Daily Assignment Sheet '11
(check them off as you complete them)

Name: ____________________ Per ____

+ Packet 8: Water & Solutions

Due Date	Assignment
Mon 1/31	___ Do WS 8.1
Tue 2/1	___ Do WS 8.2
Wed 2/2	___ Do WS 8.3 #1-16 (solubility curves)
Thur 2/3	___ Read *supersaturated lab*
	___ Finish WS 8.3
	___ Do WS 8.4 (% problems)
Fri 2/4	___ Do supersaturated lab ?'s
Mon 2/7	___ Start WS 8.5 (side 1)
Tue 2/8	___ Do WS 8.5 (molarity problems)
Wed 2/9	___ Turn-In Molarity Lab
	___ Do WS 8.6 (dilutions)
Thu 2/10	___ Finish *Colloid Lab*
Fri 2/11	** Mustard Day **
	___ Do WS 8.7 (we'll do #2 in class)
Mon 2/14	___ Do WS 8.9 (review)
	___ Do WS 8.8 (molality)

•• QUIZ TODAY ••

•• PACKETS DUE TODAY ••

Come to class with packets ready to be turned in, with the above underlined assignments in proper order, in your pocket folder (1/2 pt), with this page as the cover page & grade report stapled inside (1/2 pt)
For 1/2 point, do not turn in old packets.

packet order:
- assignment sheet
- bonus (optional)
- WS 8.1-8.9
- colloid lab

Bonus! (pts divided among the best answers)

Something to think about...
What do the following things have in common? Explain.
- the Titanic
- pot holes
- life on Earth

Instructions for submitting bonus: answer on separate sheet of paper, and place it in right behind this assignment sheet. Turn in when packets are due.

+ WS 8.1 Solutions

1. Identify the solute and solvent in the following solutions:

a) 10.0 g of sugar & 40.0 g of water — solute: ___________ solvent: __________

b) 50 g of water & 5.0 g of NaCl — solute: ___________ solvent: __________

c) 18.0 L of nitrogen & 12.0 L of oxygen — solute: ___________ solvent: __________

2. List an example of the following solutions: (***try your best to be original!***)

a) solid in liquid solution example: ___________ solute: ___________ solvent: __________
b) gas in gas solution example: ___________ solute: ___________ solvent: __________
c) solid in solid solution example: ___________ solute: ___________ solvent: __________
d) liquid in liquid solution example: ___________ solute: ___________ solvent: __________
e) gas in liquid solution example: ___________ solute: ___________ solvent: __________
f) liquid in solid solution example: ___________ solute: ___________ solvent: __________

3. Draw a picture of 7 water molecules (with proper shape), and the **hydrogen bonding** between them:

4. A water molecule has a __________ shape, with the hydrogen atoms carrying a partial _____________ charge and the _____________ atom carrying a partial negative charge. As a result of these charges, we say water is a ____________ molecule. Water molecules are attracted to each other. This attraction is called ____________ bonding. This type of bonding occurs between any molecules containing a ____________ bonded to a ____________, ____________, or ____________. These 3 elements are the most _________________ on the periodic ____________.

If you place a paper clip on water, it will ____________, even though the paper clip is more ____________ than water. Upon careful observation, it may appear the surface of the water has a ____________ on which the paper clip floats. This is due to the ____________ tension of water. ____________ tension is caused by the ____________ hydrogen bonding on the surface of the liquid. Water _____________ in the interior feel attractive forces all around, whereas molecules at the surface only feel the attractive forces from the side and ____________. It is these unequal forces which creates the "skin" we call surface tension. Surface tension can easily be ___________ if ____________ is added to the water. This is because water molecules are more ____________ to soap than they are to each other. This is one way soaps get things clean: they break down the surface tension of __________ so that water can "wet" things.

Cellulose is composed of a long chain of molecules with an O--H _________ on each molecule. Since the H is ____________ connected to the O, cellulose can do ____________ bonding. Paper is made of ____________, so if the bottom of a paper towel is placed in water, the water can climb, or _______ up the towel. The water molecules are attracted to the cellulose because they can form H-bonds with each other. This is partially responsible for how water can be ____________ to the tops of __________.

Ans (IAO): attracted, below, bent, bond, broken, cellulose, directly, electronegative, dense, float, fluorine, hydrogen, hydrogen, hydrogen, molecules, nitrogen, oxygen, oxygen, polar, positive, soap, skin, surface, surface, table, transported, trees, unequal, water, wick

+ WS 8.2 Formation of Solutions

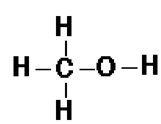
1. Describe the u-tube demonstration that was shown in class. Include a diagram. Make an educated guess as to how it was set up. Be specific!!

2. Does oil dissolve in water? Explain.

3. Will I_2 solid dissolve in water? Explain.

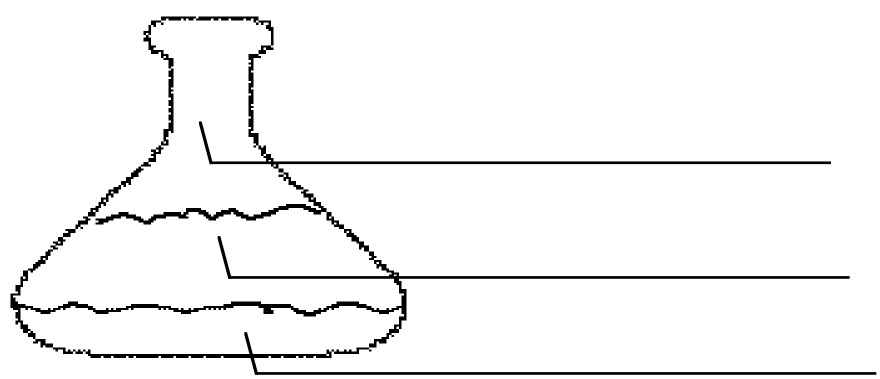
4. Will nitrogen gas dissolve in helium gas? Explain.

