CBSE Test Paper-03

Class - 12 Chemistry (Coordination Compounds)

1. The oxidation number of cobalt in $K[Co(CO)_4]$ is
   a. -1
   b. +1
   c. -3
   d. +3
2. Lithiumtetrahydridoaluminate is represented as
   a. $Al_2[LiH_4]_3$
   b. $Li[AlH_4]_2$
   c. $Al[\ LiH_4]$
   d. $Li[AlH_4]$
3. Which among the following has trigonal bipyramidal geometry?
   a. Pentacarbonyliron (0)
   b. Potassium tetracyanidonickelate(II)
   c. Tetracarbonylnickel(0)
   d. Hexaamminecobalt(II) nitrate
4. The correct name of the compound $[Cu(NH_3)_4](NO_3)_2$ is
   a. Cuprammonium nitrate
   b. Tetraamminecopper(I) nitrate
   c. Tetraamminecopper(II) nitrate
   d. Tetraamminecopper(II)dinitrate
5. Which of the following complex species involves d^2sp^3 hybridization?
   a. $[Cr(NH_3)_6]^{3+}$
   b. $[Fe(CN)_6]^{3-}$
   c. $[Co(N\{H_3)_6]^{3+}$
   d. $[CoF_6]^{3-}$

6. What is the coordination number of central metal ion in $[Fe(C_2O_4)_3]^{3-}$?
7. What are complex compounds?
8. Name the metal present in haemoglobin.
9. Explain why a chelating complex is more stable than unchelated complex.
10. Give IUPAC name of linkage isomer of $[(NH_3)_3Pt(NO_2)]Cl$.
11. Describe briefly the nature of bonding in metal carbonyl.
12. Draw the structures of the given:
    i. cis-dichloro tetracyano chromate III
    ii. pentaammine nitrite-N-cobalt (III)
    iii. Hexamethyldialuminium.
13. a. What are ambidentate ligands? Give example.
    b. Write the IUPAC names of the following:
        i. $K_3[Fe(C_2O_4)_3]$
        ii. $Pt[(NH_3)_6]Cl_4$
    c. Draw the structure of cis isomer of $[Co(NH_3)_4Cl_2]^+$
14. $[Fe(CN)_6]^{4-}$ and $[Fe(H_2O)_6]^{2+}$ are different colours in dilute solution why?
15. Write the formulas for the following coordination compounds:
    i. Tetraamminediaquacobalt (III) chloride
    ii. Potassium tetracyanonickelate (II)
    iii. Tris(ethane-1,2-diamine) chromium(III) chloride
    iv. Amminebromidochloridonitrito-N-platinate (II)
    v. Dichloridobis(ethane-1,2-diamine)platinum(IV) nitrate
    vi. Iron(III) hexacyanoferrate (II)

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Solutions

1. (a) -1

   Explanation: Potassium ion K^+ carries a +1 charge. So the overall charge on the given complex is -1. Now CO is a neutral ligand. Hence the oxidation number of Co in this complex is -1.

2. (d) $Li[AlH_4]$

   Explanation: The cation is named first and then the anion. When the anion is the complex then the -ate is added to the name of the central metal. Here there are 4 hydride ligands represented as H^- each carries a charge of -1 and hence a total of -4 charge on the ligands. Lithium ion is represented by Li^+ and carries a +1 charge which means the charge on the complex is -1. In the complex, central metal atom/ion is written followed by the ligands in alphabetical order.
   Lithium tetrahydridoaluminate(III) is $Li[AlH_4]$.

3. (a) Pentacarbonyliron (0)

   Explanation: Iron (Z=26) has an electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2$. CO being a strong field ligand, causes pairing of electrons in the d orbital and shifting of 4s electrons to 3d orbital. With a coordination number 5 it results in $sp^3 d$ hybridisation and hence a trigonal bipyramidal geometry.

4. (c) Tetraamminecopper(II) nitrate

   Explanation: In ionic compound, cation is named first and then the anion. If cation is the complex then ligands are named first in alphabetical order and then the central metal atom/ion with its oxidation state in paranthesis in roman numerals. Here, NH_3 (ammine) is the neutral ligand and there are 4 NH_3 bound to Cu (copper). Nitrate NO_3^- is the anion there are two NO_3^- outside the square bracket each carries -1 charge so there is a total of -2 charge on anions and thus the complex carries a total of +2 charge. Since ammine is a neutral ligand so Cu has +2 oxidation state. So, $[Cu(NH_3)_4](NO_3)_2$ is tetraamminecopper(II) nitrate.

5. (b) $[Fe(CN)_6]^{3-}$

   Explanation: In this complex there are 6 CN^- ligands means a total of -6 charge on ligands. There is a charge of -3 on the complex so oxidation state of Fe is +3. Atomic number of Fe is 26. So the electronic configuration of Fe^{+3} is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3$.Coordination number of the metal is 6 so the complex has octahedral geometry and since CN^- is a strong field ligand so it causes pairing and hence inner orbital complex is formed. So the hybridization is $d^2 sp^3$.

6. Six

7. Complex compounds or coordination compounds are those compounds in which the metal atoms are bound to a number of anions or neutral molecules.

8. Fe

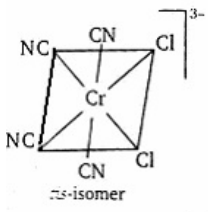
9. Chelating complex is more stable than unchelated complex because there is strong force of attraction between cation and polydenatate ligand as compared to monodentate ligand.

10. The linkage isomer is $[Pt(ONO)(NH_3)_3]Cl$

    IUPAC Name - triaminenitrito-o-platinum II chloride.

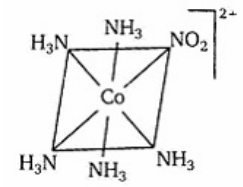
11. The metal carbon bond in metal carbonyls possess both S & P character. The M-C σ bond is formed by the donation of lone pair of electrons on the carbonyl carbon into a vacant orbital of the metal. M-C π bond is formed by the donation of a pair of electrons from a filled d-orbital of metal into the antibonding πorbital of carbon monoxide.

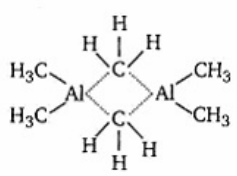
12. i.



cis-isomer

ii.



iii. 

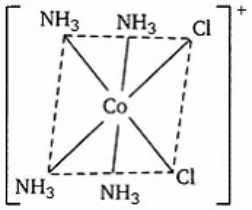
13. a. Ambidenctate ligand. Ligands which can ligate (link) through two different atoms present in it are called ambidentate ligands, e.g. NO_2^-, SCN^-, $\underset{Thiocyanato}{M \leftarrow SCN}$

$\underset{Isothiocyanato}{M \leftarrow NCS}$

b. i. Potassium Trioxalato Ferrate (III)

ii. Hexaamine platinum (IV) chloride

c. cis- $[Co(NH_3)_4Cl_2]^+$



14. In both the complexes, Fe is in +2 state with the configuration $3d^6$, i.e. it has four unpaired electrons.

As the ligands H_2O and CN^- posses different crystal field splitting energy (Δ_0) they absorb different components of the visible light (VIBGYOR) for d-d transition. Hence, the transmitted colours are different.

15. i. $[CO(H_2O)_2(NH_3)_4]Cl_3$

ii. $K_2[Ni(CN)_4]$

iii. $[Cr(en)_3]Cl_3$

iv. $[Pt(NH)_3BrCl(NO_2)]^-$

v. $[PtCl_2(en)_2](NO_3)_2$

vi. $Fe_4[Fe(CN)_6]_3$