[Chapter 14 Worksheet 1]

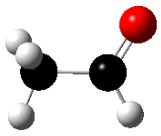
Name: _____ UGA myID: _____

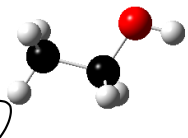
Instructions:

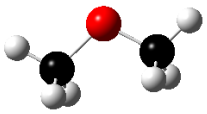
- Please enter your first and last name as it appears on the eLC roster (do not use a nickname).
- Your UGA myID is a combination of letters and numbers (example: mine is aw00285). **Do not use your 81x number.**
- If you do not have a printer, type your answers in the boxes then upload the worksheet template to Gradescope by **Friday, February 19th at 11:59 p.m.** Write your work on separate sheets of paper, convert to a PDF and upload to the dropbox on eLC.
- If you have a printer download the worksheet, write your answers and show your work on the worksheet template, convert it to a PDF and upload to Gradescope by **Friday, February 19th at 11:59 pm.**

Chapter 14-Part 1

Question 1: Which one of the following would you expect to be **most** soluble in water?

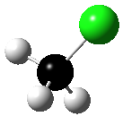
A. 

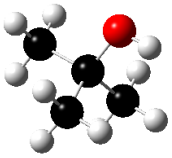
B. 

C. 

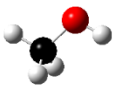
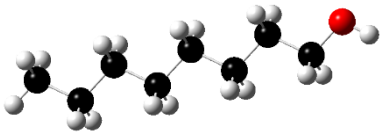
B

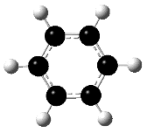
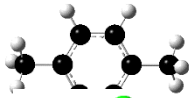
Most similar intermolecular forces of attraction.

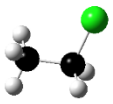
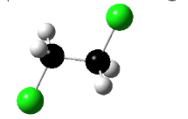
D. 

E. 

Question 2: Of the solvent/solute pairs given, which of the solutes would you expect to be least soluble in the solvent?

A.  in 

B.  in 

C.  in 

Question 3: A dynamic equilibrium is established where some solute dissolves and other solute precipitates.

$CuCl_2(s) \leftrightharpoons Cu^{2+}(aq) + 2\ Cl^-(aq)$

The solution is said to be _____.

B

A. Concentrated
B. Saturated
C. Strong
E. Supersaturated

Question 4: When a solution is saturated, which is **not** true?

D

A. The rates at which solute molecules go in and out of solution are equal.
B. The net rate of dissolution of solute is zero.
C. The net rate of precipitation of solute is zero.
(D.) The solute concentration depends on the amount of precipitated solute present.

Question 5: Can two miscible liquids be combined to form a supersaturated solution?

B

A. Yes
(B.) No

Question 6: 5.478 grams of potassium acetate and 2.143 grams of iron(III) hydroxide are added to a beaker containing 100.0 mL of water and stirred vigorously. A solid settles to the bottom of the beaker. If the water is decanted and the solid is dried, what is the maximum mass of solid that should be recovered?

2.143 grams

Question 7: Which of the compounds will be most soluble in ethanol (CH_3CH_2OH)?

C

A. trimethylamine ($N(CH_3)_3$)
B. acetone (CH_3COCH_3)
(C.) ethylene glycol ($HOCH_2CH_2OH$)
D. hexane ($CH_3CH_2CH_2CH_2CH_2CH_3$)
E. None of these compounds should be soluble in ethanol.

Question 8: Which of these statements is generally TRUE?

D

A. The solubility of a solid is not dependent on either temperature or pressure.
B. The solubility of a solid is highly dependent on pressure.
C. The solubility of a solid is highly dependent on both pressure and temperature.
(D.) The solubility of a solid is highly dependent on temperature.
E. None of the above.

Question 9: A student mixes 0.0100 grams of sodium chloride into a beaker containing 1 liter of water. Select all true statements.

A, B, C

(A.) The solution is 10.0 ppm sodium chloride.
(B.) The solution is 0.001% w/w sodium chloride.
(C.) The solution is 0.000171 M sodium chloride.
D. The solution is 0.0171 m sodium chloride.
E. The mole fraction of sodium chloride is 3.08×10^{-4}. The density of water is 1.00 g/mL.

