Emmanuel Peter Wonigban
Mechanical
18/ENG06/071

(1) Slope of s-t curve given:

$s = 0.5t^3$ $s = 108m$

for time interval $0 \leq t \leq 6$

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

$v = 0.5 \times 3t^2 = 1.5t^2$

at $v = 0$, $t = 0$

But at $t = 6$

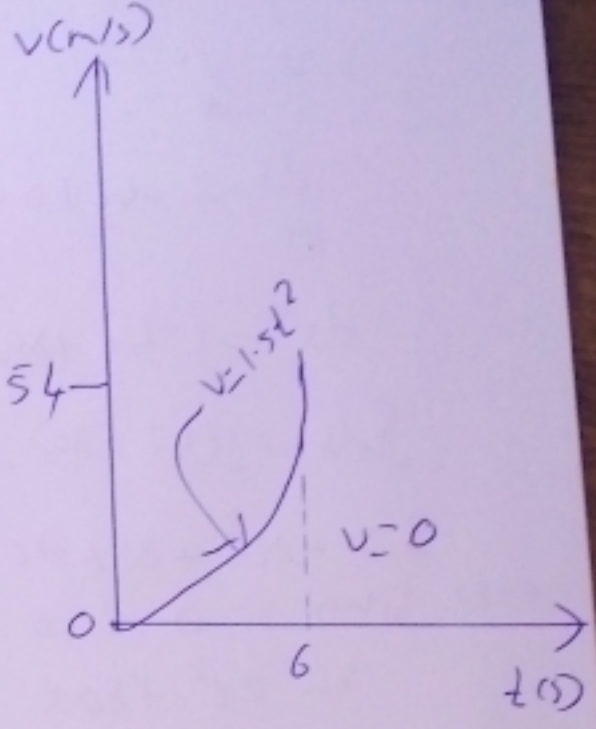
$v = 1.5(6)^2$

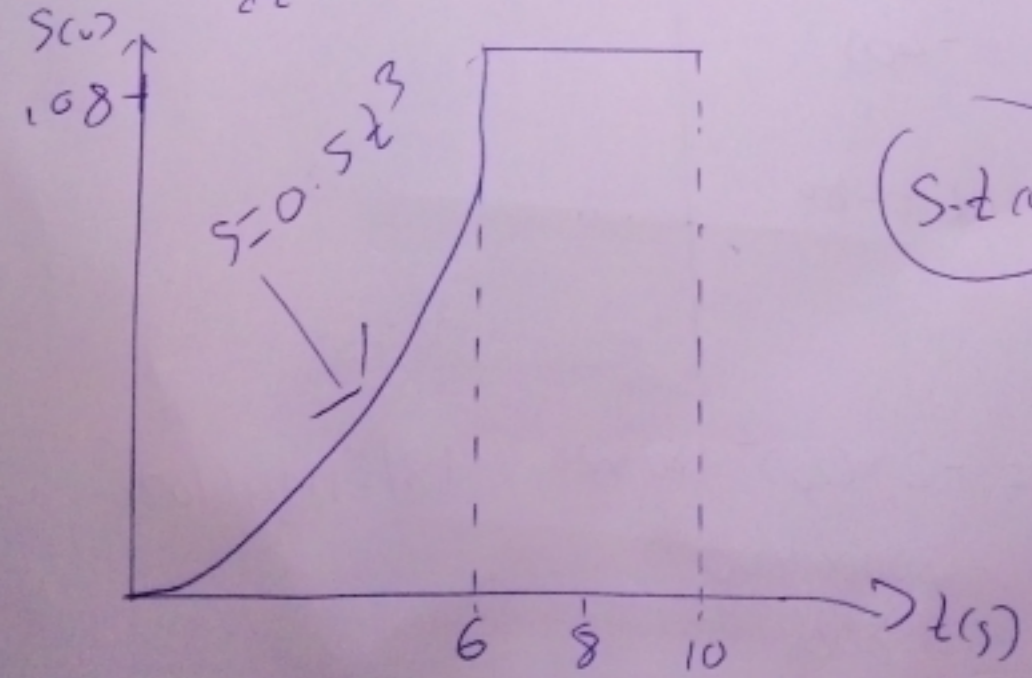
$= 54 ms^{-1}$

for time interval $6 \leq t \leq 10$

displacement = 10s

$v = \frac{ds}{dt} = 0$





S-t curve.

