AQA GCSE Chemistry: Topic 5
## "Grade 7" Examiner Cheat Sheet — Energy Changes

Section 1: The Energy Change Rosetta Stone

Fundamental Principle: Energy is conserved in chemical reactions. The total energy in the universe at the end is the same as at the start.

Feature	Exothermic	Endothermic
Energy Flow	Transfers energy **to** the surroundings.	Takes energy **in from** surroundings.
Temp Change	Surroundings get **hotter**.	Surroundings get **colder**.
Examples	Combustion, Neutralisation, Hand warmers.	Thermal decomposition, Sherbet, Ice packs.

Section 2: Reaction Profile (Exothermic Example)

Activation Energy (E_a): The **minimum amount of energy** particles must have to react.
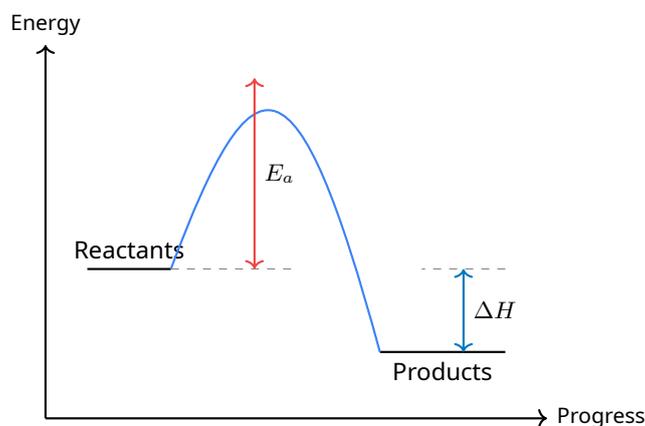
GRADE 7 LOGIC:

- **Exothermic:** Products are **lower** than reactants (Energy released).
- **Endothermic:** Products are **higher** than reactants (Energy absorbed).

Section 3: Catalysts & Success

Mechanism: Catalysts provide an **alternative reaction pathway** with a **lower activation energy**.

- They increase the **frequency of successful collisions**.
- They are not used up; the same mass remains at the end.

Section 4: The Bond Energy Algorithm (Higher Tier)

The Rule: Energy is needed to **break** bonds. Energy is released when bonds are **made**.

Process	Energy Type
Breaking Bonds (Reactants)	**Endothermic** (Energy in)
Making Bonds (Products)	**Exothermic** (Energy out)

The "Master Equation":

$$\text{Overall Energy Change} = \text{Sum of Bonds Broken} - \text{Sum of Bonds Made}$$

Interpret your result:

- If the answer is **Negative ($-$)** $\rightarrow$ **Exothermic**.
- If the answer is **Positive ($+$)** $\rightarrow$ **Endothermic**.

Section 5: Worked Calculation Strategy

Task: Calculate energy change for: $H_2 + Cl_2 \rightarrow 2HCl$ *Bonds (kJ/mol):* $H - H(436)$, $Cl - Cl(242)$, $H - Cl(431)$.

Step 1: Bonds Broken (Reactants)

- $(1 \times 436) + (1 \times 242) =$ **678** kJ/mol

Step 2: Bonds Made (Products)

- $2 \times (H - Cl) = 2 \times 431 =$ **862** kJ/mol

Step 3: Final Calculation

- $678 - 862 = -$**184** kJ/mol
- **Result:** Exothermic (negative sign).

Section 6: Required Practical 4 — Temperature Changes

Objective: To investigate variables affecting temperature changes in solutions.
The Procedure:

1. Place 30 cm^3 of dilute acid into a **polystyrene cup**.

2. Stand the cup inside a glass beaker for stability.

3. Record the starting temperature.

4. Add 5 cm^3 of alkali and add a **plastic lid**.

5. **Stir** the solution through the lid with the thermometer.

6. Record the **maximum** temperature reached.

7. Repeat until 40 cm^3 of alkali has been added in total.

Section 7: Experimental Accuracy Masterlist

How do we reduce energy loss to the surroundings?

1. **Polystyrene Cup:** It is a good **thermal insulator** (unlike glass).

2. **Plastic Lid:** Reduces energy loss through evaporation and convection.

The Variables:

- **Independent:** Volume of alkali added.
- **Dependent:** Maximum temperature reached.
- **Control:** Concentrations of solutions, initial temperature.

Section 8: The Cooling Curve Trap (HT)

Graph Observation: Why does the temperature start to fall after a certain volume?

- All the acid has been **neutralised** (limiting reactant is gone).
- No more energy is being released.
- Adding more cool liquid just **dilutes and cools** the existing hot mixture.

Section 9: Chemical Cells & Batteries (Triple Only)

The Cell: Two different metals in an electrolyte connected by a wire.

- **Voltage Rule:** The bigger the **difference in reactivity** between the two metals, the higher the voltage produced.

- **Batteries:** Two or more cells connected in series.

Non-rechargeable: One of the reactants is **used up**. Reaction stops (e.g. Alkaline batteries). **Rechargeable:** The chemical reaction can be **reversed** by an external electric current.

Section 10: Hydrogen Fuel Cells (Triple Science)

Overview: Hydrogen is oxidised to produce a potential difference. **Overall Equation:** $2H_2 + O_2 \rightarrow 2H_2O$
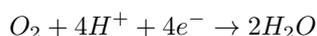
Fuel Cell Pros	Rechargeable Battery Pros
Refills faster than charging.	No flammable hydrogen to store.
Only waste product is water.	Cheaper to produce initially.
No pollutants at point of use.	More widespread charging points.

Section 11: Fuel Cell Half Equations (HT Only)

At the Negative Electrode (Anode):
$$2H_2 \rightarrow 4H^+ + 4e^-$$

At the Positive Electrode (Cathode):
$$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$$

Grade 7 Logic: Hydrogen is **oxidised** (loses electrons) at the anode. Oxygen is **reduced** (gains electrons) at the cathode.

"Topic 5: Mastering energy profiles and bond maths completes your Paper 1 skills."