5. Below is the structure for methanol (race car fuel). It is a covalent molecule. Can it do hydrogen bonding? _____
Draw 2 water molecules & show the bonds they form to the methanol.



6. Describe in detail how KCl (an ionic substance) dissolves in water. Use diagrams of *hydration spheres*, like we did in our notes:

7. If **sugar**, **oil**, **helium**, **gasoline**, **water** and **oxygen** were all placed together in the same flask, and the flask were shaken, you'd end up with 3 layers (2 chemicals in each).
On the lines below, label where each component would be in each of the 3 layers:



+ WS 8.3 Solubility Curves

Based on the solubility below, decide whether each of the following is **A**: unsaturated, **B**: saturated, **C**: supersaturated, or whether **D**: not enough information is given. *** assume it's dissolved ***

1) 50 g KCl in 100 g of water at 90˚C. ____
2) 50 g KCl in 100 g of water at 60˚C. ____
3) 50 g KNO_3 in 100 g of water at 60˚C. ____
4) 50 g KNO_3 in 25 g of water at 60˚C. ____
5) 65 g KNO_3 in 50 g of water at 70˚C. ____
6) 25 g KNO_3 in 100 g of water. ____
7) 25 g NaCl in 100 g of water. ____
8) 40 g of KCl in 100 g of water at 20˚C. ____

9) How many grams of KCl can dissolve in 100.0 g of water at 65˚C? _____

10) What temperature would be required to get 85 g of KNO_3 to dissolve in 100.0 g of water? ____

SHOW ALL WORK FOR THE FOLLOWING

11) How many grams of KNO_3 can be dissolved in 50.0 g of water at 50.0˚C? _____

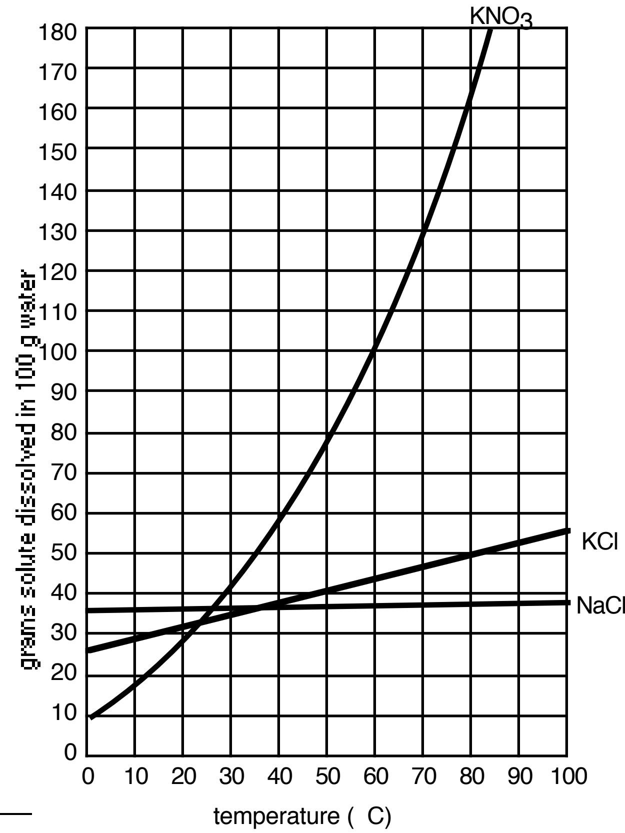
12) What mass of KCl can be dissolved in 200.0 g of water at 15.0˚C? _____

13) How much KNO_3 can be dissolved in 14.3 g of water at 69.0˚C? _____

14) How many grams of water will it take to dissolve 28.0 g NaCl at 60.0˚C? _____

15) How much water is needed to dissolve 46.6 g of KNO_3 at 52˚C? _____

16) What temperature would be required to get 51.0 g of KCl to dissolve in 156 g of water? _____



17) What is the % KCl in a solution that is saturated at 61˚C? _____

18) What temperature is required to make a 50.0% KNO_3 solution? _____

19) What temperature is required to make a 63.0% KNO_3 solution? _____

20) Based on what you've learned in class about soda & fish, do gases behave the same as or different than solids when it comes to solubility & temperature? What do you think a solubility graph of **gases** would look like?

21) Read about Henry's Law (go on-line!). Sketch what you think a pressure vs solubility graph would like like:

Ans (iro+5): A, A, A, B, B, C, C, C, D, 18, 19, 25, 31, 39, 39, 46, 54, 57, 60, 60, 68, 76, 82
Units (iro+1): %, g, g, g, g, g, g, ˚C, ˚C, ˚C , ˚C, ˚C

+ WS 8.4 Percentage Problems *SHOW WORK!*

1. A class is comprised of 13 boys and 19 girls. What is the % boys? % girls?

Ans: _______ _______

2. A solution is comprised of 14.65 g $NaNO_3$ and 56.23 g water. What is the % $NaNO_3$? % water?

Ans: _______ _______

3. 17.89 mg of iron, 34.70 mg of aluminum and 12.03 mg of cadmium are mixed together to form a metallic solution known as an alloy. What are the % Fe, % Al and % Cd in the alloy?

Ans: _______ _______ _______

4. 78.0 g of solution are found to contain 14.32 g of $NaNO_3$. What is the % $NaNO_3$? % water?

