I apologize for the spraeling messiness of this packet. It is a combination of 1) things to know 2) unsolved problems 3) solved problems. It is a broad survey meant to be a starting point that jogs your memory.

Review for the June 2014 Chemistry Final Exam

(The exam covers only second semester, from Jan 27 to June 6th)

Disclaimer: Studying this packet is a great start but is not a substitute for actually studying all 80 days of material. Hopefully time spent with this packet will help you find what parts of the semester you need to go back and study in depth, either from your notes or from http://genest.weebly.com

Of the 80 days we have been together this semester, the things in this packet are the ones that came up over and over.

About a third of what you need to know are specific facts. Get these from your notes.

Two thirds of what you need to know are skills. Get these by doing, redoing, and redoing one more time, all of the old homework problems that you learned to solve this semester.

UNIT 10 SOLUTIONS

VOCABULARY

Solvent
Solute
cation
anion

FORMULAS

Solutions Math equations:
(1) molarity = moles solute divided by liters of solution
(2) the dilution equation (M x V = M x V

Solutions skills:
(1) If given a words description of a dissolving or a precipitating, students will be able to (SWBAT) write the symbolic letters of a balanced equation AND a particle cartoon

(2) If given any two data parts of the molarity formula, calculate the missing one.
(3) If given a list of solid ionic compounds, SWBAT rank the substances according to which gives the most and least particles of solute.
(4) if given a description of a solution students will be able to identify the solute and the solvent

1. How many pieces will this fall apart into if made into an aqueous solution? (circle your choice)

$AlBr_3$	1? 2? 3? 4? 5?
$(NH_4)_2CO_3$	1? 2? 3? 4? 5?
$Ca(CH_3COO)_2$	1? 2? 3? 4? 5?
CH_3OH	1? 2? 3? 4? 5?

2. In each blank write I (ionic) or M (molecular) to indicate what the substance is

   _____ SO_2

   _____ CH_4

3. $Na_2O_{(s)}$ dissolving. Show each ion separately. Show each ion separately. Show the symbol for phase (solid, etcetera). Show the charge of any charged species.

   _____ --> _____ + _____ + _____

4. When ionic substances such as potassium nitrate are dissolved in water they often make the water colder. This is because heat is (entering / leaving) the ionic substance and heat is (entering / leaving) the water.

For each of the following, Underline compounds that are molecular, circle compounds that are ionic

1. C_2H_3OH SO_3 $MgCl_2$ $CH_3OH_{(L)}$ FeF_3

For each substance below write a dissociation equation (something like "$A_{(s)}$ -> $B_{(aq)}$ + $C_{(aq)}$") to describe that substance dissolving:

(a) LiCl This is □ionic □molecular therefore its dissolved particle(s) will have the formula _____

_____ → _____ + _____ (don't forget to write solid, liquid, aqueous next to each symbol)

(b) $CH_3OH_{(L)}$ This is □ionic □molecular therefore its dissolved particle(s) will have the formula _____

_____ → _____ (don't forget to write solid, liquid, aqueous next to each symbol)

(c) LiNO This is □ionic □molecular therefore its dissolved particle(s) will have the formula _____

_____ → _____ + _____ (don't forget to write solid, liquid, aqueous next to each symbol)

(d) $NaBr_{(s)}$ This is □ionic □molecular therefore its dissolved particle(s) will have the formula _____

_____ → _____ + _____ (don't forget to write solid, liquid, aqueous next to each symbol)

(e) $C_{12}H_{22}O_{11(s)}$ This is □ionic □molecular therefore its dissolved particle(s) will have the formula _____

_____ → _____ + _____ (don't forget to write solid, liquid, aqueous next to each symbol)

4. Write the correct formula that each compound would have. Remember, the total charge of any substance is **zero charge**

	O^{2-}	OH^-	PO_4^{3-}
Mg^{2+}			
K^+			
NH_4^+			
Iron(III) ion {look up the symbol on your chart}			

Introduction to Concentration Units

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Name ANSWERS

Period

Sample Problem 1

Find the molarity of 100 mL of a solution that contains 0.25 moles of dissolved solute.

