Chapter 8: Chemical Composition

These Notes are to <u>SUPPLIMENT</u> the Text, They do NOT Replace reading the Text Material. Additional material that is in the Text will be on your tests! To get the most information, <u>READ THE CHAPTER</u> prior to the Lecture, bring in these lecture notes and make comments on these notes. These notes alone are NOT enough to pass any test!

The author is providing these notes as an addition to the students reading the text book and listening to the lecture. Although the author tries to keep errors to a minimum, the student is responsible for correcting any errors in these notes.

Atomic Mass $C + O_2 \rightarrow CO_2$ 1 atom plus 1 Molecule = 1 Molecule.

1 Atomic Mass Unit = 1 amu = 1.66×10^{-24} g = @ weight of a proton & neutron

Atomic weight is the average of the isotopes

Carbon 3 isotopes C_{12}, C_{13}, C_{14} the AVERAGE AMU = 12.01

Hydrogen = 1.008 Carbon = 12.01 Nitrogen = 14.01 Oxygen = 16.00

Sodium = 22.99 Aluminum = 26.98"

What is the mass of 75 atoms of Aluminum

75 Al At * 26.98 amu / Al Atom = 2024 amu

Common Laboratory unit of measurement is the **gram [we usually use the milligram – mg, or 0.001 g]**

Mole **Avogadro's number** $6.022 \times 10^{+23}$ = number of carbon atoms in 12.01 g C

- 1 mole of marbles covers the earth to a depth of 50 miles
- Ratio of Sample Masses = Ratio of Atomic Masses
- A sample of an element with a mass equal to that elements average atomic mass express in grams contains 1 mol of atoms

<u>ONE MOLE</u> of atoms of a sample = it's Average Atomic Weight in grams

C	$+ O_2$	$\rightarrow$	CO_2

Do as 1 Atom, 10 Atoms, 1 Mole - then the weight in grams.

$2 H_2$	$+ O_2$	$\rightarrow$	$2 H_2O$
1 Molecule	+ 2 Molecule	$\rightarrow$	2 Molecule
1 Mole	+ 1 Mole	$\rightarrow$	2 Mole
2.016 g	32 g		66.016 g

In a lab we usually deal in milli-moles and not moles [moles are usually too big of a value to deal with]

# of atoms? Calcul # of Atoms 5.68 mg of Si. It's Amu = 28.09 g/mol

5.68 mg = 5.68×10^{-3} g

5.68×10^{-3} g / 28.09 g/mole = 2.02×10^{-4} mole

2.02×10^{-5} mole * 6.022×10^{23} atoms / mole = $1.22 \times 10^{+20}$ Si Atoms"

Molar Mass

Mass in grams of 1 mole of the substance = FORMULA WEIGHT

Do molar mass of H_20, NaCl, $CaCo_3$,$NaHCO_3$, Na_2CO_3, Na_2SO_4

Percent Composition - Mass Percent

Go through examples of formulae % Composition Ethanol = C_2H_5OH

C = 2 mole x 12.01 g/mole = 24.02 g

H = 6 mole x 1.008 g/mole = 6.048 g

O = 1 mole x 16.00 g/mole = 16.00 g Total = 46.07 g

Weight Percent of Carbon = $\frac{24.02}{46.07}$ * 100 % = 34.73%

Mass Percent = Weight Percent = $\frac{\text{Mass of element}}{\text{Mass of Compound}}$ * 100 %

Percent Comp

0.2015g sample = 0.0806 g C + 0.01353 g H + 0.1074 g O_2

Convert to moles

$\frac{0.0806 \text{ g C}}{12.01 \text{ g/mole}}$ = 0.00671 moles C * $6.022 \times 10^{+23}$ = $4.04 \times 10^{+21}$ Atoms C

$\frac{0.01353 \text{ g H}}{1.008 \text{ g / mole}}$ = 0.01342 mole H * $6.022 \times 10^{+23}$ = $8.08 \times 10^{+21}$ Atoms H

$\frac{0.1074 \text{ g O}}{16.00 \text{ g / mole}}$ = 0.006713 mile O * $6.022 \times 10^{+23}$ = $4.043 \times 10^{+21}$ Atoms O

