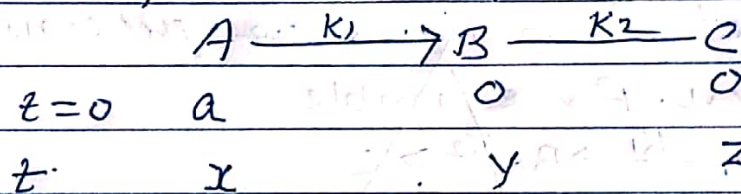


Consecutive reaction :- When product formed in one stage is converted in another product after reaction, the reaction is called consecutive reaction. The simple reaction of the type is



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,  $-\ln x = k_1 t + C$  ——— (ii)

or,  $t=0, x=a$

$\Rightarrow -\ln a = 0 + C$  ——— (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  $x = a e^{-k_1 t}$  ——— (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.

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

$$\Rightarrow \frac{dy}{dt} = k_1 x - k_2 y \quad \text{--- (VI)}$$

$$\Rightarrow \frac{dy}{dt} = k_1 a e^{-k_1 t} - k_2 y \quad \text{--- (VII)}$$

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

$$y = a e^{-k_2 t} \left[ \frac{k_1 e^{(k_2 - k_1)t}}{(k_2 - k_1)} - \frac{k_1}{k_2 - k_1} \right]$$

$$\Rightarrow y = \frac{k_1 a}{k_2 - k_1} \left[ e^{(k_2 - k_1)t} \cdot e^{-k_2 t} - e^{-k_2 t} \right]$$

$$\Rightarrow y = \frac{k_1 a}{k_2 - k_1} \left[ e^{-k_1 t} - e^{-k_2 t} \right] \quad \text{--- (VIII)}$$

But  $z = a - x - y$

$$\Rightarrow z = a - a e^{-k_1 t} - \frac{k_1 a}{k_2 - k_1} \left[ e^{-k_1 t} - e^{-k_2 t} \right]$$

$$\Rightarrow z = \frac{a k_2}{k_2 - k_1}$$

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

- (i) A fall continuously
- (ii) B increases at maximum and then fall.
- (c) C rises consequently.