Step 1: Convert all volumes to liters

$100\ mL \times \frac{1\ L}{1000\ mL} = 0.1\ L$

Step 2: Substitute values into the definitional equation

$M = \frac{moles}{L} = \frac{0.25\ moles}{0.1\ L} = 2.5\ M$

1. Find the molarity of 350.mL of a solution that contains 0.0049 moles of NaCl.

$350.\ mL \times \left(\frac{1\ L}{1000\ mL}\right) = 0.350\ L$

$M = \frac{mol}{L}$ $\quad M = \frac{0.0049\ mol}{0.350\ L}$

$M = 0.014\ \frac{mol}{L}$

Sample Problem 2

Find the molarity of 250 mL of a solution that contains 4 g of dissolved sodium hydroxide (NaOH).

Step 1: Find the GFM

Na = 23 × 1 = 23
O = 16 × 1 = 16
H = 1 × 1 = 1
40

Step 2: Convert all volumes to liters

$250\ mL \times \frac{1\ L}{1000\ mL} = 0.25\ L$

Step 3: Substitute values into the correct equation

$M = \frac{g}{GFM \times L} = \frac{4\ g}{40\ g/mole \times 0.25\ L} = 0.4\ M$

2. Find the molarity of 350.mL of a solution that contains 0.0049 grams of NaCl.

1×Na = 22.99
1×Cl = 35.45
58.44 grams/mol

$0.0049\ grams \times \left(\frac{1\ mol}{58.44\ g}\right) = 0.0000838\ mol$

$M = \frac{mol}{L}$ $\quad M = \frac{0.0000838\ mol}{0.350\ L}$

ANswer $0.00024\ M$

Sample Problem 3

How many moles of solute are dissolved in 30 mL of a 2 M solution?

Step 1: Convert all volumes to liters

$30\ mL \times \frac{1\ L}{1000\ mL} = 0.03\ L$

Step 2: Substitute values into the correct equation

$moles = M \times L = (2\ moles/L)(0.03\ L) = 0.06\ moles$

3. How many moles of CH_3Br are dissolved in 40. mL of 2 M solution?

$2\ \frac{mol}{L}$ $\quad 0.040\ liters$

$M = \frac{moles}{liters}$

$M \cdot liters = \frac{moles \cdot liters}{liters}$

$M \cdot liters = moles$

$\left(2\ \frac{mol}{L}\right)(0.040\ L) = 0.080\ mol$

If 49 grams of pure H_2SO_4 are added to enough water to make 1,000 ml of solution, what is the molarity of the solution? (1) 1.0 M (2) 0.25 M (3) 0.50 M (4) 0.10 M

4.

$49\ grams \left| \frac{1\ mol}{98\ g} \right| = 0.50\ moles$

$M = \frac{moles}{L}$

$M = \frac{0.50\ mol}{1.000\ L} = 0.50\ \frac{mol}{L}$

5. 29 grams of NaCl are added to enough water to make 1.000. ml of solution. What is the molarity of the solution? (1) 1.00 M (2) 0.29 M (3) 0.50 M (4) 5.00 M

1.000 L

$29\text{ g} \times \frac{1\text{ mol}}{58.443\text{ g}} = 0.496\text{ moles of NaCl}$

$M = \frac{\text{mol}}{\text{L}}$

$M = \frac{0.496\text{ moles}}{1.00\text{ L}}$ $M \approx 0.496\ \frac{\text{mol}}{\text{L}}$

6. In a 2.0 M solution of KOH. how many moles of KOH are contained in 500 milliliters of the solution? (1) 1 (2) 2 (3) 0.5 (4) 4

2.0 mol/L

0.5 L

$M = \frac{\text{mol}}{\text{L}}$ Rearranges to → $M \times L = \text{mol}$ $\left(2.0\ \frac{\text{mol}}{\text{L}}\right)(0.5\text{ L}) = 1.0\text{ moles}$

7. One liter of a solution of nitric acid contains 126 grams of solution. HNO_3 The molarity of the solution is (1) 1.00 (2) 2.00 (3) 1.26 (4) 0.500

$126\text{ g } HNO_3 \times \left(\frac{1\text{ mol } HNO_3}{63.02\text{ g } HNO_3}\right) = 2.00\text{ moles}$