Diagram 12 - 10

Given $v = -4t + 80$

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

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

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

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

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

also given $s = 0, t = 0$

$s = 2t^2 + 80t$

When $s = 0$

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

$0 = 2t^2 + 80t$

$-80t = 2t^2$

$t = -40s$

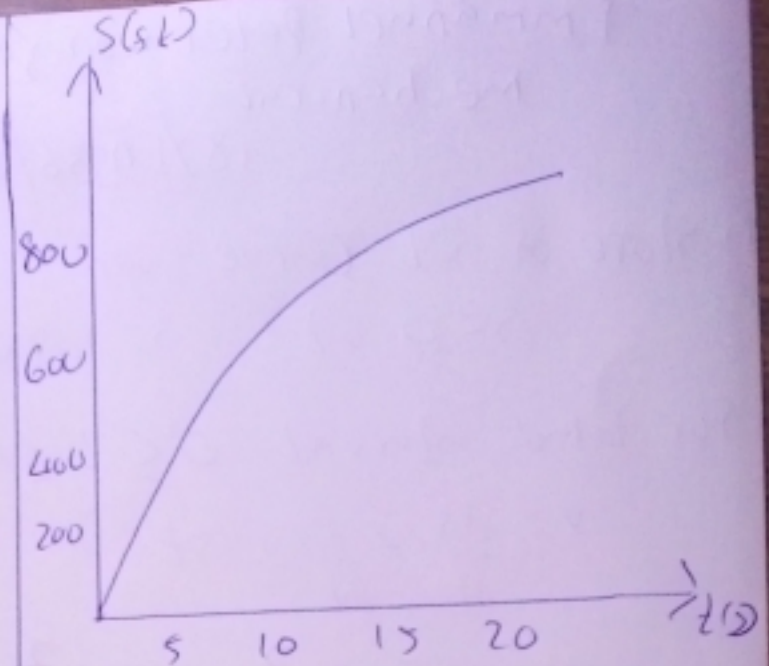
(b) $\frac{ds}{dt} = 0 = -4t = -80$

$t = 20s$

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

$= -800 \times 1600$

$= 800ft$



s-t graph

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

18/Eng06/07,

18/Eng06/071

Diagram F12 - 11

$v dv = a ds$ - ①

$v = 0.25 s$

$dv = 0.25$

$\frac{dv}{ds}$

$dv = 0.25 ds$

from eqn 1 compare

$a ds = v dv$

$\frac{a\,ds}{v}$

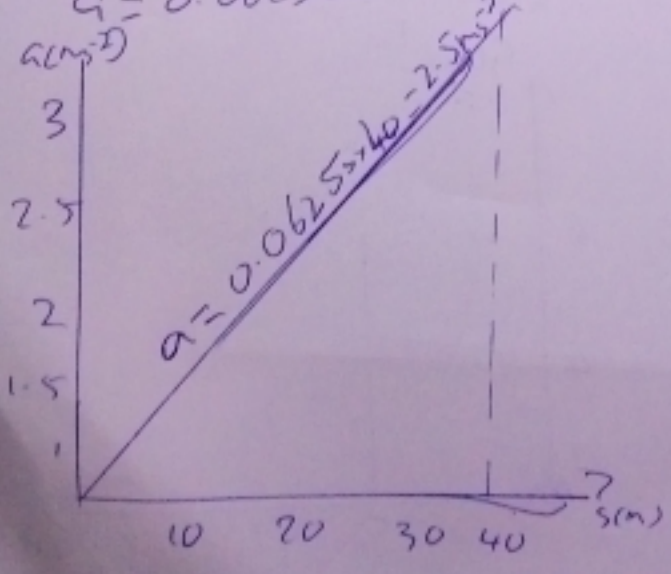
$a ds = (0.25).(0.25 ds)$

$a ds = 0.0625 ds$

$a = 0.0625 s$

at $s = 40$

$a = 0.0625(40) = 2.5 ms^{-2}$



v-s graph.

