Solutions Homework One **ANSWERS**

1. Name and distinguish between the 2 parts of any solution. The solute is dissolved into the solvent.

2. What are the three factors that affect the rate dissolving? Temperature (hotter is usually faster), surface area (more is faster), and agitation makes dissolving faster too.

3. Miscible liquids can dissolve into each other, while immiscible liquids cannot dissolve into each other.

4. How much $NaNO_3$ will saturated 250.0 mL at 20°C? Table G shows us that 100 mL water at this temp holds 88 grams. We have to make a proportional that to our 250 mL, so think: 88 grams is to 100 mL as X grams is to 250 mL. 100 x = 22000, Solve for X = 220 grams sodium nitrate.

5. You remember that most solutes do not supersaturate their solutions when cooled. Sugar does, but sodium nitrate does not. If you cooled your sodium nitrate solution in question 4 to zero centigrade, what happens? Table G shows us that at 0°C that 100 mL water holds 72 grams of this $NaNO_3$. Do the math: if 72 g fits into 100 mL while X grams fits into 250 mL. Solve for X. You see that X = 180 g $NaNO_3$. THINK HARD NOW… Our original solution held 220 grams, but now that same water colder only holds 180 grams solute. The rest, the 220 - 180 = 40 grams difference falls out of solution onto the beaker bottom.

6. Carbon dioxide can be forced into water to make seltzer or soda, if it's pumped in under high pressure. Why does CO_2 NOT want to stay in solution with water? The gas is NONpolar and water is POLAR. Like Dissolves Like, water cannot "hold onto" the gas, and as it warms up, more and more gas escapes from solution.

7. Explain why if you drink cold soda quickly that you will likely burp, in terms of temperature change and the solubility of CO2 in the soda. Cold soda can hold more gaseous carbon dioxide. When you drink the soda, your body temp warms it up quickly and the CO_2 falls out of solution, filling your stomach sac with gas, which leads to your burp!

Solutions Homework #2 ANSWERS

1. Define Molarity, include the formula from your Reference table with a key to show what each letter stands for. Molarity is the ratio between the number of moles of solute divided by liters of solution. This formula is on the back page of your reference tables.

2. Define concentrated and dilute solutions. About how many grams of sugar would make a dilute 100 mL aqueous solution at 20°C? A concentrated one at the same temperature? At 20°C, saturated is 230.9 grams. Dilute is a much smaller number, say under 50 grams per 100 mL water. Concentrated would be a high number of grams, close to but less than saturated.

3. You mix a 100 mL saturated solution of sodium chloride at 10°C. What is the molarity of this solution? Since 38 grams fits into 100 mL at this temperature, the molarity is equal to 0.66 moles, and 100 mL is equal to 0.100 Liters, do the math as see that the molarity equals 6.6 Molar.

4. You dissolve 2.4 moles of KCl into 5.00 liters of water. What is the molarity of this solution? Molarity equals 2.4 moles divided by 5.00 Liters, or 0.48 Molar.

5. You dissolve 7.85 moles of KNO_3 into 16.0 liters of water, what is the molarity of this solution? Molarity is 7.85 moles divided by 16.0 Liters, or 0.490 Molar.

6. You put 53 grams of sucrose into your 250 mL hot water for sweet tea. What is the molarity of this sucrose ($C_{12}H_{22}O_{11(AQ)}$) solution? Molar mass of sucrose is 342 g/mole. You have 0.15 moles, divided by 0.250 Liters, or 0.6 Molar.

7. "Normal" saline is $NaCl_{(AQ)}$ solution that you get via an IV line in the hospital if you are dehydrated. There are 9.0 g NaCl per liter of water, which is the same salt concentration in your body. What's the molarity of this solution? You have 0.16 moles NaCl divided by 1.0 liters, so you have 0.16 Molar.