$M = \frac{\text{moles}}{\text{L}}$, $M = \frac{2.00\text{ moles}}{1\text{ L}}$

$M = 2.00\ \frac{\text{mol}}{\text{L}}$

8. A 500 ml solution containing 28 grams of KOH is diluted with water to 1,000. ml. What is the molarity of the resulting solution? (1) 1.0 M (2) 2.0 M (3) 0.25 M (4) 0.50 M

useless

useful

$M = \frac{\text{mol}}{\text{L}}$

$28\text{ g} \times \left(\frac{1\text{ mol}}{56.11\text{ g}}\right) = 0.50\text{ mol}$

$M = \frac{0.50\text{ mol}}{1.000\text{ L}}$

$M = 0.50\ \frac{\text{mol}}{\text{L}}$

9. Circle the metallic element in each.

Circle any element that is a metal	This substance is…
$Al(NO_3)_3$	ionic / molecular

Circle any element that is a metal	This substance is…
N_2H_4O	ionic / molecular

10. How many pieces will this fall apart into if made into an aqueous solution? (circle your choice)

$(NH_4)_2CO_3$	1?	2?	3?	4?	5?
K_2CO_3	1?	2?	3?	4?	5?

$Al(NO_3)_3$	1?	2?	3?	4?	5?
Li_2S	1?	2?	3?	4?	5?

11. Write your answer with a coefficient in front of each particle. *For example, instead of writing Br- Br- Br- it is more common and easier to write a coefficient: 3Br-*

a. $Li_2S_{(s)}$ dissolving. Use a coeffiecient where appropriate.

$Li_2S_{(s)} \rightarrow 2Li^+_{(aq)} + S^{2-}_{(aq)}$

b. $Al(NO_3)_{3\,(s)}$ dissolving. Use a coeffiecient where appropriate.

$Al(NO_3)_{3(s)} \rightarrow Al^{3+}_{(aq)} + 3NO_{3(aq)}^-$

anions

1. Just write the formulas of the Cations and anions

formula	the cation is:	the anion is:
carbonated water (soda)		
	oxygen	nitrogen
lemonade		

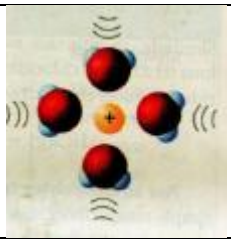
2. Take 99 mL of sugar water that is 0.730mol/L. Add 99 mL of water to it. What is the final concentration of the new solution?

3. 1.5 moles of carbon dioxide can make a 4 mol/L solution. What volume should the solution be?

4. A study of dog sweat finds 0.003 moles of potassium ion in 30 milliliters of sweat. What is the concentration?

5. Write the charges of the following ions with the aid of a periodic table:
   _____ Na ion _____ Oxygen ion _____ Zn ion _____ Al ion
6. How many of the ions in the previous question are "Anions"? ___

7. In the second box, redraw how the first drawing would look if the ion in the middle were "-" instead of "+".



8. In $(NH_4)_2CO_3$ Carbonate is the (cation / anion) and Ammonium is the (cation / anion)

9. If you have 1.0 M solutions of the compounds above which would lower the freezing point the most? Which would lower the freezing point the least?
   a. Sugar($C_{12}H_{22}O_{11}$)
   b. Sodium chloride
   c. Aluminum fluoride
   d. Magnesium bromide

10. Explain why salt is added to water when you are cooking pasta.

11. Explain why you put antifreeze in your car during the winter AND also during the summer.

12. In $FeCO_{3(s)}$ iron is the (cation / anion) and CO_3 is the (cation / anion)

13. The following are all water based solutions. Rank the solutions from coldest freezing point (1) to highest freezing point (4)
    a. _____ 0.5*M* $AuF_{3(aq)}$
    b. _____ 0.5*M* $NO_{2(aq)}$
    c. _____ pure water
    d. _____ 0.5*M* $NaCl_{(aq)}$
14. How many grams of SF_4 are contained in 606. mL of a 0.075 M solution?

