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Third Semester (B. Tech.) Chemical Engineering and Engineering Physics

CY2001: PHYSICAL CHEMISTRY

Test I: August 2012

Time: 1 hour
Max Marks: 15

(Answer all questions)

1. Describe the conditions for spontaneity of a reaction. (2 marks)
2. Discuss the Lead-Silver eutectic system. (2 marks)
3. The addition of 5 g of a compound to 250 g of naphthalene (Enthalpy of fusion = 19107 J mol^{-1}, melting point = 80.26 °C and molar mass = 128.17 g mol^{-1}) lowered the freezing point of the solvent by 0.780 K. Calculate the molar mass of the compound. (2 marks)
4. The complex compound $Al_2(SO_4)_3$ in 0.1 M aqueous solution, maintained at 27 °C, is 45% dissociated. Calculate the osmotic pressure of the solution. (2 marks)
5. At 1 atm pressure and 627 °C, SO_3 is partially dissociated into SO_2 and O_2 as per the given equation.

$$SO_{3(g)} \rightleftharpoons SO_{2(g)} + {}^1/_2\, O_{2(g)}$$

   a) If the density of equilibrium mixture is 0.925 g/liter, what is the degree of dissociation of SO_3 under these conditions?

   b) If $K_p = 3.3 \times 10^{-8}$ atm for the given reaction at the given temperature, estimate $\Delta G°$.

(3 marks)

6. For the following reaction at a certain temperature, it is found that the equilibrium concentrations in a 5 L container are $[H_2] = 0.05$ M, $[F_2] = 0.01$ M, and $[HF] = 0.4$ M. To this equilibrium mixture 0.238 M of F_2 is added, calculate the concentrations of all gases once equilibrium is reestablished.

$$H_{2(g)} + F_{2(g)} \rightleftharpoons 2HF_{(g)}$$

(4 marks)

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