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42. Among $[Ag(NH_3)_2]Cl$, $[Ni(CN)_4]^{2-}$ and $[CuCl_4]^{2-}$ which remains colourless in aqueous solutions and why?

(Atomic number of Ag=47, Ni = 28, Cu= 29).

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43. $[Co(H_2O)_6]^{3+}$ is diamagnetic wheras $[Co(F_6)]^{3-}]$ is paramagnetic. Explain.

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44. $\left[Fe(H_2O)_6\right]^{3+}$ has five unpaired electrons while $\left[Fe(CN)_6\right]^{3-}$ has one unpaired electron. Explain.

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45. Giving suitable example, describe the importance of the formation of complex compounds in the extraction of particular metal from its natural source.

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46. (a) What is a ligand ? Give an example of a bidentate ligand.

(b) Explain as to how the two complexes of nickel,

$[Ni(CN)_4]^{2-}$ and $Ni(CO)_4$ have different structures but do not differ in their magnetic behaviour. (Ni = 28)

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47. (a) What is a ligand ? Give an example of a bidentate ligand.

(b) Explain as to how the two complexes of nickel, $[Ni(CN)_4]^{2-}$ and $Ni(CO)_4$ have different structures but do not differ in their magnetic behaviour. (Ni = 28)

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48. For the complex $[Fe(en)_2Cl_2]Cl$ (en = ethylene diamine) , identify

(i) the oxidation number of iron ,

(ii) the hybrid orbitals and the shape of the complex,

(iii) the magnetic behaviour of the complex ,

(iv) the number of geometrical isomers ,

(v) whether there is an optical isomer also , and

(vi) name of the complex . (At. no. of Fe = 26)

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49. For the complex $\left[Fe(en)_2Cl_2\right]Cl$ (en = ethylene diamine) , identify

(i) the oxidation number of iron ,

(ii) the hybrid orbitals and the shape of the complex,

(iii) the magnetic behaviour of the complex ,

(iv) the number of geometrical isomers ,

(v) whether there is an optical isomer also , and

(vi) name of the complex . (At. no. of Fe = 26)

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50. For the complex $\left[Fe(en)_2Cl_2\right]Cl$ (en = ethylene diamine) , identify

(i) the oxidation number of iron ,

(ii) the hybrid orbitals and the shape of the complex,

(iii) the magnetic behaviour of the complex ,

(iv) the number of geometrical isomers ,

(v) whether there is an optical isomer also , and

(vi) name of the complex . (At. no. of Fe = 26)

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51. For the complex $\left[Fe(en)_2Cl_2\right]Cl$ (en = ethylene diamine) , identify

(i) the oxidation number of iron ,

(ii) the hybrid orbitals and the shape of the complex,

(iii) the magnetic behaviour of the complex ,

(iv) the number of geometrical isomers ,

(v) whether there is an optical isomer also , and

(vi) name of the complex . (At. no. of Fe = 26)

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52. For the complex $\left[Fe(en)_2Cl_2\right]Cl$ (en = ethylene diamine) , identify

(i) the oxidation number of iron ,

(ii) the hybrid orbitals and the shape of the complex,

(iii) the magnetic behaviour of the complex ,

(iv) the number of geometrical isomers ,

(v) whether there is an optical isomer also , and

(vi) name of the complex . (At. no. of Fe = 26)

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53. For the complex $\left[Fe(en)_2Cl_2\right]Cl$ (en = ethylene diamine) , identify

(i) the oxidation number of iron ,

(ii) the hybrid orbitals and the shape of the complex,

(iii) the magnetic behaviour of the complex ,

(iv) the number of geometrical isomers ,

(v) whether there is an optical isomer also , and

(vi) name of the complex . (At. no. of Fe = 26)

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54. Compare the following complexes with respect to their shape , magnetic behaviour and the hybrid orbitals involved :

(i)

$[CoF_4]^{2-}$ $(ii)\left[Cr(H_2O)_2(C_2O_4)_2\right]^-$ $(iii)\left[Ni(CO)_4\right]$

(Atomic number : Co = 27 , Cr = 24 , Ni = 28)