15. Circle the metallic element in each.

Circle any element that is a metal	This substance is…
$Al(OH)_3$	ionic / molecular

Circle any element that is a metal	This substance is…
NH_4Br	ionic / molecular

Colligative Properties

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Name_____

Period_____

1. Fill in the missing blanks to describe each mixture. Remember that the solvent is the thing you have the most of.

the solution is called:	the solute is:	the solvent is:
carbonated water (soda)	CO_2	water
air	oxygen	nitrogen
lemonade	sugar, lemon flavor	water

2. Predict the particles that will form in solution

compound:	Gives these pieces if dissolved
$AlCl_{3(aq)}$	Al^{3+}, Cl^-, Cl^-, Cl^-
$CH_3OH_{(aq)}$	CH_3OH
$Ca(OH)_{2(aq)}$	Ca^{2+} OH^- OH^-

3. When liquids are impure, their freezing points are (lower/higher) than normal.
4. When liquids are impure, their boiling points are (lower/higher) than normal.

substance	boiling point [°C]	melting point [°C]
boron	3675	2079
tungsten	5660	3410
oxygen	-182	-218

5. If tungsten is made into an alloy by adding copper, what would be a possible boiling point for the alloy?
   a. 5500 b. 5660 c. 5700
6. If boron were made into a solution by mixing it with N_2 what would be a possible boiling point for the solution?
   a. 3600 b. 3675 c. 3700

7. You have 3.05 grams of aluminum nitrate and want to make a 5L of solution. What concentration could you make?

→ moles

The formula	$concentration = \frac{moles\ of\ solute}{volume\ of\ solution}$
The units	$[M] = \frac{[moles]}{[L]}$

$3.05\,g\ Al(NO_3)_3 \times \left(\frac{1\ mol}{213.01\,g}\right) = 0.0143\ mol$

formula: $M = \frac{moles}{L}$ $M = \frac{0.0143\,mol}{5L}$ $M = 0.00286\ \frac{mol}{L}$

8. What is the molarity of the solution produced when 145 g of sodium chloride is dissolved in sufficient water to prepare 2.75 L of solution?

moles

$145\ g\ NaCl \times \left(\frac{1\ mol\ NaCl}{58.44\ g\ NaCl}\right) = 2.48\ mol\ NaCl$

from the periodic table

The formula	$concentration = \frac{moles\ of\ solute}{volume\ of\ solution}$
The units	$[M] = \frac{[moles]}{[L]}$

Formula

$M = \frac{moles}{L}$

$M = \frac{2.48\ mol}{2.75\ L}$ $M = 0.902\ \frac{mol}{L}$

9. How many grams of potassium chloride are needed to prepare 0.750 L of 1.50 M KCl?

$M = \frac{moles}{L}$ ← unknown

$Moles = (1.50\ M)(0.750\ L)$

$moles = 1.125\ moles$

rearranges to

$moles = M \cdot L$

$1.125\ mol \times \left(\frac{74.55\ grams\ KCl}{1\ mol\ KCl}\right) = 83.9\ grams$

10. To prepare 10.5 L of 2.50 M potassium hydroxide, how many grams of potassium hydroxide must be used?

$M = \frac{mol}{L}$ $mol = M \cdot L$ $moles = (2.50M)(10.5L)$

$moles = 26.25\ moles$

$26.25\ mol \times \left(\frac{56.11\ KOH\ grams}{1\ mol\ KOH}\right) = 1473\ grams$

For each pair of quantities mark < , =, or >.

Example:	**The temperature in Madison today**	**>**	**The temperature on a hot day on Mars**
	11. the melting point of pure ice	**>**	**The melting point of salty ice**
	12. The boiling point of a 0.100 M solution of NaCl	**<**	**The boiling point of a 0.200 M solution of NaCl**
	13. The melting point of a 0.100 M solution of NaCl	**>**	**The melting point of a 0.200 M solution of NaCl**

SKIP

Review for the Test.

ANSWERS

vv

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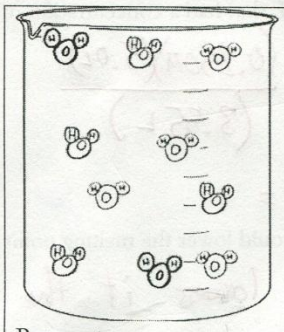
Name_____

Period_____

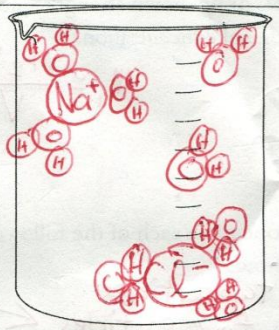
1. Draw!



