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MATRIC NO: 18/ENG09/006

DEPARTMENT: AERONAUTICAL ENGINEERING

TITLE: ASSIGNMENT

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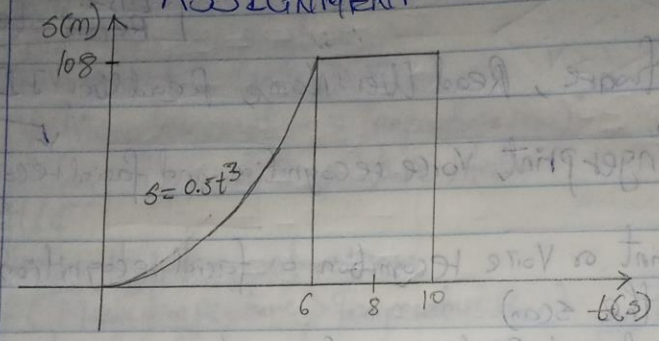
COURSE: ENG224

ASSIGNMENT

1.)



The graph above is divided into two areas bounded by different curves

From $t = 0s$ to $t = 6s$,

$s = 0.5t^3$

Velocity $(v) = \frac{ds}{dt}$

$\therefore v = 1.5t^2$

at $t = 0$, $v = 1.5 \times 0^2 = 0 m/s$

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

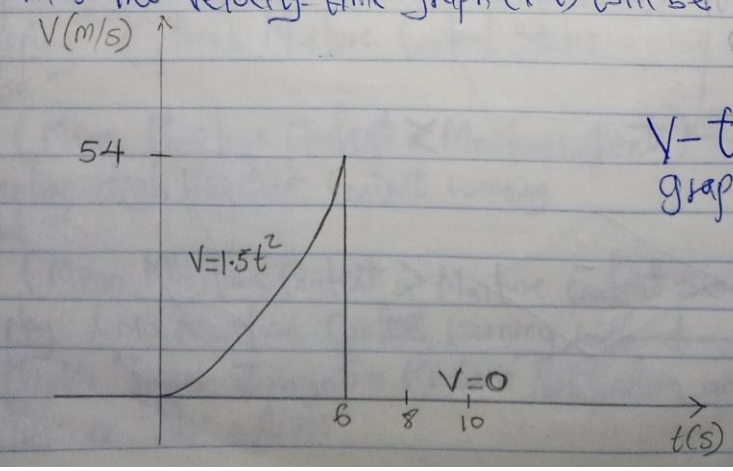
From $t = 8s$ to $t = 10s$

$s = 108$

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

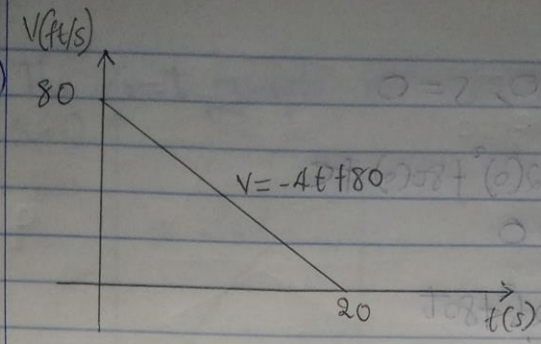
$\therefore v = 0 m/s$

Thus the Velocity-time graph (v-t) will be



V-t graph

2.)



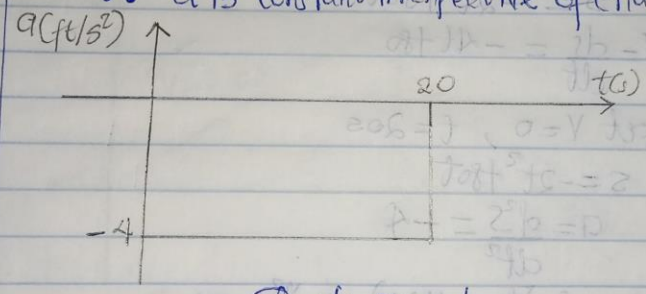
i.) from time $t=0$, to $t=20$ s,

$$V=-4t+80$$

$$\text{acceleration}(a)=\frac{dv}{dt}$$

$$a=-4\ ft/s^2$$

$\therefore$ a is constant irrespective of changes in time (t)



