AQA GCSE Energy changes

Types of reaction

Endothermic	*Energy is taken in from the surroundings so the temperature of the surroundings decreases*	• Thermal decomposition • Sports injury packs
Exothermic	*Energy is transferred to the surroundings so the temperature of the surroundings increases*	• Combustion • Hand warmers • Neutralisation

Reaction profiles	*Show the overall energy change of a reaction*

The energy change of reactions (HT only)

Breaking bonds in reactants	*Endothermic process*
Making bonds in products	*Exothermic process*

Overall energy change of a reaction		
	Exothermic	Energy released making new bonds is greater than the energy taken in breaking existing bonds.
	Endothermic	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 $N_2 + 3H_2 \rightleftharpoons 2NH_3$ Bond energies (in kJ/mol): H-H 436, H-N 391, N≡N 945
	Bond breaking: 945 + (3 x 436) = 945 + 1308 = 2253 kJ/mol Bond making: 6 x 391 = 2346 kJ/mol Overall energy change = 2253 - 2346 = -93kJ/mol Therefore reaction is exothermic overall.

Cells and batteries (Chemistry only)

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

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

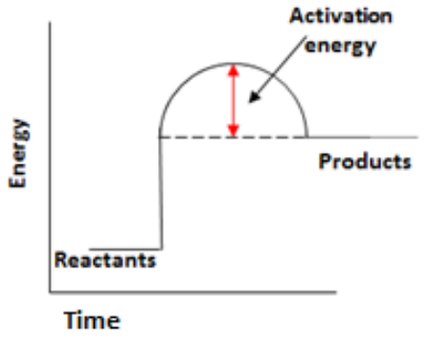
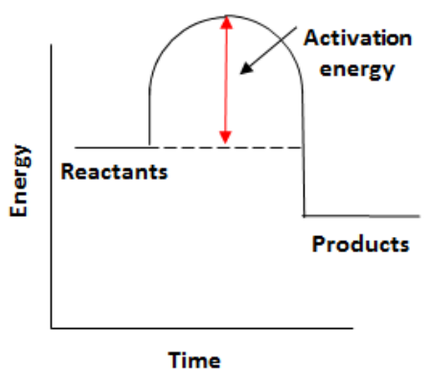
Fuel cells (Chemistry only)

Ionic half equations		
	Negative electrode: $2H_2$ (g) + $4OH^-$ (aq) → $4H_2O$ (l) + $4e^-$	Positive electrode: O_2 (g) + $2H_2O$ (l) + $4e^-$ → $4OH^-$ (aq)

Hydrogen fuel cells		
	Word equation: *hydrogen + oxygen → water*	Symbol equation: $2H_2 + O_2 \rightarrow 2H_2O$
	Advantages: • No pollutants produced • Can be a range of sizes	Disadvantages: • Hydrogen is highly flammable • Hydrogen is difficult to store

Reaction profiles

Activation energy		
	Chemical reactions only happen when particles collide with sufficient energy	The minimum amount of energy that colliding particles must have in order to react is called the activation energy.

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.

AQA GCSE Energy changes

Types of reaction

Energy is taken in from the surroundings so the temperature of the surroundings decreases	• Thermal decomposition • Sports injury packs
Energy is transferred to the surroundings so the temperature of the surroundings increases	• Combustion • Hand warmers • Neutralisation

Show the overall energy change of a reaction	

The energy change of reactions (HT only)

	Endothermic process
	Exothermic process

Exothermic	Energy released making new bonds is greater than the energy taken in breaking existing bonds.
Endothermic	Energy needed to break existing bonds is greater than the energy released making new bonds.

Calculate the overall energy change for the forward reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$ Bond energies (in kJ/mol): H-H 436, H-N 391, N≡N 945
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Cells and batteries (Chemistry only)

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

Stop when one of the reactants has been used up		Alkaline batteries
Can be recharged because the chemical reactions are reversed when an external electrical current is supplied		Rechargeable batteries

Fuel cells (Chemistry only)

	Negative electrode: $2H_2$ (g) + $4OH^-$ (aq) → $4H_2O$ (l) + $4e^-$	Positive electrode: O_2 (g) + $2H_2O$ (l) + $4e^-$ → $4OH^-$ (aq)

