

What is Bond Enthalpy?

Core Definition

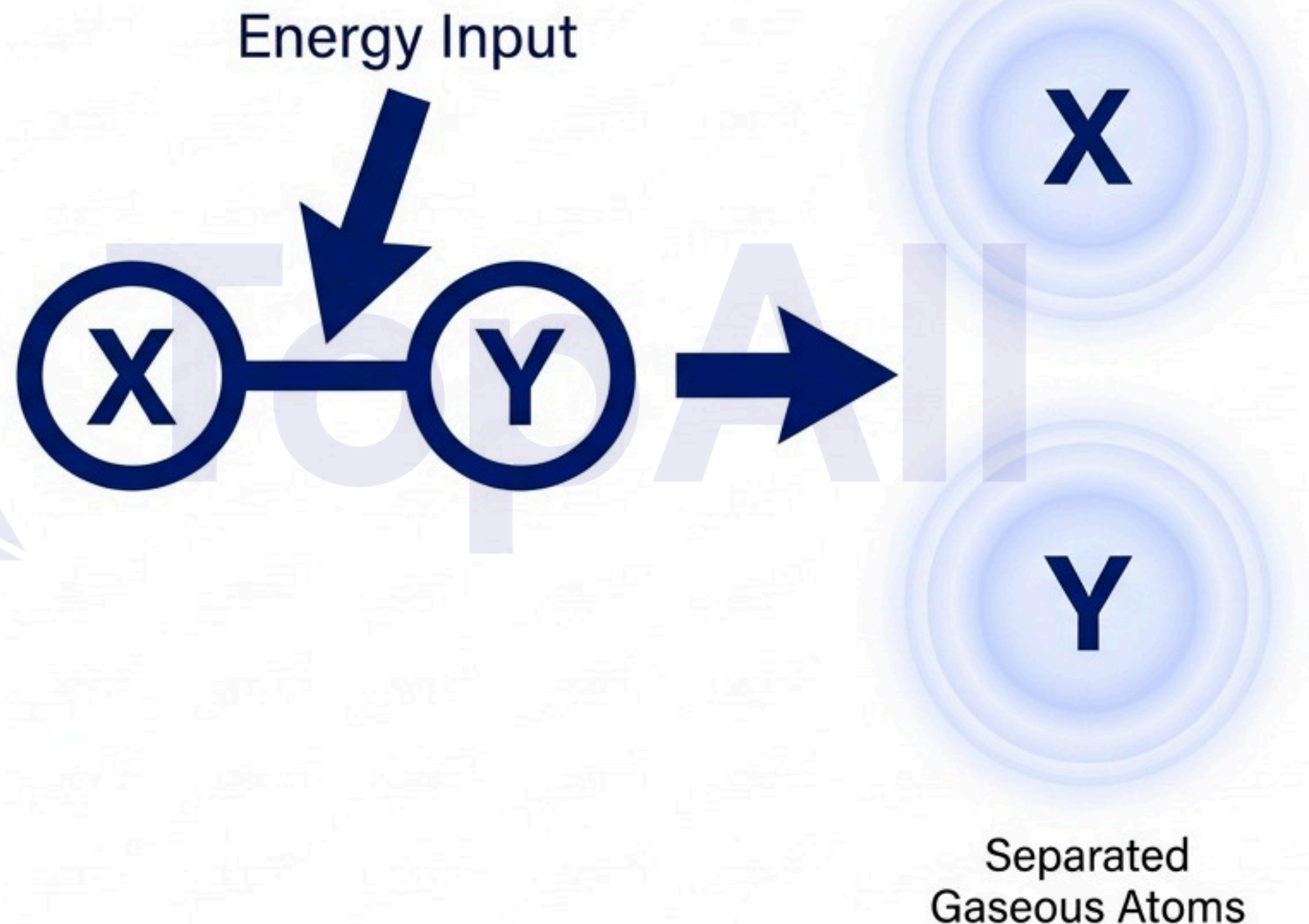
The amount of energy required to break one mole of bonds of a particular type between two atoms.

Unit of Measurement

kJ mol^{-1}

Crucial Condition

The atoms must be in a gaseous state.



The Simplest Case: Hydrogen (H₂)



$$\Delta_{\text{aH}}^{\ominus} =$$

$$435.8 \text{ kJ mol}^{-1}$$

Energy cost to break one mole of H–H single bonds.

