

From Identity to Proportion

The transition from Qualitative to Quantitative Analysis.

What is it?



Determines the presence of elements.

Example: Lassaigne's Test confirms the unknown organic compound contains Carbon, Hydrogen, and Nitrogen.

How much is it?



Determines the precise mass percentage of constituent elements from a known mass of the sample.

Example: Estimation methods reveal the compound is exactly **60% C**, **5% H**, and **35% N** by mass.

The Ultimate Goal: Organic chemistry relies on quantitative analysis to provide the raw numerical data required to deduce a molecule's exact chemical formula.

The Universal Gravimetric Engine

Every estimation formula relies on the same core principle of mass percentage.



$$\% \text{ Element} = \left(\text{Stoichiometric Factor} \right) \times \left(\text{Experimental Yield} \right) \times 100$$

$$\% \text{ Element} = \left(\frac{\text{Atomic Mass of Element in Product}}{\text{Molar Mass of Product}} \right) \times \left(\frac{\text{Mass of Product formed}}{\text{Mass of Organic Compound}} \right) \times 100$$

What fraction of the target element is locked inside the precipitate or gas?

What fraction of the original organic sample was successfully converted into the product?

By understanding this single fundamental framework, students can derive the formula for Carbon (CO_2), Hydrogen (H_2O), Halogens (AgX), Sulphur (BaSO_4), and Phosphorus ($\text{Mg}_2\text{P}_2\text{O}_7$) without pure memorization.



You've Learned the Theory. Let's Test Them Now.

$$E=mc^2$$



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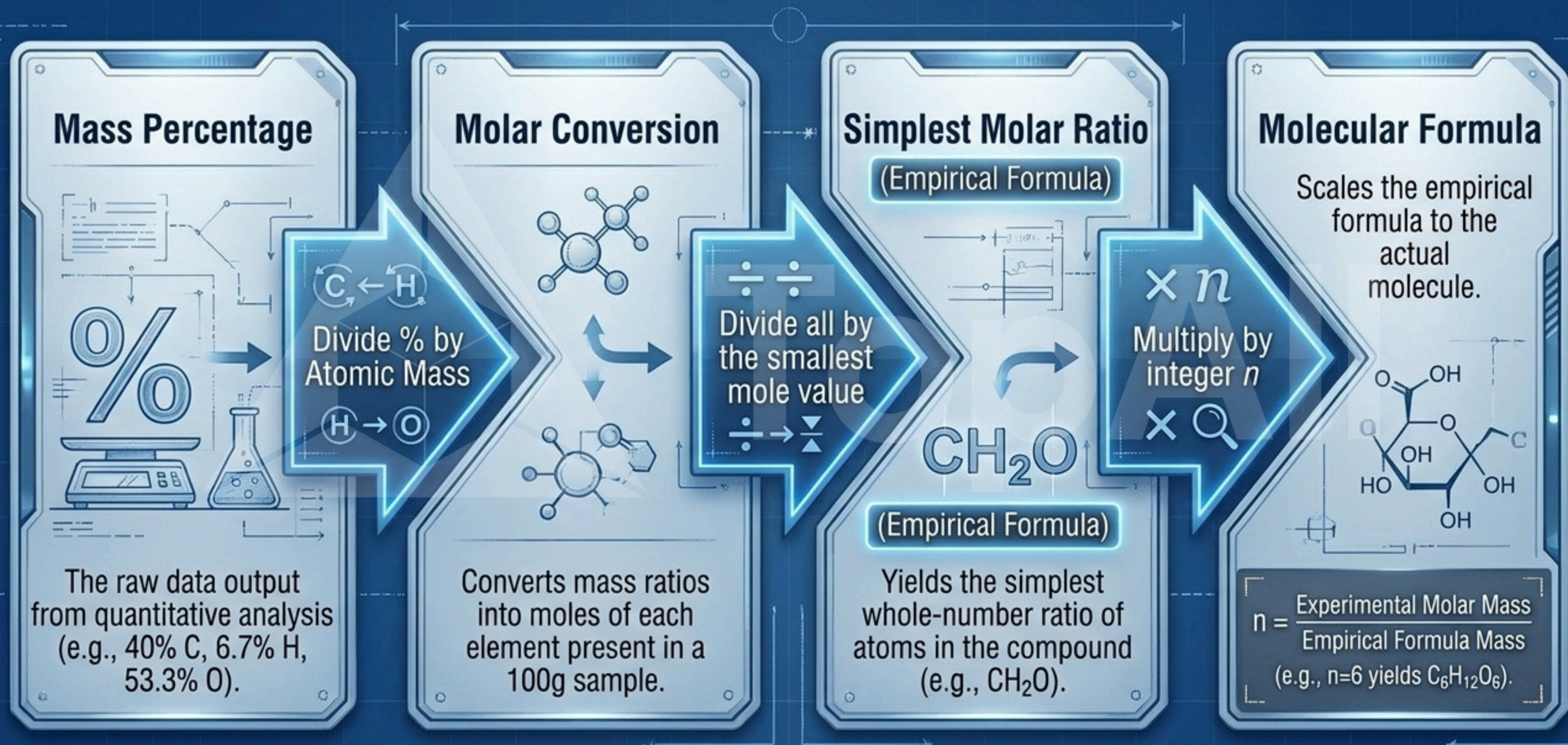
The Estimation Matrix

