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18/SC114/025
CIVIL ENGINEERING

1) find the velocity of particle using
$v = \frac{ds}{dt}$ — (1)

for $0 \leq t \leq 6s$, Substitute, $0.5t^3$ for s in the equation (1)

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

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

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

$= 1.5t^2$

⇒ Velocity the $t = 6s$ (maximum velocity)

$v = 1.5t^2$

$= 1.5 \times 6^2$

$= 54 m/s$

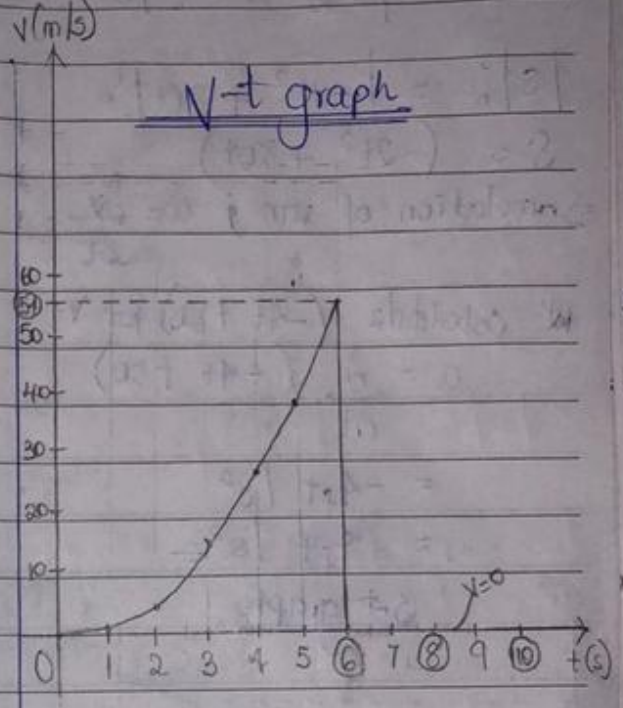
⇒ For $6 \leq t \leq 108$ substitute, 108 for S in the equation (1)

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

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

$= 0$

at $t = 0s$, $v = 0 m/s$; at $t = 1s$, $v = 1.5 m/s$
at $t = 2s$, $v = 6 m/s$; at $t = 3$, $v = 13.5 m/s$,
at $t = 4$, $v = 24 m/s$; at $t = 5s$, $v = 37.5$,
at $t = 6s$, $v = 54 m/s$



2) Eqn for velocity of van

$v = \frac{ds}{dt}$ — (1)

$ds = v\,dt$

where v = velocity of van
s = displacement of van
t = t is the van time

substitute $(-4t + 80)$ for v in eqn (1)

$ds = v\,dt$

$ds = (-4t + 80)\,dt$ — (2)

Indentify the initial condition

$s = 0m$ when $t = 0$

Integrate eqn (2)

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

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

$$|s|_0^s = |-2t^2 + 80t|_0^t$$

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

⇒ accelation of van; $a = \frac{dv}{dt}$

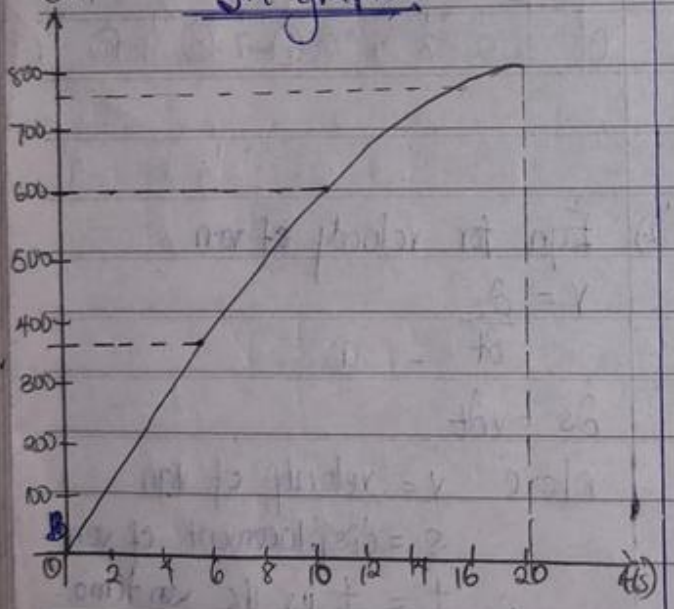
Wi substitute $(-4t + 80)$ for v

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

$$= -4_1 t\ /s^2$$

$$= 4_1 t\ /s^2 \leftarrow$$

s-t graph



3. Acceleration of the bayde is given as; $a = v\frac{dv}{ds}$ — ①

for $0 \leq t < 40s$;

$v = 0.25s$

Accn from eqn ①

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

$$a = (0.0625s) \quad - (2)$$

At $s = 40s$; we have from (2)

