KNOWLEDGE — Chemistry Topic C6 Rates & Extent of Chemical Change — ORGANISER

Section 1: Rate of reaction Key terms

Rate of reaction	Tells you **how fast** reactants turn into products
Collision theory	**Reactions can only take place** when **particles collide with enough energy**.
Activation energy	The minimum amount of **energy particles** need in order **to react**.
Catalyst	A chemical (or **enzyme**) that **increases the rate of reaction without being used up itself**. They **provide an alternative pathway** for the reaction with a **lower activation energy**.
Concentration	The **number of particles** in a certain **volume.**
Surface area	The surface area of a solid is a measure of the **total area** that the **surface of the solid occupies**.
Pressure	The pressure of a gas is the **force** that the **gas exerts** on the **walls of the container**.

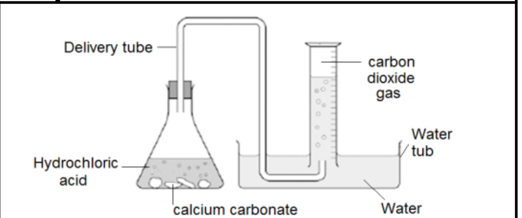
Section 2: How can you find out the rate of reaction

There are two ways you can work out the rate of a chemical reaction. You can find out how quickly:

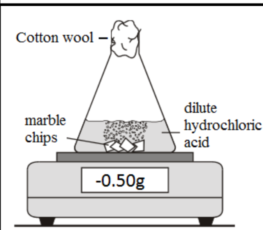
- The reactants are used up
- The products are made

There are **three techniques** that can be used:

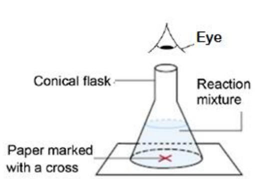
1. Measuring the increasing volume of a gas given off.



2. Measuring the decreasing mass of a reactant mixture.



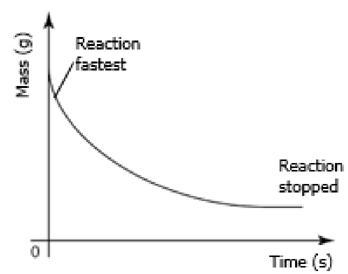
3. Disappearing cross method: measuring the decreasing light passing through a solution.



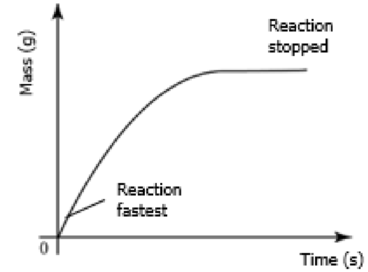
Section 3: Calculating rate of reaction

$$\text{Mean rate of reaction} = \frac{\text{quantity of reactant used}}{\text{time}} \quad \textit{or} \quad \text{Mean rate of reaction} = \frac{\text{quantity of product formed}}{\text{time}}$$

Typical graph when measuring **reactants used**



Typical graph when measuring **products formed**



Section 4: Factors Affecting Rate of reaction

Factor	Effect on Rate	Explanation
Concentration of reactants	Increasing the concentration **increases** the rate of reaction.	**Increases the frequency of a collision** as particles are **closer together**.
Pressure **of gases**	Increasing the pressure **increases** the rate of reaction.	**Increases the frequency of a collision** as particles are **closer together**.
Surface area of solid reactants	Increasing the surface area **increases** the rate of reaction.	**Exposes more of the solid** so that there is a **greater frequency of collisions** occurring.
Temperature	Increasing the temperature **increases** the rate of reaction.	Particles **collide more frequently** and with **more energy**.
Catalyst	Catalysts **increase** the rate of reaction.	**Lowers** the **activation energy** by providing an **alternate pathway**.

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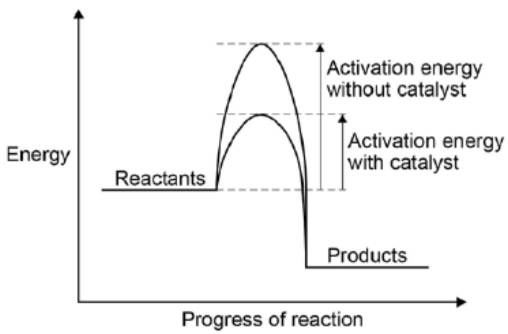
Section 4 (cont): How Catalysts work

The reaction profile diagram of an uncatalysed and a catalysed exothermic reaction is shown below. The catalyst lowers the activation energy of the reaction.



Section 5: Reversible Reactions key terrms

Reversible reaction	A reaction in which the **products can also form the reactants**. Its symbol is ⇌ Shown as: A + B ⇌ C + D
Exothermic	A reaction that **transfers energy to** the **surroundings**
Endothermic	A reaction that **takes in energy from** the **surroundings**
Equilibrium (HT)	Equilibrium is reached when the **forward and backwards reactions** occur at **exactly the same rate**. The **amounts of reactants and products present remain constant**. Requires a **sealed container**.
Le Chatelier's Principle (HT)	When a **change in conditions** is introduced to a system at equilibrium, the **position of equilibrium shifts** so as **to cancel out the change.**

Section 6: Altering conditions (HT)

	If the forward reaction is exothermic	If the forward reaction is endothermic
Changing temperature (HT)	An **increase in temperature** shifts the equilibrium in the **backwards (endothermic) direction**. Hence the amount of **products decreases.**	An **increase in temperature** shifts the equilibrium in the **forwards (endothermic) direction**. Hence the amount of **products increases**.
	A **decrease in temperature** shifts the equilibrium in the **forwards (exothermic) direction**. Hence the amount of **products increases**.	A **decrease in temperature** shifts the equilibrium in the **backwards (exothermic) direction**. Hence the amount of **products decreases**.

Changing concentration (HT)

- If we increase the concentration of one of the reactants, Le Chatelier's principle says that the **equilibrium will shift in the direction** that tends to **reduce the concentration** of this reactant.
  A + B ⇌ C + D
- Increasing the concentration of reactant A, the only way the system can reduce the concentration of A, is by some of A reacting with B. Hence the equilibrium moves in the forwards direction and more C & D are made.

- If the **concentration of a reactant is increased**, the equilibrium shits in **the forwards direction** to decrease the amount of reactant, **hence more products** will be formed.
- If the concentration of a product is decreased, more products will be formed.

Changing pressure (HT)

For reactions of **gases**:
- an **increase in pressure** causes the reaction to favour the **side with the smaller number of molecules** (as shown by the balanced symbol equation for that reaction).
- A **decrease in pressure** causes the reaction to favour the **side with the larger number of molecules** (as shown by the balanced symbol equation for that reaction).
  e.g. $N_2O_{4(g)} \rightleftharpoons 2NO_{2(g)}$
- **Decreasing the pressure** in this reaction shifts the equilibrium to the side with the **most gas molecules.** Hence the equilibrium shifts in the **forwards direction**.