## **Kinetics**

The rate of a chemical reaction is the change in concentration of a substance in a unit time. Substance monitored by decrease in reactant or increase in product- titration, pH, colorimetry The rate of chemical reaction depends on concentration and temperature of reagents.

## Rate $\alpha[A]^m[B]^n$

Where [] refers to the concentration of a species in the SI units of mol dm<sup>-3</sup>

M and n values are determined experimentally and proportional constant can be replaced by k, rate constant.

Rate=  $k[A]^m[B]^n$ 

M and n values are usually integers and are called orders of reaction with respect to reactants A and B.

The overall order of a reaction is the sum of the powers of the concentration terms in the rate equation.

Zero- order reactions

- Rate= k[A]<sup>x</sup>
- When x=0 then rate=k so rate does not depend on the concentration of [A] present
- Reactions between gases are sometimes zero-order often indicating that the reaction then depends on the frequency with which the non-absorbed molecules collide with the noide of the vessel and not the concentration of this gas species
- With enzyme catalysts above a certain substrate consultation, all active sites are occupied and the rate becomes zero- order in the set time.

First- order reactions

- Rate= k[A]<sup>1</sup>
- Bate is first order in respect to A so (here conc<sup>11</sup> A doubles, the rate will double
  K=rate/[A] and measured in 1<sup>-1</sup> as (mor dm<sup>-3</sup> s<sup>-3</sup>)/(mol dm<sup>-3</sup> s<sup>-3</sup>)

Second- order reactions

- Rate= k[A]<sup>2</sup> -Second order with respect to A
- Rate= k[A][B] -Second order with respect to A and B
- Measured in mol<sup>-1</sup>dm<sup>3</sup>s<sup>-1</sup>
- K= (rate)/[A][B] so cancels

Higher-order Reactions

- Rate=  $k[A]^m[B]^n$
- M + n= order of reaction

| Order of Reaction<br>m+n | Rate equation<br>Rate= k[rate] <sup>(m+n)</sup> | Units of Rate<br>Constant                          |
|--------------------------|-------------------------------------------------|----------------------------------------------------|
| 0                        | Rate=k*concentation <sup>0</sup>                | mol dm <sup>-3</sup> s <sup>-1</sup>               |
| 1                        | Rate=k*concentation <sup>1</sup>                | s <sup>-1</sup>                                    |
| 2                        | Rate=k*concentation <sup>2</sup>                | mol <sup>-1</sup> dm <sup>3</sup> s <sup>-1</sup>  |
| 3                        | Rate=k*concentation <sup>3</sup>                | mol <sup>-2</sup> dm <sup>6</sup> s <sup>-1</sup>  |
| 4                        | Rate=k*concentation <sup>4</sup>                | mol <sup>-3</sup> dm <sup>9</sup> s <sup>-1</sup>  |
| 5                        | Rate=k*concentation <sup>5</sup>                | mol <sup>-4</sup> dm <sup>12</sup> s <sup>-1</sup> |