LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **CHEMISTRY**

SECOND SEMESTER – **APRIL 2016**

CH 2816 - THERMODYNAMICS AND STATISTICAL MECHANICS

Date: 22-04-2016   Dept. No.   Max. : 100 Marks
Time: 01:00-04:00

Part-A

Answer ALL questions.   **(10 x 2= 20)**

1. What are partial molal properties?

2. Calculate the ionic strength of 0.05 M NaCl.

3. Define activity coefficient.

4. Mention the importance of tie line.

5. What are Bosons and Fermions?

6. Define internal entropy production.

7. What is most probable distribution?

8. What are azeotropic mixtures?

9. Prove that the electronic partition function for H_2 is unity.

10. Calculate the ground state nuclear energy level for para hydrogen.

Part-B

Answer any EIGHT questions.   **(8 x 5= 40)**

11. How is the rate constant of a reaction evaluated using statistical mechanics?

12. Calculate the vibrational contribution to the entropy of F_2 molecules at 25 ºC. Given that the fundamental vibrational frequency is 892.1 cm^{-1}.

13. Discuss the effect of temperature on equilibrium constant.

14. Calculate the chemical potential, over and above the standard chemical potential, of N_2 present in a mixture where the partial pressure is 2 atm.

15. Write a note on the fractional distillation of binary liquid solutions.

16. Explain thermo mechanical effects with an example.

17. What is residual entropy? Mention its significance.

18. State Stirling's theorem and prove that it is applicable only to a collection of large number of particles.

19. Mention the assumptions of Einstein's theory of molar heat capacity of solids.

20. Derive Sackure-Tetrode equation and mention its significance.

21. Derive Maxwell-Boltzmann distribution law using its assumptions.

22. Prove that carbon is a good reducing agent for several metal oxides.

Part-C

Answer any FOUR questions.   **(4 x 10= 40)**

23a. Derive Gibbs-Duhem equation and mention its significance.   **(6)**

 b. Calculate the fugacity of H_2 at 100 ºC and 300 atm. The density of H_2 at the above condition is 16.79
 g/dm^3.   **(4)**

24a. Derive the relation between partition function and energy.   **(5)**

 b. Explain flux-force concept with an example.   **(5)**

25a. Explain the different types of phenomenological coefficients. Mention their significance.   **(6)**

 b. What is dissipation function? Mention its unit.   **(4)**

26a. Obtain van't Hoff equation to illustrate the temperature dependence of equilibrium constant.   **(6)**

 b. Mention the importance of Onsager reciprocal relationship.   **(4)**

27. Discuss the variation of chemical potential with temperature and pressure.

28a. Describe the phase diagram of a two component system and obtain the degrees of freedom for all the
 regions.   **(6)**

 b. State and explain Lever Rule.   **(4)**

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