UNIT—9

CO-ORDINATION COMPOUNDS

1 MARK & 2 MARKS QUESTIONS

Q. 1. A cationic complex has two isomers A & B. Each has one Co^{3+}, five NH_3, one Br and one SO_4^{2}. A gives a white precipitate with $BaCl_2$ solution while B gives a yellow precipitate with $AgNO_3$ solution.

(a) What are the possible structures of the complexes A and B ?

(a) Will the two complexes have same colour ?

Ans. (a) $[CO(NH_3)_5 Br] SO_4$ and $[CO(NH_3)_5 SO_4] Br$

(b) NO

Q. 2. $FeSO_4$ solution mixed with $(NH_4)_2SO_4$ solution in 1 : 1 molar ratio gives the test of Fe^{2+} ion but $CuSO_4$ solution mixed with aqueous ammonia in 1 : 4 molar ratio does not give the test of Cu^{2+} ion. Explain why ?

Ans. When $FeSO_4$ and $(NH_4)_2SO_4$ solution are mixed in 1 : 1 molar ratio, a double salt is formed. It has the formula $FeSO_4 (NH_4)_2SO_4 . 6 H_2O$. In aqueous solution, the salt dissociates.

When $CuSO_4$ and NH_3 are mixed in the molar ratio of 1 : 4 in solution, a complex $[Cu(NH_3)_4] SO_4$ is formed.

Q. 3. If to an aqueous solution of $CuSO_4$ in two tubes, we add ammonia solution in one tube and HCl (aq) to the other tube, how the colour of the solutions will change ? Explain with the help of reaction.

Ans. In first case, colour will change from blue to deep blue.

$$[Cu(H_2O)_4]^{2+} + 4\ NH_3 \longrightarrow [Cu(NH_3)_4]^{2+} + 4\ H_2O$$

deep blue

While in second case, its colour will change to yellow.

$$[Cu(H_2O)_4]^{2+} + 4\ Cl^- \longrightarrow [CuCl_4]^{2+} + 4\ H_2O$$

www.AnkitGuptaClasses.weebly.com
gupta.ankit54@yahoo.com
ankitgupta.gupta175@gmail.com
9899875480,
9541241201

yellow

Q. 4. A, B and C are three complexes of Chromioum with the empirical formula $H_{12}O_6Cl_3Cr$. All the three complexes have Cl and H_2O molecules as the ligands. Complex A does not react with conc. H_2SO_4. Complexes B and C lose 6.75% and 13.5% of their original weight respectively on heating with conc. H_2SO_4. Identify A, B and C.

Ans. Data suggests that the complexes are hydrate isomers.

As comples A does not lose any molecule of H_2O on heating which shows that no water molecule of H_2O is outside the co-ordination sphere.

$\therefore$ A = $[Cr(H_2O)_0]Cl_3$

As B loses 6.75% $\therefore$ actual loss in wt.

= × 266.5 = 18 au

B = $[Cr(H_2O)_5 Cl]Cl_2 . H_2O$

As C loses 13.5% of wt. on heating which is twice the loss in the first case, $\therefore$ C isomer exists as a dihydrate :

$[Cr(H_2O)_4 Cl_2]Cl . 2H_2O$

Q. 5. $Fe^{3+} \xrightarrow[\text{excess}]{SCN^-} (A) \xrightarrow[\text{excess}]{F^-} (B)$

What are (A) and (B) ? Give IUPAC name of (A). Find the spin only magnetic moment of (B).

Ans. A = $Fe(SCN)_3$, B = $[FeF_6]^{3-}$

IUPAC name of A = trithiocyanato iron (III)

E. C. of Fe (III) = d^5, unpaired e^-s = 5

www.AnkitGuptaClasses.weebly.com
gupta.ankit54@yahoo.com
ankitgupta.gupta175@gmail.com
9899875480,
9541241201

Spin only magnetic moment = $\sqrt{5(5+2)}$ B. M.

= 5.916 B. M.

Q. 6. A complex is prepared by mixing $COCl_3$ and NH_3 in the molar ratio of 1 : 4, 0.1 M solution of this complex was found to freeze at – 0.372 °C. What is the formula of the complex ? Given that molal depression constant of water K_f = 1.86 °C/m.

