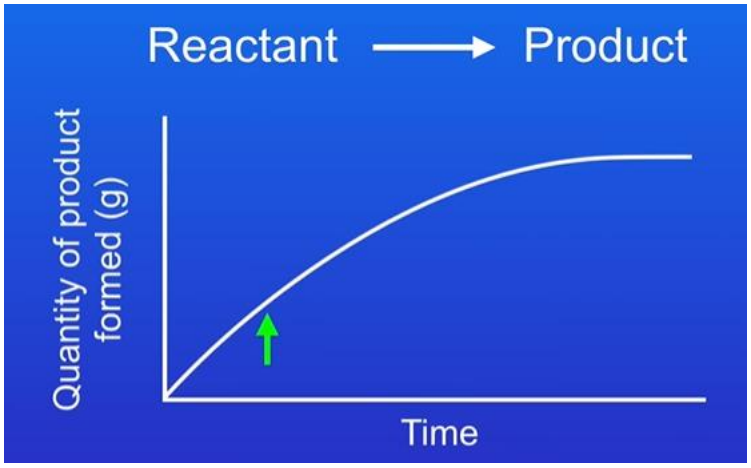
Mean rate of reaction:

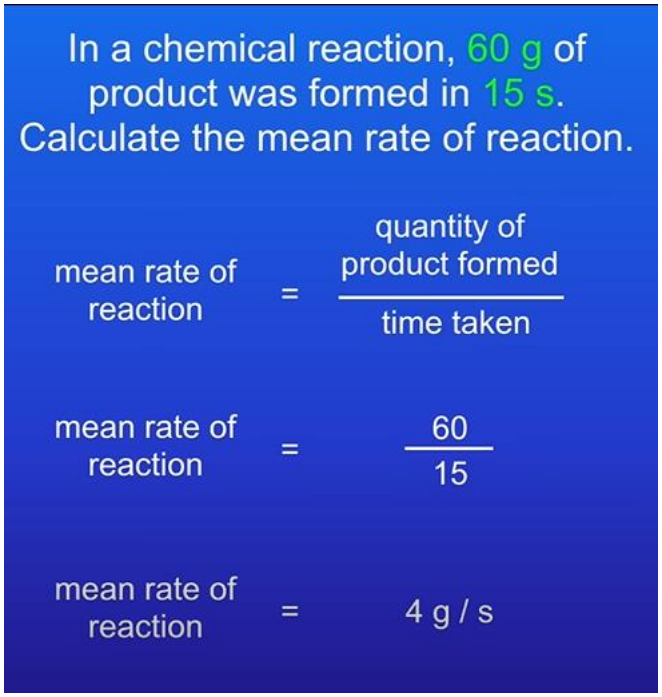


At the start, the line is more steep which shows that the rate of reaction is higher than another point on the curve.

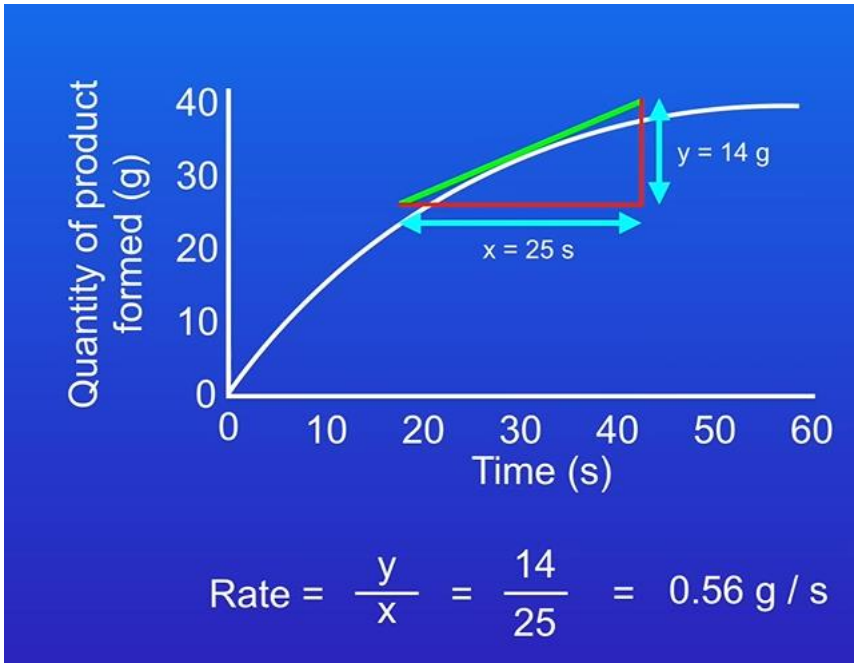
At the start, there are more molecules to react and form the product.

