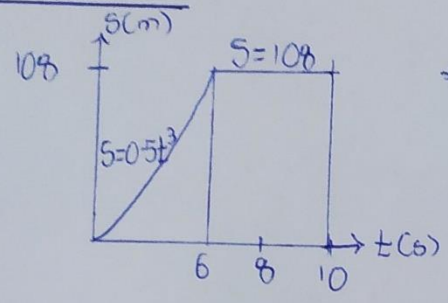
IZUCHUKWU CHIDERA VICTOR
18/ENG05/024
MECHATRONICS

F12-9



$\Rightarrow 0 \leq t < 6; \quad S = 0.5t^3 m$

$V = \frac{\delta S}{\delta t} = 3(0.5)t^2$

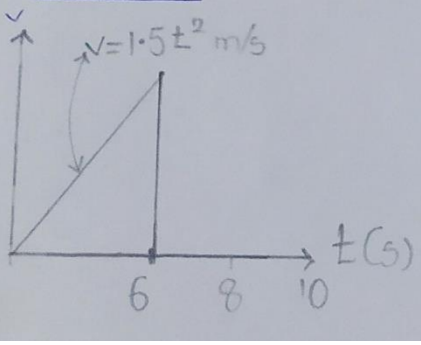
$V = 1.5t^2 \ m/s$ //

$\Rightarrow 6 < t \leq 10s;$

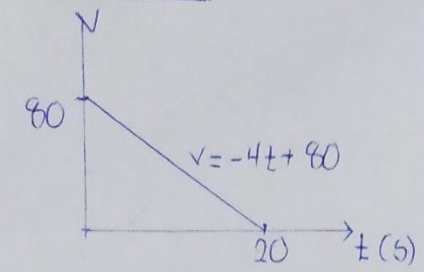
$S = 108m$

$V = \frac{\delta S}{\delta t} = 0 \ m/s$ //

V-t GRAPH



F12-10



I) $0 < t \leq 20$

$$v = \frac{\delta s}{\delta t} = -4t + 80$$

$$\delta s = v\,\delta t$$

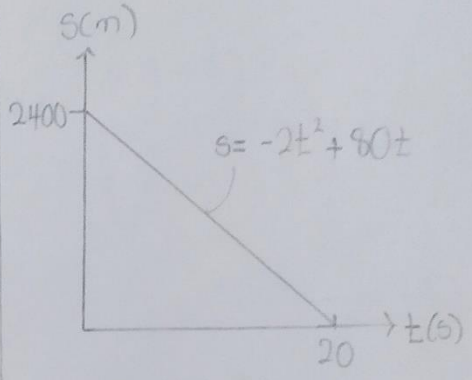
$$\delta s = (-4t + 80)\,\delta t$$

$$\int_0^s \delta s = \int (-4t + 80)\,\delta t$$

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

$$s = -2t^2 + 80t \text{ (m)}$$

s-t GRAPH



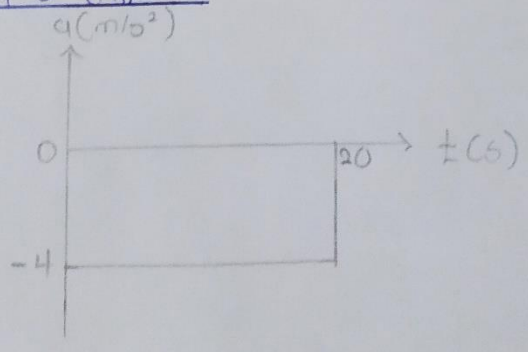
$s = -2(20)^2 + 80(20)$

$= 2400\text{m}$

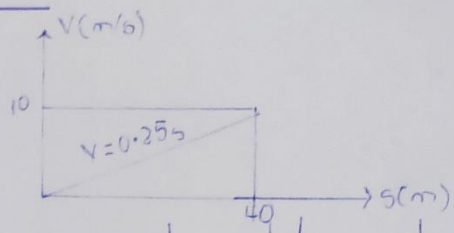
II) $$a = \frac{\delta v}{\delta t} = \frac{\delta(-4t + 80)}{\delta t}$$

$$a = -4\,m/s^2$$

a-t GRAPH



F12-11



The a-s graph is determined using

$$a\,\delta s = v\,\delta v$$

$$a = v\frac{\delta v}{\delta s}$$

$$a = (0.25s)\cdot\frac{\delta(0.25s)}{\delta s}$$

$$= 0.25s \times 0.25$$

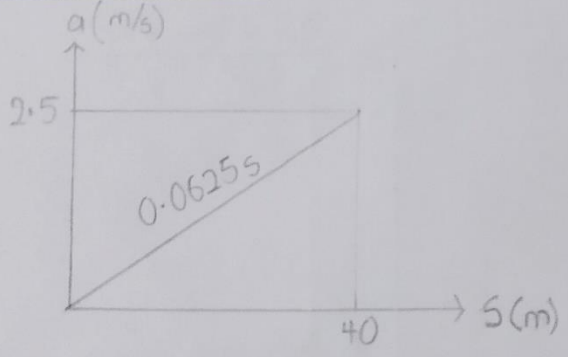
$$= 0.0625s$$

At $s = 40s$

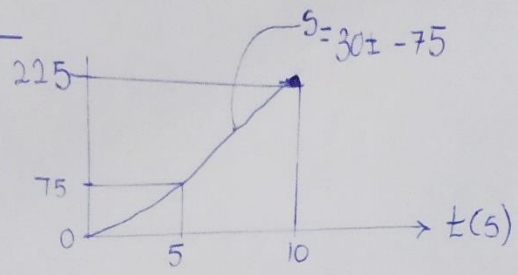
$$a = 0.0625(40)$$

$$= 2.5\ m/s^2$$

a-s GRAPH



F12-12



I) V-t

For $0 \le t \le 5$; $v = \frac{ds}{dt} = \frac{d(30t - 75)}{dt} \quad \frac{d}{dt}(3t^2)$

