

Unique Paper Code: 2174000038

Name of the Paper: Main Group Clusters-Basics and Applications

Name of the Course: B.Sc. (H) Semester: VII

Duration: 2 hours

Maximum Marks: 60

Instructions for candidates

Write your Roll no. on top immediately on receipt of this question paper.
Attempt any **four** questions. All questions carry equal marks.

1. (a) What are the clusters in elemental states? How can they be classified.
 (b) Classify the following as closo, nido, arachno, hypo or klado:
 (i) $\text{PCB}_9\text{H}_{117}$
 (ii) B_3H_8
 (iii) B_5H_9
 (iv) PB_7H_8
 (v) $\text{C}_2\text{B}_2\text{H}_{12}$
 (c) Complete and balance the following equations:
 (i) $\text{B}_6\text{H}_{10} + \text{B}_2\text{H}_6 \xrightarrow{\quad\quad\quad} \xrightarrow{\quad\quad\quad} \text{B}_{13}\text{H}_{19} + \text{H}_2$
 (ii) $\text{NaBH}_4 \xrightarrow[\text{THF}]{\text{alkyl halide}} \xrightarrow{\text{oxidation}}$
 (iii) $\text{B}_5\text{H}_9 + \text{NaH} \xrightarrow{\quad\quad\quad}$
 (5, 5, 5)
2. (a) Draw and discuss the structure of hexaborane.
 (b) Predict the skeleton electrons in each of them (attempt any two):
 (i) $\text{B}_{12}\text{H}_{12}^{2-}$
 (ii) $\text{B}_{10}\text{H}_{14}^{2-}$
 (iii) $\text{C}_2\text{B}_7\text{H}_{13}$
 (c) What are carbides and give the preparation of boron carbide.
 (5, 5, 5)
3. (a) Define the terms "s", "t", "y", "x" in STYX code.
 (b) How many B-H-B (3c-2e) and B-B-B (3c-2e) bonds in B_4H_8 , B_6H_{12} , B_5H_{11} and B_6H_{10} .
 (c) How $\text{B}_{10}\text{H}_{14}$ undergoes electrophilic substitution reactions.
 (2, 8, 5)
4. (a) What is Wade-Mingos rule for predicting structures of boranes and carboranes?
 (b) Explain the structural relationship between closo, nido and arachno type boranes.
 (c) Discuss the structure and bonding in diborane.
 (6, 4, 5)
5. (a) What are metal borides. Describe their methods of preparation and different structural types.
 (b) Compare Wade's rule and Jemmis m-n-o rule.
 (c) White phosphorous is thermodynamically least stable. Why?
 (6, 5, 4)
6. (a) Write short notes on the following
 (i) Carboranes
 (ii) Sulfur (S_8)
 (iii) Heteroboranes
 (5, 5, 5)