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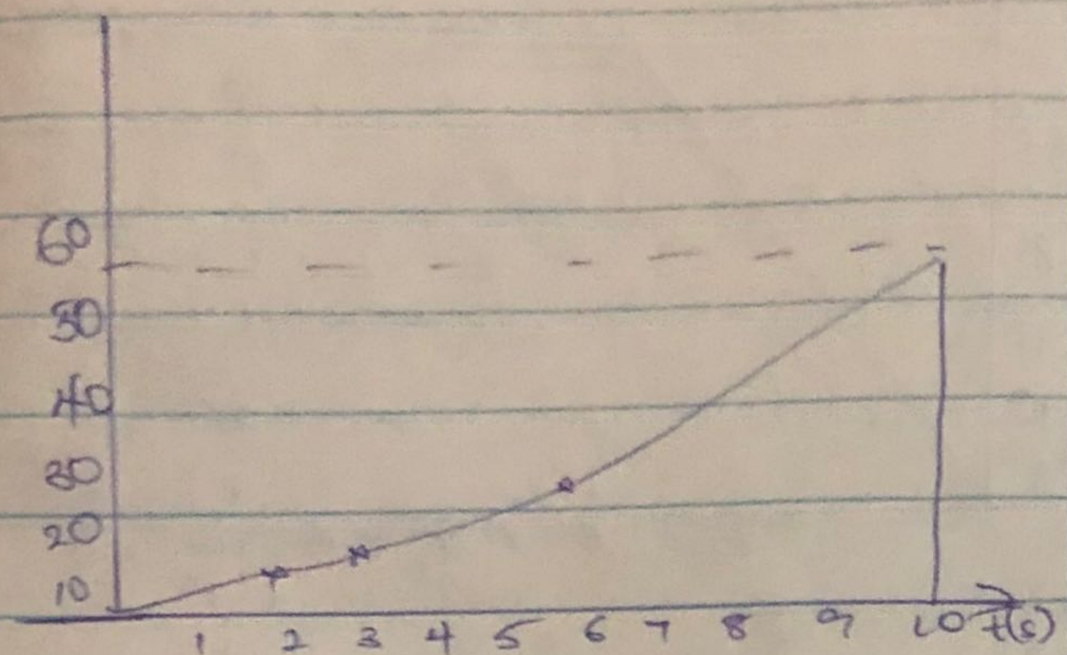
DEPT: MECHATRONICS

Fig 12-9



find the velocity $v = ds/dt$

$0 \leq t < 6s$ sub $0.5t^3$ for s

$v = ds/dt$

$= d/dt(0.5t^2)$

$= 0.5\, d/dt(t^3)$

$= 1.5t^2$

Velocity at a point where $t = 6s$

$v = 1.5t^2$

$= 1.5 \times 6^2 = 54 m/s$

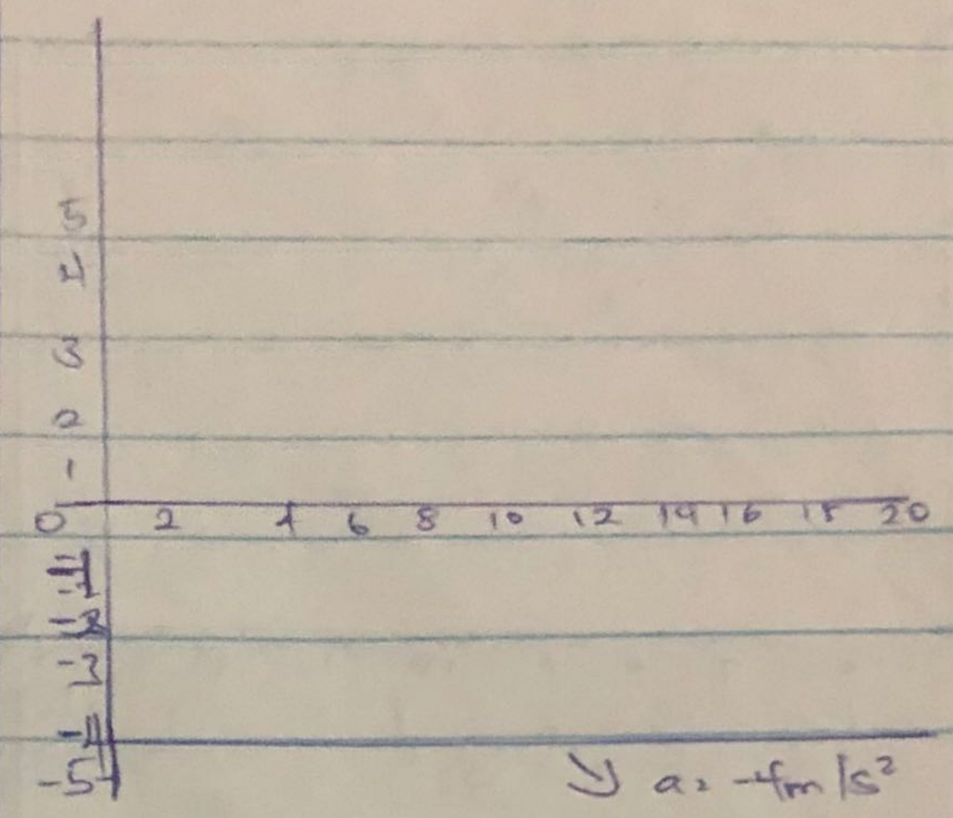
$6s < t \leq 10s$ sub $10s$ for s in the eqn

