

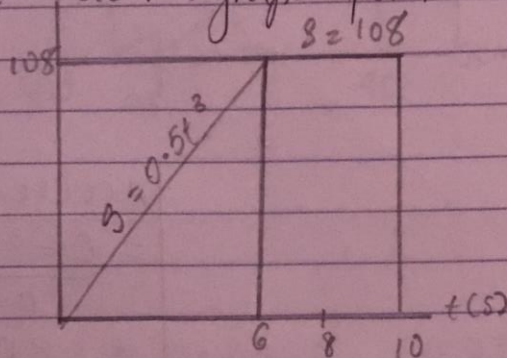
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MATRIC NOS: 18/ENG02/095

COURSE CODE & TITLE: ENGINEERING MECHANICS II
ENG 234

DEPARTMENT: COMPUTER ENGINEERING

- ① The particle travels along a straight track such that its position is described by the s-t graph. Construct the v-t graph for the same time interval.



Solution:

$$t_1 = 6s$$

$$s_1 = 0.5t^3$$

$$s_2 = 108$$

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

$$v = \frac{d}{dt} (0.5t^3) = 1.5t^2$$

Since $t = 6s$

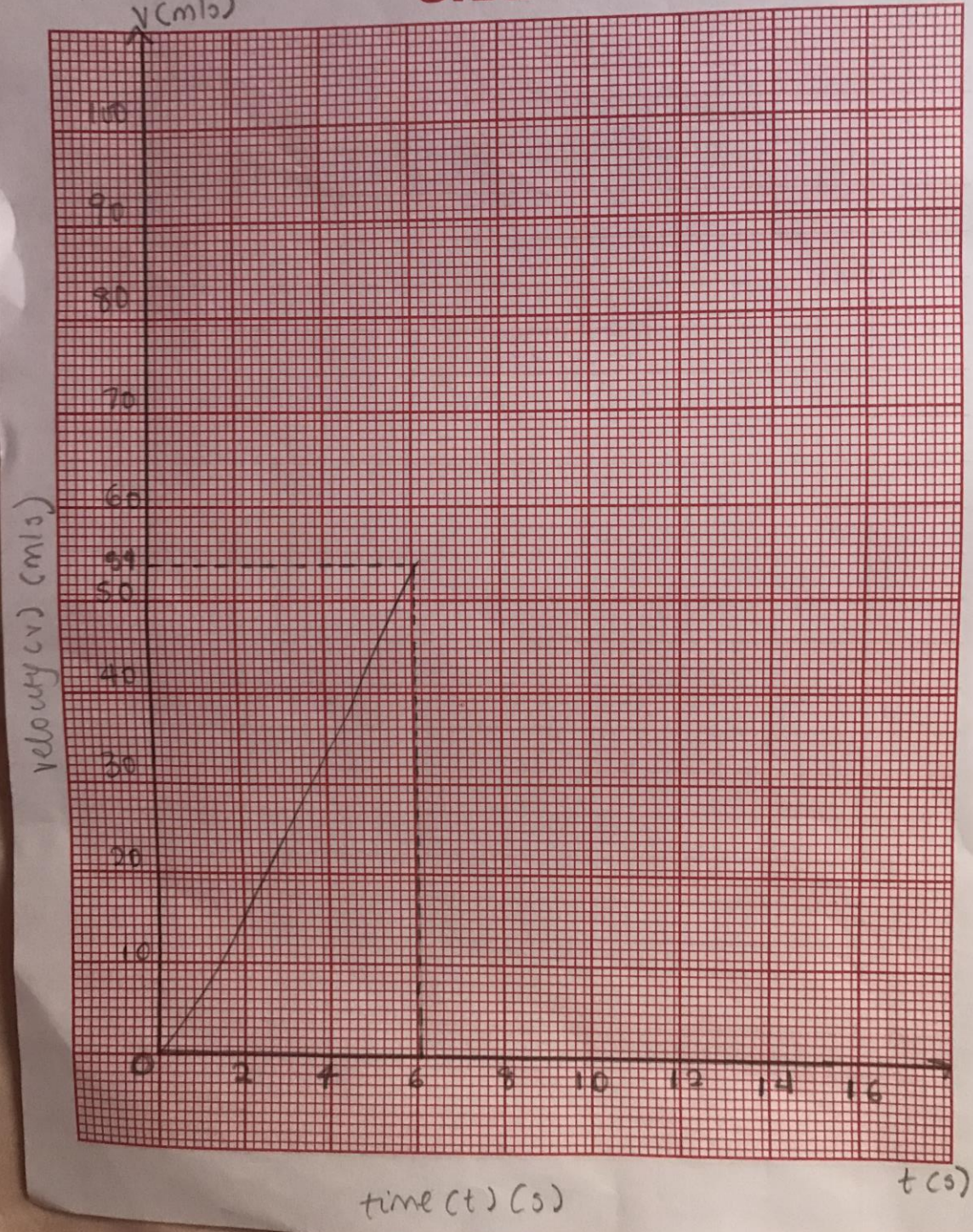
$$1.5t^2 = (1.5) \times (6)^2 \\ = 1.5 \times 36 = 54$$

