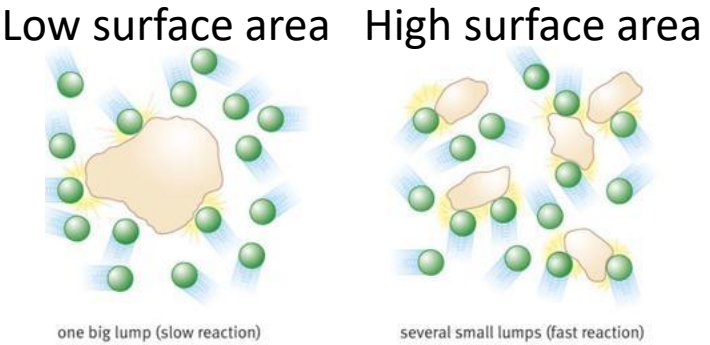
Knowledge Organiser – The Rate and Extent of Chemical Change

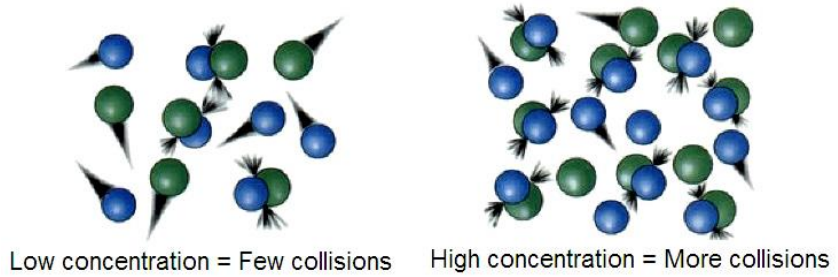
Key Terms

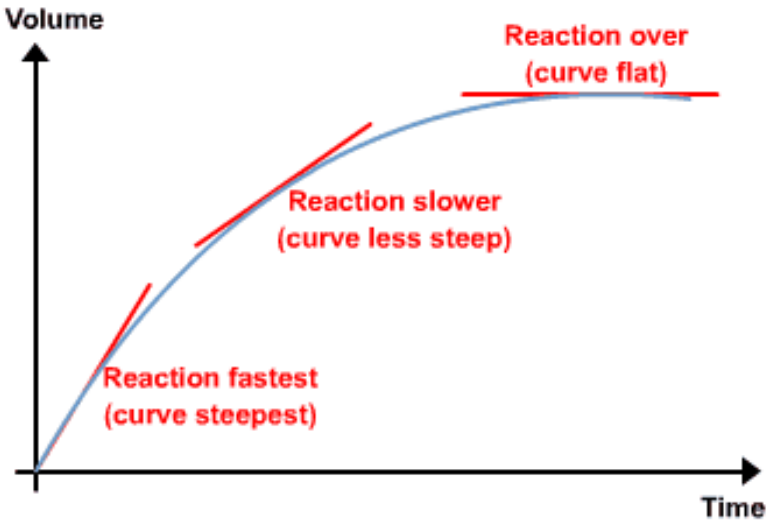
Rate of reaction	The speed at which a reaction takes place. This can be worked out in two ways: Mean rate of reaction = quantity of reactant used ÷ time Mean rate of reaction = quantity of product formed ÷ time
Activation energy	The minimum energy particles must have to react
Catalyst	A substance that speeds up a chemical reaction by lowering the activation energy
Enzymes	Molecules that act as catalysts in biological systems
Closed system	A system where no substances can get in or out
Dynamic equilibrium	System where both the forward and reverse reactions are taking place simultaneously and at the same rate

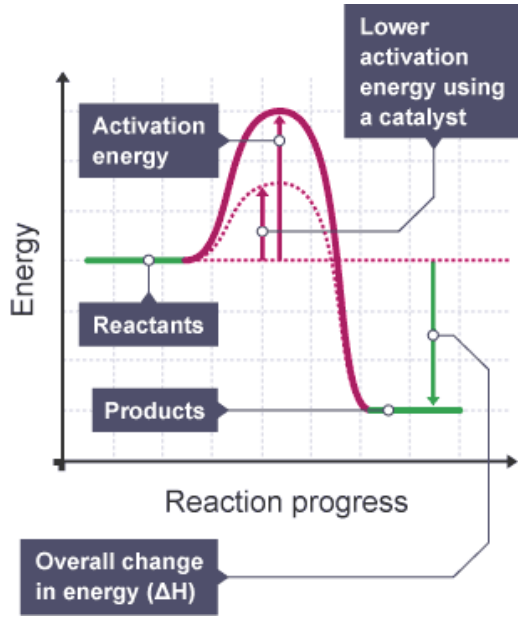
Diagrams

Factors affecting rates of reaction









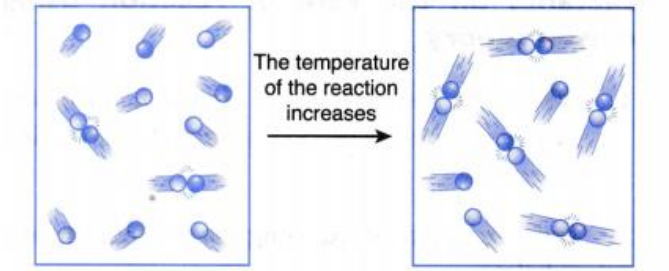
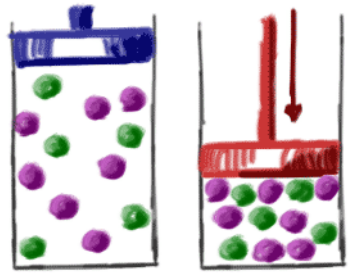


