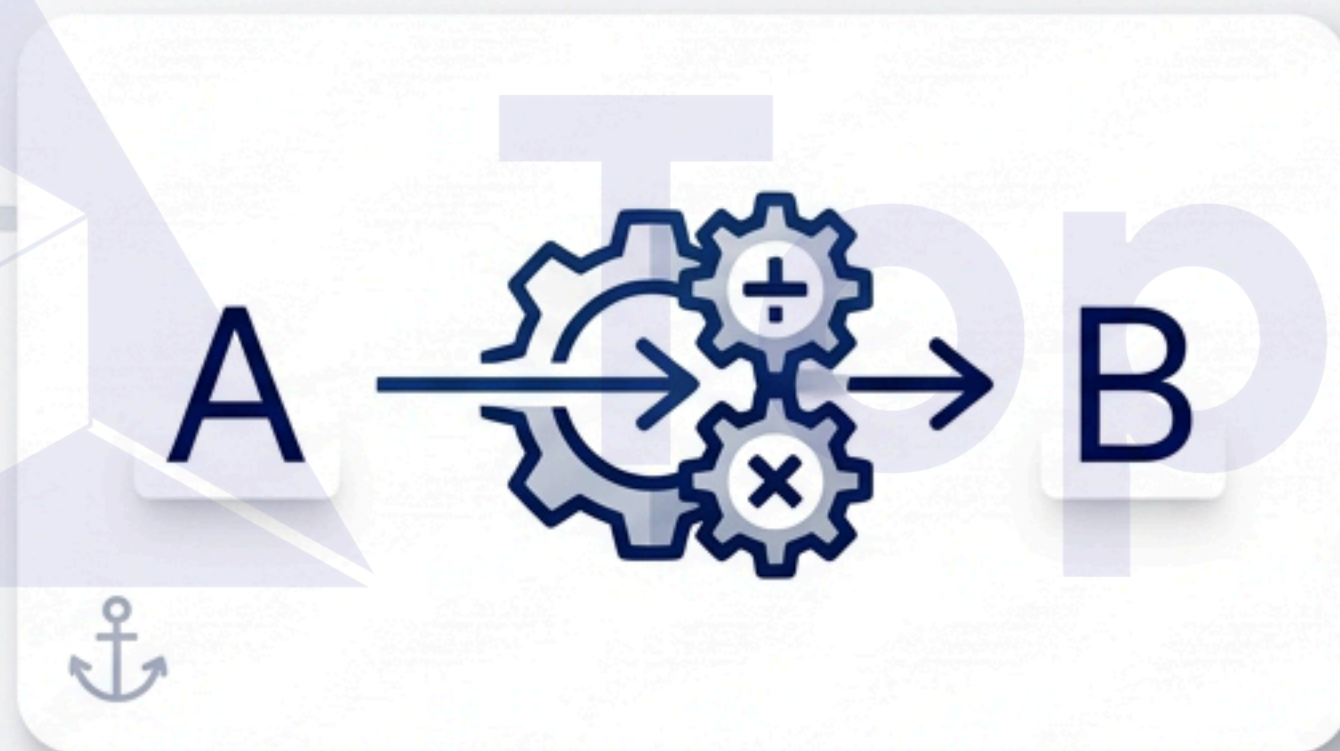


Convert Units Without Confusion

Mastering Dimensional Analysis & The Unit Factor Method



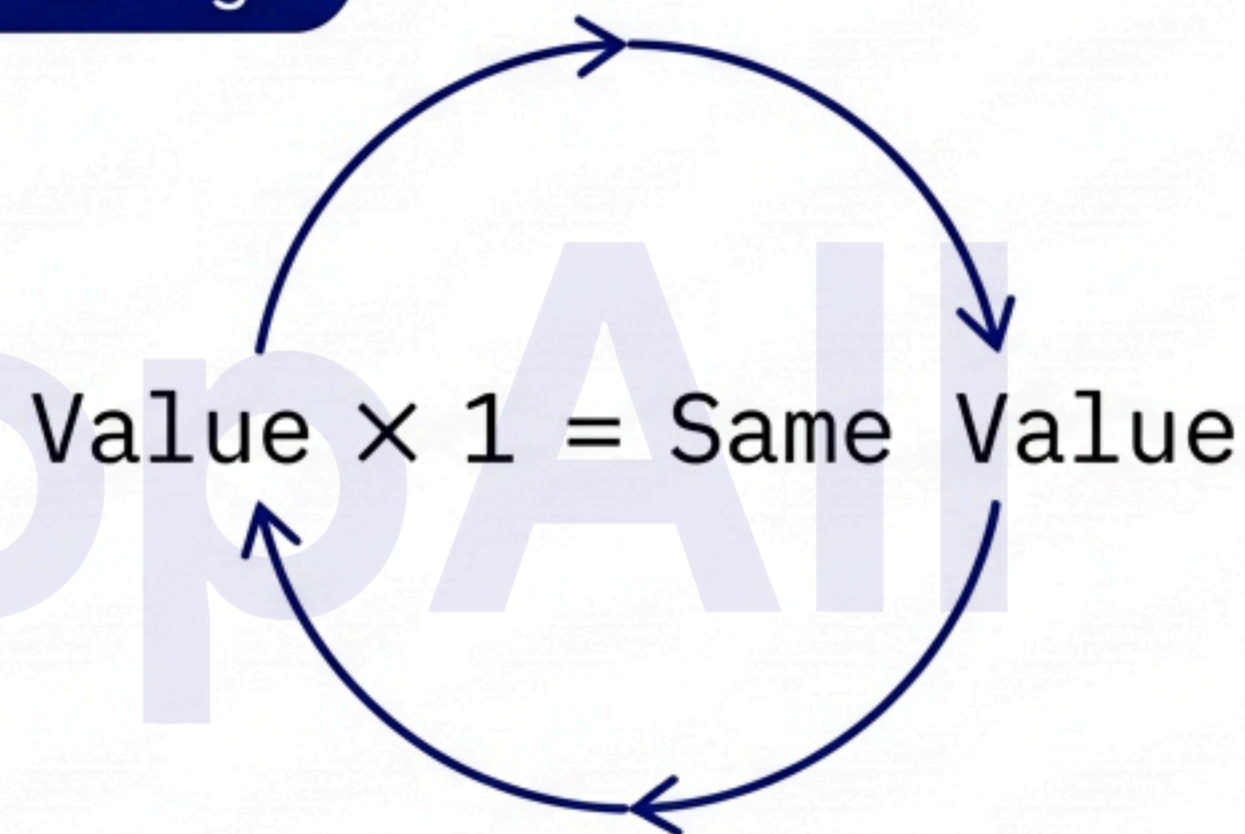
A Visual Guide to Chemical Calculations

The Framework: Dimensional Analysis

The Terminology

Also known as the **Factor Label Method** or **Unit Factor Method**. It is the standard process for converting units from one system to another without changing the actual physical quantity.

The Logic



Multiplying a measurement by a fraction equal to 1 changes the name of the unit, but not the value of the measurement.

The Mechanism: Creating Unit Factors



The Equality

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

Factor A

$$(1 \text{ in}) / (2.54 \text{ cm}) = 1$$

Factor B

$$(2.54 \text{ cm}) / (1 \text{ in}) = 1$$

Both fractions equal exactly 1. The secret to dimensional analysis is simply choosing the fraction that puts your desired unit on top and your unwanted unit on the bottom.