Element-wise pipeline from raw sample to final measurable product.

Element	Estimation Method	Intermediate Product	Measured Variable
Carbon (C) & Hydrogen (H)	Combustion	CO ₂ and H ₂ O	Mass of CO ₂ (via KOH absorption) & H ₂ O (via CaCl ₂ or Mg(ClO ₄) ₂)
Nitrogen (N) - Volume	Dumas Method 	N ₂ Gas	Volume of N ₂ gas collected over water at STP.
Nitrogen (N) - Titration	Kjeldahl's Method 	Ammonia (NH ₃)	Volume of standard H ₂ SO ₄ neutralized.
Halogens (X) & Sulphur (S)	Carius Method	AgX (Halogens) or BaSO ₄ (Sulphur)	Mass of the dried precipitate.
Phosphorus (P)	Oxidation + Precipitation	Ammonium phosphomolybdate or Mg ₂ P ₂ O ₇	Mass of the precipitate.
Oxygen (O)	By Difference	None	100% - Sum (Mass % of all other elements)

Reverse-Engineering the Molecule

The computational pipeline from mass percentage to molecular identity.



Quantitative Analysis: Revision Frame

Master formula sheet for JEE estimation methods.



Carbon & Hydrogen

$$\%C = \frac{12}{44} \times \frac{m_2}{m} \times 100$$

$$\%H = \frac{2}{18} \times \frac{m_1}{m} \times 100$$

(where m = mass of organic compound)

Halogens, Sulphur, Phosphorus (Gravimetric)

$$\text{Halogens (Carius): } \%X = \frac{\text{Atomic Mass of X}}{\text{Molar Mass of AgX}} \times \frac{m_1}{m} \times 100$$

$$\text{Sulphur (Carius): } \%S = \frac{32}{233} \times \frac{m_1}{m} \times 100 \text{ (via BaSO}_4\text{)}$$

$$\text{Phosphorus: } \%P = \frac{62}{222} \times \frac{m_1}{m} \times 100 \text{ (via Mg}_2\text{P}_2\text{O}_7\text{)}$$

Nitrogen Estimation (Critical)

Dumas Method:

$$\%N = \frac{28}{22400} \times \frac{V_{\text{STP}}}{m} \times 100$$

(where V_{STP} = volume of N_2 in mL at standard temperature and pressure)

Kjeldahl's Method:

$$\%N = \frac{1.4 \times M \times 2(V - V_1/2)}{m}$$

(where M = molarity of standard H_2SO_4 , V = volume of H_2SO_4 taken, V_1 = volume of NaOH used in titration)



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