PYQs FROM THE CHAPTER "CO-ORDINATION COMPOUNDS"

1) The crystal field splitting energy for Octahedral (Δo) and Tetrahedral (Δt) complexes are related as
   (a) $\Delta t = 3/5\Delta o$ (b) $\Delta t = 5/3\Delta o$ (c) $\Delta t = 4/9\Delta o$ (d) $\Delta t = 9/4\ \Delta o$ (1)
2) Write the IUPAC name of the following :
   (i) $[Ni(CO)_4]$ (ii) $K_4[Fe(CN)_6]$ (2)

3) Draw the geometrical isomers of $[PtCl_2(en)_2]^{2+}$. Which among the isomer is optically active? Give reason. (4) [SAY 2019]
4) Identify the co-ordination compound which can exhibit linkage isomerism, among the following:
   (a) $[Pt(NH_3)_2Cl_2]$ (b) $[Co(NH_3)_5(SO_4)]Br$ (c) $[Co(NH_3)_5(NO_2)]Cl_2$ (d) $[Cr(NH_3)_6][CoF_6]$ (1)
4) (i) With the help of a diagram give the splitting of d-orbitals of Mn^{2+} ion in an octahedral crystal field. (2)
   (ii) On the basis of crystal field theory, explain why $[Mn(H_2O)_6]^{2+}$ contains five unpaired electrons while $[Mn(CN)_6]^{4-}$ contains only one unpaired electron. (2) [March 2019]
5) Write the IUPAC names of the following compounds :
   (a) $[Ni(CO)_4]$
   (b) $K_3[Fe(C_2O_4)_3]$ (2)

6) Draw a diagram depicting crystal field splitting in an octahedral environment of d-orbitals. Label the diagram properly. Calculate the crystal field stabilization energy for a d^3 configuration. (4) [SAY 2018]
7) Explain how the complexes of nickel, $[Ni(CN)_4]^{2-}$ and $[Ni(CO)_4]$ have different structures, but do not differ in their magnetic behaviour. (Atomic no. of Ni = 28) (2)
8) (a) Draw the structures of geometrical isomers of $[Fe(NH_3)_2(CN)_4]^-$ (2)
   (b) Write the formula of pentaamminecarbonatocobalt (III) chloride. (1)
   (c) Write any two limitations of valance bond theory. (1) [March 2018]
9) a) In which of the following, the central atom/ion is in zero oxidation state.
   i) $[Ni(CN)_4]^{2-}$ ii) $[NiCl_4]^{2-}$ iii) $[Ni(CO)_4]$ iv) $[Ni(NH_3)_6]^{2+}$ (1)
   b) $[Ni(CN)_4]^{2-}$ has square planar structure and it is diamagnetic.
   i) On the basis of valence bond theory explain why $[Ni(CN)_4]^{2-}$ exhibit these properties. (2)
   ii) Identify the ligand in the above mentioned complex. (1) [SAY 2017]
10) $[Co(NH_3)_5SO_4]Cl$ and $[Co(NH_3)_5Cl]SO_4$ are co-ordination compounds.
   a) Identify the isomerism shown by the above compounds. (1)
   b) Write the IUPAC names of the above compounds. (2)
   c) Identify the ligands in each of the above compounds. (1) [March 2017]
11) Consider the co-ordination compound $[Co(NH_3)_5Cl]Cl_2$.
   a) Write the IUPAC name of the above compound. (1)
   b) i) What is the primary valency and secondary valency of the central metal ion in the above co-ordination compound? (1)
   ii) Write the name of isomerism exhibited by the complex $[Pt(NH_3)_2Cl_2]$. Represent the possible isomers. (2) [SAY 2016]
12) a) Write down the ionization isomer of $[Co(NH_3)_5Cl]SO_4$. (1)
   b) Write the IUPAC name of the above compound. (1)
   c) $[Ni(CO)_4]$ is diamagnetic while $[NiCl_4]^{2-}$ is paramagnetic though both are tetrahedral. Why? (2)
   [March 2016]

13) a) Write the IUPAC name of the complex $K_3[Cr(C_2O_4)_3]$. (1)

b) Draw the figure to show the splitting of 'd' orbitals in octahedral crystal field. (1)

c) $[Fe(H_2O)_6]^{3+}$ is strongly paramagnetic, whereas $[Fe(CN)_6]^{3-}$ is weakly paramagnetic. Write the reason. (2)

[SAY 2015]

14) Co-ordination compounds contain central metal atom/ion and ligands.

a) Primary valency of central metal atom/ion in $[Co(NH_3)_6]Cl_3$ is:

i) 3 ii) 6 iii) 4 iv) 9 (1)

b) i) What are the postulates of Werner's theory? (2)

ii) Write the IUPAC names of $K_3[Fe(CN)_6]$ and $[Co(NH_3)_6]Cl_3$. (1) [March 2015]

