

(7 pages)

Reg. No. :

Code No. : 7420

Sub. Code : ZCHM 33

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

Third Semester

Chemistry — Core

GROUP THEORY AND CHEMICAL
THERMODYNAMICS

(For those who joined in July 2021-2022 onwards)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. Which pairing of molecule and point group is correct?

- (a) CH_2Cl_2 , T_d (b) CHCl_3 , C_{3v}
(c) CCl_4 , D_{4d} (d) CCl_2Br_2 , C_{2h}

2. Which of the following molecules or ions belongs to the C_{4v} point group?

- (a) SF_5Cl (b) $[\text{BH}_4]^-$
(c) XeF_4 (d) $\text{trans-WCl}_2\text{F}_4$

3. Which of the following symmetry elements does $\text{cis-N}_2\text{F}_2$ contain?

- (a) a C_2 axis
(b) a σ_h plane
(c) an inversion centre, i
(d) an S_2 axis

4. The number of degrees of vibrational freedom possessed by CH_4 is :

- (a) 10 (b) 6
(c) 4 (d) 9

5. Thermodynamics mainly deals with

- (a) Interrelation of various forms of energy and their transformation from one form to another
(b) The system in equilibrium state or moving from one equilibrium state to another equilibrium state
(c) Both of these
(d) None of these

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6. Thermodynamics is not concerned about _____.

- (a) energy changes involved in a chemical reaction
- (b) the extent to which a chemical reaction proceeds
- (c) the rate at which a reaction proceeds
- (d) the feasibility of a chemical reaction

7. Ensemble averaging represents the average of

- (a) unsteady quantities
- (b) steady quantities
- (c) identical quantities
- (d) mean quantities

8. Maxwell-Boltzmann law is for the _____

- (a) Distinguishable particles
- (b) Indistinguishable Particles
- (c) Particles with half integral spin
- (d) Particles with integral spin

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9. Irreversibility of a process may be due to

- (a) lack of equilibrium during the process
- (b) involvement of dissipative effects
- (c) both of the mentioned
- (d) non feasibility of the process

10. All actual heat transfer processes are

- (a) irreversible
- (b) take place through a finite temperature difference
- (c) both of the mentioned
- (d) none 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) Construct a multiplication table for C_{2h} point group.

Or

(b) Write briefly about classes of symmetry operations.

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[P.T.O.]



12. (a) Explain briefly about Symmetry selection rule for Raman and Infrared spectra.

Or

- (b) Give brief account on determination of hybridisation of atomic orbitals in non-linear Molecule XeF_4 .
13. (a) Derive any two Maxwell relations.
- Or
- (b) Write a note on Fugacity and its determination by graphical method.
14. (a) Write briefly about Partition functions.

Or

- (b) Give a note on heat capacities of diatomic gases.
15. (a) Write briefly about phenomenological laws and their applications in Chemistry.

Or

- (b) Discuss application of irreversible thermodynamics to non-linear system.

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PART C — ($5 \times 8 = 40$ marks)

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

Each answer should not exceed 600 words.

16. (a) What is The Great Orthogonality theorem and apply it to construct character table for C_{2v} .

Or

- (b) Give a detailed account on constructing character table for C_{4v} using The Great Orthogonality theorem.
17. (a) Give a detailed account on determination of hybridisation of atomic orbitals in non-linear Molecule methane and PF_5 .

Or

- (b) Write a note on electronic Spectra of Ethylene and Formaldehyde.
18. (a) Discuss the significances of free energy concepts.

Or

- (b) Write a note on chemical potential and derive Gibbs-Duhem equation.

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19. (a) Give the derivation of Fermi-Dirac statistics.

Or

(b) Give the derivation of Maxwell-Boltzmann Statistics.

20. (a) Discuss Onsager reciprocal relations and application of irreversible thermodynamics to biological system

Or

(b) Discuss the entropy changes due to coupling of chemical reaction.