a-t graph

ii.) from time $t=0$, to $t=20$ s

$$V=-4t+80$$

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

$$s=\int v\,dt$$

$$s=\int -4t+80\,dt$$

$$s=-\frac{4t^2}{2}+80t+C \quad (\text{where } C=\text{constant})$$

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

But at $t=0$, $s=0$

$\therefore 0 = -2(0)^2 + 80(0) + C$

$\therefore C = 0$

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

at $t=0$, $s=0$

at $t=20$,

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

$s = -800 + 1600$

$s = 800\,ft$

To find the Maximum and minimum values of ~~$s=2t$~~

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

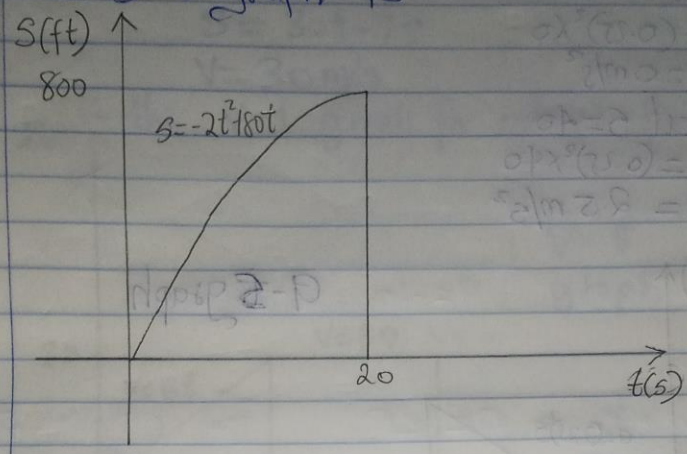
$V = \frac{ds}{dt} = -4t + 80$

at $V=0$, $t=20s$

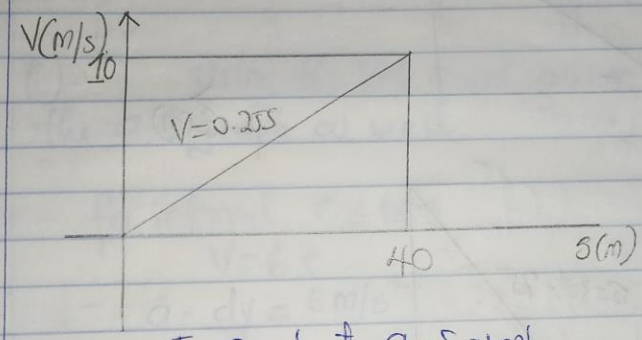
for $s = -2t^2 + 80t$

$a = \frac{d^2s}{dt^2} = -4$

The s-t graph is



3.)



