Solution

Chemistry-4311
October 16, 2015

Quiz #5 **Name**_____

R = 8.314 J/mol-K = 0.08206 L-atm/mol-K = 1.987 cal/mol-K, $N_A = 6.02 \times 10^{23}$

1. Matching (Use a letter only once)

Raoult's Law is __h__ .

Henry's Law is __a__ .

The relationship between activity and mole fraction is __g__ .

The hydration energy for Li^+ is more negative than that of K^+. True or false, __b__ ,

The expression for freezing point depression is $\Delta T_f = K_f m_2$, where m_2 is the __e__ .

a. $P_2 = x_2 K_2$
b. true
c. $P_2 = RT \ln x_2$
d. $P_1 = n_1 RT/V_1$
e. molality
f. false
g. $a_1 = \gamma_1 x_1$
h. $P_1 = x_1 P_1^*$
i. molarity
j. $\gamma_1 = a_1 x_1$

2. An ideal solution is made from 5.00 mol of benzene and 3.25 mol of toluene. At 298 K, the vapor pressure of the pure substances are $P^*_{benzene} = 96.4$ torr and $P^*_{toluene} = 28.9$ torr.

(a) What is the mole fraction of benzene in the solution?

$$\chi_{benzene} = \frac{5}{(5+3.25)} = 0.61$$

(b) What is the total vapor pressure of this solution?

$P_{Benzene} = 0.61 \times 96.4 \text{ torr} = 58.8 \text{ torr}$

$P_{toluene} = \frac{3.25}{8.25} \times 28.9 \text{ torr} = 11.27 \text{ torr}$

$P_{total} = P_{Benzene} + P_{toluene} = 70.07 \text{ torr}.$

(c) What is the mole fraction of benzene in the vapor?

$$\chi^{Vapor}_{benzene} = \frac{58.5}{70.07} \sim 0.83$$

3. When 690 grams of a compound is added to 4 kg of water the freezing point is depressed by 10 °C. What is the molecular weight of the compound? K_f for water is 1.855.

$$\Delta T_f = k_f m = k_f \times \frac{(mass)_{solute}}{M_{solute}} \times \frac{1}{(mass)_{solvent}}$$

$$M_{solute} = \frac{k_f \times (mass)_{solute}}{\Delta T_f \times (mass)_{solvent}} = \frac{1.855 \text{ K mol}^{-1}\text{kg} \times 690 \text{ g}}{10 \text{ K} \times 4 \text{ kg}}$$

$\sim 32 \text{ g/mol}$