[This question paper contains 8 printed pages.]

Your Roll No. .....

Sr. No. of Question Paper : 1142

Unique Paper Code : 32171401

Name of the Paper : Inorganic Chemistry – III

Name of the Course : **B.Sc. (H) Chemistry**

Semester : IV

Duration : 3.5 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **Six** questions in all.
3. **All** questions carry equal marks.

1. (a) Name of the following complexes according to the IUPAC system of nomenclature :

(i) $[Pt(NH_3)_2Cl(NH_2CH_3)]Cl$

(ii) $[(NH_3)_5Cr(NH_2)\ Cr(NH_3)_4(H_2O)]Cl_5$

(iii) $[Co(NH_3)_6]_3[Co(CN)_6]_2$

P.T.O.

(b) Write the formulae of the following complexes :

(i) Sodium bis(thiosulphato)argentate(I)

(ii) Triamminechlorocyanonitrocobalt(III)

(iii) Potassium diaquatetrabromovanadate(III)

(c) Given below is the Latimer diagram for Fe in acidic medium :

$FeO_4^{2-} \xrightarrow{2.20} Fe^{3+} \xrightarrow{0.77} Fe^{2+} \xrightarrow{-0.47} Fe$

(i) Why FeO_4^{2-} is strong oxidising agent?

(ii) Is there any tendency of Fe^{2+} to reduce to Fe. Give reasons.

(d) A strong oxidizing agent(A) on heating with KCl and conc. H_2SO_4 gives red coloured gas B which on passing through potassium hydroxide solution gives yellow solution C. C may also be obtained on heating A on treatment with conc. H_2SO_4 gives a red product D which decomposes on heating to give a product. Identify A, B, C, D.

(3,3,3,3.5)

2. (a) Which of the following is more stable :

$[Co(en)_3]^{3+}$, $[Co(dien)_3]^{3+}$

(b) Justify the presence of copper in the transition series.

(c) Explain $d_\pi - p_\pi$ bonding in complexes.

(d) Explain Jahn Teller effect.

Which of the following complex have all equal bond length and why?

$[CrF_6]^{3-}$ and $[MnF_6]^{3-}$ (3,3,3,3.5)

3. (a) Identify A, B, C, D in the following reactions :

(i) $[PtCl_4]^{2-} \xrightarrow{NH_3} [A] \xrightarrow{NH_3} [B]$

(ii) $[Pt(NH_3)_4]^{2+} \xrightarrow{Cl^-} [C] \xrightarrow{Cl^-} [D]$

(b) What happens when

(i) KI is added to $KMnO_4$ in acidic medium.

(ii) SO_2 is passed through acidified $K_2Cr_2O_7$ solution.

P.T.O.

(c) +3 is the most common oxidation state of lanthanides. Explain.

(d) Fe_3O_4 is inverse spinel while Mn_3O_4 is normal spinel. Explain on the basis of CFT. (3,3,3,3.5)

4. (a) The pairing energy (P) for the $[Cr(H_2O)_6]^{2+}$ ion is 23000 cm^{-1} and crystal field splitting (Δ_0) is 14000 cm^{-1}. Calculate the crystal field stabilization energy in high spin and low spin state. Which state is more stable?

(b) 4d and 5d elements usually form low spin complexes. Justify.

(c) Tetrahedral complexes are high spin. Explain

(d) Using the valence bond theory method, work out following for $[Cr(CN)_6]^{3-}$

(i) Assign the electronic configuration to the central metal ion,

(ii) predict the type of hybridization involved,

(iii) geometry, and

(iv) the magnetic moment (3,3,3,3.5)

5. (a) What are differences between valence bond theory and crystal field theory?

(b) Explain Spectrochemical series.

(c) Higher Oxidation states of transition elements are stabilized by small anions like F^-, O^{2-}. Explain.

(d) For Cr^{2+} octahedral complexes in strong and weak field, determine the (i) configuration in terms of $t_{2g}^{\ x}\ e_g^{\ y}$, (ii) number of unpaired electrons, and (iii) crystal field stabilization energy. (3,3,3,3.5)

6. (a) Write three differences between the characteristic features of lanthanides and actinides.

(b) Ce^{4+} ion is coloured whereas Ce^{3+} ion is colourless. Why?

(c) Work out the number of unpaired electrons in the following ions :

Eu^{2+}, Tb^{4+}, Lu^{3+}

(Atomic number of Eu = 63, Tb = 65, Lu = 71)

(d) What is lanthanide contraction? What are the major consequences of lanthanide contraction on the chemistry of d block elements? (3,3,3,3.5)

P.T.O.

7. (a) The compound $CoCl_3.4NH_3$ gives one Cl^- ion on the addition of Ag^+ ion. Draw the structure of the compound on the basis of Werner's coordination theory.

(b) Explain the following with suitable examples :

(i) Ionisation isomerism

(ii) Linkage isomerism

(c) Using valence bond theory, discuss hybridization and structure of the following :

(i) $[Cr(NH_3)_6]^{3+}$

(ii) $Ni(CO)_4$

(d) $[Fe(CN)_6]^{4-}$ ion is diamagnetic but $[Fe(CN)_6]^{3-}$ ion is paramagnetic in nature. Explain using V.B.T. (3,3,3,3.5)

8. (a) Explain why does colour of $KMnO_4$ disappear when oxalic acid is added to its solution in acidic medium.

(b) $K_2Cr_2O_7$ is a good oxidising agent in acidic medium.

Explain.

(c) Write down the number of 3d electrons in each of the following ions :

(i) Cr^{3+}

(ii) Fe^{3+}

(iii) Cu^{2+}

(d) Transition elements and their compounds are generally found to be good catalyst in chemical reaction. Discuss. (3,3,3,3.5)

9. (a) Give the reasons for the following **(any two)** :

(i) Mn(II) ion shows maximum magnetic character among the bivalent ions of first transition series.

(ii) Cu(I) is diamagnetic while Cu(II) is paramagnetic.

(iii) Zn^{2+} salts are white while Cu^{2+} salts are blue.

(b) Although Cr^{3+} and Co^{2+} ions have same number of unpaired electrons but the magnetic moment of

Cr^{3+} is 3.87 B.M. and that of Co^{2+} is 4.87 B.M. Explain.

(c) Explain why Fe(II) and Fe(III) form complexes with CN^- ions but not with NH_3. (6,3,3.5)