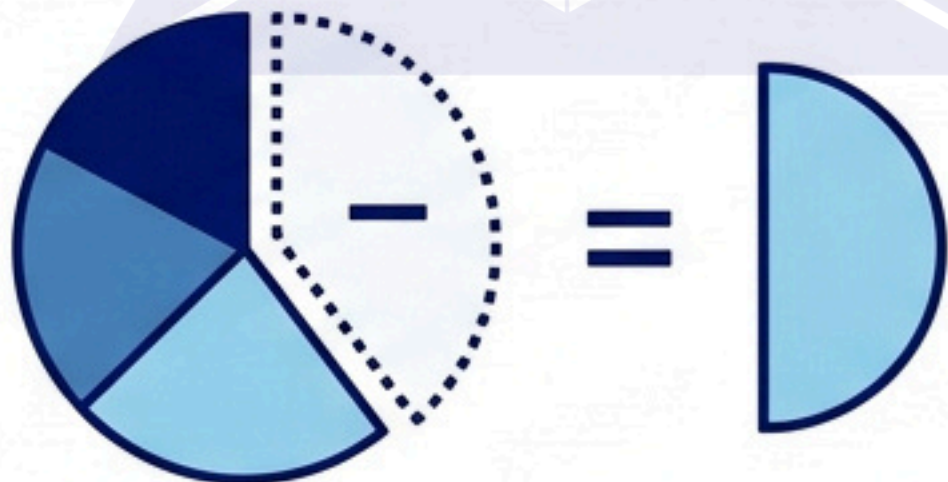


Quantitative Analysis of Oxygen

Two pathways to determining oxygen content in organic compounds.

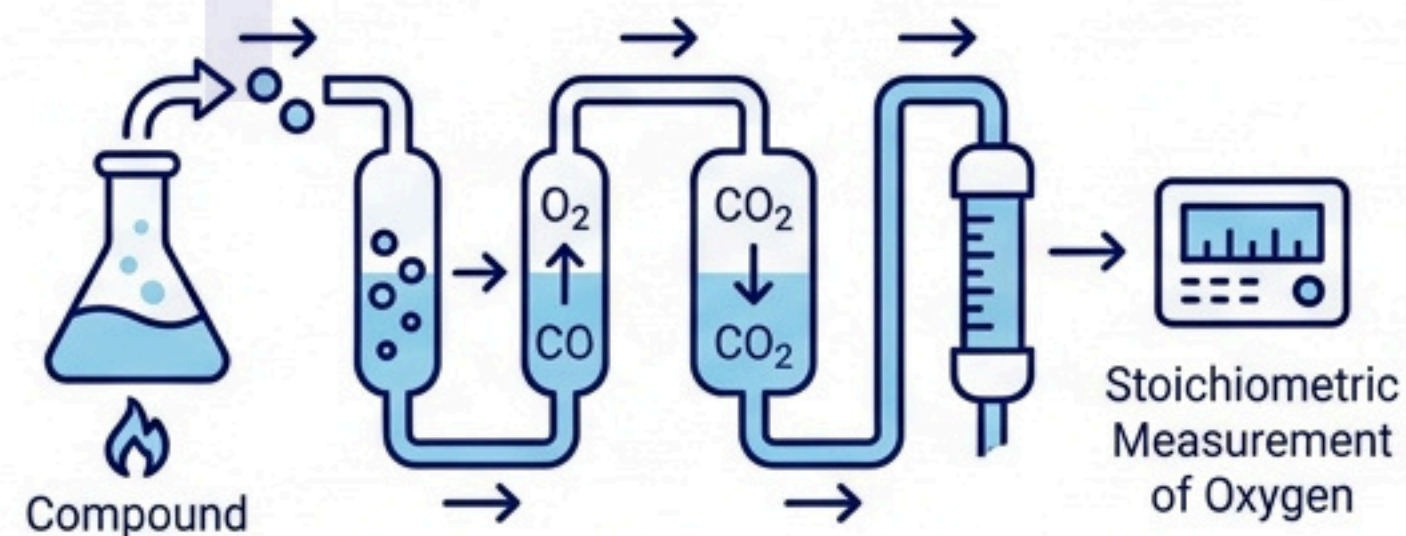
Method 1: Estimation by Difference

The standard, practical method. Because oxygen is ubiquitous and tricky to isolate, its percentage is usually deduced mathematically after all other elements are quantified.



