***Study Guide for the Unit Test on Chapters 2-7! The test will be on _____***

**Topics:** **I.** Mole conversions: Converting between atoms, molecules, grams, and moles.

**II.** Protons, neutrons, and electrons, atoms, ions, and the periodic table.
Know the mass and charge of an individual proton, neutron, or electron, and apply this knowledge to problems.
Know the difference between an atom and ion. How do ions form: how many electrons must be lost or gained to form an ion with a given charge?
Where are the metals and nonmetals on the periodic table? Do metals tend to gain or lose electrons when they form ions? Do nonmetals tend to gain or lose electrons when they form ions?
For the "A" columns on the periodic table, how many electrons do elements in these column lose or gain (which one?) to form ions, and why?

~~**III.** Isotopes: How are isotopes of a given element the same? How are they different?~~
~~Know how to calculate atomic mass using a weighted average.~~

**IV.** Percent composition:
Given a formula, compute the percent composition of each element (use the periodic table masses.)
Use these percents to solve problems.
Use lab data to calculate the percent composition of an element in a compound.

**V.** Empirical Formula: If you are given the mass (or percent by mass) of each element in a compound, can you calculate the empirical formula? Given the rough molecular weight, can you covert an empirical formula to a molecular formula?

**VI.** Ionic and Covalent Bonding, Formula Writing/Naming, ~~and Lewis Dot Structures~~
Be able to classify a compound as ionic or covalent if given the name or formula.
Be able to write a compound's formula (if given the name), and write the name (if given the formula.)
What is happening with the electrons in each type of bonding? Are they gained/lost/shared?
If gained or lost, which type of element gains and which loses? (This is related to section **II**, above.)
~~Lewis Dot Structures! Be able to draw them and answer concept questions about them.~~

**VII.** Significant figures and Scientific Notation: Be able to report the answer to the correct number of significant figures when you add, subtract, multiply, or divide, or some combination of these.

~~**VIII.**Density: Know the formula for density (D = m/V) and be able to calculate density (including water displacement problems). Solve for D, m, or V if given the other two variables. (Remember that density can be used as a conversion factor, for example if the density is 1.26 g/mL, then 1.26 g = 1 mL for that substance. )~~

**IX.** Unit conversions, including converting square units and cubic units.

**Worksheets to study:**
3.0, ~~3.1, 3.2~~, 3.3, 6.0, 6.1, 6.2, 6.3, 2.0, 2.1, 2.2, 2.3, 7.0 part I, 7.0 part II, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6
See also WS 6.6, which had practice problems for your formulas, sig figs, and conversions quiz!
**Labs to study:** ~~Density Lab,~~ Silver Nitrate Lab, Magnesium Oxide Lab.
**The answer key to the study guide is here:** https://blogs.4j.lane.edu/hocken_s

**I. Mole Conversions** **1a.** What is the molar mass of Calcium phosphate; $Ca_3(PO_4)_2$?
**b.** What is the mass of 0.123 moles of calcium phosphate?
**c.** Convert 5.0 grams of calcium phosphate into moles.
**2a.** Convert 100.0 grams of copper (II) nitrate to moles.
**b.** Convert $1.0 \times 10^{22}$ chlorine molecules into moles of chlorine gas.
**c.** Find the mass of $1.0 \times 10^{22}$ chlorine molecules.
**d.** How many atoms are in $1.0 \times 10^{22}$ chlorine molecules?

**3.** What is the mass of one Cobalt atom, in grams?

**4a.** Convert 8.4 grams of sulfur dioxide gas into molecules.
**b.** How many total atoms are in the 8.4 grams of sulfur dioxide?
**c.** What is the mass of $4.0 \times 10^{23}$ molecules of $P_2O_5$?
**d.** How many atoms are in the above sample (in c)?
**e.** How many moles of $P_2O_5$ are in the above sample (in c/d)

## II. Protons, Neutrons, Electrons, Periodic Table

**5a.** What is the difference between an atom and an ion?
**b.** How many electrons are lost/gained when a calcium atom forms an ion?_____
**c.** How many electrons are lost/gained when a phosphorus atom forms an ion? _____
**d.** How many electrons must an aluminum ion gain or lose in order to become an aluminum atom? _____
**6a.** Which column on the periodic table contains elements that don't tend to bond?_____
**b.** Which elements in column IA form ions, what is the charge on the ion?_____
What about elements in IIA?_____ IIIA?_____ VA_____ VIA_____ VIIA_____

| **8.** | Mass # | Symbol | # of protons | # of electrons | # of neutrons | Charge |
|---|---|---|---|---|---|---|
| **a.** | _____ | $^{192}Ir^{+3}$ | _____ | _____ | _____ | _____ |
| **b.** | 80 | _____ | _____ | 36 | _____ | -2 |
| **c.** | _____ | _____ | _____ | 74 | 115 | +4 |
| **d.** | 131 | _____ | _____ | 54 | 78 | _____ |