Ans: _______ _______

5. A mixture is 34.5% NaCl. How much NaCl would there be in 78.2 g of the mixture? in 78.2 kg?

Ans: _______ _______

6. An iron ore is 82.6% iron. How much iron can be extracted from 34.5 tons of the ore? From 100.0 tons of the ore?

Ans: _______ _______

7. An alloy is 3.75% silver. How much silver is needed to make 745 mg of the alloy?

Ans: ________

8. A certain procedure calls for a 28.9% KCl solution. How much of this solution can be made from 12.4 g of KCl?

Ans: _______

9. A compound is 16.35% oxygen. How much of the compound must be decomposed to produce 67.4 mg of oxygen?

Ans: _______

10. A 65,200 mg sample of air is found to contain 3.2 mg of carbon monoxide. What is the carbon monoxide level in: a) % b) pph c) ppt d) ppm e) ppb?

Ans: ________ ________ ________ ________ ________

11. The EPA considers water unfit for human consumption if it contains lead at a concentration of 50 ppb or higher. a) What would this be in ppm? b) in %? c) A 2300 g sample of water is analyzed and found to contain 78.5 μg of lead... would that be considered safe to drink? **hint: μg = 10^{-6} g**

Ans: _______ _______ _______

12. A water sample is found to contain a lead level of 2.80 ppm. How much lead would there be in 855 g of the sample?

Ans: _______

Ans:(IRO + 2) 0.0000050 0.0024 0.0049 0.0049 0.0208 0.049 0.050 18.4 18.62 20.67 27.0 27.0 27.68 27.9 28.5 36.3 41 42.9 49 53.70 59 79.33 81.6 82.6 412 49000 yes

Units: % % % % % % % % % % % g g g g g mg mg kg ton ton pph ppt ppm ppm ppb

+ WS 8.5 Molarity *Cross-off answers as you find them* **SHOW WORK!**

1. Determine the concentration (molarity) for each of the solutions:

a) 3.0 mol sugar dissolved in 2.0 L of solution. ____ b) 0.40 mol NaCl dis. in 10.0 L of soln. ____

c) 0.030 mol KNO_3 dis. in 50.0 mL of soln. _______ d) 350 g KNO_3 dis. in 5.0 L of soln. ______

e) 6.45 g of Na_2SO_4 dis in 250 mL of soln. _____ f) 465 mg KF of dis. in 0.054 L of soln. _____

2. How many moles of sugar are needed to make 2.5 L of 1.4 M sugar solution? Ans: ______

3. How many moles of NaBr are needed to make 150 mL of 3.0 M NaBr solution? Ans: ______

4. How many grams of $NaNO_2$ are needed to make 3.5 L of 0.50 M $NaNO_2$ solution? Ans: ______

5. How many grams of K_2CO_3 are needed to make 300.0 mL of 1.25 M K_2CO_3 solution?

Ans: ______

6. What volume of 0.25 M sugar solution can be made using 4.0 moles sugar? Ans: ______

7. How many mL of 2.50 M Na_3PO_4 solution can be made using 1.8 g of Na_3PO_4? Ans: ______

8. 65.0 mL of K_3PO_4 solution are evaporated, and 1.54 g of solid K_3PO_4 are recovered. What was the molarity of the original solution?

Ans: ______

(more on back)

Ans (IRO +1): 0.040 0.112 0.15 0.18 0.45 0.60 0.69 1.5 2.85 3.5 4.4 16 51.8 120

Units: (IRO + 1): moles, moles, g, g, g, L, mL, M, M, M, M, M, M, M

9. Sketch a volumetric flask and explain precisely how you would use a 500.0 mL volumetric flask to make some 1.500 M $NaNO_3$ solution. (hint: look at the 5 steps on how to use a vol. flask).

Be sure to show your calculations, including how many grams of solute to use

10. ***Do this question after you've completed part 1 of the molarity lab:***

You are handed a large flask containing a K_2CO_3 solution of unknown molarity. Describe precisely, step by step, how you would go about determining the molarity. Use any equipment you want!

(hint: look at what you did in part 1 of the molarity lab)

11. One grain of sugar with a mass of 0.25 mg is dissolved in a 25.0 m x 10.0 m x 3.0 m swimming pool filled with water. Determine the sugar concentration, and then use it to determine how many molecules of sugar would be contained in just one drop of the "sweetened" pool water solution.

(sorry, answer not in ans. bank!)

[1 g = 1000 mg, 1 m^3 = 1000 L, 20 drops = 1 mL, sugar = $C_{12}H_{22}O_{11}$]

Ans: _______

+ WS 8.6 Dilutions **Show Work!**

1. Determine the concentrations for each of the following mixtures:

a) equal volumes of 3.0 M KCl & water: ____ b) equal volumes of 3.0M KCl & 7.0 M KCl: ____

c) one vol. of 8.0 M KCl & one vol. water: ____ d) one vol. of 6.0 M KCl & two vol's water: ____

e) one vol. water & two vol's of 6.0M KCl: ____ f) one vol. of 5.0 M KCl & 4 vol's of water: ____

g) one vol. of 2.5 M KCl & 9 vol's water: ____ h) one vol. of 2.5 M KCl & 99 vol's water: ____

2. To make orange juice from frozen concentrate, one usually mixes the can of concentrate with three cans of water. This dilutes the concentrate to _______ (what fraction?) its original concentration.

