



ICH 401

I Semester M.Sc. Degree Examination, May 2022
INDUSTRIAL CHEMISTRY
Inorganic Chemistry

Time : 3 Hours

Max. Marks : 70

Instructions : Answer **any five** questions from Part – A and **any five** questions from Part – B. Figures to the **right** indicate marks.

PART – A

1. Answer **any five** questions : (2×5=10)
- a) Find out the number of geometrical isomers of the complex, $[\text{Co}(\text{NO}_2)_3(\text{NH}_3)_3]$.
 - b) How does charge of the metal ions influence the stability of complexes ?
 - c) What is meant by the hapticity of a ligand ? How is it designated ?
 - d) The 17e species $\text{Mn}(\text{CO})_5$ dimerizes forming $\text{Mn}_2(\text{CO})_{10}$ but 17e species $\text{V}(\text{CO})_6$ does not dimerize. Why ?
 - e) Depict the active site of alcohol dehydrogenase.
 - f) Which macrocycle is present in Vitamin B_{12} ? How does it differ from porphyrin ?
 - g) How many symmetry elements does BF_3 have and what are they ?
 - h) Find the symmetry product of the operation $\sigma_{xy} \times C_{2z}$.

PART – B

Answer **any five full** questions : (5×12=60)

2. a) Discuss carefully and concisely the splitting of d orbitals in the case of CrCO_6 and distribute the electrons in different sets of the d-orbitals.
- b) Give the number of unpaired electrons in a strong and weak octahedral field for (i) Cr^{2+} (ii) Co^{2+} (iii) Fe^{3+} (iv) Pt^{4+} .
- c) Calculate the magnetic moment for $[\text{Ni}(\text{en})_3]^{2+}$ taking into account the fact that there is angular momentum contribution to the moment ($\Delta = 11,500 \text{ cm}^{-1}$ and $\lambda = -315 \text{ cm}^{-1}$). (4+4+4)

P.T.O.



3. a) Ligands such as Co , CN^- forms low spin complexes and all halides form high spin complexes : Explain using molecular orbital theory.
- b) Explain splitting of d orbital energy levels, when transition metal ion is placed in the centre of a tetrahedral field and justify why $\Delta_t < \Delta_o$.
- c) Account for the magnetic moments of the complex, $(\text{Et}_4\text{N})_2[\text{NiCl}_4]$ recorded at 80, 99 and 300 K, 3.25 3.43 3.89 B.M. respectively. (5+4+3)
4. a) Write a note on structure and bonding in metal carbonyls.
- b) Explain the preparation, structure and bonding of metal-alkene complexes.
- c) Check the stability of the following organometallic compounds.
- i) ReH_9^{2-}
- ii) $[\text{Co}(\eta^5 - \text{C}_5\text{H}_5)_2]^+$ (4+4+4)
5. a) Write a note on insertion and deinsertion reactions in organometallic compounds.
- b) Explain the structure and nature of bonding in metal – η^3 -allyl complexes.
- c) Describe the structure and bonding in Metal-Butadiene complexes. (4+4+4)
6. a) Write a note on structure and functions of Hemerythrin.
- b) What are sulphur proteins ? Explain the types.
- c) Explain the terms cooperative effect and Bohr effect. What explanation is offered for the cooperative effect in Haemoglobin ? (4+4+4)
7. a) What is meant by poisoning of enzymes ? Describe briefly the poisoning of enzyme catalysts. Discuss the mechanism which is adopted by the nature to counteract the poisoning of metal catalysts.
- b) Identify the coordination environment of metal ions in carboxy peptidase and carbonic anhydrase and explain the role of these enzymes in biological oxidation. (6+6)



8. a) Construct the character table for C_{3v} point group and generate reducible representation of NH_3 on the basis of vectors.
b) Classify the following molecules into appropriate point group listing their symmetry elements. (i) H_2O_2 (ii) Platin. (6+6)
9. a) Find the IR, Raman and total modes of vibrations in m-dichlorobenzene by using C_{2v} character table.

C_{2v}	E	C_{2z}	σ_{xz}	σ_{yz}		
A_1	1	1	1	1	z	x^2, y^2, z^2
A_2	1	1	-1	-1	R_z	xy
B_1	1	-1	1	-1	x, R_y	xz
B_2	1	-1	-1	1	y, R_x	yz

- b) Obtain the matrix representation for $C_n(z)$ for rotation in anticlockwise direction along z-axis.
c) Find out point groups for linear molecules using suitable examples. (5+4+3)
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