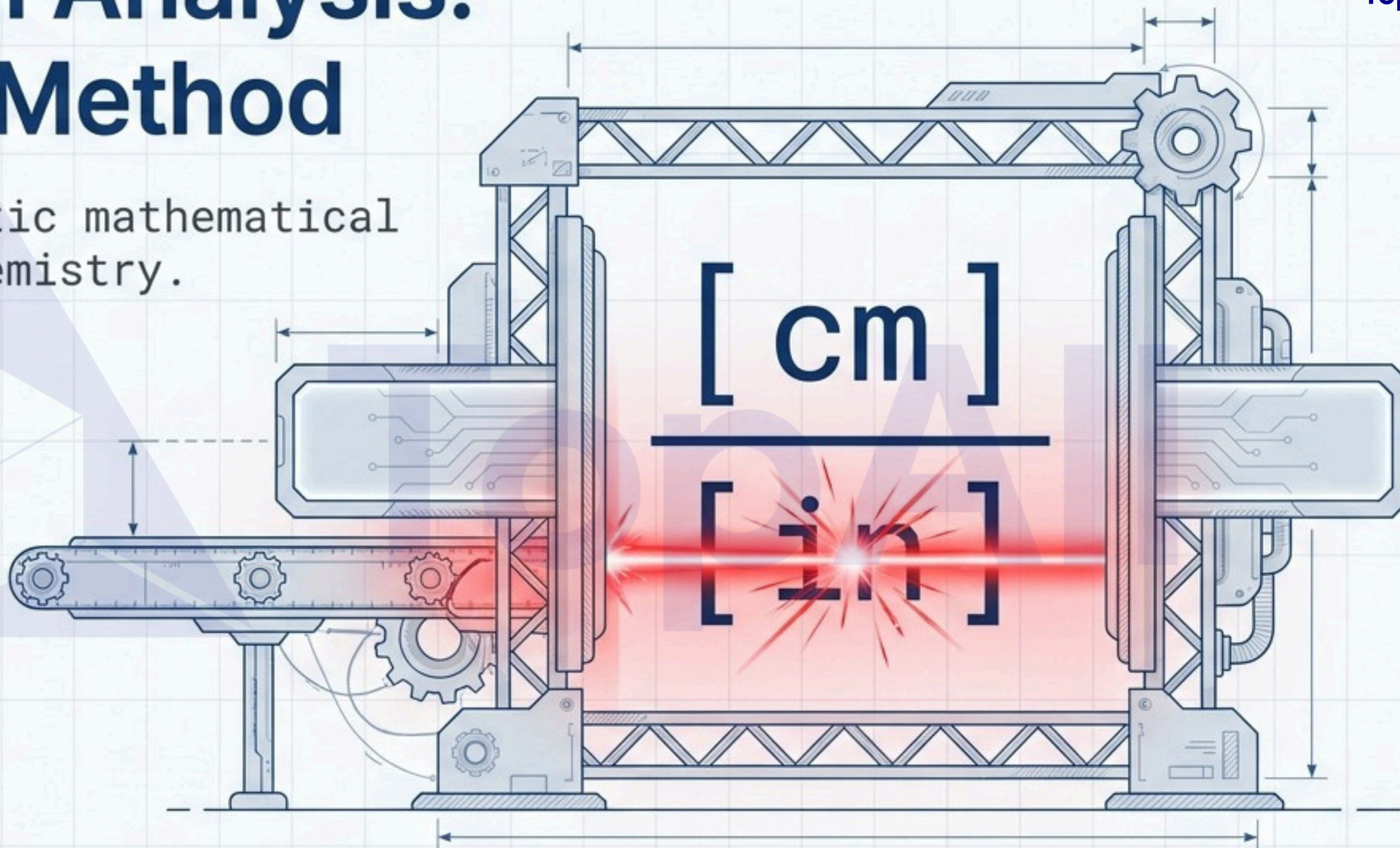


Dimensional Analysis: Unit Factor Method

A foolproof, systematic mathematical framework for JEE Chemistry.



OPERATION: UNIT FACTOR CANCELLATION / STATUS: [cm] REMAINING / [in] FILTERED

The Core Concept: Multiplying by 1

The Unit Factor Method relies on a simple rule: Multiplying a value by 1 does not change its physical amount, only its numerical label.

