n_{H_2O}: $500.0\ g\ H_2O \times \frac{1\ mol}{18.0\ g} = 27.8\ mol$

n_{CaCl_2}: $50.0\ g \times \frac{1\ mol}{110.\ g} = 0.455\ mol$

$n_{glucose}$: $50.0\ g \times \frac{1\ mol}{180.\ g} = 0.278\ mol$

3 ions

$CaCl_2$ → Ca^{2+} + Cl^- + Cl^-

Problem Set #2 Colligative Properties

Raoult's law

1. Calculate the vapor pressure of a solution made by dissolving 50.0 grams of calcium chloride and 50.0 grams of glucose ($C_6H_{12}O_6$) in 500.0 grams of water. The vapor pressure of pure water is 47.1 torr at 37.0 °C.

$P = (47.1\ torr) \times 0.944 = 44.5\ torr$

$P_{new} = \chi_{solvent} P^\circ_{solvent}$

$\chi_{solvent} = \frac{n_{solvent}}{3 \times n_{CaCl_2} + n_{glucose} + n_{solvent}}$

$\chi_{solvent} = \frac{27.8\ mol}{3 \times (0.455\ mol) + 0.278\ mol + 27.8\ mol}$

$\chi_{solvent} = 0.944$

2. Lysozyme is an enzyme that cleaves cell walls. A 0.100-L sample of a solution of lysozyme that contains 0.0750 g of the enzyme exhibits an osmotic pressure of 1.32×10^{-3} atm at 25 °C. Assuming ideal solution behavior, what is the molar mass of lysozyme?

$\Pi = MRT$

$M = \frac{\Pi}{RT}$

① $M = \frac{1.32 \times 10^{-3}\ atm}{\left(0.08206 \frac{L \cdot atm}{mol \cdot K}\right)(298\ K)}$

$M = 5.38 \times 10^{-5}\ M$

$5.38 \times 10^{-5} \frac{mol}{L} \times 0.100\ L = 5.38 \times 10^{-6}\ mol$

(2) $MM = \frac{g}{mol}$ $MM = \frac{0.0750\ g}{5.38 \times 10^{-6}\ mol}$

$13,945\ \frac{g}{mol}$

$1.39 \times 10^{4}\ \frac{g}{mol}$