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18/ENG051063

Mechatronics ENG 234

Assignment 2

(1) For the first 6 seconds, where $s = 0.5t^2$

$$v = \frac{ds}{dt} = 1.5t^2$$

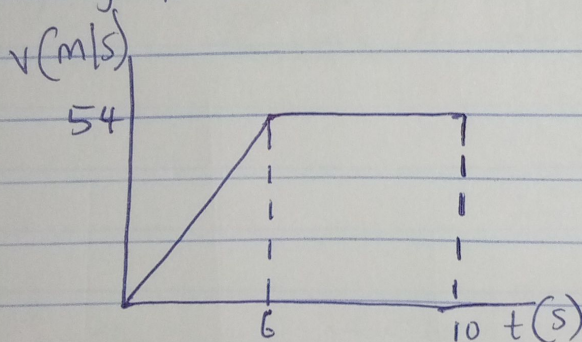
$$v = 1.5(6)^2 = 54 \text{ ms}^{-1}$$

for $6-10$, where $s = 108$

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

$$v = 0$$

v-t graph



(2) Since $v = \frac{ds}{dt}$

~~$s = \int v dt$~~

$\therefore s = \int v$

$s = \int -4t + 80$

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

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

$\therefore s_{0-20} = -2(20^2) + 80 \times 20$

$s = 800 \text{ ft}$

s-t graph

s(ft)

800

0

20 t(s)

Where $s=0, t=0$

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

where $v = -4t + 80$

$\therefore a = -4 \text{ ft/s}^2$

a-t graph

a(ft/s²)

0

-4

20

12

t(s)

(3) $a ds = v dv$

~~But~~ $v = 0.25s$

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

$$dv = 0.25 ds$$

$\therefore$

$$a ds = v(0.25 ds)$$

Divide both sides by ds

$$a = 0.25v$$

But $v = 0.25s$

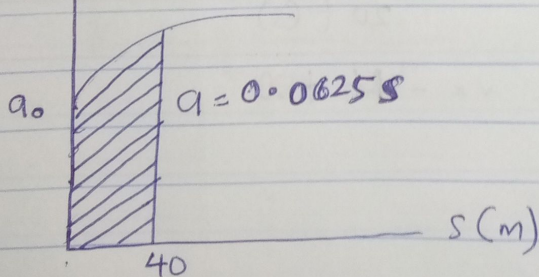
$$\therefore a = 0.25 \times 0.25s$$

$$a = 0.0625s$$

where $s = 40 \text{ m}$

$$a = 2.5$$

$a(\text{m/s}^2)$ $a-s$ graph



(4)(i)