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

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

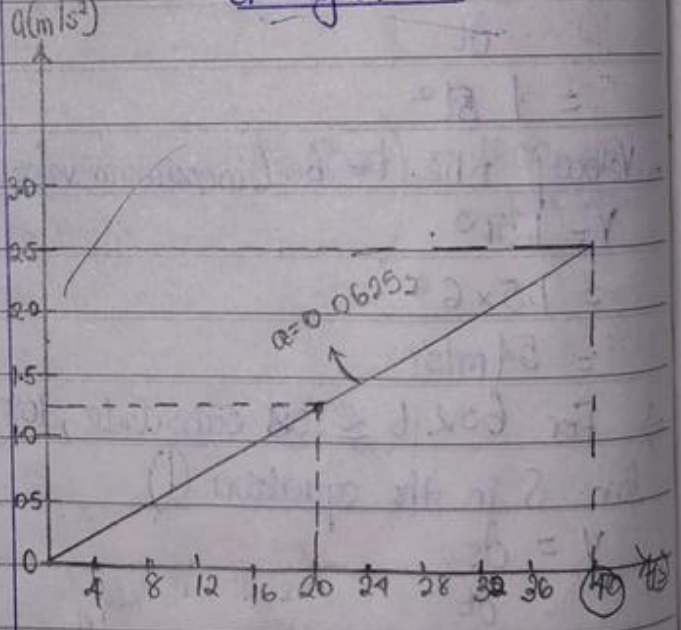
$a/_{40s} = 2.5 m/s^2 \longrightarrow$

$a = 0.25s \times 0.20 = 0.0625s$

at $t = 40m$ $\therefore s = 40$

at $= 0.0625(40 = 2.5 m/s^2$

a-t graph



4.) Velocity of the car is expressed as

$$v = \frac{ds}{dt} \quad — ①$$

According to

for $0 \leq t \leq 5s$

$s = 3t^2$

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

$v = 6t$ — (2)

At $t = 5s$

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

for $5s < t \leq 10s$

$S = 30t - 75$

from eqn (1)

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

$v = 30 m/s$ — (3)

Acceleration of the car

$a = \frac{dv}{dt}$ — (4)

for $0 \leq t \leq 5s$

use from eqn (2)

$v = 6t$

from eqn 4

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

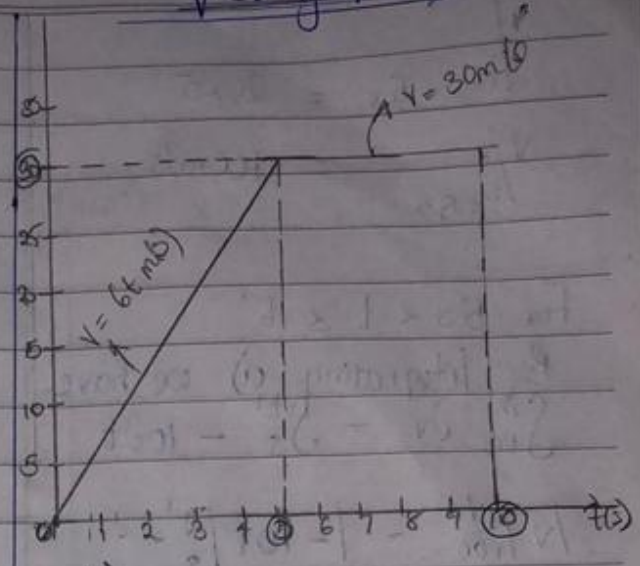
$a = 6 m/s^2$

use from eqn 3; $v = 30 m/s$

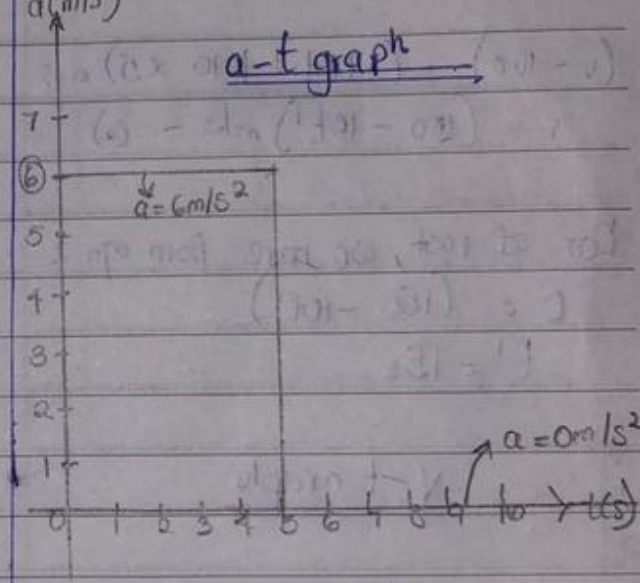
$a = \frac{d}{dt}(30 m/s)$

$a = 0$

v-t graph



a-t graph



5.) Acceleration: $a = \frac{dv}{dt}$

$dv = a\,dt$ — (1)

for $0 \leq t < 5s$

By integrating (1), we have

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

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

By applying the limit,

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

At $= 5s$;

