GCSE · CHEMISTRY · FOUNDATION & HIGHER (H = HIGHER ONLY)

Rates of reaction

Learn with Fred
cheat sheet

A reaction happens when particles **collide** with enough energy. Anything that makes collisions **more frequent** or **more energetic** speeds the reaction up.

1 Mean rate

$$\text{mean rate} = \frac{\text{quantity}}{\text{time}}$$

quantity product made (or reactant used up)

units cm^3/s, g/s or mol/s

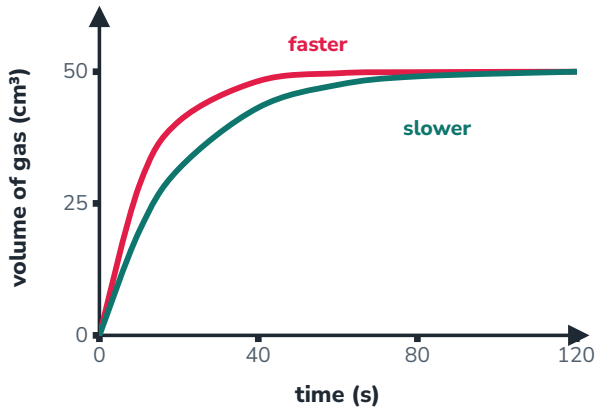
Example: marble chips + acid

48 cm^3 of carbon dioxide is made in 60 s

48 ÷ 60 = 0.8 cm^3/s

Measure it by **gas volume** (syringe), **loss of mass** on a balance, or time for a cross to **disappear** as the mixture goes cloudy.

2 Reading the graph



- **Steeper** line = **faster** rate.
- It is steepest at the **start**, when the reactants are at their highest concentration.
- The line **levels off** when the limiting reactant is used up.
- Same amounts of reactants: **same final volume**.

3 Collision theory: four ways to speed it up

Change	Why the rate goes up
higher temperature	particles move faster: **more collisions** per second, and **more have enough energy** (activation energy)
higher concentration or gas pressure	more particles in the same space: collisions **more frequent**
larger surface area (smaller pieces)	more particles exposed: collisions **more frequent**
catalyst	a different route with **lower activation energy**: more collisions succeed. It is **not used up**

4 Rate at one moment (H)

1. Draw a **tangent**: a straight line touching the curve at that time.
2. Pick two points on the tangent, far apart.
3. Rate = **change in y ÷ change in x**.

Example

tangent rises 30 cm^3 over 40 s

30 ÷ 40 = 0.75 cm^3/s

Watch out

- ✕ Mixing up **rate** with **amount**. A faster reaction does not make more product: that depends on how much reactant you start with.
- ✕ Saying a higher temperature just means "more collisions". Also say **more of them have enough energy**.
- ✕ Saying a catalyst gets **used up**, or that it adds energy. It lowers the activation energy and is unchanged at the end.
- ✕ Reading the graph backwards: a curve that is **still rising** means the reaction is **not finished**.

Exam tips

- In explanations, use the words **frequency of collisions** and **energy of collisions**, not "more collisions" alone.
- Always give **units** with a rate, and show the division.
- For "compare two curves", say which is **steeper** and whether they end at the **same height**.

Try it: a reaction makes 90 cm^3 of gas in 45 s. What is the mean rate? Then say what powdering the solid would do to the graph.

Check your answer with Fred: scan the code or go to **learnwithfred.co.uk/cs** to try Learn with Fred free.