Method 2: Direct Estimation

The advanced, experimental method. Oxygen is actively liberated from the compound, converted through a series of gaseous reactions, and measured stoichiometrically.



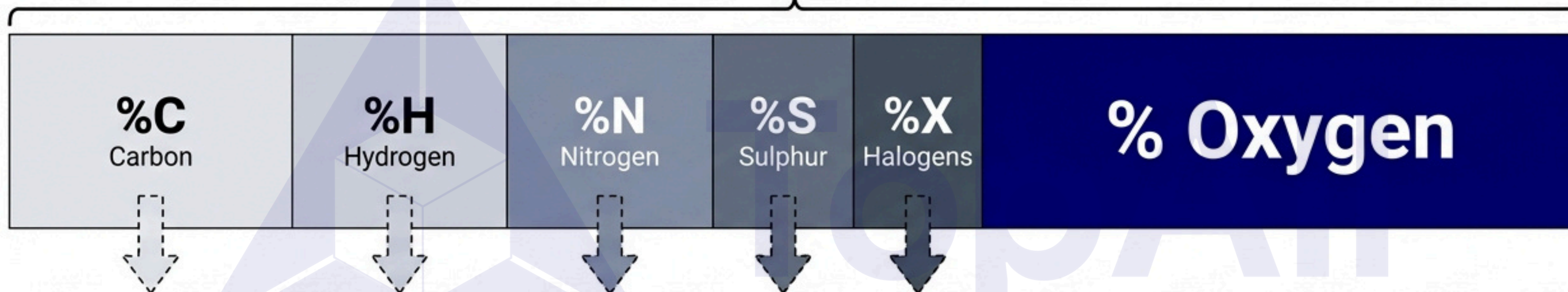
Method 1: Oxygen by Difference

The mathematical deduction of oxygen content.

Subtraction Visualizer

If the sum of the mass percentages of Carbon, Hydrogen, Nitrogen, Halogens, and Sulphur does not equal 100%, the remainder is assumed to be Oxygen.

100% Total Mass

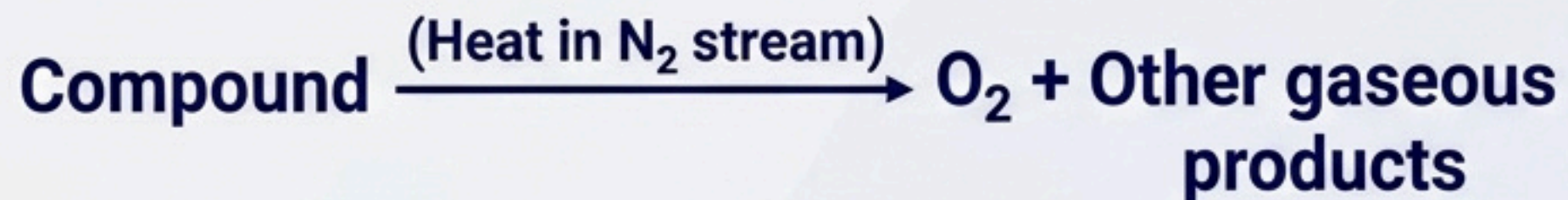
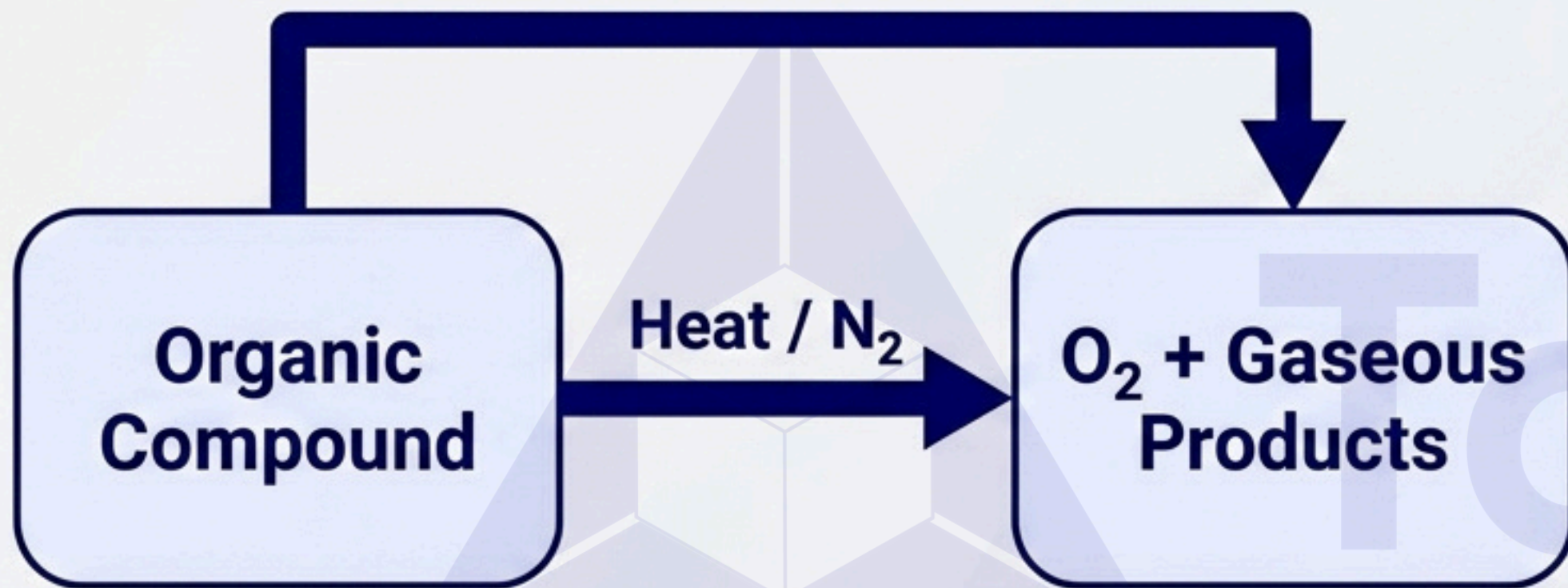


