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Doc - I (H/S) Physical Chemistry  
(Part-II)

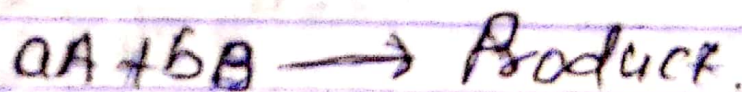
Chapter - Chemical Kinetics

Topic - Order of Reaction.

Order of Reaction :- The sum of the powers through which the concentration must be raised in the experimentally verified rate law expression.

It is an important for every chemical reaction. It is always determined experimentally and cannot be determined from the balanced chemical equation.

In general for a hypothetical reaction.



Its rate law expressed as

$$\text{Rate} = K [A]^m [B]^n$$

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$K = \text{Rate-Const.}$

The O.R is equal to  $(m+n)$

Remember :- The exponent / powers  $m$

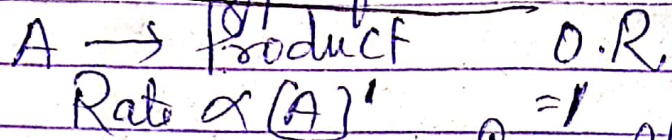
a & b have no relation to the stoichiometric coefficient a & b of the balanced chemical equation.

only the order with respect to A is m & B is n. But-  
 But-  $a+b = m+n$ , in that case order of reaction is equal to molecularity of that chemical rxn.

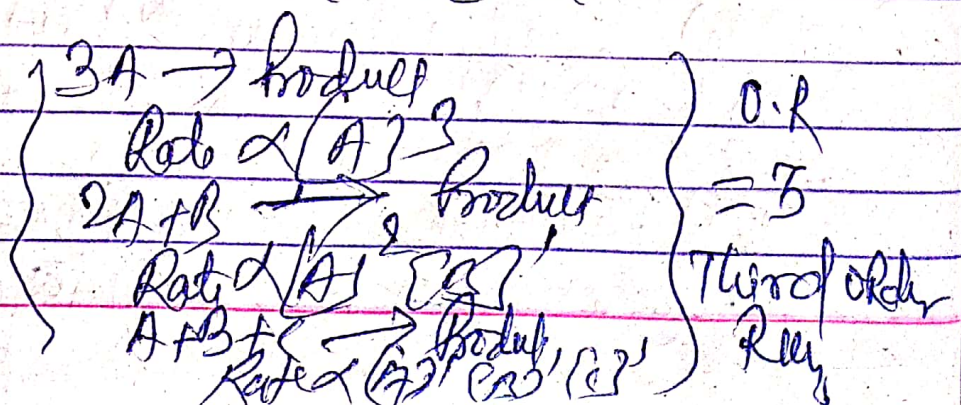
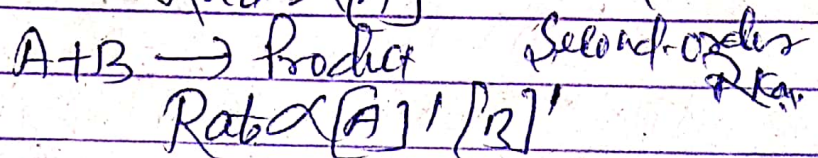
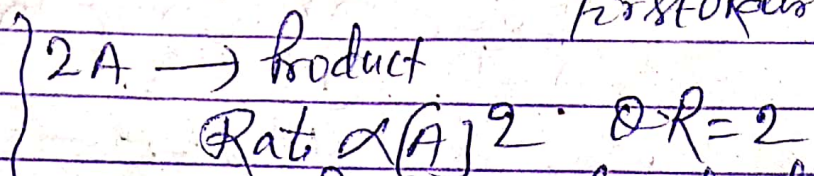
The order of rxn may be one, two, three, zero & fractional also and -ve value also.

The order of reaction never greater than three or infinite and imaginary <sup>value</sup> are not possible.

In general type of rxn.