To Construct a-S graph,

$$a = \int \frac{da}{ds}\, ds$$

$$\frac{da}{ds} = ?$$

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

$$dv = a\,dt$$

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

but $V = \frac{ds}{dt}$

$$\therefore \frac{dv}{ds} = \frac{a}{V}$$

$$a = V\frac{dv}{ds}$$

but

$$V = 0.25S$$

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

$$\therefore a = V \times \frac{dv}{ds}$$

$$a = (0.25S) \times (0.25)$$

$$a = 0.0625S$$

OR

$$a = (0.25)^2 S$$

At $s=0$

$a=(0.25)^2\times 0$

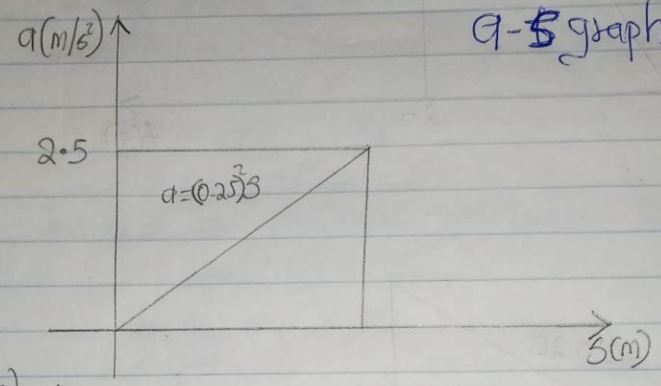
$a=0\ m/s^2$

at $s=40$

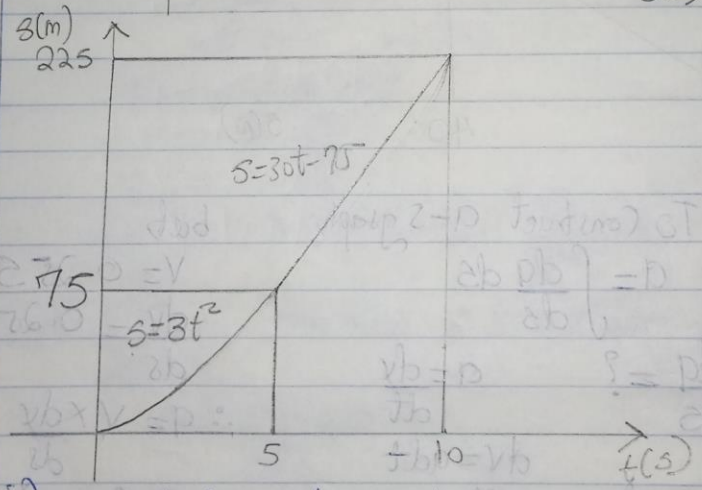
$a=(0.25)^2\times 40$

$a=2.5\ m/s^2$

a-s graph



4)