$v = ds/dt$

$= d/dt(10s)$

$= 0$

Fig 12-10



formation of velocity of v

$v = ds/dt$ - (1), $dt = v\,dt$

V is velocity and S is displacement of v, t is the time

Sub $(-4t + 80)$ for v in eq (1)

$ds = v\,dt$

$ds = (-4t + 80)dt$ (2)

Initial conditions

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

Upper limits of displacement and time be s and t

Integrate eq (2)

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

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

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

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

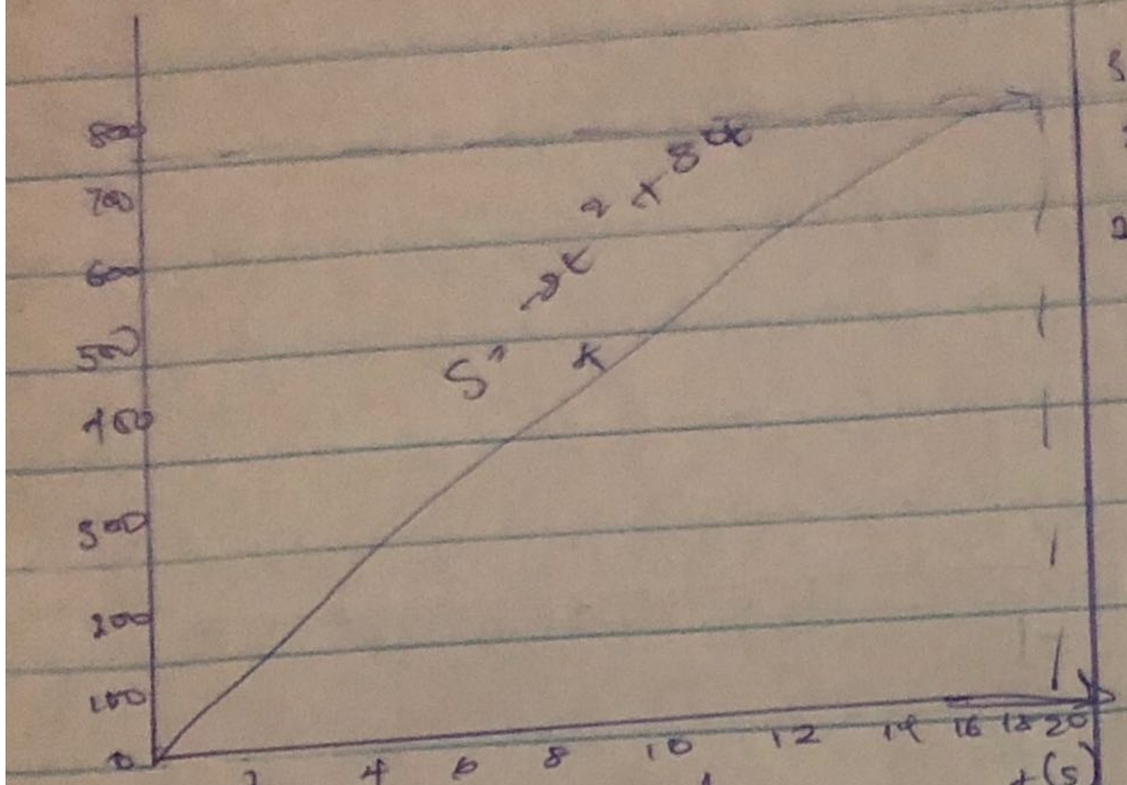
white eqn for acceleration

$a = dv/dt$

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

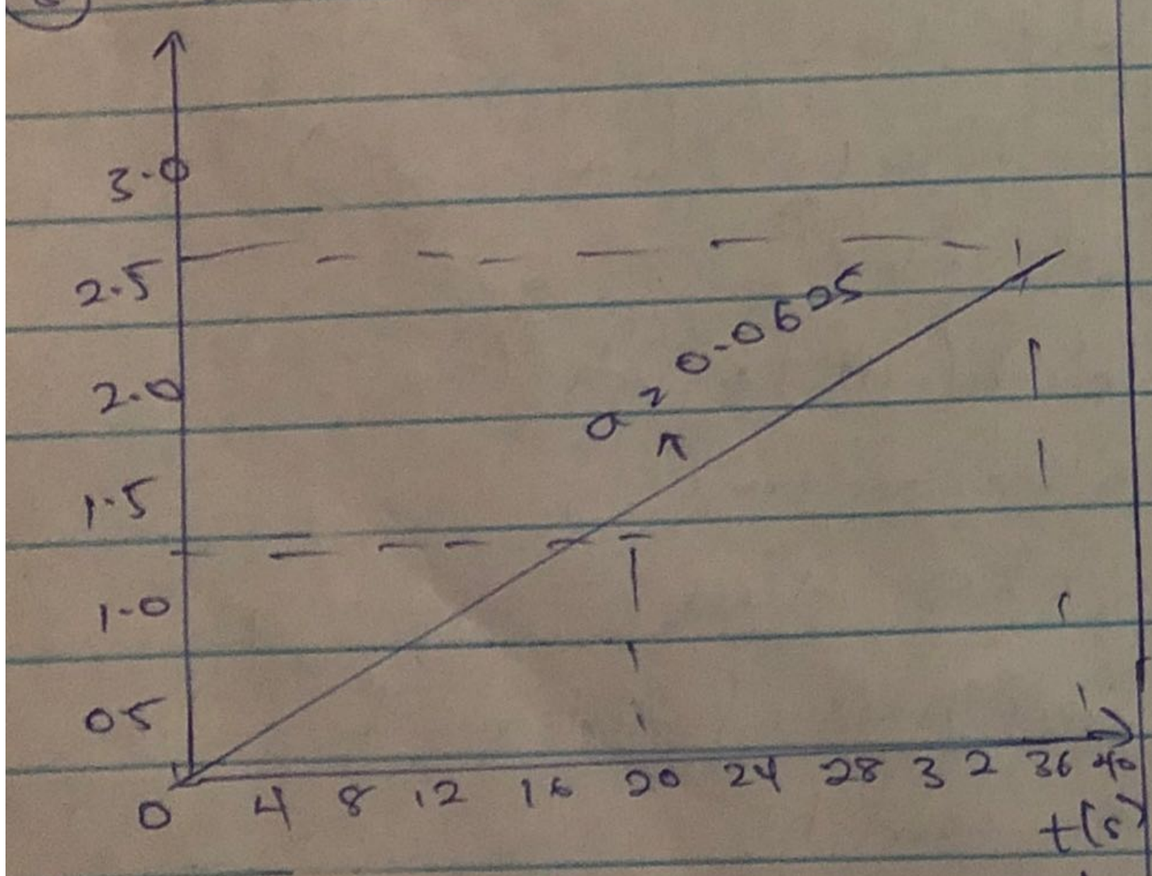
$a = d/dt(-4t + 80)$

$= -4 m/s^2$



f-s graph

Fig 12 - 11



Acceleration of the bicycle is expected as

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

for $0 \le t < 40s$

$v = 0.25s$

Accordingly from (1)

