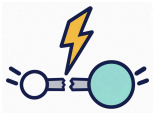
Bond Energies Map

Cambridge International AS & A Level Chemistry · Topic 5 Chemical energetics · Bond energies

1 Bond energy 3.4.3

- Energy to **break 1 mol** of a bond
- All species **gaseous**
- HCl(g) → H(g) + Cl(g): +432
- Always **positive**
- Making the bond: same, negative



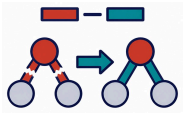
2 Average bond energy 5.1.6

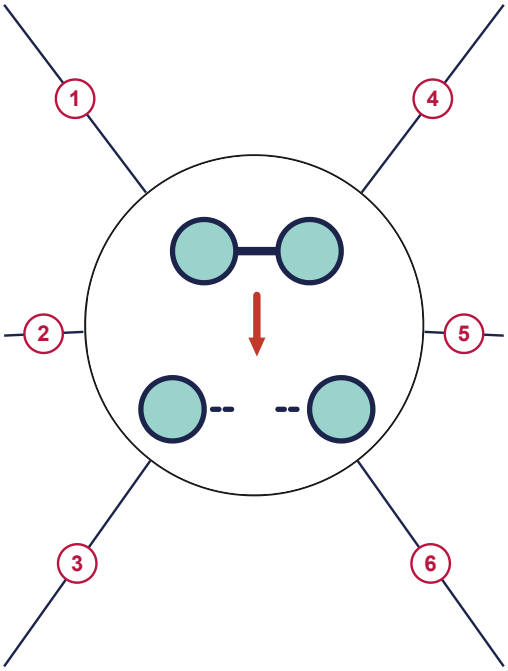
- A bond varies with its molecule
- Data values: **averages**
- C–H = 413 (mean)
- Diatomics: **exact** values
- Cl–Cl = 2 × $\Delta_{at}H$(Cl)



3 ΔH from bonds 5.1.5

- List bonds broken and made
- **ΔH = Σ(broken) − Σ(made)**
- Multiply by the number of bonds
- Only changed bonds needed
- Made stronger: exothermic





4 Working back 5.2.2

- Unknown bond as **x**
- Put in ΔH with its sign
- Solve; divide by bond count
- H–I from H_2 + I_2: 298
- N–H from NH_3: 391



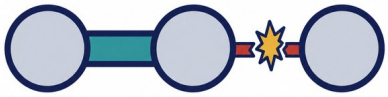
5 Limitations 5.1.6

- Mean values: **estimates**
- **Gases only**
- No changes of state
- CH_4: −818 by bonds, −890 data
- Hess data are more accurate



6 Which bond breaks? 3.4.3

- The **weakest** bond first
- Cl–Cl (243) before C–H (413)
- Strong N≡N: slow reactions
- C–I fastest to hydrolyse
- Only an indication of rate



Average bond energies used in this topic

kJ mol⁻¹; values for diatomic molecules are exact

Bond	kJ mol⁻¹	Bond	kJ mol⁻¹	Bond	kJ mol⁻¹
H–H	436	C–H	413	O=O	498
Cl–Cl	243	C–C	347	C=O (CO_2)	805
H–Cl	432	C=C	612	O–H	464
Br–Br	193	C–Cl	346	N≡N	945
H–Br	366	C–Br	290	N–H	391

Worked examples

$H_2 + Cl_2 \rightarrow 2HCl$

- broken 436 + 243 = 679
- made 2 × 432 = 864
- **ΔH = −185 kJ mol⁻¹**

$CH_4 + 2O_2$

- broken 2648
- made 3466
- **ΔH = −818 kJ mol⁻¹**

Working back

- $H_2 + I_2 \rightarrow 2HI$: −9
- −9 = 587 − 2x
- **H–I = 298 kJ mol⁻¹**

The forces between molecules are far weaker than any of these bonds.

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