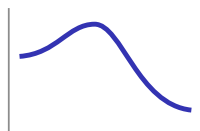


Chemical Energetics

A-Level Chemistry ■ Topic 5

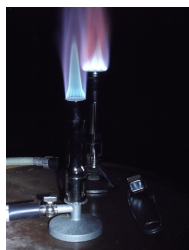
A-Level Chemistry



Chemical Energetics

What we will cover

- 1 Enthalpy change ΔH
- 2 Types of enthalpy change
- 3 Bond energy
- 4 Measuring ΔH
- 5 Hess's law



burning fuel is exothermic

1 Enthalpy

Enthalpy change ΔH

Enthalpy change 焓变 ΔH is the heat transferred at constant pressure.

exothermic

$\Delta H < 0$ – heat given
out; products more stable

endothermic

$\Delta H > 0$ – heat
taken in; a cold pack

Types of enthalpy change

$\Delta H_r^\ominus$ **reaction** 反应焓变 – for the
equation as written

$\Delta H_c^\ominus$ **combustion** 燃烧焓变 – 1
mol burnt in oxygen

$\Delta H_f^\ominus$ **formation** 生成焓变 – 1
mol of compound from elements

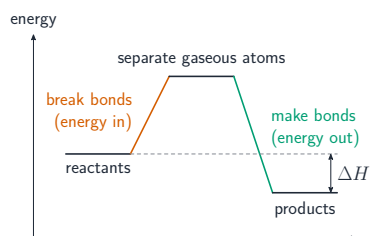
$\Delta H_{\text{neut}}^\ominus$ **neutralisation** 中和焓变
– 1 mol of water formed

Standard conditions 标准条件 ($^\ominus$): 298 K, 101 kPa, each substance in its normal state.

2

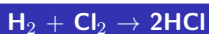
Calculating ΔH

Bond energy



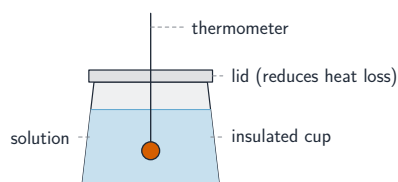
Breaking bonds takes energy in;
making bonds gives it out:

$$\Delta H_r = \sum(\text{broken}) - \sum(\text{made})$$



$$(436 + 242) - (2 \times 431) = -184 \text{ kJ mol}^{-1}$$

Measuring ΔH



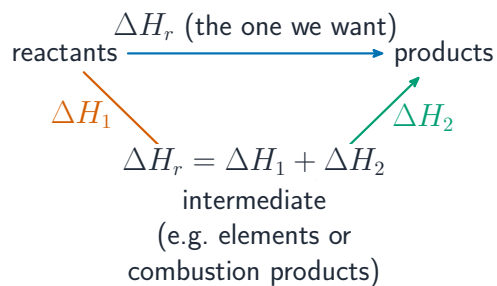
Heat transferred: $q = mc\Delta T$ (specific
heat capacity 比热容 c).

$$\Delta H = -\frac{mc\Delta T}{n}$$

0.50 g methanol heats 100 g water
by 18°C

$$q = 7520 \text{ J}, n = 0.0156 \Rightarrow \Delta H_c \approx -480 \text{ kJ mol}^{-1}$$

Hess's law



Hess's law 盖斯定律: the total
enthalpy change is the same by
any route (energy is conserved).

An **energy cycle** 能量循环
finds a ΔH you cannot
measure directly: $\Delta H_r =$
 $\Delta H_1 + \Delta H_2$.

3

Recap

Chemical Energetics

└ Recap

Topic 5 – key takeaways

1 Enthalpy

exothermic $\Delta H < 0$; endothermic $\Delta H > 0$

2 Bond energy

$\Delta H = \text{bonds broken} - \text{bonds made}$

3 Calorimetry

$q = mc\Delta T$; $\Delta H = -q/n$

4 Hess's law

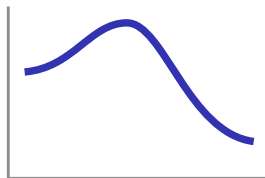
ΔH is route-independent

Chemical Energetics

└ Recap

Check yourself

- 1 Sign of ΔH for an exothermic reaction?
- 2 Does breaking a bond take in or give out energy?
- 3 Write the equation for heat transferred.
- 4 What does Hess's law say about the route?



Answers 1. negative 2. takes in energy 3. $q = mc\Delta T$ 4. it is the same by any route