$$v = 54 \text{ m/s}$$

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

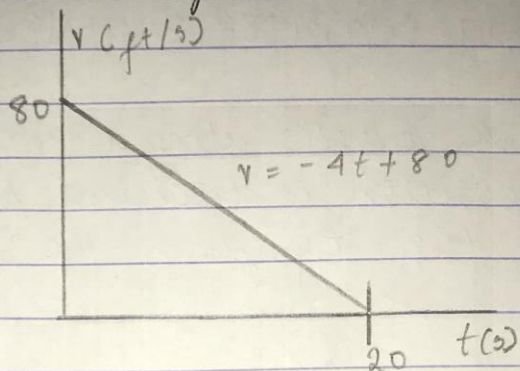
$$= \frac{d(108)}{dt} = 0 //$$

① GRAPH OF VELOCITY AGAINST TIME (V-T) GRAPH
1cm rep 10 unit on the y axis
1cm rep 2 unit on the x axis
GRAPH



2) A van travels along a straight road with a velocity described by the graph. Construct the $s-t$ and $a-t$ graphs during the same period. Take $s=0$ when $t=0$

Solution:



Solution:

$$v = -4t + 80,$$

$$s = ?$$

$$t = 20s$$

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

$$ds = v dt$$

$$s = \int v dt$$

$$s = \int (-4t + 80)$$

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

$$\text{at } t = 20s$$

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

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

$$= -800 + 1600 = 800$$

$$s = 800ft$$

ii Acceleration

$$a = \frac{dv}{dt} \quad \text{or} \quad a = \frac{\Delta v}{\Delta t}$$

$$v_1 = 80 \quad t_1 = 0$$

$$v_2 = 0 \quad t_2 = 20$$

Acceleration

$$= \frac{0 - 80}{20 - 0}$$

$$= \frac{80}{20}$$

$$= -4$$

$$= -4$$

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

$$\text{at } t = 20s,$$

$$a = 4 \text{ m/s}^2$$

3.

A
wh
g
tim

sol

da

v

s

a

∴

Graph of distance against time (s-t graph)