3. Use the dilution equation to determine the concentrations of the following mixtures...

a) 45 L of 3.6 M KCl & 71 L of water:

Ans: ______

b) 215 mL of 2.8 M KCl & 47 mL water:

Ans: ______

c) 45 mL of 3.6 M KCl & 71 mL of 6.2 M KCl:

Ans: ______

d) 83 mL of 2.0 M KCl & 25 mL of water:

Ans: ______

e) 38 mL of 6.0 M KCl dil. to a tot vol of 100 mL:

Ans: ______

4. To what total volume must <u>26.0 mL</u> of <u>4.80 M</u> KCl be diluted to reduce its concentration to...

a) ... 2.10 M

Ans: ______

b) ... 0.480 M

Ans: ______

(continued on back)

Ans (IRO+1): 0.025 0.25 1/4 1.0 1.4 1.5 1.5 2.0 2.0 2.3 2.3 3.6 4.0 4.0 5.0 5.2 59.4 125 260.

Units (IRO+1): M M M M M M M M M M M M M M M M mL mL gooseberries

+WS 8.6 (**Warning:** one of the questions on this page is impossible... When you find it, explain why it's impossible!)
side 2

5. What volume of water must be added to 35 mL of 2.6 M KCl to reduce its concentration to...

a) ... 1.2 M

Ans: ______

b) ... 0.26 M

Ans: ______

6. What volume of 2.5 M KCl must be added to 37 mL of 6.0 M KCl to make the total concentration:

a) ... 1.5 M

Ans: ______

b) ... 4.2 M

Ans: ______

7. What volume of 2.5 M KCl must be added to 37 mL of water to make the total concentration 1.8M?

Ans: ______

8. You mix 32 mL of 4.5 M KCl, 56 mL of 6.2 M KCl and some water, and the total concentration comes out to be 1.7 M. How much water must have been added?

Ans: ________

9. Sketch a volumetric flask and explain precisely how you would use a 500.0 mL volumetric flask to make some 1.500 M $NaNO_3$ solution. (You have available some 2.000 M NaNO3 solution and whatever other lab equipment you need) **How much 2.000 M solution is needed?**
(hint- this is identical to part III of the molarity lab)

10. You need to make up some 5.0 M KCl solution but all you have is 125 mL of 3.0 M KCl.
Explain what to do to make up the 5.0 M solution. How much 5.0 M KCl will you get? Show calculations:
(hint- calculate how much water to evaporate)

Ans (IRO+1): 39 41 75 95 172 201 315 375 Units(IRO+1) mL mL mL mL mL mL mL mL mL hogshead

+ WS 8.7 Solutions, Colloids & Suspensions

1. How does the size of the dispersed particles compare for solutions, colloids and suspensions. **Use diagrams**: (hint: look back at your colloid post-lab notes)

2. Colloids form when one state of matter of large particle size is dispersed in another. Complete the table below, from examples given in class:

minor component		major component	is called a...	(example)
solid	dispersed in...	*gas*		
solid		*liquid*		
solid		*solid*		
liquid		*gas*		
liquid		*liquid*		
liquid		*solid*		
gas		*liquid*		
gas		*solid*		

3. Check (√) all the boxes that apply for the following descriptions (the first is done for you):

	solution	colloid	suspension
a) particles do not settle	√	√	
b) small, invisible particles			
c) particles can be separated by filters			
d) Tyndall effect occurs			
e) transparent			
f) opaque (not transparent)			
g) stays cloudy			
h) particles are too big to remain evenly distributed			
i) can involve a solid in a liquid			
j) a medicine that says shake before using			
k) maintains a homogenous (even) distribution of particles			
l) passes through a filter unchanged			

4. Categorize the following as an **element**, a **compound**, a **solution**, a **colloid**, a **suspension**, or **???**:

a) salt ______________
b) salt water ______________
c) water ______________
d) peptobismol ______________
e) sand & water ______________
f) air ______________
g) helium ______________
h) smoky air ______________
i) fire ______________

answer bank, in random order:

element, compound, compound, solution, solution, ???, colloid, suspension, suspension

+ WS 8.8 - Molality & Colligative Properties
(side 1)

1. Molality (*m*) represents the number of _______ of ________ in one ___________ of _________. The units of molality are thus ______________.

2. Compute the molality (*m*) of 78 g of NaCl in 1000 g of H_2O.

3. Compute the molality (*m*) of 23.7 g of $NaNO_3$ in 250 ml of H_2O.
(*Hint: the density of water is 1g/ml*)

4. What is the molar mass of a substance in which 475.6 g of the substance is dissolved in 2 L of water yielding a 2 *m* solution?

5. The van't Hoff factor (*i*) indicates how many moles of solute are in a solution, per mole of solid solute added to the solution. For example, in water one mole of $C_6H_{12}O_6$ does not form any ions, so i=1. In water, one mole of NaCl will yield one mole of Na+ ions and one mole of Cl- ions, so i=2.

   In water, one mole of $CaCl_2$ forms one mole of Ca+ ions and two moles of Cl- ions, so i=____. In contrast, in water, one mole of $NaNO_3$ forms ___ mole(s) _____ and ____ mole(s) _____, so i= _____.

6. What is the freezing point depression of water in a solution of 10.0 g of NaCl and 1300 g of water? (k_f for water is -1.86 ˚C/*m*)

7. What is the actual freezing point for an aqueous solution of 25 g of $CaCl_2$ in 500 ml of water?

8. How many grams of NaCl are required to lower the freezing point of 1.0 L of water by 6 ˚C? How many grams of $CaCl_2$ would be required to achieve the same temperature change?

9. What is the boiling point elevation for an aqueous solution of 50. g of NaCl in 475 ml of water? (k_b for water is 0.51 ˚C/*m*)

10. In water, HCl forms two ions and hence *i*=2. In benzene, however, HCl does not form any ions and *i*=1. Pure benzene boils at 80.1 ˚C. Imagine that you have 1000 g of water and 1000 g of benzene in separate beakers. Into each beaker you add 250 g of HCl. What will be the new boiling points of benzene and water?

