

Class \Rightarrow B.Sc.(Hons) Part-1

Subject \Rightarrow Chemistry

Chapter \Rightarrow Chemical Kinetics

Topic \Rightarrow Rate of reaction,

order and Molecularity of a reaction

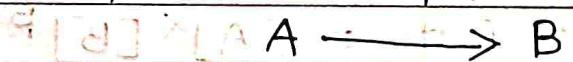
* The Branch of chemistry which deals with the name \Rightarrow Dr. Amarendra Kumar, rate of reaction is called \Rightarrow Deprt. of Chemistry, Chemical Kinetics. Jain college, Ara.

Rate of Reaction

The rate of reaction is defined as the change in Concentration of any of reactant or products per unit time.

The rate of a reaction tells as to what speed the reaction occurs.

Let us consider a simple reaction



The concentration of the reactant A decreases and that of B increases as time passes.

For the given reaction the rate of reaction may be equal to the rate of disappearance of A which is equal to the rate of appearance of B.

Thus, of

Rate of reaction = rate of disappearance of A

= rate of appearance of B

$$\text{or, } \text{Rate} = -\frac{d[\text{A}]}{dt} = \frac{d[\text{B}]}{dt}$$

$$= +\frac{d[\text{B}]}{dt}$$

Where [] represents the concentration in moles

per litre where as α represents infinitesimally small change in concentration. Negative sign shows the concentration of the reactant A decreases whereas the positive sign indicates the increase in concentration of the product B.

Units of Rate

mole/litre sec OR mol l⁻¹s

mole/litre min OR mol l⁻¹min⁻¹

mole/litre hour OR mol l⁻¹h⁻¹

Order of a Reaction

The sum of the concentration terms on which the rate of a reaction actually depends is called the order of the reaction.

Let us consider the reaction



According to rate law,

$$\text{Rate} = [A]^\alpha [B]^\beta$$

Order of reaction = $\alpha + \beta$

Depending upon whether $\alpha + \beta$ is equal to 0, 1, 2 or 3, the reactions are said to be zero order, 1st order, 2nd order and 3rd order respectively.

α and β are called the orders of the reaction with respect to A and B.

e.g.: ~~the nature of the reaction~~

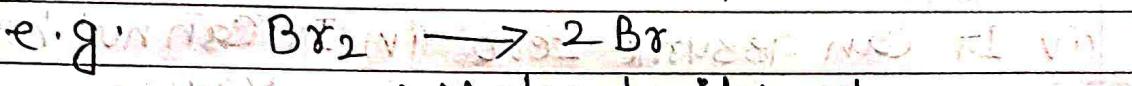
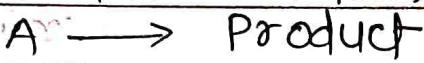
A Rate law	order of a reaction
(i) rate = $K[N_2O_5]$	1
(ii) rate = $K[H_2][I_2]$	$1+1=2$
(iii) rate = $K[NO_2]^2$	2
(iv) rate = $K[H_2][NO]^2$	$1+2=3$
(v) rate = $K[CHCl_3][Cl_2]^{1/2}$	$1+\frac{1}{2}=1\frac{1}{2}$

Molecularity of a Reaction

The number of reacting species (atoms, molecules or ions) which react to bring about a chemical reaction is called Molecularity of a Reaction.

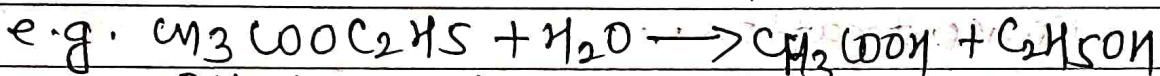
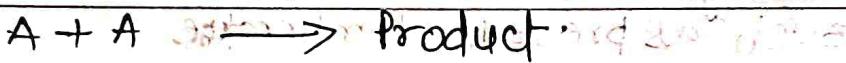
When one, two or three reactant molecules are participating in the reaction are called unimolecular, bimolecular and trimolecular reactions. e.g.

(i) Unimolecular reaction



\therefore Molecularity = $\frac{1}{2}$

(ii) Bimolecular reaction



Ethyl acetate

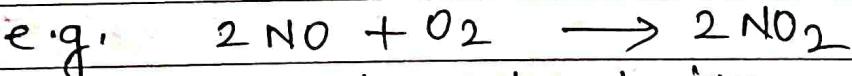
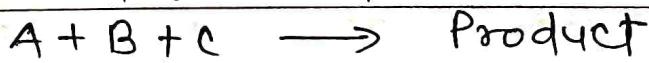
Acetic acid Ethanol

$$\therefore \text{Molecularity} = 2$$



\therefore Molecularity = 2

(iii) Trimolecular Reaction

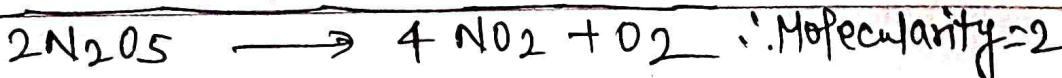
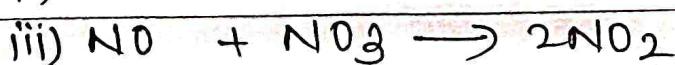
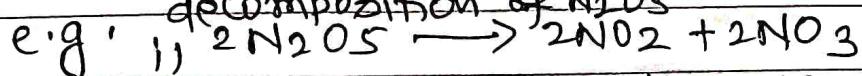


\therefore Molecularity = 3



\therefore Molecularity = 3

some reactions takes place through a sequence of two or more consecutive steps are complex reactions



(4)

Differences between Order and Molecularity of a Reaction

Order of a Reaction

(i) It is the sum of powers of the concentration terms in the rate law expression.

(ii) It is an experimentally determined value.

(iii) It can have fractional value.

(iv) It can assume zero value.

(v) Order of a reaction can change with the conditions such as pressure, temperature, concentration.

Molecularity of a Reaction

(i) It is no. of reacting species in the chemical reaction.

(ii) It is a theoretical concept.

(iii) It is always a whole number.

(iv) It can not have zero value.

(v) Molecularity is invariant for a chemical equation.