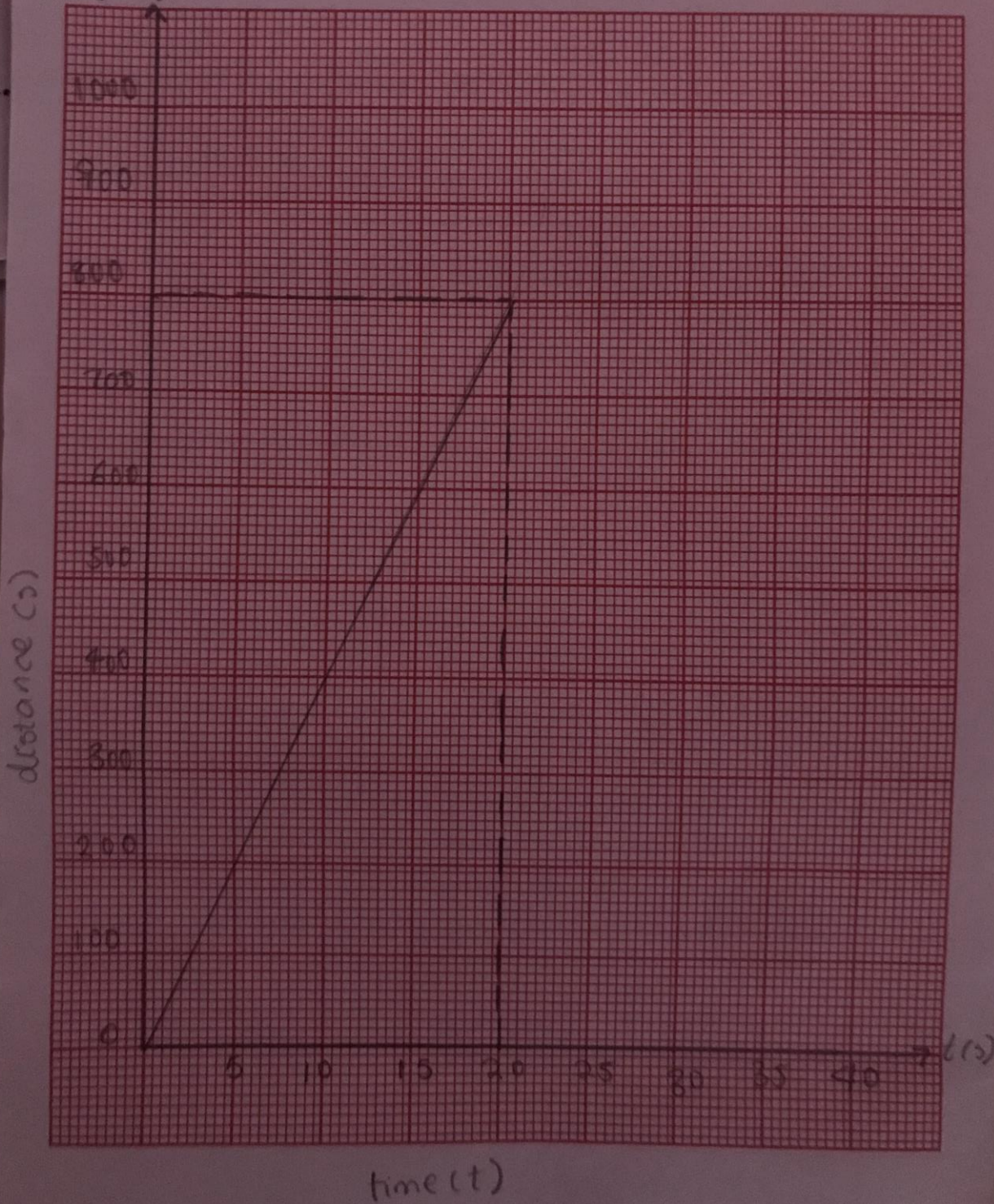
Q1

1cm rep 100 on the y axis

1cm rep 5 on the x axis

5(m)

GRAPH



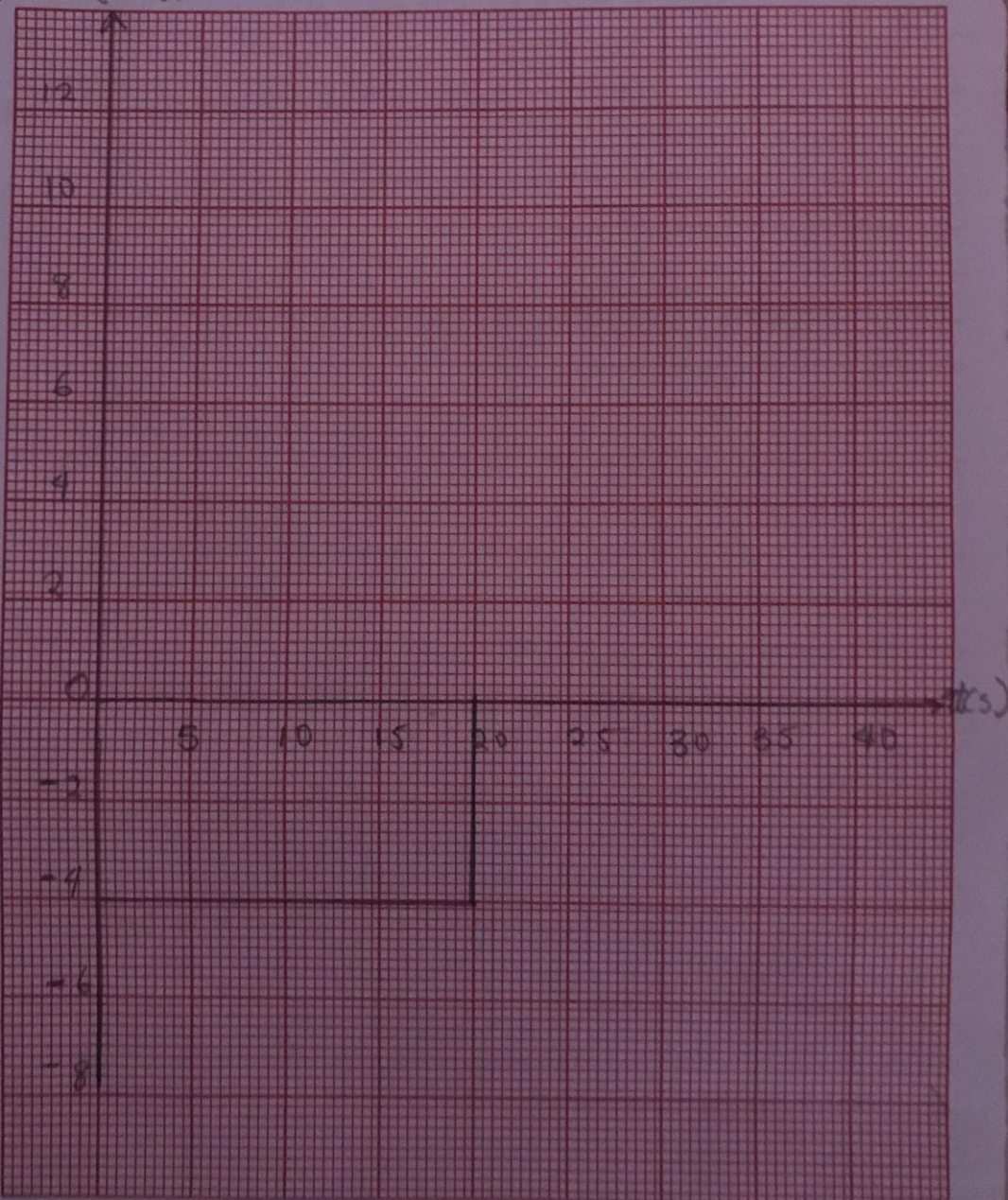
GRAPH OF ACCELERATION AGAINST TIME
(a-t graph)