(k_b for benzene is 2.53 ˚C/*m* while the k_b for water is 0.51 ˚C/*m*)

11. Suppose 65.0 g of a nonionic substance is dissolved in 2.00 L of water. The freezing point is observed to decrease by 1.30 ˚C. What is the molar mass of the substance? (k_f for water is -1.86 ˚C/*m*)

Answers (IRO+1):

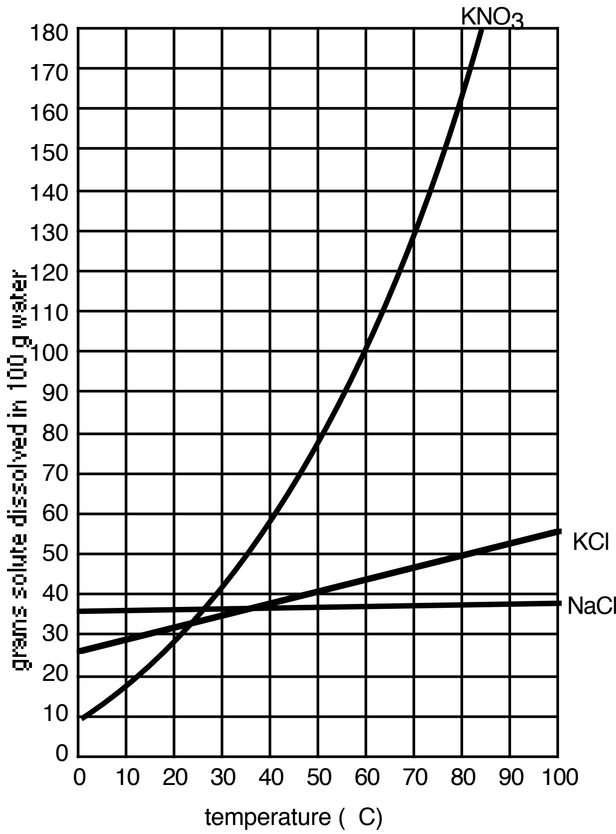
2 gram 1.1 3 7.00 moles 2 1 1 1.3 moles Na^+ solvent N^{-3} 1.8 O_3 dogs kilogram NO_3^- 118.9

1.8 -0.49 97 -2.5 2.5 107 130.8 201 solute / kilogram /Liter 17.3 120 94.2 46.5

+WS 8.9 Review Worksheet

1. How much KCl can be dissolved in 100 g of water at 62.0°C? _____

2. How much KNO_3 can be dissolved in 136.0 g of water at 71.0°C? _____



3. How many grams of water will it take to dissolve 26.0 g KCl at 56.0°C? _____

4. What temperature would be required to get 42.4 g of KCl to dissolve in 100 g of water? _____

5. What temperature would be required to get 42.4 g of KCl to disolve in 142 g of water? _____

6. 6490 g of solution contain 18 mg of sugar.

What is the % sugar in the solution? ______

What is the ppm sugar in the solution? ______

7. How many grams of HF would there be in 15.6 g of 32.0% HF solution?

Ans: _____

8. How much 5.30% salt solution can be made using 16.7 g of salt?

Ans: _____

9. What is the molarity of a solution containing 1.2 moles NaCl dissolved in 750 mL of NaCl solution?

Ans: _____

10. How many moles of sugar are needed to make 1.30 mL of 1.50 M sugar solution?

Ans: _____

Ans (iro+2): 0.00028 0.00195 0.025 1.6 2.8 4.99 9.6 13 44 53 60 146.0 178 315
Units (iro+1): g g g g g g % ppm moles °C °C L L mL M M

11. How many grams of $NaNO_2$ are needed to make 150 ml of 3.0 M $NaNO_2$ solution?

Ans: _____

12 . What volume of 1.3 M $CaCl_2$ solution can be made using 3.6 g $CaCl_2$?

Ans: ______

13. 17.5 mL of 3.00 M HCl is place in a 100.0 mL volumetric flask and water is added up to the mark. What will be the molarity of the diluted HCl?

Ans: ______

14. What volume of 1.3 M HBr should be added to 55 mL of 5.0 M HBr to make the total concentration 4.5 M?

Ans: ______

15. Calculate the boiling point for a solution of 75 g K_2O in 0.50 L water.

Ans: ______

16. Some room temperature water (A) has some KBr mixed in and it all dissolves (B). Some more KBr is added and it all settles to the bottom (C). After vigorous shaking, however, about 1/2 of the KBr dissolves (D). This is then cooled down to 5˚C and some of the dissolved KBr recrystallizes out (E). This is then heated to 75˚C, and all the KBr quickly dissolves (F). This is then cooled back down to room temp with no KBr recrystallizing out (G). A single granule of KBr is added and a bunch of crystals form throughout the container (H). Indicate whether the solution was **uns**aturated, **sat**urated, or **sup**ersaturated at each point in time:

A_____ B_____ C_____ D_____ E_____ F_____ G_____ H____

17. You are given what appears to be a clear, colorless liquid in a sealed flask. You are asked to determine whether it is a solution, a colloid or a suspension. What would you do, and what would it show?

18. You are given two beakers each of what contains what appears to be water. One contains water; the other contains a solution of $LiNO_3$ in water. Describe at least three distinct ways you could differentiate which liquid is which.

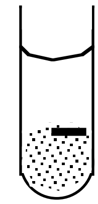
Ans (IRO +2): sat sat sat uns uns uns uns sup 0.525 0.788 8.6 25 31 100.8 102.4

UNSATURATED, SATURATED & SUPERSATURATED LAB Name: ___________ partner: _______

Follow the procedure below, and record all observations. Ignore the letters in ( ).

