RASI UMMI - SALMA ONIZE
18/ENG08/020
BIOMEDICAL ENGINEERING
ASSIGNMENT

F12-9

1.] Slope of s-t curve given velocity,

From s-t curve,

$S = 0.5t^3$ ---- $0 \le t \le 6$

$S = 108\ m$ ----- $6 \le t \le 10$

∴ for time interval, $0 \le t \le 6$,

$V = \frac{ds}{dt} = \frac{d}{dt}(0.5t^3)$

$V = 0.5 \times 3t^2$ $\left[\because \frac{d}{dt}(t^n) = nt^{n-1}\right]$

$V = 1.5t^2$ --- $0 \le t < 6$

at $t = 0$, $V = 0$

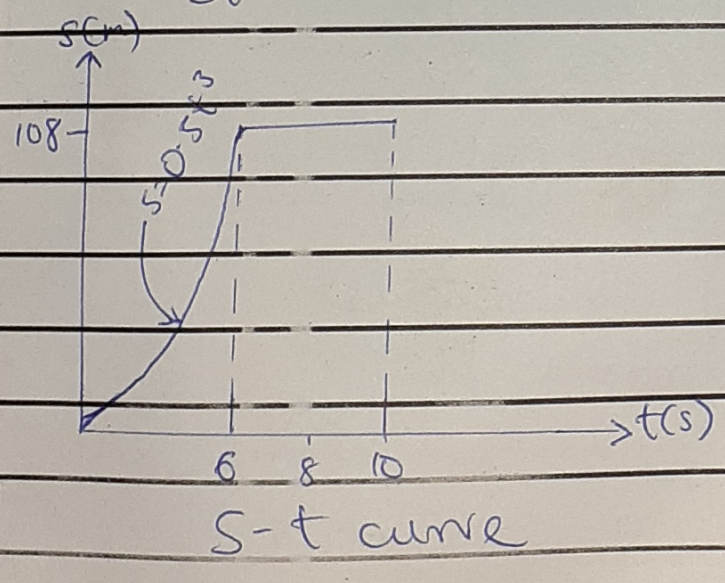
at $t = 6$ sec, $V = 1.5 \times 6^2 = 54$ m/s

during the time interval,

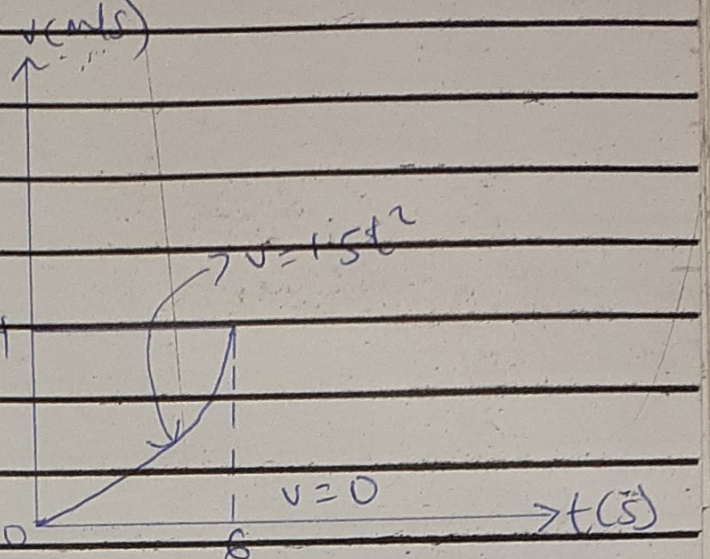
$6 < t \le 10$

displacement, $S = 108$ i.e $S = $ constant

∴ $V = \frac{ds}{dt} = 0$ --- $6 < t \le 10$

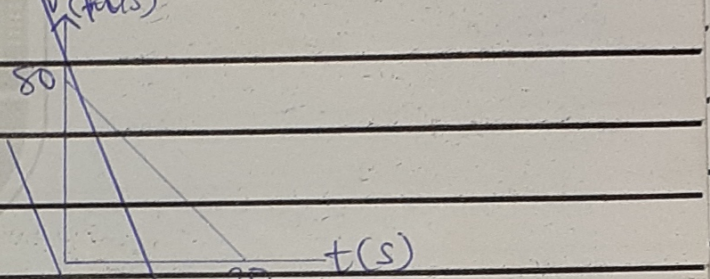


S-t curve



v-t curve.

