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Chemistry

For the IB Diploma

Brighter Thinking
Better Learning

Chapter 13

Energy cycles in reactions

Bond enthalpy

- **Bond enthalpy** the enthalpy change when one mole of covalent bonds, in a gaseous molecule, is broken under standard conditions. Bond breaking requires energy (endothermic), ΔH is positive; bond making releases energy (exothermic), ΔH is negative.
- **Average bond enthalpy** the average amount of energy required to break one mole of covalent bonds, in gaseous molecules, under standard conditions.
- *'Average'* refers to the fact that the bond enthalpy is different in different molecules and, therefore, the value quoted is the average amount of energy to break a particular bond in a range of molecules.

Bond enthalpies

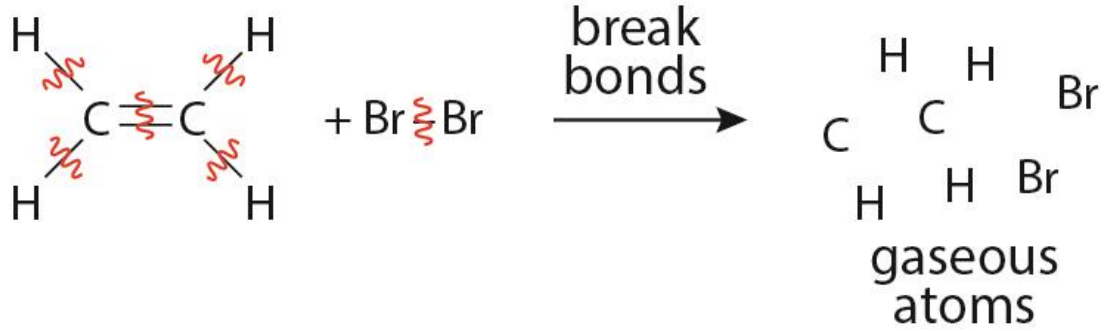

Figure 13.1: All bonds in reactants breaking.

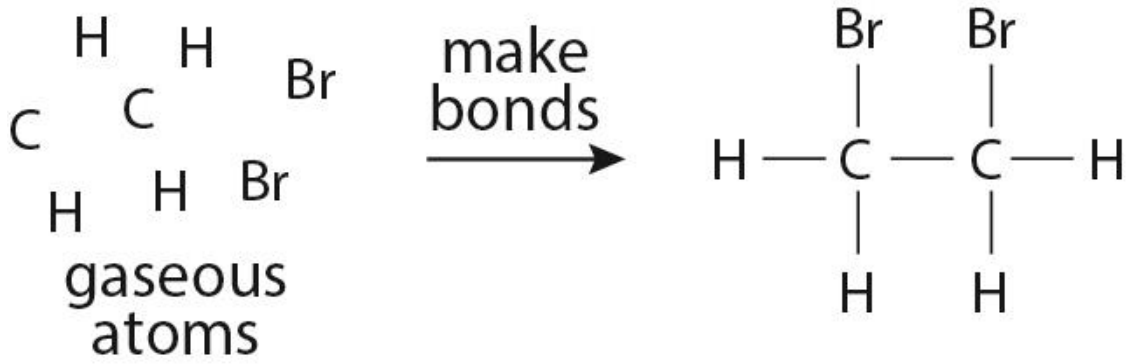

Figure 13.2: All bonds being formed to make the product.

Hess' law

The enthalpy change accompanying a chemical reaction is independent of the pathway between the initial and final states.