$a = (0.25t) \times d/ds\,(0.25s)$

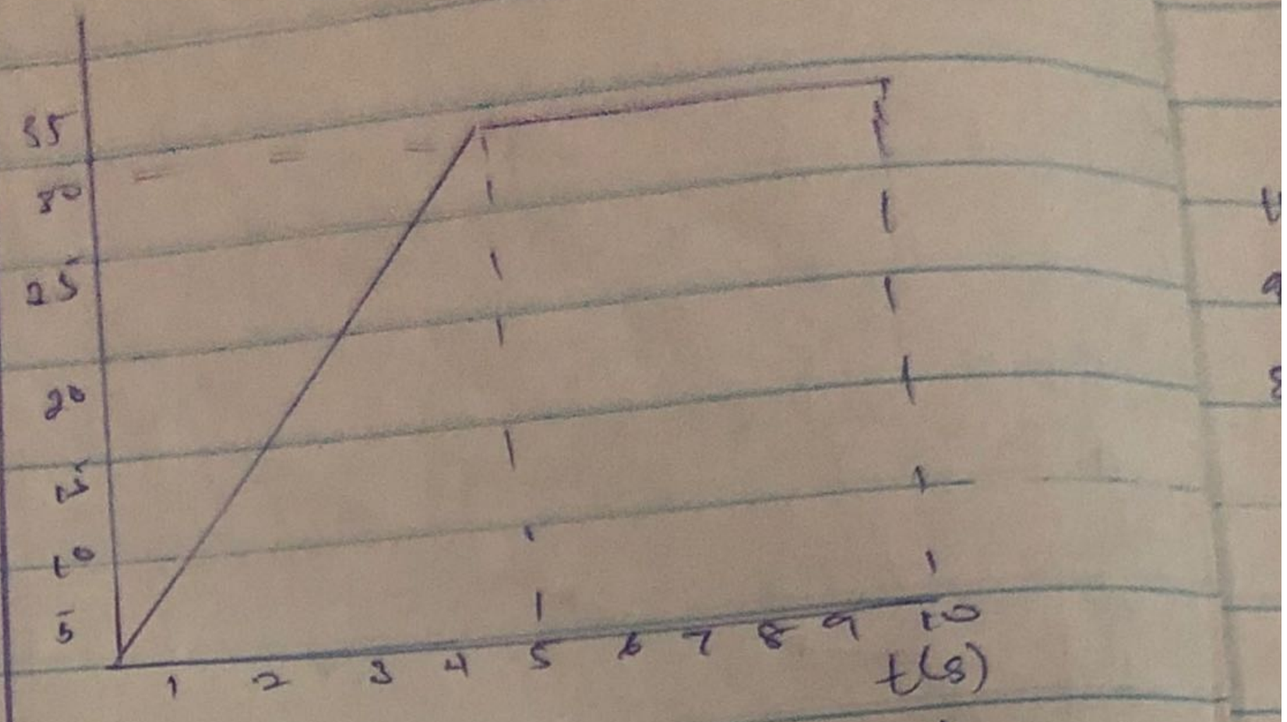
$a = (0.0625s) - (2)$

At $s = 40s$ from (2)

