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GCSE Chemistry

Complete Revision Summary

Rates and Equilbrium

Organic Chemistry

Chemical Analysis

Chemistry of the Atmosphere

Using Resources

Rate of Reaction

The Rate of reaction

Factors Affecting Rates of Reaction

Collission Theory

Catalysts

Reversible Reaction

Dynamic Equilbrium

Altering Conditions

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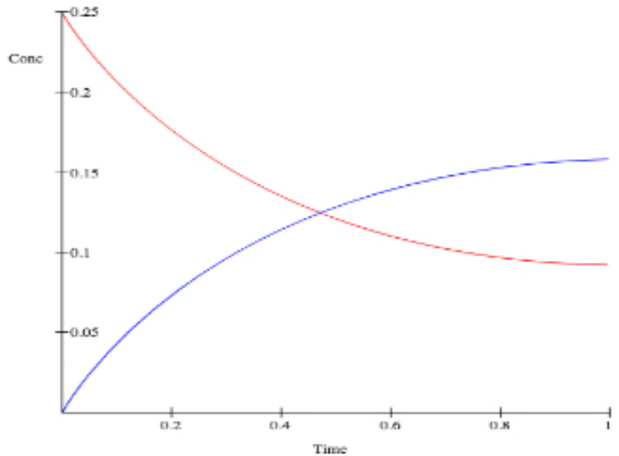
RATE OF REACTION



Products

In a reaction, the concentration of reactants decreases with time

In a reaction, the concentration of products increases with time.

Rate of reaction = $\frac{\text{Increase in concentration of products}}{\text{Time}}$ = $\frac{\text{Decrease in concentration of reactants}}{\text{Time}}$

a) Weigh the mass of the reactants at different time interval and plot the graph.

b) If the products are gas, we can measure the volume of gas evolved at different time intevals

c) If the precipiration reaction, we can measure absorbance value

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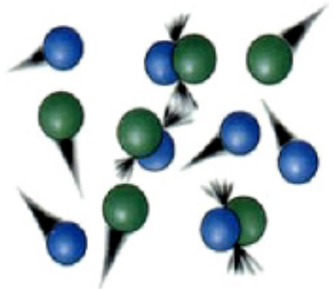
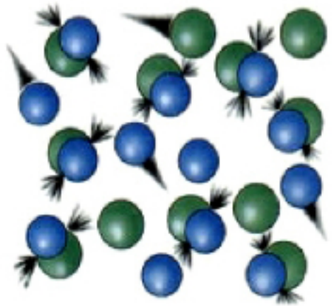
COLLISSION THEORY



Low concentration = Few collisions



High concentration = More collisions

For a reaction to take place, the three important things are required.

COLLISSIONS

For the reactions to take place the particles should collide or bump into each other.

ACTIVATION ENERGY (SUCCESSFULL COLLISIONS)

The particles should collide with the minimum energy required to start the reaction- Activation Energy.

The collission with the energy equal to or greater than activation energy is successful collission.

CORRECT ORIENTATION

The particles should have correct orientation for the reaction to take place.

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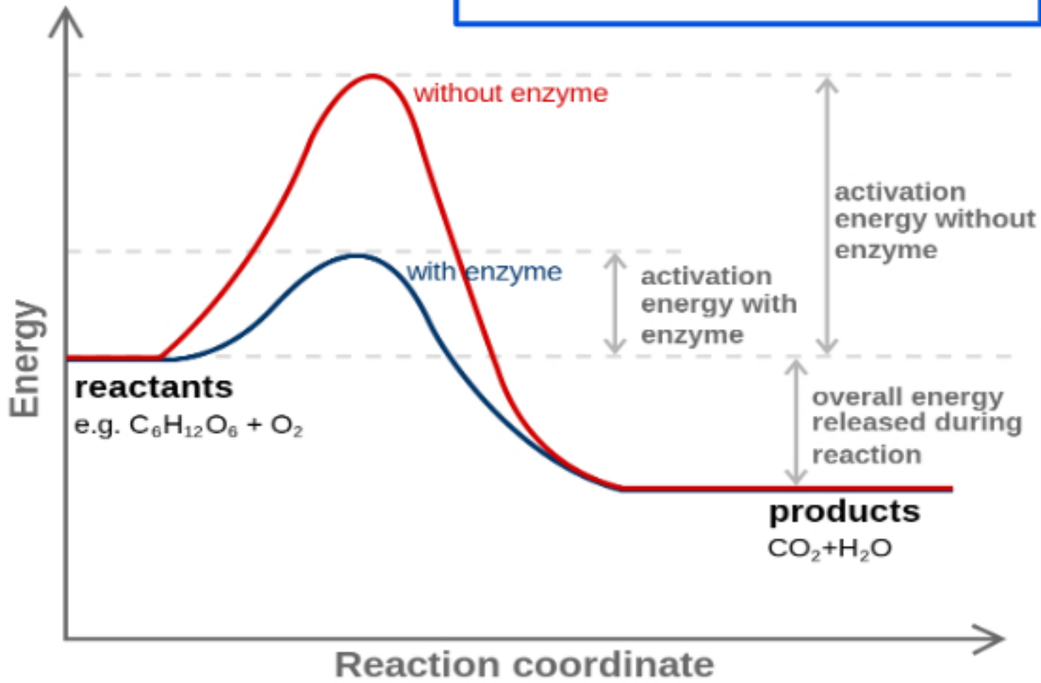
FACTORS AFFECTING RATE OF REACTION

