Q 2.

A car accelerates from rest at a constant rate α for some time after which it decelerates at a constant rate β to come to rest. If the total time lapse is t seconds, evaluate. [1978]

(i) maximum velocity reached, and

(ii) the total distance travelled.

Ans

(i) Let t_1 be the time taken by the car to attain the maximum velocity v_m while it is acceleration.

Using $v = u + at$

$$v_m = 0 + \alpha t_1 \text{ or } t_1 = \frac{v_m}{\alpha} \quad \ldots (i)$$

Since the total time elapsed is t, the car decelerators for time $t_2 = (t - t_1)$ to come by rest, $a = -\beta$ and $v = 0$

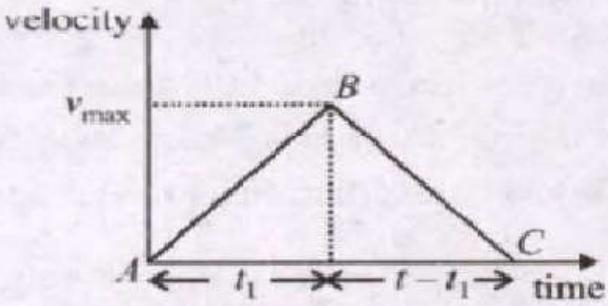
Usint $v = u + at_2$

$$0 = v_m - \beta(t - t_1) \text{ or } t_1 = t + \frac{v_m}{\beta} \quad \ldots (ii)$$

Using (i) in (ii), we get

$$\frac{v_m}{\alpha} = t - \frac{v_m}{\beta} \text{ or } t = v_m\left(\frac{1}{\alpha} + \frac{1}{\beta}\right)$$

$$\text{or} \quad v_m = \frac{t\alpha\beta}{(\alpha + \beta)} \quad \ldots (iii)$$



(ii) Total distance travelled = area of ΔABC

$$= \frac{1}{2} \times \text{base} \times \text{altitude} = \frac{1}{2} \times t \times v_{max}$$

$$= \frac{1}{2} \times t \times \frac{\alpha\beta}{\alpha + \beta} t = \frac{1}{2}\left(\frac{\alpha\beta}{\alpha + \beta}\right) t^2$$