LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – CHEMISTRY
SECOND SEMESTER – APRIL 2015
CH 815 - THERMODYNAMICS

Date : 17/04/2015   Dept. No. [   ]   Max. : 100 Marks
Time : 09:00-12:00

Part-A

Answer all questions. Each question carries two marks: *(10x2=20)*

1. Define chemical potential.
2. Mention the significance of inversion temperature.
3. Calculate the change in the free energy of 2 moles of a substance when its activity changes from 0.05 to 0.25 at 27ºC.
4. Define phase rule and explain the terms involved.
5. What is residual entropy?
6. Predict the symmetry number for N_2 and HCl molecules.
7. What are Bosons and Fermions? Give an example each.
8. Give the importance of collision number.
9. What are ortho and para hydrogen?
10. Calculate the ionic strength of 0.05m NaCl.

Part-B

Answer any eight questions. Each question carries five marks: *(8x5=40)*

11. Derive Gibbs-Duhem equation and mention its importance.
12. How is Joule-Thomson coefficient calculated for a van der Waals gas?
13. State Nernst heat theorem and mention the need for the third law of thermodynamics.
14. Obtain van't Hoff equation to illustrate the temperature dependence of equilibrium constant.
15. Derive the relation between partition function and equilibrium constant.
16. A system containing N identical molecules is cooled to 0 K. Calculate the entropy i) if the energy levels are not degenerate ii) if the degeneracy of each energy level is 2.
17. What is Stirling's approximation? Evaluate ln N! when $N = 10^{25}$.
18. Describe the thermodynamic properties of an atomic crystalline system using Einstein's model.
19. How is the fugacity of a gas determined?
20. Describe the use of Bose-Einstein statistics for a photon gas.
21. Define partition function and explain factorization of partition function.
22. Calculate the translational partition function of an oxygen molecule confined in a 1 litre vessel at 27°C.

Part-C

Answer any four questions. Each question carries ten marks: *(4x10=40)*

23a. Explain the determination of activity and activity coefficient of non-electrolytes.   **(6)**
  b. The equilibrium constant K_p for the reaction $H_{2(g)} + S \rightleftharpoons {}_{(g)}H_2S_{(g)}$ is 20.2 atm^{-1} at 945ºC and 9.21 atm^{-1} at 1065ºC. Calculate $\Delta H°$.   **(4)**
24. Discuss the variation of chemical potential with temperature and pressure.
25a. Describe the phase diagram of a two component system and obtain the degrees of freedom in all the regions formed in the phase diagram.   **(6)**
  b. Calculate the vibrational contribution to the entropy of F_2 molecules at 25ºC. Given that the fundamental vibrational frequency is 892.1 cm^{-1}.   **(4)**
26. Explain the equilibrium theory of the rate of association and dissociation.
27. Derive Maxwell-Boltzmann statistics using its assumptions.
28. Derive Sackure-Tetrode equation for the determination of translational entropy of a monoatomic gas.