

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. FIFTH SEMESTER EXAMINATION, DECEMBER 2019

THIRD YEAR (BATCH 2017-20)

CHEMISTRY (Honours)

Date : 19/12/2019

Time : 11 am – 1 pm

Paper : VI

Full Marks : 50

(Attempt one question from each Unit)

Unit-I

[9 marks]

1. a) State the factors that affect the difference in energy between t_{2g} and e_g sets of orbitals in an octahedral complex. 3
- b) What is a tetragonal distortion? Which d^n configuration would lead to weak and strong Jahn-Teller distortion in octahedral complexes? 3
- c) Give the d -orbital splitting pattern in $VO(acac)_3$ and $Ni(CN)_4^{2-}$. 3
2. a) Explain the followings with the help of VBT: 2+2
 - (i) Co^{2+} - octahedral complexes are reducing agent,
 - (ii) F^- is ionic but a weak ligand than H_2O , while CO is neutral yet a stronger ligand than H_2O . Explain.
- b) Chromium (II) fluoride and manganese(II) fluoride both have a central metal ion are surrounded by six fluoride ligands. The Mn-F bond lengths are equidistant, but four of Cr-F distances are long and two are short. –Explain. 3
- c) Depict the crystal field splitting patterns of d -orbitals in $Au(CN)_4^-$. 2

Unit-II

[8 marks]

3. a) Using qualitative Orgel diagram explain the electronic spectral transitions for $3d^6$ ion in a weak octahedral field. 3
- b) The colour intensity of $KMnO_4$ is higher than $K_2Cr_2O_7$ even though in both cases central metal contain d^0 electronic configuration. Explain. 3
- c) Predict the magnetic moment of $Ni(II)$ -octahedral complexes with proper justification. 2
4. a) Electronic spectra of $[Co(H_2O)_6]^{3+}$ shows two maxima in the visible region. Explain. 3
- b) The tris-(dialkyl lithiocarbamate)iron(III) has $\mu = 5.7$ to 5.8β at 300K, 4.7 to 5.0β at 150 K and 3.6 to 4.0β . Rationalize the data. 3
- c) FeF_6^{3-} is colourless but $Fe(SCN)_6^{3-}$ is intense red in colour. – Explain. 2

Unit-III

[8 marks]

5. a) What are the roles of Mg^{2+} and Zn^{2+} in biological system? 2
- b) Discuss the biological importance of creatine-phosphocreatine interconversions. 3
- c) Why use of KCl in intravenous fluid used in hospital procedures can give fatal result? 3
6. a) Define with example, (i) Essential elements and (ii) Beneficial elements. 1½+1½
- b) Heavy metals are in general toxic, comments. 2
- c) Write short note on active and passive transport of ions. 3

Unit-IV

[8 marks]

7. a) Discuss the role of photosystem I and photosystem II in photosynthesis. 4
b) Would chelation therapy be useful in case of lead poisoning? Explain your answer. 2
c) What is the toxic effect of the presence of arsenic in drinking water? 2
8. a) What is cis-platin? State its medicinal use. 1+2
b) Describe in brief the biological function of hemoglobin indicating the role of metal ion present in the active site of the protein. 3
c) Explain the role of Haemoglobin in maintaining the pH of blood. 2

Unit-V

[9 marks]

9. a) Using 18-electron rule, establish the structure of $\text{Os}_3(\text{CO})_{12}$ and $\text{Mn}_2(\text{CO})_{10}$. 4
b) What are the different modes of binding of NO in metal nitrosyl? How would you identify the same using IR data? 2
c) A metal complex $\text{Cr}(\text{CO})_x(\text{NO})_y$ obeys 18 electron rule, determine the value of x and y (the value of x and y is non-zero). Explain the bonding mode of nitrosyl ligand (Hint: $\nu_{\text{NO}} = 1780 \text{ cm}^{-1}$.) 3
10. a) How is ferrocene prepared? Draw its structure. How would you oxidise ferrocene to ferricinium ion? 2+1+1
b) Room temperature magnetic moment value of the complex ion $[\text{Fe}(\text{H}_2\text{O})_5(\text{NO})]^{+2}$ is 3.9 BM. Comment on the different bonding patterns of NO in the complex ion according to two different opinions and explain the magnetic moment value. 3
c) Justify the statement – in solution $[\text{Co}_2(\text{CO})_8]$ shows two ν_{CO} values while in solid state it shows only one ν_{CO} value. 2

Unit-VI

[8 marks]

11. a) Predict the molecular geometries of the following compounds:
 $[\text{Fe}_5\text{C}(\text{CO})_{15}]$, $[\text{Os}_5(\text{CO})_{16}]$ and $[\text{Fe}_4\text{C}(\text{CO})_{12}]^{-2}$. 3
b) Discuss the bonding pattern in $\text{Re}_2\text{Cl}_8^{2-}$. Mention its magnetic property. 2
c) What are Zintl cluster ions? Discuss the structures of Pb_5^{2-} and Sn_9^{4-} . 3
12. a) What products do you expect if ethylene and propylene are separately subjected to Ziegler-Natta catalysis? 4
b) Predict the influence of added triphenylphosphine on the rate of hydroformylation catalysed by $[\text{Rh}(\text{CO})\text{H}(\text{PPh}_3)_3]$. 4

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