(6 pages)

Reg. No. : .....

Code No. : 5420 **Sub. Code : ZCHM 33**

M.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2023.

Third Semester

Chemistry – Core

GROUP THEORY AND CHEMICAL THERMODYNAMICS

(For those who joined in July 2021 onwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. What is the symmetry of CH_3Cl?
   (a) C_{2v} (b) C_{3v}
   (c) D_{3h} (d) no symmetry

2. What is the symmetry of CFHIBr?
   (a) No symmetry (b) C_{3v}
   (c) D_{3h} (d) T_d

3. When is a vibrational mode of a molecule IR active?
   (a) when the vibrational mode has the same symmetry as a component of the molecule's electric dipole moment vector
   (b) when the vibrational mode has the same symmetry as a component of the molecule's polarizability
   (c) vibrational modes of molecules are Raman active only; they cannot be IR active at the same time
   (d) none of the above

4. The number of vibrational degrees of freedom for NH_3 is
   (a) 6 (b) 7
   (c) 4 (d) 5

5. Chemical potential of any constituent of an ideal solution depends on the _____ of the solution?
   (a) Temperature (b) Pressure
   (c) Composition (d) All the above

6. Fugacity is most helpful in
   (a) representing actual behaviour of real gases
   (b) representing actual behaviour of ideal gases
   (c) the study of chemical equilibria involving gases at atmospheric pressure
   (d) none of these

7. Bosons have symmetrical wave functions. They do not obey _____.
   (a) Aufbau principle
   (b) Pauli's Exclusion Principle
   (c) Hund's Rule of Maximum Multiplicity
   (d) Heisenberg's Uncertainty Principle

8. The wave function of fermions is not _____.
   (a) Continuous (b) Single Valued
   (c) Symmetric (d) Differentiable

9. Entropy change of an irreversible process has a _____ value.
   (a) Positive (b) Negative
   (c) Zero (d) Both (a) or (b)

10. A reversible process is performed in such a way that
    (a) at the conclusion of process, both system and surroundings can be restored to their initial states without producing any change
    (b) it should not leave any trace to show that the process had ever occurred
    (c) it is carried out infinitely slowly
    (d) all of the mentioned

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) What are symmetry elements? Give example.

Or

(b) Give example for a plane of symmetry.

12. (a) Explain Vibrational modes as bases for group representations.

Or

(b) Explain Normal mode analysis for $POCl_3$ molecule.

13. (a) What are partial molar quantities?

Or

(b) Define Chemical Potential and arrive at Gibbs-Duhem equation.

14. (a) Explain Ensembles.

Or

(b) Write note on Heat capacity of diatomic gases.

15. (a) Compare reversible and irreversible processes.

Or

(b) Explain Electrokinetic effect.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Explain Schoenflies symbols.

Or

(b) Discuss the Construction of multiplication Table for C_{2v}.

17. (a) Explain mutual exclusion principle.

Or

(b) Discuss determination of hybridization of atomic orbitals in PF_5.

18. (a) Derive Duhem-Margules equation and apply it to Roults law.

Or

(b) Define activity coefficient and explain a method of determination for a non electrolyte.

19. (a) Explain population inversion.

Or

(b) Derive Rotational partition function and explain.

20. (a) Explain Applications or irreversible thermodynamics to biological systems.

Or

(b) Enumerate Entropy change due to coupling of chemical reactions.

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