1. The compound has the same number of Carbon and Oxygen
2. The compound has twice as many H as C or O

The relative number are CH_2O. This sugar is $C_6H_{12}O_6$ = $(CH2O)_6$

Empirical Formula Smallest whole number ratio of atoms

Molecular Formula Gives the composition of the molecules present

Sugar = Glucose = $C_6 H_{12} O_6$ = $(C\ H2\ O)_6$. Discuss ()"

[C 57.14 %, H 4.76 %, O 2.4 %, mw = 42 or 84]

Empircal Formula

1. Detn mass of each element in grams
2. Detn # of moles of each
3. Divide # of moles by smallest.
4. Mult the numbers by the smallest integer that will convert to whole numbers.

0.2636 g Ni heated in air to form 0.3354 g of nickel oxide

0.3354 - 0.2636 = 0.0718 g O

0.2636 g Ni / 58.69 g/M = 0.004491 Mole Nickel

0.0718 g O / 16.00 g/M = 0.00449 Mole Oxygen

Empirical Formula = Ni O

4.151g of Aluminum reacts with 3.692 g of O_2 to form Aluminum Oxide

4.151 g Al / 26.98 g/mole = 0.1539 moles / 0.1539 = 1 of Al

3.692 g O / 16.00 g/mole = 0.2308 moles / 0.1539 = 1.5 of O

mult by 2 **Empirical Formula is** = $Al_2 O_3$

V + O = VO VO = 0.6330 g [0.6330 g - 0.3546 g V = 0.2784 g O]

0.3546 g V / 50.94 g/mole = 0.006961 moles / 0.006961 = 1

0.2784 g O / 16.00 g/mole = 0.01740 mole O / 0.006961 = 2.5

Empirical Formula is mult by 2 = $V_2 O_5$

Formula from percent Composition

Cisplatin is a Platinum Compound

65.02% Platinum / 195.1 g / mole = 0.3333 mole Pt / 0.3333 = 1 mole Pt

9.34% Nitrogen / 14.01 g / mole = 0.667 mole N / 0.3333 = 2.00 mole N

2.02% Hydrogen / 1.008 g / mole = 2.00 mole H / 0.3333 = 6.01 mole H

23.63% Chlorine / 35.45 g / mole = 0.6666 mole Cl / 0.3333 = 2.000 mile Cl

Empirical Formula is Pt N_2 H_6 Cl_2

Molar Mass is known, Determine the molecular formulae

Emp Form = $P_2 O_5$ has a molar mass of 283.88, what is the molecular formula

2 * P 30.97 = 61.94 5 * O 16.00 = 80.00 Mw = 141.94 g/mole

283.88g / 141.94 = 2, therefore the molecular formula is $P_4 O_{10}$

10 g of Al is how many moles? How many Atoms? Al = 26.98

2.000g Fe reacts with oxygen to form 2.573 g Iron Oxide, what is the molecular formulae?

4.550 g Co + 5.475 g Cl → $CoCl_2$

Phosphoric Acid:	0.3086g H 3.161g P 6.531g O	→ $H_3 PO_4$	**Prove It**
pDichlorobenzene	5.657g C 3.165g H 5.566g Cl	→ $C_3 H_2 Cl$	**Prove It**
Amino Acid Glycine	32.00% C, 6.71 % H, 18.66% N	→ $C_2 H_5 O_2 N$	**Prove It**
Copper Compound	66.75% Copper 10.84% Phosphorous 22.51% Oxygen	→ $Cu_3 PO_4$	**Prove It**

How many Moles are there in:

21.4 mg of Nitrogen Dioxide

1.56 g of Copper (II) Nitrate

2.47 g of Carbon Disulfide

5.04 g of Aluminum Sulfate

2.99 g of Lead (II) Chloride

62.4 g of Calcium Carbonate

2.5 g of Ammonium Nitrate

2.5 Tons of Ammonium Nitrate

628,340 kg of Liquid Oxygen

106,261 kg of Liquid Hydrogen