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18/ENG04/005

ELECT/ELECT

①

① find the velocity of the particle using

$$V = \frac{ds}{dt} \quad -①$$

for $0 \le t \le 6s$ Substitute, $0.5t^3$ for S in the equation ①

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

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

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

$$= 1.5t^2$$

find the velocity at point where time is 6s (maximum velocity)

$$V = 1.5t^2$$

$$= 1.5 \times 6^2$$

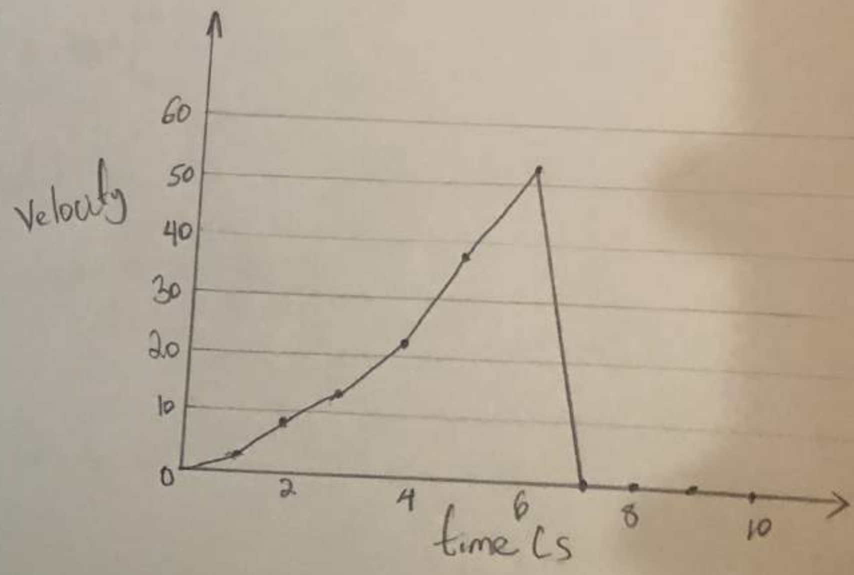
$$= 54 m/s$$

for $6s < t \le 10s$ Substitute, 108 for S in the equation (1)

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

$$= \frac{d}{dt}(108)$$

$$= 0$$



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Write equation for velocity of van:

$$v = \frac{ds}{dt} \quad \text{——} (1)$$

$$ds = v\,dt$$

Here, v is velocity of van, s is displacement of van, t is the time

Substitute $(-4t + 80)$ for v in equation (1)

$$ds = v\,dt$$

$$ds = (-4t+80)\,dt \quad \text{——} (2)$$

Identify the Initial Conditions:

$S = 0m$ when $t = 0s$.

let the upper limits of displacement and time be s and t respectively

Integrate equation (2) between the above specified limits.

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

$$\left|s\right|_0^s = \left|\frac{-4t^2}{2} + 80t\right|_0^t$$

$$\left|s\right|_0^s = \left|-2t^2 + 80t\right|_0^t$$

$$S = (-2t^2 + 80t)$$

Write equation for acceleration of the van:

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

Here, a is acceleration of car

Substitute $(-4t+80)$ for v

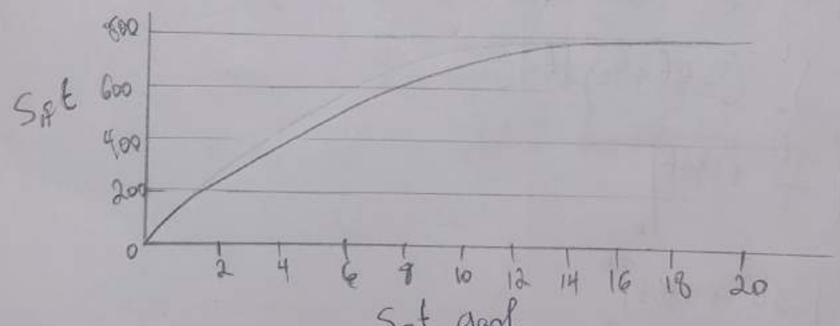
$$a = \frac{d}{dt}(-4t+80)$$

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

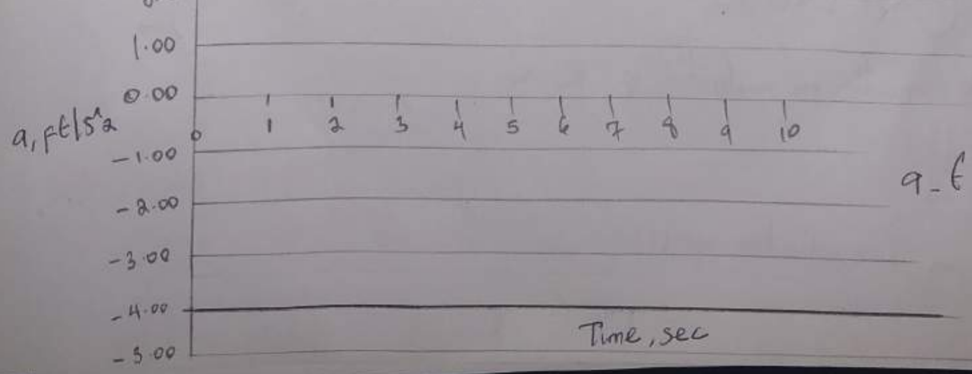
$$= 4\,ft/s^2 \leftarrow$$

Tabulate values of displacement for time range 0 sec to 20 sec.

Time Seconds	$S=-2t^2+80t$ (m)	Time Seconds.	$S=-2t^2+80t$ (m)
0	0	12	672
2	152	14	728
4	288	16	768
6	408	18	792
8	512	20	800
10	600		



S-t graph



a-t graph

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Fig12-11

Acceleration of the bicycle is expressed as

$$a = v\frac{dv}{ds} \quad -(1)$$

For $0 \le t < 40s$:

$$v = 0.25s$$

Accordingly, we have from (1)

$$a = (0.25s) \times \frac{d}{ds}(0.25s)$$

$$a = (0.0625s) \quad —— (2)$$

At $S = 40s$: we have from (2)

$$a|_{40s} = (0.0625 \times 40)$$

$$a|_{40s} = 2.5 m/s^2$$

$$a|_{40s} = 2.5 m/s^2 \longrightarrow$$

The a-s graph is plotted ~~based on~~

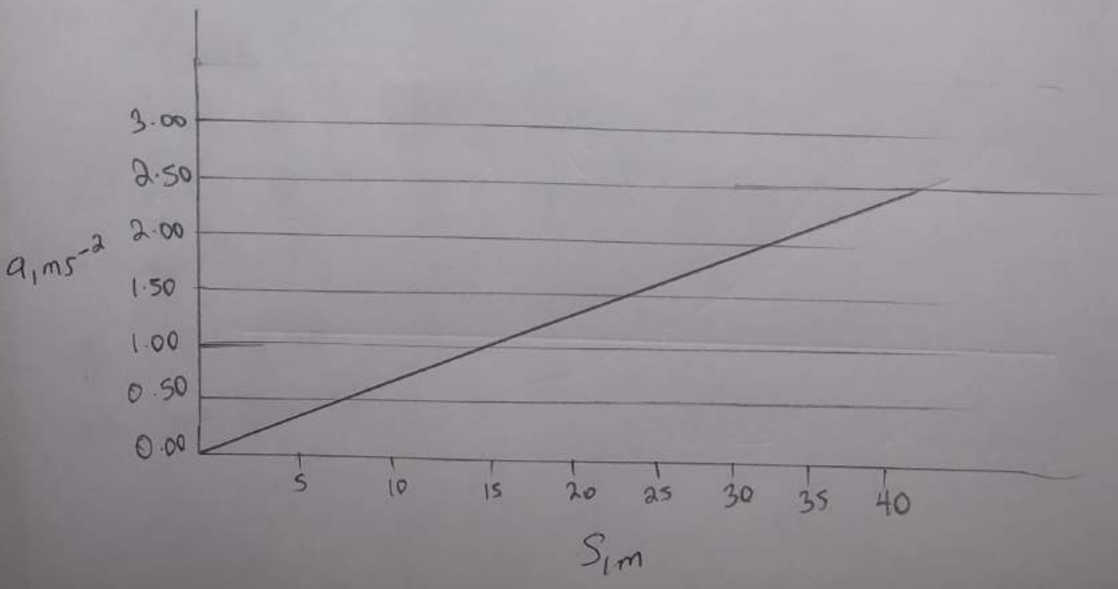

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Fig 12-12

Velocity of the Car is expressed as

$v = \frac{ds}{dt}$ — (1)

