84.122-204
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Quiz 4 – Solutions Name KEY
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Be sure to clearly show your work and your final answer for any problems. Make sure your final answer has the correct number of significant figures and proper units. Show cancellation of units.

$\Delta vp = -X_{solute}\,P^o$ $\quad \Delta T_f = -K_f mi$ $\quad \Delta T_b = K_b mi$ $\quad \pi = MRTi$

1. Which of the following aqueous solutions should have the highest boiling point? Circle your choice (3 pt) and explain your reasoning. Be specific. (5 pts)

   0.10m sucrose ($C_{12}H_{22}O_{11}$); (0.10m magnesium nitrate; $Mg(NO_3)_2$) 0.10m potassium fluoride

   $i = 1$ $\quad i = 3$ $\quad i = 2$

   Explanation:
   The concentration of particles is greatest for the $Mg(NO_3)_2$, so, due to the larger value of i, the magnesium nitrate solution will have the highest boiling point.

2. Ethylene glycol is used as antifreeze. It is a non-volatile solute with a molar mass of 62.01 g/mol. Calculate the freezing point of a solution made by adding 1.5×10^3 grams of ethylene glycol to 6.5 kg of water. Ethylene glycol is a non-electrolyte, and K_f for water = 1.86 °C/m. Clearly show your method. (10 pts)

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

$$m = \frac{\text{moles solute}}{\text{kg solvent}} = \frac{1.5 \times 10^3 \text{ g} \times \frac{1 \text{ mole}}{62.01 \text{ g}}}{6.5 \text{ kg}} = \frac{24.2 \text{ mole}}{6.5 \text{ kg}}$$

$$= 3.7 m$$

$$\Delta T_f = -\left(1.86 \tfrac{^\circ C}{m}\right)(3.7 m) = -6.9 ^\circ C$$

freezing point $= -6.9 ^\circ C$

Answer: $-6.9 ^\circ C$

3. Elemental sulfur exists in molecular form. The addition of 0.180 grams of sulfur to 75.0 grams of CCl_4 lowers the freezing point of the solvent by 0.28 °C. Determine the molar mass and molecular formula of sulfur. K_f for carbon tetrachloride is 29.8 °C /m. (12 pts)

$\Delta T_f = -K_f m i \quad i = 1$

$-.28°C = -(29.8°C/m)m$

$m = \frac{-.28°C}{29.8°C/m} = .00940m$

$.00940 \frac{mol}{kg} \times .0750kg = 7.05 \times 10^{-4} mol$

$\text{molar mass} = \frac{.180g}{7.05 \times 10^{-4} mol} = 255 g/mol$ (2 sig figs)

$\frac{255}{32} = 8.0$

Answers: Molar Mass $2.6 \times 10^{2} g/mol$ Molecular Formula S_8

4. How many grams of sodium chloride must be used to make a liter of an aqueous solution that is isotonic with blood. The osmotic pressure of blood is 7.70 atm at 25°C. Clearly show your method. (10 points)

$\pi = MRTi \qquad NaCl \} i = 2$

$7.70atm = M(.0821 \frac{L \cdot atm}{mol \cdot K})(298K)(2)$

$M = \frac{7.70atm}{.0821 \frac{L \cdot atm}{mol \cdot K}(298K)(2)}$

$= .0.157 \frac{mol}{L}$

$.157 \frac{mol\ NaCl}{L} \times 1.00L \times \frac{58.5g}{mole} = 9.18 grams$

Answer: 9.18g