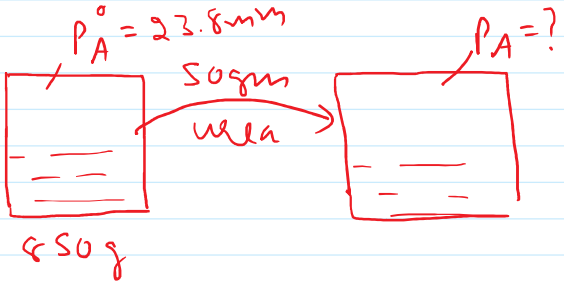
Question

Vapour pressure of pure water at 298 K is 23.8 mm Hg. 50g of urea (NH_2CONH_2) is dissolved in 850g of water. Calculate the vapour pressure of water for this solution and its relative lowering.



Answer

urea → B, water → A

$$n_B = \frac{w_B}{M_B} = \frac{50}{60} = \frac{5}{6}$$

$$n_A = \frac{w_A}{M_A} = \frac{850}{18} = \frac{425}{9}$$

$$x_A = \frac{n_A}{n_A + n_B} = \frac{\frac{425}{9}}{\frac{425}{9} + \frac{5}{6}} = 0.983$$

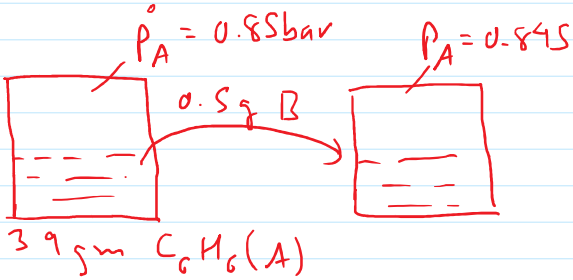
Raoult's Law

i) $P_A = P_A^\circ x_A = 23.8 \times 0.983 = 23.4$ mm Hg

ii) $RLVP = x_B = 1 - x_A = 1 - 0.983 = 0.017$

Question

The vapour pressure of pure benzene at a certain temperature is 0.85 bar. A non volatile, non-electrolyte solid weighing 0.5 g when added to 39.0 g benzene (molar mass = 78 g mol^{-1}). Vapour pressure of the solution then is 0.845 bar. What is the molar mass of the solid substance?



Answer

$$\frac{P_A^\circ - P_A}{P_A} = \frac{n_B}{n_A}$$

$$\frac{0.85 - 0.845}{0.845} = \frac{w_B \times M_A}{M_B \times w_A}$$

$$\frac{0.845}{0.005} = \frac{M_B \times W_A}{0.5 \times 78}$$

$$\frac{0.845}{0.005} = \frac{M_B \times 39}{0.5 \times 78}$$

$$M_B = 169\ g$$

Question

Calculate the mass of a non volatile solute (molar mass 40 g mol^{-1}) which should be dissolved in 114 g octane to reduce its vapour pressure to 80%

Answer

$$\frac{P_A^\circ - P_A}{P_A} = \frac{n_B}{n_A}$$

$$\frac{P_A^\circ - 0.8 P_A^\circ}{0.8 P_A^\circ} = \frac{W_B \times M_A}{M_B \times W_A}$$

$$\frac{2}{8} = \frac{W_B \times 114}{40 \times 114}$$

$$W_B = 10\ gm$$