F12-10

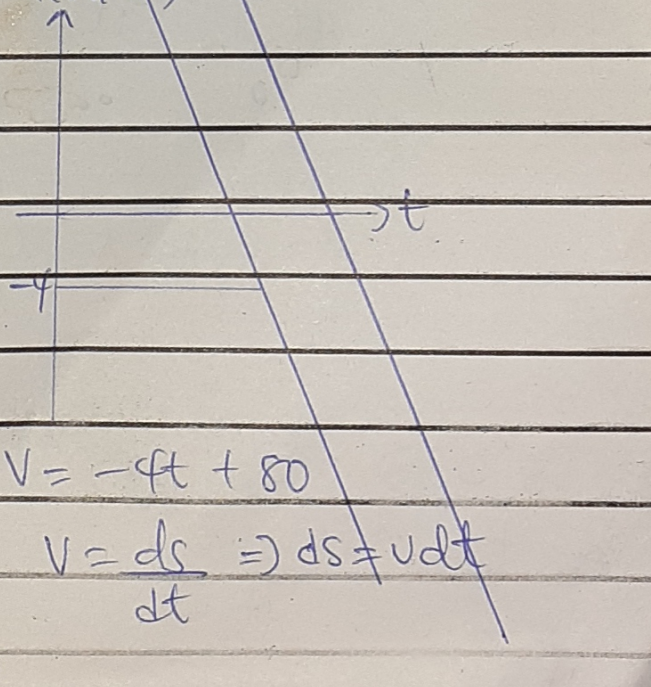


Given, $S = 0$, at $t = 0$

$V = 4t + 80$

$V = -4t + 80$ $\Rightarrow a = \frac{dv}{dt}$

$= -4\ ft/s^2$



$V = -4t + 80$

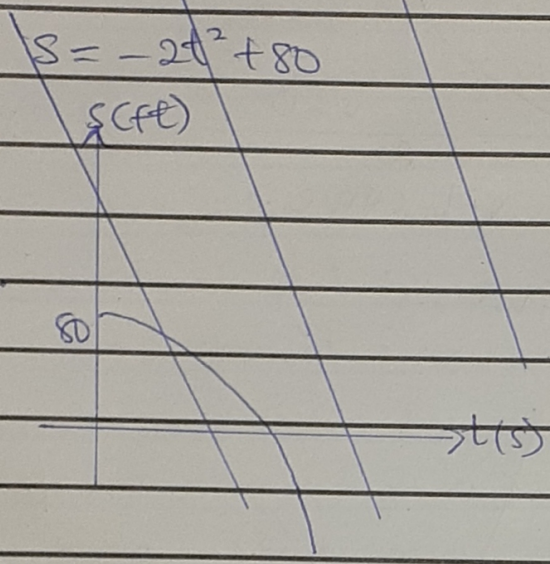
$V = \frac{ds}{dt} \Rightarrow ds = v\,dt$

$\int_0^s ds = \int_0^t (-4t + 80)\,dt$

$s = -\int_0^t 4t\,dt + \int_0^t 80\,dt$

$= \frac{-4t^2}{2} + 80t = -2t^2 + 80$

$s = -2t^2 + 80$



F12-10

Given $v = -4t + 80$

$\frac{ds}{dt} = -4t + 80$

$ds = (-4t + 80)\,dt$

$\int ds = \int (-4t + 80)\,dt$

$s = -2t^2 + 80t + C$

also given $s = 0$ for $t = 0$

$s = -2t^2 + 80t$

① $s = 0$, at $t = 0$

② $s = 0 \Rightarrow 2t^2 = 80t$

$t = 40s$

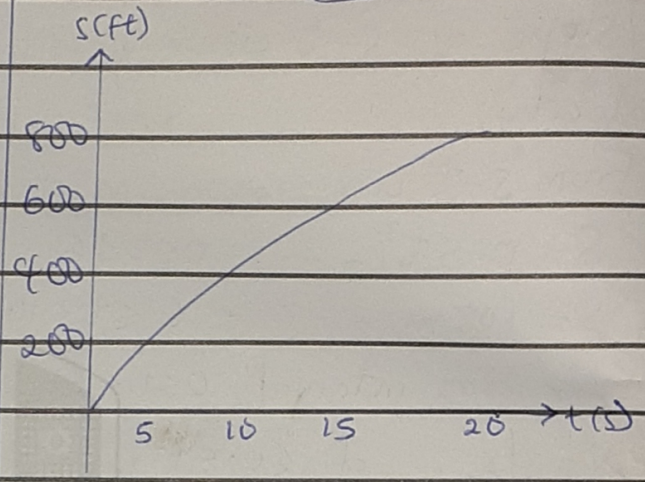
③ $\frac{ds}{dt} = 0 \Rightarrow -4t = -80$