FACTOR	EFFECT	EXPLANATIONS
SURFACE AREA	With increase in surface area the rate of reaction increases. Powdered reactants react faster.	Greater the surface area or surface area to volume ratio more particles will be exposed and reactants have greater chance of colliding increasing the rate of reaction.
TEMPERATURE	With increase in temperature the reaction rate increases.	With increase in temperature, the particles gain kinetic energy. They collide more frequency. Greater the collission greater are the chances of successful collisions. Also as the energy increases more particles have energy equal or greater than activation energy increasing the rate of a reaction.
CONCENTRATION OF REACTANTS	With increase in concentration of reactant the reaction rate increases.	Increasing the concentration increases more particles in the given volume. More the particles more the chance of collissions. Greater the collission greater the chance of successful collission increasing the rate of the reaction.
PRESSURE	With increase in pressure the rate of reaction of the gaseous reactants increaes.	Increasing the pressure increases the rate of the reaction as there will be more particles in a lesser volume. So they bump into each other more increasing the rate of the reaction.
CATALYST	With the use of catlyst the rate of reaction increases.	Catalyst increases the rate of the reaction by providing the alternative route that works by lowering the activation energy. So there are more number of particles with energy equal to activation energy increasing the rate of the reaction.

CATALYSTS

Required in small quantity and is regenerated after the reaction.

Catalysts increases the rate of the reaction by providing an alternative route.



The alternative route lowers the activation energy.

As the activation energy is lowered there are more number of particles having energy equal to or greater than the activation energy increasing the rate of the reaction.

Examples
a) Iron in Haber's process

$$N_2 + 3H_2 \xrightarrow{Fe} 2NH_3$$

b) Nickel in the hydrogenation of alkene

$$\text{Ethene} + H_2 \xrightarrow{Ni} \text{Ethane}$$

The catalysts help those reactions to carry out at a lower temperature which require very high temperature so saves us on energy and electricity costs.

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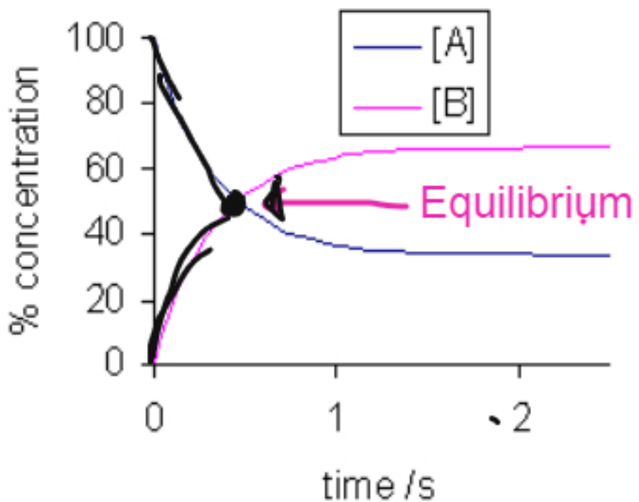
REVERSIBLE REACTION

Reactions that proceed both in forward and reverse direction.

eg- $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$



At the start the concentration of the reactants decreases. The reactants decreases and the concentration of products start to increase.

$A \rightleftharpoons B$

There comes a point where concentration of reactants and the products are same as the rate of appearance of products and rate of disppearance of reactants is the same. That point is the equilbrium point.

