Sol. $A_2 + B_2 \longrightarrow 2AB$

Mech. $\div$ (i) $A_2 \rightleftharpoons A + A$ (fast)

(ii) $A + B_2 \longrightarrow AB + B$ (Slow)

(iii) $A + B \longrightarrow AB$ (Fast)

Apply rate law in Step-(ii)

$r = k[A]^1 \cdot [B_2]^1$ — (1)

↓ intermediate ✓

Apply L.m.A in Step-(i)

$$k_1 = \frac{[A] \cdot [A]}{[A_2]}$$

$$k_1 = \frac{[A]^2}{[A_2]}$$

$[A]^2 = k_1 \cdot [A_2]$

Take Sq. root Both Side

$[A] = \sqrt{k_1} \cdot \sqrt{[A_2]}$

$[A] = \sqrt{k_1} \cdot [A_2]^{1/2}$ — (2)

Put value of [A] in eq. (1)

$r = k\sqrt{k_1} \cdot [A_2]^{1/2} \cdot [B_2]$

$\boxed{r = k'[A_2]^{1/2} \cdot [B_2]}$ → Rate law

→ order $= \frac{1}{2} + 1 = \frac{3}{2} = 1.5$

Molecularity :-

Total number of Atoms, molecules & ions participating (reactant Speecies) in an elementary reaction is called molecularity of reaction.

It is theoritical Quantity.

molecularity Can be integer (1, 2, 3, 4, ---), But it Cannot be Zero, negative & fractional.

In elementary reaction molecularity is equal to it's order.

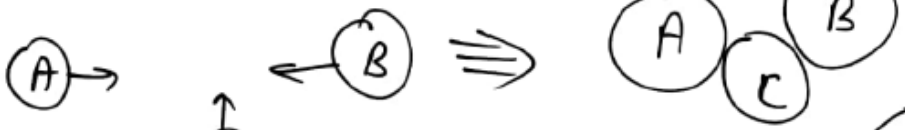
In Complex reaction molecularity of each Stel of mechanism is defined Seperately.

Total molecularity / overall molecularity of complex reaction is meaningless.

In Complex reaction generally molecularity of Slowest Step is Same as order of reaction. Which can be Considered as Total molecularity of reaction.

Maximum Value of molecularity or order is 3, Because Chances of effective Collision of more then 3 is very rare.

Ex:- (i) 

(ii) 

(iii) 

In Complex reaction generally molecularity of Slowest Step is Same as order of reaction. Which can be Considered as Total molecularity of reaction.

Maximum Value of molecularity or order is 3, Because Chances of effective Collision of more then 3 is Very rare.

$O_2 \rightarrow m = 1$

$2O \rightarrow m = 2$

(ii)

Ex:- (i) $2A + B \longrightarrow D + E$

Mech. :- (i) $A + B \longrightarrow C + D$ (Slow)

(ii) $A + C \longrightarrow E$ (fast)

$\Rightarrow$ Slow $R = k[A]^1 \cdot [B]^1$

Step (i) $m. = 2$; (ii) $\rightarrow m. = 2$

Order $= 1 + 1 = 2 \rightarrow$ Same.

Total molecularity $= 2$.

$A_2 + B_2 \longrightarrow 2AB$

Mech :- (i) $A_2 \rightleftharpoons A + A$ (fast) $m. = 1$

(ii) $A + B_2 \longrightarrow AB + B$ (Slow) $m. = 2$

(iii) $A + B \longrightarrow AB$ (Fast) $m. = 2$

$R = k[A_2]^{1/2} \cdot [B_2]^1$

Order $= \frac{1}{2} + 1 = 3/2 = 1.5$

Total molecularity is meaningless.

Pseudo order reaction / Pseudo first order reaction

(elementary)

A Chemical reaction in which value of order of reaction is one, But molecularity is more then one is k/a Pseudo first order reaction.

ex:) Hydrolysis of ester in Acidic medium.

$$CH_3-\underset{\underset{O}{\|}}{C}-OC_2H_5 + H-OH \xrightarrow{H^+} CH_3COOH + C_2H_5OH$$

ethyl acetate (excess) → ethanoic Acid; → ethyl Alchol.

$m. = 2$

$$r = k[CH_3COOC_2H_5]^1 \cdot \underbrace{[H_2O]^1}_{\text{Constant}} \quad -①$$

k → Constant

$$k' = k \cdot [H_2O] \quad -②$$

$$\boxed{r = k' \cdot [CH_3COOC_2H_5]} \rightarrow \text{rate law.}$$

Order of rexn. = 1

Pseudo order reaction / Pseudo first order reaction :-

(elementary)

A Chemical reaction in which value of order of reaction is one, But molecularity is more then one is k/a Pseudo first order reaction.

ex-(ii) Inversion of cane sugar.
in Acidic medium.

$$C_{12}H_{22}O_{11} + H\text{-}OH \longrightarrow \underset{\text{glucose}}{C_6H_{12}O_6} + C_6H_{12}O_6$$

Cane Sugar → Fructose.

m. = 2

$$r = k[C_{12}H_{22}O_{11}][H_2O]$$

(k → const., H_2O → const.)

$$k' = k \cdot [H_2O] \quad -(2)$$

$$\boxed{r = k' \cdot [C_{12}H_{22}O_{11}]} \rightarrow \text{rate law}$$

Order of rexn. = 1