$a_{40s} = (0.0625 \times 40)$

$a_{40s} = 2.5 m/s^2$

Fig 12 - 12



Velocity of the car is expressed as

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

for $0 \le t \le 5s$

$s = 3t^2$

Accordingly we have

$v = d/dt\,(3t^2)$

$v = 6t$

At $t = 5s$

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

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

$5s < t \le 10s$

$s = 30t - 75$

$v = d/dt\,(30t - 75)$

$v = 30 m/s$

Acc of the car is expressed as

$$a = dv/dt$$

for $0 \le t \le 5s$

we have from 2 as $v = 6t$

and we have $a = d/dt\,(6t)$

$a = 6 m/s^2$

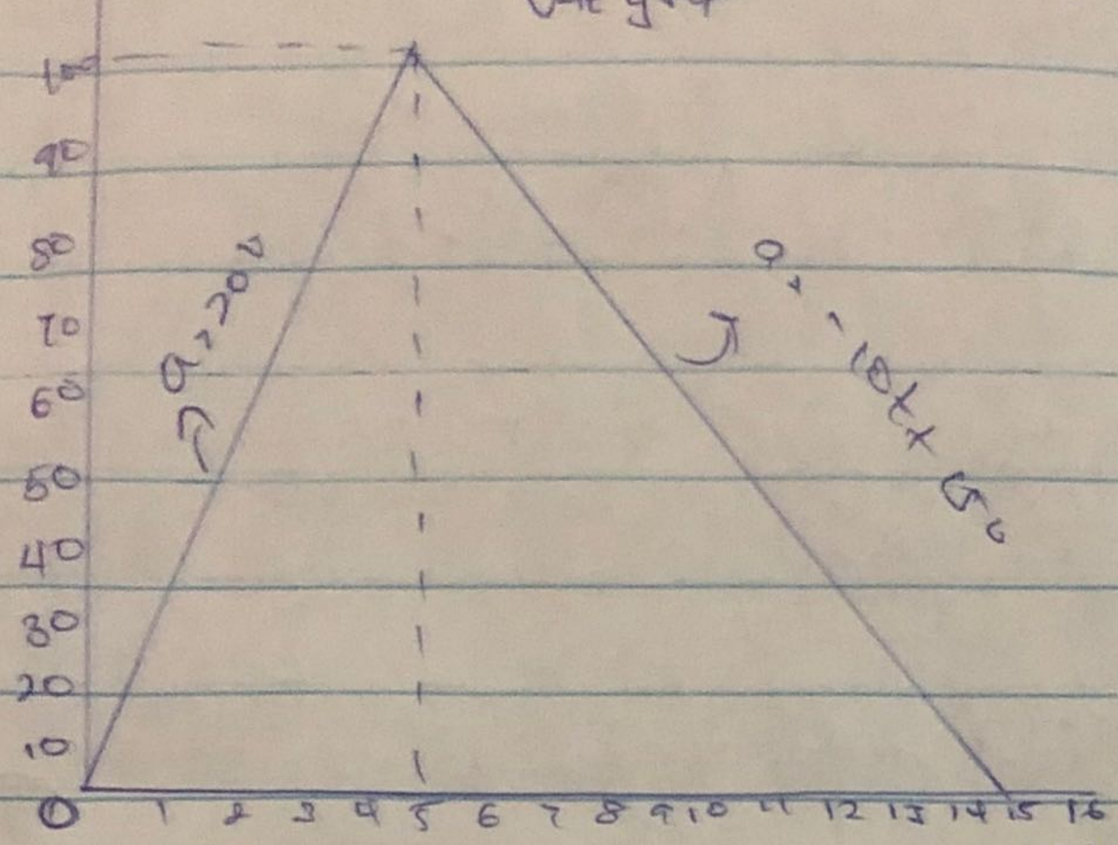
for $5s < t \le 10s$

we have from (2) $v = 30 m/s$

$a = d/dt\,(30 m/s)$

$a = 0$

Fig 12 -13



the eqn of the Acc is expressed as

$a = dv/dt$

$dv = a\,dt$

for $0 \leq t \leq 5s$

Integrating (1) we have

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

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

Applying limits we have

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

At $t = 5s$

$v/t = 5s = 20 \times 5$

$v/t = 5s = 100\,m/s$

for $5s \leq t \leq t$

Integrating (1) we have

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

$|v|_{100}^v = |-10t|_5^t$

By applying the limits we have

$(v - 10t)_{100}^{v} = (-10t + 10 \times 5)_{5}^{t}$

