~~Mini~~ Quiz Solutions KEY Name

1. Which one of the following solutions has the **lowest freezing point**? *(1 kg of water is the solvent in each case)*

One that contains:

A. 0.03 mole of NaCl
B. 0.04 mole of Na_2SO_4
C. 0.05 mole of $Mg(NO_3)_2$
D. 0.06 mole of $NaNO_3$
E. 0.10 mole of ethylene glycol (a nonelectrolyte)

2. *Squalene* is a hydrocarbon that can be isolated from shark liver oil and is involved in the biosynthesis of cholesterol in mammals. Squalene has the empirical formula C_3H_5 and, like all hydrocarbons, is not ionic. If a solution containing 3.00 g of squalene in 100 g of benzene freezes at 5.15 °C, what is the **molecular formula** of squalene? The freezing point of pure benzene is 5.50 °C and its freezing point depression constant is -4.90 deg/molal.

A. C_3H_5 B. C_6H_{10} C. $C_{18}H_{30}$ D. $C_{24}H_{40}$ E. $C_{30}H_{50}$

3. Li_2CO_3 is the least soluble of the Group 1A metal carbonates, dissolving to the extent of 1.3 g in 100.0 mL of water at 20°C. If the density of water is 1.00 g·mL^{-1}, what is the **molality** of Li_2CO_3 in a saturated aqueous solution?

A. 0.036 *m* B. 0.054 *m* C. 0.09 *m* D. 0.18 *m* E. 0.42 *m*

4. What is the mole fraction (X) of methylcyclohexane (C_7H_{14}, a nonelectrolyte) in a 5.0 *m* (molal) solution of methylcyclohexane in ethanol?

A. 0.08 B. 0.10 C. 0.12 D. 0.15 E. 0.19

5. Henry's law can be expressed in different ways. One handbook gives Henry's law as:

$$K = \frac{P}{X}$$

where K is a constant, P is the partial pressure of the gas in mm of Hg, and X is the mole fraction of the gas in solution.

This handbook gives the value of K for acetylene as 9.0×10^{-9}. What are its units according to the equation given above?

A. mm of Hg
B. (mm of Hg)·mol^{-1}
C. atm
D. mol·L^{-1}
E. mol·L^{-1}·atm^{-1}

$\Pi = MRT$ $\quad \frac{mol}{L}$

6. ______ An aqueous solution containing 0.700 g of a certain protein in a volume of 20.00 mL has an osmotic pressure of 0.013 atm at 25 °C. What is the molecular weight of this substance?

A. 18,000 B. 23,000 C. 38,000 D. 51,000 E. 66,000

7. ______ The solubility of O_2 in water has been measured as a function of O_2 pressure. Calculate the Henry's Law constant for O_2.

A. 380 $L{\cdot}atm{\cdot}mol^{-1}$
B. 540 $L{\cdot}atm{\cdot}mol^{-1}$
C. 790 $L{\cdot}atm{\cdot}mol^{-1}$
D. 880 $L{\cdot}atm{\cdot}mol^{-1}$
E. 970 $L{\cdot}atm{\cdot}mol^{-1}$

Pressure (atm)	Concentration (mol/L)	Henry's Law constant ($L{\cdot}atm{\cdot}mol^{-1}$)
0.395	0.00050	790
0.545	0.00069	790
0.803	0.00102	787
1.000	0.00128	781

8. ______ Which one of the following statements is true? (Assume the solutions are ideal in each case.) The freezing point of a solution containing 0.10 mole of sucrose (a nonelectrolyte) in 1 kg of water is:

A. the same as that of pure water.
B. the same as that of a solution containing 0.033 mole of Na_2SO_4 in 1 kg of water.
C. the same as that of a solution containing 0.05 mole of $Mg(NO_3)_2$ in 1 kg of water.
D. the same as that of a solution containing 0.10 mole of $NaNO_3$ in 1 kg of water.
E. the same as that of a solution containing 0.20 mole of NaCl in 1 kg of water.

9. ______ (Assume an ideal solution.) A solution contains equal masses of dichloromethane (CH_2Cl_2) and trichloromethane ($CHCl_3$) at 25°C. If the vapor pressure of pure CH_2Cl_2 is 435 mm Hg and the vapor pressure of pure $CHCl_3$ is 195 mm Hg, what is the total vapor pressure of the solution?

A. 285 mm Hg B. 335 mm Hg C. 440 mm Hg D. 565 mm Hg E. 630 mm Hg

10. ______ What is the mole fraction (χ) of CH_2Cl_2 in the vapor phase in equilibrium with the solution described in the preceding problem?