When the reaction is slowing down, there are fewer reactant molecules available to react

At the end, the reaction has stopped because all the reactant molecules reacted



Using tangents:



How to calculate:

1. Draw a tangent across the point that is needed

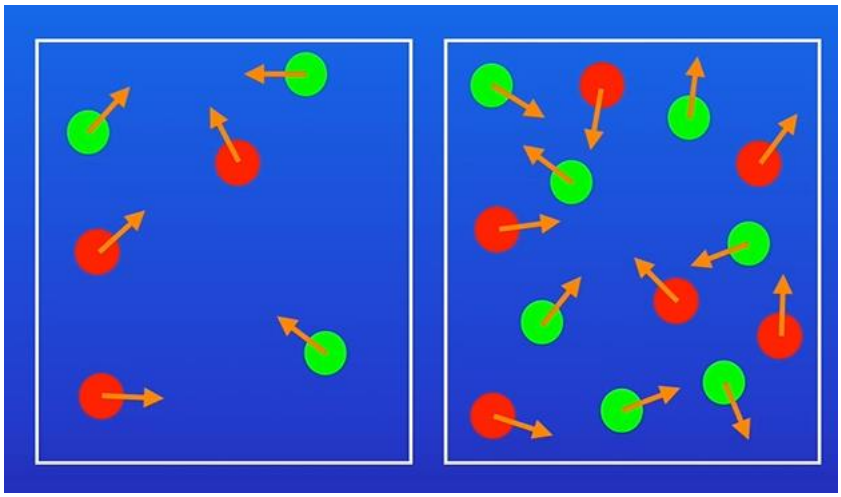
2. Draw a right angled triangle
3. Find the x and y sides of the triangle
4. Find the gradient of the tangent

Effect on concentration on rate:

Collisions theory:

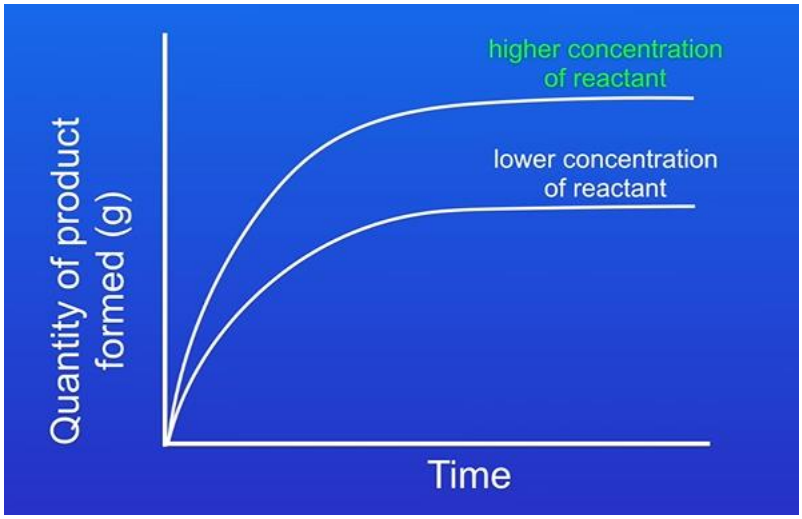
- Chemical reactions can only take place when the reacting particles collide with each other.
- The collisions must have sufficient energy.
- Rate of chemical reaction is determined by the frequency of successful collisions
- Frequency means number of collisions per second

If we have a container with the same volumes but have different amount of particles. The one with the more particles in the container has a higher rate of reactions because there are more collisions happening



The concentration is proportional to the concentration

This would also apply to gases



Required practical: Rate of reactions:

Hypothesis is a something which could explain a fact or an observation and it must be testable

How to perform disappearing cross reaction:

1. Use a measuring cylinder to pour 10cm^3 sodium thiosulfate solution into a conical flask
2. Place the conical flask onto a printed black cross
3. Add 10cm^3 hydrochloric acid into the conical flask
4. Swirl the solution and start a stopwatch
5. We look down through the top of the flask and after a certain amount of time, the solution will become cloudy

6. We then stop the stopwatch once the black cross is no longer visible
7. We record the time
8. We carry out the experiment using lower concentrations of sodium thiosulfate solution
9. We repeat the whole experiment again and calculate the mean and do not include the anomalous mean

