QP CODE: 24045541

24045541

Reg No : .....

Name : .....

M.Sc DEGREE (CSS) EXAMINATION, DECEMBER 2024

First Semester

CORE - CH500104 - THERMODYNAMICS, KINETIC THEORY AND STATISTICAL THERMODYNAMICS

M.Sc CHEMISTRY, M.Sc ANALYTICAL CHEMISTRY, M.Sc POLYMER CHEMISTRY,M.Sc APPLIED CHEMISTRY, M.Sc PHARMACEUTICAL CHEMISTRY

2019 ADMISSION ONWARDS

770DF53A

Time: 3 Hours

Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

*Weight **1** each.*

1. What is meant by free energy? Why are free energy functions needed for a system?
2. What is meant by chemical potential and explain its significance?
3. "Mixing of ideal gases is always a spontaneous process" evaluate the statement based on the concept of Free energy of mixing.
4. Define chemical affinity. What is its significance?
5. Derive RMS velocity from Maxwell's equation for the distribution of molecular velocities.
6. How mean free path and collision diameter are related?
7. Write a note on the statistical treatment of Boltzmann distribution law.
8. Bring out the main features of the quantum theory of heat capacities of gases.
9. Classify the following into bosons and fermions: (a) ^3He (b) Alpha particle (c) Deuterium (d) Hydrogen molecule (e) Electron (f) Photon.
10. Explain the significance of Debye Theory for heat capacity of solids.

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

*Weight **2** each.*

11. Derive the expression showing the variation of fugacity with temperature.

12. Discuss Nernst heat theorem and explain how it paves way for the formulation of third law of thermodynamics.

13. Bring out the salient features of Maxwell Boltzmann distribution of molecular velocities. Depict the graphical representation and comment on it.

14. (a) The total partition function of system is the product of the translational, rotational, vibrational and electronic partition functions. Verify this statement. (b) Discuss on the partition function for hydrogen.

15. Derive Bose-Einstein distribution law.

16. The free energy change accompanying a given process is -85.77 kJ at 25^0C and -83.68 kJ at 35^0C. Calculate the change in enthalpy for the process at 30^0C.

17. At what temperature will the RMS velocity of SO_2, H_2 and O_2 be the same as N_2 at 300 K?

18. Calculate the vibrational partition function for H_2 at 300 K if $\overline{\nu}$ = 4405 cm^{-1} .

(6×2=12 weightage)

Part C (Essay Type Questions)

*Answer any **two** questions.*

*Weight **5** each.*

19. Draw the phase diagram of a three component system of three liquids where one pair is partially miscible and explain the application of Gibbs phase rule into it.

20. Explain in detail the transport properties of gas with reference to thermal conductivity.

21. Write short notes on
(a) Phase-space (b) Microstates (c) Equal-apriori principle (d) Ensembles (e) Thermodynamic probability

22. (a) Explain Sakur Tetrode equation (b) How is the third law of thermodynamics formulated from statistical thermodynamics?

(2×5=10 weightage)