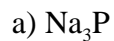


Chem 130
Problem Set Ch. 12

[Key begins on page 3.](#)

1. Calculate the number of grams of oxalic acid dihydrate, $\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$, that is required to prepare 250.0 mL of 1.50 M solution.
2. What is the mole fraction of methanol, CH_3OH , in an ethanol, $\text{C}_2\text{H}_5\text{OH}$, solution that is 40% ethanol by mass?
3. The vapor pressures of xylene and toluene at 20°C are 50 mm and 80 mm respectively. What is the vapor pressure of the mixture containing 4.0 mol xylene and 6.0 mol toluene. (note: they both have a vapor pressure)
4. When 10.0 grams of an unknown nonelectrolyte were dissolved in 150 grams of water, the boiling point was raised by 0.63°C . What is the **molecular weight** of the unknown. k_b for water is $0.512^\circ\text{C}/\text{m}$
5. What is the molality of a solution that contains 20.0 grams of glucose, $\text{C}_6\text{H}_{12}\text{O}_6$, in 500.0 grams of water?

6. Solutions are made which contain 0.10 moles of each of the following substances in 1000 g. water. Choose the compound whose solution will have the **lowest** freezing point.



7. At body temperature of 37°C , what is the osmotic pressure of a physiological solution of glucose (a nonelectrolyte) with a concentration of 0.168 M. ($R = 0.0821 \text{ l-atm/mol-K}$)

8. What is the approximate **freezing point** of an aqueous 2.00 molal MgF_2 solution? (k_f for water = 1.86°C/m) (assume complete ionization.)

9. For a 0.01 m solution of $(\text{NH}_4)_3\text{PO}_3$, the van't Hoff factor, **i**, would be approximately:

a) 6

b) 2

c) 3

d) 4

e) 8

1. Calculate the number of grams of oxalic acid dihydrate, $\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$, that is required to prepare 250.0 mL of 1.50 M solution.

$$(1.50 \frac{\text{mol}}{\text{L}})(0.250 \text{L}) = 0.375 \text{ mol OXALIC ACID.} \quad \xrightarrow{126 \text{ g/mol}}$$

$$(0.375 \text{ mol})(126 \text{ g/mol}) = \boxed{47.25 \text{ g}}$$

2. What is the mole fraction of methanol, CH_3OH , in an ethanol, $\text{C}_2\text{H}_5\text{OH}$, solution that is 40% ethanol by mass?

$$40 \text{ g ETHANOL} \left(\frac{1 \text{ mol}}{46 \text{ g}} \right) = 0.8696 \text{ mol ETHANOL}$$

$$60 \text{ g METHANOL} \left(\frac{1 \text{ mol}}{32 \text{ g}} \right) = 1.875 \text{ mol METHANOL}$$

$$\underline{2.745 \text{ mol TOTAL}}$$

$$\chi_{\text{METHANOL}} = \frac{1.875 \text{ mol}}{2.745 \text{ mol TOTAL}}$$

$$= 0.683$$

3. The vapor pressures of xylene and toluene at 20°C are 50 mm and 80 mm respectively. What is the vapor pressure of the mixture containing 4.0 mol xylene and 6.0 mol toluene. (note: they both have a vapor pressure)

$$P_{\text{MIX}} = \chi_{\text{XYLENE}} P_{\text{XYLENE}}^{\circ} + \chi_{\text{TOLUENE}} P_{\text{TOLUENE}}^{\circ}$$

$$= (0.4)(50 \text{ mm}) + (0.6)(80 \text{ mm})$$

$$= 20 \text{ mm} + 48 \text{ mm} = 68 \text{ mm}$$

4. When 10.0 grams of an unknown nonelectrolyte were dissolved in 150 grams of water, the boiling point was raised by 0.63°C . What is the **molecular weight** of the unknown. k_b for water is 0.512°C/m

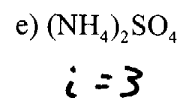
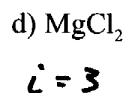
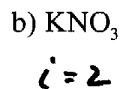
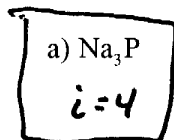
$$\text{MW} = \frac{(\text{g solute})(k)}{\text{kg solvent}(\Delta T)} = \frac{(10.0 \text{ g solute})(0.512^\circ\text{C/m})}{(0.150 \text{ kg H}_2\text{O})(0.63^\circ\text{C})} = 54.2 \text{ g/mol}$$

5. What is the molality of a solution that contains 20.0 grams of glucose, $\text{C}_6\text{H}_{12}\text{O}_6$, in 500.0 grams of water?

$$20 \text{ g} \left(\frac{1 \text{ mol}}{180 \text{ g}} \right) = 0.111 \text{ mol C}_6\text{H}_{12}\text{O}_6 \quad \xrightarrow{180 \text{ g/mol}}$$

$$m = \frac{0.111 \text{ mol}}{0.500 \text{ kg H}_2\text{O}} = 0.222 \text{ m C}_6\text{H}_{12}\text{O}_6$$

6. Solutions are made which contain 0.10 moles of each of the following substances in 1000 g. water. Choose the compound whose solution will have the **lowest** freezing point.



7. At body temperature of 37°C , what is the osmotic pressure of a physiological solution of glucose (a nonelectrolyte) with a concentration of 0.168 M. ($R = 0.0821 \text{ l-atm/mol-K}$)

$$\begin{aligned}\pi &= iMRT \\ &= (1)(0.168 \text{ M})(0.0821 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(310 \text{ K}) \\ &= 4.28 \text{ ATM.}\end{aligned}$$

8. What is the approximate **freezing point** of an aqueous 2.00 molal MgF_2 solution? (k_f for water = 1.86°C/m) (assume complete ionization.)

$$\Delta T = i k_f m$$

$i = 3$

$$= (3)(1.86^\circ\text{C/m})(2.00 \text{ m}) = 11.16^\circ \quad \text{so New F.P.} = -11.16^\circ\text{C}$$

9. For a 0.01 m solution of $(\text{NH}_4)_3\text{PO}_4$, the van't Hoff factor, i , would be approximately:

a) 6

b) 2

c) 3

d) 4

e) 8