Department of Chemistry
University of Texas at Austin

Name:_____

Colligative Properties – Supplemental Worksheet

PROBLEM #1: Give the molecular formula, the van't Hoff factor for the following Ionic Compounds as well as guess the solubility of the compounds. If you cannot write the molecular formulas of these compounds, review your polyatomic ions at http://gchem.cm.utexas.edu/data/section2.php?target=ions.php. Remember that the rule of thumb for solubility is if the salt has a Group I metal or a nitrate group it will be soluble

Ionic Compound	Molecular Formula	van't Hoff Factor	Solubility Guess
manganese (IV) phosphate			
chromium (III) carbonate			
chromium (III) hydroxide			
chromium (II) chlorate			
copper (II) sulfate			
copper (II) hydroxide			
aluminium sulfate			
aluminium phosphate			
strontium chlorate			
barium nitrate			
ammonium hydroxide			
lithium nitrate			
lithium chlorate			

N.B. We expect you to know the solubility of lithium chlorate, lithium nitrate, and barium nitrate. The others you'll most likely have to look up. There is a solubility rules chart on the gchem site at https://gchem.cm.utexas.edu/data/section2.php?target=solubility.php.

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PROBLEM #2: At a lake in the Rocky Mountains, the partial pressure of oxygen is 0.19 atm. What is the molar concentration of oxygen in the lake at 25 °C? The value of Henry's Law constant for O_2 dissolved in water at 298 K is $4.34 \bullet 10^4$ atm. Assume the density of the lake is 1 g/ml.

STEP-BY-STEP QUESTIONS

1. What equation did we learn in class that has to do with the material in this problem?

2. Is what we are looking for found in this equation?

3. What can we find using this equation and what we have been given? Calculate that value.

4. This value is going to help us find the molar concentration of oxygen. Assume a sample that contains 4.378E-6 moles of oxygen. How many moles of water are in the sample?

5. What is the mass of this sample?

6. What is the volume of this sample?

7. What then is the molar concentration of this sample? Remember the molar concentration is the moles of solute in 1 liter of solution.

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PROBLEM #3: Calculate the equilibrium vapor pressure of the 100 mL of 0.1 M lithium sulfate. The density of the solution is 1.15 g/mL) and the vapor pressure of pure water is 25 Torr at room temperature.

STEP-BY-STEP QUESTIONS

1. What equation did we learn in class that has to do with the material in this problem?

2. Is what we are looking for found in this equation?

3. Do we have everything we need to solve for the vapor pressure of the solution? If not, what are we missing?

4. What do we need to find the information we are missing?

5. How many moles of lithium sulfate do we have in the solution? What is the equation for lithium sulfate? How much mass does lithium sulfate contribute to the mass of the solution?

6. What is the total weight of the solution?

7. How much of the mass of the solution is due to the water molecules?

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8. How many moles of water molecules are in the solution?

9. What is the solvent molar fraction?

10. Calculate the vapor pressure of the solution.

Compare and Contrast Moment

What aspects were the same about problem #3 and problem #2?

What aspects were different about problem #3 and problem #2?

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PROBLEM #4: The addition of 125 mg of caffeine to 100 g of cyclohexane lowered the freezing point by 0.13 k. Calculate the molar mass of caffeine. The k_f for cyclohexane is 20.1 $K \cdot kg \cdot mol^{-1}$.

STEP-BY-STEP QUESTIONS

1. What equation did we learn in class that has to do with the material in this problem?

2. Is what we are looking for found in this equation?

3. What can we find using this equation? Calculate that value.

4. Can that value help us find the molar mass of caffeine? How?

5. How many moles of caffeine are in the solution?

6. What is the molar mass of caffeine? Remember that the molar mass of a compound is the mass of 1 mole of the compound.

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PROBLEM#5: A mysterious ionic compound is soluble in water and dissociates into one anion and one cation in solution. The aqueous solution of this mysterious compound containing 25 g/L develops an osmotic pressure of 0.54 torr at 25°C. Find the approximate molecular weight of this compound.

STEP-BY-STEP QUESTIONS

1. What equation did we learn in class that has to do with the material in this problem?

2. Is what we are looking for found in this equation?

3. What can we find using this equation? Calculate that value.

4. Is the above value the molarity of the compound or molarity of ions in solution?

5. Can that value help us find the molecular weight of the compound? How?

6. Calculate the molecular weight of the mysterious compound.

Compare and Contrast Moment

What aspects were the same about problem #4 and problem #5?

What aspects were different about problem #4 and problem #5?

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