**e.** An ion has a mass number of 140, and has 83 neutrons and 54 electrons. Write the symbol of the ion (same style as in a-d).
**f.** A lead atom lost two electrons to form an ion. This lead isotope has 128 neutrons. Write the symbol of the ion.
**g.** If a tellurium atom with 73 neutrons gains 2 electrons, write the symbol for what forms.

**9a.** Identify each element as a metal or a nonmetal, and indicate whether the element will be more likely to gain or lose electron(s) when it forms an ion. P Li Zn Cl Ca

**b.** Of the above elements, which one is LEAST likely to obtain a noble gas configuration when it forms an ion?
**c.** Find a pair of ions in 9a that could bond together to form an ionic compound.
**d**. Find a pair of ions in 9a that could bond together to form a covalent compound.

## III Isotopes.

~~**10.** Chlorine has two common isotopes. 75.77% of chlorine atoms have a mass of 34.968853 amu, and the remainder of Cl atoms have a mass of 36.965903 amu.~~
~~a. What is the "natural abundance" of the Cl-37 isotope?~~
~~b. Calculate the atomic mass of chlorine.~~
~~c. Write the symbol for each of these chlorine isotope, in the same style as in #8.~~
~~d. How are the two isotopes of chlorine the same? Give at least two answers.~~
~~e. How are the two isotopes of chlorine different? Give at least two answers.~~

~~**11.** 99.63% of nitrogen atoms have a mass of 14.003074, and the remainder have a mass of 15.000108 amu. Calculate the atomic mass of nitrogen.~~
~~**12.** (This type of question would be in the extra credit section if given on a test.)~~
~~Boron has only two isotopes: B-10 (10.012936 amu), and B-11 (11.009305 amu). Use these masses, along with info from the periodic table, to determine the natural abundance percents for each boron isotope.~~

## IV. Percent Composition

**13a.** Determine the percent composition of iron in $Fe_2(CO_3)_3$.
**b.** How many milligrams of iron are in a 250 mg sample of iron (III) carbonate?

**14.** A chemist has 150.2 grams of silver nitrate. He plans to extract the silver from the silver nitrate using a physical/chemical change (which is it?). How many grams of silver can be extracted from this silver nitrate?

**15a.** A different chemist has a sample of gold (III) nitrate, from which she plans to extract gold. If she plans to extract 50.0 grams of gold, what mass of gold nitrate would she need to start with?
**b.** Another chemist did an experiment to determine the percent gold in gold (III)nitrate. Gold nitrate was added to water and dissolved, and then reacted with zinc in order to extract the gold from gold (III) nitrate. Data was as follows: Mass of empty flask: 23.22 g
Mass of flask and gold nitrate (before adding water): 25.12 g
Mass of empty beaker: 33.30 g
Mass of beaker and dry gold crystals collected after the reaction: 34.26 g
Use the data to determine the percent gold (by mass) in the compound gold nitrate.
**c.** Calculate the percent error for the percent gold.

## V. Empirical Formula

**16.** What is the empirical formula of $C_4H_8$_____ $C_4H_{10}$_____ $C_6H_{14}O_4$_____

**17.** "Hexane" is an organic liquid that contains only carbon and hydrogen. It is 83.6% carbon by mass. The molar mass of the compound is between 75 and 100 amu. Determine a) the empirical formula b) the molecular formula and c) the molar mass of hexane.

**18.** Phenolphthalein is an acid-base indicator; it is pink in basic solutions and colorless in acidic and neutral solutions. Phenolphthalein is 75.5% carbon, 4.43 % hydrogen, and 20.1 % oxygen, by mass. It has a molar mass of roughly 300 amu.
Determine a) the empirical formula, and b) the molecular formula of phenolphthalein.

