CBSE Test Paper-01

Class - 12 Chemistry (Coordination Compounds)

1. Tetraaminecopper(II) ion is a square planar complex with one unpaired electron. According to valence bond theory the hybrid state of copper should be
   a. dsp^2
   b. sp^3d^2
   c. d^2sp^3
   d. sp^3
2. Which of the following pair contains a complex salt and double salt respectively?
   a. $[Cu(NH_3)_4]SO_4$, $FeSO_4.7H_2O$
   b. $FeSO_4$, $K_4[Fe(CN)_6]$
   c. $MgSO_4.7H_2O$, $CuSO_4$
   d. $[Cu(NH_3)_4]SO_4$, $K_2SO_4.Al_2(SO_4)_3.24H_2O$
3. The type of isomerism that is exhibited by $[Co(NH_3)_5SO_4]Br$ and $[Co(NH_3)_5Br]SO_4$ is:
   a. Linkage isomerism
   b. Solvate isomerism
   c. Ionisation isomerism
   d. Coordination isomerism
4. The oxidation number of Fe in $K_4[Fe(CN)_6]$ is
   a. 0
   b. +1
   c. +3
   d. +2
5. The anti pernicious anaemia factor which is a coordination compound of Cobalt is:
   a. Cyanocobalamine
   b. Haemoglobin
   c. Desferrioxime B
   d. Carbonic anhydrase
6. Write formula for Hexammineplatinum (VI) Chloride.

7. What is the coordination number of central metal ion in $[Fe(C_2O_4)_3]^{2-}$.
8. Write formula forTetramminedichloridooplatinum (IV) Bromide.
9. What are the different shapes or coordination polyhedra in the complexes?
10. Name a ligand which is bidentate and give an example of the complex formed by this ligand.
11. Give the chemical formula of pentaammine chloro cobalt (III) chloride.
12. $[NiCl_4]^{2-}$ is paramagnetic while $[Ni(CO)_4]$is diamagnetic though both are tetrahedral. Why?
13. Draw the structures of following:
    a. cis-dichlorotetracyanochromate(III)
    b. Pentaamminenitrito-N-cobalt(III)
    c. Hexamethyldialuminium
14. Which isomerism is shown by a compound having ambidentate ligand? Give example.
15. Explain with two examples each of the following: Coordination entity, ligand coordination number, coordination polyhedron, homoleptic and heteroleptic.

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Solutions

1. (a) dsp^2

   Explanation: Tetraaminecopper(II) ion is square planar. Square planar complexes have dsp^2 hybridisation. So hybridization is dsp^2.
2. (d) $[Cu(NH_3)_4]SO_4$, $K_2SO_4.Al_2(SO_4)_3.24H_2O$

   Explanation: $[Cu(NH_3)_4]SO_4$ this is a complex salt because it contains a coordination entity (central metal ion Cu^{2+} with 4 ligand molecules of NH_3 in coordination sphere) while $K_2SO_4.Al_2(SO_4)_3.24H_2O$ is double salt as it can dissociate completely into simple ions when it is dissolved in water.
3. (c) Ionisation isomerism

   Explanation: Ionisation isomerism arises when the counter ion in a complex salt is itself a potential ligand and can displace a ligand which can then become a counter ion. Here Br^- and SO_4^{2-} exchanged places as counter ion and ligand. So these complexes exhibit ionisation isomerism.
4. (d) +2

   Explanation: The ligand CN^- has charge of –1. So the overall charge carried by 6 CN^- ligands is -6. Each potassium ion K^+ carries a charge of +1. So 4 potassium ions carry an overall charge of +4. This implies that the overall charge on the coordination sphere is -4 to balance the +4 charge of the potassium ions. Let the oxidation number of Fe be x. Then

   x + (-6) = -4

   x = -4 - (-6)

   x = -4 + 6

   x = +2

   So, the oxidation number of Fe is +2.
5. (a) Cyanocobalamine

   Explanation: Vitamin B_{12}, cyanocobalamine, the antipernicious anaemia factor is a coordination compound of Cobalt.