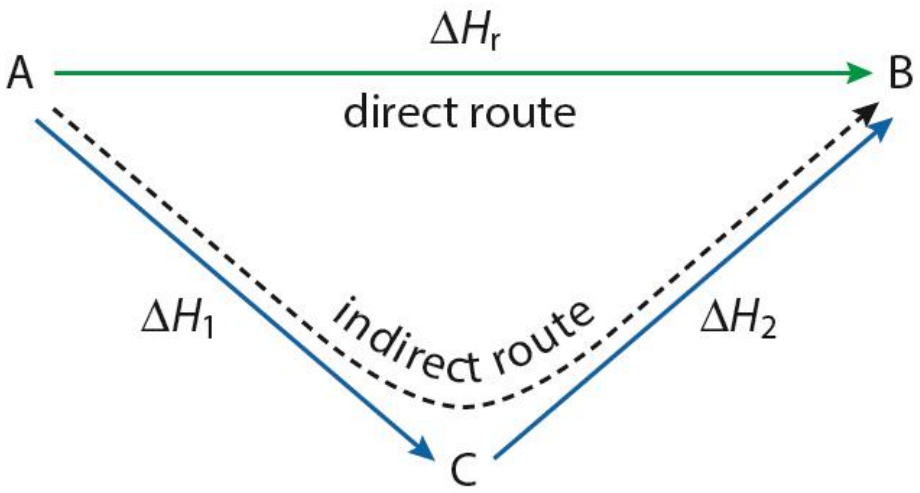

Figure 13.3: If we know the enthalpy change for the conversion B → C, rather than C → B, the arrow between B and C is the other way around.

How to calculate Δ*H* using Hess's law

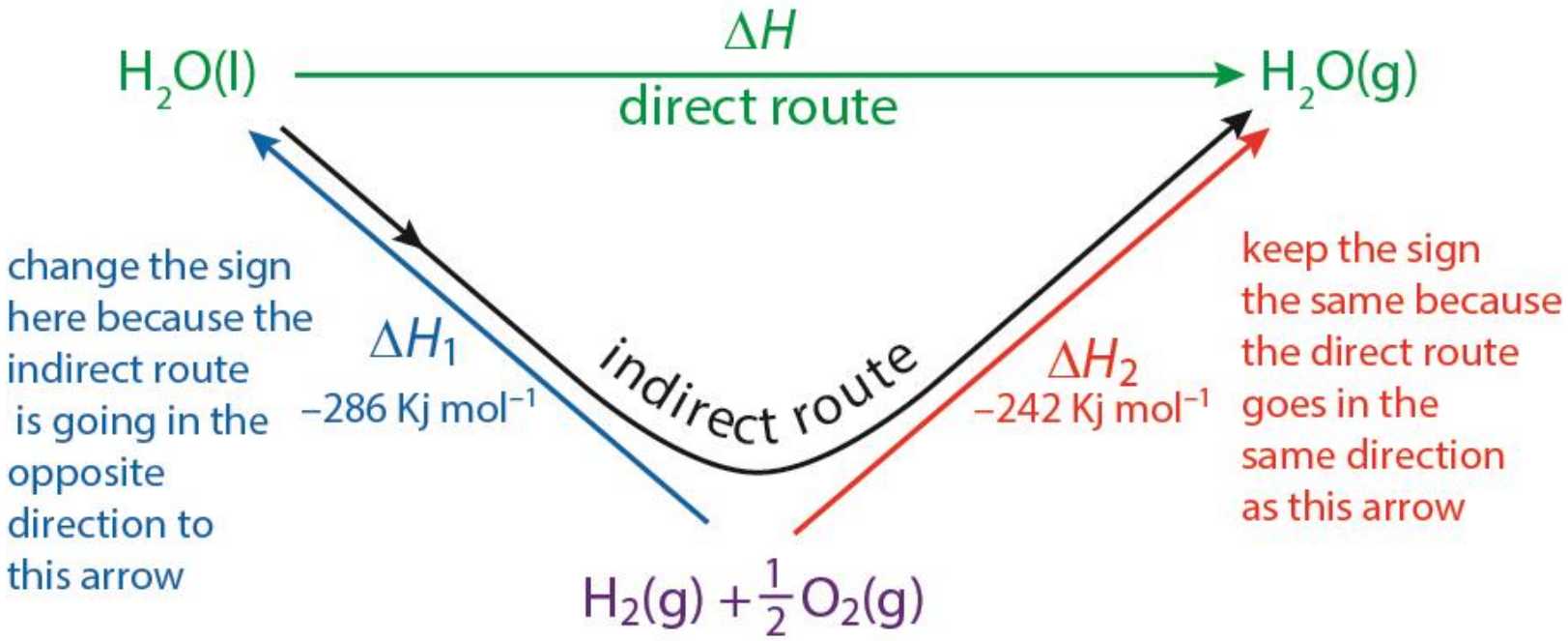

Figure 13.4: Calculating Δ*H* using Hess's law.

