Reaction Kinetics

Rate Of Reaction : $\frac{\text{CHANGE IN CONCENTRATION}}{\text{TIME TAKEN FOR THE CHANGE}}$

$mol\,dm^{-3}s^{-1}$

Methods for following the rate of reaction :

1] Sampling : Reaction is carried out and samples are taken at regular intervals and tested

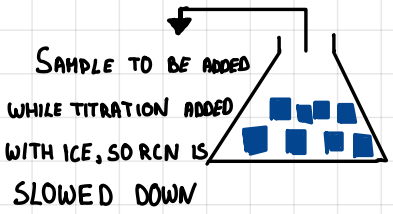
Eg. Nucleophilic Substitution Reaction of Halogenoalkane

$CH_3CH_2Br\,(l) + OH^-\,(l) \longrightarrow CH_3CH_2OH + Br^-$

↳ Take sample of OH^- and titrate it to find out how many moles of OH^- are remaining

↳ Sample taken out will react for some time so result will not be accurate. So Quenching bath is used.

↳ Uses ice to slow down the rate of reaction



↳ Process repeated at regular intervals, 5 min, 10 min, 15 min to get concentration of OH^- left at each point in the reaction, then a graph is plotted.

2] Continous: being monitered as the reaction takes place

Method 1: Gas Collection (Gas Syringe)

Eg. $2H_2O_2 \xrightarrow{MnO_2} 2H_2O + O_2$

Method 2: Calorimetry (Calorimeter)

Light is passed through a substance and data is collected about the darkness of solution. As the light transmisson value changes

↑ darkness ↑ concentration

Method 3: Electrical Conductivity (Electrical conductivity meter)

Size of ions present determine if this method is to be used

Larger ions = Less Conductivity

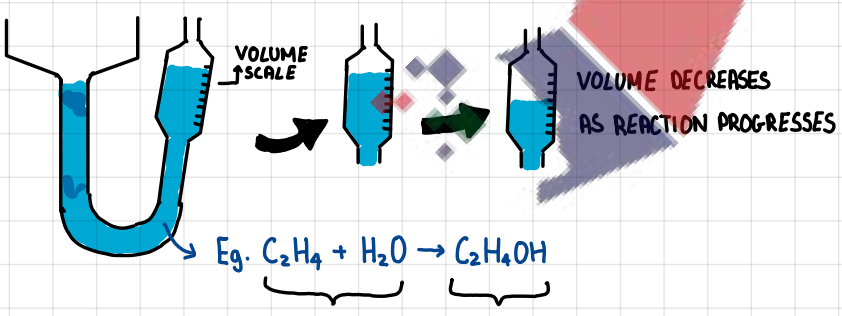
Smaller ions = More Conductivity

Ion concentration overtime changes the electrical coductivity and hence reaction progress can be measured.

Ion conc ↑ Electrical conductivity ↑

* If the same number of ions are present on both sides then size of the ions are seen

Method 4 : Measuring Change In Volume (Dilatometer)



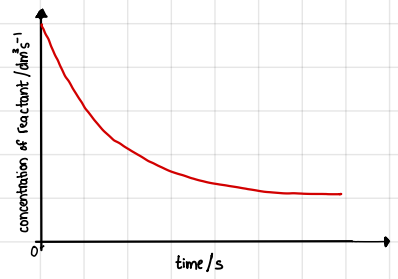
Eg. $C_2H_4 + H_2O \rightarrow C_2H_4OH$

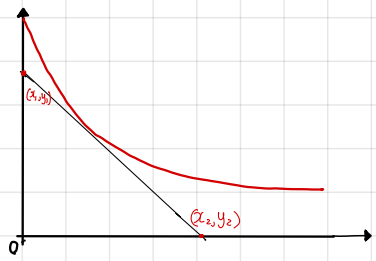
Consumes more volume

Consumes less volume when ethanol is produced

Change in volume is used to measure the rate of reaction

Calculating The Rate Of Reaction - Graphicly





① Plot continous data [reactant] against time

② Draw a tangent at a point and extrapolate it

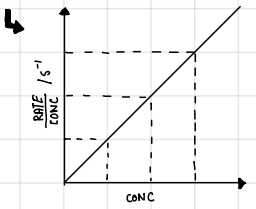
③ Find the gradient of tangent which is the rate of reaction

④ Note : The gradient is negetive because reactants are used up.

[Reactant] / $mol\,dm^{-3}$	Rate $mol\,dm^{-3}s^{-1}$	Rate / [Reactant] / s^{-1}
1·50	1.00×10^{-3}	6.67×10^{-4}
1·00	6.67×10^{-4}	6.67×10^{-4}
0·50	3.30×10^{-4}	6.67×10^{-4}

↳ Rate found at different values of concentration

↳ Rate / Reactant concentration is plotted against conc of reactant



Constant gradient of line shows that the rate and concentration are propotional

Rate Equations

K = Proportionality constant / Rate Constant

Order of reaction : It is the power to which the concentration of that reactant is raised in the rate equation

Zero order : Rate not affected by reactant

First order : Rate $\propto$ concentration of reactant

Second order : Rate $\propto [\text{Reactant}]^2$

Overall order : $K[N_2]^a[H_2]^b$

Overall order = $a + b$

Finding The Order Of A Reaction

Method 1: Graph of reaction rate against concentration of reactant

Questions

1] $H_2O_2\,(aq) + 2I^-\,(aq) + 2H^+\,(aq) \rightarrow 2H_2O\,(l) + I_2\,(aq)$

Calorimetry

2] $HCOOCH_3 + H_2O\,(l) \rightarrow HCOOH\,(aq) + CH_3OH\,(aq)$

Sampling

3] $2H_2O_2\,(aq) \rightarrow 2H_2O\,(l) + O_2\,(g)$

Volume of gas produced

4] $BrO_3^-\,(aq) + 5Br^-\,(aq) + 6H^+\,(aq) \rightarrow 3Br_2\,(aq) + 3H_2O$

Electrical Conductivity