Homework:

Part I: Calculate the empirical formula for each of the following.

1. What is the empirical formula of a compound that is 25.9% nitrogen and 74.1% oxygen?

N: 25.9 ÷ 14.01 = 1.85 ÷ 1.85 = 1 x 2 = 2
O: 74.1 ÷ 16.00 = 4.63 ÷ 1.85 =2.5 x 2 = 5
N_2O_5

2. Determine the empirical formula of a compound that is composed of 88.8% O, 11.1% H.

O: 88.8 ÷ 16.00 = 5.55 ÷ 5.55 = 1
H: 11.1 ÷ 1.01 = 11.1 ÷ 5.55 = 1.98
OH_2 or **H_2O**

3. Magnetite is an iron ore with natural magnetic properties. It contains 72.5% Fe & 27.5% O. What is the empirical formula for magnetite?

Fe: 72.5 ÷ 55.85 = 1.30 ÷ 1.30 = 1 x 3 = 3
O: 27.5 ÷ 16.00 = 1.72 ÷ 1.30 = 1.32 x 3 = 4
Fe_3O_4

4. An inorganic chemical used to treat burn patients is made up of silver, nitrogen, and oxygen in corresponding percentages of 78, 10, and 12. Calculate the empirical formula of this substance.

Ag: 78 ÷ 107.87 = 0.72 ÷ 0.71 = 1.0 x 1 = 1
N: 10 ÷ 14.01 = 0.71 ÷ 0.71 = 1.0 x 1 = 1
O: 12 ÷ 16.00 = 0.75 ÷ 0.71 = 1.1 x 1 = 1
AgNO

5. Propane is a hydrocarbon composed of 81.8% carbon and 18.2% hydrogen. What is its empirical formula?

C: 81.8 ÷ 12.01 = 6.82 ÷ 6.82 = 1.00 x 3 = 3
H: 18.2 ÷ 1.01 = 18.2 ÷ 6.82 = 2.67 x 3 = 8
C_3H_8

6. What is the empirical formula of a compound that is sixty six percent calcium and the rest phosphorus?

Ca: 66.0 ÷ 40.08 = 1.65 ÷ 1.10 = 1.50 x 2 = 3.0
P: 34.0 ÷ 30.97 = 1.10 ÷ 1.10 = 1.00 x 2 = 2.0
Ca_3P_2

7. Gigi is given 14.0 grams of an oxide of iron and asked to determine the empirical formula of the oxide. She finds that the sample contains 9.8 grams of iron and 4.2 grams of oxygen. What answer did she get?

Fe: 9.8 ÷ 55.85 = 0.176 ÷ 0.176 =1.0 x 2 = 2
O: $\frac{4.2}{14.0}$ ÷ 16.00 = 0.263 ÷ 0.176 = 1.5 x 2 = 3
Fe_2O_3

Part II: Calculate the empirical and molecular formula for each of the following.

8. 2-Methylpropene is a compound used to make synthetic rubber. A sample contains 0.556 g of carbon and 0.0933 g of hydrogen. Determine its empirical formula. Determine the molecular formula if the molecular formula mass is 56 g/mol.

C: 0.556 ÷ 12.01 = .0463 ÷ .0463 = 1 **C: 1 x 12.01 = 12.01** **56 ÷ 14.03 = 4**
H: $\frac{0.0933}{0.6493}$ ÷ 1.01 = .0933 ÷ .0463 = 2 **H: 2 x 1.01 = 2.02**

CH_2 (empirical formula) $\longrightarrow$ **14.03 g/mol** $\longrightarrow$ $\boxed{C_4H_8}$

9. What is the empirical formula of a compound that contains 46.2% carbon & 53.8% nitrogen? What is its molecular formula if it has a molecular mass of 52 g/mol.