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Reaction profiles

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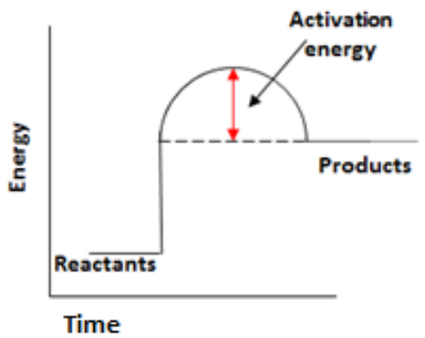
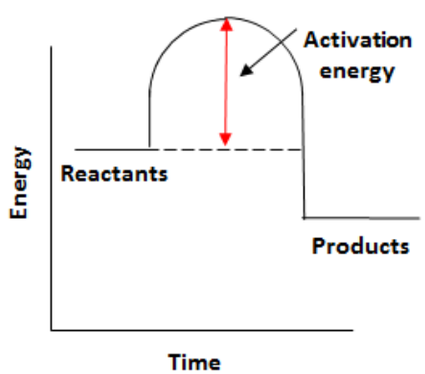
		Products are at a higher energy level than the reactants. As the reactants form products, energy is transferred from the surroundings to the reaction mixture. The temperature of the surroundings decreases because energy is taken in during the reaction.
		Products are at a lower energy level than the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

AQA GCSE Energy changes

Types of reaction

Endothermic		• Thermal decomposition • Sports injury packs
Exothermic		• Combustion • Hand warmers • Neutralisation

Fuel cells (Chemistry only)

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	Word equation:	Symbol equation:
	Advantages:	Disadvantages:

The energy change of reactions (HT only)

Reaction profiles	
Breaking bonds in reactants	
Making bonds in products	

Overall energy change of a reaction		Energy released making new bonds is greater than the energy taken in breaking existing bonds.
		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

$N_2 + 3H_2 \rightleftharpoons 2NH_3$

Bond energies (in kJ/mol): H-H 436, H-N 391, N≡N 945

Bond breaking: 945 + (3 x 436) = 945 + 1308 = 2253 kJ/mol

Bond making: 6 x 391 = 2346 kJ/mol

Overall energy change =

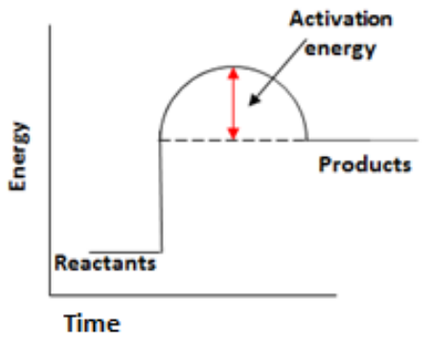
Therefore reaction is exothermic overall.

Cells and batteries (Chemistry only)

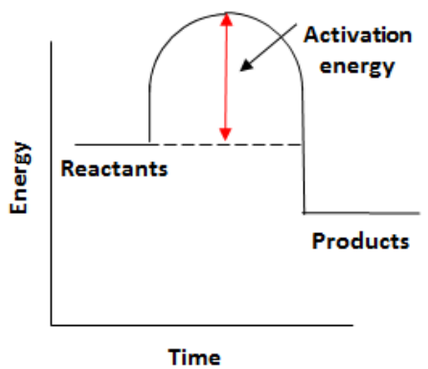
Simple cell		Increase the voltage by increasing the reactivity difference between the two metals.
Batteries		
Non-rechargeable cells		Alkaline batteries
Rechargeable cells		Rechargeable batteries

Reaction profiles

Activation energy		The minimum amount of energy that colliding particles must have in order to react is called the activation energy.



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.



AQA GCSE Energy changes

Types of reaction

Endothermic		Examples:
Exothermic		Examples:

Reaction profiles

Reaction profiles	

The energy change of reactions (HT only)

Breaking bonds in reactants	
Making bonds in products	

Overall energy change of a reaction		

Bond energy calculation

Calculate the overall energy change for the forward reaction **$N_2 + 3H_2 \rightleftharpoons 2NH_3$** **Bond energies (in kJ/mol): H-H 436, H-N 391, N≡N 945**

Cells and batteries (Chemistry only)

Simple cell		
Batteries		

Non-rechargeable cells		Example:
Rechargeable cells		Example:

Ionic half equations

Negative electrode:	**Positive electrode:**

Fuel cells (Chemistry only)

Word equation:	**Symbol equation:**
Advantages:	**Disadvantages:**

Reaction profiles

Activation energy