The Anatomy of a Unit Factor

$$1 \text{ in} = 2.54 \text{ cm}$$

Fraction Card A

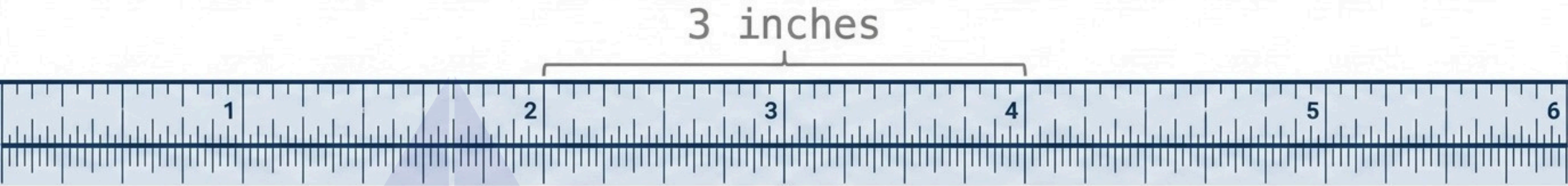
$$\frac{1 \text{ in}}{2.54 \text{ cm}} = 1$$

Fraction Card B

$$\frac{2.54 \text{ cm}}{1 \text{ in}} = 1$$

Both of these fractions are called **unit factors**. Multiplying any number by these will not alter its true value, but it will physically **transform** its **unit**.

The Assembly Line: 1-Step Conversion



7.62 cm

Unit Factor Gate

$$\begin{array}{c} \boxed{3 \text{ in}} \rightarrow \boxed{\times \frac{2.54 \text{ cm}}{1 \text{ in}}} \rightarrow \boxed{= 7.62 \text{ cm}} \end{array}$$

Units are handled exactly like numerical parts. They can be multiplied, divided, squared, and cancelled.



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Rule Bank: The Chain-Link Equation

Single-Step Recap

$$\cancel{3 \text{ in}} \times \frac{2.54 \text{ cm}}{\cancel{1 \text{ in}}} = 7.62 \text{ cm}$$

Multi-Step Cascading Chain: Convert 2 days to seconds

$$\cancel{2 \text{ days}} \times \frac{\cancel{24 \text{ h}}}{\cancel{1 \text{ day}}} \times \frac{\cancel{60 \text{ min}}}{\cancel{1 \text{ h}}} \times \frac{60 \text{ s}}{\cancel{1 \text{ min}}} = 172,800 \text{ s}$$

JEE Trap Alert: Improper Dimensional Alignment

✓ CORRECT ALIGNMENT

✗ JEE TRAP ALERT

$$3 \text{ in} \times \frac{2.54 \text{ cm}}{1 \text{ in}} = 7.62 \text{ cm}$$

Unwanted units are arranged diagonally to cancel out.

$$3 \text{ in} \times \frac{1 \text{ in}}{2.54 \text{ cm}} = \frac{3 \text{ in}^2}{2.54 \text{ cm}} = 1.18 \text{ in}^2/\text{cm}$$

Units multiply instead of cancelling.

The Trap: Flipping the unit factor the wrong way. If your arrangement produces nonsensical units like in^2/cm , your fraction is upside down.

Mini Application: The Dimensional Leap



Context: Converting 2 Litres (2000 cm³) to cubic metres (m³).