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55. Compare the following complexes with respect to their shape , magnetic behaviour and the hybrid orbitals involved :

(i)

$[CoF_4]^{2-}$ $(ii)\left[Cr(H_2O)_2(C_2O_4)_2\right]^-$ $(iii)\left[Ni(CO)_4\right]$

(Atomic number : Co = 27 , Cr = 24 , Ni = 28)

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56. Compare the following complexes with respect to their shape , magnetic behaviour and the hybrid orbitals involved :

(i)

$[CoF_4]^{2-}$ $(ii)\left[Cr(H_2O)_2(C_2O_4)_2\right]^-$ $(iii)\left[Ni(CO)_4\right]$

(Atomic number : Co = 27 , Cr = 24 , Ni = 28)

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57. Giving a suitable example for each , explain the following :

(i) Crystal field splitting

(ii) Linkage isomerism

(iii) Ambidentate ligand

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58. Giving a suitable example for each , explain the following :

(i) Crystal field splitting

(ii) Linkage isomerism

(iii) Ambidentate ligand

Watch Video Solution

59. Explain the following terms giving a suitable in each case :

(i) Ambident ligand

(ii) Denticity of a ligand

(iii) Crystal field splitting in a octahedral field

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60. Compare the following complexes with respect to structural shapes of units, magnetic behaviour and hybrid orbitals involved in units

$[Co(NH_3)_6]^{3+}, [Cr(NH_3)_6]^{3+}, [Ni(CO)_4]$

$[At.\ Nos. : Co = 27, Cr = 24, Ni = 28]$

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61. A metal ion M^{n+} having d^4 valence electronic configuration combines with three didentate ligands to form a complex compound. Assuming $\Delta_o > P$

draw the diagram showing d-orbital splitting during this complex formation.

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62. A metal ion M^{n+} having d^4 valence electronic configuration combines with three didentate ligands to form a complex compound. Assuming $\Delta_o > P$

write the electronic configuration of the valence electrons of the metal M^{n+} ions in terms of t_{2g} and e_g.

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63. A metal ion M^{n+} having d^4 valence electronic configuration combines with three didentate ligands to form a complex compound. Assuming $\Delta_o > P$

What type of hybridization will M^{n+} ion have ?

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64. A metal ion M^{n+} having d^4 valence electronic configuration combines with three didentate ligands to form a complex compound. Assuming $\Delta_o > P$

Name the type of isomerism exhibited by this complex.

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65. Give IUPAC name of $\left[CrCl_2(H_2O)_4\right]Cl$

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66. Give the number of unpaired electrons in the following complex ions:

$[FeF_6]^{4-}$ and $\left[Fe(CN)_6\right]^{4-}$

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67. What type of isomerism is shown by $\left[Co(NH_3)_5\right]SO_4$ and $\left[Co(NH_3)_5SO_4\right]Br$?

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68. Give the electronic configuration of the d-orbitals of Ti in $\left[Ti(H_2O)_6\right]^{3+}$ ion in an octahedral crystal field.

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69. a) Give the electronic configuration of the d-orbitals of Ti in $\left[Ti(H_2O)_6\right]^{3+}$ ion in the octahedral crystal field.

b) Why is this complex coloured ? Explain on the basis of distribution of electrons in d-orbitals.

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70. Give the electronic configuration of the How does the colour change on heating $\left[Ti(H_2O)_6\right]^{3+}$ ion?

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71. How is stability of coordination compounds determined in aqueous solution ?

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72. Square planar complexes with a coordination number four exhibit geometrical isomerism whereas tetrahedral complexes do not, why?

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73. The spin only magnetic moment of `[MnBr_4]^(2-) is 5.9 B.M. Predict the geometry of the complex ion.

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74. Explain why a chelating complex is more stable than unchelated complex.

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Exercise Part Ii Descriptive Questions Long Answer Questions

1. Explain with two examples each of the following: coordination entity, ligand, coordination number,

coordination polyhedron, homoleptic and heteroleptic

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2. What is meant by unidentate, didentate and ambidentate ligands? Give two examples for each.

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3. Describe the postulates of Werner's coordination theory.

