

Empirical Formula to Molecular Formula

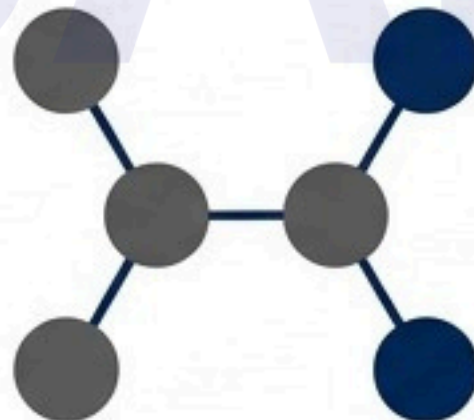
Concept 1.9.1 | Some Basic Concepts of Chemistry

Raw Data (%)

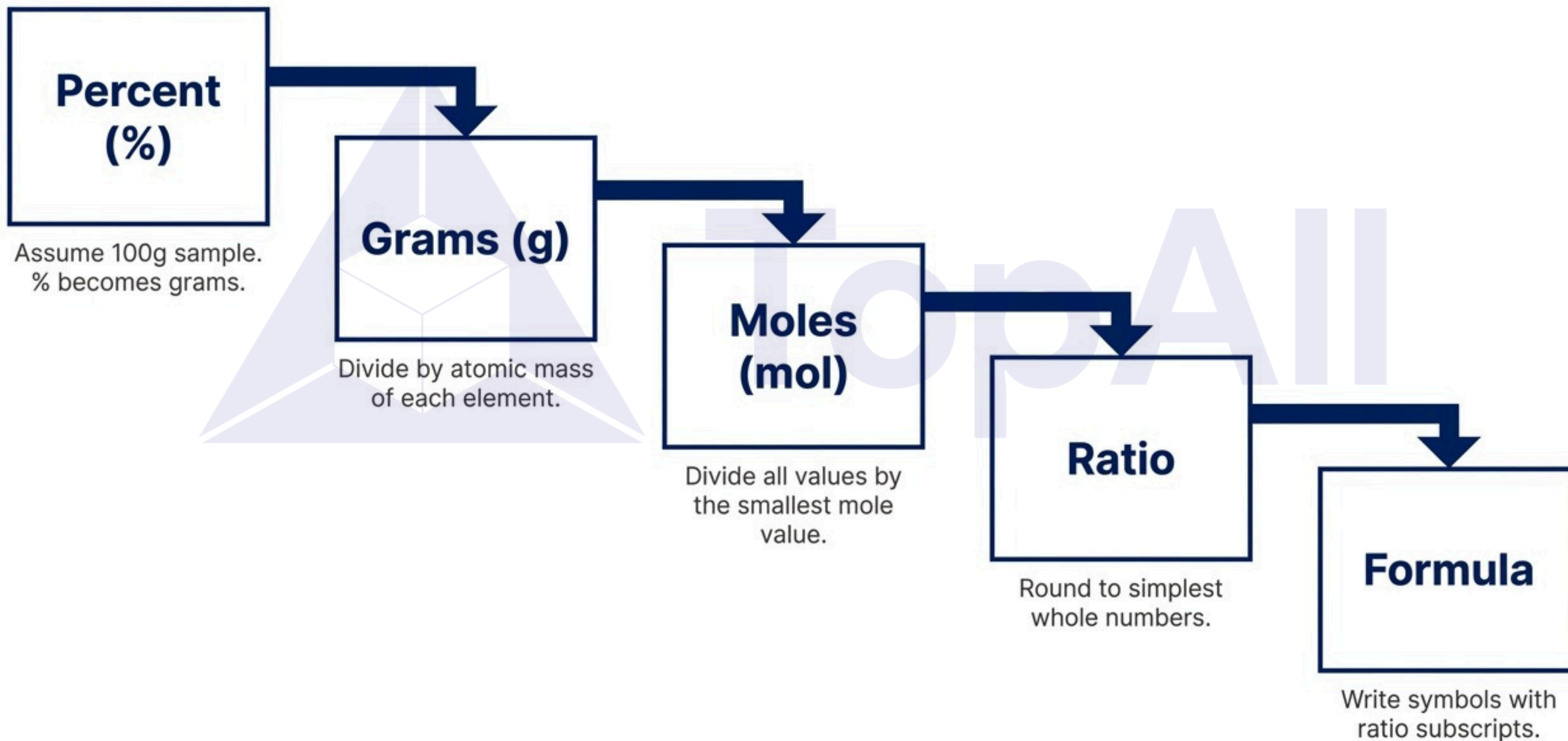
**Simplest Ratio
(Empirical)**

**Exact Count
(Molecular)**

Core Concept: Empirical vs. Molecular Formula

Empirical Formula	Molecular Formula
The simplest whole-number ratio of various atoms in a compound.	The exact number of different types of atoms present in a molecule.
Proportions. (The Base Recipe) 	Actual composition. (The Final Molecule) 
CH_2Cl (Ratio is 1:2:1)	$\text{C}_2\text{H}_4\text{Cl}_2$ (Actual atom count)

The 5-Step Formula-Building Process





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$$E=mc^2$$



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Formula Bank: Bridging Empirical to Molecular



The Multiplier (n)

$$n = \frac{\text{Molar mass}}{\text{Empirical formula mass}}$$

The Final Molecule

$$\text{Molecular formula} = (\text{Empirical formula}) \times n$$

Common Error

JEE TRAP



ALERT

Empirical formula is a MOLE ratio, NOT a MASS ratio.



Taking mass % directly as the subscript ratio. (e.g., 24g C and 4g H $\rightarrow$ C₂₄H₄)



You MUST convert mass to moles first! (24g C = 2 mol, 4g H = 4 mol $\rightarrow$ C₂H₄ $\rightarrow$ CH₂)

Mini Application: Determining C₂H₄Cl₂

Context: Molar mass = 98.96 g.

Element	1. Mass (g)	2. Moles (Mass / At. Mass)	3. Ratio (Divide by min)
C	24.27	$24.27 / 12.01 = 2.02$	$2.02 / 2.02 = 1$
H	4.07	$4.07 / 1.008 = 4.04$	$4.04 / 2.02 = 2$
Cl	71.65	$71.65 / 35.45 = 2.02$	$2.02 / 2.02 = 1$

Empirical Formula Result: CH₂Cl (Mass approx 49.48 g)

$$n = 98.96 / 49.48 = 2 \rightarrow \text{C}_2\text{H}_4\text{Cl}_2$$

Summary

✓ KEY TAKEAWAYS

- ✓ **Simplest Ratio First:** Always find the Empirical Formula before attempting to find the Molecular Formula.
- ✓ **Mass -> Moles:** Percentage composition must always be routed through atomic mass to find the true molar ratio.
- ✓ **Exact Formula Second:** Use the integer multiplier (n) derived from the molar mass to scale up to the exact Molecular Formula.



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