

WHY DO CHEMISTS NEED ENTHALPY?

Enthalpy H & ΔH - ΔU Relation | JEE

The Problem:

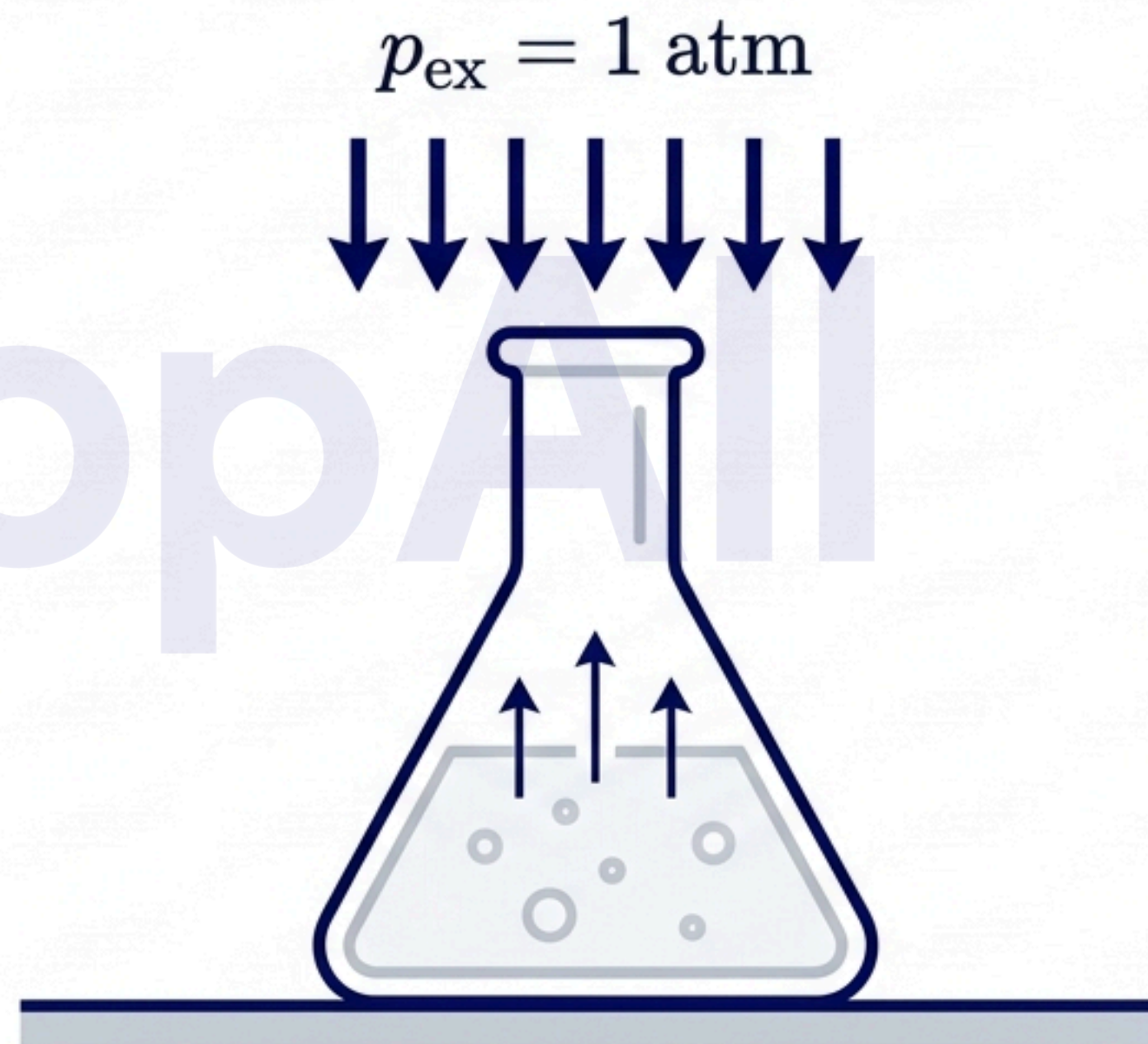
Internal Energy (ΔU) perfectly tracks heat in a sealed, rigid bomb (constant volume).

The Reality:

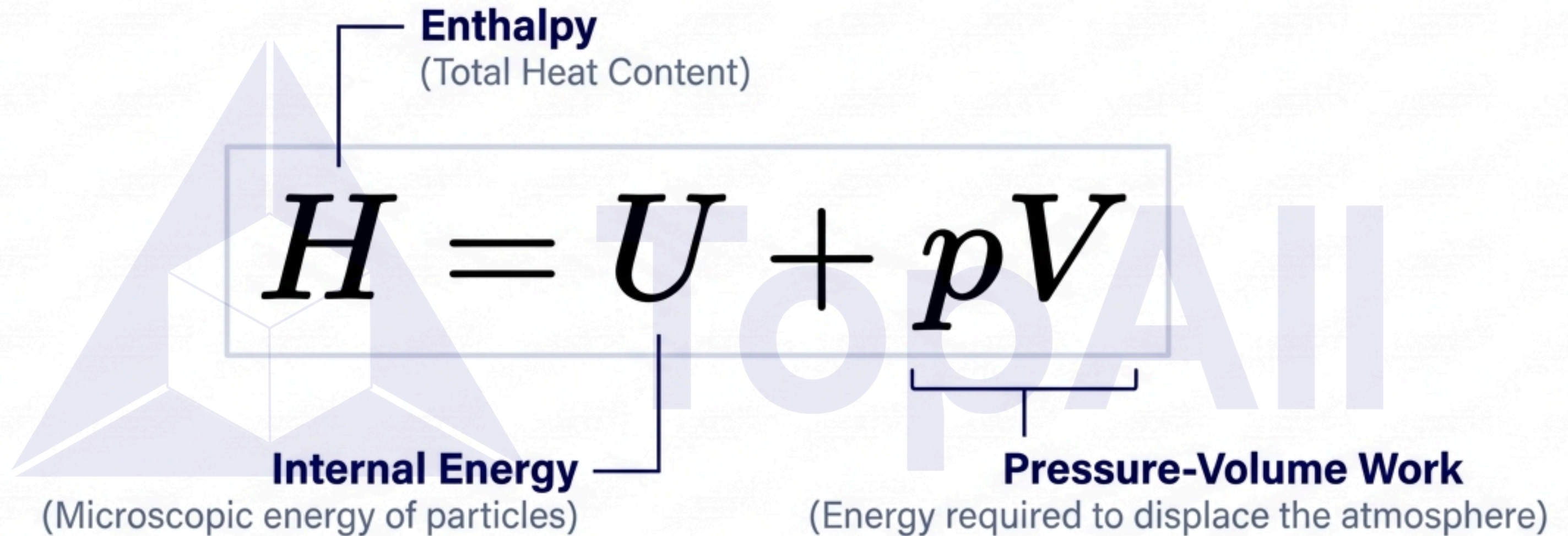
Real chemical reactions happen in open beakers under constant atmospheric pressure.

The Solution:

We need a new mathematical tool that automatically accounts for the invisible pressure-volume work done against the atmosphere.



THE DEFINITION OF ENTHALPY



Enthalpy
(Total Heat Content)

$$H = U + pV$$

Internal Energy
(Microscopic energy of particles)

Pressure-Volume Work
(Energy required to displace the atmosphere)

- H is a State Function (path-independent).
- Invented specifically to calculate heat changes for constant-pressure processes.

CLOSED SYSTEM VS. OPEN SYSTEM

CONSTANT VOLUME

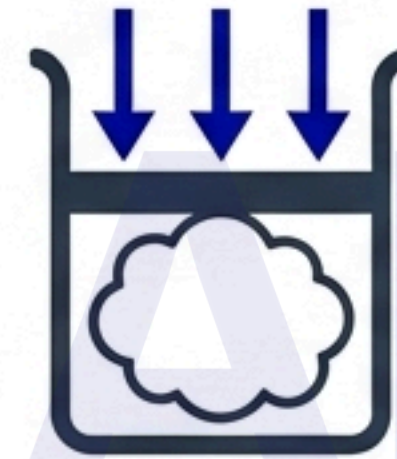


$$\Delta V = 0$$

$$q_V = \Delta U$$

All added heat goes purely into increasing Internal Energy.

CONSTANT PRESSURE



$$p = \text{constant}$$

$$q_p = \Delta H$$

Heat added increases Internal Energy and does expansion work.



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$$E=mc^2$$



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BRIDGING ΔH AND ΔU FOR GASES

The Finite Change

Starting from $H = U + pV$ at constant pressure:

$$\Delta H = \Delta U + p\Delta V$$



Substitute Ideal Gas Law

The Gas Condition

For an ideal gaseous reaction at constant T and p :

$$p\Delta V = \Delta n_g RT$$



Combine

The Golden Equation

$$\Delta H = \Delta U + \Delta n_g RT$$

JEE TRAP ALERT: CALCULATING Δn_g

$$\Delta n_g = n_g(\text{products}) - n_g(\text{reactants})$$



(*g*)

COUNT ✓



(*l*)

DON'T COUNT ✗



(*s*)

DON'T COUNT ✗

Example: ~~$H_2O(l) \rightarrow H_2O(g)$~~

$$\Delta n_g = 1 - 0 = 1$$

REVISION SNAPSHOT: ENTHALPY

The Definition

$$H = U + pV$$

Enthalpy is a state function specifically for constant-pressure open systems.

The Heat Relations

Constant Volume: $q_V = \Delta U$

Constant Pressure: $q_p = \Delta H$

The Gas Equation

$$\Delta H = \Delta U + \Delta n_g RT$$

Golden Rule: Only count gaseous moles (g) for Δn_g . Strictly ignore solids (s) and liquids (l).



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