$t = 20s$

$s|_{t=20} = -2 \times (20)^2 + 80 \times 20$

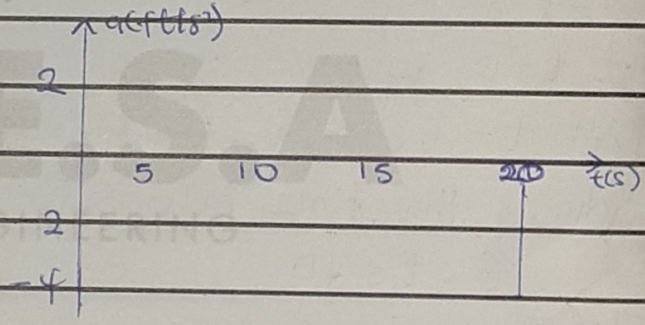
$= -800 + 1600$

$= 800ft.$



s-t graph

$\frac{dv}{dt} = a = -4$



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$v\,dv = a\,ds$

$v = 0.25s$

$\frac{dv}{ds} = 0.25$

$dv = 0.25\,ds$

$a\,ds = v\,dv$

$a\,ds = (0.25s) \cdot (0.25\,ds)$

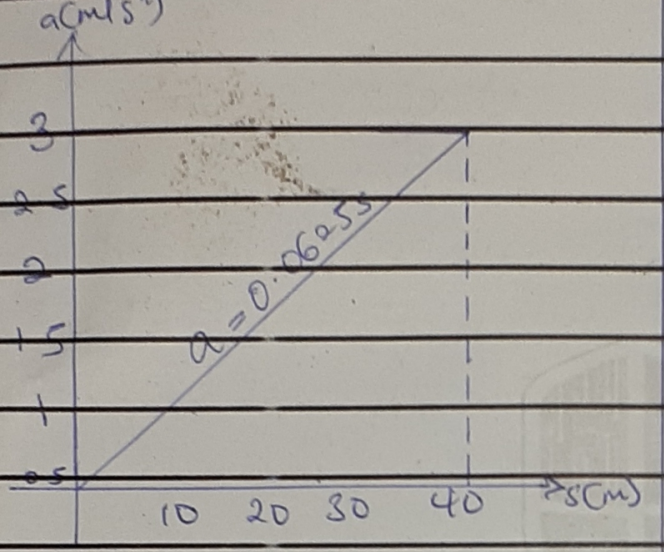
$a = 0.25s \times 0.25$

$a = 0.0625s$

at $s = 40$

$a = 0.0625(40)$

$a = 2.5 \text{ m/s}$



above graph represent a-s graph for given v-s graph.

F12-12

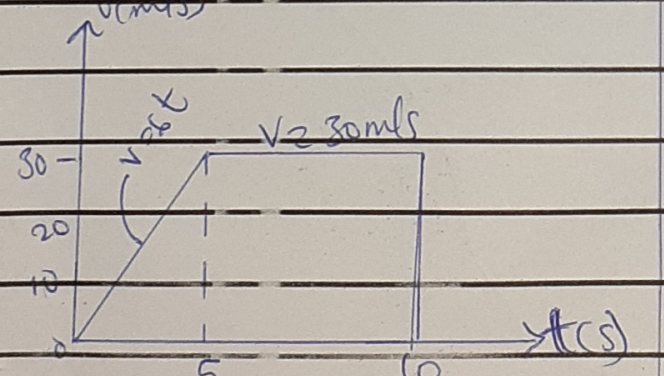
Solution

$0 \le t \le 5s, \quad s = 3t^2$

$v = \frac{ds}{dt} = 6t \text{ m/s}$

$5 < t \le 10, \quad s = 30t - 75$

$v = \frac{ds}{dt} = 30 \text{ m/s}$



v-t graph

$v = \frac{\Delta s}{\Delta t}$

$= \frac{225 - 25}{10 - 5} = 40 \text{ m/s}$

a-t graph

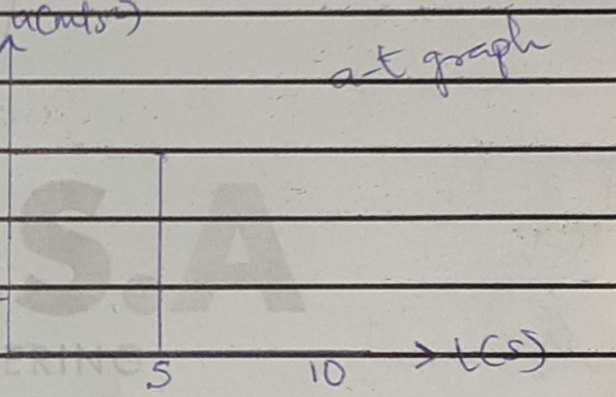
$0 \le t < 5s, \quad v = 6t \text{ (m/s)}$