18/Eng06/071

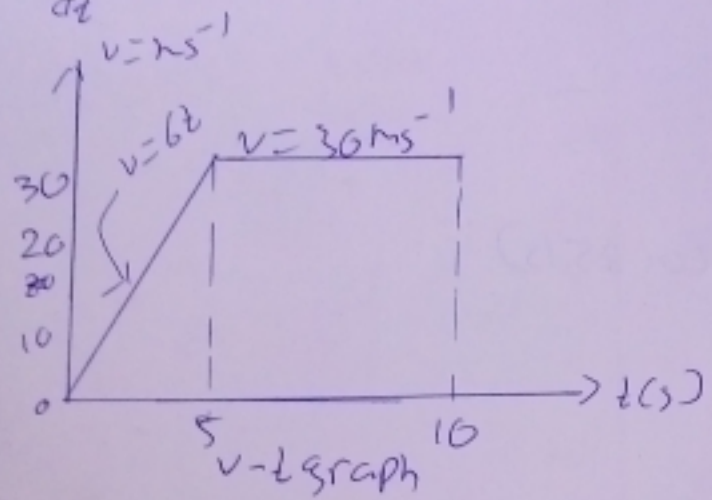
Diagram F 12 - 12

$0 \leq t \leq 5$, $s = 3t^2$

$v = \frac{ds}{dt} = 6t\ ms^{-1}$

$5 \leq t \leq 10$, $s = 30t - 75$

$v = \frac{ds}{dt} = 30\ ms^{-1}$



v-t graph

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

$= \frac{225 - 25}{10 - 5} = 40\ ms^{-1}$

a-t graph

$0 \leq t \leq 5$ $v = 6t\ (ms^{-1})$

$a = \frac{dv}{dt} = 6\ ms^{-2}$

$5 \leq t \leq 10$ $v = 30\ ms^{-1}$

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

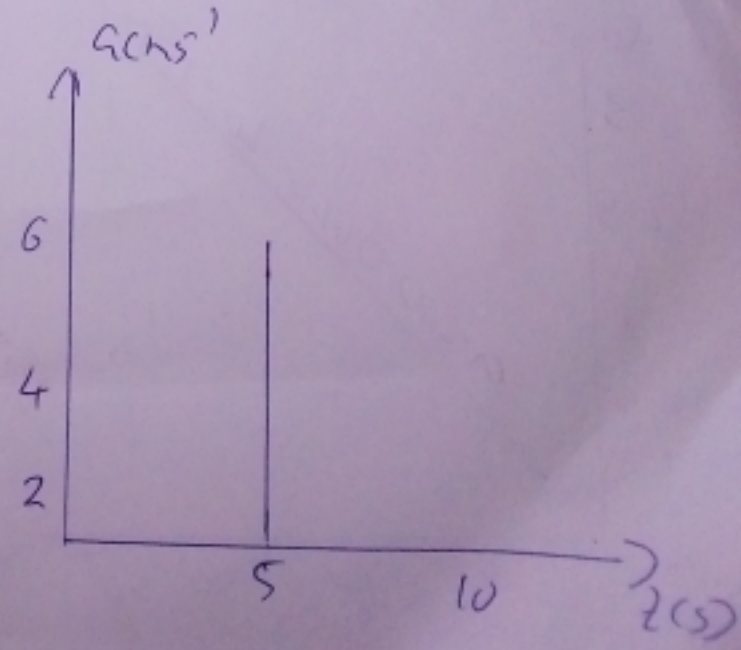


Diagram F12-13

18/Eng06/071

at $0 \le t \le 5$

$dv = a\,dt$

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

$v = 20t$

at $t = 5$ s

$v = 20(5) = 100\ ms^{-1}$

at $5 \le t \le t'$

$a = -10$

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

$v\,|_{100}^{v} = -10t\,|_5^t$

$v - 100 = -10t + 50$

$v = -10t + 150$

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

