LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – CHEMISTRY

SECOND SEMESTER – NOVEMBER 2016

CH 2816 - THERMODYNAMICS AND STATISTICAL MECHANICS

Date: 17-11-2016   Dept. No.   Max. : 100 Marks
Time: 09:00-12:00

Part-A

Answer ALL questions.   (10 × 2= 20)

1. Define partial molal entropy.

2. What are azeotropic mixtures?

3. Write an expression for molecular partition function and mention the terms involved.

4. Mention the importance of reduced phase rule.

5. What is Seebeck effect?

6. Define internal entropy production.

7. What are Bosons and Fermions? Give an example each.

8. Evaluate $\ln N!$ where $N = 6.022 \times 10^{23}$.

9. What are ortho and para hydrogen?

10. Calculate the ionic strength of 0.25 m KNO_3 solution.

Part-B

Answer any EIGHT questions.   (8 × 5= 40)

11. Derive Gibbs-Duhem equation and mention its importance.

12. What are macro and micro states? Give examples.

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

14. Obtain the integrated Kirchhoff's equation.

15. Derive the relation between partition function and equilibrium constant.

16. A system of N particles has two energy levels with $g_1 = 2$, $g_2 =3$, $E_1 = 41.84$ kJ/mol and $E_2 = 58.58$ kJ/mol. Calculate the ratio of the number of particles in the two energy states at 1000 K.

17. Explain flux-force relationship with an example.

18. Compare Debye's theory of heat capacity of solids with Einstein's theory.

19. How is the fugacity of a gas determined?

20. Describe the use of Bose-Einstein statistics for a photon gas.

21. What are phenomenological coefficients? Mention their significance.

22. A 5.21 molal aqueous solution of a non-volatile solute has a vapour pressure of 2466 Nm^{-2} at 25°C. At the same temperature, the vapour pressure of pure water is 3146 Nm^{-2}. Assuming ideality, calculate the activity and activity coefficient of water in the solution.

Part-C

23 a. What is thermoelectricity? Explain the phenomena involved in thermoelectricity. **(5)**

   b. Calculate the translational partition function for hydrogen molecule at 1000 K and at 1 atm pressure
   (5)

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

25 a. Describe the phase diagram of a two component system and obtain the degrees of freedom in all the

   regions formed in the phase diagram. **(5)**

   b. Explain Onsager theory in the light of phenomenological coefficients. **(5)**

26 a. How will you establish a relation between partition function and energy? **(5)**

   b. Discuss the use of Ellingham diagram to study the reduction of oxides. **(5)**

27.   Derive Sackure-Tetrode equation for the determination of translational entropy of a monoatomic gas.

28.   Derive Maxwell-Boltzmann statistics using its assumptions.

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