1cm rep - 0.1 on the y axis
1cm rep 5 unit on the x axis

GRAPH

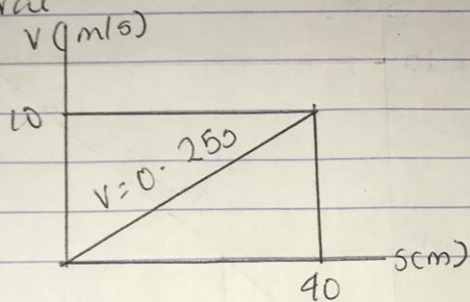
20

acceleration



time (t)

3. A bicycle travels along a straight road where its velocity is described by the $v-s$ graph. Construct the $a-s$ graph for the same time interval.



Solution:

data:

$$v = 0.25s$$

$$s = 40\text{m}$$

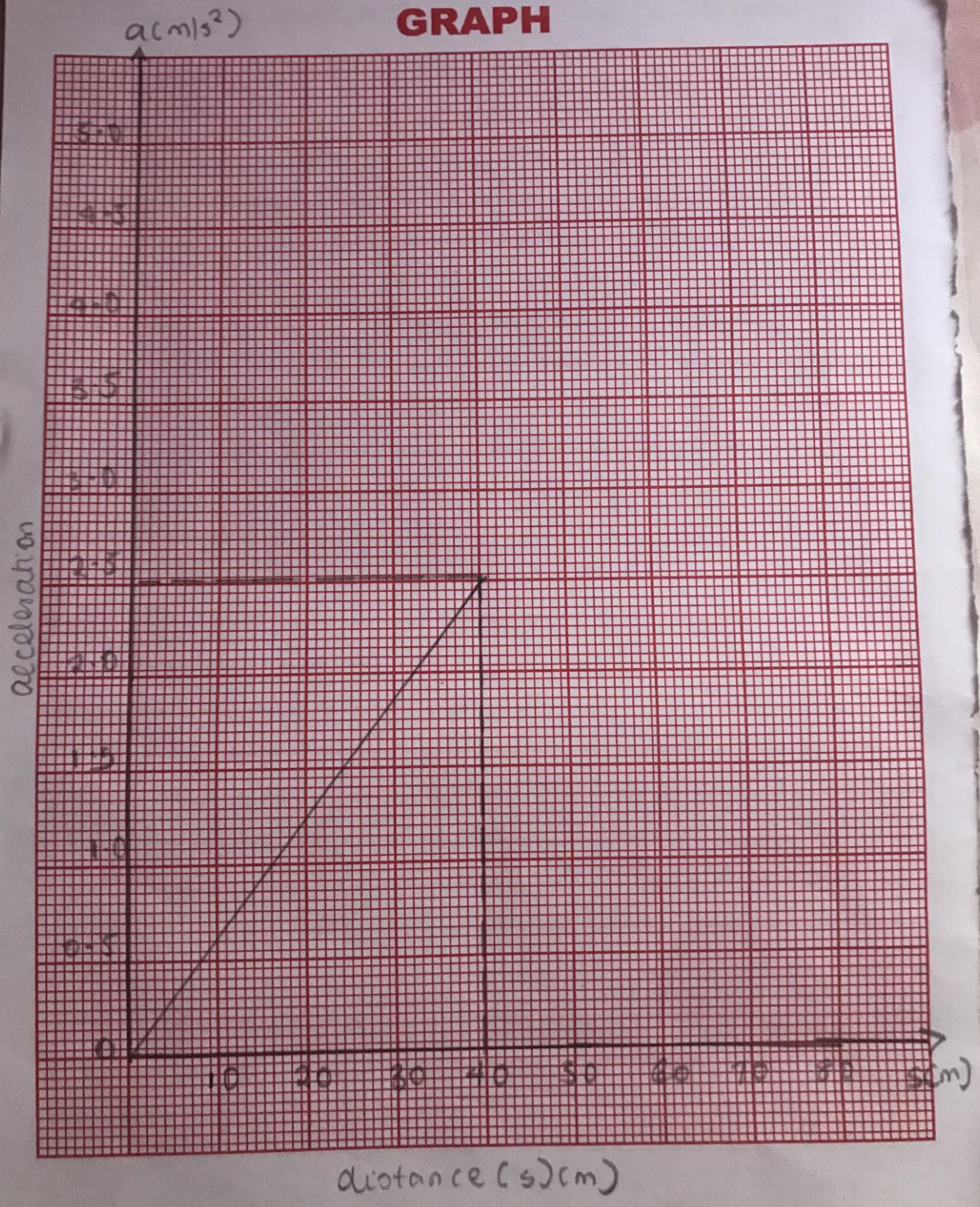
$$a = \left(\frac{dv}{ds}\right)_v = 0.25s \frac{d}{ds} (0.25s)$$
$$= 0.0625s$$

