

Chemistry C8 - Rates and Equilibrium

1: What is rate of reaction? And why is it important to know?

Rate means speed. We can increase the rate of a reaction to make a product faster. Scientists want to increase the speed of a reaction but also **reduce the energy needed** (£££).

2: Collision Theory - describing how reactions happen

For a reaction to take place particles must:

1. collide in the **right orientation** (direction) to react
2. collide with **enough energy** to react.

frequency of collisions: how often particles bump into each other
Higher frequency is likely to lead to a faster reaction so long as the particles have enough energy when they collide.

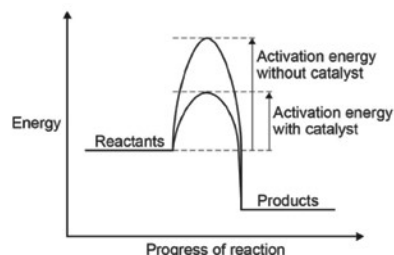
activation Energy (E_A): minimum amount of energy they require.

The effect on the rate of increasing a variable:

Variable to increase	Effect on collisions	Effect on Energy	Overall rate change
surface area	more frequent	no change	increase
concentration	more frequent	no change	increase
pressure	more frequent	no change	increase
temperature	more frequent	increases energy	increase
use a catalyst	no change	reduces the E_A	increase

Reaction profiles show the relative difference in the energy level of the reactants compared to the products.

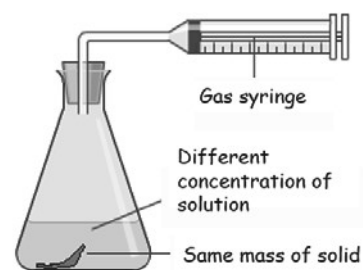
You also learnt about reaction profiles in C7 Energy Changes.



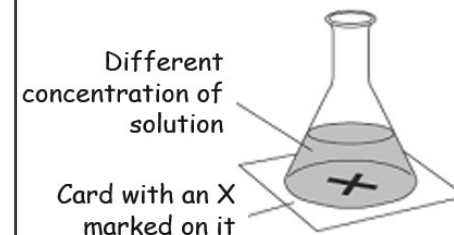
3: Measuring rate as concentration changes (required practical)

As the concentration of a reagent is increased, the reaction rate increases. This can be observed and tested for in two ways:

Measure volume of gas produced:



Measure the turbidity of solution (how quickly the X disappears):



4: Calculating the rate of a reaction

$$\text{Mean rate of reaction} = \frac{\text{quantity of reactants used (g)}}{\text{time taken (s)}} = \text{rate (g/s)}$$

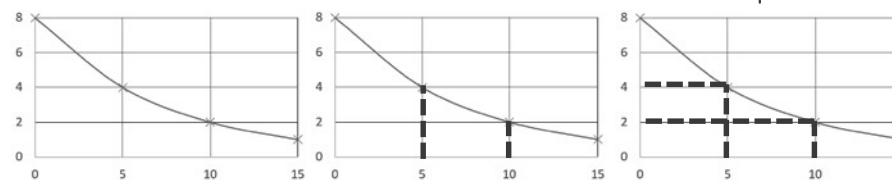
or

$$\frac{\text{volume of gas produced (cm}^3\text{)}}{\text{time taken (s)}} = \text{rate (cm}^3\text{/s)}$$

Tip: always calculate rates per second (1 min = 60 seconds)

(HIGHER ONLY)
need to know mol/s as well!

Steps to calculating the mean rate from a graph: What is the mean rate of reaction between 5 to 10 seconds for the mass of reactants used up?



$$\begin{aligned} \text{Mean rate of reaction} &= \text{quantity of reactants used (g)} \div \text{time taken (s)} \\ &= (4 \text{ g} - 2 \text{ g}) \div (10 \text{ s} - 5 \text{ s}) \\ &= 0.5 \text{ g/s} \end{aligned}$$

A **catalyst** is a chemical added to a reaction which increase the rate.

Catalysts are **not** used up and be used over and over many times.

Enzymes are biological catalysts.

Catalysts are **not** reactants, so they are **not** written in the chemical equation.

They increase the rate by providing an **alternative reaction pathway** with **lower activation energy**.

Different reactions need different catalysts.