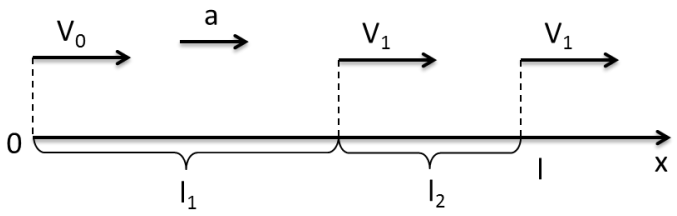
Answer on Question #43159, Physics, Mechanics | Kinematics | Dynamics

A body is travelling with a velocity of 100m/s accelerates uniformly at the rate of 10m/s2 for a period of 20 second. Calculate the velocity & the distance travelled in 30 second

Solution.

Lets mark t_1=20 s, t_{all}=30 s



All way can be divided on two parts: uniformly accelerated motion (l_1) and uniform motion (l_2)

From relations of uniformly accelerated motion:

$$l = V_{0x}t + \frac{a_x t^2}{2}$$

$$V_x = V_{0x} + a_x t$$

Thus:

$$l_1 = V_0 t_1 + \frac{a t_1^2}{2}$$

$$V_1 = V_0 + a t_1$$

For the second part (uniform motion):

$$l_2 = V_1(t_{all} - t_1)$$

And the velocity at the end of the segment stays the same.

So finally:

$$V_1 = V_0 + a t_1$$

$$l = l_1 + l_2 = V_0 t_1 + \frac{a t_1^2}{2} + V_1(t_{all} - t_1)$$
$$= V_0 t_1 + \frac{a t_1^2}{2} + (V_0 + a t_1)(t_{all} - t_1)$$

Numerically:

$$V_1 = V_0 + a t_1 = 100\frac{m}{s} + 10\frac{m}{s^2} \cdot 20s = 300\frac{m}{s}$$

$$l = V_0 t_1 + \frac{a t_1^2}{2} + (V_0 + a t_1)(t_{all} - t_1) =$$

$$= 100\frac{m}{s} \cdot 20s + \frac{10\frac{m}{s^2} \cdot (20s)^2}{2} + \left(100\frac{m}{s} + 10\frac{m}{s^2} \cdot 20s\right)(30s - 20s) =$$

$$= 2000m + 2000m + 3000m = 7000m$$

Answer:

$V_1 = 300\frac{m}{s}$

$l = 7000m$