

Reaction Enthalpy & Standard State | JEE

Reactants  Products

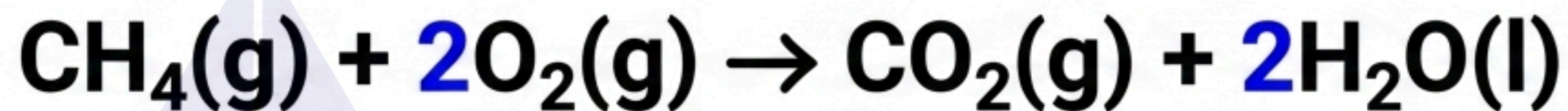
**HOW MUCH ENTHALPY CHANGES
DURING A REACTION?**

The Reaction Enthalpy ($\Delta_r H$)

$$\Delta_r H = \sum a_i H_{products} - \sum b_i H_{reactants}$$

- **Where:** $\sum$ represents the sum of the enthalpies.
- **Crucial Detail:** Enthalpies must be multiplied by their respective stoichiometric coefficients (a_i for products, b_i for reactants) from the balanced chemical equation.

Applying Coefficients: Methane Combustion



$$\left(1 \times H_{\text{m}}(\text{CO}_2) + 2 \times H_{\text{m}}(\text{H}_2\text{O}) \right) - \left(1 \times H_{\text{m}}(\text{CH}_4) + 2 \times H_{\text{m}}(\text{O}_2) \right)$$

Coefficients (**1**, **2**) physically multiply the molar enthalpies (H_{m}).



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$$E=mc^2$$



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Defining the Standard State ($\ominus$)

Enthalpy depends on conditions. To compare reactions objectively, we use standard reference conditions, denoted by the superscript $\ominus$ (e.g., $\Delta H^\ominus$).



Pure substance



1 bar pressure



Specified temperature



Common data temperature: 298 K (25°C)

The Thermochemical Equation Trap

! NEVER IGNORE THESE 3 VARIABLES

- ✗ **Stoichiometric Coefficients:** Moles matter. If you multiply the entire equation by 2, you must multiply ΔH by 2.
- ✗ **Physical States:** $\text{H}_2\text{O}(\text{l})$ has a fundamentally different enthalpy than $\text{H}_2\text{O}(\text{g})$. Missing a phase label changes the answer.
- ✗ **Standard-State Conditions:** Ensure the data provided actually matches standard 1 bar pressure.

Revision & Checklist

The Master Formula

$$\Delta_r H^\ominus = \sum a_i \Delta_f H^\ominus (\text{Products}) - \sum b_i \Delta_f H^\ominus (\text{Reactants})$$



Equation Balanced?

(Check all stoichiometric coefficients)



States Verified?

(Explicitly track s, l, g, aq)



Conditions Standard?

(Verify 1 bar, pure form)



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