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

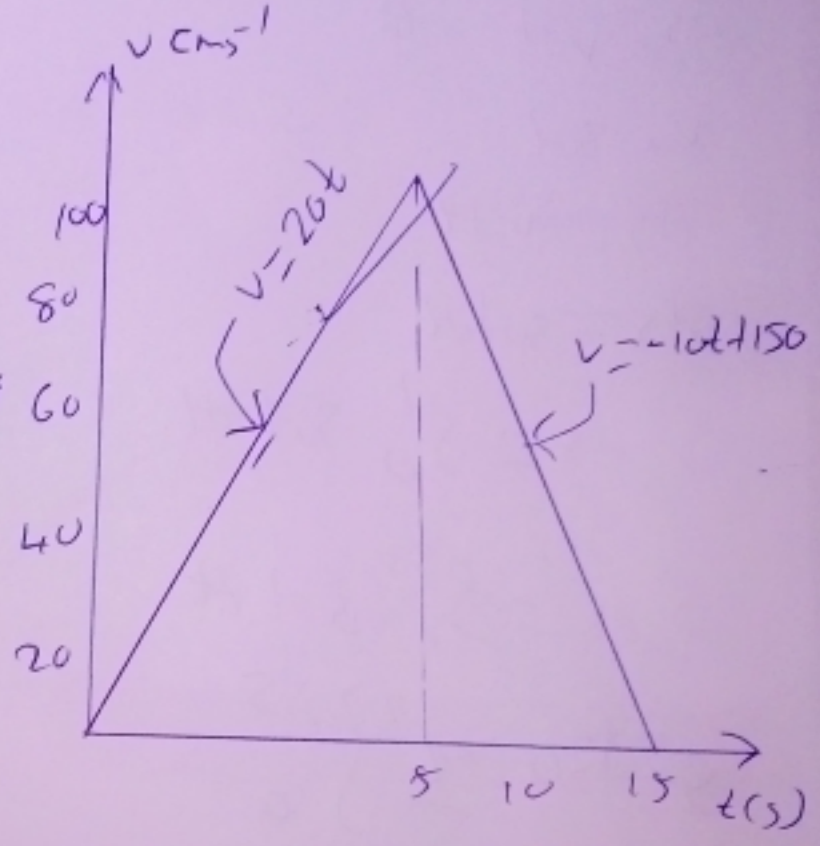


Diagram F12-14

18/Eng06/011

$v = 30t$ for $0 \leq t \leq 55$

$v = -15t + 225$ for $55 \leq t \leq 155$

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

$ds = v\,dt$ - ①

$v = 30t$

$ds = v\,dt$

$ds = 30t\,dt$

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

$\int_0^s ds = \int_0^{55} 30t\,dt$

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

$= 15 \times 5^2$

$s = 375$

while for $55 \leq t \leq 155$

$\int_{375}^{s} ds = \int_{55}^{t} (-15t + 225)\,dt$

$[s]_{375}^{s} = \left[\frac{-15t^2}{2} + 225t\right]_{55}^{t}$

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

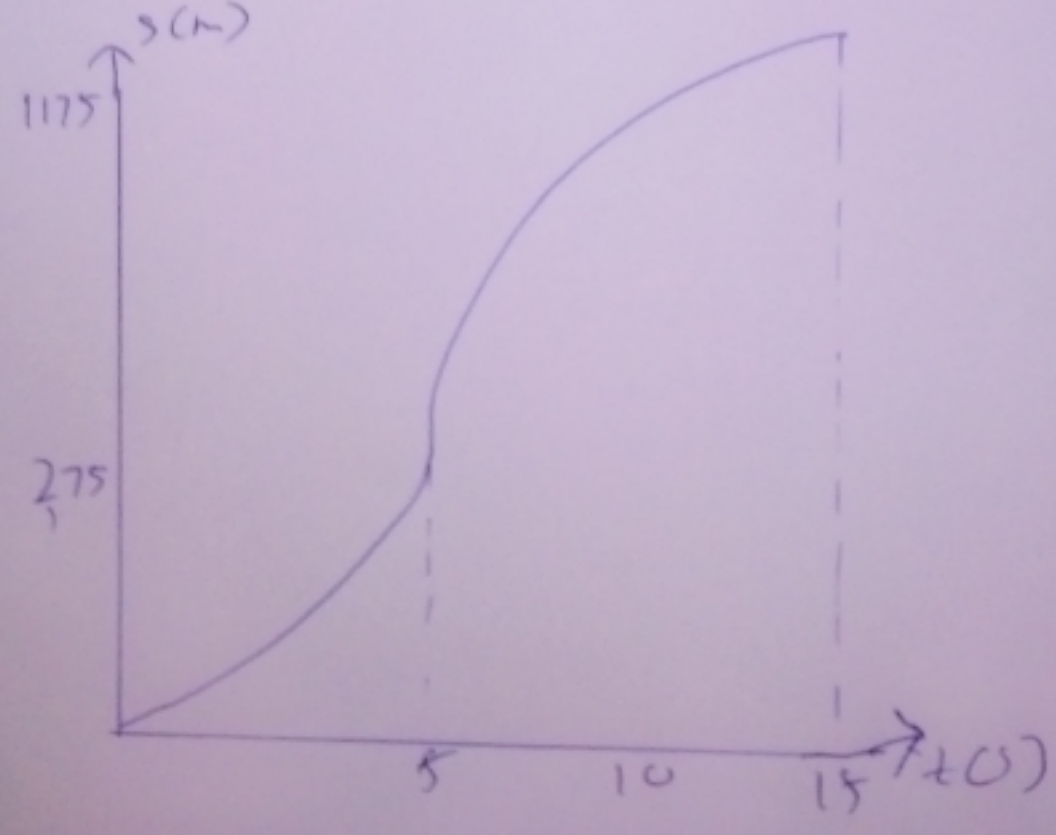
$$s = [-7.5t^2 + 225t - 562.5]\,m$$

Substitute $t = 15\,s$

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

$$s = 1125\,m$$

18/Eng06/071



s-t graph

F12-14 Contd