CHEM 3423 001 Spring 2024 **Name:**
ID:

Worksheet # 12 (Total number of points you can get is 3 pts)

1. An ideal solution of 3 mol of A and 2 mol of B is at 300K in equilibrium with vapor. At this temperature, P^*_A = 2.5 bar and P^*_B = 3.0 bar. What is the mass percentage of A in the vapor phase? (molar Mass of A (B): M_A = 50 g/mol; M_B = 10 g/mol)

$x_A = \frac{3}{3+2}$, $x_B = \frac{2}{3+2}$, $\frac{x_A}{x_B} = \frac{3}{2}$ (in liquid)

$\frac{y_A}{y_B} \cdot \frac{p_A}{p_B} = \frac{p^*_A x_A}{p^*_B x_B} = \frac{3}{2}\frac{p^*_A}{p^*_B}$

$= \frac{n_A/M_A}{n_B/M_B} = \frac{m_A}{m_B}\frac{M_B}{M_A}$

$\frac{m_A}{m_B} = \frac{3}{2}\frac{p^*_A}{p^*_B}\frac{M_A}{M_B} = 1.5 \cdot \frac{25}{30}\frac{50}{10} = 6.25$

$w_A y_A = \frac{m_A}{m_A + m_B} = \frac{m_A/M_B}{1 + m_A/m_B}$ 0.862

2. At T=330 K a liquid solution of 0.5 mol fraction of A and 0.5 mol fraction of is in equilibrium with vapor. A and B are miscible and the vapor pressure of the solution is 1 bar. The composition of the vapor is 0.65 mol fraction of A and 0.35 mol fraction of B. What would be the vapor pressures P^*_A and P^*_B of the pure components A and B at this temperature?

$y_A = \frac{p_A}{p} = \frac{x_A p^*_A}{p} \Rightarrow p^*_A = p\frac{y_A}{x_A}$ 1.3 bar

$p^*_B = p\frac{y_B}{x_B}$ 0.7 bar

3.The ratio of a component A to water collected in a steam distillation is4, when the mixture was boiled at 344 K and 80 kPa. If the vapor pressure of water at this temperature is 43.2 kPa, calculate the molar mass of A (molar mass of water: 18.02 g/mol

$m = n \cdot M$

$\frac{m_A}{m_{H_2O}} = \frac{n_A M_A}{n_{H_2O} M_{H_2O}} = \frac{p^*_A}{p^*_{H_2O}}\frac{M_A}{M_{H_2O}}$ | $P = p^*_A + p^*_{H_2O}$, $\Rightarrow p^*_A = P - p^*_{H_2O}$

$\Rightarrow M_A = \frac{p^*_{H_2O}}{p^*_A}\cdot\frac{m_A}{m_{H_2O}}\cdot M_{H_2O} = \frac{p^*_{H_2O}}{P - p^*_{H_2O}}\frac{m_A}{m_{H_2O}}\cdot M_{H_2O}$

$= \frac{43.2}{80-43.2}\cdot 4 \cdot 18.02\ \frac{g}{mol}$

$= 1.173 \cdot 4 \cdot 18.02\ g/mol = 84.62\ g/mol$