Consecutive reaction :- When product formed in one stage is converted in another product after reaction, the reaction is called consecutive reaction. The simple reaction of the type is

$$A \xrightarrow{K_1} B \xrightarrow{K_2} C$$

	A	B	C
$t=0$	a	0	0
t	x	y	z

Here $a = x + y + z$ —— (i)

Rate of reaction w.r.to $A = -\frac{dx}{dt} = K_1 x$

or, $-\frac{dx}{x} = K_1 dt$

or, $-\ln x = K_1 dt + C$ —— (ii)

or, $t = 0,\ x = 0$

$\Rightarrow -\ln a = 0 + C$ —— (iii)

Putting value of C in (ii) we get

$-\ln x = K_1 t - \ln a$

$\Rightarrow \ln \frac{x}{a} = -K_1 t$ —— (iv)

or $\boxed{x = a e^{-K_1 t}}$ —— (v)

Rate of formation of $C = \frac{dz}{dt} = K_2 y$

Here K_2 is rate constant for formation of C from B.

Rate of formation of B = Rate of formation of B − rate of formation of C.

$\therefore \frac{dy}{dt} = -\frac{dx}{dt} - \left[+\frac{dz}{dt}\right]$

Scanned with CamScanner

Page :
Date : / /

$$\Rightarrow \frac{dy}{dt} = K_1 x - K_2 y. \quad \text{——— (VI)}$$

$$\Rightarrow \quad = K_1 a e^{-K_1 t} - K_2 y \quad \text{——— (VII)}$$

this is linear differential eqn of first order and solution of this eqn is

$$Y = a e^{-K_2 t} \left[K_1 \frac{e^{(K_2 - K_1)t}}{(K_2 - K_1)} - \frac{K_1}{K_2 - K_1} \right]$$

$$\Rightarrow Y = \frac{K_1 a}{K_2 - K_1} \left[e^{(K_2 - K_1)t} \cdot e^{-K_2 t} - e^{-K_2 t} \right]$$

$$\Rightarrow \boxed{Y = \frac{K_1 a}{K_2 - K_1} \left[e^{-K_1 t} - e^{-K_2 t} \right]} \text{ — (VIII)}$$

But $Z = a - x - y$

$$\Rightarrow \boxed{Z = a - a e^{-K_1 t} - \frac{K_1 a}{K_2 - K_1} \left[e^{-K_1 t} - e^{-K_2 t} \right]}$$

$\Rightarrow$

In the consecutive reaction of type $A \longrightarrow B \longrightarrow C$ of first order, following graph is obtained.

(i) A fall contenously

(ii) B increases at maximum and then fall.

(c) C rises consequently.