R – 7476

Reg. No. : ....

Name : ....

Second Semester M.Sc. Degree Examination, November 2023

Chemistry/Analytical Chemistry/Polymer Chemistry

CH/CL/PC 223 – PHYSICAL CHEMISTRY-II

(2020 Admission Onwards)

Time : 3 Hours

Max. Marks : 75

SECTION – A

Answer **two** among (a) (b) and (c) from each questions. **Each** sub question carries **2** Marks

1. (a) For a rigid rotator the orientation is specified by two angles θ and ϕ on solving we get $\Phi(\phi) = A_m e^{im\phi}$ where $m = 0, +1, \pm 2,...$ If $\Phi(\phi)$ is normalized, find A_m?

   (b) Distinguish between symmetric and anti-symmetric wave functions.

   (c) List the selection rule involved in vector atom model.

2. (a) Write down the formula to calculate the number of modes of vibration of linear and nonlinear molecules?

   (b) Which of the following molecules are infra-red active: $N_2O, H_2O, OCS, CH_2 = CH_2$? Justify your answer.

   (c) Discuss the Birge - Sponer plot.

P.T.O.

3. (a) Describe the physical significance of the partition function.

   (b) What is the significance and importance of the principle of equal *a priori* Probabilities?

   (c) What is the origin of residual entropy?

4. (a) Discuss Debye theory of specific heat capacity of solids.

   (b) State Kopps law and discuss its limitations.

   (c) What are the limitations of Einstein's theory of heat capacity?

5. (a) What is stripping voltametry?

   (b) What is mean by ionic mobility?

   (c) What is overvoltage? What are the factors contributing it?

(10 × 2 = 20 Marks)

SECTION – B

Answer either (a) or (b) from each question, each sub question caries **5** Marks

6. (a) Derive the wave equation for a quantum particle on a ring.

   (b) Explain the origin of spectral lines of H atom.

7. (a) Give a brief account on Frank-Condon principle.

   (b) Discuss the selection rules for transitions in electronic spectrum of a molecule?

8. (a) State and prove Boltzmann's theorem connecting entropy and probability.

   (b) Briefly explain Ensemble and why is it useful in statistical thermodynamics?

9. (a) Briefly compare Maxwell Boltzmann, Bose Einstein and Fermi – Dirac statistics.

    (b) Discuss the anomalous heat capacity of hydrogen.

10. (a) Explain Debye – Huckel limiting Law and its verification.

    (b) Discuss the significance of Tafel plots.

(5 × 5 = 25 Marks)

SECTION – C

Answer any **three** questions, **each** question carries **10** marks.

11. Discuss a non- polar rigid rotator using the example of a particle on a sphere.

12. (a) Discuss the Harmonic Oscillator model for molecular vibrations. How is anharmonicity introduced to treat a "real" diatomic oscillator?

    (b) Describe why we often consider Infrared and Raman spectroscopies complementary with respect to each other with suitable examples.

13. Explain the various thermodynamic parameters in terms of partition function.

14. Explain Fermi-Dirac energy distribution in particles.

15. Write an essay on the principle, types and applications of Fuel cells.

(3 × 10 = 30 Marks)

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