Competition Corner: Model, Then Qualify

Bond-Energy Estimates | g10_u02_w07

Use only this gas-phase mean-bond data (kJ/mol): C–H 413, C–C 348, C=C 614, H–H 436, O=O 498, O–H 463, and C=O in CO_2 799. Use $\Delta H \approx E_{\text{broken}} - E_{\text{formed}}$. Every answer must state one limitation of this model.

1. Estimate ΔH for both $C_2H_4 + H_2 \rightarrow C_2H_6$ and $C_2H_6 + \frac{7}{2}O_2 \rightarrow 2CO_2 + 3H_2O(g)$. Identify which bond-count changes make each sign plausible.

2. A measured reference for the combustion equation is -1428 kJ/mol. Compute the percent difference using the reference magnitude, then give two reasons it would be misleading to treat this as a grading error in the arithmetic alone.

3. A teammate writes $\Delta H = E_{\text{formed}} - E_{\text{broken}}$ and obtains the opposite sign for combustion. Diagnose the conceptual error in a single energy-flow sentence, then repair the calculation structure.

4. Design a two-row evidence table for a report comparing a mean-bond estimate and a Hess-law result. Include equation/state labels, data source, numerical value/unit, and one uncertainty or applicability note for each row.