C: 46.2 ÷ 12.01 = 3.85 ÷ 3.84 = 1.00	**C: 1 x 12.01 = 12.01**	**52÷26.02 = 2**
N: 53.8 ÷ 14.00 = 3.84 ÷ 3.84 = 1.00	**N: 1 x 14.01 = <u>14.01</u>**	
CN (empirical formula) →	**26.02 g/mol** →	$\boxed{\mathbf{C_2N_2}}$

10. A compound has a percentage composition of 40.0% carbon, 6.71% hydrogen and 53.3% oxygen. What is the empirical formula? What is the molecular formula if the compound has a molecular mass of 180.0 g/mol.

C: 40.0 ÷ 12.01 = 3.33 ÷ 3.33 = 1.00	**C: 1 x 12.01 = 12.01**	**180.0 ÷ 30.03 = 6**
H: 6.71 ÷ 1.01 = 6.71 ÷ 3.33 = 2.02 →	**H: 2 x 1.01 = 2.02** →	
O: 53.3 ÷ 16.00 = 3.33 ÷ 3.33 = 1.00	**O: 1 x 16.00 = <u>16.00</u>**	
$\mathbf{CH_2O}$ (empirical formula)	**30.03 g/mol**	$\boxed{\mathbf{C_6H_{12}O_6}}$

11. Ascorbic acid, also known as vitamin C, has a percentage composition of 40.9% carbon, 4.58% hydrogen, and 54.5% oxygen. Its molecular mass is 176.1 g/mol. What is its molecular formula?

C: 40.9 ÷ 12.01 = 3.41 ÷ 3.41 = 1.00 x 3 = 3	**C: 3 x 12.01 = 36.03**	**176.1 ÷ 88.07 = 2**
H: 4.58 ÷ 1.01 = 4.58 ÷ 3.41 = 1.32 x 3 = 4	**H: 4 x 1.01 = 4.04**	
O: 54.5 ÷ 16.00 = 3.41 ÷ 3.41 = 1.00 x 3 = 3	**O: 3 x 16.00 = <u>48.00</u>** →	
$\mathbf{C_3H_4O_3}$ (empirical formula) →	**88.07 g/mol**	$\boxed{\mathbf{C_6H_8O_6}}$

12. Aspirin contains 60.0% carbon, 4.48% hydrogen, and 35.5% oxygen. It has a molecular mass of 180.0 g/mol. What are its empirical and molecular formulas?

C: 60.0 ÷ 12.01 = 5.00 ÷ 2.22 = 2.25 x 4 = 9	**C: 9 x 12.01 = 108.08**	**180.0 ÷180.16 = 1**
H: 4.48 ÷ 1.01 = 4.48 ÷ 2.22 = 2.02 x 4 = 8	**H: 8 x 1.01 = 8.08**	
O: 35.5 ÷ 16.00 = 2.22 ÷ 2.22 = 1.00 x 4 = 4	**O: 4 x 16.00 = <u>64.00</u>** →	
$\mathbf{C_9H_8O_4}$ (empirical formula) →	**180.16 g/mol**	$\boxed{\mathbf{C_9H_8O_4}}$

13. Find the molecular formula of a compound with percentage composition 26.7% P, 12.1% N, and 61.2% Cl and a molecular mass 695 g/mol.

P: 26.7 ÷ 30.97 = 0.861 ÷ 0.861 = 1.00 x 1 = 1	**P: 1 x 30.97 = 30.97**	**695 ÷ 115.88 = 6**
N: 12.1 ÷ 14.01 = 0.864 ÷ 0.861 = 1.00 x 1 = 1	**N: 1 x 14.01 = 14.01**	
Cl: 61.2 ÷ 35.45 = 1.72 ÷ 0.861 = 2.00 x 1 = 2	**Cl: 2 x 35.45 = <u>70.90</u>** →	
$\mathbf{PNCl_2}$ →	**115.88 g/mol**	$\boxed{\mathbf{P_6N_6Cl_{12}}}$

The Empirical Formula Rhyme:

Percent to Mass
Mass to mole
Divide by small
Multiply 'til whole