$v = 6t$ m/s //

$At = 5s$

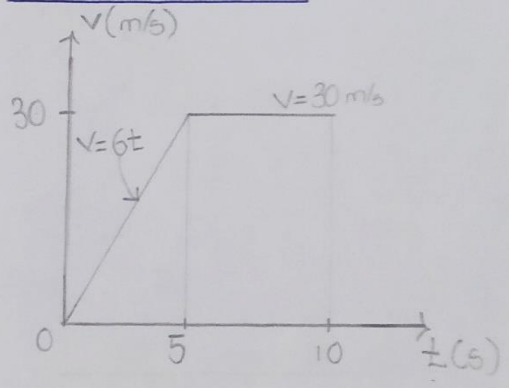
$v = 6(5) = 30$ m/s

For $5 < t \le 10$:

$v = \frac{ds}{dt} = \frac{d(30t - 75)}{dt}$

$v = 30$ m/s //

V-t GRAPH



II) a-t

For $0 \le t \le 5$

$a = \frac{dv}{dt} = \frac{d(6t)}{dt}$

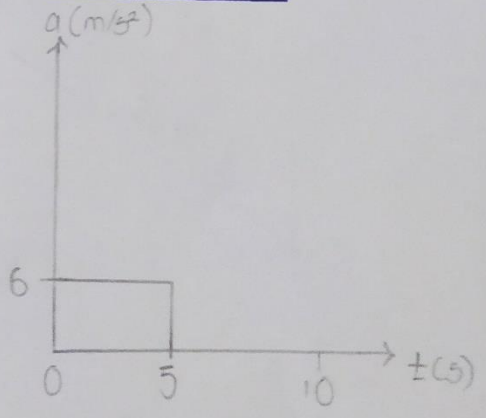
$a = 6$ m/s^2 //

For $5 < t \le 10$

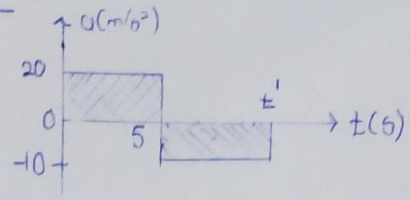
$a = \frac{dv}{dt} = \frac{d(30)}{dt}$

$a = 0$ m/s^2

a-t GRAPH



F12-13



$a = \frac{\delta v}{\delta t}$

$\delta v = \int a \, \delta t$

For $0 \leq t < 5$

$\int_0^v \delta v = \int_0^t 20 \, \delta t$

$v = 20t$

At $t = 10s$

$v = 20(10) = 200 \, m/s$

For $5 < t \leq t'$

$\int_{200}^v \delta v = \int_5^t -10 \, \delta t$

$v - 200 = -10t + 50$

$v = -10t + 50 + 200$

$v = -10t + 250 \, m/s$

t' = time at rest

∴ At t', $v = 0$ and $t = t'$

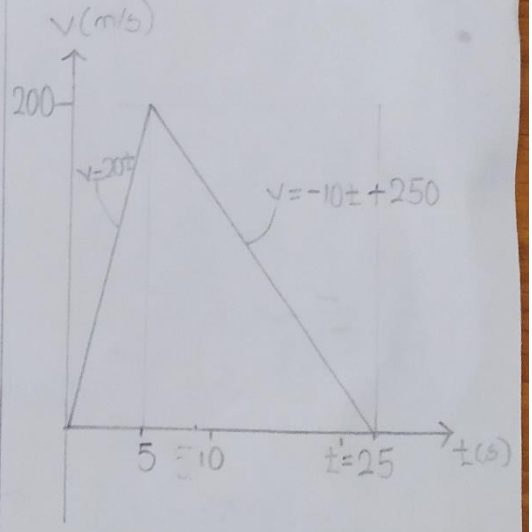
$0 = -10t + 250$

$10t = 250$

$t = 250/10$

$t' = t = 25 \, s$

v-t GRAPH



F12-14

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

$ds = v\,dt$

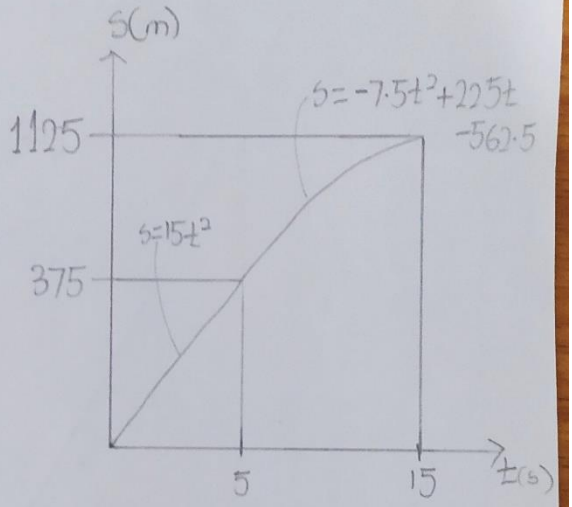
For $0 \le t < 5$

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

$s = \frac{30t^2}{2} = 15t^2$

At $t = 5s$

$s = 15(5^2) = 375\,m$



For $5 < t \le 15$

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

$s - 375 = -7.5t^2 + 225t \Big]_5^t$

$s - 375 = -7.5t^2 + 225t - \left(-7.5(5)^2 + 225(5)\right)$

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

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

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

At $t = 15s$

Total Distance, $s = -7.5(15^2) + 225(15) - 562.5$

$= 1125\,m$