For $0 \le t \le 5s$

$S = 3t^2$

According we have

$v = \frac{d}{dt}(3t^2)$

$v = 6t$ — (2)

At $t = 5s$

$v/t = 5s = 6 \times 5$

$v/t = 5s = 30m/s$

$5s < t \le 10s$

$S = 30t - 75$

According we have from (1)

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

$v = 30m/s$ — (3)

Acceleration of the Car is expressed as

$a = \frac{dv}{dt}$ — (4)

for $0 \le t \le 5s$

we have from (2) eq, $v = 6t$

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we have (4)

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

$a = 6m/s^2$

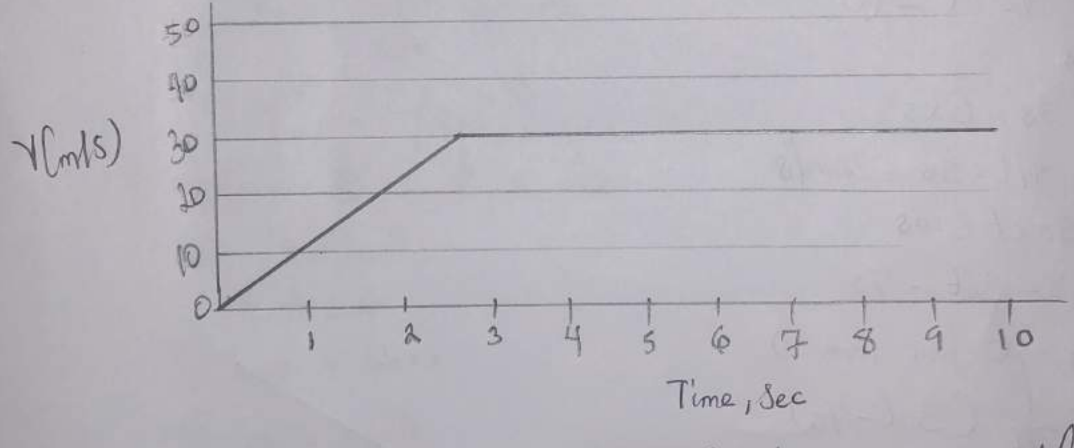
For $5s < t \leq 10s$

we have from (3) $v = 30m/s$

$a = \frac{d}{dt}(30m/s)$

$a = 0m/s^2$

v-t graph is plotted based on the data.