$$\% O = 100 - (\%C + \%H + \%N + \%S + \%X)$$

This is the most common method used in routine organic quantitative analysis unless direct estimation is specifically required.

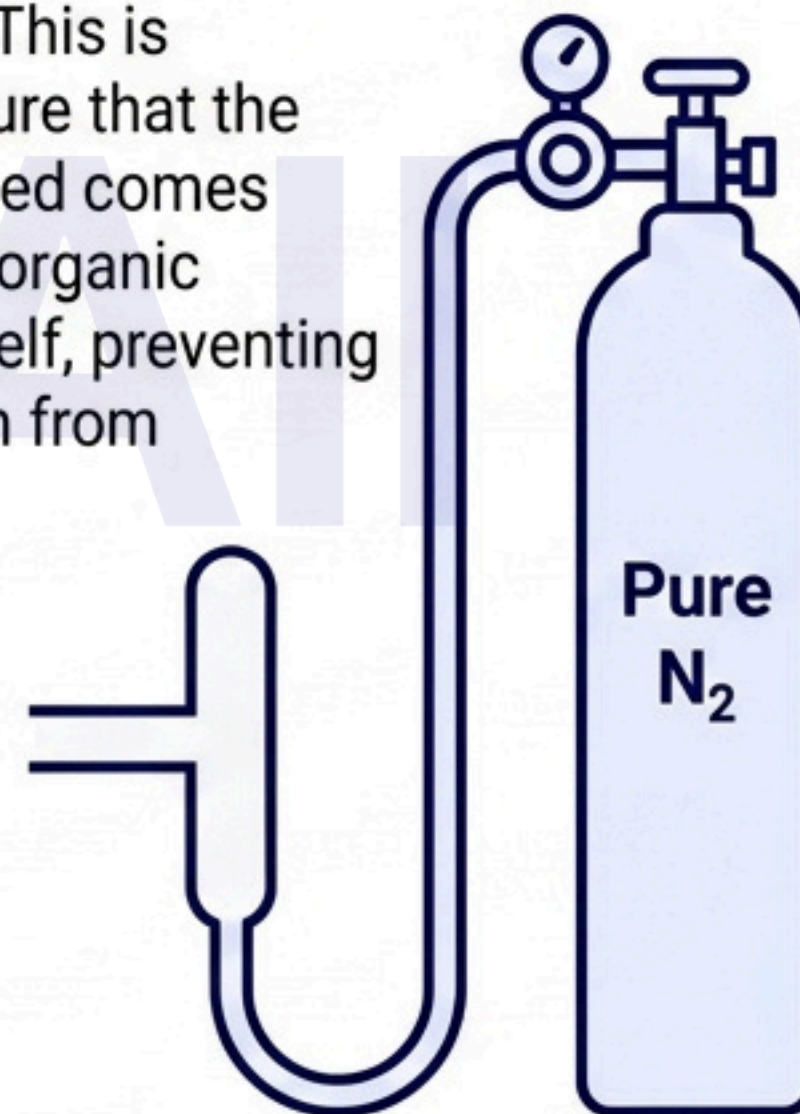
Method 2: Direct Estimation (Step 1)

Thermal decomposition in an inert atmosphere.



