KMM 2621 Physical Chemistry for Engineers

Homework 4- Simple Mixtures

P1. The volume of an aqueous solution of NaCl at 25°C was measured at a series of molalities b, and it was found that the volume fitted the expression;

$$v = 1003 + 16.62x + 1.77x^{3/2} + 0.12x^2$$

where $v = V/\text{cm}^3$, V is the volume of a solution formed from 1 kg of water, and $x = b/b^0$. Calculate the partial molar volume of the components in a solution of molality 0.1 mol kg^{-1}.

P2. The molar mass of an enzyme was determined by dissolving it in water, measuring the osmotic pressure at 20°C, and extrapolating the data to zero concentration. The following data were obtained:

c(mg/cm^3)	3.221	4.618	5.112	6.722
h(cm)	5.746	8.238	9.119	11.99

Calculate the molar mass of the enzyme.

P3. A solution of ethanol (eth) and chloroform (chl) at 45°C with x_{eth}=0.99 has a vapor pressure of 177.95 torr. At this high dilution of chloroform, the solution can be assumed to be essentially ideally dilute. The vapor pressure of pure ethanol at 45°C is 172.76 torr. (*a*) Find the partial pressures of the gases in equilibrium with the solution. (*b*) Find the mole fractions in the vapor phase. (*c*) Find the Henry's law constant for chloroform in ethanol at 45°C. (*d*) Predict the vapor pressure and vapor-phase mole fractions at 45°C for a chloroform–ethanol solution with x_{eth} = 0.98. Compare with the experimental values P =183.38 torr and y_{eth}= 0.9242.