i) at time interval $t=0$, to $t=5$

$s=3t^2$

$V=\frac{ds}{dt}$, $V=6t$

at $t=0s$ $V=0\times 6=0\ m/s$

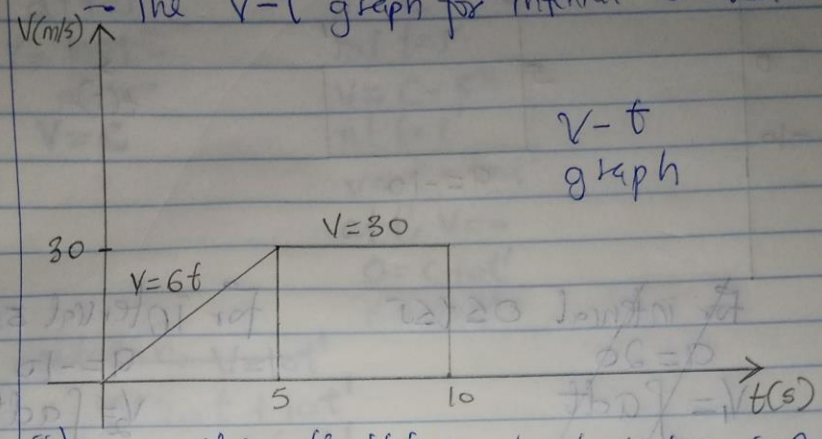
at $t=5s$ $V=5\times 6=30\ m/s$

At interval $t = 5s$ to $t = 10s$

$$S = 30t - 75$$

$$V = 30 m/s$$

$\therefore$ The V-t graph for interval $0 \le t \le 10$ is



ii) Using the V-t graph above, we can obtain the a-t graph as well

for interval $0 \le t \le 5$

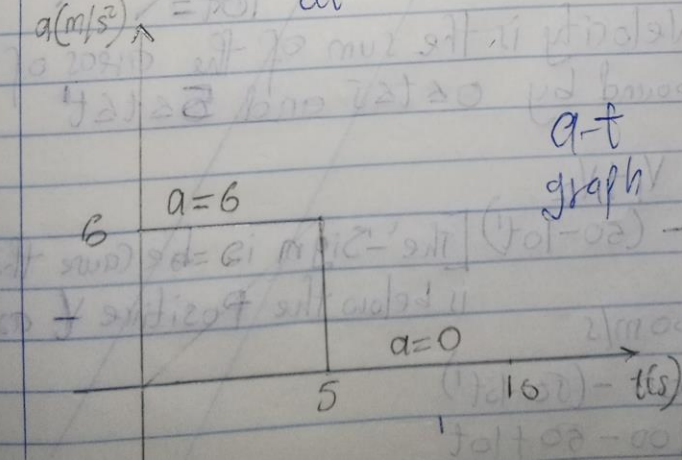
$$V = 6t$$

$$a = \frac{dv}{dt} = 6 m/s^2$$

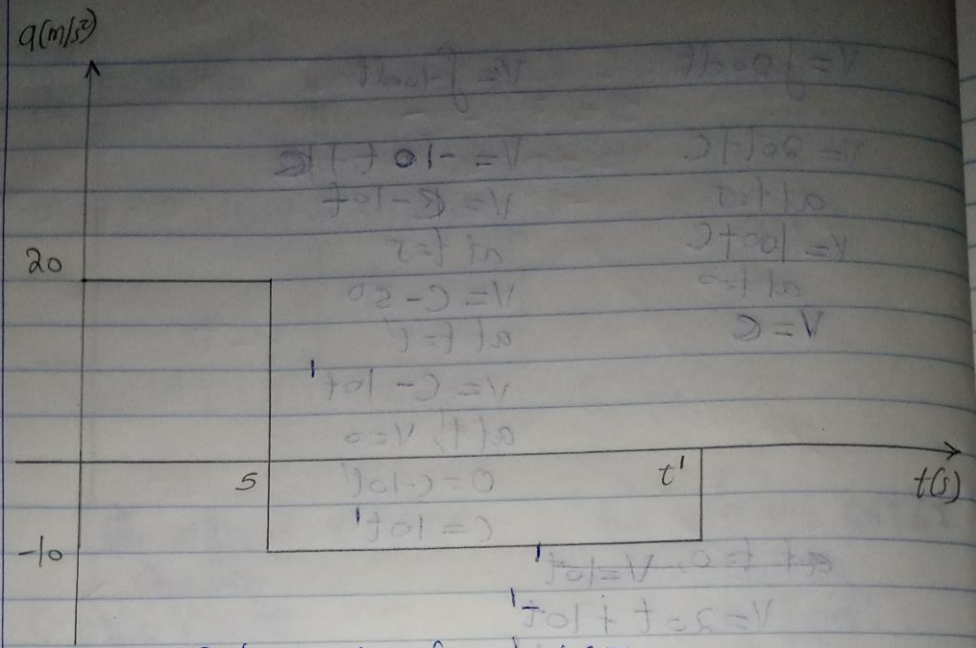
for interval $5 \le t \le 10$

$$V = 30$$

$$\therefore a = \frac{dv}{dt} = 0 m/s^2$$



5.)



