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W – 5624

Reg. No. :

Name :

First Semester M.Sc. Degree Examination, January 2026
Chemistry/Analytical Chemistry/Polymer Chemistry/Chemistry with
Specialisation in Drug Design and Development
CH 51325/CL 51325/PC 51325/CHDD 51325: PHYSICAL CHEMISTRY — I
(2025 Admission)

Time : 3 Hours

Max. Marks : 75

SECTION – A

Answer any **two** questions from each unit.

- I. 1. Define the Laplacian operator.
2. What is the difference between a linear and a nonlinear operator?
3. What is a Hermitian operator?
- II. 4. Differentiate between physisorption and chemisorption.
5. How does temperature affect physisorption and chemisorption?
6. Define Harkins-Jura theory of adsorption.
- III. 7. Define activity coefficient.
8. What is Henry's law in thermodynamics?
9. What is fugacity in the thermodynamics?
- IV. 10. What is a symmetry element in group theory?
11. Name the different types of symmetry elements found in molecules.
12. What is the difference between a symmetry element and a symmetry operation?
- V. 13. Define vanishing and non-vanishing integrals in group theory.
14. Give an example of a non-vanishing integral in group theory.
15. State the Lewis-Randall rule in thermodynamics.

(10 × 2 = 20 Marks)

SECTION – B

Answer **all** questions. **Each** question carries **5** marks.

16. Explain the Lindemann theory of unimolecular reactions.

OR

17. Describe the RRK and RRKM theories of unimolecular reactions.
18. Explain the non-commuting property of operators in quantum mechanics.

OR

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19. Explain the eigenvalue Postulate of quantum mechanics.
20. Explain enzyme catalysis based on the Michaelis-Menten theory.

OR

21. Explain the theories and mechanisms of homogeneous catalysis with suitable examples.
22. Explain the Great Orthogonality Theorem in group theory and state the important results derived from it.

OR

23. Explain and rationalize the mutual exclusion principle using group theory.
24. State and explain the conditions for a set with a binary operation to form a mathematical group.

OR

25. Explain the Hammett and Taft equations.

(5 × 5 = 25 Marks)

SECTION – C

Answer any **three** questions. **Each** question carries **10** marks.

26. Explain the steps involved in setting up the character table for the C_{2v} point group and construct the table. What are the applications of the character table?
27. Explain the postulates of quantum mechanics. Describe the state function (wavefunction) postulate in detail.
28. Write a brief note on different surface characterization techniques like PES, XPES, LEED, EXAFS and Auger electron spectroscopy.
29. Identify the hybrid orbitals involved in the hybridization of BF₃ and CH₄ molecules. Explain the mutual exclusion principle and rationalized it using group theory.
30. Explain the theories of reaction rate with special reference to collision theory. Derive the expression according to collision theory and discuss its limitations.

(3 × 10 = 30 Marks)