First order Rxn



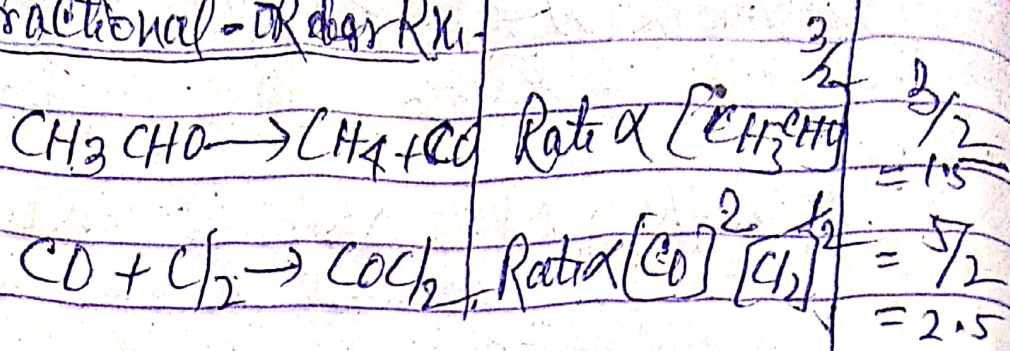
Again  $A \rightarrow \text{Product}$  OR  
 $\text{Rate} \propto [A]^0 = \text{zero}$   
 zero order Rxn.

In that Rxn, Rate is independent upon Concentration but depends upon other factors like Temp<sup>o</sup>, Press<sup>r</sup> & Catalysts.

### Examples of Reaction having Different order.

| Examples                                                                                   | Rate-law                                            | order. |
|--------------------------------------------------------------------------------------------|-----------------------------------------------------|--------|
| ① Zero-order Rxn.<br>$\text{Pt} \quad 2\text{NH}_3 \rightarrow \text{N}_2 + 3\text{H}_2$   | $\text{Rate} \propto [\text{NH}_3]^0$               | 0      |
| $\text{N}_2\text{O} \xrightarrow{\text{Pt}} \text{N}_2 + \frac{1}{2}\text{O}_2$            | $\text{Rate} \propto [\text{N}_2\text{O}]^0$        | 0      |
| ② First-order Rxn.<br>$2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$ | $\text{Rate} \propto [\text{H}_2\text{O}_2]^1$      | 1      |
| $\text{SO}_2\text{Cl}_2 \rightarrow \text{SO}_2 + \text{Cl}_2$                             | $\text{Rate} \propto [\text{SO}_2\text{Cl}_2]^1$    | 1      |
| ③ Second-order Rxn.<br>$\text{H}_2 + \text{I}_2 \rightarrow 2\text{HI}$                    | $\text{Rate} \propto [\text{H}_2]^1 [\text{I}_2]^1$ | 2      |
| ④ Third-order Rxn.<br>$2\text{NO} + \text{O}_2 \rightarrow 2\text{NO}_2$                   | $\text{Rate} \propto [\text{NO}]^2 [\text{O}_2]^1$  | 3      |

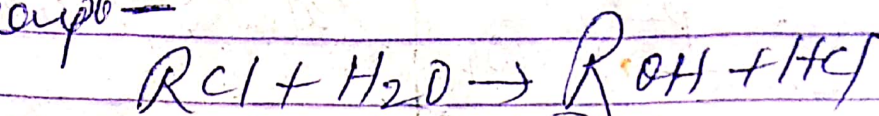
### ⑤ Fractional-Order Rxn.



### Pseudo-order Reaction

Those reaction whose actual-order is different from the expected using rate law expression are called pseudo-order Rxn.

Examp -



Expected Rate law

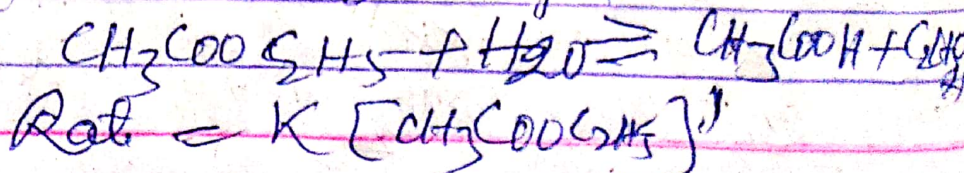
$$\text{Rate} = k[\text{RCI}][\text{H}_2\text{O}] \quad \text{Expected order} = 2$$

Actual Rate-law

$$\text{Rate} \propto k[\text{RCI}]^1$$

Actual o.r = 1

Water is taken as excess. Thus its concn is taken to be constant. Thus rxn is pseudo first-order. Another example



$$\text{Rate} = k[\text{CH}_3\text{COOCH}_3]^1$$