$$\therefore s = 40\text{m}$$

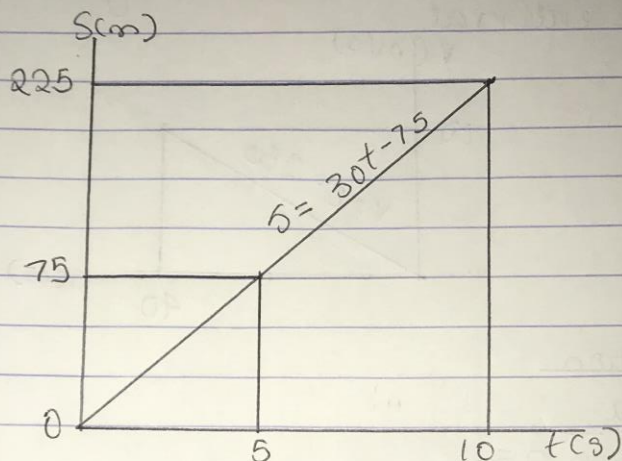
$$a = 0.0625(40) = 2.5\text{m/s}^2$$

3) GRAPH OF ACCELERATION AGAINST DISTANCE
(A-S GRAPH)

GRAPH



④ The sports car travels along a straight road such that its position is described by the graph. Construct the $v-t$ and $a-t$ graphs for the time interval $0 \leq t \leq 10$



Solution:

