$$v_{max} = k_{cat} \times [E]_T = 210 \times 0.1 = 21\ \mu M s^{-1}$$

(a) $$v_0 = \frac{v_{max}[S]}{K_M + [S]} = \frac{21 \times 10^{-6} \times 10^{-6}\ \mu M}{(5+10)\mu M}$$ (1)

$$= 14 \times 10^{-6}\ M/s$$

$$14\ \mu M s^{-1}$$ (1)

(b) $$\frac{2}{v} = \frac{1}{v_{max}}\left[1 + \frac{[I]}{K_{ESI}}\right] + \frac{K_M}{V_{max}}\frac{1}{[S]}$$ — (i)

In absence $$\frac{1}{v} = \frac{1}{v_{max}} + \frac{K_M}{V_{max}}\frac{1}{[S]}$$ — (ii)

(i) − (ii) $$\frac{1}{v} = \frac{1}{v_{max}}\left[1 + \frac{[I]}{K_{ESI}} - 1\right]$$ (1)

$$\frac{1}{v} = \frac{1}{v_{max}} \times \frac{5}{K_{ESI}}$$

$$K_{ESI} = \frac{v}{v_{max}} \times 5 = \frac{14}{21} \times 6 = 4\ mM$$ (

(c) $$\frac{v_{S_2}}{v_{S_1}} = \frac{k_{cat,S_2}/K_{M,S_2} \times [S_2]}{k_{cat,S_1}/K_{M;S_1} \times [S_1]}$$ (1)

$$= \frac{100/10}{210/5} \times \frac{10}{10} = \frac{100}{210} \times \frac{5}{10}$$

$$= \frac{100}{}$$ (1)

(b) Some of the possible scenario for Reaction are

$\theta_{H_2} \times \theta_{C_2H_4}$, $\theta_{H_2} \times [C_2H_4]$, $H_2 \times \theta_{C_2H_4}$

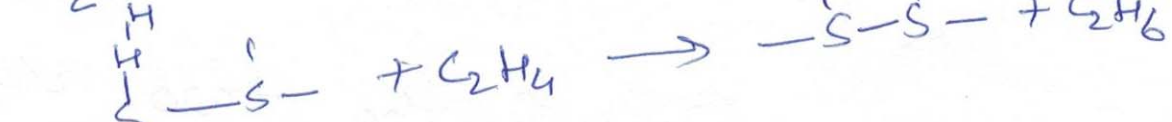
$\theta_{H_2}^2 \times \theta_{C_2H_4}$ (with dissociation), $\theta_{H_2}^2$ (with dissociation) $\times [C_2H_4]$

One with the right expression as given in exam will be given 2 marks 2 other possibility with wrong expression will be given 1 Marks each, thus ruling mechanism out.

(i) $\theta_{H_2} \times \theta_{C_2H_4}$

$$2\theta = \frac{k[H_2][C_2H_4]}{(1 + k[C_2H_4] + k'[H_2])^2}$$ → NOT RIGHT (1)

(ii) $\theta_{H_2} \times [C_2H_4]$

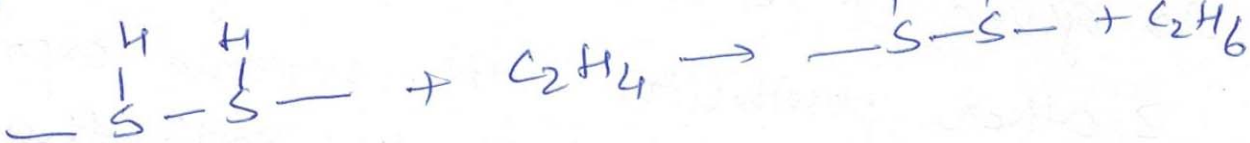


$$2\theta = \frac{K[H_2][C_2H_4]}{(1 + K.[H_2])^2}$$ → NOT Right (1)

(iii) $\theta_{C_2H_4} \times \theta_{H_2}$

Rate $= \dfrac{k K [C_2H_4][H_2]}{(1 + K[C_2H_4])}$. Right mechan. (2)

(iv) $\theta_{H_2}^2 \times C_2H_4$ (with dissociation)



$$v = k \theta_{H_2}^2 \theta_{C_2H_4}$$

$$= k \left(\frac{K'^{1/2} [H_2]^{1/2}}{1 + K'^{1/2} [H_2]^{1/2}} \right)^2 \frac{K' [C_2H_4]}{(1 + K' [C_2H_4])}$$

If H_2 is adsobed weakly

$$v = k \frac{K[H_2]}{1} \times \frac{K'[C_2H_4]}{(1 + K'[C_2H_4])}$$

$$v = \frac{k K K' [H_2] [C_2H_4]}{1 + K'[C_2H_4]}$$ Right

One of the two right mechanism will fetch 2 marks.

(3) $\text{Rate} = k_3 \frac{[EAB]}{[E]_0} [E]_0 = k_3 F_{EAB} [E_0]$ — (1)

$$F_{EAB} = \frac{[EAB]}{[E] + [EA] + [EAB]}$$

$$\frac{k_2}{k_{-2}} = \frac{[EAB]}{[EA][B]}$$

$$[EA] = \frac{k_{-2}}{k_2} \frac{[EAB]}{[B]} \quad \text{— (i)} \qquad (1)$$

$$\frac{k_1}{k_{-1}} = \frac{[EA]}{[E][A]} = \frac{k_{-2}[EAB]}{k_2 [E][A][B]}$$

$$[E] = \frac{k_{-1} k_{-2}}{k_1 k_2} \frac{[EAB]}{[A][B]} \quad \text{— (ii)} \qquad (1)$$

$$F_{EAB} = \frac{[EAB]}{[E] + [EA] + [EAB]}$$

$$= \frac{1}{\frac{k_{-1} k_2}{k_1 k_2 [A][B]} + \frac{k_{-2}}{k_2} \frac{1}{[B]} + 1}$$

$$= \frac{k_1 k_2 [A][B]}{k_{-1} k_2 + k_{-2} k_1 [A] + k_1 k_2 [A][B]}$$

$$\text{Rate} = \frac{k_1 k_2 k_3 [A][B][E]_0}{k_{-1} k_{-2} + k_{-2} k_1 [A] + k_1 k_2 [A][B]}$$

— (1)