

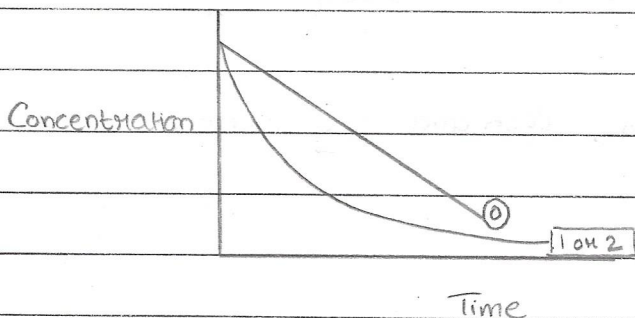
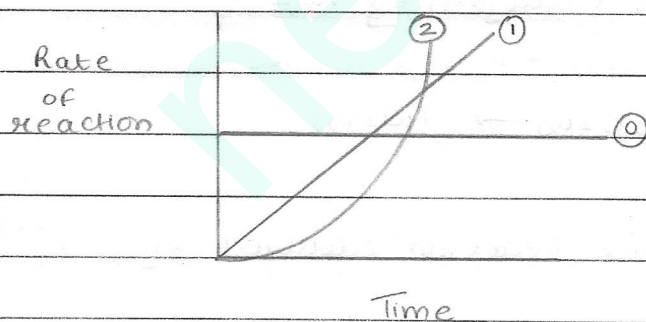
21 - Reaction Kinetics

Q-1) What is rate of reaction?

> Rate of reaction is a measure of the rate at which reactants are used up or the rate at which products are formed.

order → overall order = m+n.

$[mol\ dm^{-3}\ s^{-1}]$  Rate =  $k [A]^m [B]^n$  → concentration of reactants.  
rate constant; units vary.



1<sup>st</sup> order will have a constant half life.

[Time for concentration to halve each time is the same]

For 1<sup>st</sup> order:  $k = \frac{\ln 2}{t_{1/2}} = \frac{0.693}{t_{1/2}}$

\* The rate determining step is the slowest step overall. The reactants before this step are included in determining the order of reaction.

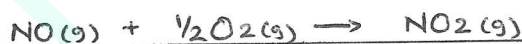
- > Increasing temperature increases the value of the rate constant (k)  $\therefore$  increases the rate of reaction.
- > Decreasing activation energy <sup>increases</sup> also decreases k.
- > For a 2 step reaction, the curve with the higher activation energy will be the rate determining step.

### Q-2) Catalysis

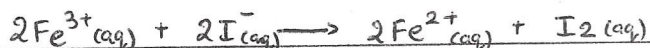
#### > Homogeneous catalysis:

Reaction mixture and catalysts reactants and products, are in the same phase (state)

eg: The oxidation of  $\text{SO}_2$  is catalysed by  $\text{NO}_2$



eg: The iodine-peroxodisulfate reaction catalysed by  $\text{Fe}^{3+}$



eg: Catalytic role of enzymes; lock and key model.

#### > Heterogeneous catalysis

Reaction mixture and catalysts are not in same phase (state)

eg: The Haber process catalysed by iron.

① Diffusion of  $\text{H}_2$  and  $\text{N}_2$  on surface of iron

② Adsorption; these <sup>covalent</sup> weaker bonds within  $\text{N}_2$  and  $\text{H}_2$



③ Reaction :  $N_2 + 3H_2 \rightarrow 2NH_3$

④ Description : bonds between  $NH_3$  and iron weaken.

⑤ Diffusion of  $NH_3$  away from the surface.

\* The same mechanism is for catalytic converters in car engines catalysed by Platinum.

Q-3) What is order of reaction?

> The order of reaction with respect to a particular reactant is the power to which the concentration of that reaction is raised in the rate equation.