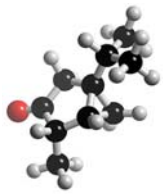
4.1 – INTRODUCTION TO KINETICS



Name …… Form ……

Rate of reaction = change in concentration per unit time (e.g. per second).

Consider any reaction where one of the reactants is A. By <u>experiment</u> the rate of the reaction can be related to the concentration of A:

rate $\propto [A]^n$ where [ ] means concentration in mol dm^{-3}

n is called the **order of reaction** with respect to that reactant, and is usually 2, 1 or 0

Order	Zero order	First order	Second order
n	0	1	2
The effect	the reaction rate is proportional to $[A]^0$ (= 1) and so the rate is not affected by changes in [A]	the reaction rate is proportional to [A]	the reaction rate is proportional to $[A]^2$
[A] x 2	rate unchanged	rate x 2	rate x 2^2 (i.e. x 4)
[A] x 3	rate unchanged	rate x 3	rate x 3^2 (i.e. x 9)
[A] x 10	rate unchanged	rate x 10	rate x 10^2 (i.e. x 100)
[A] is ÷ 2	rate unchanged	rate ÷ 2	rate ÷ 2^2 (i.e. ÷ 4)

Consider a reaction between A and B: $x\,A + y\,B \rightarrow$ products

For any reaction the effects of the concentration of each individual reactant can be combined into a rate equation, which for the above reaction would be of the form:

reaction rate $\propto$ **$[A]^m [B]^n$**

reaction rate = k $[A]^m [B]^n$ (k = rate constant)

e.g. for the above rate equation: order of reaction with respect to: A is m, B is n,

the overall order is (m+n)

> The **order of reaction** with respect to a given reactant is the power to which the concentration of the reactant is raised in the rate equation.
>
> The **overall order of reaction** is the sum of the powers of the concentration terms in the rate equation.

- The values of m and n must be found experimentally and cannot be found from looking at the equation (i.e. m and n are nothing to do with x and y) - so the rate equation can only be found by experiment.
- Rate equations provide a lot of information about the mechanism for the reaction.
- In some reactions, a catalyst appears in the rate equation (or even one of the products if the product is a catalyst for that reaction – autocatalysis).
- k is the rate constant for a reaction (k is different for different reactions).
- The only thing that affects the value of k is temperature (k increases with temperature).
- The units of k depend on the order of the reaction (note rate is usually in mol dm^{-3} s^{-1}, concentrations are in mol dm^{-3}).