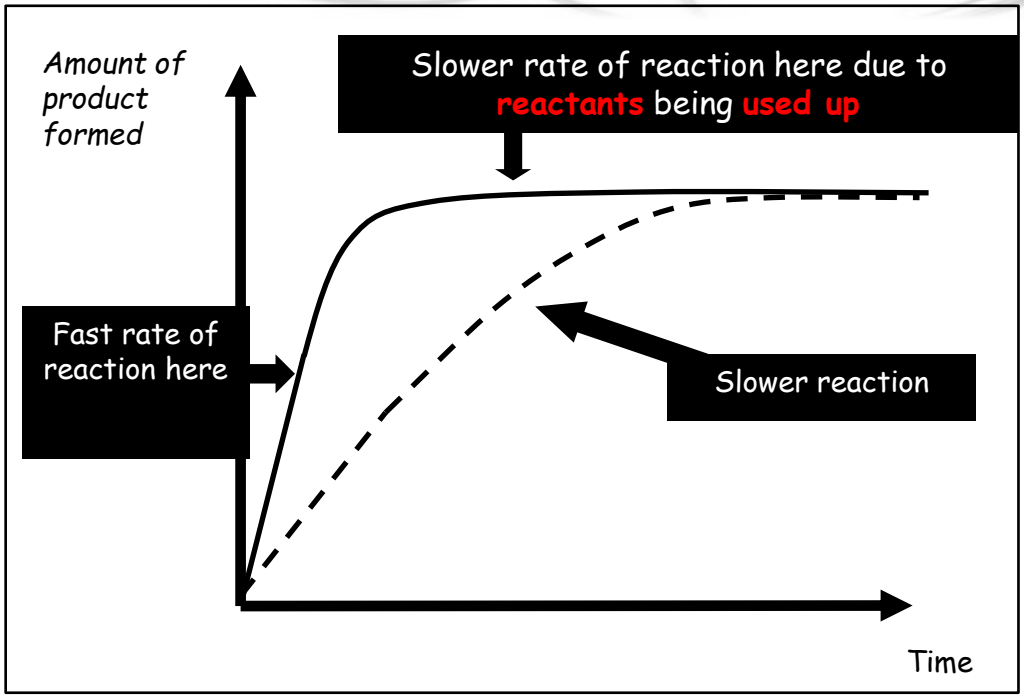
Reaction rates



Reactions occur when particles **collide** with sufficient **energy**. The minimum amount of energy required for particles to react on collision is called the **activation energy**.

Reaction can be followed by:

- **Loss** in mass if **gas** produced.
- Measuring **volume** of a gas produced every min.
- Appearance/disappearance of **colour**.
- Change in **pH** etc.

$$Rate\ of\ reaction = \frac{amount\ of\ \mathbf{reactant}\ used}{time}$$

$$Rate\ of\ reaction = \frac{amount\ of\ \mathbf{product}\ formed}{time}$$

Factors affecting reaction rate

Concentration: **Increasing** concentration increases number of collisions and **increases** rate

Temperature: Particles have more energy and move **faster** and collide **more** often. More particles have energy greater than the **activation** energy so more successful collisions

Catalyst: Catalysts increase the rate of chemical reactions but are **not used up** during the reaction. Catalysts **reduce** the activation energy of a reaction. Different reactions need **different** catalysts. Catalysts are important in increasing the rates of chemical reactions used in industrial processes to reduce **costs**.

Pressure: Increasing pressure **increases** the number of **collisions** as the particles are closer.

Surface area: Increases the number of collisions as there is more surface exposed

Equilibria and Reversible Reactions Revision

A reversible reaction is a chemical reaction in which the products can be converted back to the original reactants under suitable conditions.
This means the reaction can go in either direction i.e.
A + B ⇌ C + D
In a reversible reaction, changing the reaction conditions e.g. concentration, pressure or temperature will change the net/overall direction the reaction goes i.e. more to the right (forward) or more to left (backward).
It is really important you understand that the terms right & left AND forward & backward are used in the context of how the equation of a reversible reaction is presented:
a half-arrow to the right means the direction of the forward reaction,
a half-arrow to the left means the direction of the reverse or backward reaction.
If you say the equilibrium is over to the right, you mean there are more products than reactants.
If you say the equilibrium is over to the left, you mean there are more of the original reactants than products formed.

Condition	Effect on equilibrium position
Temperature	If the temperature is increased the equilibrium position shifts in the endothermic direction If the temperature is decreased the equilibrium position shifts in the exothermic direction
Concentration (for liquids and solutions)	A + B ⇌ C + D If the concentration of A is increased the equilibrium position shifts to decrease the amount of A If the concentration of A is decreased the equilibrium position shifts to increase the amount of A
Pressure (for gases)	If the pressure is increased the equilibrium position shifts to the side with the fewer molecules If the pressure is decreased the equilibrium position shifts to the side with the more molecules.
Catalyst	Adding a catalyst speeds up the time it takes to reach equilibrium, but does not change the equilibrium position.

WHAT IS A CHEMICAL EQUILIBRIUM?
When a reversible reaction occurs in a **closed system** *(so none of the reactants or products can escape)* an equilibrium is formed, in which the original reactants and products formed coexist in the same reaction mixture AND the concentrations of all components in the mixture remain constant. We call this a **dynamic equilibrium** because neither the forward reaction or backward reaction stops and the concentration of the reactants/products does not change. At this stage the rate of the forward reaction is equal to the rate of the backward reaction.