

[ Time: 3 Hours]

[Total marks :100]

N.B.: (1) All questions are compulsory.

(2) Figures to the right indicate full marks.

(3) Use of logarithmic table/non-programmable calculator is allowed.

1. Attempt any four of the following:
  - A. What is crystal field splitting? Explain with reference to tetrahedral complexes. 5
  - B. Explain the following factors affecting crystal field splitting. 5
    - i] Nature of the ligands.
    - ii] position of metal in transition series.
  - C. Explain the term crystal field stabilization energy [CFSE]. Calculate CFSE for  $d^8$  and  $d^9$  configurations in strong field octahedral complexes. 5
  - D. Discuss any five merits of crystal field theory. 5
  - E. Explain Jahn-Teller distortions in octahedral complexes with suitable example. 5
  - F. Write a note on intensity of d-d transition as an evidence of covalent bonding in metal complex. 5
  
2. Attempt any four of the following:
  - A. Discuss molecular orbital diagram of  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$  complex and give its magnetic behaviour. 5
  - B. Write a note on Steric effect on the stability of metal complexes. 5
  - C. Explain charge transfer transitions in metal complexes. 5
  - D. Write a note on  $S_N1$  mechanism in ligand substitution reaction of octahedral metal complexes. 5
  - E. Distinguish between thermodynamic and kinetic stability in metal complexes. 5
  - F. Write a note on base hydrolysis in ligand substitution reaction of octahedral metal complexes. 5
  
3. Attempt any four of the following:
  - A. Define organometallic compound. Write a note on multicentred electron deficient organometallic compound. 5
  - B. Describe the method of preparation of organometallic compound by oxidative addition reaction. 5
  - C. Write a note on Complex formation reactions of organometallic compounds. 5
  - D. What is ferrocene? Explain structure of ferrocene according to valence bond theory. 5
  - E. Write a note on any five chemical reactions of ferrocene. 5
  - F. Differentiate between homogeneous and heterogeneous catalysis. 5

4. Attempt **four** of the following:
- Define metallurgy. Explain Hydrometallurgy with suitable example. 5
  - What are the different methods used for concentration of ore? Discuss in detail Hydraulic Classifier Method. 5
  - Write the steps involved in extraction of copper. Explain the electrolytic refining of copper. 5
  - How are noble gases isolated by Charcoal Adsorption methods. 5
  - Give the method of preparation and structure of following compound on the basis of VSEPR Theory: 5
    - $\text{XeF}_6$
    - $\text{D}_3$
  - Write note on importance of sodium potassium ion pump in biological system. 5

5. Answer the following:

- A. Select the correct option and complete the following statements: (any five) 5
- CFSE for strong field octahedral complexes with  $d^5$  configuration is -----  
-----  
a)  $0+4P$     b)  $-12Dq+3P$     c)  $-24Dq+3P$     d)  $-20Dq+2P$
  - In octahedral complex, d-orbital of central metal degenerates into ----- energy levels  
a) 1    b) 3    c) 4    d) 2
  - Jahn-Teller distortions are more common among the octahedral complexes with ----- distribution of electrons.  
a) proportional    b) symmetric    c) asymmetric    d) equal
  - Crystal field splitting energy in square planar complex is denoted as -----  
a)  $\Delta$     b)  $\Delta_{sp}$     c)  $\Delta_q$     d)  $\Delta_o$
  - is a strong field ligand.  
a)  $\text{S}^{2-}$     b)  $\text{Cl}^-$     c)  $\text{CO}$     d)  $\text{F}^-$
  - In transition metal complexes, d-orbitals of the metal are affected by -----  
-----  
a)  $\text{M}^{n+}$     b) Co-ions    c) Ligands    d) cations.
  - Colour observed for a complex is ----- to the colour that is absorbed.  
a) same    b) complimentary    c) alike    d) identical
  - Electron spin resonance spectra of  $[\text{IrCl}_6]^{2-}$  shows ----- curve  
a) Double hump    b) smooth    c) Serrated    d) linear
- B. State whether true or false: (any five) 5
- $[\text{Ti}(\text{O})_6]^{3-}$  is low spin complex.
  - Number of microstates for  $p^1$  configuration is 21.
  - $\Delta E$  for this transition is Laporte allowed.
  - Ground state term for  $1s^1$  is  $^2S$ .
  - Complexes with polydentate ligands are more stable than those with unidentate ligands.
  - Associative mechanism for ligand substitution reaction forms seven coordinate intermediate with pentagonal bipyramidal structure.
  - $2S+1$  is called spin multiplicity.

- C. Fill in the blanks with correct alternatives given in the bracket : (any five) 5  
 (M – C, increases,  $\text{CH}_3\text{MgCl}$ , oxidation, heterogeneous, reductive elimination, 2  $\text{C}_5\text{H}_6$ , Mannich.)
- The essential requirement for an organometallic compound is the presence of at least one ..... bond
  - In preparation of organometallic compound by oxidative addition reaction, oxidation number of metal .....
  - ..... is the example of organometallic compound.
  - Condensation of ferrocene rings with formaldehyde and amine is called as ..... reaction.
  - During nitration ferrocene undergoes .....
  - $\text{Fe} + \dots \rightarrow (\text{C}_5\text{H}_5)_2\text{Fe} + \text{H}_2$
  - When the reactants and catalyst are in the different phase, catalyst is referred as .....
  - High formal positive charge on the metal and presence of bulky groups on the molecule, facilitates ..... reactions.

- D. Match the column: (Any five ) 5
- | Column A              | Column B                          |
|-----------------------|-----------------------------------|
| a. Grinding           | i. Source of $\beta$ radiation    |
| b. Frothing agent     | ii. Incandescent electric bulbs   |
| c. Acidic impurities  | iii. Iron Deficiency              |
| d. Bessemerisation    | iv. Source of $\alpha$ radiation  |
| e. Krypton Clathrates | v. Pulverization                  |
| f. Argon              | vi. Skin pigmentation             |
| g. Anaemia            | vii. Pine oil                     |
| h. Trypsinase         | viii. Used in treatment of cancer |
|                       | ix. Blister Copper                |
|                       | x. Basic Flux                     |
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