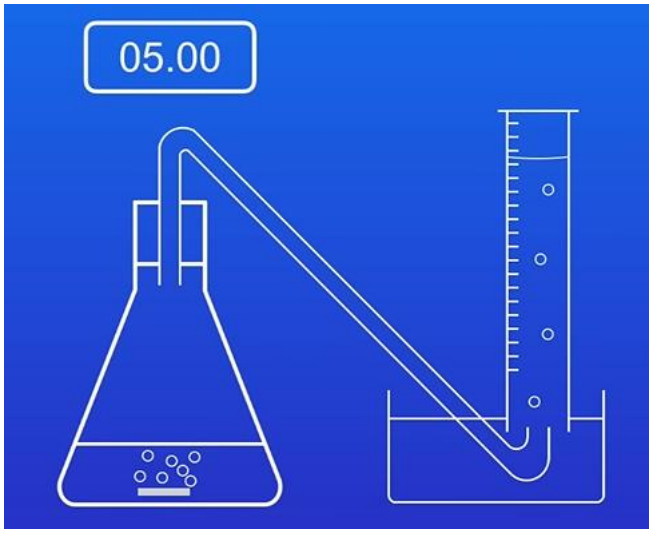
A measurement is reproducible if another person can use a different technique or equipment but still get the same result

A problem with the black cross experiment is that people have different eyesights so others may see it longer but because all the students use the same size print cross, it is not too great of a problem

How to perform:

1. Use a measuring cylinder to pour 50cm^3 of hydrochloric acid into the conical flask
2. Attach the conical flask to a bung and delivery tube
3. Place delivery tube into container filled with water
4. Place upturned measuring cylinder filled with water over the delivery tube
5. Add 3cm strip of magnesium to the hydrochloric acid and start the stopwatch

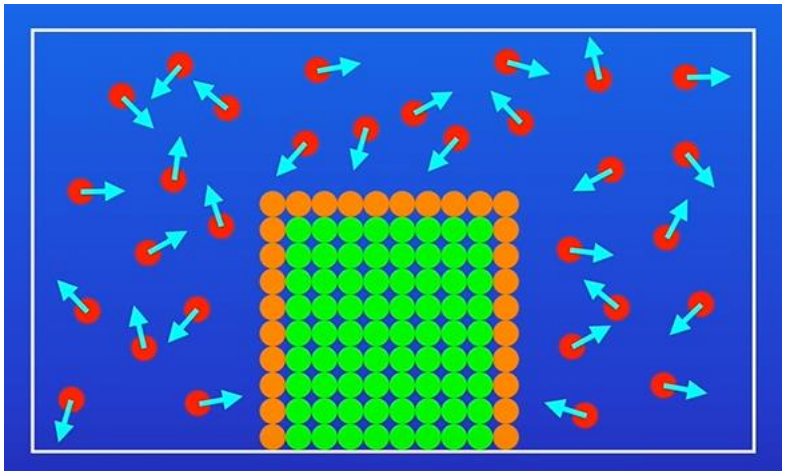
6. This reaction produces hydrogen gas and this gets trapped into the measuring cylinder
7. Every 10 seconds, measure the volume of hydrogen gas in the measuring cylinder
8. Continue until no more hydrogen gas is present
9. We repeat the experiment using different concentrations of hydrochloric acid



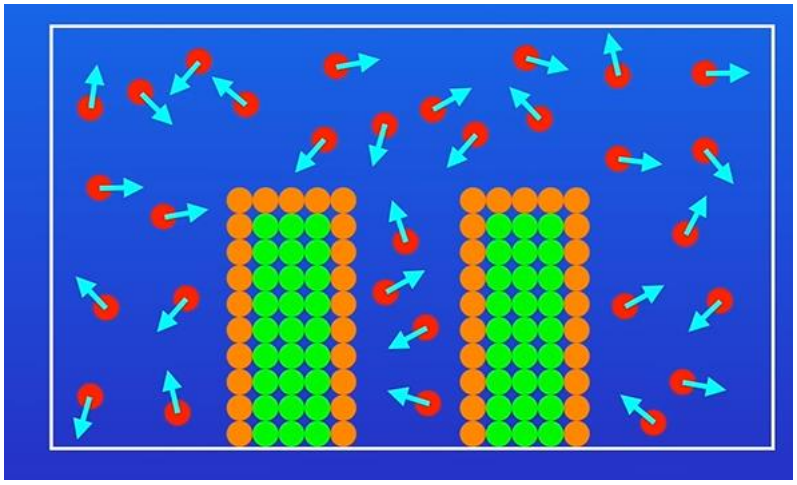
Both of these experiments show us that the more concentration, the faster the reaction takes place

