CHEM 361A - Lecture 9 Activity

Mixtures

In Class

1. Why is the preferred standard state for the solvent in a real dilute solution the Raoult's Law standard state? Why is the preferred standard state for the solute in a real dilute solution the Henry's Law standard state? Is there a preferred standard state for the solution in which $x_{solvent} = x_{solute} = 0.5$?

2. You have an acetone-CS_2 solution. where the following data has been collected

Table 1: Partial and Total Pressures above a CS_2-Acetone Solution

x_{CS_2}	p_{CS_2} (kPa)	$p_{acetone}$ (kPa)	p_{total} (kPa)
0	0	45.7	45.7
0.1991	36.3	38.7	75.0
0.3502	47.8	35.2	83.0
0.4933	53.8	32.4	86.2
0.6161	57.1	30.1	87.1
0.8280	62.0	24.0	86.0
1.0000	68.3	0	68.3

   (a) Sketch a pressure vs mole fraction of CS_2 (x_{CS_2}) plot with p_{CS_2}, $p_{acetone}$, and p_{total}.

   (b) On this same plot, indicate for CS_2 the prediction of the partial pressure according to Raoult's Law and the Henry's Law.

   (c) Calculate the activity of the CS_2 at $x_{CS_2} = 0.3502$ according to Raoult's Law and Henry's Law. Use $K_{H,CS_2} = 233.3$ kPa.

   (d) What is the activity coefficient for CS_2 assuming a Raoult's Law standard state, and the Henry's Law standard state?

   (e) Which model (Raoult or Henry) would be appropriate to use as the standard state for $x_{CS_2} = 0.3502$?

Homework

3. The symptoms induced by the release of air into the bloodstream are known to divers as the bends. Let's assume that the average human with a body weight of 70 kg has a blood volume of 5.0 L. The Henry's Law constant for the solubility of N_2 in H_2O is 9.04×10^4 bar at 298 K. Assume that this is also the value of the Henry's Law constant for blood, that the density of blood is 1.00 kg L^{-1}, that blood's molar mass is the same as water, and that the N_2 behaves ideally.

(a) Calculate the number of moles of nitrogen absorbed in this amount of blood in air of composition of 80% N_2 at sea level where the pressure is 1 bar, and at a pressure of 50 bar. ($n_{N_2}(1\ bar) = 2.46 \times 10^{-3}$ moles; $n_{N_2}(50\ bar) = 0.123$ moles)

(b) Assume that a diver accustomed to breathing compressed air at a pressure of 50 bar is suddenly brought to sea level. What volume of N_2 gas is released as bubbles in the diver's bloodstream? ($V = 3.7$ L)