PRACTICE PROBLEMS:

1. The total mass of a solution is 153.4 g. The solvent mass is 125.2 g. What is the percent of the solute?

solute mass = 153.4g - 125.2g = 28.2g

$$\%\ \text{solute} = \frac{\text{mass of solute}}{\text{mass of solution}} \times 100$$

$$\%\ \text{solute} = \frac{28.2\ g}{153.4\ g} \times 100 = 18.38\%$$

2. An oven-cleaning solution is 40% (by mass) NaOH. If one jar of this product contains 454 g. of solution, how much NaOH does it contain?

40% of 454 g = ?

40 * 454 g = ?

181.6 ≈ 182 g = ?

3. A nitric acid solution containing 71% HNO_3 (by mass) has a density of 1.42 g/mL. How many moles of HNO_3 are present in 1.00L of this solution?

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

$$1.42\ g/mL = \frac{\text{mass}}{1000\ mL}$$

1,420g = mass of HNO_3

71% of 1,420 = 1,008.2 g

periodic mass of HNO_3 = ?

1 + (14) + (3 × 16) = ?

63 g = ?

$$\#\ \text{of moles} = \frac{g}{\text{periodic } g}$$

$$\#\ \text{of moles} = \frac{1,008.2}{63}$$

# of moles = 16.0 moles

4. Commercial concentrated aqueous ammonia is 28% NH_3 by weight has a density of 0.90 g/mL. What is the molality and Molarity of this solution?

10 mL = .001 L

$\text{density} = \frac{\text{mass}}{\text{volume}}$

$.90 = \frac{9}{10}$

$\text{molality} = \frac{\text{moles}}{\text{kg}} = \frac{\text{solute}}{\text{solvent}}$

$\text{molality} = \frac{.1481 \text{ moles}}{.00648 \text{ kg}} = 22.9 \frac{\text{moles}}{\text{kg}}$

$.28 \times 9 = \frac{2.52 \text{ g}}{17.01 \text{ g}} = .1481 \text{ moles}$

$\text{molarity} = \frac{\text{moles}}{\text{liter}}$

$NH_3 = 14.01 + (1 \times 3) = 17.01 \text{ g}$

$\text{Molarity} = \frac{.1481}{.001} = 148.1 \frac{\text{moles}}{\text{liter}}$

5. Lauryl alcohol is obtained from coconut oil and is used to make detergents. A solution of 5.00g. of lauryl alcohol in 100.0 g. of benzene freezes at 4.10°C/m and its normal freezing point is 5.5°C, determine the molar mass of the lauryl alcohol.

$\Delta T = K_f m$

$1.4 = (5.12) m$

$.273 = m$

$.273 = \frac{\text{moles of solute}}{.1 \text{ kg}}$

$.0273 = \text{moles of solute}$

$.0273 = \frac{5}{mm}$

183.2g = molar mass of lauryl acid

6. A solution is made by dissolving 2 moles of A in 7 moles of B. What is the mole fraction of A?

$\frac{\#\text{ moles of A}}{\#\text{ moles of total solution}} = \frac{2}{9} = .22$

7. What is the osmotic pressure (in atm.) of a .884 M urea solution at 16 °C?

$\Pi = MRT$

$\Pi = (.884)(.0821)(289\ K)$

$\Pi = 20.9\ atm$

8. A solution of 0.85 g. of an organic compound in 100.0 g. of benzene has a freezing point of 5.16°C. What are the molality of the solution and Molarity of the solute?

$$\text{molality} = \frac{\Delta T_f}{K_f} = \frac{5.16\ ^\circ C}{5.12\ ^\circ C/m} = 1.008\ m$$

.205 mole of the solute in 1 kg of solvent

$$.100\ kg \times \frac{.205\ mol}{1\ kg} = .0205\ mol$$

$$\text{molar mass} = \frac{\text{g of compound}}{\text{moles of compound}} = \frac{.85}{.0205} = 41.5\ g/mol$$

9. The freezing-point depression of a 0.100 m $MgSO_4$ solution is 0.225°C. Calculate the van't Hoff factor of $MgSO_4$ at this concentration.

* note $MgSO_4$ is a strong electrolyte

$\Pi = i MRT$

$\Pi = 2(.100\ m)\left(.0821\ L \cdot \frac{atm}{K}\right)(273.225\ K)$

$\Pi = 4.49\ atm$

$$i = \frac{\Pi}{MRT}$$

$$i = \frac{4.49\ atm}{(.100m)\left(.0821\ L \cdot \frac{atm}{K}\right)(273.225\ K)}$$

$i = 2.004$

10. Calculate the boiling point and freezing point of a solution containing 478 g. of ethylene glycol in 3202 g. of water.

ethylene glycol = $CH_2(OH)CH_2(OH)$

Periodic mass = 62.02 g

$m = \frac{\text{moles of solute}}{\text{mass of solvent (kg)}}$

$m = \frac{7.71 \text{ moles}}{3.202 \text{ kg}} = 2.41 \text{ m}$

Moles of EG = $\frac{478 \text{ g}}{62.02 \text{ g}} = 7.71$

$\Delta T_f = K_f m$

$= (1.86)(2.41)$

$= 4.48^\circ C$

$\Delta T_B = K_b m$

$= (.52)(2.41)$

$= 2.2^\circ C$

11. A solution is made by dissolving NaCl in water the solution boils at 103°C. What is the molality of the solution? The K_b for water is 0.51°C kg/mol?

$\Delta T = K_b m$

$3 = .51 m$