Ans. The oretical $\Delta T_f = K_f \cdot m$

$= 1.86 \times 0.1$

$= 0.186°$

observed ΔT_f $= 0.372°$

As observed ΔT_f is double of the theoretical value this shows that each molecule of the complex dissociates to form two ions. ∴ formula is :

$[CO(NH_3)_4 Cl_2] Cl$

Q. 7. How t_{2g} and eg orbitals are formed in an octahedral complex ?

Ans. In an octahedral complex, positive metal ion is considered to be present at the centre and negative ligands at the corners. As lobes of $dx^2 – y^2$ and dz^2 lie along the axes, i. e. along the ligands repulsions are more and so is the energy. The lobes of the remaining three d-orbitals lie between the axes i. e. between the ligands, the repulsions between them are less and so is the energy.

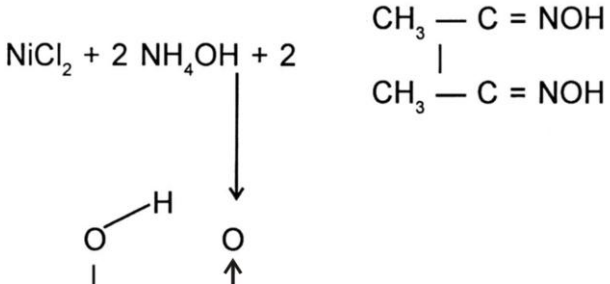
Q. 8. Dimethyl glyoxime is added to alcoholic solution of $NiCl_2$. When ammonium hydroxide is slowly added to it, a rosy red precipitate of a complex appears.

(a) Give the str. of the complex showing hydrogen bond.

(b) Give oxidation state and hybridisation of central metal ion.

(c) Identify whether it is paramagnetic or diamagnetic.

Ans. (a)



www.AnkitGuptaClasses.weebly.com
gupta.ankit54@yahoo.com
ankitgupta.gupta175@gmail.com
9899875480,
9541241201

(b) O. S. = + 2
bybridisation = dsp^2

(c) diamagnetic as no unpaired electron.

Q. 9. Explain the reason behind a colour of some gem stone with the help of example.

Ans. The colours of many gem stones are due to the presence of transition metal ions & colour are produced due to d-d transition. For example the mineral corundum Al_2O_3 is colourless when pure but when various M^{3+} transition metal ions are present in trace amounts various gem stones are formed. Ruby is Al_2O_3 containing about 0.5 – 1% Cr^{3+}.

Q. 10. How many EDTA (lethylendiamine tetra acetic acid) molecules are required to make an octahedral complex with a Ca^{2+} ion.

Ans. EDTA is a hexadentate ligand therefore only one EDTA molecule is required to form octahedral complex.

Q. 11. What is the hybridisation of central metal ion and shape of Wilkinson's catalyst ?

Ans. Wilkinson's catalyst is $(PH_3P)_3$ RhCl. In this Rh has dsp^2 hybridisation and square planar shape.

Q. 12. Which vitamin is a complex compound of cobalt ?

Ans. Vitamin B_{12} is a complex compound in which central metal atom is cobalt.

Q. 13. Write the IUPAC name of $[CO(NH_3)_4 B_{12}]_2 [ZnCl_4]$.

Ans. Tetraamminedibromocobalt (III) tetrachlorozincate (II)

Q. 14. What is the value of x in the complex $HxCO(CO)_4$ on the basis of EAN rule. (At. No. Co` = 27)

Ans. $x = 36 – (27 + 4 \times 2)$

$= 36 – 35$

$= 1$

Q. 15. Why is the silver plating of copper, $K[Ag(CN)_2]$ is used instead of $AgNO_3$?

www.AnkitGuptaClasses.weebly.com
gupta.ankit54@yahoo.com
ankitgupta.gupta175@gmail.com
9899875480,
9541241201

Ans. This is because if $AgNO_3$ is used Cu will displace Ag^+ from $AgNO_3$. The deposit so obtained is black, soft, non-adhering. To get a good shining deposit, $[Ag(CN)_2]^-$ are used as it is a stable complex, the conc. of Ag^+ is very small in the solution. As such no displacement of Ag^+ ions with Cu is possible.

❑❑❑