Question 10: 100.00 g of a solution of copper(II) sulfate in water is 14.00% copper(II) sulfate by mass. Its density is 1.1545 g/cm^3 at 20 °C.

A. What is the concentration of copper(II) sulfate expressed in **molarity**?

1.013 M

$$\frac{0.08771 \text{ mol}}{0.08662 \text{ L}}$$

$$14.0 \text{ g } CuSO_4 \times \frac{1 \text{ mol}}{159.61 \text{ g } CuSO_4} = 0.08771 \text{ mol } CuSO_4$$

$$100.00 \text{ g solution} \times \left(1 \text{ mL} / 1.1545 \text{ g}\right) \times \frac{1 \text{ L}}{1000 \text{ mL}} = 0.08662 \text{ L}$$

B. What is the concentration of copper(II) sulfate expressed in **molality**?

1.020 m

$$\frac{0.08771 \text{ mol } CuSO_4}{0.08600 \text{ kg } H_2O} = 1.020 \text{ m}$$

C. What is the concentration of copper(II) sulfate expressed as a **mole fraction**?

0.01805

$$\text{mol } H_2O = 86.00 \text{ g} \times \frac{1 \text{ mol } H_2O}{18.02 \text{ g}} = 4.772 \text{ mol } H_2O$$

$$\frac{0.08771 \text{ mol } CuSO_4}{0.08771 \text{ mol } CuSO_4 + 4.772 \text{ mol } H_2O} = 0.1805$$

$50\ ppm = \frac{50\ mg\ CaCO_3}{1\ kg\ sdm} \times \frac{1\ g}{1000\ mg} \times \frac{1\ mol}{100\ g} = 5.0 \times 10^{-4}$

Question 11: Which of the four solutions is most concentrated?

A

A. 50 ppm $CaCO_3$
B. 1 x10^{-7} M $CaCO_3$
C. X_{CaCO3} = 3.6 x 10^{-8}
D. 1 x 10^{-7} *m*

$\simeq 5.0 \times 10^{-4}$ mol/L

$\Rightarrow \frac{3.6 \times 10^{-8}\ mol}{18\ g\ H_2O} \simeq \frac{3.6 \times 10^{-8}}{18\ mL} \times \frac{1000\ mL}{1\ L} = 2.0 \times 10^{-6}$ mol/L

b) $\simeq 10^{-7}$ mol/L

c) MM = 119 g/mol

Question 12: An aqueous solution is 36.0% by mass potassium bromide, KBr, and has a density of 1.33g/mL. Calculate the molality of the solution:

Assume 100 g solution.

I

A. 2.27 *m*
B. 3.03 *m*
C. 3.50 *m*
D. 4.02 m
E. 4.73 m

$36\ g\ KBr \times \frac{mol\ KBr}{119\ g\ KBr} = 0.303\ mol\ KBr$

64 g solvent → 0.064 kg solvent

$m = \frac{0.303\ mol\ KBr}{0.064\ kg\ solvent} = 4.73$

Question 13: An aqueous solution is 36.0% by mass potassium bromide, KBr, and has a density of 1.33g/mL. Calculate the molarity of the solution:

From the previous problem: 0.303 mol / Br.

D

A. 2.27 *M*
B. 3.03 *M*
C. 3.50 *M*
D. 4.04 M
E. 4.73 M

Volume of 100 g solution:

$100\ g \times \frac{mL\ KBr}{1.33\ g} \times \frac{1\ L}{1000\ mL} = 0.0752\ L$

$M = \frac{0.303\ mol}{0.0752\ L}$

Question 14: Procaine hydrochloride (MW= 272.77 g/mol) is used as a local anesthetic. Calculate the molarity of a 4.666 *m* solution which has a density of 1.1066 g/mL.

A

A. 2.272 *M*
B. 4.056 *M*
C. 4.216 *M*
D. 4.666 *M*

$4.666\ mol\ solute \times \frac{272.77\ g}{mol} = 1271.1\ g$

Mass solution = 1271.1 g + 1000 g solvent = 2271.1 g

Volume solution = $2271.1\ g \times \frac{mL}{1.1066\ g} \times \frac{1\ L}{1000\ mL} = 2.052\ L$

$M = \frac{4.666\ mol}{2.052\ L}$

Question 15: The mole fraction of potassium nitrate (MW = 101.1 g/mol)in an aqueous solution is 0.0194. The solution's density is 1.063 g/mL. Calculate the molarity (M) of the solution.

