[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5307 **L**

Unique Paper Code : 2174001203

Name of the Paper : GE: Coordination and Organometallic Compounds

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

Semester : VIII

Duration : 2 Hours Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **4** questions in all. **All** the questions carry equal marks.
3. The questions should be numbered in accordance to the number in the question paper.
4. Calculators and log tables may be used.

1. **(a)** Which of the following will have larger value of Δ_o and why?

(i) $[Co(CN)_6]^{3-}$ or $[Co(NH_3)_6]^{3+}$

(ii) $[Co(H_2O)_6]^{3+}$ or $[Rh(H_2O)_6]^{3+}$

(iii) $[Co(H_2O)_6]^{2+}$ or $[Ni(H_2O)_6]^{2+}$

(b) Write the formulae of the following complexes:

(i) Tetrammineaquabromidocobalt(III)nitrate

(ii) Dibromotetraammineplatinum (IV) bromide

(iii) Sodium triiodidomethylplatinate (II)

(iv) Potassium carbonylpentacyanoferrate(II).

(v) Hexaamınecobalt(III)-trioxalatochromate (III)

(c) Answer the following:

(i) Apart from CO give an example of a π -- acid ligand.

(ii) Through which atom does CO act as an electron pair donor?

(iii) Through which atom does CO act as an electron pair acceptor?

(iv) Why is CO a π acid ligand? (6, 5, 4)

2. **(a)** The magnetic moments of $[Fe(H_2O)_6]^{3+}$ and $[Fe(CN)_6]^{3-}$ are 5.9 BM and 1.8 BM respectively. Explain on the basis of VBT. Indicate which of this is inner- orbital and which is outer orbital?

(b) In a carbonyl complex with a linear OC – M -- CO group, how will the CO stretching frequency change when

(i) One CO is replaced by PF_3

(ii) A positive charge is put on the complex

(iii) If the complex is given a negative charge

(c) Account for the following:

(i) Manganese does not form a stable mononuclear carbonyl.

(ii) Iron forms a pentacarbonyl but nickel forms a tetracarbonyl (6, 5, 4)

P.T.O.

3. **(a)** $[FeF_6]^{3-}$ has higher magnetic moment than $[Fe(CN)_6]^{3-}$, though both are octahedral complex ions. Explain on the basis of CFT. Draw the crystal field splitting of d-orbitals for both the complex ions.

(b) What is meant by the term hapticity? How it is denoted for a ligand? Give an example where the same ligand can show varying hapticity.

(c) For a metal ion having d^6 configuration in an octahedral complex, the magnitude of crystal field splitting is 32,000 cm^{-1}, and the electron-pairing energy is 17,600 cm^{-1}. Predict whether the complex will be high spin or low spin. Calculate the crystal field stabilization energy for the predictable spin state. (6, 5, 4)

4. **(a)** Using the 18 electron rule as a guide find/ identify:

(i) the number of CO ligands in $[Fe(NO)_2(CO)_n$

(ii) the number of metal -- metal bonds in $Fe_3(CO)_{12}$

(iii) the charge on the species $[Fe(CO)_4]^x$

(b) Define an organometallic compound. Which of the following are organometallic compounds? Give reasons.

(i) $Hg(C_6H_5)_2$

(ii) $Ti(OEt)_4$

(iii) $Li(C_2H_5)$

(iv) $Ti(CH_3)(OEt)_3$

(c) What is the cause of distortion with some octahedral complexes? The high-spin octahedral complexes of Ni^{2+} ion are not expected to show distortion, whereas low-spin octahedral complexes of Ni^{2+} show strong distortion. Explain. (6, 5, 4)

5. **(a)** Predict the appropriate choice and give brief reasons:

(i) Bidentate ligand: $C_2O_4^{2-}$, SCN^-

(ii) Ambidentate ligand: Br^-, NO_2^-

(iii) Diamagnetic: $[Co(CN)_6]^{3-}$, $[CoF_6]^{3-}$

(b) Write a short note on – Limitations of Valence bond theory.

(c) Give the structure of Zeise's salt. Discuss about its bonding. (6, 5, 4)

6. **(a)** Arrange the following species in increasing order of the property mentioned and give reason:

(i) $Ni(CO)_4$, $[Co(CO)_4]^-$ and $[Fe(CO)_4]^{2-}$ - IR stretching frequency of C – O bond

(ii) $[Mn(CO)_6]^{2+}$, $[Cr(CO)_6]^+$, $[V(CO)_6]$ - M – C bond order

(iii) CO, NO^+, CN^- - π-acidity.

(b) Calculate the crystal field stabilization values for high spin and low spin octahedral complexes of (i) d^4 ion and (ii) d^7 ion.

(c) Predict whether the following obey the EAN rule:
$[Mn(C_2H_4)(CO)_5]^+$, $[Co(\pi\text{-}C_3H_5)(CO)_3]$, $Cr(CO)_6$ and $[V(CO)_6]$, (6, 5, 4)