1) $A + B \longrightarrow P : r = K[A]^2[B]$

$t=0 \quad 0.2 \quad \underbrace{2\times10^3}_{\text{very large}}$ $\qquad K = 5\times10^{-5}$

$\text{rate} = K[A]^2 \times 2\times10^3$

$\text{rate} = K'[A]^2 \Rightarrow K' = 5\times10^{-5} \times 2\times10^3 = 10^{-1}$

$$t_{1/2} = \frac{1}{0.2\times10^{-1}} = 50 \text{ min}$$

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~~3~~ 2

$$A \xrightarrow{k_1} B \qquad A \xrightarrow{k_2} C$$

$$k' = k_1 + k_2$$

$$A' e^{-\frac{E'}{RT}} = A_1 e^{-\frac{E_1}{RT}} + A_2 e^{-\frac{E_2}{RT}}$$

Differentiating w.r.t $\left(\frac{1}{T}\right)$:

$$A' e^{-\frac{E'}{RT}} \left(\frac{-E'}{\cancel{R}}\right) = A_1 e^{-\frac{E_1}{RT}} \left(\frac{-E_1}{\cancel{R}}\right) + A_2 e^{-\frac{E_2}{RT}} \left(\frac{-E_2}{\cancel{R}}\right)$$

$$k' E' = k_1 E_1 + k_2 E_2$$

$$E' = \frac{k_1 E_1 + k_2 E_2}{k'} = \frac{k_1 E_1 + k_2 E_2}{k_1 + k_2}$$

~~4~~ 3

$$\ln 3 = \frac{E_a}{R}\left[\frac{1}{280} - \frac{1}{300}\right]$$

$$E_a = 9.24 \text{ Kcal/mole}$$

$27^\circ C$ (300K) $\longrightarrow$ 64 hrs

$47^\circ C$ (320K) $\longrightarrow$ t hour.

$$\ln\left(\frac{64}{t}\right) = \frac{9240}{2}\left[\frac{1}{300} - \frac{1}{320}\right]$$

$$t = 25.6 \text{ hrs.}$$

16 4

$$\log\left(\frac{x \times 4}{t \times x}\right) = \frac{23.8 \times 1000}{2}\left[\frac{1}{340} - \frac{1}{350}\right]$$

$$\log\left(\frac{4}{t}\right) = 1$$

$$t = \frac{4}{10}\,hr = 1440\ sec.$$

(5)

$$\overset{+50}{A} \longrightarrow \overset{-20}{B} + \overset{+10}{C}$$

$t=0$ let a

100min $(a-x)$ $\quad x \quad x.$

$$50(a-x) - 20x + 10x = 0$$

$$50a - 60x = 0 \qquad x = \frac{5a}{6}$$

$$k = \frac{1}{100} \ln\left(\frac{a}{a/6}\right) = \frac{\ln 6}{100}$$

$$t = \frac{100}{\ln 6} \ln\left(\frac{100}{100 - \frac{875}{9}}\right) = 200 \text{ min}$$

(6)

$$t_{1/2} \propto \frac{1}{a^{n-1}}$$

$$10 \times 40^{n-1} = 160 \times 10^{n-1}$$

$$4^{n-1} = 16 = 4^2$$

$$n = 3$$

(7) Start with zero-order: $k = \frac{A_0 - A_t}{t} \Rightarrow t = \frac{A_0 - A_t}{k}$

$\cancel{k = A_0}$ $\quad t_{7/8} = \frac{A_0 - A_0/8}{k}$

$$t_{1/4} = \frac{A_0 - 3A_0/4}{k} \qquad \frac{t_{7/8}}{t_{1/4}} = \frac{7}{2}$$

8

$$(t_{1/2})_{I} = \frac{\ln 2}{K_{I}} \Rightarrow \cancel{K_I}$$

$$(t_{1/2})_{II} = \frac{0.1}{2K_{II}} \quad \text{given: } (t_{1/2})_{I} = (t_{1/2})_{II}$$

$$\frac{\ln 2}{K_{I}} = \frac{0.1}{2K_{II}}$$

$$\frac{K_{I}}{K_{II}} = \frac{2\ln 2}{0.1} \approx 14$$

9

$$0.04 = K[A]_{10}$$

$$0.03 = K[A]_{22} \Rightarrow \frac{4}{3} = \frac{[A]_{10}}{[A]_{22}}$$

$$k = \frac{1}{(22-10)} \ln\left(\frac{4}{3}\right) \text{min}^{-1} = 0.025 \text{ min}^{-1}$$

$$t_{1/2} = \frac{0.7}{0.025} \text{ min} = 1680 \text{ sec}$$

~~3~~ 10 rate = $K[A]^n$

rate doubled when conc. is 4 times.

$n = 1/2$

for n^{th} order ($n \neq 1$).

$$t = \frac{1}{K(n-1)}\left[\frac{1}{A_t^{\,n-1}} - \frac{1}{A_0^{\,n-1}}\right]$$

$$t_{1/2} = \frac{-2}{K}\left[\sqrt{A_t} - \sqrt{A_0}\right] \quad A_t = \frac{A_0}{2}$$

$$t_{1/2} = \frac{2}{K}\left[\sqrt{A_0} - \frac{\sqrt{A_0}}{\sqrt{2}}\right] = 8\sqrt{2} \quad -(1)$$

$$t_{3/4} = \frac{2}{K}\left[\sqrt{A_0} - \frac{\sqrt{A_0}}{2}\right] = t \quad -(2)$$

from $\frac{(1)}{(2)} \Rightarrow t = 8$

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