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, $[Co(NO_2)_3(NH_3)_3]$.

   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 $Mn(CO)_5$ dimerizes forming $Mn_2(CO)_{10}$ but 17e species $V(CO)_6$ 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 $[Ni(en)_3]^{2+}$ taking into account the fact that there is angular momentum contribution to the moment ($\Lambda = 11,500\ cm^{-1}$ and $\lambda = -315\ cm^{-1}$). **(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 $\Delta_t < \Delta_0$.

   c) Account for the magnetic moments of the complex, $(Et_4N)_2$, $[NiCl_4]$ 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) $[Co(\eta^5 - C_5H_5)_2]^+$ **(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 Cn(z) for rotation in anticlockwise direction along z-axis.

   c) Find out point groups for linear molecules using suitable examples. **(5+4+3)**