Multiple Bonds: Oxygen vs. Nitrogen

Oxygen (Double Bond)



498 kJ mol⁻¹

Nitrogen (Triple Bond)



946.0 kJ mol⁻¹



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$$E=mc^2$$



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Key Highlights

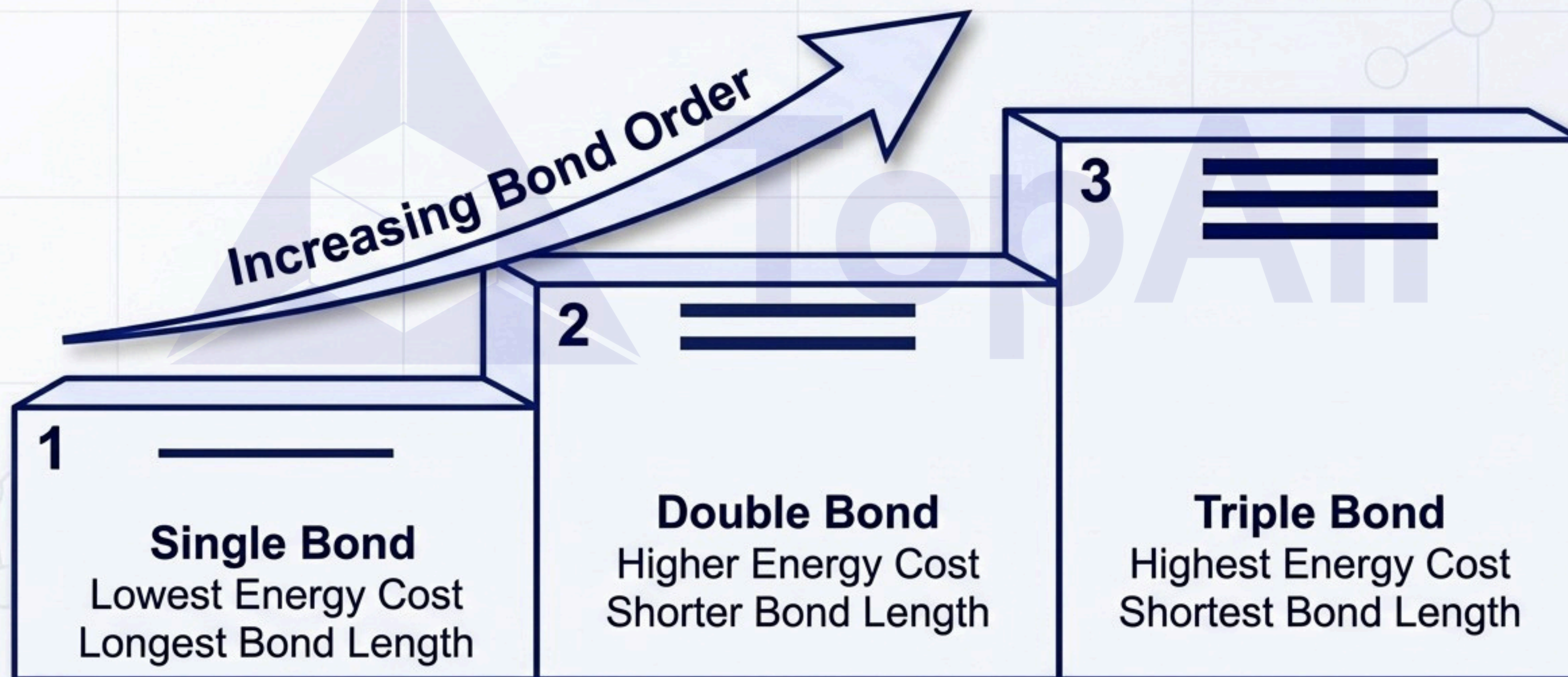
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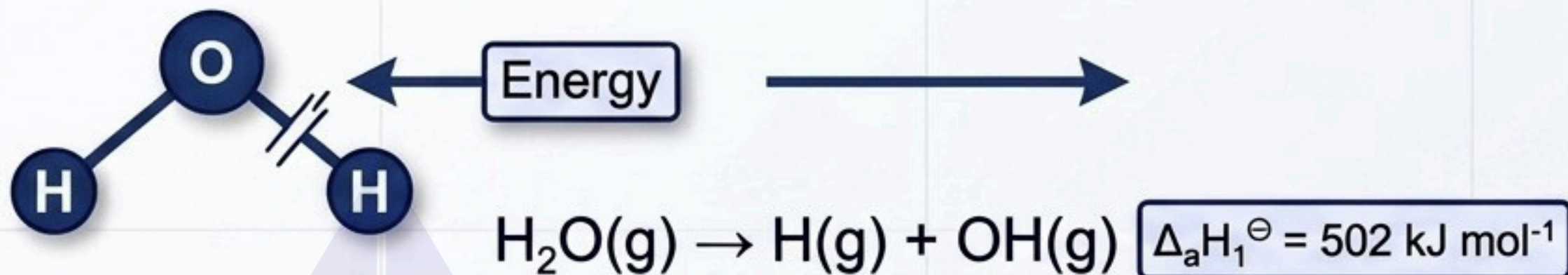
The Golden Rule of Bond Enthalpy