For time interval, $0 \le t \le 5$

$a = 20$

$a = \frac{dv}{dt} \therefore v = \int a\,dt$

$v = \int 20\,dt$

$v = 20t + C$

but, since the cars starts from rest,

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

$0 = 20 \times 0 + C$

$\therefore C = 0$

So, $v = 20t$

For interval $5 \le t \le t'$

$a = -10$

$v = \int -10\,dt$

$v = -10t + K$

at t', $v = 0$

$\therefore 0 = -10(t') + K$

$k = 10t'$

$\therefore V = -10t + 10t'$

but, the curves $a = 20$ and $a = -10$, intersect at $t = 5$

$\therefore V = 20t$ and $V = -10t + 10t'$ will intersect at $t = 5$

$V = 20t = -10t + 10t'$, at $t = 5$

$\therefore 20 \times 5 = -10 \times 5 + 10t'$

$100 = -50 + 10t'$

$10t' = 100 + 50$

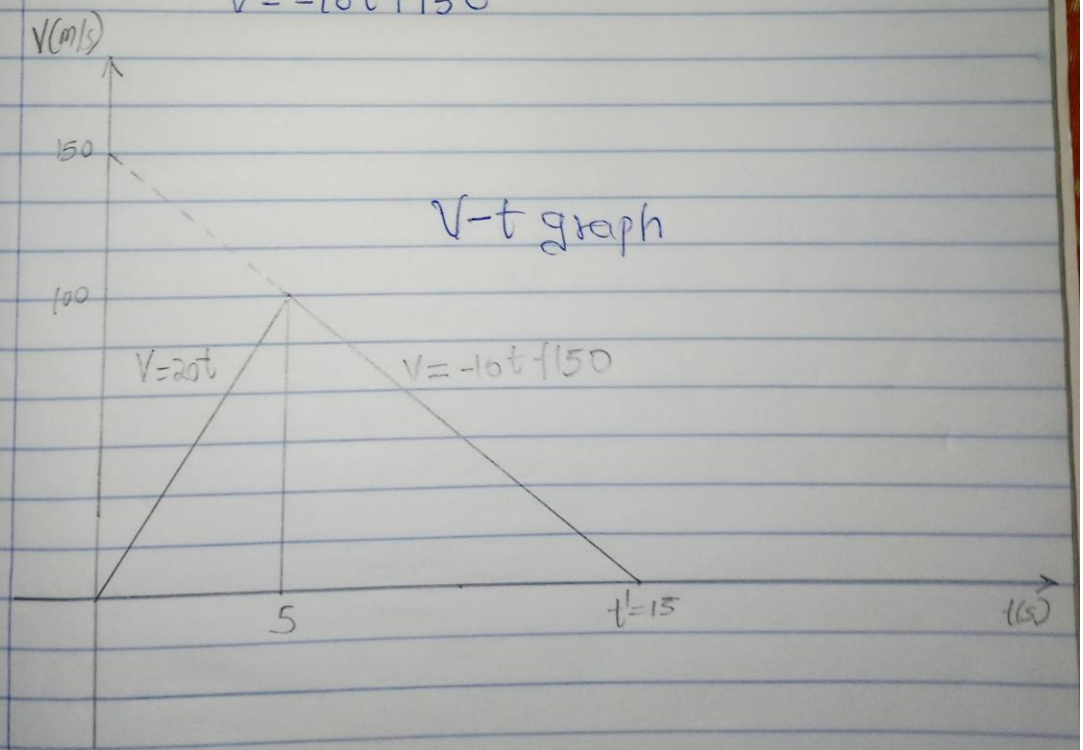
$10t' = 150$

$t' = 15s$

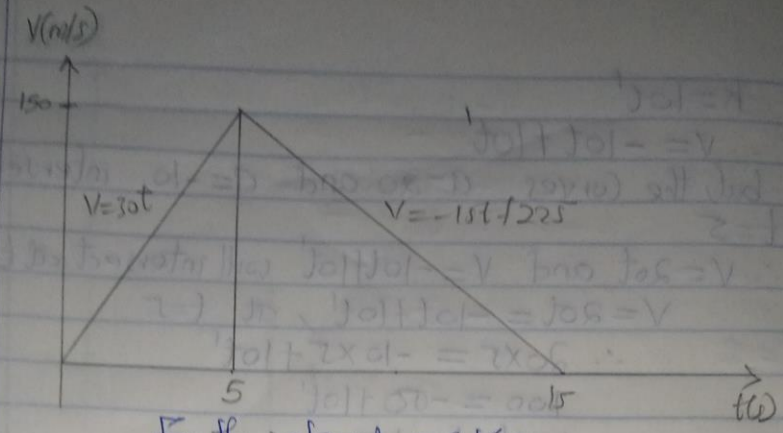
$\therefore V = -10t + 10t'$ is given as

$V = -10t + 10(15)$

$V = -10t + 150$



6.)