Figure *Temperature of a reaction controls the frequency of collision*



AS PRESSURE INCREASES, THE GAS MOLECULES CAN HAVE MORE COLLISIONS.

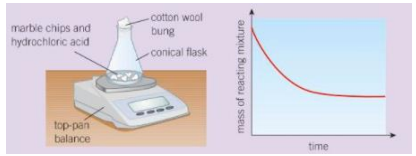
C8 Rates and Equilibrium

Measuring Rate

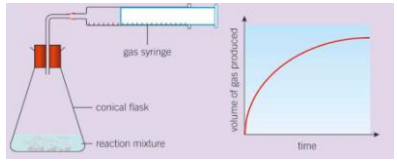
To measure the rate of a reaction you can:

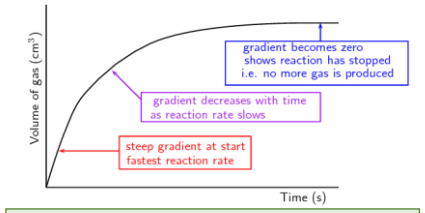
- **Measure how fast the reactants are used up**
- **Measure how fast the products are made**

e.g. Measure mass lost due to gas formed



e.g. Measure volume of gas made

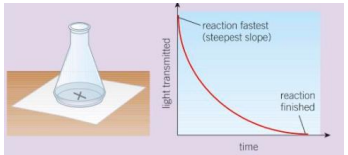




Rate = volume of gas ÷ time

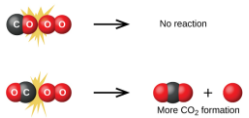
cm^3/s

e.g. Measure time for insoluble product to form



Collision theory

For a reaction to happen reactants must:
collide with **enough energy** (activation energy)



A successful collision is one that leads to a reaction

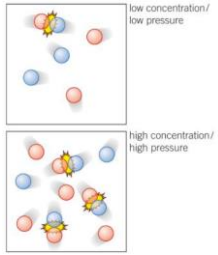
So to increase the rate of a reaction you must either

- **Increase the frequency of collisions**
- **Increase the energy of the collisions**
- **Decrease the energy needed for a collision to be successful**

Factors affecting rate

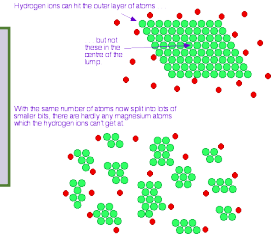
Concentration and Pressure

More particles in the same space.
More frequent collisions



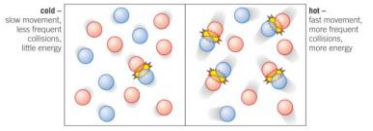
Surface area

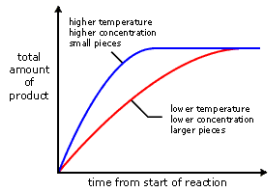
More particles available to react.
More frequent collisions



Temperature

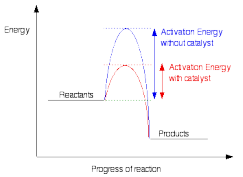
Particles **move faster**.
So they **collide more frequently**.
Particles collide **with more energy**.
So more of the collisions are **successful**.





Catalysts

Lower the energy needed for successful collisions. (Activation energy)
Not used up.
Biological catalysts are called **enzymes**

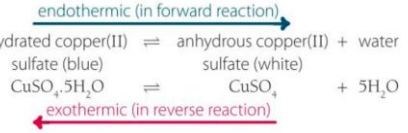


Reversible reactions

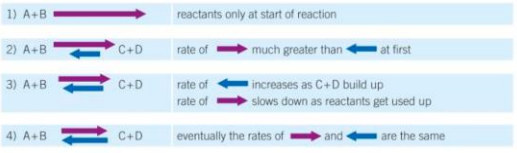
Can go in both directions.

$$A + B \rightleftharpoons C + D$$

If a reaction is exothermic in one direction it is endothermic in the other direction.



In a **closed system** (where nothing can get in or out) an **equilibrium** is reached where the **rate of reaction is the same in both directions**.



At equilibrium:

- Rate of forward reaction = rate of reverse reaction.
- Mount of products and reactants don't change.