Chem 130
Problem Set Ch. 12

Key begins on page 3.

1. Calculate the number of grams of oxalic acid dihydrate, $H_2C_2O_4 \cdot 2H_2O$, 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, C_2H_5OH, 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°C/m

5. What is the molality of a solution that contains 20.0 grams of glucose, $C_6H_{12}O_6$, 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.

a) Na_3P b) KNO_3 c) CO_2 d) $MgCl_2$ e) $(NH_4)_2SO_4$

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 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 $(NH_4)_3PO_3$, the van't Hoff factor, **i**, would be approximately:

a) 6 b) 2 c) 3 d) 4 e) 8

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KEY.

1. Calculate the number of grams of oxalic acid dihydrate, $H_2C_2O_4 \cdot 2H_2O$, that is required to prepare 250.0 mL of 1.50 M solution.

$H_2C_2O_4 \cdot 2H_2O$ → 126 g/mol

$(1.50 \frac{mol}{L})(0.250L) = 0.375$ mol OXALIC ACID.

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

2. What is the mole fraction of methanol, CH_3OH, in an ethanol, C_2H_5OH, solution that is 40% ethanol by mass?

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

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

2.745 mol TOTAL

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

$= 0.683$

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)

$P_{MIX} = \chi_{XYLENE} P^o_{XYLENE} + \chi_{TOLUENE} P^o_{TOLUENE}$

$= (0.4)(50 mm) + (0.6)(80 mm)$

$= 20 mm + 48 mm = 68 mm$

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

$MW = \frac{(g\ solute)(k)}{kg\ solvent\ (\Delta T)} = \frac{(10.0 g\ solute)(0.512\ °C/m)}{(0.150 kg\ H_2O)(0.63°C)} = 54.2 g/mol$

5. What is the molality of a solution that contains 20.0 grams of glucose, $C_6H_{12}O_6$, in 500.0 grams of water?

$20g (\frac{1 mol}{180g}) = 0.111$ mol $C_6H_{12}O_6$ (180 g/mol)

$m = \frac{0.111 mol}{0.500 kg H_2O} = 0.222\ m\ C_6H_{12}O_6$

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.

a) Na_3P $i = 4$ | b) KNO_3 $i = 2$ | c) CO_2 $i = 1$ | d) $MgCl_2$ $i = 3$ | e) $(NH_4)_2SO_4$ $i = 3$

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 l-atm/mol-K)

$\pi = iMRT$

$= (1)(0.168\ M)(0.0821\ \frac{L \cdot atm}{mol \cdot K})(310K)$

$= 4.28\ ATM.$

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.)

$i = 3$

$\Delta T = i\, k_f\, m$

$= (3)(1.86°C/m)(2.00m) = 11.16°$ So New F.P $= -11.16°C$

9. For a 0.01 m solution of $(NH_4)_3PO_3$, the van't Hoff factor, **i**, would be approximately:

a) 6 | b) 2 | c) 3 | d) 4 | e) 8