For the interval $0 \le t \le 5$

$V = 30t$

$S = \int V\,dt$

$S = \int 30t\,dt$

$S = \frac{30t^2}{2} + k$

$S = 15t^2 + k$

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

$0 = 15(0)^2 + k$

$\therefore k = 0$

$\Rightarrow S = 15t^2$

For interval $5 \le t \le 15$

$V = -15t + 225$

$S = \int V\,dt$

$S = \int -15t + 225\,dt$

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

For the graph of $V = -15t + 225$, total distance covered by $t = 10s$ is given by the area under the graph

~~Area = 15~~

$$\text{Area} = \frac{1}{2} b \times h$$

$$= \frac{1}{2} \times (15-5) \times 150$$

$$\text{Area} = 750$$

$$\therefore s = 750$$

$S = 15t^2$ and $s = -\frac{15t^2}{2} + 225t + k$ intersect at

$t = 5$

$$\therefore 15(5)^2 = -\frac{15(5)^2}{2} + 225(5) + k$$

$$\therefore k = 15(5)^2 + \frac{15(5)^2}{2} - 225(5)$$

$$k = -562.5$$

$$\therefore s = -\frac{15t^2}{2} + 225t - 562.5$$

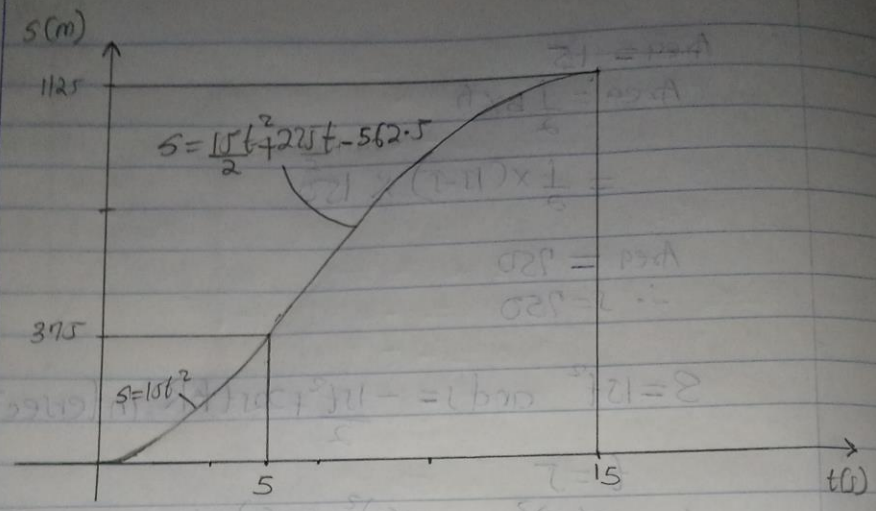
$\frac{ds}{dt} = -15t + 225$, at $t = 15$, $\frac{ds}{dt} = 0$

$$\frac{d^2s}{dt^2} = -15$$

$\therefore$ Maximum Value of $s = -\frac{15t^2}{2} + 225t - 562.5$ occurs

at $t = 15s$

The s-t graph is given as follows



Total distance covered after the interval of $0 \le t \le 15$ from the graph is

$$S = 1125\,m$$

Also,

from the graph of Velocity against time

Area under $V=-15t+225$ curve is given as 750 m from previous calculation

Area under $V=30t$ curve is given as

$$\text{Area} = \frac{1}{2} b \times h$$

$$= \frac{1}{2} \times (5-0) \times 150$$

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

Total distance = sum of Areas

Total distance (S) = 375 + 750

$$S = 1125m$$