

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

M.A./M.Sc. FIRST SEMESTER EXAMINATION, DECEMBER 2018

FIRST YEAR [BATCH 2018-20]

APPLIED CHEMISTRY

Date : 14/12/2018

Time : 11 am – 1 pm

Paper : I (Inorganic Chemistry)

Full Marks : 50

(Use a separate Answer Book for each Unit)

UNIT-I

Answer **any six** questions:

[6 × 5]

- Show the d -orbital splitting of the metal ions in the following complexes using CFT. Calculate the crystal field stabilisation energies (CFSE) and the spin-only magnetic moments (μ_s) for each.
i) $[\text{CoF}_6]^{3-}$ ii) $[\text{Fe}(\text{CN})_6]^{4-}$ [2.5+2.5]
- Using Orgel diagram, explain the electronic spectral transitions for $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ in a weak octahedral field. Find the ground state term symbol for the concerned ion. [3+2]
- Discuss on the nature of the Jahn-Teller distortion expected for an octahedral complex of d^9 metal ion. [5]
- (i) On addition of conc. HCl , $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ transforms to CoCl_4^{2-} , but the same does not happen for $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$, Why? [3]
(ii) Intensity of LMCT is more than that of $d-d$ transition why? [2]
- Which one of the following pairs has higher CFSE values? Explain.
(i) Tetrahedral and octahedral complex of the same d^3 metal ion.
(ii) $[\text{M}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{M}(\text{H}_2\text{O})_6]^{3+}$ where both have three d electrons. [2.5+2.5]
- (i) Mention which of the following ions will undergo Jahn-Teller distortion and which will not in an octahedral field: Co^{2+} (L.S.) and Fe^{3+} (H.S.). Give reason.
(ii) Of the two salts CrF_2 and MnF_2 , the former has distorted octahedral while the latter regular octahedral geometry. Explain. [2+3]
- State the basic assumptions of Crystal Field Theory (CFT). Explain the variation of hydration energies of divalent $3d$ transition metal ions with atomic numbers, using CFT. [2+3]
- Discuss the crystal field splitting patterns of d -orbitals in (i) square pyramid (ii) square planar and (iii) trigonal bipyramidal geometries. [1+2+2]
- Predict the spinel structure of (i) Mn_3O_4 and (ii) NiAl_2O_4 , with proper justification. [3+2]

UNIT-II

Answer **any four** questions:

[4 × 5]

- How is ferrocene prepared? Give all the reactions involved. Discuss the structure of ferrocene. What is its magnetic moment value? [1+1+2+1]

11. a) Find the number (n) of CO ligands in the complex $\text{Fe}_3(\text{CO})_n$ using 18-electron rule. [2]
 b) What products do you expect if $\text{CH}_2=\text{CH}_2$ and $\text{CH}_3\text{-CH}=\text{CH}_2$ are separately subjected to Zeigler-Natta catalytic process? Discuss the steps involved. [3]
12. a) What happens when Zeise salt is boiled with alkaline water? give equation. [2]
 b) Account for the carbonyl stretching frequency ($\bar{\nu}_{\text{co}}$ in cm^{-1}) of the followings: [3]
- | | | | |
|------|-----------------------------------|----------------------------|-----------------------------------|
| CO | $[\text{V}(\text{CO})_6]^\ominus$ | $[\text{Cr}(\text{CO})_6]$ | $[\text{Mn}(\text{CO})_6]^\oplus$ |
| 2143 | 1860 | 2000 | 2090 |
13. a) State the differences between 'oxidative addition' and 'insertion' reactions. give examples. [3]
 b) What is hapticity? Give an example of pentahapto compound. [2]
14. a) What are LNCC and HNCC? Give examples. [3]
 b) What happens when $\text{Co}_2(\text{CO})_8$ reacts with acetylene? [2]
15. What is Wilkinson's catalyst? Give the mechanism of the hydrogenation of $\text{HC}_3\text{-CH}=\text{CH}_2 + \text{H}_2 \rightarrow \text{H}_3\text{C-CH}_2\text{-CH}_3$ in the presence of Wilkinson's catalyst. [2+3]
16. a) Which one of the following is stronger π -acceptor ligand and why? CO and $\text{CN}^\ominus$ [2]
 b) Write down the structure of $\text{Fe}_2(\text{CO})_9$, stating hybrid orbitals used for the bonding in that compound. [3]

_____ × _____