## VI. Formula Writing and Naming

**19.** Determine the name (if the formula is given) or formula (if the name is given) of the following substances.

| | | | |
|---|---|---|---|
| potassium nitride | lead (IV) sulfate | $NH_4NO_2$ | helium |
| $NO_2$ | $Ca(ClO_2)_2$ | Iodine | silver carbonate |
| $BaI_2$ | magnesium phosphide | SnO | $B_2Br_4$ |
| $PI_3$ | Iron (II) peroxide | phosphorus pentabromide | $Na_2O$ |
| aluminum sulfide | $CuC_2H_3O_2$ | $S_2F_{10}$ | $Na_2O_2$ |
| $Cl_2O_7$ | $Li_2Cr_2O_7$ | ferric chromate | bromine |
| aluminum thiosulfate | $Br_2O$ | $N_2O_5$ | $As_4O_6$ |

**20.** For each of the first six compounds in #19 (the first 6 in the left hand column), answer these questions:
a. Is the compound ionic or covalent?
b. When elements bond to form the compound, will the elements need to gain, lose, or share electrons to form the bond?
c. If the elements must gain or lose electrons to form the compound, which element will lose electrons in order to bond, and which will gain electrons in order to bond?

**VII. Significant figures and Scientific Notation:**

**21.** Perform these operations and report the answer to the correct number of significant figures.

a. 1400 + 188
b. 1400.2 +188
c. 13.4 x 2111.11
d. 120/6.33
e. (3622 $cm^3$)(8 $g/cm^3$)
f. 13.4 + 2111.11
g. 600./6.0
h. 12.2 x 0.0011
i. 600./125

**IX. Unit conversions**

**24.** Make the following conversions. (See chart at the top of WS 2.3. A similar chart will be given on the test)

a. 340 nm to cm
b. 1.6 x $10^{-2}$ kilometers (km) to cm
c. 0.872 $m^3$ to $cm^3$
d. 3650 inches to km
e. 0.00040 micrograms per second to grams per hour.
f. 0.55 liters of liquid to $cm^3$
g. 30.0 miles per hour to meters per second
i. 0.500 kg copper to $cm^3$, if the density is 8.90 $g/cm^3$
j. 8450 $cm^3$ to $ft^3$
k. 4.4 liters of saltwater to grams, if the density is 1.1 g/mL
l. 0.300 square feet to $cm^2$.

***More Mole Conversion Practice!***

**1.** Propane has the formula $C_3H_8$.
**a.** Find the molar mass of propane. Report units in two possible ways.
**b.** If a propane tank contains 13500 grams of propane, how many molecules of propane are in the tank?
**c.** Convert 4.0 x $10^{22}$ propane molecules to moles.
**d.** How many total atoms are in the 4.0 x $10^{22}$ molecules of propane?

**2. a.** What is the mass of 3.00 x $10^{21}$ uranium atoms?
**b.** Convert 345 grams of bromine to molecules.
**c.** How many hydrogen peroxide molecules are in 0.0015 moles of hydrogen peroxide?
**d.** 1 cup of table sugar (sucrose; $C_{12}H_{22}O_{11}$) has a mass of approximately 290 grams. How many sucrose molecules are in this mass?
**e.** How many atoms are in 1.00 x $10^{20}$ sucrose molecules?
**f.** What is the mass (in grams) of 1 molecule of sucrose?

**3. a.** Determine the molar mass of copper (II) phosphate; $Cu_3(PO_4)_2$
**b.** Convert 32.21 grams of copper (II) phosphate to moles.
**c.** What is the percent composition (by weight) of phosphorus in this compound?
**d.** If 3.00 grams of phosphorus were extracted from copper (II) phosphate, how many grams of copper (II) phosphate were initially present?
**e.** How many grams of phosphorus can be extracted from 30.0 grams of copper (II) phosphate?

**4.** Determine the empirical formula of $C_{20}H_{36}O_8$
**5.** A compound is 53.31% carbon, 35.51% oxygen, and 11.12% hydrogen, by weight. Determine the empirical formula.

**6.** A compund is 39.34% carbon, 8.25% hydrogen, and 52.41% oxygen by weight. The molecular weight of the compound is between 225 and 250 amu. **a.** Determine the empirical formula. **b.** Determine the molecular formula.

**Answers to the mole conversion practice:**

1a. 44.0962 amu or 44.0962 g/mole <---- notice it is g/mole, not just g.
1b. 1.84 x $10^{26}$ molecules c. 0.066 moles d. 4.4 x $10^{23}$ atoms
2. a. 1.19 g b. 1.30 x $10^{24}$ molecules c. 9.0 x $10^{20}$ molecules d. 5.1 x $10^{23}$ molecules.
2e. 4.5 x $10^{21}$ atoms 2f. 5.69 x $10^{-22}$ g
3. a. 380.581 amu or g/mole b. 0.08463 moles c. 16.2771% P d. 18.4 g e. 4.88 g
4. $C_5H_9O_2$ 5. $C_2H_5O$ 6a. $C_2H_5O_2$ b. $C_8H_{20}O_8$