Last Name/ First Name KEY

QUIZ on Chapter 11: Solutions and Their Properties

1) Rubbing alcohol often is composed of 70% isopropyl alcohol and 30% water. In this solution,
A) isopropyl alcohol is the solvent. / water is the solute
B) water is the solvent. not true, water is the minor component
C) both water and isopropyl alcohol are solvents. } nope
D) neither water nor isopropyl alcohol is a solvent. }

My answer is: A

2) Iodine, $I_2(s)$, is more soluble in dichloromethane, $CH_2Cl_2(l)$, than in water because
A) both iodine and dichloromethane have strong ion-dipole interactions. (NO IONS exist)
B) the dipole-dipole forces in dichloromethane are much stronger than the dispersion forces in iodine. no
C) the intermolecular forces are similar in both iodine and dichloromethane.
D) iodine is ~~polar~~ and dichloromethane has a ~~large number of~~ hydrogen bonds.
no no

My answer is: C

3) For which case would ΔH_{soln} be expected to be negative?
A) if solute-solute interactions are much greater than solvent-solvent and solute-solvent interactions ΔH = +
B) if solvent-solvent interactions are much greater than solute-solvent and solute-solute interactions ΔH = +
C) if solute-solvent interactions are much greater than solvent-solvent and solute-solute interactions
D) if solute-solvent interactions are the same as solvent-solvent and solute-solute interactions
no change in ΔH

My answer is: C

4) Commercial cold packs often contain solid NH_4NO_3 and a pouch of water. The temperature of the pack drops as the NH_4NO_3 dissolves in water. Therefore, for the dissolving of NH_4NO_3 in water,
A) ΔH_{soln} is negative and ΔS_{soln} may be negative or positive.
B) ΔH_{soln} is negative and ΔS_{soln} is positive.
C) ΔH_{soln} is positive and ΔS_{soln} may be negative or positive.
D) ΔH_{soln} is positive and ΔS_{soln} is positive.

Endothermic (ΔH = +)
solid → soln (ΔS = +) more random

My answer is: D

5) Which cation in set I and which in set II has the larger (more negative) hydration energy?
I. Mg^{2+} or Ba^{2+} II. K^+ or Al^{3+}
A) Mg^{2+} in set I and K^+ in set II
B) Mg^{2+} in set I and Al^{3+} in set II
C) Ba^{2+} in set I and K^+ in set II
D) Ba^{2+} in set I and Al^{3+} in set II

The smaller ion the higher the charge, the larger the hydration energy
Mg^{2+} can get closer to H_2O.

My answer is: B

6) When an ionic solute dissolves in water to form an unsaturated solution, the free energy change (ΔG_{soln}) is
A) negative.
B) zero.
C) positive.
D) either A or C, depending on the ionic compound

$\Delta G = \Delta H - T\Delta S$

ΔH is neg for dissolution and ΔS is positive. So −TΔS is negative. The overall ΔG is negative.

My answer is: A

7) Most gases become less soluble in water as the temperature increases. What can be concluded about the signs of ΔH_{soln} and ΔS_{soln} in this case?

A) ΔH_{soln} is negative and ΔS_{soln} is negative.
B) ΔH_{soln} is negative and ΔS_{soln} is positive.
C) ΔH_{soln} is positive and ΔS_{soln} is negative.
D) ΔH_{soln} is positive and ΔS_{soln} is positive.

If temp increases and $\Delta H = +$ then solubility would increase
If ΔS was positive it would drive solubility.
This doesn't happen, so ... My answer is: A

8) Arrange the following in order **from lowest to highest solubility in water**:
KCl, CH_3CH_2-O-CH_2CH_3, $CH_3CH_2CH_2CH_2$-OH, $CH_3CH_2CH_2CH_2CH_3$

A) $CH_3CH_2CH_2CH_2CH_3 < KCl < CH_3CH_2$-O-$CH_2CH_3 < CH_3CH_2CH_2CH_2$-OH
B) $KCl < CH_3CH_2$-O-$CH_2CH_3 < CH_3CH_2CH_2CH_2$-OH $< CH_3CH_2CH_2CH_2CH_3$
C) $CH_3CH_2CH_2CH_2CH_3 < CH_3CH_2$-O-$CH_2CH_3 < KCl < CH_3CH_2CH_2CH_2$-OH
D) $CH_3CH_2CH_2CH_2CH_3 < CH_3CH_2$-O-$CH_2CH_3 < CH_3CH_2CH_2CH_2$-OH $< KCl$

My answer is: D

9) ID the major solute-solvent interactions created when:
KBr dissolves in water? My answer is: D
$HOCH_2CH_2OH$ dissolves in water? My answer is: C
can hydrogen bond
$KBr \rightarrow K^+ + Br^-$

A) dipole-dipole
B) dispersion
C) hydrogen bonding
D) ion-dipole

10) A saturated solution is defined as
A) a concentrated solution. Doesn't say anything about whether you are unsaturated, sat. or supersat.
B) a solution that is in equilibrium with pure solvent. pure solvent won't exist in a solution
C) a solution that is in equilibrium with undissolved solute. yes, yes, and yes
D) a solution that is in equilibrium with both pure solvent and undissolved solute.
in a solution, pure solvent won't exist

My answer is: C

11) Which of the following statements is **true** for a supersaturated solution?
A) The solute in the solution is at equilibrium with undissolved solute. this is saturated
B) The solution contains more than the equilibrium amount of solute. this is supersaturated
C) The solution is stable and the solute will not precipitate. supersat. solutions are not stable.
D) A supersaturated solution is more than 50% solute by mass. nonsense

