.135mol KF × 58.1g / 1mol = 7.84g KF

1007.84g × 1mL / 1.22g = 826mL soln'

Assume .135m KF → .135mol KF in 1Kg H2O → 1000g H2O + 7.84g KF = 1007.84g Soln'

Chapter 12 Practice Problems

CHS Chemistry Spring 2018

M?

1. How many moles of KF are contained in 244 mL of 0.135 m KF solution? The density of the solution is 1.22 g/mL. 244mL × 1.22g/mL = 298 g soln' .298 kg soln'

.135mol / 826mL soln' = x / 244mL soln' → x = .0399mol KF

2. What is the molality of a solution prepared by dissolving 84.7 g of $KMnO_4$ (potassium permanganate, an oxidizing agent) in 165 g of water?

84.7g × 1mol/158g = .536mol

m = .536mol / .165kg = 3.25m

3. How many grams of water are needed to dissolve 27.8 g of ammonium nitrate NH_4NO_3 in order to prepare a 0.452 *m* solution?

27.8g × 1mol/80g = .348

.452m = .348mol / x, x = .770kg H_2O = 770g H_2O

4. Calculate the molality of a 20.0% by mass ammonium sulfate $(NH_4)_2SO_4$ solution. The density of the solution is 1.117 g/mL. ×100% = 111.7mL ×.20% → 22.34 ~~20~~g $(NH_4)_2SO_4$ × 1mol/132.1 = .169

m = .169mol / .0894kg = 1.89m

5. The density of a 20.3 *M* CH_3OH (methanol) solution is 0.858 g/mL. What is the molality of this solution? H_2O is the solvent.

20.3mol CH_3OH × 32g/1mol = 650g

20.3mol / L soln

1L soln × 1000mL/1L × .858g/1mL = 858g soln

M = 20.3mol / .208kg = 98M

650g / 208g H_2O

6. What is the vapor pressure at 75°C of an aqueous solution prepared by the addition of 58.4 g of the nonvolatile solute urea, $CO(NH_2)_2$, to 172 g of water? The vapor pressure of pure water at 75°C is 290. mmHg.

$P_A = \chi P_A^\circ$

A. 136 mm Hg
B. 26.8 mm Hg
C. 153 mm Hg
D. 263 mm Hg
E. 216 mm Hg

P_A = (.0921)(290mm) = 26.7mm

58.4g × 1mol/60g = .97

172g × 1mol/18g = 9.56

χ = .97 / (.97 + 9.56) = .0921

7. Determine the freezing point of a solution that contains 78.8 g of naphthalene ($C_{10}H_8$, molar mass = 128.16 g/mole) dissolved in 722 mL of benzene (d = 0.877 g/mL). Pure benzene has a melting point of 5.50°C and a freezing point depression constant of 4.90°C/m.

78.8g × 1mol/128.16g = .615

722mL × .877g/mL = 633g

m = .615mol / .633kg = .972m

$\Delta T_f = (1)(4.9°C/m)(.972m)$ = 4.76

5.50°C − 4.76 = .74°C

8. A 2.2-g sample of a small protein having a molecular weight of 42,000 g/mol is dissolved in

$\pi = iMRT$

$\pi = (1)(.00168M)(.0821)(301k)$

$\pi = .0415\ atm$

31.2 mL of water at 28°C. What is the osmotic pressure of the solution? (R = 0.0821 L · atm/(K · mol)) 1 atm = 760 mm Hg

$2.2g \times \frac{1mol}{42,000g} = 5.24 \times 10^{-5} mol$

$M = 5.24 \times 10^{-5} mol / .0312L = .00168M$

9. A solution consisting of 0.276 mol of methylbenzene, $C_6H_5CH_3$, in 242 g of nitrobenzene, $C_6H_5NO_2$, freezes at –2.0 °C. Pure nitrobenzene freezes at 6.0°C. What is the freezing-point depression constant of nitrobenzene?

$6.0 - (-2.0) = 8°C = \Delta T_f$

$m = .276mol / .242kg = 1.14m$

$\Delta T_f = i k_f m$

$8°C = (1)(k_f)(1.14m)$

$k_f = 7.02\ °C/m$

A. 7.2°C/m
B. 29°C/m
C. 14.0°C/m
D. 3.5°C/m
E. 7.0°C/m

10. What is the molar mass of an aromatic hydrocarbon if 0.75 g of the compound depresses the freezing point of 123 g of benzene (C_6H_6) by 0.28°C? (K_f for benzene is 5.12°C/m.)

$.28°C = (1)(5.12°C/m)\ m$

$m = .0547 \frac{mol}{Kg}$

$.0547m = \frac{x}{.123kg}, x = .00673\ mol$

$MM = \frac{.75g}{.00673m} = 111 g/mol$

A. 43 g/mol
B. 150 g/mol
C. 110.00 g/mol
D. 2900 g/mol
E. 140 g/mol

11. A compound is found to have a molar mass of 598 g/mol. If 35.8 mg of the compound is dissolved in enough water to make 175 mL of solution at 25°C, what is the osmotic pressure of the resulting solution? Assume this compound is molecular, not ionic.

$.0358g \rightarrow 5.99 \times 10^{-5} mol$

$M = \frac{5.99 \times 10^{-5}}{.175L} = 3.42 \times 10^{-4} M$

$\pi = (1)(3.42 \times 10^{-4} M)(298K) = .102\ atm$

12. What is the Henry's law constant for ammonia in water at 25°C if an ammonia pressure of 0.022 atm produces a solution with a concentration of 1.3 M?

$S = kP$

$1.3M = k(.022\ atm)$

$k = 59\ M/atm$

A. 59 M/atm
B. 0.017 M/atm
C. 0.029 M/atm
D. 35 M/atm
E. 0.038 M/atm

$\Delta T_b = i\, K_b\, m$ $\quad 100 - 95 = 5 = \Delta T_b$

$5°C = (2)(.512°C/m)\, m$

$m = 4.88\ mol/kg = 4.88\ mol\ NaCl \times \frac{58.5g}{mol} = 286g\ NaCl$

13. In a mountainous location, the boiling point of pure water is 95°C. How many grams of sodium chloride must be added to 1 kg of water to bring the boiling point back to 100°C? Assume that i = 2. K_b of water = 0.512°C/m

14. Choose the aqueous solution below with the **lowest** freezing point. These are all solutions of nonvolatile solutes and you should assume ideal van't Hoff factors where applicable.

A. 0.075 m NaI $\times 2$ $\quad .15$

B. 0.075 m $(NH_4)_3PO_4$ $\times 4$ $\quad .30$

C. 0.075 m $NaBrO_4$ $\times 2$ $\quad .15$

D. 0.075 m LiCN $\times 2$ $\quad .15$

E. 0.075 m KNO_2 $\times 2$ $\quad .15$

15. Determine the freezing point of a solution that contains 78.8 g of naphthalene ($C_{10}H_8$, molar mass = 128.16 g/mole) dissolved in 722 mL of benzene (d = 0.877 g/mL). Pure benzene has a melting point of 5.50°C and a freezing point depression constant of 4.90°C/m.

$722\ mL \times \frac{.877g}{mL} = 633g = .633\ kg$

See #7