Solutions Homework #3 ANSWERS

1. How many moles of ammonium nitrate are in 335 mL of 0.425 M $NH_4NO_{3(AQ)}$?
   0.425 M equals the number of moles divided by 0.355 L, solve for moles, 0.425 X 0.355 = 0.142 moles

2. How many moles of solute are in 250 mL of 2.0 M $CaCl_{2(AQ)}$? How many grams of calcium chloride is this?
   2.0 M = number of moles divided by 0.250 Liters, solve for moles,
   2.0 X 0.250 = 0.50 moles. Then, 0.50 moles X 110 g/mole = 55 grams calcium chloride.

3. If you have a stock solution of 2.0 M $Ca(OH)_2$, use: FORMULA: $M_1V_1 = M_2V_2$

A. How many mL are needed to form a 1.4 M solution of 550 mL? $(2.0)(V_1) = (1.4)(550)$ $V_1 = 385 = 390$ mL stock (2SF)

B. How many mL are needed to form a 0.75 M solution of 305 mL? $(2.0)(V_1) = (0.75)(305)$ $V_1 = 114.375 = 110$ mL stock (2SF)

C. How many mL are needed to form a 1.4 M solution of 785 mL? $(2.0)(V_1) = (1.4)(785)$ $V_1 = 549.5 = 550$ mL stock solution (2SF)

D. How many mL are needed to form a 0.250 M solution of 25.0 mL? $(2.0)(V_1) = (0.250)(25.0)$ $V_1 = 3.125 = 3.1$ mL stock solution (2SF)

Solutions HW #4 ANSWERS

1. How many parts per million of lead be present in a water tank of 250,000 liters if 1.1 kg of lead dissolved into this water?

   PPM = [grams solute divided by grams solution] X one million

   PPM = [1100 grams lead divided by 250,000,000 grams solution] X 1,000,000

   PPM = 1100 divided by 250 (cancel 6 zeros in the denominator and numerator) PPM = 4.4 PPM (2SF)

2. What is the concentration of $O_{2(G)}$ in parts per million, in a solution that contains 0.008 grams of O_2 dissolved into each 1000. grams of $H_2O_{(L)}$? (NYS Regents Jan 2008, #38) <u>You must show work here</u>.

   PPM = [grams solute divided by grams solution] X one million

   PPM = [0.008 grams O_2 divided by 1,000 grams solution] X 1,000,000

   PPM = [0.008 divided by 1] X 1,000
   (cancel 3 zeros in the denominator and numerator) PPM = 8 PPM (1SF)

3. An aqueous solution has 0.0070 grams of oxygen dissolved into 1000. grams of water. Calculate the dissolved oxygen concentration of this solution in parts pre million. Your response must include a correct numerical set up and an answer with proper significant figures. (NYS Regents June 2007 # 66)

   PPM = [grams solute divided by grams solution] X one million

   PPM = [0.0070 grams O_2 divided by 1,000. grams solution] X 1,000,000

   PPM = [0.0070 divided by 1] X 1,000
   (cancel 3 zeros in the denominator and numerator) PPM = 7.0 PPM (2SF)

4. List the 3 colligative properties of water. Tell how solute affects each one.

Boiling point: pure water boils at 100°C while adding solute will INCREASE THE BP. More solute takes more temperature (energy) to boil the solution. More particles in solution = more internal attraction to overcome to get to the gas phase.

Freezing Point: pure water freezes at 0°C while adding solute will DECREASE THE FP. More solute gets in the way of the hexagon shaped ice crystals, it takes even lower than normal temperatures (lower energy) to help the hydrogen bonds between molecules attach by pushing the particles out of the way. More particles = lower temperature needed to freeze.

Vapor Pressure: the measure of evaporation in a closed system, pure water evaporates poorly because of all of the hydrogen bonding between molecules. If solute is dissolved, the water is also attracted to these particles, so the evaporation rate lowers. Measured as vapor pressure (table H) the more concentrated the solution, the more particles dissolved in the water, the lower the vapor pressure (the worse it evaporates).