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

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

For $5s < t \leq t'$

By Integrating (i) we have

$\int_{100}^{v} dv = \int_{5}^{t'} -10 dt$

$|v|_{100}^{v} = |-10t|_{5}^{t'}$

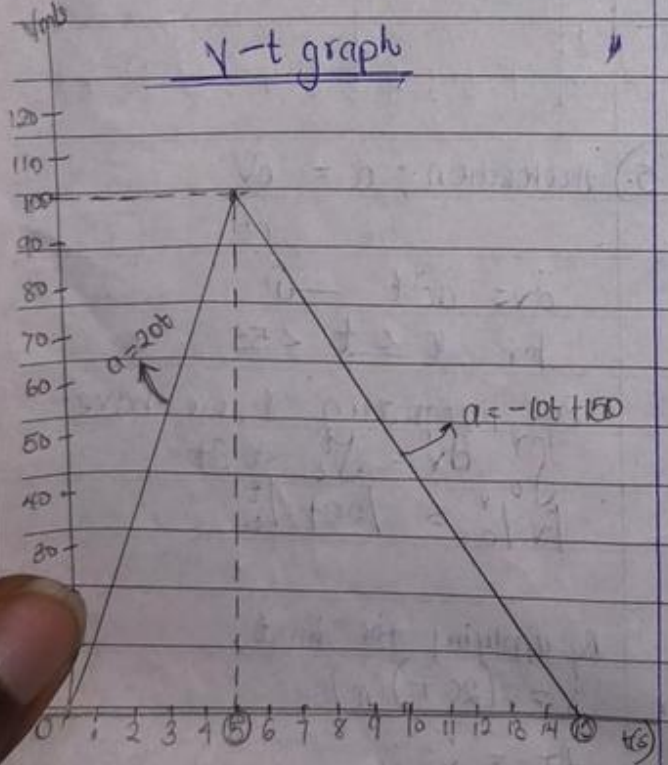
$(v - 100) = (-10t' + 10 \times 5) m/s$

$v = (150 - 10t') m/s$ - (a)

Car at rest, we have from eqn 2

$0 = (150 - 10t')$

$t' = 15s$



v-t graph

6 eqn of velocity

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

$ds = v dt$ - (i)

Eqn for the distance travelled between $0 \leq t \leq 5s$:

substitute $30t$ for v in eqn (i)

$ds = v dt$

$= 30t \times dt$

Integrating

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

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

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

$S = \left[15t^2\right]_0^5$

$= 15 \times 5^2$

$= 375m$

Eqn for distance travelled btw $5s < t \leq 15s$

Substitute $(-15t + 225)$ for v in eqn (i)

$ds = v dt$

$= (-15t + 225) dt$

Integrating $5s < t \leq 15s$

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

$$\left[s\right]_{375}^{s} = \left[\frac{-15t^2}{2} + \frac{225t}{m}\right]_0^t$$

$$(s-375) = \left(\frac{-15t^2}{2} + 225t\right] - \left[\frac{-15\times15^2}{2} + 225\times6\right]$$

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

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

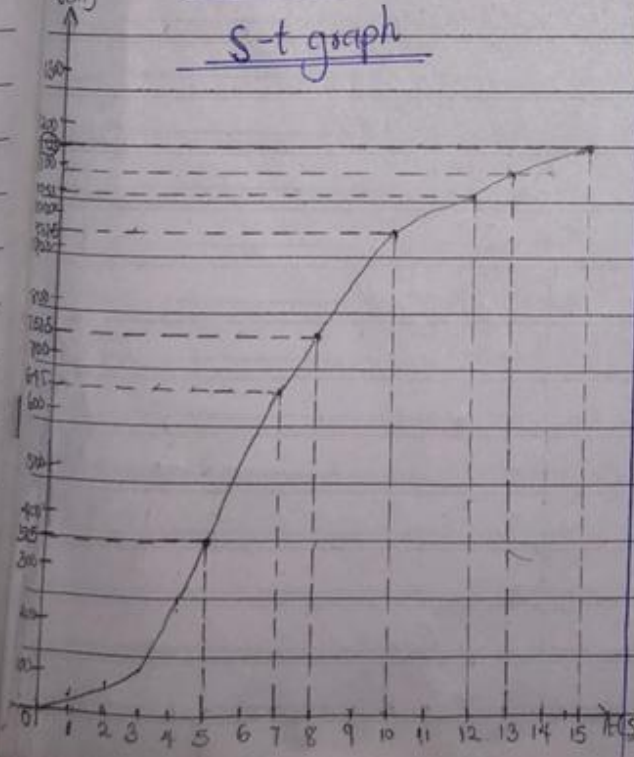
$$\Rightarrow s = (-7.5t^2 + 225t - 562.5)\,m$$

$$= (-7.5\times15^2 + 225\times15 - 562)\,m$$

$$\Rightarrow s = 1125\,m$$

∴ the total distance travelled in the interval $0s < t < 150$ is 1125m.

s-t graph



a-t graph for No ②