Unit 6 Practice Test – Dr. Levens – Chem I Honors – 2008

You will get a periodic table and you will be permitted to use MY calculator on this test.

1. Write the formula for:
   a) ammonium carbonate $(NH_4)_2CO_3$
   b) calcium nitrate $Ca(NO_3)_2$
   c) copper (II) oxide CuO
   d) dinitrogen pentaoxide N_2O_5
   e) fluorine gas F_2
   f) tin (IV) sulfate $Sn(SO_4)_2$
   g) lead (IV) oxide PbO_2
   h) triphosphorus tetrachloride P_3Cl_4
   i) potassium phosphate K_3PO_4
   j) phosphoric acid H_3PO_4

2. Name the following:
   (a) Al_2O_3 aluminum oxide
   (b) $Mn(OH)_2$ manganese (II) hydroxide
   (c) ZnF_2 zinc fluoride
   (d) Pb_3N_2 lead (II) nitride
   (e) OF_2 oxygen difluoride
   (f) $Be(NO_3)_2$ beryllium nitrate
   (g) FeS iron (II) sulfide
   (h) Xe_2Cl_4 dixenon tetrachloride
   (i) Na_2CO_3 sodium carbonate
   (j) I_2 iodine

3. What is the formula mass (a.k.a. molar mass or molecular mass) of the compound listed in 2(i) above?
   Na_2CO_3: Na 2(22.99 g/mol) + C 12.01 g/mol) + 3(16.00 g/mol) = 105.99 g/mol Na_2CO_3

4. Calculate the number of moles in 25.0 g of 2(i) above.

$$25.0\text{ g } Na_2CO_3 \times \frac{1\text{ mol } Na_2CO_3}{105.99\text{ g } Na_2CO_3} = 0.236\text{ moles } Na_2CO_3$$

   a. Calculate the number of ions in 25.0g of 2(i) above. (recall, f.u. are "ionic molecules")

$$25.0\text{ g } Na_2CO_3 \times \frac{1\text{ mol } Na_2CO_3}{105.99\text{ g } Na_2CO_3} \times \frac{6.022\times10^{23}\text{ f.u. } Na_2CO_3}{1\text{ mol } Na_2CO_3} \times \frac{3\text{ ions}}{1\text{ f.u. } Na_2CO_3} = 4.26\times10^{23}\text{ ions}$$

5. Calculate the number of grams in 7.53×10^{22} molecules of 2(e) above.

$$7.53\times10^{22}\text{ molecules } OF_2 \times \frac{1\text{ mol } OF_2}{6.022\times10^{23}\text{ molecules } OF_2} \times \frac{54.0\text{ g } OF_2}{1\text{ mol } OF_2} = 6.75\text{ g}$$

   a. Calculate the number of atoms in 7.53×10^{22} molecules of 2(e) above.

$$7.53\times10^{22}\text{ molecules } OF_2 \times \frac{3\text{ atoms}}{1\text{ molecule } OF_2} = 2.26\times10^{23}\text{ atoms}$$

6. For a compound that contains 3.156g Al, 5.626 g S, & 11.218 g O:
   a. Find the % composition (for each atom).

3.156g Al + 5.626 g S + 11.218 g O = 20.000 g

$$\frac{3.156\text{g Al}}{20.000\text{ g total}} \times 100\% = 15.78\% \quad \frac{5.626\text{ g S}}{20.000\text{ g total}} \times 100\% = 28.13\% \quad \frac{11.218\text{ g O}}{20.000\text{ g total}} \times 100\% = 56.090\%$$

   b. Find the empirical formula.

$$3.156\text{g Al} \times \frac{1\text{ mol Al}}{26.98\text{g Al}} = 0.1170\text{ mol Al};\ \frac{0.1170}{0.1170} = 1\ \ldots \times 2 = 2$$

$$5.626\text{ g S} \times \frac{1\text{ mol S}}{32.06\text{g S}} = 0.1755\text{ mol S};\ \frac{0.1755}{0.1170} = 1.5\ldots \times 2 = 3 \qquad Al_2S_3O_{12}\text{ obviously } Al_2(SO_4)_3$$

$$11.218\text{ g O} \times \frac{1\text{ mol O}}{15.999\text{ g O}} = 0.70117\text{ mol O};\ \frac{0.70117}{0.1170} = 5.99\ldots \times 2 = 12 \qquad \text{aluminum sulfate}$$

7. Find the % composition for each atom in 2(a) above.

Al_2O_3 assume one mole of Al_2O_3 which is 2 moles of Al and 3 moles of O

$2 \text{ mol Al} \times \frac{26.98 \text{g Al}}{1 \text{ mol Al}} = 53.96 \text{ g Al}$; $53.96\text{g} + 47.997\text{g} = 101.96 \text{ g total}$; $\frac{53.96 \text{g Al}}{101.96 \text{ g total}} \times 100\% = 52.92\% \text{ Al}$

$3 \text{ mol O} \times \frac{15.999 \text{ g O}}{1 \text{ mol O}} = 47.997 \text{ g O}$; $\frac{47.997 \text{ g O}}{101.96 \text{ g total}} \times 100\% = 47.074\%$

