Assignment 6

Indian Institute of Science Education and Research

CHM202: Energetics and dynamics of chemical reactions

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Ques. 1 Suppose that (a) the attractive interactions between gas particles can be neglected, (b) the attractive interaction is dominant in a van der Waals gas, and the pressure is low enough to make the approximation $4aP << (RT)^2$. Find expressions for the fugacity coefficient of a van der Waals gas in terms of the pressure for both the cases.

Ques. 2 Given that $p^*(H_2O) = 0.02308$ atm and $p(H_2O) = 0.02239$ atm in a solution in which 0.122 kg of a non-volatile solute (M= 241 g mol^{-1}) is dissolved in 0.920 kg water at 293 K, Calculate the activity and activity coefficient of water in the solution.

Ques. 3 The equilibrium constant of a reaction is found to fit the expression:

$$\ln K = A + \frac{B}{T} + \frac{C}{T^3}$$

between 400 K and 500 K with A = −2.04, B = −1176 K, and $C = 2.1 \times 10^7$ K^3. Calculate the standard reaction enthalpy and standard reaction entropy at 450 K.

Ques. 4 By measuring the equilibrium between liquid and vapour phases of a solution at 30°C at 1.00 atm, it was found that $x_A = 0.220$ when $y_A = 0.314$. Calculate the activities and activity coefficients of both components in this solution on the Raoult's law basis. The vapour pressures of the pure components at this temperature are: $p_A^* = 73.0$ kPa and $p_B^* = 92.1$ kPa. (x_A is the mole fraction in the liquid and y_A the mole fraction in the vapour)

Ques. 5 The standard enthalpy of a certain reaction is approximately constant at +125 kJ mol^{-1} from 800 K up to 1500 K. The standard reaction Gibbs energy is +22 kJ mol^{-1} at 1120 K. Estimate the temperature at which the equilibrium constant becomes greater than 1.