This practical is reproducible

Effect of surface area on rate of reaction:



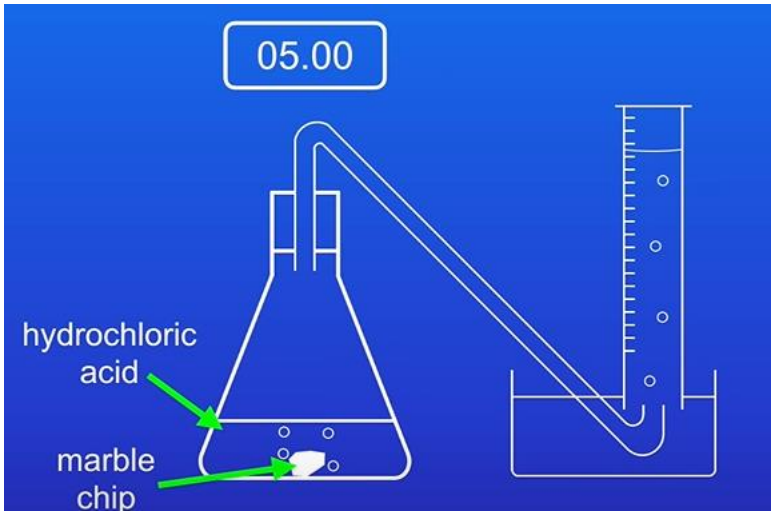
Particles of the solution in red can only collide with the surface particles of a solid



The same solid has been split and shows that more particles are able to react with the solution because of higher frequency of collisions

The larger the surface area, the higher the rate of reaction

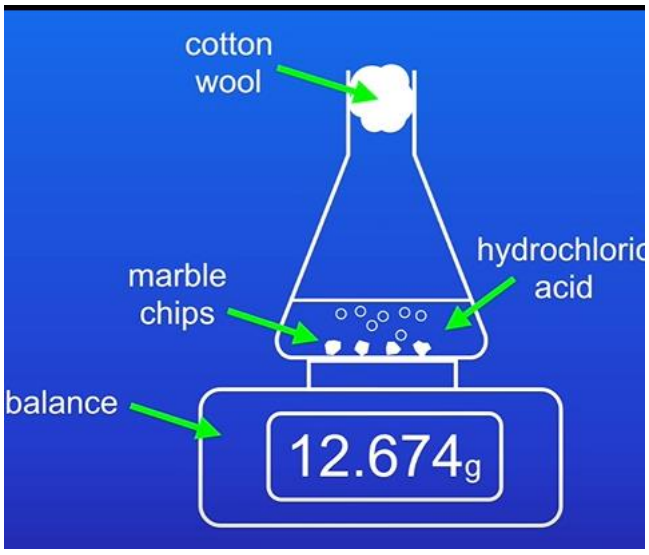
The small sized particle blocks have a larger surface area : volume ratio than a larger solid block



Marble chip contains calcium carbonate which reacts with hydrochloric acid to produce carbon dioxide. We can measure the volume of carbon dioxide.

We can use smaller marble chips and react them with hydrochloric acid and measure the volume of carbon dioxide.

We can get more accurate results using a gas syringe



We can place a conical flask filled with marble chips reacting with hydrochloric acid on a balance.

As the carbon dioxide is produced, the mass decreases

The cotton wool does allow carbon dioxide to escape but prevents the acid from splashing out which could cause the mass to decrease significantly

Effect of temperature on surface area:

Activation energy is the minimum amount of energy required for particles must have in order for them to react

