

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. FIFTH SEMESTER EXAMINATION, MARCH 2021

THIRD YEAR [BATCH 2018-21]

CHEMISTRY [HONOURS]

Date : 18/03/2021

Time : 11.00 am – 1.00 pm

Paper : VI

Full Marks : 50

Attempt one question from each unit

Unit – I

[9 marks]

1. a) Using molecular orbital bonding concept of tetrahedral MO_4 -type oxo-anions, arrange and explain the order of $10Dq_t$ change in $[\text{MnO}_4]^-$, $[\text{CrO}_4]^{2-}$ and $[\text{VO}_4]^-$ ions. [3]
b) Among the $[\text{Cu}(\text{OH}_2)_6]^{2+}$ and $[\text{Co}(\text{OH}_2)_6]^{2+}$, which one has more distorted structure and why? [3]
c) $[\text{Fe}(\text{CN})_6]^{4-}$ is diamagnetic while $[\text{FeF}_6]^{3-}$ is paramagnetic. Explain the bonding and reactivity in terms of the VBT. [3]
2. a) Sketch the d-orbital energy level diagrams for five-coordinate trigonal bipyramidal and square pyramidal complexes of formula ML_5 . Explain your arrangements. [3]
b) Derive the spinel structures of FeCrO_4 and NiCrO_4 [3]
c) What is Nephelauxtic effect? Arrange the following ligands in terms of their Nephelauxtic power: F^- , O^{2-} , H_2O and S^{2-} . [1+ 2]

Unit – II

[8 marks]

3. a) The spectrum of $[\text{Co}(\text{NH}_3)_6]^{3+}$ has a very weak band in the red and two moderate-intensity bands in the visible to near-UV. Justify the bands from the Crystal Field Theory. [3]
b) The optical absorption spectrum of $[\text{Ti}(\text{OH}_2)_6]^{3+}$ has its absorption maximum at 20300 cm^{-1} . Find out CFSE value in cm^{-1} . [2]
c) Hydrous chromium (II) acetate shows diamagnetic behavior while hydrous copper(II) acetate shows abnormally low paramagnetism. Rationalize the respective magnetic behavior of the compounds. [3]
4. a) The electronic spectrum of the $[\text{CrF}_6]^{3-}$ ion contains two bands with maxima at approximately 11500 and 14500 cm^{-1} . Rationalize the bands from Orgel diagram and find out CF-splitting value. [3]
b) Octahedral high spin Ni(II) complexes have magnetic moments in the range 2.9-3.4 BM, and tetrahedral Ni(II) complexes have moments upto 4.1 BM. Explain the observations. [3]
c) Which one has more colour intensity among trans and cis forms of $\text{Co}(\text{en})_2\text{Cl}_2$ and why? [2]

Unit – III

[8 marks]

5. a) Define with example, (i) Essential elements and (ii) Beneficial elements [2 + 2]
b) What is active transport? Write down the mechanism through which the nerve cells maintain the concentrations of Na^+ and K^+ inside and outside of the cells? [1+3]
6. a) Explain the biological importance and its adverse effect of (i) Ca (ii) Fe. [3+3]
b) Heavy metals are in general toxic, comments. [2]

Unit – IV

[8 marks]

7. a) Give a brief account of the structural differences between cytochromes 'a', 'b' and 'c' [3]
b) Blood is red in colour —why? [2]
c) Illustrate the use of metal compounds as drugs. [3]
8. a) Explain the role of Haemoglobin/ Myoglobin in maintaining the pH of blood. What is Bohr Effect? [3+1]
b) Discuss the role of photosystem I and photosystem II in photosynthesis. [4]

Unit – V

[9 marks]

9. a) Write the structure of Schwartz reagent. Whether it obeys 18 electron rule or not – justify. [2]
b) The complex $[\text{Cp}_2\text{TiCl}_2]$ does not follow 18 electron rule, still it is stable – Explain. [2]
c) What will happen when Ferrocene reacts with toluene in presence of AlCl_3 and aqueous HPF_6 ? [1]
d) What is synergic bonding and how it is significant in case of metal-carbonyl cluster? [2]
e) Among $\text{Cr}(\text{CO})_6$, $\text{Ni}(\text{CO})_4$ and $[\text{Fe}(\text{CO})_4]^{-2}$ complexes which one has the highest C-O stretching frequency and why? [2]
10. a) What will be the product when Ferrocene undergoes Mannich condensation? [1]
b) What is the magnetic property of Ferrocene? Explain with the help of valence bond theory. [2]
c) Explain Trans effect in Zeise's salt. [2]
d) $\text{V}(\text{CO})_6$ is a 17-electron compound and doesn't dimerise. Why? [2]
e) $[\text{Mn}(\text{CO})_6]$ is unstable but its mono-positive ion is stable – Explain. [2]

Unit – VI

[8 marks]

11. a) Determine the number of metal-metal bonds in $[\text{Co}_2\text{Fe}_2(\text{CO})_{11}(\mu_4\text{-PPh})_2]$. [2]
b) What is Berry-pseudorotation? Explain with a proper example. [2]
c) Why does ^{19}F -NMR spectrum of PF_5 contain one signal at room temperature but two signals at low temperature? [2]
d) Why C –C olefin bond length in Zeise's salt is greater than the C –C bond in free hydrocarbon? [2]
12. a) What do you mean by Carbonyl hopping? [1]
b) Write the product when $\text{Cis-}[\text{Ir}(\text{CO})_2\text{I}_2]^-$ reacts with methyl iodide. Also show the mechanistic pathway. [2]
c) Give an example of HNCC. [1]
d) How a solvent can affect the rate of reductive elimination of a complex? [2]
e) Discuss briefly on Ziegler-Natta catalysis. [2]

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