1) Obtain a clean, unscratched test tube. Using a pipet, add 2.0 mL of water (A). Then add 4.00 g of $NaC_2H_3O_2$ ("sodium acetate," which we will abbreviate **SA** from here on), but don't shake yet (B). Use a perm. pen to mark the top of the undissolved **SA** level on the side of test tube. Stopper and mix for 3 sec, tilt to get any undissolved crystals off the sides, and note any changes (C).

Observations:____



2) Re-mark the top of the undissolved solute level. Mix for another 5 sec and observe the changes, including feeling the test tube (D).

Observations: ____

3) Repeat step #2 until no more change occurs (E).

Observations: ____

4) <u>REMOVE STOPPER</u>! Heat test tube (by placing in hot water) for 90 sec (while waiting, weigh out another 0.10 g of **SA** for step #5). Remove test tube from heat, stopper & mix for 10 sec (F).

Observations: ____

5) While still hot, add the 0.10 additional grams of **SA**, stopper & mix for 10 sec (G)

Observations: ____

6) Add an additional 4.00 g of **SA**, stopper & mix for 10 sec (H).

Observations: ____

7) REMOVE STOPPER! Heat for 2 min (while waiting, weigh out 1.00 g of **SA** for step #8), then remove from heat, stopper and mix for 10 sec (I). Observations: __________________________

8) Add the 1.00 g of **SA** & mix (J). Observations: ____

9) Reheat until <u>all</u> crystals have dissolved (K), stopper and mix, and then cool in cold water for 50-60 sec (L), *(If recrystallization occurs during cooling, reheat to redissolve it, then re-cool it.)*
* Then add 1 crystal **SA** & observe (M). Observations: ____________________________________

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10) (<u>bonus</u>) Reheat until <u>all</u> crystals have dissolved and then an additional 30 sec (N), make sure your test tube rim is ULTRA-clean, and cool in water for 50-60 sec (O). Place a crystal or two on a clean petri dish lid. Then, carefully, drop-by-drop, pour your solution out onto the crystal. Observe what happens (P). Advice: Don't allow the growing pillar to come too close to the mouth of the test tube... (The tallest pillars will receive bonus!)
Observations: ____

11) Clean up your lab area and equipment , <u>leave it the way you found it</u>, and place your final product in the sodium acetate recovery container. **don't forget to answer questions on back...**

QUESTIONS:

1. Consider each of the points throughout the procedure indicated by the letters (A-P) and decide whether at each particular moment, the test tube contained a solution that was unsat, sat. or supersat. **Briefly justify your answers**. *The first one is done for you.*

A unsat it's pure water... there is no solute in it. I ____ ________________________________

B ____ ________________________________ J ____ ________________________________

C ____ ________________________________ K ____ ________________________________

D ____ ________________________________ L ____ ________________________________

E ____ ________________________________ M ____ ________________________________

F ____ ________________________________ N ____ ________________________________

G ____ ________________________________ O ____ ________________________________

H ____ ________________________________ P ____ ________________________________

2. If you were handed a solution and told to determine whether it was unsaturated, saturated or supersaturated, explain what you would do and what you would expect to see for each of three possible cases: *(hint- think of the demo we did in class)*

unsaturated: ____

saturated: ____

supersaturated: ____

3. A solution has some undissolved crystals sitting on the bottom. Could it be...

unsaturated? Y / N Explain: ____

saturated? Y / N Explain: ____

supersat.? Y / N Explain: ____

4. Use the solubility curves on Worksheet 7.3 to explain precisely, step-by-step, how you would go about making a **supersaturated** KNO_3 solution. State precisely how many grams of water, how many grams of KNO_3 and what temperatures you would use.

MOLARITY LABS I & II & III Name: __________________ partner: _____________

Part I: Purpose: To determine the molarity of a given NaCl solution using a sample of the solution, a graduated cylinder, an electronic balance and a petri dish.

Write down in numbered steps precisely what you did.

Record a data table below:

Calculations: (show all work neatly)

Results**: The NaCl solution was found to have a molarity of ________** ←

(Remember sig figs and units. Results will be graded for accuracy within 15%)

No units for results (above) = -1/2

(5 points)

Part II: Using a volumetric flask, an electronic balance, some water and some store-bought salt (NaCl), make up some 1.40 M NaCl solution and have it tested by Mr. A. Grade =

show calculations

(5 points)

Part III: Using a volumetric flask, a graduated cylinder, some water and some prepared 3.10 M NaCl solution (colored green!), make up some 1.40 M NaCl solution & have it tested. Grade =

show calculations

MOLARITY LABS I & II & III FOLLOW-UP QUESTIONS:

1. **Lab I:** (To determine the concentration of a given X M NaCl solution.)
Consider each of the following potential error sources. Answer:
- "H" if it would have caused your calculated value for X to come out too high,
- "L" if it would have caused it to come out too low, or
- "N" if it would have had no effect at all on your value.

___ There were a few salt crystals in your GC (graduated cylinder) when you started.
___ There were a few drops of water in your GC when you started.
___ There was a small pebble in your GC when you started.
___ There were a few salt crystals in your petri dish when you started.
___ There were a few drops of water in your dish when you started.
___ There was a small pebble in your dish when you started.
___ The salt was not completely dry in the end.
___ You accidentally used 48.45 for the molar mass of NaCl.
___ You thought the formula for sodium chloride was Na_2Cl

Ans (IRO): H H H L L L L N N

---

2. **Lab II**: (To make up some 1.40 M NaCl solution from granular salt and water.)
Consider each of the following potential error sources. Answer: "H" if it would have made your solution concentration come out too high, "L" if it would have made it come out too low, or "N" if it would have had no effect at all.