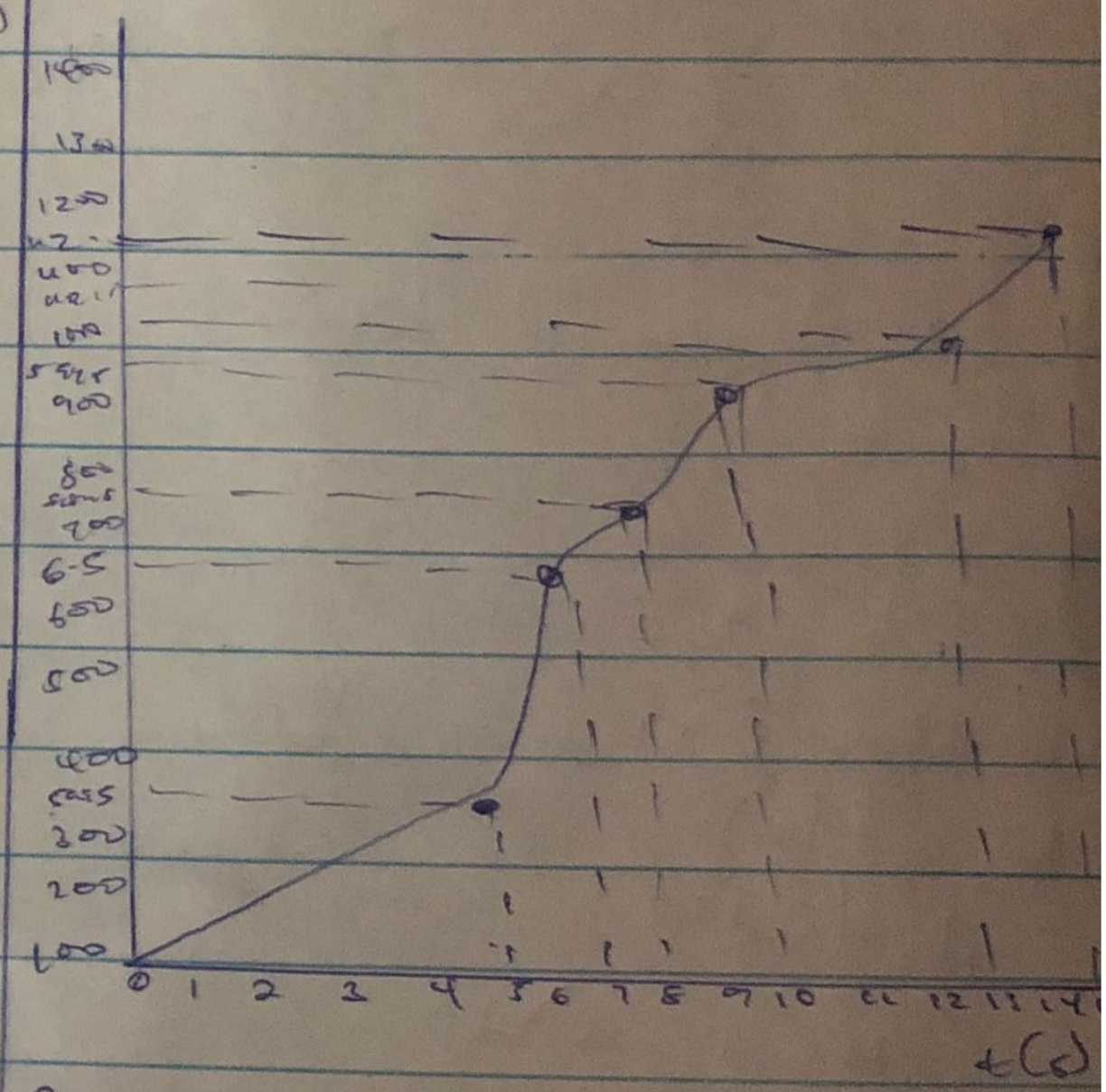
$v - (150 - 10t)\,m/s - (1)$

when the car is at rest

$0 = (150 - 10t')$

$t' = 15\,s$

Fig 12 -14



Calculate the equation for velocity

$v = ds/dt$

$ds = v\,dt$

Calculate the equation for the distance travelled $0 \leq t \leq 5s$

substitute $= 20t$ for v in the eqn

$ds = v\,dt$

$= 20t \times dt$

applying integral for the equation for the region $0 \leq t \leq 5s$

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

$$S_0^s ds = \int_0^{sec} 30t\, dt$$

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

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

$$S = 15 \times 5^2 = 375m$$

Calculate mean of distance travelled

$$5 \leq t \leq 15$$

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

$$ds = v\,dt$$

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

Apply integral for the equation for $5s \leq t \leq 15s$

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

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

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

$$S = (7.5t^2 + 225t - 562.5)m$$

Substitute 15 sec for t in equation 2 to calculate distance travelled

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

$$S = 1125m$$

Total distance travelled in this time interval

$$0 < t \leq 15s \; ; \; 1125m$$