Pure water

In the beaker on the right draw a Na+ and a Cl- ion.

Draw the same number of water molecules as the beaker on the left and what direction each would face.



An aqueous solution of $NaCl_{(aq)}$

2. If 4.55M hydrochloric acid is diluted from 36.0mL to 90.0mL, what is the new concentration?

$M_1V_1 = M_2V_2$ $\quad \frac{M_1V_1}{V_2} = M_2$ $\quad \frac{(4.55\,M)(36.0\,mL)}{(90.0\,mL)} = M_2$

$1.82\,M = M_2$

3. What is the molarity if 0.65 moles $CaCl_2$ in 750 mL of solution are mixed?

$M = \frac{\text{moles solute}}{\text{Liters solution}}$ $\quad M = \frac{0.65\,mol}{0.750\,L}$ $\quad M = 0.87\,\frac{mol}{L}$

4. In NaBr bromide is the (cation / anion) and sodium is the (cation / anion)

substance	boiling point [°C]	melting point [°C]
boron	3675	2079
tungsten	5660	3410
oxygen	-182	-218

5. If oxygen is mixed with another gas, what would be a possible ~~melting~~ BOILING point for the mixture?

a. -184°C b. -182°C c. -180°C

6. If tungsten were made into a solution by mixing it with iron what would be a possible ~~boiling~~ point for the solution?

d. 5650 e. 5660 f. 5670

7. If you took 455 mL of 0.110M solution and diluted it to 790. mL, what would the new concentration be?

$M_1V_1 = M_2V_2$ $\quad \frac{M_1V_1}{V_2} = M_2$ $\quad \frac{(0.110M)(455mL)}{(790mL)} = M_2$ $\quad 0.063M = M_2$

8. If you took 3.55L of unknown strength solution and diluted it to 5.0L that had a concentration of 0.250M, what was the original concentration?

$M_1V_1 = M_2V_2$ $\quad M_1 = \frac{M_2V_2}{V_1}$ $\quad M_1 = \frac{(0.250M)(5.0L)}{(3.55L)}$

$M_1 =$

9. If you dumped one mole each of the following compounds, which would lower the melting point of frozen snow the most?
   a. KNO_3 two particles
   b. $Al(NO_3)_3$ four particles ← answer: this lowers it the most

10. In $FeCO_{3(s)}$ iron is the (cation / anion) and CO_3 is the (cation / anion)

11. The following are all water based solutions. Rank the solutions from coldest freezing point (1) to highest freezing point (5)
   a. 2 $0.5M\ KNO_{3(aq)}$ two particles of solute
   b. 1 $0.5M\ Al(NO_3)_{3(aq)}$ four solute particles
   c. 5 pure water none
   d. 2 $0.5M\ NaBr_{(aq)}$ two solute particles
   e. 4 $0.5M\ CH_3OH_{(aq)}$ one solute particle

   tie

12. How many grams of ammonium chloride are contained in 300. mL of a 0.875 M solution?

$M = \frac{mol}{L}$ $\quad mol = M \times L$ $\quad mol = (0.875M)(0.300L) = 0.263$ moles (0.300 L)

convert: 0.263 mol (92.5 g / 1 mol) = 24.3

13. How many moles of nitrate ions are in 50.0 mL of a 1.9850 M magnesium nitrate solution?

$M = \frac{mol}{L}$ $\quad mol = M \times L$ $\quad mol = (1.9850M)(0.0500L)$ (0.0500 L)

$mol = 0.09925$ moles $Mg(NO_3)_2$

answer: 0.1985 mol NO_3

Determine the molarity of the following solutions. Show your work and remember that the unit on your answer must be in moles/Liter = M.

14. What is the molarity if 3.00 moles of $C_6H_{12}O_6$ dissolved to make 2.0 liters of solution?

$M = \frac{moles}{L}$ $\quad M = \frac{(3.00\ mol)}{(2.0L)}$ $\quad M = 1.5M$