___ There were a few salt crystals in your flask when you started.
___ There were a few drops of water in your flask when you started.
___ There was a small pebble in your flask when you started.
___ You accidentally measured from the top of the meniscus instead of from the bottom.
___ You forgot to account for the mass of the paper upon which you weighed out your salt sample.
___ You accidentally used 48.45 for the molar mass of NaCl.

Ans (IRO): L L H H H N

---

3. **Lab III**: (To make up some 1.40 M NaCl solution from some prepared 3.10 M NaCl soln.)
Consider each of the following potential error sources. Answer: "H" if it would have made your solution concentration come out too high, "L" if it would have made it come out too low, or "N" if it would have had no effect at all.

___ There were a few salt crystals in your graduated cylinder when you started.
___ There were a few drops of water in your graduated cylinder when you started.
___ There were a few drops of the 3.10 M NaCl soln in your graduated cylinder when you started.
___ There were a few drops of water in your volumetric flask when you started.
___ There were a few drops of the 3.10 M NaCl soln in your volumetric flask when you started.

Ans (IRO): L H H N N

Solutions, Suspensions, & Colloids Lab side 1 Name: ________________

Pre-Lab Reading:

After a solute, such as salt, dissolves in water, the salt is gone, right? NO! It is said to be "in solution". A ***solution*** is a mixture that is completely uniform throughout. In water, the salt crystals dissolve by separating into ions, which are on the atomic level. These ions become uniformly "mingled" with water molecules, producing a ***homogeneous*** mixture, one that is uniform throughout.

Water mixtures are classified according to the size of particles dispersed in the water. ***Suspensions*** are mixtures containing relatively large, easily-seen particles. The particles remain suspended for a while after stirring, but then settle out or form layers within the liquid. Suspensions are classified as ***heterogeneous*** mixtures because they are not uniform throughout. Muddy water is a good example of a suspension: if the water sits, after time, the dirt will settle out. *In a suspension, the component particles are much larger than in a solution*.

Particles of a size *between* those in a solution and those in a suspension are called *colloidal* . A ***colloid*** is a mixture of water that contains colloidal particles. The properties of colloids differ from those of solutions and suspensions. Many colloids are cloudy or milky in appearance but look clear when they are very dilute. Unlike a suspension, the particles in a colloid are not large enough to settle out. Homogenized milk is an example of a colloid.

Colloidal mixtures exhibit the ***Tyndall effect*** -- the scattering of visible light in all directions. You can see a beam of light passed through a colloid just as you see a sunbeam in a dusty room. Suspensions also exhibit the Tyndall effect, but solutions never do.

Answer these questions before starting the lab:

1. How is a suspension different from a colloid?

2. How is a solution different from a colloid?

3. Which has the largest particle size, a solution, colloid, or suspension? ________________
4. The Tyndall effect can be used to tell the difference between which types of mixtures?

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post-lab notes:

SOLUTIONS, COLLOIDS, AND SUSPENSIONS LAB side 2 Name: ________________

Purpose: To determine by observation if a given mixture is a solution, colloid, or suspension.

Obtain six vials, lableled "A" through "F." Two of the vials contain solutions, two contain colloids, and two contain suspensions. Your objective here is to determine, just by visual observations, which are which. Be sure to shake the vial for 5 seconds before making your observations. Do not open any of the vials. You may bring **three of the vials** (you choose) up to the laser beam to observe any Tyndall effect (very faint). Ignore any bubbles that you may see from having shaken the vials. Record your observations below for each of the vials, making sure to explain why you chose the answer that you did:

OBSERVATIONS	Solution, Colloid or Suspension?	EXPLANATION
Vial A		
Vial B		
Vial C		
Vial D		
Vial E		
Vial F		

Crystal Growing   Home Lab   Name: _______________

When a salt solution is allowed to evaporate, it is important to realize that it is only the water (solvent) that is evaporating; the salt (solute) is left behind. So what would happen if some of the water in a saturated salt solution is allowed to evaporate? (Suppose the salt being used is not easily "fooled" into becoming supersaturated.) In the space below , write down what you think will happen and why you think it will happen:

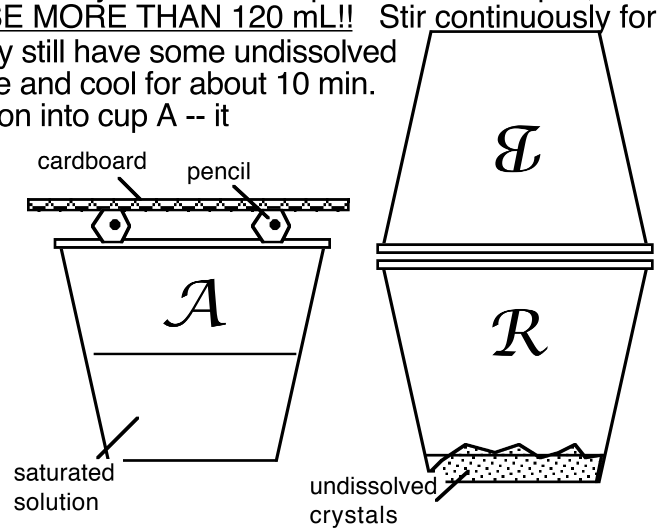
Materials:

- 20 g of "alum" [AKA: potassium aluminum sulfate: $KAl(SO_4)_2$] obtained from the instructor
- 3 clear plastic cups -- clear, clean and preferably wide mouth
- water -- tap water works OK, distilled* is even better (*available at supermarkets)
- two pencils, a piece of cardboard or stiff paper, and a plastic spoon

Procedure: **This lab project will take A FEW WEEKS to complete**. *Start it immediately*! Then spend 4-5 minutes each day attending to the project.

