



Endothermic	<i>Energy is taken in from the surroundings so the temperature of the surroundings decreases</i>	- Thermal decomposition - Sports injury packs
Exothermic	<i>Energy is transferred to the surroundings so the temperature of the surroundings increases</i>	- Combustion - Hand warmers - Neutralisation

Ionic half equations	Negative electrode: $2\text{H}_2 (\text{g}) + 4\text{OH}^- (\text{aq}) \rightarrow 4\text{H}_2\text{O} (\text{l}) + 4\text{e}^-$	Positive electrode: $\text{O}_2 (\text{g}) + 2\text{H}_2\text{O} (\text{l}) + 4\text{e}^- \rightarrow 4\text{OH}^- (\text{aq})$
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Hydrogen fuel cells	<i>Word equation:</i> <i>hydrogen + oxygen → water</i>	Symbol equation: $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
	Advantages: - No pollutants produced - Can be a range of sizes	Disadvantages: - Hydrogen is highly flammable - Hydrogen is difficult to store

Reaction profiles	<i>Show the overall energy change of a reaction</i>
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Breaking bonds in reactants	<i>Endothermic process</i>
Making bonds in products	<i>Exothermic process</i>

Overall energy change of a reaction	<i>Exothermic</i>	Energy released making new bonds is greater than the energy taken in breaking existing bonds.
	<i>Endothermic</i>	Energy needed to break existing bonds is greater than the energy released making new bonds.

Bond energy calculation	Calculate the overall energy change for the forward reaction $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$ Bond energies (in kJ/mol): H-H 436, H-N 391, N≡N 945
	Bond breaking: $945 + (3 \times 436) = 945 + 1308 = 2253 \text{ kJ/mol}$ Bond making: $6 \times 391 = 2346 \text{ kJ/mol}$ Overall energy change = $2253 - 2346 = -93 \text{ kJ/mol}$ Therefore reaction is exothermic overall.

Types of reaction

The energy change of reactions (HT only)

AQA GCSE Energy changes

Fuel cells (Chemistry only)

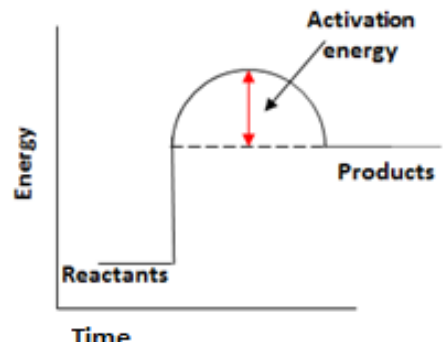
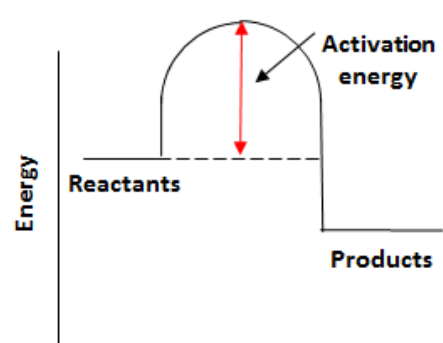
Reaction profiles

Activation energy	<i>Chemical reactions only happen when particles collide with sufficient energy</i>	The minimum amount of energy that colliding particles must have in order to react is called the activation energy.
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Cells and batteries (Chemistry only)

Simple cell	<i>Make a simple cell by connecting two different metals in contact with an electrolyte</i>	Increase the voltage by increasing the reactivity difference between the two metals.
Batteries	<i>Consist of two or more cells connected together in series to provide a greater voltage.</i>	

Non-rechargeable cells	<i>Stop when one of the reactants has been used up</i>	Alkaline batteries
Rechargeable cells	<i>Can be recharged because the chemical reactions are reversed when an external electrical current is supplied</i>	Rechargeable batteries

Endothermic		Products are at a higher energy level than the reactants. As the reactants form products, energy is transferred from the surroundings to the reaction mixture. The temperature of the surroundings decreases because energy is taken in during the reaction.
Exothermic		Products are at a lower energy level than the reactants. When the reactants form products, energy is transferred to the surroundings. The temperature of the surroundings increases because energy is released during the reaction.