

- N.B.** (1) All questions are **compulsory**.
 (2) **Figures** to the **right** indicate **full** marks.
 (3) Use of **non-programmable calculator** is **allowed**.

1. (a) Answer any **two** of the following :— 8

- (i) Discuss any two methods to prepare alkyl and aryl derivatives of 'f' block elements.
- (ii) Calculate the formal oxidation state of the metal, total electron count (TEC), number of metal-metal bonds and basic geometry of the following clusters :
 - (A) $\text{Co}_4(\text{CO})_{12}$
 - (B) $\text{Os}_3(\text{CO})_{12}$
- (iii) Explain capping rules with suitable example and what are the its limitation.
- (iv) What is isolobal analogy ? Explain giving reasons which organic fragment is isolobal with :
 - (A) $\text{Cp W}^1(\text{CO})_2$
 - (B) $\text{Cp Rh}(\text{CO})$
 - (C) $\text{Co}(\text{CO})_4$

(b) Answer any **one** of the following :— 4

- (i) Explain insertion of isocyanides and carbon monoxide properties of heteroleptic organometallics of lanthanides and actinides.
- (ii) Calculate the Total Electron Count (TEC), Polyhedral Electron Count (PEC) predict the structure of the following :—
 - (A) $[\text{Os}_{10}\text{C}(\text{CO})_{24}]^{2-}$
 - (B) $[\text{Ni}_5(\text{CO})_{12}]^{2-}$
 - (C) $[\text{Rh}_6(\text{CO})_{16}]$
 - (D) $[\text{Ru}_6\text{C}(\text{CO})_{17}]$

2. (a) Answer any **two** of the following :— 8

- (i) Explain the mechanism of hydrogenation of alkenes using Wilkinson's catalyst. Is Wilkinson Catalyst organometallic compound ? Justify your answer.
- (ii) What is role of organometallics of Group I to Group III and Group 14 in medicine.
- (iii) Explain carbonyl insertion and hydride elimination reactions involving modification of ligands.
- (iv) Discuss the use of organometallic compounds in agriculture and horticulture.

(b) Answer any **one** of the following :— 4

- (i) Explain ligand dissociation-association and reductive elimination reactions involving loss and gain of ligands with suitable example of each.
- (ii) What is meant by asymmetric hydrogenation ? Explain its mechanism.

3. (a) Answer any **two** of the following :— 8
- Write a note on Gas-phase clusters and fullereness.
 - What is meant by styx number ? Assign styx number for (A) $B_2 H_6$, (B) $B_5 H_{11}$ (C) $B_4 H_{10}$.
 - Discuss the structure and bonding in diborane molecule.
 - What are carboranes ? Give one method of preparation of 1-2, dicarbo closododecaborane ($1, 2 - C_2 B_{10} H_{12}$). Name its different isomers.
- (b) Answer any **one** of the following :— 4
- Explain the bonding for three centered two electron B – B – B bonds in boranes according to LCAO method.
 - Classify the following carboranes into closo, nido, arachno by electron pair count using Wade's Rules :

(A) $C_2 B_4 H_6$	(C) $C_2 B_7 H_{13}$
(B) $C_2 B_5 H_7$	(D) $C_3 B_3 H_7$
4. (a) Answer any **two** of the following :— 8
- Explain bonding in phosphazenes.
 - Write a brief account on zeolites. What are its applications.
 - Explain sheet silicates and chain silicates with suitable examples.
 - Discuss polycationic compounds with reference to their structure.
- (b) Answer any **one** of the following :— 4
- What are ultramarines ? Discuss its properties and uses.
 - What is the importance of talc and asbestos in our daily life ?
5. Answer any **four** of the following :— 12
- How are cyclopentadienyl derivations of lanthanides and actinides classified ?
 - What is the importance of organo metallics as antitumour drugs.
 - Write balanced reactions for action of ammonia on diborane at low temperature and high temperature.
 - Write a brief note on three dimensional silicates with a suitable example and diagram.
 - Draw molecular energy level diagram for octahedrally co-ordinated metal complexes with d^6 electrons with corresponding tetrahedral organic fragments.
 - Explain diagrammatically mercury conversion in the environment.
 - Classify the following boranes into closo, nido, arachno, hypho showing their electron count :

(A) $B_{10} H_{14}$	(C) $[B_{11} H_{13}]^{2-}$
(B) $[B_{12} H_{12}]^{2-}$	
 - What is water soluble silicate ? How is it prepared. Give its commercial applications.