$$S = 3t^2,$$

$$t = 5$$

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

$$v = \frac{d}{dt} (3t^2) = (6t) \text{ m/s} = 6t \text{ m/s}$$

$$\text{Since } t = 5, \quad = 6 \times t = 6 \times 5 = 30 \text{ m/s}$$

$$5 \text{ s} < t \leq 10 \text{ s}$$

$$S = 30t - 75, \quad S_1 = 75 \text{ m}$$

$$v = \frac{ds}{dt} \quad S_2 = 225 \text{ m}$$

$$t_1 = 5 \text{ sec}$$

$$t_2 = 10 \text{ sec}$$

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

$$= 30 \text{ m/s}$$

$$v = \frac{\Delta s}{\Delta t}$$

$$v = \frac{S_2 - S_1}{t_2 - t_1}$$

$$= \frac{225 - 75}{10 - 5}$$

$$= \frac{150}{5} = 30 \text{ m/s}$$

$$0 \leq t < 5 \text{ s},$$

$$v = 6t,$$

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

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

$$= 6 \text{ m/s}^2$$

④

$$5s < t \leq 10s,$$

$$v = 30 \text{ m/s}$$

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

$$a = \frac{d}{dt}(30) = 0$$

∴

$$0 \leq t < 5s$$

$$s = 3t^2,$$

$$v = 6t$$

$$a = \frac{\Delta v}{\Delta t}$$

$$a = 6 \text{ m/s}^2$$

$$5s < t \leq 10s$$

$$s = 30t - 75$$

$$v = 30$$

$$a = \frac{\Delta v}{\Delta t}$$

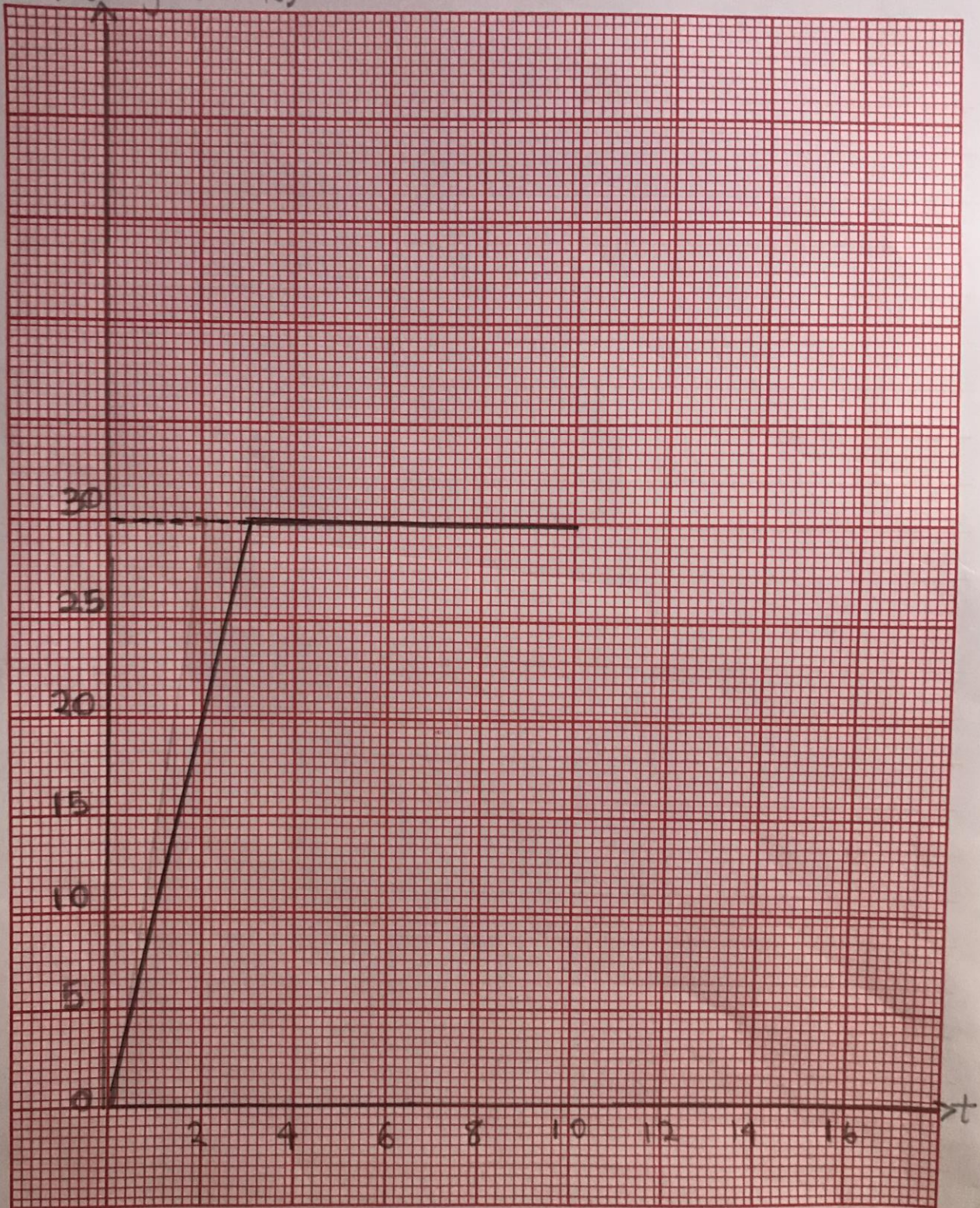
$$= 0 //$$

Velocity time graph (v-t) graph

1 cm rep 5 unit on the y axis, 1 cm rep 2 unit on x axis

GRAPH

Velocity (v) (m/s)



time (t) (seconds) (s)

