Raoult's Law

non-volatile, non-ionizing solute ($i=1$)

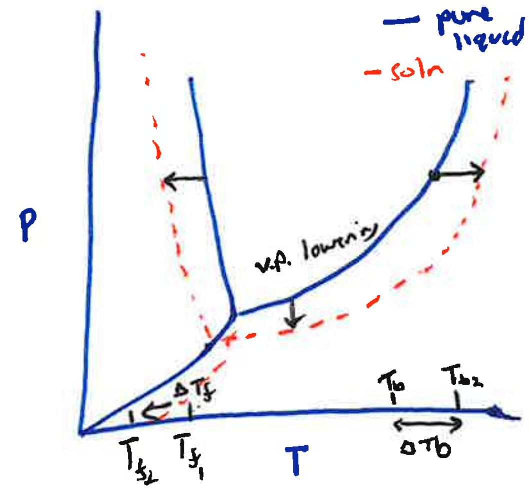
$$P_{soln} = X_{solvent} \, P^{\circ}_{solvent}$$

volatile solute

$$P_{solute} = X_{solute} \, P^{\circ}_{solute} \rightarrow = 0 \text{ for non volatile solute}$$

$$P_{solvent} = X_{solvent} \, P^{\circ}_{solvent}$$

$$P_{soln} = P_{solute} + P_{solvent}$$



$$X = \frac{n_a}{n_{tot}}$$

So, if a solution is 90% water, the vapor pressure is 90% of pure water?

1g / 100g

$$K_f = \frac{\Delta T}{im}$$

$$\Delta T_f = i\, m\, K_f$$

$$\Delta T_b = i\, m\, K_b$$

$$\Pi = iMRT$$

"Salty sweat"

Salt makes way to sweat glands

Pulls water behind it (osmotic pressure)

Sweat more → cools body

122 g sucrose (342.2 g mol^{-1}) in 350 g H_2O.

$P^{\circ}_{H_2O} = 0.0313$ atm

$$X_{solvent} = \frac{350\text{ g } H_2O\left(\frac{mol}{18.02 g}\right)}{350 g\left(\frac{mol}{18.02g}\right) + 122 g\left(\frac{mol}{342.3 g}\right)} = 0.982$$

$$P = X P^{\circ}$$

$$= (0.982)(0.0313 \text{ atm}) = 0.0307 \text{ atm}$$

$K_f(H_2O) = 1.86\ °C\ m^{-1}$

$$m = \frac{122 \text{ sucrose}\left(\frac{mol}{342.3 g}\right)}{350 g\ H_2O\left(\frac{kg}{10^3 g}\right)} = 1.017\ m$$

$$\Delta T_f = i\, m\, K_f = (1)(1.017\ m)(1.86\ °C\ m^{-1})$$

$$= 1.89 °C$$

$$\therefore T_f = 0°C - 1.89°C$$

$$= -1.89\ °C$$

$$\Pi = iMRT$$

$$= (1)\frac{(122 g)\left(\frac{mol}{342.3 g}\right)}{1 L}(0.08206 \text{ L atm mol}^{-1} K^{-1}) 298.K$$

$$= 8.71 \text{ atm}$$

$K_b = 0.513\ °C\ m^{-1}$

$$\Delta T_b = i\, K_b\, m = (1)(1.017\ m)(0.513\ °C\ m^{-1})$$

$$= 0.522 °C$$

$T_b = 100.522 °C$