$$PV = nRT$$

$$\downarrow$$

$$P = \frac{nRT}{V} = \left(\frac{n}{V}\right)RT$$

$$P = M \cdot RT$$

$$\Pi = MRT$$ Morse equation

A 3.12 g sample of a protein having a molecular weight of 36700 $\frac{g}{mol}$ was dissolved in enough water to produce 53.4 mL of solution. What is the osmotic pressure of this solution at 25°C ?

$$\Pi = M \cdot R \cdot T$$

$$\left(0.001592 \frac{mol}{L}\right)\left(0.08206 \frac{L\,atm}{K\,mol}\right)\left(298.15\,K\right)$$

$$M = \frac{\#\,mol}{\#\,L} = \frac{8.501 \times 10^{-5}\,mol}{0.0534\,L}$$

$$3.12\,\cancel{g}\left(\frac{1\,mol}{36700\,\cancel{g}}\right) = 8.501 \times 10^{-5}\,mol$$

$$\Pi = 0.03895\,atm$$

$$0.03895\,\cancel{atm}\left(\frac{760\,torr}{1\,\cancel{atm}}\right) = 29.6\,torr$$

A 2.87 g protein sample was dissolved in enough water to produce 28.7 mL of solution. The solution was found to have an osmotic pressure of 19.8 torr at 25 °C. What is the molecular weight of the protein?

$$MWT = \frac{\#\ g}{\#\ mol} = \frac{2.87\ g}{3.056 \times 10^{-5}\ mol} = 9.39 \times 10^{4}\ \frac{g}{mol}$$

$$M = \frac{\#\ mol}{\#\ L} \rightarrow \#\ mol = M(\#\ L)$$

$$\#\ mol = \left(0.001065\ \frac{mol}{L}\right)(0.0287\ L)$$

$\rightarrow 3.056 \times 10^{-5}\ mol$

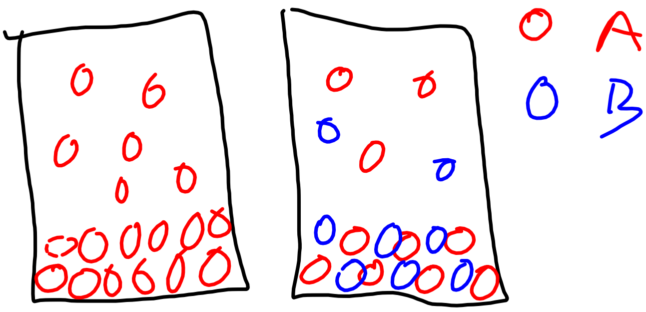
$$\Pi = M \cdot R \cdot T$$

$\downarrow$

$$M = \frac{\Pi}{RT} = \frac{0.02605\ atm}{\left(0.08206\ \frac{L\ atm}{K\ mol}\right)(298\ K)}$$

$\rightarrow 0.001065\ \frac{mol}{L}$

$$19.8\ torr\left(\frac{1\ atm}{760\ torr}\right) = 0.02605\ atm$$



$$P_T = P_A + P_B$$

Raoult's Law

$$P_A = X_A \cdot P_A^\circ$$

$$P_B = X_B \cdot P_B^\circ$$

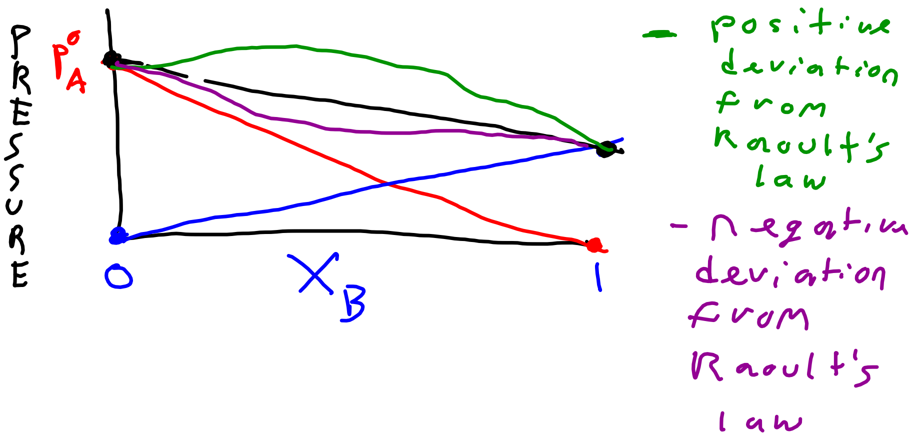
$$P_T = X_A \cdot P_A^\circ + X_B \cdot P_B^\circ$$

$$X_A + X_B = 1$$

$$\downarrow$$

$$X_A = 1 - X_B$$

$$P_T = (1 - X_B) \cdot P_A^\circ + X_B \cdot P_B^\circ$$



A solution contains these components at 35 °C

3.95 g CS_2 $P^{o}_{CS_2} = 515$ torr

2.43 g C_3H_6O $P^{o}_{C_3H_6O} = 332$ torr

CH_3COCH_3

1. What pressure does Raoult's law predict for this solution?

2. If the actual solution pressure is 645 torr, are the CS_2-C_3H_6O attractive forces the strongest or the weakest in this solution?

$$\overset{285\text{ torr}}{} \quad \overset{148\text{ torr}}{} = 433\text{ torr}$$

$$P_T = P_{CS_2} + P_{C_3H_6O}$$

$$= X_{CS_2} \cdot P^{\circ}_{CS_2} + X_{C_3H_6O} \cdot P^{\circ}_{C_3H_6O}$$

$$(0.5535)(515\text{ torr}) + (0.4465)(332\text{ torr})$$

$$3.95\text{ g } CS_2 \left(\frac{1\text{ mol } CS_2}{76.15\text{ g } CS_2} \right) = 0.051871\text{ mol } CS_2$$

$$2.43\text{ g } C_3H_6O \left(\frac{1\text{ mol } C_3H_6O}{58.078\text{ g } C_3H_6O} \right) = 0.041840\text{ mol } C_3H_6O$$

$$X_{CS_2} = \frac{0.051871\text{ mol}}{0.051871\text{ mol} + 0.041840\text{ mol}}$$

$$= 0.5535$$

$$X_{C_3H_6O} = 1 - X_{CS_2}$$

$$= 1 - 0.5535$$

$$= 0.4465$$