1 M-71663

Total No. of Pages : 02

Total No. of Questions : 09

M.Sc.(Chemistry) (2015 to 2017) (Sem.-2) SYMMETRY AND GROUP THEORY Subject Code : MSCH-202 M.Code: 71663

Time: 3 Hrs.

Roll No.

INSTRUCTIONS TO CANDIDATES :

Attempt any FIVE questions in all, including question no. 1 which is 1. compulsory and selecting one each from units I-IV

Answer briefly : 1.

- a. Define point group and space group.
- b. What kind of improper rotation axis is present in ethane molecule?
- c. Write any two important rules for the great orthogonality theorem.
- d. Write all the symmetry elements present in CCl₄ molecule.
- e. What is the difference between proper and improper rotation axis?
- f. What is the point group of ethylene molecule? How its point group is changed on dimerization?
- g. Write the irreducible representation formed by the $[Ni(CN)_4]^{2-}$.
- h. How d-orbital split in octahedral environment according to the symmetry?
- i. What does the symbol S, P, D and F stands for in Free Ion terms?
- What do you mean by the mulliken symbol T_{lg} and E_u in the character table? i.

UNIT-I

- 2. a. Consider the following sequential structural changes $(I \rightarrow II \rightarrow III)$. For each series indicate :
 - (i) Point group of each structure
 - (ii) The specific symmetry elements lost or gained in the transition $I \rightarrow II$.



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 $10 \times 2 = 20$

Max. Marks: 100

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- b. For the following molecules, sketch all the symmetry elements and list all the symmetry operations associated with each symmetry element :
 - i) CHCl₃ 5
 - ii) PF₅
- 3. a. Take the example of ethane molecule and sketch the proper and improper rotation axis present in the molecule. 10
 - b. What is the point group of (i) 1,2-Dichloroethane, (ii) cyclobutadiene and (iii) PF₅? Write all the symmetry elements present in the molecules. 10

UNIT-II

- 4. a. Construct the character table for the CHCl₃ molecule having point group C_{3v} . 10
 - b. What are the important rules for irreducible representation and their characters? Verify each rule by taking example of HCHO molecule. 10
- 5. a. Describe the relationship between reducible and irreducible representations by taking the example of MX₄ type of molecule. 10
 - b. Write the matrix notations for the geometric transformation of symmetry element, E, i, σ_v and C₂. 10

UNIT-III

- 6. a. Write the symmetry adapted linear combination belongs to C_4H_4 molecule. 10
 - b. What is the symmetry based selection rules for cyclization reactions? Explain with the help of suitable example. 10
- 7. a. Construct the irreducible representation formed by the AB₃ type of trigonal planar molecule. Also calculate the SALCs on atom B. 10
 - b. Draw the molecular orbitals for the σ -bonding in square planar AB₄ molecule. 10

UNIT IV

- 8. a. Draw the correlation diagram for a d^2 ion in an tetrahedral environment. 10
 - b. Discuss the splitting of free ion terms (${}^{1}S$, ${}^{1}G$, ${}^{3}P$) of d² ion in D_{4h} and T_d point groups. 10
- 9. a. Construct the energy level diagram of e and t₂ orbitals resulting from splitting of dorbital in octahedral environment. 10
 - b. What is orbital and spin degeneracy? Explain by taking example of e_g configuration.

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NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.