Your notes

GCSE Chemistry: revision notes

Rates of reaction

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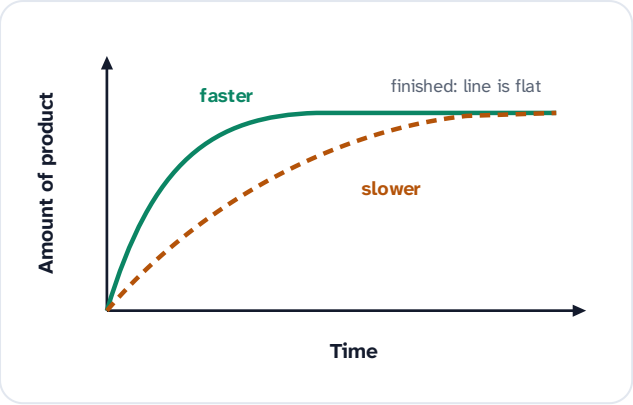
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Start here: how fast a reaction goes

- Some reactions are very fast (an explosion), some very slow (rusting). The rate is how much reactant is used up, or product made, each second.
- For particles to react, they have to collide with enough energy. The smallest energy they need is the **activation energy**.
- Anything that makes successful collisions happen more often speeds a reaction up: a higher temperature, a higher concentration or pressure, a bigger **surface area**, or a **catalyst**.

Measuring rate

- The rate of a reaction can be found by measuring how quickly a reactant is used up or a product is formed.
- Mean rate = quantity of reactant used ÷ time taken, or quantity of product formed ÷ time taken.
- Units are often g/s or cm^3/s. (Higher) Rate can also be measured in mol/s.
- On a graph of product against time, a steeper gradient means a faster rate. The line levels off when the reaction stops.
- (Higher) The rate at a particular time is the gradient of a **tangent** drawn to the curve at that time.



Collision theory

- Chemical reactions can only happen when reacting particles collide with enough energy: at least the **activation energy**.
- The rate depends on how often particles collide (frequency) and how many collisions have enough energy.

Factors that affect rate

- Concentration (or pressure of gases): more particles in the same volume, so collisions are more frequent.
- **Surface area**: breaking a solid into smaller pieces exposes more particles, so collisions are more frequent.
- Temperature: particles move faster, so they collide more often and more of the collisions have enough energy. This has the biggest effect.
- **Catalysts**: they speed up reactions without being used up.

Catalysts

- A **catalyst** changes the rate of a reaction but is not used up. It is not included in the word equation.
- It provides a different reaction pathway with a lower **activation energy**, so more collisions are successful.
- Different reactions need different **catalysts**. Enzymes are biological **catalysts**.

Required practical: concentration and rate

- Gas method: react magnesium ribbon with hydrochloric acid of different concentrations, and measure the volume of hydrogen collected in a **gas syringe** at regular intervals.
- Colour change method: react sodium thiosulfate with hydrochloric acid in a flask over a cross drawn on paper. Time how long it takes for the cloudy sulfur to hide the cross.
- Keep other variables the same: temperature, volumes and mass or length of magnesium.

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Exam tip

- Use **collision theory**: say more frequent successful collisions, or more collisions per second, not only 'more collisions'.
- Rate is the gradient of the graph: steepest at the start, flat when the reaction stops.

Common mistakes

- Forgetting that higher temperature also gives particles more energy, so more collisions succeed.
- Saying a **catalyst** gets used up, or that it gives particles more energy. It lowers the **activation energy**.

Worked examples

A reaction gives off 60 cm^3 of gas in 30 s. Find the mean rate of reaction.

Use mean rate = amount of product ÷ time. **60 ÷ 30**

Answer: 2 cm^3/s

Key terms

Rate of reaction	How quickly reactants are used up or products are formed.
Collision theory	Reactions happen when particles collide with enough energy.
Activation energy	The minimum energy particles need to react when they collide.
Catalyst	A substance that speeds up a reaction without being used up.
Surface area	The total area of the surface of a solid that is exposed to other reactants.
Tangent	A straight line that touches a curve at one point; its gradient gives the rate at that time.
Gas syringe	Apparatus used to measure the volume of gas produced.

Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

1. What must happen for particles to react?
2. Why does increasing concentration increase the rate?
3. Why does powder react faster than a lump of the same solid?
4. Why does raising the temperature increase the rate?

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5. How does a catalyst speed up a reaction?
6. A reaction produces 60 cm^3 of gas in 30 s. What is the mean rate?
7. What does a steeper line on a volume–time graph show?
8. Why does the graph level off at the end?

Answers

1. They must collide with enough energy
2. Particles collide more frequently
3. It has a larger surface area
4. Particles collide more often and with more energy
5. It provides a pathway with a lower activation energy
6. 2 cm^3/s
7. A faster rate
8. One of the reactants has been used up

What to do next

Practise 11 questions on this topic

Try 7 exam questions, with mark schemes

Read the lesson, one step at a time

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