

TM211100TR

Reg. No : .....

Name : .....

M. Sc. DEGREE (C.S.S.) EXAMINATION, NOVEMBER 2021  
[ 2021 Admissions Regular and 2020 Admissions Improvement & Supplementary ]  
SEMESTER I - CORE COURSE ( CHEMISTRY )

CH1C04TM20 - THERMODYNAMICS, KINETIC THEORY AND STATISTICAL THERMODYNAMICS

Time : 3 Hours

Maximum Weight : 30

**Part A**

**I. Answer any Eight questions. Each question carries 1 weight (8x1=8)**

1. State Third law of thermodynamics. How can you calculate the standard entropy changes accompanying chemical reactions?
2. State Nernst Heat Theorem. What are its applications?
3. What is the sign of entropy of mixing? Justify your answer.
4. Write a note on the different types of molecular velocities.
5. Give the graphical representation of Maxwell Boltzmann distribution of velocities.
6. Discuss Graham's law of effusion.
7. Prove Stirling's approximation and find the value of  $\ln 50!$  using the same.
8. Write a note on the concept of residual entropy.
9. The rotational constant of gaseous HCl, determined from microwave spectroscopy, is  $10.59 \text{ cm}^{-1}$ . Calculate the rotational partition function of HCl at a) 100 K and b) 500 K.
10. Give a brief account of Liquid Helium.

**Part B**

**II. Answer any Six questions. Each question carries 2 weight (6x2=12)**

11. How does activity vary with temperature and pressure?
12. Show that if Raoult's law is applicable to one of the components of an ideal binary solution at all compositions, it is applicable to the other component.
13. Discuss the experimental verification of Maxwell's law of distribution of velocities.
14. Assuming ideal behaviour, calculate the pressure at which the mean free path of Nitrogen molecules will be at  $700 \text{ \AA}$  at 300K. The molecular diameter of  $\text{N}_2 = 3.74 \text{ \AA}$ . Also calculate the number density of the gas.
15. Write a note on the thermal conductivity of gas.
16. Give a detailed account of the concept of Phase space.
17. Write a short note on permutation and combination. Calculate the number of ways of arranging five energy quanta among three energy levels such that one quanta is in one energy level and other two quanta are in other two levels each.
18. Define the term ensemble. Explain the different types of ensembles.

**Part C**

**III. Answer any Two questions. Each question carries 5 weight (2x5=10)**

19. A) Explain the determination of fugacity of a real gas from equation of states. B) Explain the determination of excess volume and excess enthalpy.
20. Explain the determination of a) partial molar enthalpy b) partial molar volume.

21. a) Derive an expression for translational partition function and show how it is related to thermal de Broglie wavelength. b) Derive the expression for rotational partition function and give a brief account of its modification by symmetry factor.
22. Give a detailed account of Ideal Fermi Dirac gas and the application of Fermi Dirac statistics to electron gas.