for first time interval V_{0-5}

$$v = \frac{ds}{dt} \quad \text{where } s = 3t^2$$

$$\therefore v = 6t$$

$$t = 5 \text{ sec}$$

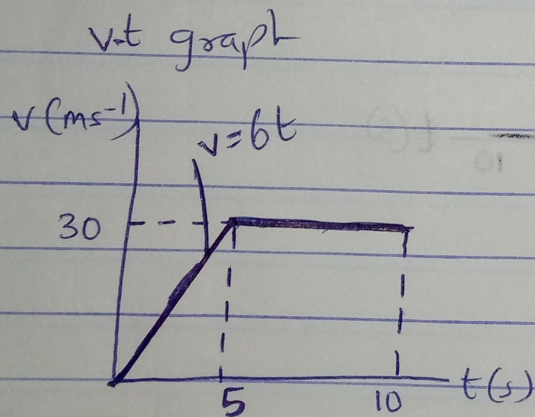
$$\therefore v = 6 \times 5$$

$$v = 30 \text{ ms}^{-1}$$

for second time interval V_{5-10}

$$v = \frac{ds}{dt} \quad \text{where } s = 30t + 75$$

$$v = 30 \text{ ms}^{-1}$$



~~the~~

~~for the second time interval~~

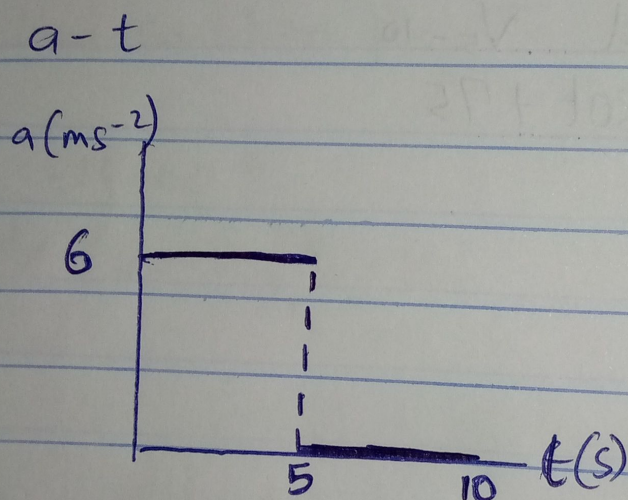
(4.11) for first time interval, a_{0-5} ...
 $a = \frac{dv}{dt}$ where $v = 6t$

$$\therefore a = 6 \text{ ms}^{-2}$$

for second time interval a_{5-10}

$$a = \frac{dv}{dt}, \text{ where } v = 30$$

$$\therefore a = 0$$



5 segments of a-t graph

$$0 \leq t < 5s$$

$$a = 20 \text{ ms}^{-2}$$

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

$$v = 20t$$

where $t = 5 \text{ sec}$

$$v = 100 \text{ ms}^{-1}$$

Using this initial condition for the next time period
 $5 < t \leq t'$

$$a = -10 \text{ ms}^{-2}$$

$$\cancel{\int_{100}^v dv} \quad v = \int_5^t -10$$

$$v = (-10t + 150) \text{ ms}^{-1}$$

$$\text{when } t = t', \quad v = 0$$

$$\therefore 0 = -10t + 150$$

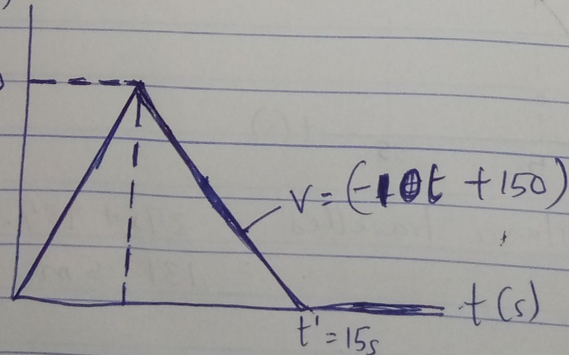
$$10t = 150$$

$$t = 15 \text{ sec}$$

V-t graph

v (ms⁻¹)

100



$$(6) \quad s = \int v$$

$$\text{for } 0 \leq t < 5$$

$$s = \int 30t$$

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

$$s = 15t^2$$

$$s = 15(5)^2$$

$$s = 375 \text{ m}$$

$$\text{for } 5-15$$

$$s = \int v$$

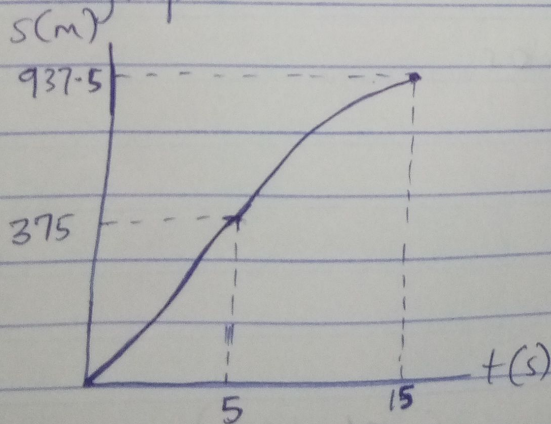
$$s = \int -15t + 225$$

$$s = \frac{-15t^2}{2} + 225t$$

$$s = \frac{-15 \times 25}{2} + 225 \times 5$$

$$s = 937.5 \text{ m}$$

$s-t$ graph



$$\therefore \text{Total distance travelled} = 375 + 937.5$$

$$= 1312.5 \text{ m}$$