

2020
CHEMISTRY
[HONOURS]
Paper : VII

Full Marks : 80

Time : 4 Hours

The figures in the right-hand margin indicate marks.

*Candidates are required to give their answers in
 their own words as far as practicable.*

GROUP-A

1. Answer any **two** questions: 1×2=2
- a) Calculate the CFSE of $[\text{NiCl}_4]^{2-}$ in terms of Dq . The complex is paramagnetic having $\mu_{s.o.} = 2.83 \text{ BM}$.
- b) Show the splitting pattern of d orbital in trigonal bipyramid ligand field.
- c) Give structure of a molecule which is optically active but has no chiral centre.
- d) What is meant by 'Curie temperature'?
2. Answer any **two** questions: 2×2=4
- a) List the elements of symmetry present in D_{5d} point group.

- b) Find the symmetry point group of $\text{cis-MBr}_4\text{Cl}_4$ complex.
- c) Calculate the CFSE of d_6 ion in tetrahedral ligand field in terms of Δ_0 .
- d) Show the symmetry properties of p and d orbitals with respect to plane of symmetry and inversion.
3. Answer any **four** questions: 6×4=24
- a) i) Comment on the dipole moments of CHCl_3 , CH_3Cl and CH_2Cl_2 employing symmetry arguments.
- ii) 'Presence of C_6 symmetry element confirms presence of C_3 ' – Justify.
- iii) Compare the magnetic moments of $[\text{NiBr}_4]^{2-}$ and $[\text{PdCl}_4]^{2-}$. 2+2=2
- b) Define Jahn-Teller theorem. Which of the following high-spin complexes may exhibit Jahn-Teller distortion? State with reasons.
- $[\text{Cr}(\text{NH}_3)_6]^{3+}$, $[\text{MnCl}_6]^{3-}$ and $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$
- 3+3
- c) i) '[$\text{Fe}(\text{phen})_2(\text{NCS})_2$] is high spin at room temperature while it is low spin below 175K.' – Explain.

- ii) State the structures of Mn_3O_4 and Fe_3O_4 in terms of spinel and inverse spinel. 3+3
- d) i) Discuss the structure, bonding (VBT) and magnetic property of $[Ni(CO)_4]$.
 ii) Explain the bonding (VBT) in aqua complex of Cu(II). 3+3
- e) Explain the experimental procedure (with diagram) for determining the magnetic moment by Gouy method. 6
- f) i) Compare the intensities of d-d transition in octahedral and tetrahedral complexes mentioning the selection rule.
 ii) What is meant by 'ferromagnetism'? 3+3

4. Answer any **one** question: 10×1=10

- a) i) Discuss the magnetic property of $[EuCl_6]^{4-}$.
 ii) Draw the Orgel diagram of d^2 and d^8 metal ions in octahedral ligand field.
 iii) $[CrL_6]^{3+}$ complex exhibited three d-d transitions. Assign the transitions. [L ≡ monodentate neutral ligand]

- iv) Why does copper acetate exhibits lower magnetic moment in comparison to $\mu_{s.o.}$. $2\frac{1}{2}+2+3\frac{1}{2}+2$
- b) i) Discuss the bonding (VBT) and magnetic properties of high-spin and low-spin Co(III) complexes in octahedral ligand field.
 ii) Explain why the stability of octahedral Cu(II) complexes with bidentate ligands.
 iii) Explain the pattern of variation of hydration enthalpy of M^{2+} ions across the 1st transition series considering octahedral field only.
 iv) Prove that S_2 is nothing but an inversion. 3+2+3+2

GROUP-B

5. Answer any **two** questions: 1×2=2

- a) Draw the structure of Tebbe's reagent.
 b) Name two peptides used in chelation therapy.

- c) Write down the IUPAC nomenclature of $K_2[Pt(C_2H_4)Cl_3]$.
- d) Draw the structure of ATP.

6. Answer any **two** questions: $2 \times 2 = 4$

- a) Draw the structure of $[(\eta^5-Cp)_2TiCl_2]$ and its Lewis acid base property.
- b) What is 'tungsten bronze'?
- c) Draw the structural formula of $[W_2Cl_9]^{3-}$ and comment on W-W bond order.
- d) Give two reactions for the preparation of organozinc compounds.

7. Answer any **four** questions: $6 \times 4 = 24$

- a) Draw the active site structure of chlorophyll. What is its role in synthesis of glucose from CO_2 and H_2O . 6
- b) i) Explain why Cp_2CO is a strong reducing agent.
- ii) What is Magnus salt? Comment on its structure.
- iii) Draw the structure of methyl lithium.
- c) i) Draw the structure of tetraphenyl porphyrin.

- ii) How the tetraphenyl porphyrin can be prepared?

- iii) Show its number of π electrons.

$2+3+1$

d) Write notes on: $3+3$

- i) Wilson's disease
- ii) Chelation therapy

e) Discuss the mechanism of Wacker oxidation process catalysed by Pd complexes. 6

f) i) Write brief account on carbene complexes.

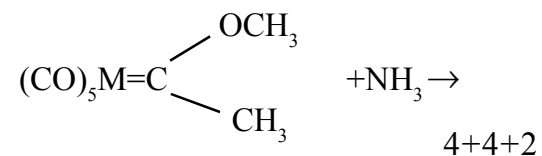
- ii) How ferrocene is prepared?

iii) Discuss the mechanism of action of cis platin. $2+2+2$

8. Answer any **one** question: $10 \times 1 = 10$

- a) i) Discuss the preparation and structural features of oxo and non-oxo halide complexes of Mo and W.
- ii) Give the mechanism of catalytic hydrogenation and isomerisation of alkenes using platinum metal catalyst.

iii) Predict the product of following reaction:



- b) i) Draw the structure of the active site of Myoglobin and discuss its role in oxygen transport by haemoglobin.
- ii) Discuss on the calcium ion transport across cell membrane indicating the roles of plasma membrane Ca^{2+} ATPase and Sarcoplasmic Reticulum Ca^{2+} ATPase. 6+4