Graph of acceleration against time

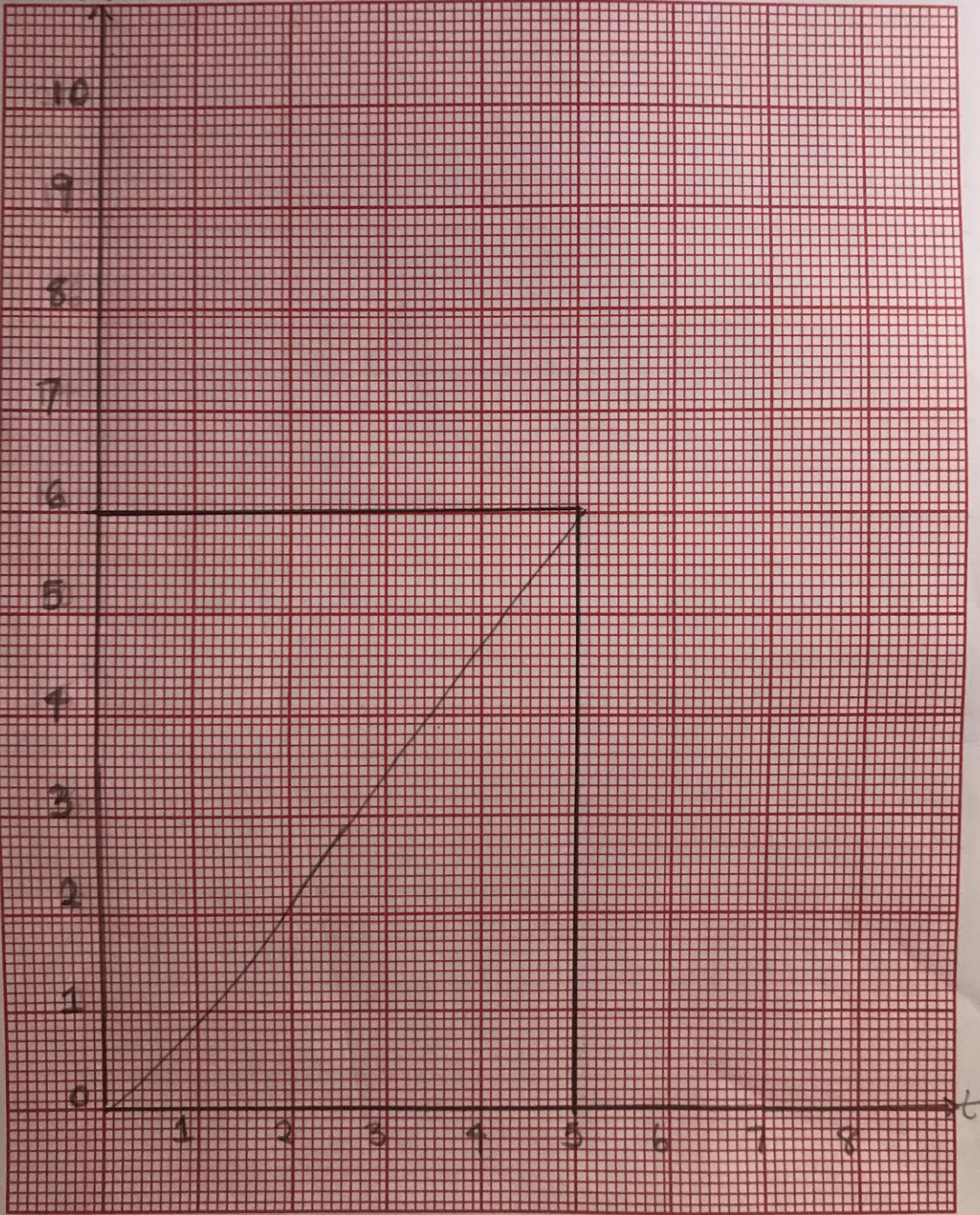
1cm rep 1 unit on the y axis

1cm rep 1 unit on the x axis

(A)

acceleration (a)

GRAPH



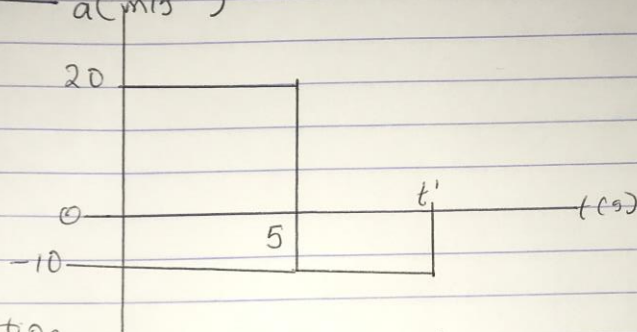
time (t) (s)

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DEPT: COMPUTER
ENGINEER

- 5) The dragster starts from rest and has an acceleration described by the graph. Construct the $v-t$ graph for the time interval $0 \leq t \leq t'$, where t' is the time for the car to come to rest.

Solution: $a(\text{m/s}^2)$



Solution

data:

$$v = 20t$$

$$t = 5s$$

$$dv = a dt$$

$$v = \int a dt$$

$$0 \leq t < 5s$$

$$v = (20t) \text{ m/s } t = 5s$$

$$v = 20 \times 5 = 100 \text{ m/s}$$

$$5s < t \leq t'$$

$$dv = a dt$$

$$\int_{100 \text{ m/s}}^v dv = \int_{5s}^t -10 dt$$

$$v - 100 = -10t + 10(5)$$

$$v - 100 = -10t + 50$$

$$\text{at } t', v = 0$$

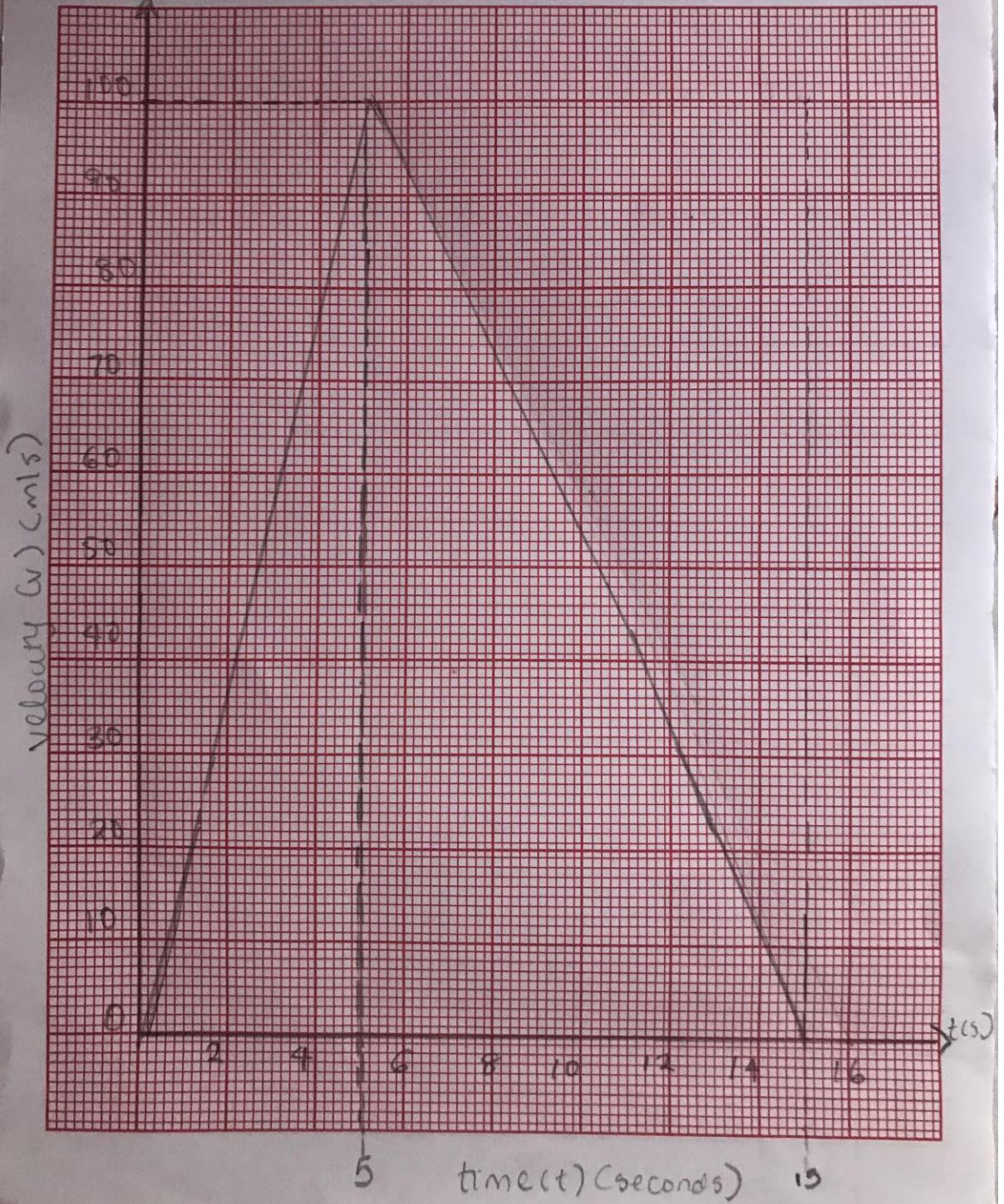
$$0 - 100 = -10t + 50$$

$$10t' = 150$$

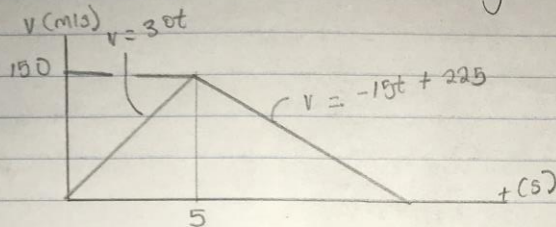
$$t' = 15s$$

⑤ GRAPH OF VELOCITY AGAINST TIME (v-t) graph.
1cm rep 10 unit on the y axis
1cm rep 0.2 unit on the x axis
v(m/s)

GRAPH



6. The dragster starts from rest and has a velocity described by the graph. Construct the $s-t$ graph during the time interval $0 \leq t \leq 150$. Also, determine the total distance travelled during this time interval.



Solution.

data

$$0 \leq t \leq 50 \quad v = 30t$$

$$50 \leq t \leq 150 \quad v = -15t + 225$$

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

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

$$ds = v dt$$

$$\int_0^{s_1} ds = \int_0^{50} 30t dt$$

$$s_1 = \frac{30t^2}{2}$$

$$= 15(50)^2 = 375 \text{ m}$$

$$\int ds = \int_50^{150} (-15t + 225) dt$$

$$s_2 - s_1 = \frac{-15t^2}{2} + 225t$$

$$s_2 - 375 = \left[\frac{-15(150)^2}{2} + 225(150) \right] - \left[\frac{15(50)^2}{2} + 225(50) \right]$$

$$= 1687.5 \text{ m}$$

$$- 937.5 \text{ m}$$

6

Each scale on the y axis \rightarrow 1cm represents 150 units
Each scale on the x axis \rightarrow 1cm represents 2 units

GRAPH
S(m) GRAPH OF DISTANCE AGAINST TIME