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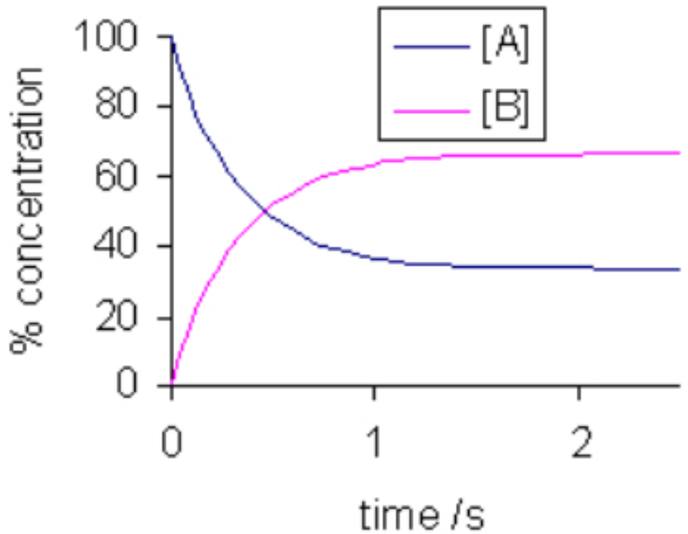
DYNAMIC EQUIBRIUM



When rate of forward reaction is equal to the rate of reverse reaction.

The reactions does not stop at equilibrium. The reactions takes place with the same rate in both the direction so overall we see no change.

CONDITIONS FOR DYNAMIC EQUILBRIUM

a) It has to be closed system. Nothing should leave or enter the system.

b) The rate of forward reaction should be equal to the rate of reverse reaction.

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Le Chattelier's Principle

When the system in equilbrium
is subject to a change,
the equilbrium is moved to a direction
to counteract the change.

Concentration

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

Forward direction ammonia is made
in the reverse direction nitrogen
and hydrogen are used up.

Add nitrogen → right
Add hydrogen → right
Add ammonia → left
Remove Ammonia → right

So in habers process nitrogen and hydrogen
are continously added and unreacted are
recycled and ammonia is removed
as soon as it is formed.

Pressure

More the gas molecules more the pressure.
Less the pressure less the gas molecules.

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

Increasing pressure = Less gas side
= Right

Decreasing pressure= more gas side
= left

So high pressure is required for manufacture of ammonia.

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Temperature and Equilbrium

If ΔH is negative the forward reaction is exothermic and produces heat.

If the forward is exothermic the reverse is endothermic and vice versa.

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$$

$\Delta H = -93\ kJ/mol$.

Forward reaction is exothermic produces heat. Reverse reaction is endothermic and takes in heat.

EXOTHERMIC REACTION

(Produces heat)

ENDOTHERMIC REACTION

(Takes in heat)

Increase in temperature will shift the equilbrium side which is left and decrease in temperature will shift to more heat side which is right.

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KEY TERMS

a) Rate of a reaction

b) Collission Theory

c) Activation Energy

d) Catalysts

e) Reversible Reaction

f) Dynamic Equilbrium

g) Le Chatellier's Principle

h) Exothermic

i) Endothermic

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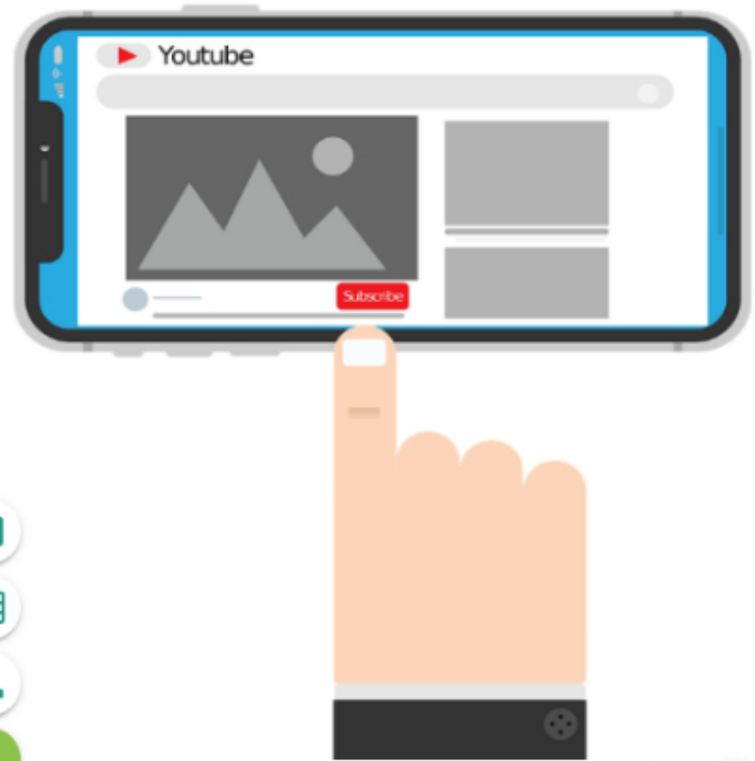
NEXT STEP



CHECK SPECIFICATION

EXAM QUESTIONS ON THIS TOPIC

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