My answer is: B

12) In general, as the temperature increases, the solubility of gases in water B and the solubility of most solids in water A. When the external pressure of the gas over the solution increases, the solubility of the gas A.
A) increases
B) decreases

13) Given a solution of 14.6 g ethanol (C_2H_5OH), in 53.6 g of water: What is the

(a) Mole fraction of ethanol?
A) 0.0964
B) 0.106
C) 0.214
D) 0.272
My answer is: A

(b) Molality of ethanol?
A) 0.00591 *m*
B) 0.272 *m*
C) 5.91 *m*
D) 272 *m*
My answer is: C

(c) Molarity of ethanol?
A) 58.9M
B) 5.91M
C) 0.00591M
D) 0.591M
My answer is: B

(a) $14.6\text{g} \times \frac{1\text{mol}}{46.07\text{g}} = 0.317\text{ mol}$ $\quad 53.6\text{g } H_2O \times \frac{1\text{mol}}{18.02\text{g}} = 2.97\text{mol}$

mole fraction ethanol $x = \frac{0.317}{0.317 + 2.97}$

$x = 0.0964$

(b) $\frac{0.317\text{mol}}{53.6\text{g } H_2O} \times \frac{1000\text{g}}{1\text{kg}} = 5.91\text{m}$

(c) $0.317\text{mol} / 53.6\text{g} \times \frac{1\text{g}}{\text{mL}} \times \frac{1000\text{mL}}{\text{L}} = 5.91\text{M}$

14) The Henry's Law constant of methyl bromide, CH_3Br, is $k = 0.159$ mol/(L·atm) at 25°C. What is the solubility of methyl bromide in water at 25°C and at a partial pressure of **250.** mm Hg? S=kP

A) 0.0523 mol/L
B) 0.329 mol/L
C) 0.483 mol/L
D) 39.8 mol/L

$S = kP = \frac{0.159\text{mol}}{\text{L·atm}} (250\text{ mm Hg}) \left(\frac{1\text{atm}}{760\text{ mm}}\right)$

$= 0.0523\text{ mol/L}$

My answer is: A

15) Given a KCl solution of 40.0 g KCl (74.6g/mol) in 250.0 g of water at 25°C. What is the vapor pressure of the solution if the vapor pressure of water at 25°C is 23.76 mm Hg?

A) 20.5 mm Hg
B) 22.1 mm Hg
C) 22.9 mm Hg
D) 25.5 mm Hg

$\frac{40.0\text{g}}{74.6\text{g/mol}} = 0.536\text{ mol} \times 2 = 1.07\text{ mol ions}$

$\frac{250\text{g}}{18.02\text{g/mol}} = 13.9\text{ mol } H_2O$

$X_{H_2O} = \frac{13.9\text{ mol } H_2O}{1.07\text{ mol ions} + 13.9\text{ mol } H_2O} = 0.929$

My answer is: B

$P_{H_2O} = X_{H_2O} P^\circ_{H_2O} = 0.929 \times 23.76\text{ mm Hg} = 22.1\text{ mm Hg}$

16) At a given temperature the vapor pressures of benzene and toluene are 183 mm Hg and 59.2 mm Hg, respectively. Calculate the total vapor pressure over a solution of benzene and toluene with $X_{benzene} = 0.600$.

A) 110 mm Hg
B) 121 mm Hg
C) 133 mm Hg
D) 242 mm Hg

$X_{benz} P^\circ_{benz} + X_{tol} P^\circ_{tol} = P$

$0.6(183\ mm\ Hg) + 0.4(59.2\ mm\ Hg) = P$

$133 = P$ in mm Hg

My answer is: C

17) What is the expected freezing point of a 0.50 *m* solution of Na_2SO_4 in water? K_f for water is 1.86°C/*m*. Pure water freezing point = 0.0°C.

$Na_2SO_4 \rightarrow 2Na^+ + SO_4^{2-}$ 3 moles ions

A) -0.93°C
B) -1.9°C
C) -2.8°C
D) -6.5°C

$\Delta T_f = m K_f = (0.50\ m)(1.86\ ^\circ C/m)$

$= 2.8^\circ C$

My answer is: C

$T_f = 0.0 - 2.8^\circ C = -2.8^\circ C$

18) The normal boiling point of pure benzene is found to be 80.10°C. What is the approximate molecular weight of a nonionizing substance if a solution of 3.55 g of the substance dissolved in 100. g of benzene has a normal boiling point of 80.19°C? $K_b = 5.12^\circ C/m$ for benzene, C_6H_6.

A) 20 amu
B) 500 amu
C) 2000 amu
D) 20,000 amu

$\Delta T = mK \quad \Delta T/K = m = \frac{3.55\ g}{.1\ kg} \times \frac{1\ mol}{X_g} = \frac{.09^\circ C}{5.12^\circ C/m}$

My answer is: C

$X = 209$ amu

19) A solution is made by dissolving 13 g of sucrose, $C_{12}H_{22}O_{11}$, in 117 g of water, producing a solution with a volume of 125 mL at 20°C. What is the expected osmotic pressure at 20°C?

A) 7.3 atm
B) 10 atm
C) 14 atm
D) 58 atm

$\Pi = MRT = 13\ g \times \frac{1\ mol}{342\ g} \times \frac{1}{.125\ L} \left(.0820\ \frac{L\ atm}{mol\ K}\right) 293.15\ K$

$= 7.3\ atm$

My answer is: A