Why a Nitrogen (N₂) Stream?

The compound is heated in a stream of pure, inert nitrogen gas. This is critical to ensure that the oxygen liberated comes only from the organic compound itself, preventing contamination from atmospheric oxygen.





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Key Highlights

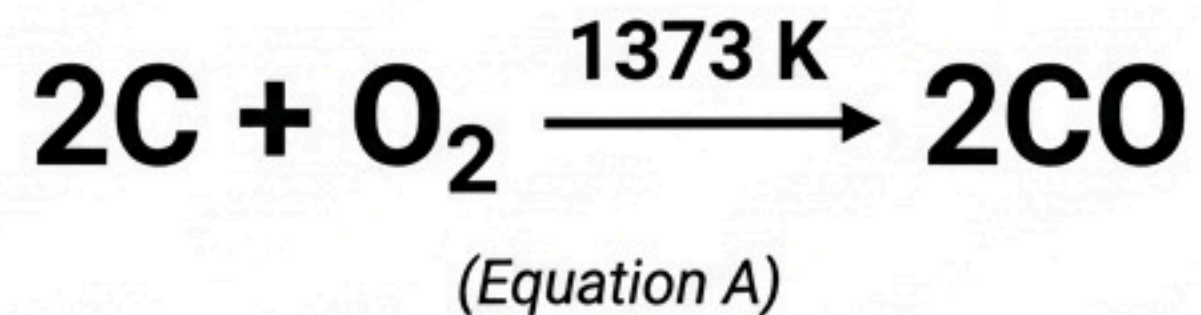
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The Conversion: Red-Hot Coke (Step 2)

Forcing the quantitative conversion of oxygen.

The mixture of gaseous products (containing the liberated O_2) is passed over a bed of red-hot coke.



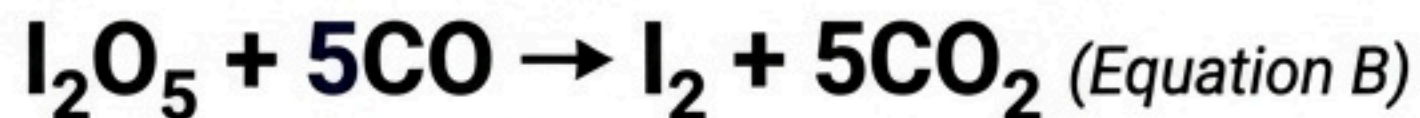
At 1373 K, the carbon completely reduces all available O_2 , ensuring that **exactly 100% of the liberated oxygen** is locked into Carbon Monoxide (CO).

Final Oxidation & Stoichiometry (Step 3)

Bridging CO production to final mass calculation.



The CO mixture is passed through warm I_2O_5 .



To match the CO across both equations:



5 moles $\text{O}_2 \equiv 10$ moles $\text{CO} \equiv 10$ moles CO_2

Simplified Ratio: 1 mole $\text{O}_2 \equiv 2$ moles CO_2

Since 32g O_2 yields 88g CO_2 :

$$\text{Percentage of Oxygen} = \frac{32 \times m_1}{88 \times m} \times 100$$

(Where m = mass of compound, m_1 = mass of CO_2 produced)

Revision Frame: Oxygen Estimation

Take a screenshot to save this summary.



Indirect Method

By Difference

Most common method for standard organic compounds.

$$\% \text{ O} = 100 - \sum (\% \text{ of all other elements})$$

Direct Method Reactions

Process Pathway

1. **Decomp:** $\text{Compound} \rightarrow \text{O}_2$
(Heated in N_2 stream)
2. **Reduction:** $2\text{C} + \text{O}_2 \rightarrow 2\text{CO}$
(at 1373 K)
3. **Oxidation:** $\text{I}_2\text{O}_5 + 5\text{CO} \rightarrow \text{I}_2 + 5\text{CO}_2$

Stoichiometry & Formula

The Calculation

Core Ratio: $5\text{O}_2 \equiv 10\text{CO} \equiv 10\text{CO}_2$

Mass Ratio: $32\text{g O}_2 \equiv 88\text{g CO}_2$

$$\% \text{ O} = \frac{32 \times m_1}{88 \times m} \times 100$$



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