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4. Write the main postulates of valence bond theory and explain the geometry and magnetic character

(paramagnetism or diamagnetism) in the $\left[Cu(NH_3)_4\right]^{2+}$

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5. Write the main postulates of valence bond theory and explain the geometry and magnetic character (paramagnetism or diamagnetism) in the $Ni(CO)_4$

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6. Write the main postulates of valence bond theory and explain the geometry and magnetic character (paramagnetism or diamagnetism) in the $[FeF_6]^{3-}$.

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7. Using valence bond theory of complexes explain the geometry and diamagnetic nature of the ion, $\left[Co(NH_3)_6\right]^{3+}$.

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8. Take one example of complex compound involving d^2sp^3 hybridization and explain magnetic character of that. Alsoexplain structure of $\left[Ni(CN)_4\right]^{2-}$.

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9. Name two factors which influence the stability of a complex.

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10. What do you understand by the term stability constant, Ks of a complex ? Knowing that the value of Ks for $\left[Cu(NH_3)_4\right]^{2+}$ is 4.5×10^{11} and for $\left[Cu(CN)_4\right]^{2-}$ is 2.0×10^{27}. Suggest (a) which complex species will furnish less Cu^{2+} ions in solution and (b) which out of NH_3 and CN^- is a stronger base ?

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11. What is an ambident group ?

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12. Select a complex formation reaction and write an expression for the stability constant of the complex species. What information is conveyed regarding the strength of ligands from the stability constant values of their complexes with a metal ion? Illustrate your answer with examples of monodentate ligands.

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13. Give the applications of coordination compounds in life process.

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14. Give the applications of coordination compounds in analytical chemistry.

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15. Give the applications of coordination compounds in metallurgy.

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16. Give the applications of coordination compounds in photography.

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Isc Examination Question Part I Objective Questions

1. The hybridization of iron atom in $\left[Fe(CN)_6\right]^{3-}$ complex is

A. sp^3

B. d^2sp^3

C. sp^3d^2

D. dsp^2

Answer: B

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2. Among the following coordination compounds, the one giving a white ppt. with $BaCl_2$ is

A. $\left[Cr(H_2O)_5Br\right]SO_4$

B. $\left[Cr(H_2O)_5SCN\right]$

C. $\left[Co(NH_3)_5SO_4\right]Br$

D. $\left[Pt(NH_3)_6\right]Cl_4$

Answer: A

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3. In the complexes $\left[Fe(CN)_6\right]^{3-}$ and $\left[Pt(en)(H_2O)_2(NO_2)(Cl)\right]^{2+}$ the

respective oxidation numbers of central metal atoms are :

A. + 3 and +4

B. + 6 and + 4

C. + 6 and + 3

D. + 3 and + 3

Answer: A

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4. The complex ion $\left[Ni(CN)_4\right]^{2-}$ is :

A. Square planar and diamagnetic

B. Tetrahedral and paramagnetic

C. Square planar and paramagnetic

D. Tetrahedral and diamagnetic

Answer: A

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Isc Examination Question Part Ii Descriptive Questions

1. Name the type of isomerism shown by the pair of co-ordination compounds:

$[Co(NH_3)_5NO_2]Cl_2$ and $[Co(NH_3)_5ONO]Cl_2$

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2. Name the type of isomerism shown by the pair of co-ordination compounds:

$[Cr(H_2O)_5Cl]Cl_2.\ H_2O$ and $[Cr(H_2O)_4Cl_2]Cl.2H_2O$

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3. Name the type of isomerism shown by the following pair of compounds :

$[PtCl_2(NH_3)_4Br_2$ and $[PtBr_2(NH_3)_4]Cl_2$

Give a chemical test to distinguish between the given pair of isomers.

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4. Draw the geometrical isomers exhibited by the compound $\left[PtCl_2(NH_3)_2\right]$

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5. Write the formulae of the following coordination compound tetracarbonylnickel (0)

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6. Write the formulae of the following coordination compound potassium dicyanoargentate (I).

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7. Give the IUPAC names for the following :

(i) $Na_3[AIF_6]$

(ii) $\left[Co(NH_3)_6\right]Cl_3$

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8. Using IUPAC norms write the systematic names of the $\left[Co(NH_3)_6\right]Cl_3$

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9. For the complex ion of $\left[Fe(CN)_6\right]^{3-}$:

Show the hybridization diagrammatically.