15) $[Co(NH_3)_5SO_4]Cl$ is an octahedral co-ordination compound.

a) Write the IUPAC name of the above compound. (1)

b) Write the formula of the ionization isomer of the above compound. (1)

c) How do d - orbitals split in an octahedral crystal field? (1)

d) Draw the diagram which indicates the splitting of d-orbitals in tetrahedral field. (1) [March 2014]

16) a) Valence Bond Theory (VBT) can explain the magnetic behaviour and shape of complexes. Using VBT explain the diamagnetism and square planar shape of $[Ni(CN)_4]^{2-}$. (2)

b) i) Suggest the shape of the following complexes – $[Ni(CO)_4]$ and $[CoF_6]^{3-}$ (1)

ii) The central ion Co^{3+} with co-ordination number 6 is bonded to the ligands NH_3 and Br^- to form a dipositive complex ion. Write the formula or IUPAC name of the complex ion. (1) [SAY 2014]

17) Many theories have been put forth to explain the nature of bonding in co-ordination compounds.

a) On the basis of valence bond theory account for the diamagnetic behaviour of $[Ni(CN)_4]^{2-}$. (1½)

b) What is the shape of the above complex? (½)

c) Arrange the following ligands in the increasing order of their field strengths (as in spectro chemical series).

Cl^-, CO, H_2O, OH^- (1) [SAY 2013]

18) The magnetic behaviour of a complex can be explained on the basis of Valence Bond (V.B) theory.

a) $[Co(NH_3)_6]^{3+}$ is a diamagnetic complex and $[CoF_6]^{3-}$ is a paramagnetic complex. Substantiate the above statement using V.B theory. (3)

b) Classify the above mentioned complexes into inner orbital and outer orbital complexes. (1)

[March 2011 & 2013]

19) $[Cr(NH_3)_5CO_3]Cl$ is a co-ordination compound.

a) Name the central metal ion of the above compound. (1)

b) What is the IUPAC name? (1)

c) Name the ligands present in the above compound. (1)

d) Whether the ligands present in the above compound are ambidentate ligands? Why? (1)

e) What is the ionisation isomer of the above mentioned co-ordination compound? (1) [SAY 2012]

20) Consider the co-ordination compound $[Co(NH_3)_5SO_4]Br$.

a) Write the IUPAC name of the above co-ordination compound. (1)

b) What are the primary and secondary valencies of the central metal cobalt in the above co-ordination compound? (1)

c) Which type of structural isomerism is exhibited by the above co-ordination compound? (1) [March 2012]

21) The central ion Ag+ with co-ordination number 2 forms a positive complex ion with NH_3 ligand. Also Ag+ forms a negative complex with CN- ligand.

a) Write the formulae of the above positive and negative complex ions. Give the IUPAC name of each. (2)

b) Give the denticity of NH_3 and CN^- ligands. (1)

c) Write the formula and name of a hexadentate ligand. (1) [SAY 2011]

22) $[Cr(NH_3)_4Cl_2]Br$ is a co-ordination compound.

a) Identify the central metal ion of the above compound. (½)

b) Name the ligands present in it. (1)

c) What is its co-ordination number? (½)

d) Write the IUPAC name. (1)

e) Write the ionisation isomer of the above compound. (1) [March 2010]

23) Na_2EDTA is used in the estimation of hardness of water.

a) Draw the structure of $EDTA^{4-}$. (1)

b) What is its denticity? (½)

c) What are the donor atoms in it? (½)

d) Why is it called a chelating ligand? (1) [March 2010]

24) a) NO_2^- and ONO^- constitute ambidentate ligands. Give another set of ambidentate ligands. (1)

b) $EDTA^{4-}$ is a chelating ligand. Give two other examples. (1)

c) Give the denticity of NO_2^- and NH_3. (1) [March 2010]

25) The central metal ion Co^{3+} with co-ordination number 6 can form a series of complexes in which both Cl^- and NH_3 are acting as ligands.

a) Give the formulae of each complex molecule (three molecules). (1½)

b) Give the IUPAC names of the above complexes. (1½) [March 2009]

26) A list of co-ordination compounds are given below: $[PtCl_2(NH_3)_2]$, $[PtCl_2(NH_3)_4]Br_2$, $[Cr(H_2O)_6]Cl_3$.
Which type of isomerism do these compounds exhibit? (3) [March 2008]

27) Teacher asked two students to write the electronic configuration of d^4 system using CFT.
Student I: $t_{2g}^3\ e_g^1$
Student II: $t_{2g}^4\ e_g^0$

a) Suggest which student gives correct configuration. Justify your answer. (2)

b) Draw figure to show splitting of degenerate'd' orbitals in an octahedral crystal field. (1) [SAY 2008]

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