$X_{KNO_3} = 0.0194$, $X_{H_2O} = 1 - 0.0194 = 0.9806$

Assume 1 mol.

C

A. 0.0194 *M*
B. 0.981 *M*
C. 1.08 *M*
D. 1.96 *M*
E. 19.4 *M*

Mass solution (g) = $(0.0194\ mol\ KNO_3)\left(101.1\ \frac{g}{mol}\right) + (0.9806)\left(18.015\ \frac{g}{mol}\right) = 19.627\ g$

$V_{solution} = 19.627\ g \times \frac{mL}{1.063\ g} \times \frac{1\ L}{1000\ mL} = 0.01846\ L$

$M = \frac{0.0194\ mol}{0.01846\ L}$

Question 16: Children under the age of six with more than 0.10 ppm of lead in their blood can suffer a reduction in I.Q. or have behavior problems. What is the molality of a solution which contains 0.10 ppm of lead?

Assume 1 kg solvent

B.

A. 4.8 × 10^{-10} *m*
B. 4.8 × 10^{-7} *m*
C. 4.8 × 10^{-4} *m*
D. 4.8 × 10^{-1} *m*

$ppm = \frac{x}{1000\ g + x} \times 1{,}000{,}000 = 0.10$

$10^6 x = 100 + 0.1x$, $x = (100)/999999.9 = 0.0001\ g$

$mol\ Pb = (0.0001\ g\ Pb)\left(\frac{1\ mol}{207.2\ g\ Pb}\right) = 4.83 \times 10^{-7}\ mol$

Question 17: If the solubility of O_2 at 0.140 atm and 25 °C is 5.82 g/100 g H_2O, what is the solubility of O_2 at a pressure of 2.24 atm and 25 °C?

$S_{O_2}(1) = K_H \cdot P_{O_2}(1)$, $S_{O_2}(2) = K_H \cdot P_{O_2}(2)$

A

A. 93.1 g/100 g H_2O
B. 18.5 g/100 g H_2O
C. 2.74 g/100 g H_2O
D. 0.0107 g/100 g H_2O
E. 0.36 g/100 g H_2O

$\frac{S_{O_2}(1)}{S_{O_2}(2)} = \frac{P_{O_2}(1)}{P_{O_2}(2)}$, $S_{O_2}(2) = \frac{S_{O_2}(1) \cdot P_{O_2}(2)}{P_{O_2}(1)}$

$S_{O_2}(2) = \frac{(2.24\ atm)(5.82/100)}{(0.14\ atm)}$

Question 18: Which of the following sets of conditions could exist when two liquids which are completely miscible in one another are mixed?

D

A. $\Delta H_{soln} > 0$, entropy of system decreases
B. $\Delta H_{soln} \approx 0$, entropy of system decreases
C. $\Delta H_{soln} \approx 0$, entropy change of system ≈ 0
D. $\Delta H_{soln} \approx 0$, entropy of system increases
E. None of the above.

Question 19: In general, a process that is exothermic is favorably spontaneous. When ammonium nitrate, NH_4NO_3, is dissolved in water, the process is endothermic yet still spontaneous. Why is this process spontaneous? (Recall that there are three steps in the dissolution process).

D

A. The process of separating the ammonium ions from the nitrate ions in the crystal lattice of NH_4NO_3 (Step 1) is exothermic thus favoring a spontaneous process.
B. The process of separating water molecules from water molecules (Step 2) is exothermic thus favoring a spontaneous process.
C. Steps 1 and 2 are both exothermic and thus the process is spontaneous.
D. The process is spontaneous because the overall solution upon mixing is more disordered than the pure substances NH_4NO_3 and water (the entropy factor), even though the overall mixing process is endothermic.

Question 20: The Henry's Law constant of methyl bromide, CH3Br, 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?

0.0523 M

$$S = k_H \cdot P_{gas}$$

$$S = \left(0.159 \frac{mol}{L \cdot atm}\right)\left(250.\ mm\,Hg \cdot \frac{1\ atm}{760\ mm\,Hg}\right)$$

$$S = 0.0523\ M$$