$a = \frac{dv}{dt}$

$= 6 \text{ m/s}^2$

$5 < t \le 10s, \quad v = 30 \text{ m/s}$

$a = \frac{dv}{dt} = 0$



a-t graph

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at $0 \le t \le 5$,

$dv = a\,dt$

$\int_0^v dv = \int 20\,dt$

$v = 20t$

at $t = 5s$,

$v = 20(5) = 100 \text{ m/s}$

at $5 \le t \le t'$

$a = -10$

$\int_{100}^{v} dv = \int_5^t -10\,dt$

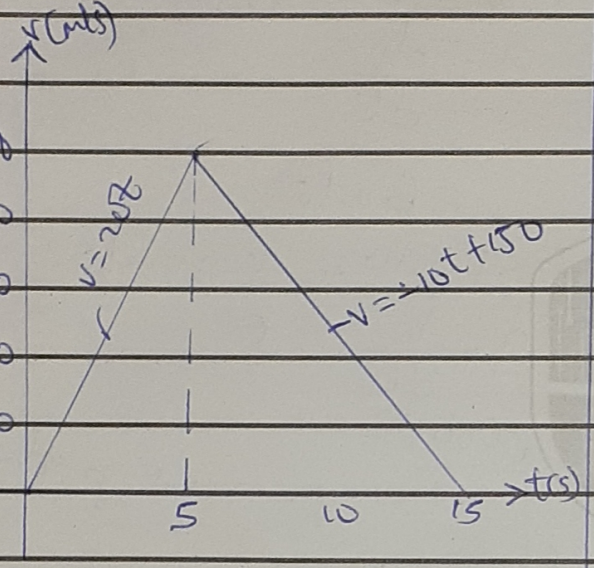
$v\Big|_{100}^{v} = -10t\Big|_{5}^{t}$

$v - 100 = -10t + 50$

$v = -10t + 150$

at $t = t'$, $v = 0$

$t = \frac{0 - 150}{-10} = 15$



F12-14

Soln

$\int ds = \int$

$v = 30t$ for $0 \le t < 5s$

$v = -15t + 225$ for $5s < t \le 15s$

$\therefore v = \frac{ds}{dt}$

$ds = v\,dt$ — (1)

The eqn for the distance travelled between $0 \le t < 5s$

$ds \quad v = 30t$

$ds = v\,dt$

$ds = 30t\,dt$

$\int_0^5 ds = \int_0^t 30t\,dt$

$\int_0^5 ds = \int_0^{5sec} 30t\,dt$

$s = \left[30 \times \frac{t^2}{2}\right]_0^5$

$= 15 \times (5)^2$

$s = 375\,m$

The equation for the distance travelled between $5s \le t \le 15s$

$\int_{375}^{s} ds = \int_5^t (-15t + 225)\,dt$

$[s]_{375}^{s} = \left[\frac{-15t^2}{2} + 225t\right]_5^t$

$[s - 375] = \left[\frac{-15t^2}{2} + 225\right] - \left[\frac{-15 \times 5^2}{2} + 225 \times 5\right]$ — (2)

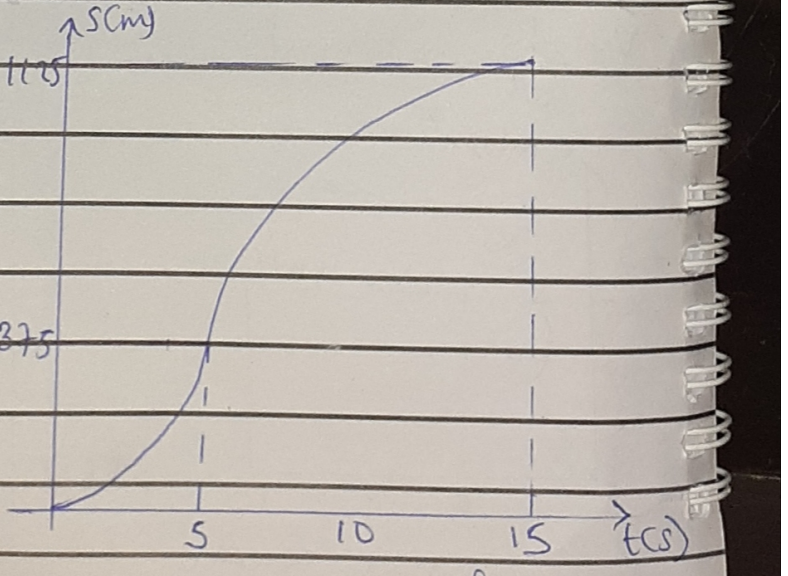
$s - 375 = (-7.5t^2 + 225t) - 937.5$

$s = [-7.5t^2 + 225t - 562.5]\,m$ — (3)

Sub $t = 15sec$ in eqn (3)

$s = (-7.5(15)^2 + 225 \times 15 - 562.5)m$

$s = 1125\,m$.



s-t graph