The Mole: No, Not That One! *Chapter 11*

I. Units of Importance

A. Counting Atoms

1. The atom is too stinkin' small to count in real life!!!

2. Amedeo Avogadro made life a little easier.

3. He defined a new unit called

B.

1. A counting unit:

a. 1 dozen =

b. 1 pair =

c.

2. This number is known as

3. Thus,

4. Examples

a. 0.25 moles of grains of rice were spilled on the floor, how many grains of rice would have to be picked up?

b. If your head contained $2.5x10^{23}$ strands of hair, how many moles of hair are on your head?

c. 0.43 moles of CO_2 contains how many molecules of CO_2?

d. 3.4×10^{22} formula units of NaCl equals how many moles of NaCl?

C.

1.

a. This measurement is based on

b.

c. Thus,

d. The units of molar mass are

2. Number on the PT can mean either the *OR the*

a. Example: sodium: one atom = *one mole =*

b. Since one mole atoms = 6.02×10^{23} atoms, *6.02×10^{23} atoms of sodium =*

3. Molar mass of a compound:

a.

i. sodium chloride =

ii. aluminum oxide =

iii. calcium acetate =

4. Converting between units:

a. You will be converting between moles, mass and units (units meaning atoms, molecules or formula units)

b. Use the factor label table to do so!

5. Examples:

a. How many moles are in 89.06 grams of sodium?

b. How many atoms are in 9.01 moles of copper?

c. How many grams is 3.9×10^{26} formula units of potassium nitride?

D. How are they related?

Use this to convert from one unit to another unit using dimensional analysis (factor label table)

II. Formula Calculations

A.

1. *Gives the relative amount (by mass) of each element in a compound. Steps:*
   a. *Write out the formula and determine the number of each atom that is present.*
   b. *Calculate mass of each element.*
   c. *Calculate the mass of the entire compound.*
   d. *Divide mass of <u>each element</u> by total mass of compound and multiply by 100 x %.*
   e. *When calculating this, you need to calculate a % for EACH element in the formula.*
2. *Equation for step d:*

3. *Example: Calculate the percent composition of water, H_2O.*

B.

1.
   a. *Which of the following is an empirical formula? Fe_2O_4, FeO_2, Fe_3O_6*
2. *Steps:*
   a. *If percentages are given, change each percentage to grams (Ex. 87.3%=87.3g).*
      i. *NOTE: if masses are given, this step can be skipped.*
   b. *convert each mass to moles (using the molar mass of the element).*
   c. *divide each answer from step b by the smallest number of moles that you got in step b.*
   d. *If <u>any</u> of the ratios from step c are decimals, multiply <u>all</u> the ratios by the same number to get whole number ratios.*
3. *Poem to help you remember:*

4. *Example: What is the empirical formula of a hydrocarbon that is composed of 80% carbon?*

C.

1. $(XY)_n$

2. Questions involving

3. Steps:

a. Complete all the steps as you did for EF.

b. Find the molar mass of the EF.

c. Divide the given molar mass from the problem by the mass of the EF (from step b) to find "n".

d. Multiply "n" by the subscripts of the EF to obtain the MF.

e. Note: The empirical formula will ALWAYS be less than or equal to the molecular formula. If it isn't, you did something wrong!

4. Example What are the empirical and molecular formulas of a compound that consists of 92.26% carbon and 7.74% hydrogen, if its molar mass is 26.02 g/mol?

5. Example: A compound is composed of 7.20 grams of carbon, 1.20 grams of hydrogen and 9.60 grams of oxygen. The molar mass of the compound is 180 grams. Find the empirical & molecular formulas of this compound.