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$$E=mc^2$$



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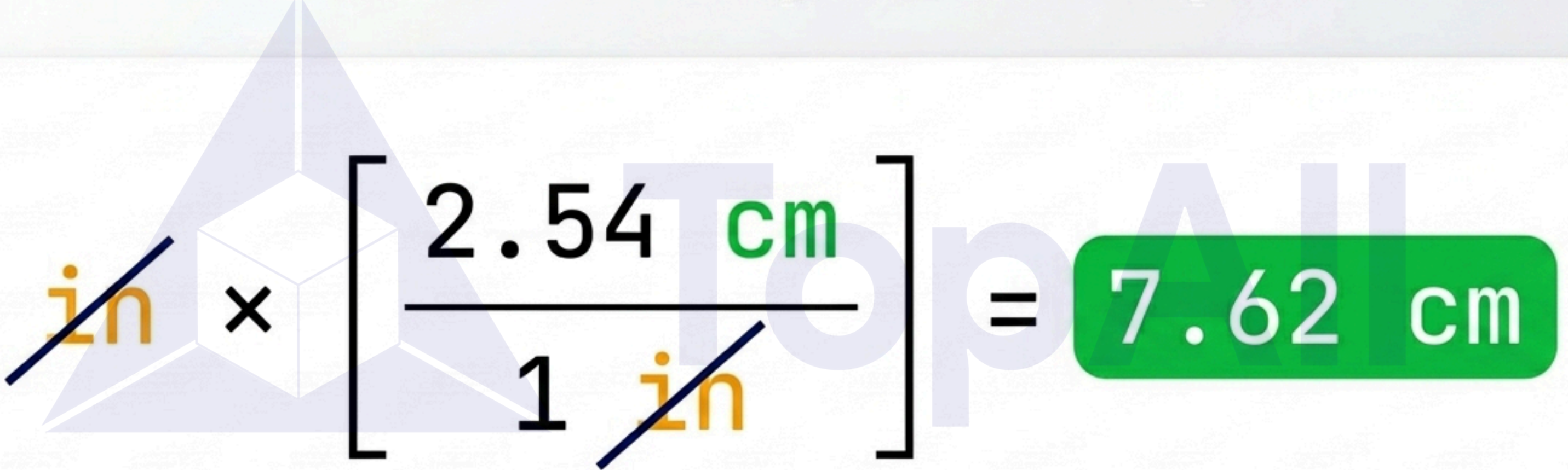
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Example 1: The Basic Step

A piece of metal is 3 inches long. What is its length in cm?


$$3 \text{ in} \times \left[\frac{2.54 \text{ cm}}{1 \text{ in}} \right] = 7.62 \text{ cm}$$

Choose the unit factor that forces the unwanted unit (**Amber**) to the denominator so it cancels out, leaving only the desired unit (**Green**).

Example 2: Dealing with Dimensions

A jug contains 2 L of milk. Calculate the volume in m³.

(Recall: 1 L = 1000 cm³)

WARNING

When converting **squared or cubed units (like volume or area)**, you must **cube the entire unit factor**, including the numbers!

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

$$2 \times 10^3 \text{ cm}^3 \times \left[\frac{1 \text{ m}^3}{10^6 \text{ cm}^3} \right] = 2 \times 10^{-3} \text{ m}^3$$

Example 3: The Chain Reaction

How many seconds are there in exactly 2 days?

$$2 \text{ ~~days~~} \times \left[\frac{24 \text{ ~~h~~}}{1 \text{ ~~day~~}} \right] \times \left[\frac{60 \text{ ~~min~~}}{1 \text{ ~~h~~}} \right] \times \left[\frac{60 \text{ s}}{1 \text{ ~~min~~}} \right] = 172800 \text{ s}$$

Unit factors can be multiplied in series in a single step.
Just set up the dominos and let them fall.

The Golden Rule of Unit Conversion



The Universal Blueprint

$$\cancel{\text{Start Unit}} \times \left[\frac{\cancel{\text{Desired Unit}}}{\cancel{\text{Start Unit}}} \right] = \text{Desired Unit}$$

1. Set up the given quantity as your starting point.
2. Multiply by a unit factor that places the unwanted unit on the bottom to cancel it out.
3. Ensure the desired unit is on top. Multiply the numbers across.

Cancel the unwanted to reveal the desired.



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