8. Write the name of a nitrogen-oxygen compound that has a molecular mass of 152 g/mol and contains 36.84% N.

36.84% N; 100 - 36.84% N = 63.13% O Assume 100 g so % become g

$36.84\% \text{ N} = 36.84\text{g N} \times \frac{1 \text{ mol N}}{14.01 \text{ g N}} = 2.631 \text{ mol N}$; $\frac{2.631 \text{ mol}}{2.631 \text{ mol}} = 1.0 \times 2 = 2$

$63.13\% \text{ O} = 63.13\text{g O} \times \frac{1 \text{ mol O}}{16.00 \text{ g O}} = 3.946 \text{ mol O}$; $\frac{3.946 \text{ mol}}{2.631 \text{ mol}} = 1.5 \times 2 = 3$ EF = N_2O_3

Mass of EF = 2(14.01) + 3(16.0) = 76.02g/mol

Molecular mass = 152 g/mol ÷ 76.02 = 1.99; molecular formula = 2 x empirical formula = N_4O_6

Answer: tetranitrogen hexaoxide

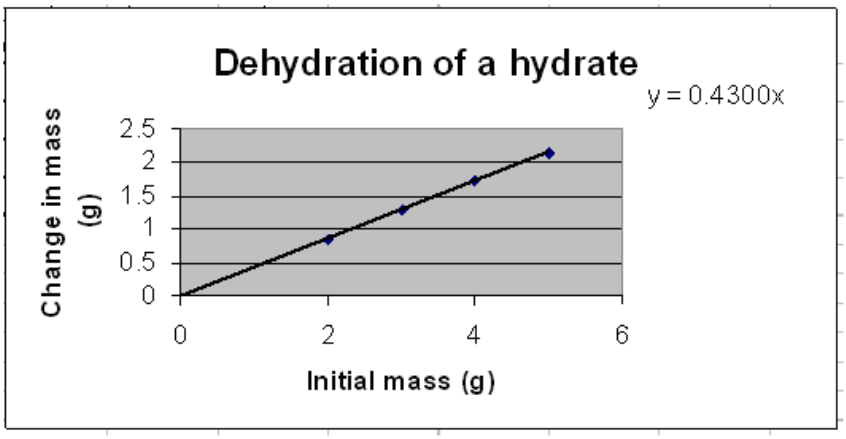
9. You completed the hydrate lab with a magnesium chloride hydrate (X is unknown). Before heating you had 5.000 g of sample (not including the weighing dish); after heating, the product had a mass of 2.848g. You wanted to be certain that you got accurate lab data, so you ran 3 more trials and got the following data: initial mass: 4.000g, final mass: 2.278g; initial mass: 3.000g, final mass: 1.705g; initial mass: 2.000g, final mass: 1.138g.

   a. Draw a graph for your data. Include the slope of the line for which b=0. Show how you arrived at the slope. Label your axes and include a title and best fit line.

Initial Mass (g)	Change in mass (g)	Final Mass (g)
5.000	2.152	2.848
4.000	1.722	2.278
3.000	1.295	1.705
2.000	0.862	1.138

Slope = $\frac{y_2-y_1}{x_2-x_1} = \frac{2.152\text{g}-0.862\text{g}}{5.000\text{g}-2.000\text{g}} = \frac{1.290}{3.000} = 0.4300$

NOTE: you must show your calculation for slope and equation for the line: **y = 0.4300 x**



   b. What is the percent water in the hydrate?

2.152 g = water lost (trial 1); 5.000 g = initial hydrate mass

$\frac{2.152 \text{ g } H_2O}{5.000\text{g hydrate}} \times 100\% =$ **43.04% H_2O**

c. Write the empirical formula for the hydrate?

43.04% H_2O; 100-43.04 = 56.96%

$$43.04\text{g } H_2O \times \frac{1 \text{ mol } H_2O}{18.02 \text{ g } H_2O} = 2.388 \text{ mol } H_2O; \quad \frac{2.388 \text{ mol}}{0.5983 \text{ mol}} = 3.991; \quad \boxed{MgCl_2 \bullet 4H_2O}$$

$$56.96\text{g } MgCl_2 \times \frac{1 \text{ mol } MgCl_2}{95.21 \text{ g } MgCl_2} = 0.5983 \text{ mol } MgCl_2; \quad \frac{0.5983 \text{ mol}}{0.5983 \text{ mol}} = 1$$

d. Does your slope agree with your percent? Should it? Explain your answer.

Slope = 43.00%, percent (trial 1) = 43.04%; they are the same to 3 sig figs and they *should* be the same b/c the slope represents the AVERAGE percent composition of the 4 trials.

10. How many grams of water are present in 20. g of $NiCO_3 \bullet 3H_2O$?

Percent comp of water in $NiCO_3 \bullet 3H_2O$: part H_2O ÷ whole $NiCO_3 \bullet 3H_2O$

$$\frac{3 \times 18.02 \text{ g/mol } H_2O}{(3 \times 18.02 \text{ g/mol } H_2O) + 58.69 \text{ g/mol Ni} + 12.01 \text{ g/mol C} + (3 \times 16.00 \text{ g/mol O})} \times 100\%$$

$$\frac{54.06 \text{ g/mol } H_2O}{172.8 \text{ g/mol } NiCO_3 \bullet 3H_2O} \times 100\% = 31.28\%$$

$$20.\text{g} \times 0.3128 = \boxed{6.3 \text{ g}}$$