Calculation Breakdown

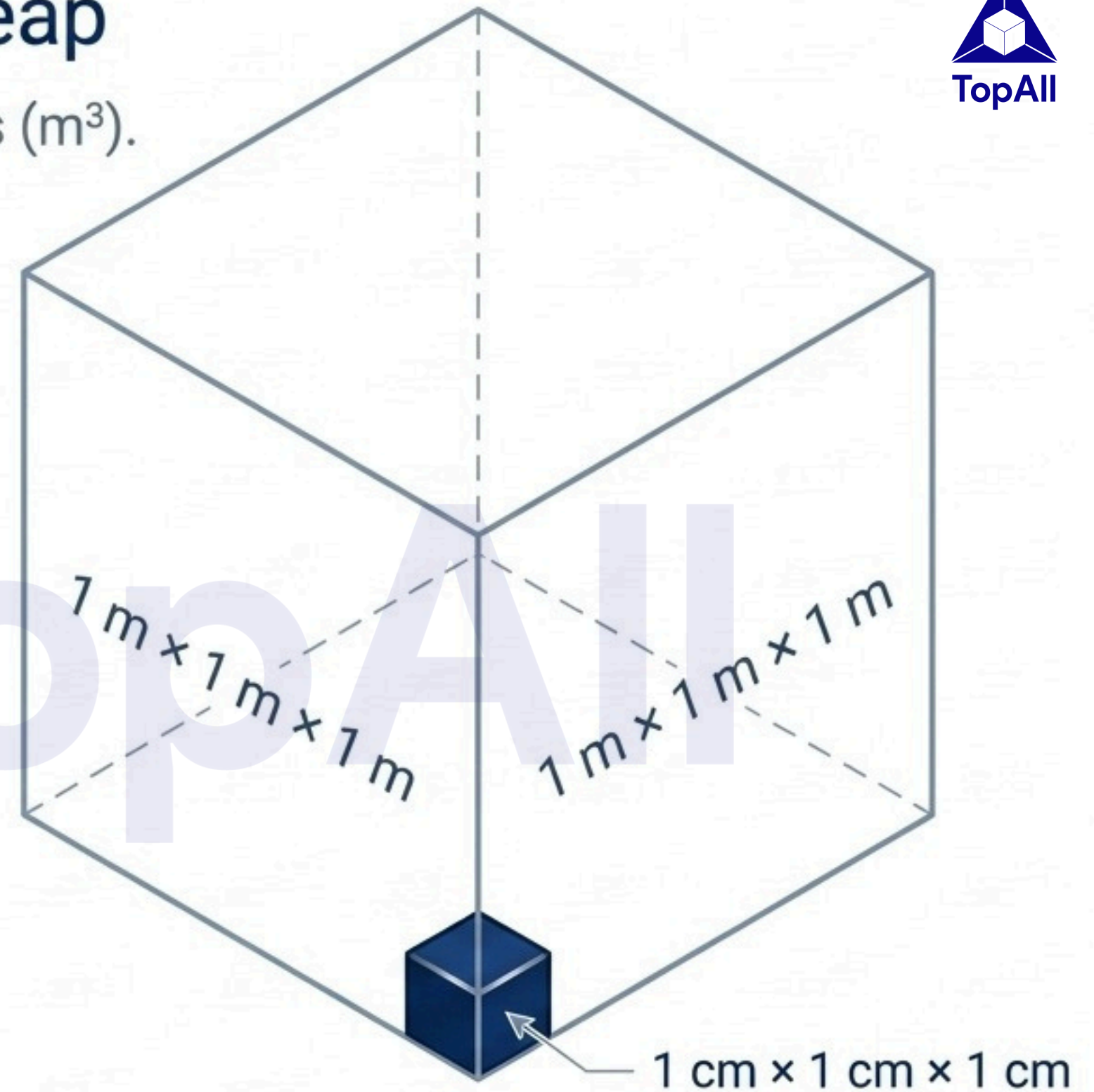
Base Equivalence: 1 m = 100 cm

The Leap (cube the entire factor):

$$(1 \text{ m} / 100 \text{ cm})^3 \rightarrow (1 \text{ m}^3 / 10^6 \text{ cm}^3)$$

Assembly Line Execution:

$$2000 \cancel{\text{cm}^3} \times (1 \text{ m}^3 / 10^6 \cancel{\text{cm}^3}) = 2 \times 10^{-3} \text{ m}^3$$



RULE: When converting volumes or areas, you must raise the ENTIRE unit factor (both the number and the unit) to the power of 2 or 3.

Revision Card: The Dimensional Analysis Protocol

1

Identify the Equivalence

Find the exact foundational conversion statement that bridges your starting point and your target (e.g., 1 in = 2.54 cm).

2

Arrange to Cancel Diagonally

Construct your chain-link equation so the denominator of the current factor **perfectly** matches the numerator of the previous factor.



3

The Final Unit Check

The last, un-cancelled unit in your equation **MUST** match your target unit. If it doesn't, a **unit factor is flipped upside down**.



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