QP CODE: 22001595

M Sc DEGREE (CSS) EXAMINATION, JULY 2022

First Semester

CORE - CH500104 - THERMODYNAMICS, KINETIC THEORY AND STATISTICAL THERMODYNAMICS

M Sc CHEMISTRY, M Sc ANALYTICAL CHEMISTRY, M Sc APPLIED CHEMISTRY , M Sc PHARMACEUTICAL CHEMISTRY, M Sc POLYMER CHEMISTRY 2019 ADMISSION ONWARDS

A267AF7D

Time: 3 Hours

Part A (Short Answer Questions)

Answer any **eight** questions. Weight **1** each.

- 1. What is meant by thermodynamic equation of state? Mention any one of its applications?
- 2. What is meant by fugacity? How is it related to pressure of a real gas.
- 3. Give Vant Hoff's reaction isotherm and Vant Hoff's reaction isochore.
- 4. What is meant by absolute entropy?
- 5. Define mean free path and describe its dependence on collision diameter.
- 6. Deduce the variation of viscosity of a gas with temperature and pressure.
- 7. Explain (a) thermodynamic probability (b) micro states (c) statistical weight factor.
- 8. Derive the expression for vibrational partition function.
- 9. Derive the statistical relation between thermodynamic probability and entropy?
- 10. Represent the equation for most probable distribution in M-B, B-E and F-D statistics.

(8×1=8 weightage)

Part B (Short Essay/Problems)

Answer any **six** questions.

Weight 2 each.

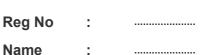
- 11. Deduce konovolovs first law from Gibbs-Duhem-Margules equation.
- 12. Discuss the phase diagram CCl₄- Acetic acid-Water System on the basis of phase rule and what happens to the phase diagram if we alter the temperature of the above system.

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Weightage: 30



- 13. Derive the expressions for average , RMS and most probable velocities from Maxwell's equation.
- 14. (a) Discuss the relation between molecular partition function and molar partition function. (b) Differentiate between distinguishable and indistinguishable particles.
- 15. Explain the classical theory of heat capacities of gases. Discuss its drawbacks.
- 16. At 300 K the partial vapour pressure of HCl vapour in liquid GeCl₄ is as follows:

X _{HC1}	0.005	0.012	0.019
P_{HC1}/K_{pa}	32.0	76.9	121.8

Show that the solution obeys Henry's law and calculate Henry's law constant at 300 K.

- Calculate the number of collisions between N₂ and O₂ molecules in air at 27°C. The partial pressure of N₂ and O₂ are 0.781 atm and 0.210 atm respectively. The collision diameter of N₂ and O₂ are 370 pm and 360 pm respectively.
- 18. Calculate the number of ways of distributing distinguishable molecules a , b , c between three energy levels so as to obtain the following set of occupation number, $N_0 = 1$, $N_1 = 1$, $N_2 = 1$.Write the different configurations.

(6×2=12 weightage)

Part C (Essay Type Questions)

Answer any **two** questions.

Weight 5 each.

- 19. Give different methods for evaluation of partial molar quantities. Illustrate the methods considering partial molar volume.
- 20. Derive the expression for Maxwell Boltzmann distribution of molecular velocities and discuss the methods for experimental verification of Maxwell Boltzmann distribution.
- 21. (a) Derive the distribution law as applied to Bosons. (b) Compare Maxwell- Boltzmann statistics with Bose –Einstien statistics.
- 22. Give an account of Einstein theory of heat capacity of solids. Comment on its limitations.

(2×5=10 weightage)