1. **Day 1**--Set up: Label your three cups R, A and B. Place your entire sample of alum in cup R, and add 120 mL (1/2 cup) of warm water. DO NOT USE MORE THAN 120 mL!! Stir continuously for 3 full minutes to try to saturate the solution. (You may still have some undissolved alum at the bottom of the cup.) Let the solution settle and cool for about 10 min. (longer if it appears cloudy). Then decant* the solution into cup A -- it should appear clean and clear. Place the two pencils across the top of cup A and then place the piece of cardboard over the pencils. The cardboard must be larger in size than the mouth of the cup (see Figure at right). The cardboard serves as a dust cover. The pencils serve as spacers to keep the cup open and allow for evaporation. Balance cup B mouth to mouth on top of cup R, to keep dust out of either one.

  * Decant means to carefully pour off just the liquid, leaving all the undissolved crystals behind.



2. **Day 2** -- Pick your crystal! Check for crystals on the bottom* of cup A (if none appear, that's OK, just check again the following day). When you finally see crystals, pick one that seems especially clean and clear (if there are zillions of little crystals, just pick any one).

  * Sometimes you might actually see crystals forming at the top of the solution, floating even though they're more dense (How is this possible?) If this happens, just use the spoon to knock them down. Place cup B upright on the table, then use the spoon to carefully transfer the one crystal from A to B. Then carefully decant the solution into cup B. place the pencils and cardboard over cup B, and set aside. Add a few mL (1/2 tsp) of water to cup A, swirl around and quickly pour into the recovery cup (R). If some crystals remain in cup A, decant the liquid back from cup R into cup A, swirl and quickly pour. The idea is to clean the extra crystals out of cup A and into the recovery cup using as little additional water as possible. When cup A is clean, place it mouth to mouth on top of cup R as you did before. The set up should now look like the above figure with two exceptions: A and B are switched, and there is a small growing crystal in the cup with the solution.

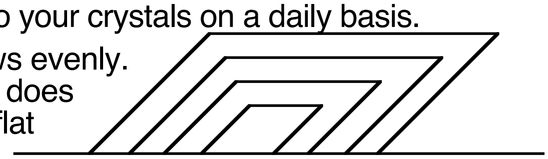
(continued on back)

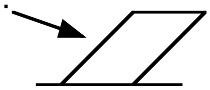
3. **Days 3 thru...**: Keep it growing! On each successive day, simply use the spoon to transfer the one main crystal from the solution cup (A or B) into the empty cup (B or A), then decant the solution onto that crystal, and rinse any extra little crystals back into the recovery cup R. Replace the pencils and dust cover, just as you did above. Repeat this technique each day, just alternating cups A and B as you go. After several days, the solution level may get a little low. It is important to keep the solution level above the top of the main crystal, so it can continue to grow evenly on all sides. If it starts to get too low, DO NOT ADD WATER TO THE MAIN CRYSTAL CUP (this should be obvious), instead add some of the saturated solution left in the recovery cup. (If there is none, add 10-15 mL of fresh hot water to the crystals in the recovery cup). Stir it well (3 min) to make sure it's saturated, let it sit for a several hours, then if it's still saturated (undissolved salt in the bottom) decant it into the main crystal cup.

Important Tips:

1) To be sure no other crystals get too attached to it, attend to your crystals on a daily basis.

2) Once it gets big enough, rotate your crystal, so that it grows evenly. The bottom side of the crystal touches the cup and therefore does not grow as fast. A crystal that is not rotated will thus end up flat (as shown at right). Once a crystal gets large enough (about the size of a pea) keep rotating it, by always leaving it balanced on its smallest face:



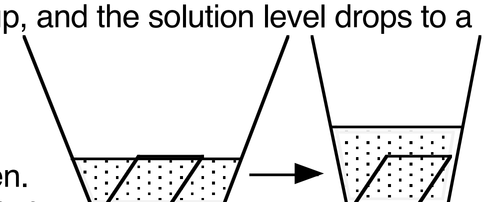


3) Try to keep the crystal growing project in a part of the house that maintains a fairly constant temperature. (What might happen if the solution all of a sudden got really warm?)

4) To maintain crystal clarity, avoid handling the crystals, or getting impurities in the solution or recovery cup, and make sure the spoon stays clean. If you do need to handle the crystal, wash your hands well before (and after!).

5) If any little crystals attach themselves to the main crystals, do your best to brush them off as best you can.

6) Very important: Once you run out of crystals in the recovery cup, and the solution level drops to a point where the main crystal starts to stick out, then you may want to transfer the crystal into a narrower cup, where the same amount of solution will give you a greater depth (see figure at right). This will give you a few more growing days, and let you take better advantage of the entire amount of alum you were given. In the narrower cup, once the crystal has outgrown the narrowest cup possible, then you have grown as large a crystal as you can. (Congratulations!) Take your award-winning (bonus winning?) crystal out, pat it dry with a paper towel, and place it in a plastic bag to keep the crystal from drying out and getting brittle.



On the day the crystal is due to be turned in, whether it is finished growing or not, place it in a plastic bag as described above, then wrap the bag in some tissues and bring it with you to school to turn in, along with the score card (will be handed to you, in class, one day prior to due date).

Your crystal will be graded for 50 points based on:

- size (20 pts)
- clarity (15 pts)
- proportions (15 pts) (how evenly shaped it is)

Good luck!

CRYSTAL DUE DATE: ____________