Using enthalpies of formation

$$\Delta H^{o} = \Sigma \quad \Delta H_f(\text{products}) - \Sigma \quad \Delta H_f(\text{reactants})$$

Born–Haber cycle of magnesium oxide

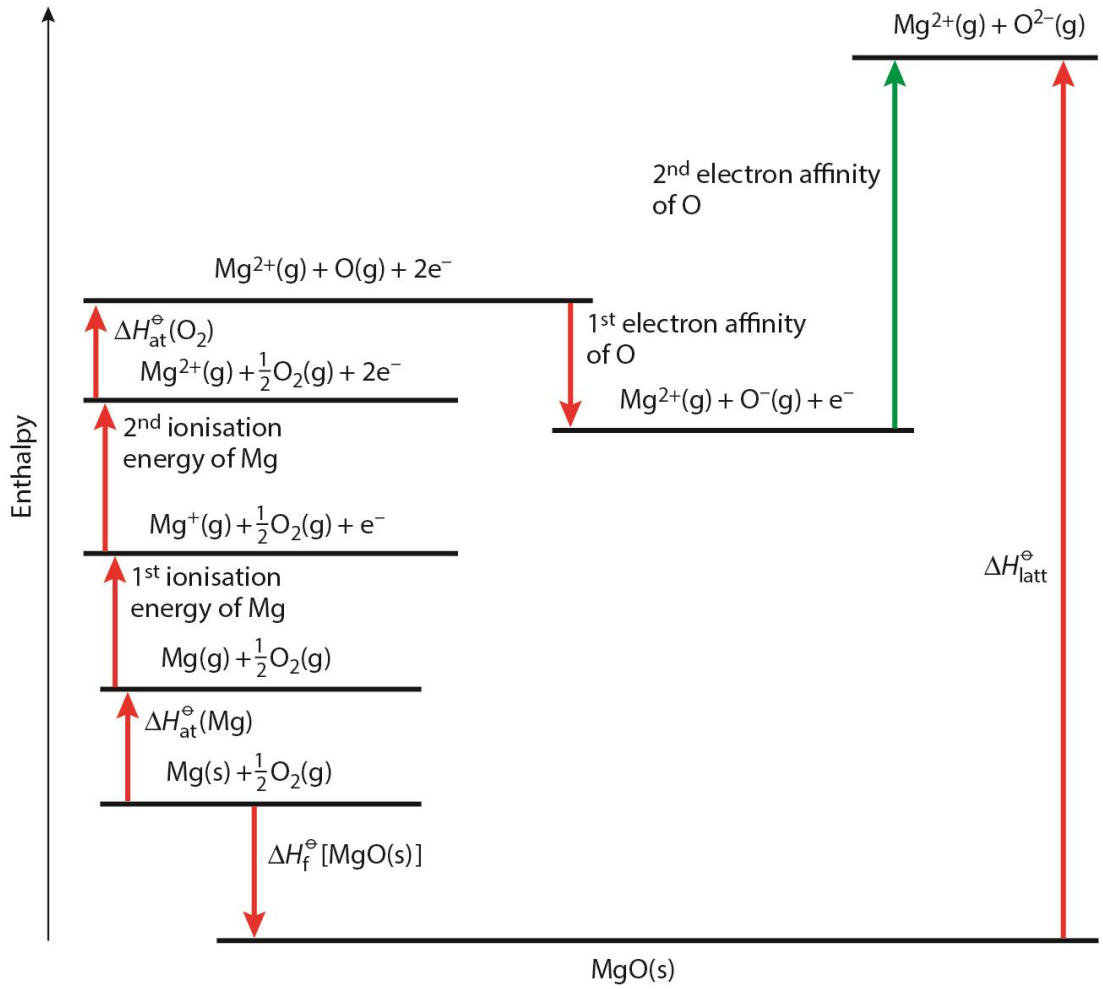

Figure 13.5: Born–Haber cycle for magnesium oxide.