

Mole, Molecular Formula Review

- **One Mole =** _____
 - This is **Avogadro's number**.
- **Molar Mass:** The mass of one mole of a substance in grams.
- **Percent Composition:** Identifies the elements present in a compound as a mass % of the total compound mass

$$\% \text{ composition by mass} = \frac{\text{mass of part}}{\text{mass of whole}} \times 100$$

Practice:

Molecular Formula	Molar Mass of Compound	% Composition of Each Element
PbO₂	Pb: 1 x 207.22 = 207.22 O: 2 x 16.00 = 32.00 1 mole PbO₂ = 239.22 grams PbO₂	$\% \text{Pb} = \frac{207.22}{239.22} \times 100 = \mathbf{86.62\% \text{ Pb}}$ $\% \text{O} = \frac{32.00}{239.22} \times 100 = \mathbf{13.38\% \text{ O}}$
CrF₃		
Al₂(SO₄)₃		
KNO₃		

*Remember: multiply the subscripts when there is a parentheses

Molar Conversions: Show work using Dimensional Analysis!

1. How many grams are in 4.5 moles of sodium fluoride, NaF? _____

2. How many moles are in 98.3 grams of aluminum hydroxide, Al(OH)₃? _____

3. How many molecules are there in 450 grams of sodium sulfate, Na₂SO₄? _____

4. How many grams are there in 7.5×10^{23} molecules of sulfuric acid, H₂SO₄? _____

Empirical/Molecular Formula Review

- Empirical Formula = _____
- Molecular Formula = _____
- Remember: the empirical and molecular formula can be the same!

1. Determine the empirical formula of the given molecular formulas below

Molecular Formula	Empirical Formula	Molecular Formula	Empirical Formula
HgBr ₂		C ₈ H ₁₄	
C ₂ H ₆ O		C ₃ H ₆	

2. Determine the molecular formula based on the information given

a.

Molecular Formula		84.18 g/mol
Empirical Formula	CH ₂	

b.

Molecular Formula		110.98 g/mol
Empirical Formula	CaCl ₂	

c.

Molecular Formula		120.12 g/mol
Empirical Formula	CH ₂ O	

3. A compound has an empirical formula of CF₃ and a molar mass of 138.02 g/mol. What is the molecular formula of the compound?

Determining Empirical Formulas from Percent Composition Data:

Ex: Determine the empirical formula for a compound containing **74.0% carbon (C)**, **8.65% hydrogen (H)**, and **17.3% nitrogen (N)** by mass.

<p>1. Assume a 100 gram sample for the compound. The percent composition of each element will then be equal to the mass of the element found in the 100 g sample.</p> <p>Assume a 100 g sample: C: 74.0 % \rightarrow 74 g C in 100 g sample H: 8.65 % \rightarrow 8.65 g H in 100 g sample N: 17.3% \rightarrow 17.3 g N in 100 g sample</p>	<p>2. Convert grams \rightarrow moles for each element</p> <p>C: $74 \text{ g C} \times \frac{1 \text{ mol C}}{12.01 \text{ g C}} = 6.16 \text{ mol C}$</p> <p>H: $8.65 \text{ g H} \times \frac{1 \text{ mol H}}{1.01 \text{ g H}} = 8.56 \text{ mol H}$</p> <p>N: $17.3 \text{ g N} \times \frac{1 \text{ mol N}}{14.01 \text{ g N}} = 1.23 \text{ mol N}$</p>
<p>3. Simplify the mole ratio for each element by dividing each number (of moles) by the smallest # of moles</p> <p>C: $\frac{6.16}{1.23} = 5.01 \rightarrow 5$ H: $\frac{8.56}{1.23} = 6.96 \rightarrow 7$ N: $\frac{1.23}{1.23} = 1.00$</p>	<p>4. Use the smallest whole-number mole ratio as the subscripts for the empirical formula</p> <p>C: 5 H: 7 N: 1</p> <p>$\text{C}_5\text{H}_7\text{N}$</p>
<p>Note: If the simplified mole ratios are not all whole numbers, multiply by the smallest factor that will produce whole number subscripts</p>	

Practice:

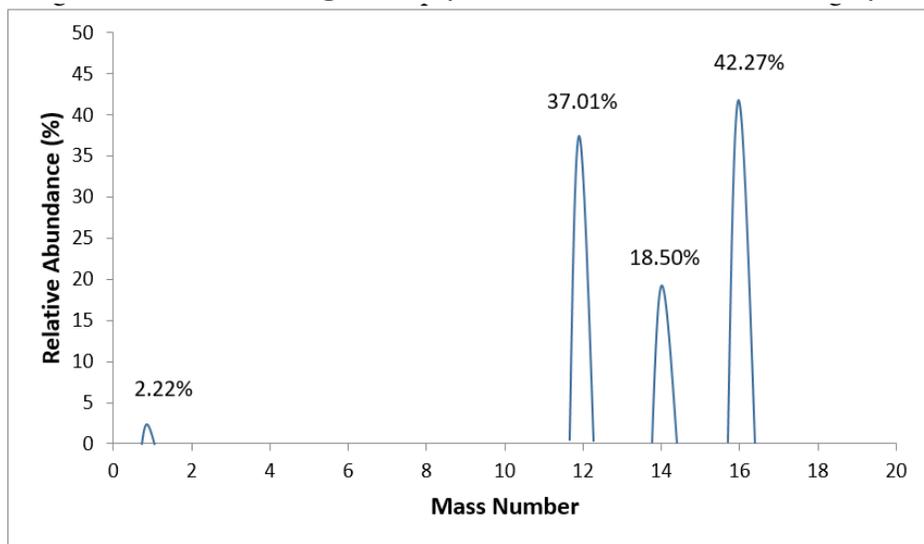
1. A compound is found to contain **63.52% iron** and **36.48% sulfur**. Determine the empirical formula
2. A combustion analysis determined that the molecule consisted of 54.5% carbon, 9.15% hydrogen, and 36.3% oxygen.
 - a. Determine the empirical formula.
 - b. Determine the molecular formula knowing that the molecular mass = 132.16g/mol.

Determining EF AND MF WS

1. Ascorbic Acid (vitamin C) is **40.92% Carbon, 4.58% Hydrogen and 54.50% Oxygen** by mass. Calculate the empirical formula of Ascorbic Acid.
2. An organic compound with a molecular mass of 140.0g/mol is 68.54% carbon, 8.63% hydrogen, and 22.83% oxygen.
 - a) What is the empirical formula?
 - b) What is the molecular formula of the compound?
3. NutraSweet is 57.14% C, 6.16% H, 9.52% N, and 27.18% O. Calculate the empirical formula of NutraSweet and find the molecular formula. (The molar mass of NutraSweet is 294.30 g/mol)
4. Caffeine is 49.5% carbon, 5.15% hydrogen, 28.9% nitrogen and 16.5% oxygen. The molecular weight is about 195g/mole. What is the molecular formula?

5. Cadaverine, produced by the action of bacteria on meat, is 58.55% C, 13.81% H, 27.40% N. MW = 102.2 g/mole. What is its molecular formula?

6. Given the following mass spec data, determine the empirical formula of the compound.



What is the molecular formula if the molar mass of the compound is 227.1 g/mol?