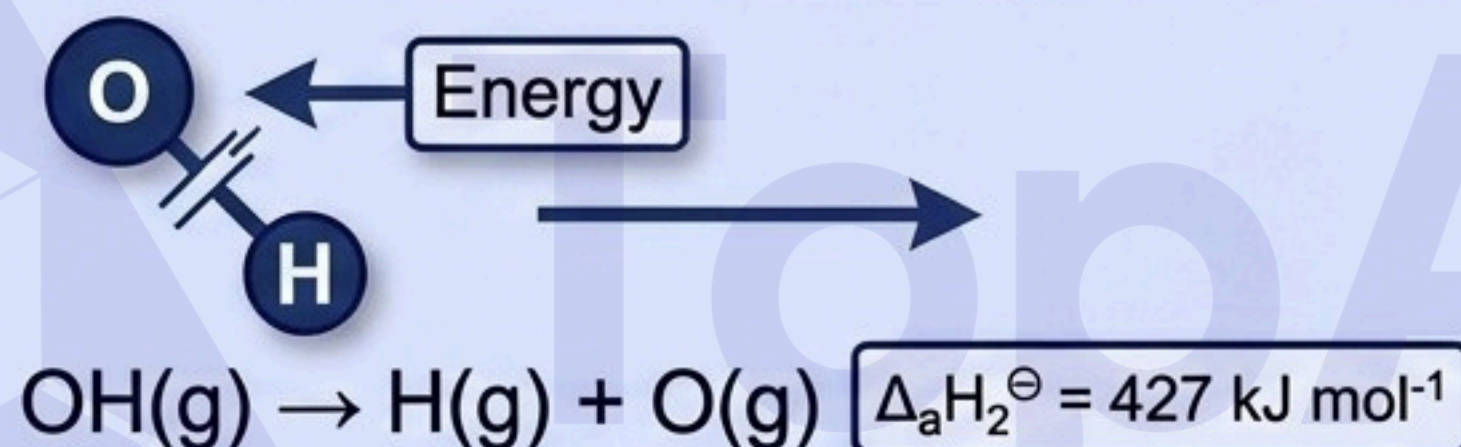
Larger Bond Dissociation Enthalpy = Stronger Bond



Polyatomic Complexity: The H₂O Exception



Altered chemical environment changes the bond strength.



The Solution: Average Bond Enthalpy
 $(502 + 427) / 2 = 464.5 \text{ kJ mol}^{-1}$

Revision Frame: Bond Enthalpy



The Definition

Energy required to break 1 mole of bonds between two atoms in a gaseous state (kJ mol^{-1}).



The Core Rule

Higher Enthalpy = Stronger Bond.
Energy cost scales directly with Bond Order, and inversely with Bond Length.



Diatomic Benchmarks

- H–H (Single): $435.8 \text{ kJ mol}^{-1}$
- O=O (Double): $498.0 \text{ kJ mol}^{-1}$
- N≡N (Triple): $946.0 \text{ kJ mol}^{-1}$



The Polyatomic Rule

Use **Average Bond Enthalpy**.
Sequential breaking of identical bonds requires variable energy due to changing chemical environments (e.g., $\text{H}_2\text{O} = 464.5$).



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