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10. For the complex ion of $\left[Fe(CN)_6\right]^{3-}$:

Is it an inner orbital complex or an outerorbital complex ?

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11. For the complex ion of $\left[Fe(CN)_6\right]^{3-}$:

State its magnetic property.

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12. Write the formulae of the following coordination compound Potassium tetracyanonickel (0)

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13. Write the formulae of the following coordination compounds :

triamminetrinitrocobalt(III).

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14. $[CoF_6]^{3-}$ is a coordination complex ion.

What is the oxidation number of cobalt in the complex?

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15. $[CoF_6]^{3-}$ is a coordination complex ion.

How many unpaired electrons are there in the complex ?

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16. $[CoF_6]^{3-}$ is a coordination complex ion.

State the magnetic behaviour of the complex.

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17. $[CoF_6]^{3-}$ is a coordination complex ion.

Give the I.U.P.A.C. name of the complex.

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18. Draw the structural isomer of $[Co(NH_3)_5NO_2]Cl_2$ and name the type of isomerism.

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19. Give the IUPAC names of the following coordina tion compounds :

$K_2\left[Zn(OH)_4\right]$

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20. Give the IUPAC names of the following compound

$\left[Co(NH_3)_5CO_3\right]Cl$

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21. For the complex ion $\left[Fe(CN)_6\right]^{3-}$ state The geometry of the ion.

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22. For the complex ion of $\left[Fe(CN)_6\right]^{3-}$:

State its magnetic property.

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23. What type of structural isouters are $\left[Co(NH_3)_5Br\right]SO_4$ and $Co\left[(NH_3)_5SO_4\right]Br$? Give a chemical test to distinguish the isomers.

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24. Write the formula of the following compounds :

Triamminetriaquachromium (III) chloride.

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25. Write the formula of the following compounds :

Potassiumhexacyanoferrate (III).

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26. Name the types of isomerism shown by the following pairs of compound $[CoCl(H_2O)(NH_3)_4]Cl_2$ and $[CoCl_2(NH_3)_4]Cl.\ H_2O$

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27. Name the types of isomerism shown by the following pairs of compound $[Pt(NH_3)_4][PtCl_6]$ and $[Pt(NH_3)_4Cl_2][PtCl_4]$

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28. For the complex ion of $[Co(NH_3)_6]^{3+}$

State the hybridization of the complex.

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29. For the complex ion of $[Co(NH_3)_6]^{3+}$:

State the magnetic nature of the complex.

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30. Write the IUPAC names of the following coordination compound $\left[Cr(NH_3)_4(H_2O)_2\right]Cl_3$

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31. Write the IUPAC names of the following coordination compound $\left[PtCl_2(NH_3)_4[PtCl_4]\right]$

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32. State the hybridization and magnetic property of $\left[Fe(CN)_6\right]^{3-}$ ion according to the valence bond theory.

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33. What type of isomerism is shown by $[Co(NH_3)_5]SO_4$ and $[Co(NH_3)_5SO_4]Br$?

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34. Name the following coordinates entities and draw the structures of their stereoisomers :

(i) $[Co(en)_2Cl_2]^+$ (en = ethan-1,2-diamine

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

(iii) $[Co(NH_3)_3Cl_3]$

(Atomic number Cr = 24 , Co = 27)

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35. Write the IUPAC name of the $[Co(NH_3)_4SO_4]NO_3$.

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36. Write the IUPAC name of the $K[Pt(NH_3)Cl_3]$

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37. What type of isomerism is exhibited by the following pairs of compounds :

$[PtCl_2(NH_3)_4]Br_2$ and $[PtBr_2(NH_3)_4]Cl_2$

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38. What type of isomersism is exhibited by the following pairs opf compound $[Cr(SCN)(H_2O)_5]^{2+}$ and $[Cr(NCS)(H_2O)_5]^{2+}$

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39. How does $K_2[PtCl_4]$ gets ionized when dissolved in water? Will it form precipitate when $AgNO_3$ solution is added to it? Give a reason for your answer.

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