6. [Pt $(NH_3)_6$]Cl_6

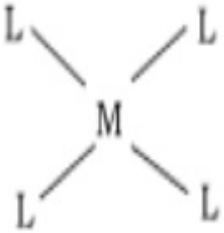
7. Six

8. [Pt $Cl_2(NH_3)_4$]Br_2

9. The various coordination polyhedra are –
   i. Octahedral

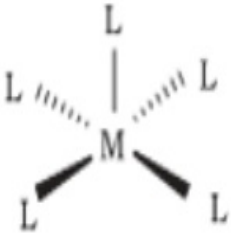
   ii. Tetrahedral

   iii. Square Planar



   iv. Trigonal bipyramidal

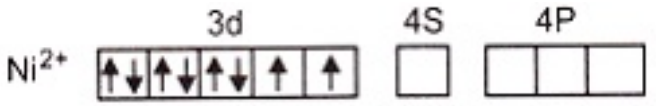
   v. Square pyramidal



10. Ethylene diamine (en) is bidentate ligand $[Co(en)_3]^{3+}$. Its IUPAC name is tris (ethylene diamine) cobalt (III) ion.

11. $[CO(NH_3)_5Cl]Cl_2$

12. In $[NiCl_4]^{2-}$ Ni is in +2 oxidation state electronic configuration = $3d^8 4s^0$.

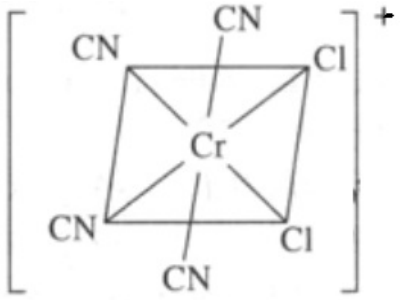


Cl^- is a weak ligand. It cannot pair up the electrons in 3d orbitals. Hence, it is paramagnetic. In $[Ni(CO)_4]$, Ni is in zero oxidation state and configuration is $-3d^8 4s^2$.

In the presence of CO ligand, the 4S electrons shift to 3d to pair up 3d electrons. Thus, there is no unpaired electron present. Hence it is diamagnetic.

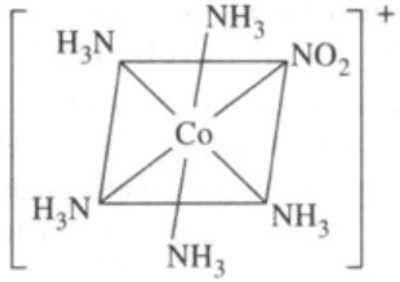
13. Structures of the three complex ions/molecules are given below:

a.

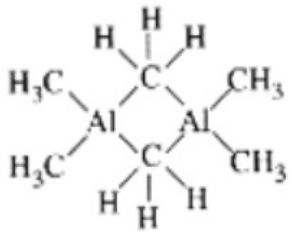


cis-isomer

b.



c.



14. A complex having ambident ligand will show linkage isomerism e.g $[Cr(NH_3)_5(NO_2)]Cl_2$

has NO_2^- as ambident Ligand and its Linkage isomer will be $[Cr(NH_3)_5(ONO)]Cl_2$.

15. **Coordination** entity: This entity usually constitutes a central metal atom or ion, to which are attached a fixed number of other atoms or ions or groups by coordinate bonds. Examples are $[Ni(CO)_4]$, $[COCl_3(NH_3)_3]$, etc.

    Ligands: It is an ion having at least one lone pair of electrons and capable of forming a coordinate bond with central atom / ion in the coordination entity.

    Examples are : Cl^-, $(OH)^-$, $(CN)^-$etc.

    Coordinate number: The total number of coordinate bonds with which central atom/ ion is linked to ligands in the coordination entity is called coordination number of central atom / ion.

    Coordination polyhedron : The spatial arrangement of the ligands which are directly attached to the central atom / ion defines a coordination polyhedron about the central atom.

    Examples are: $[Co(NH_3)_6]^{3+}$is octahedral,

    $[Ni(CO)_4]$is tetrahedral.

    Homoleptic and hedroleptic: Complexes in which a metal is bound to only one kind of donor groups are known as homoleptic.

    Example $[CO(NH_3)_6]^{3+}$

    Complex in which a metal is bound to more than one kind of donor groups are called hetroleptic. Example : $[Co(NH_3)_4Cl_2]^+$