A. 0.55 B. 0.61 C. 0.68 D. 0.76 E. 0.90

11. Which one of the following statements is **true**? (Assume the solutions are ideal in each case.) The *boiling point* of a 0.10 *m* aqueous solution of Na_2SO_4 isthe same as that of a...

A. 0.05 *m* aqueous solutionof $MgSO_4$

B. 0.067 *m* aqueous solutionof $MgSO_4$

C. 0.15 *m* aqueous solutionof $MgSO_4$

D. 0.20 *m* aqueous solutionof $MgSO_4$

E. 0.30 *m* aqueous solutionof $MgSO_4$

12. What is the molality of sulfuric acid in a solution that is 18.0 % H_2SO_4 by weight?

A. 0.84 *m* B. 1.78 *m* C. 2.24 *m* D. 3.16 *m* E. 4.78 *m*

13. Two solutions that have the same osmotic pressure are said to be:

A. Isobaric

B. Isomolal

C. Isoosmic

D. Isotonic

E. Isovapic

14. When KCl dissolves in water, the solution cools noticeably to the touch. It may be concluded that

(A) the solvation energy is greater than the lattice energy
(B) KCl is relatively insoluble in water
(C) the entropy decreases when KCl dissolves
(D) the boiling point of the solution will be less than 100°C
(E) the entropy increase overcomes the unfavorable heat of dissolution

2) $m = \frac{\Delta T_F}{K_F} = \frac{5.5°C - 5.15°C}{4.9\ °C/m} = \frac{.071}{1k}$

$\frac{.071 \text{mol se}}{1 \text{kg Ben}} \times .1 \text{kg Ben} = .0071 \text{mol se}$ $\quad \frac{3 g\ se}{.0071 \text{mol se}} = 4$

$C_3H_5 = 41 g$

$\frac{420\ g/mol}{41\ g/mol} = 10$ $\quad C_{30}H_{50}$

3) $1.3 g\ LiCO_3 \times \frac{1 \text{mol}}{74 g} = .018 \text{mol}$

$100 ml\ H_2O \times \frac{1 g}{1 ml} = 100 g\ H_2O$

$\frac{.018 \text{mol}}{.1 \text{kg}} = .18 m$

4) $\frac{5 \text{mol meth}}{1 \text{kg Eth}}$ $\quad 1000 g\ Eth \times \frac{1 \text{mol}}{46 g}$

21.

$X_{meth} = \frac{5 \text{mol}}{5 \text{mol} + 21.7 \text{mol}} = .19$

CH

$$K = \frac{P}{X}$$

5) $$\frac{mmHg}{\frac{moles}{moles}} = mmHg$$

6) $$M = \frac{\pi}{RT} = \frac{.013 atm}{(.0821 \frac{L\,atm}{mol\,K})(298)} = .00053 \frac{mol}{L}$$

$$.00053 \frac{mol}{L} \times .02L = \frac{.7g}{1.06\times10^{-5} mol} = 66000\ g/mol$$

7) $P = CK$ $$\frac{.395\ atm}{.0050\ mol/L} = 790 \frac{L\,atm}{mol}$$

8) $$\frac{.1\ mol\ suc}{Kg} = \frac{.033\ mol\ Na_2SO_4 \times 3}{1\ kg}$$

9) $P_{soln} = X_d P_d^\circ + X_t P_t^\circ$

$$P = \frac{\frac{1g}{85 g/mol}}{\frac{1g}{85g/mol} + \frac{1g}{109.5 g/mol}}(435 mmHg) + \frac{\frac{1g}{109.5 g/mol}}{\frac{1g}{85g/mol} + \frac{1g}{109.5 g/mol}}(195 mmHg)$$

$P = 246\ mmHg + 85\ mmHg = 331\ mmHg$

dichl trichl

10) $P = 246\,mmHg + 85\,mmHg = 331\,mmHg$

$P_A = X_A P_T$

$X_{dichl} = \frac{246\,mmHg}{331\,mmHg} = .74$

11) $\frac{.1\,mol\ Na_2SO_4}{1\,kg} \times 3 = \frac{.15\,mol\ MgSO_4}{1\,kg} \times$

assume 100g sample

12) $18\,g\ H_2SO_4 \times \frac{1\,mol}{98\,g} = \frac{.18\,mol\ H_2SO_4}{.082\,kg\ H_2O}$

$= \frac{2.2\,mol}{kg}$

13) Isotonic

14) E $\Delta G = \Delta H - T\Delta S$