a-t graph is plotted based on the data

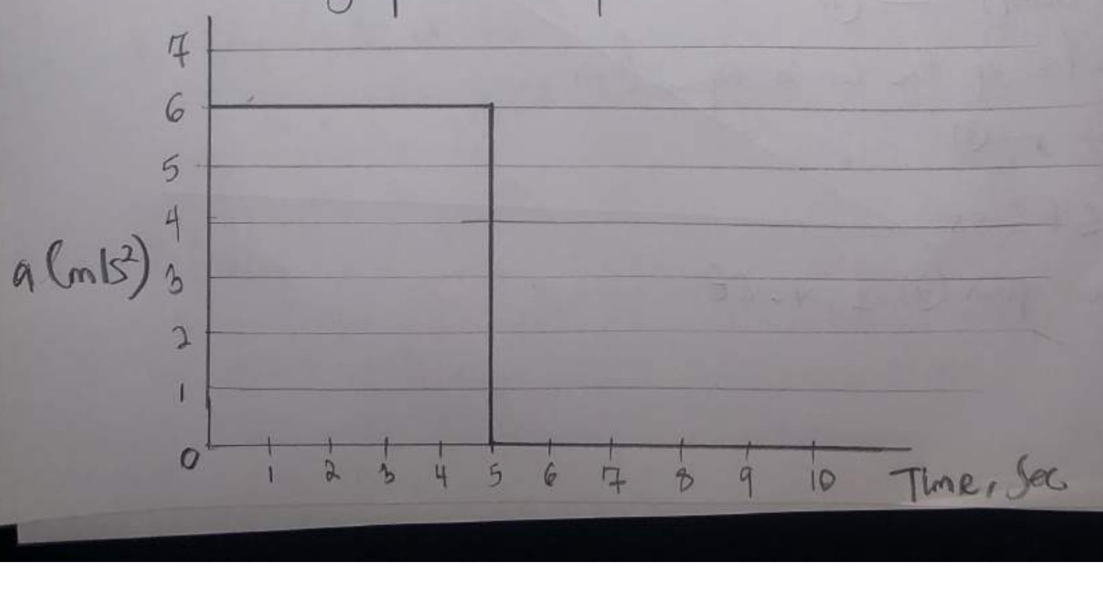


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Fig 12-13

Acceleration of the dragster is expressed as

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

$dv = a\,dt$ — (1)

for $0 \le t < 5s$.

By Integrating (1), we have

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

$|v|_0^v = |20t|_0^t$

By applying the limits, we have

$v = (20t)\,m/s$

At $t = 5s$:

$v|_{t=5s} = 20 \times 5$

$v|_{t=5s} = 100\,m/s$

for $5s < t \le t'$:

By Integrating (1), we have

$\int_{100}^{v} dv = \int_5^{t_1} -10\,dt$

$|v|_{100}^{v} = |-10t|_5^{t'}$

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By applying the limits, we have

$(v-100) = (-10t' + 10\times 5)\, m/s$

$v = (150 - 10t')\, m/s \quad -(2)$

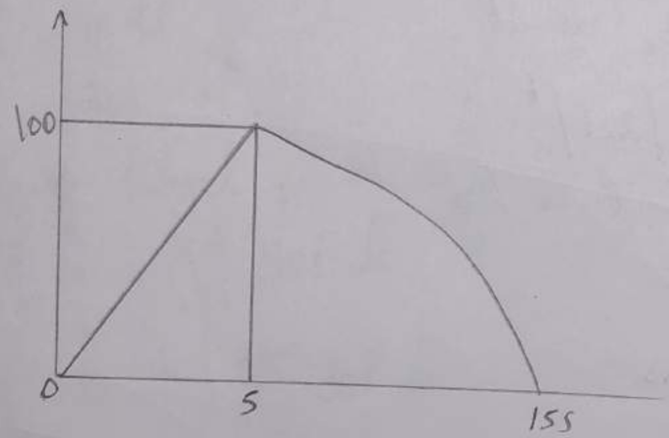
When the car comes to rest, we have

Accordingly, we have from (2)

$0 = (150 - 10t')$

$t' = 15s$

v-t graph



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Callculate the equation for the velocity of the dragster.

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

$ds = v\,dt$ —— (1)

Callculate the equation for the distance travelled between $0 \leq t < 5s$.

Substitute $30t$ for v in the equation (1).

$ds = v\,dt$

$= 30t \times dt$

Applying Integral for the equation for the region $0 \leq t < 5s$.

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

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

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

$S = [15t^2]_0^5$

$= 15 \times 5^2$

$= 375m$

Calculate the equation for the distance travelled between $5s < t \leq 15s$.

Substitute $(-15t + 225)$ for v in the equation (1)

$$ds = v\,dt$$

$$= (-15t + 225)\,dt$$

Apply Integral for the equation for the region $5s < t \leq 15s$.

$$\int_{375}^{s} ds = \int_{5}^{t} (-15t + 225)\,dt$$

$$\left| s \right|_{375}^{s} = \left| \frac{-15t^2}{2} + 225t \right|_{5}^{t}$$

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

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

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

Substitute 15 sec for t in the equation (2) to calculate the total distance travelled

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

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

$$s = 1125m$$

Therefore, the total distance travelled in the time interval $0s < t \leq 15s$ is $\boxed{1125m}$

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Tabulate the values for the distance travelled in the time interval $0s < t \leq 15s$

t	s
0	0
1	15
2	60
3	135
4	240
5	375
6	540
7	645
8	757.5
9	855
10	937.5
11	1005
12	1057.5
13	1095
14	1117.5
15	1125