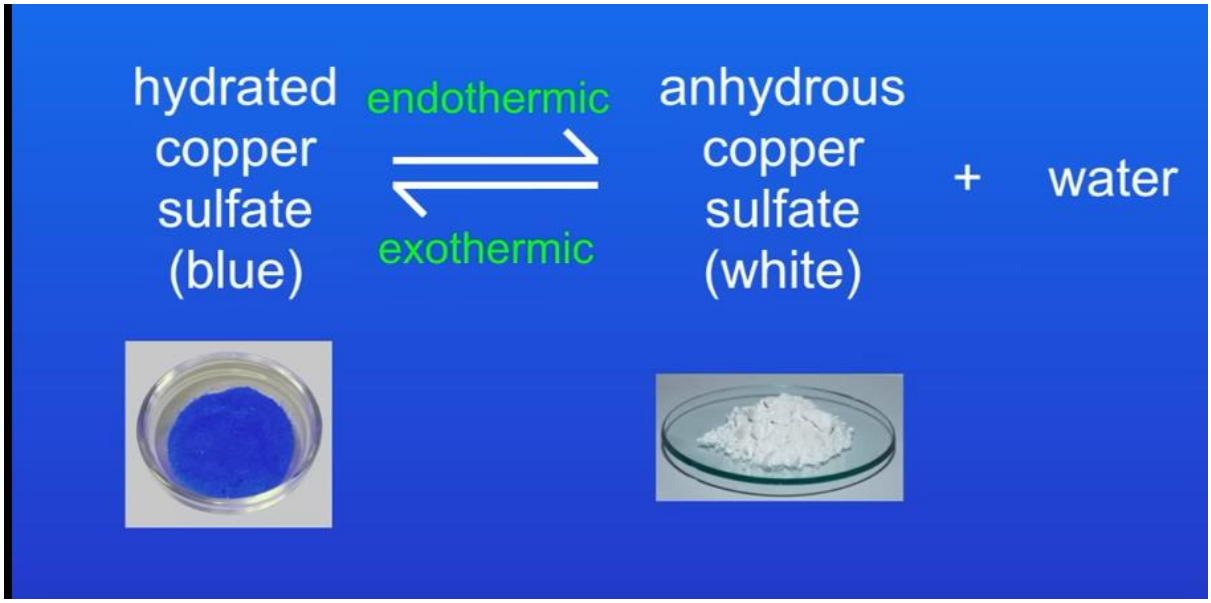
Increasing the temperature causes the particles to have more kinetic energy so they move faster causing more frequent successful collisions

Catalysts:

A catalyst is something which speeds up the reaction by providing alternate pathways for the reaction that has a lower activation energy

We do not include catalysts in reactions because they do not become used up

Reversible reactions:



If a reversible reaction is endothermic in one way then the reaction is exothermic in the other way and the same amount of energy is transferred in each way

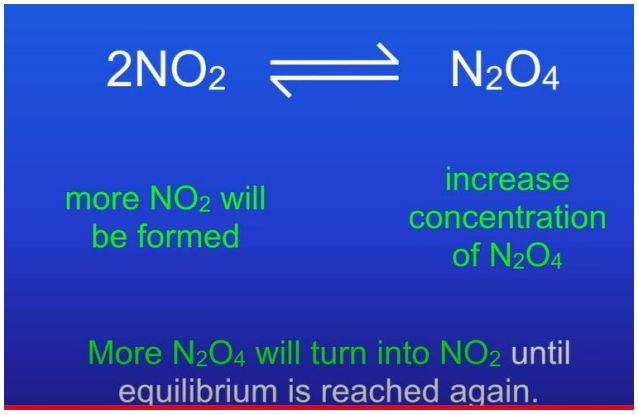
Equilibrium is the state of the reaction where the forward reaction is equal to the rate of the reverse reaction

Concentration and reversible reactions:

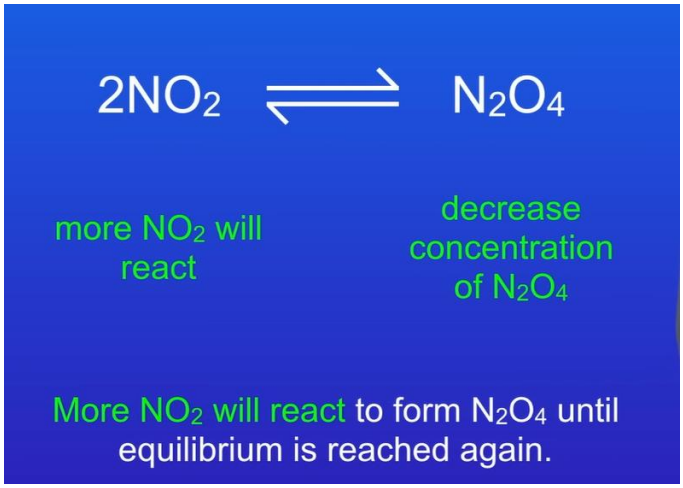
Le Chatelier's principle:

- If a system is at equilibrium and a change is made to the conditions, then the system will respond to counteract the change

This means that if I increase the concentration of one chemical, then the other will form more to reach equilibrium



If I decrease the concentration of one chemical, then the other chemical will react more to form more of the other chemical



Temperature and reversible reactions:

If the temperature is increased, the equilibrium would shift to the endothermic direction

If the temperature is decreased, the equilibrium would shift to the exothermic direction

Pressure and reversible reactions:

If we increase the pressure, the equilibrium would shift to the side with smaller number of molecules

If we reduce the pressure, the equilibrium would shift to the side with more molecules