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MATRIC NO: 18/ENG05/002

DEPARTMENT: MECHATRONICS ENGINEERING

COURSE TITLE: ENGINEERING MECHANICS II

COURSE CODE: ENG234

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18/ENG05/002

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ENGINEERING

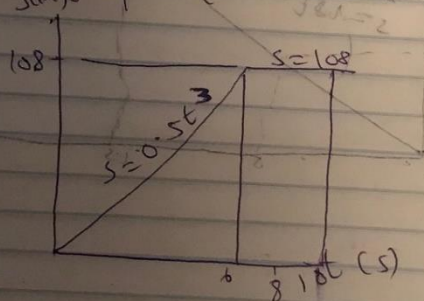
Course Title: Engineering mechanics 11

Course code: ENG 234

Assignment Solution/Answers

① Question 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.



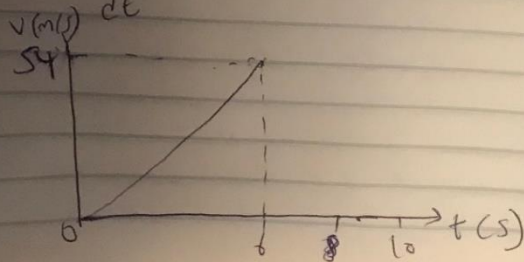
Solution

$$s = 0.5t^3 \text{ and } v = \frac{ds}{dt}$$

$$v = \frac{d(0.5t^3)}{dt}, \quad v = 1.5t^2 \text{ at } t = 6$$

$$v = 1.5(6)^2 = 1.5 \times 36 = 54 \text{ m/s}$$

$$s = 108, \quad \frac{ds}{dt} = 0, \quad v = 0.$$

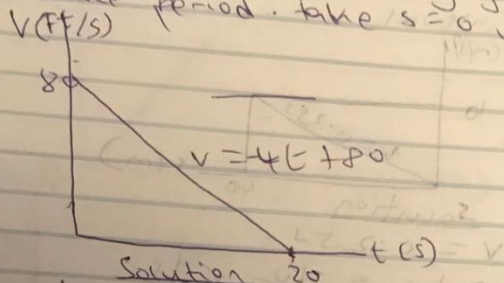


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- (2) A van travels along a straight road with velocity described by the graph. Construct the $s-t$ and $a-t$ graphs during the same period. Take $s=0$ when $t=0$.

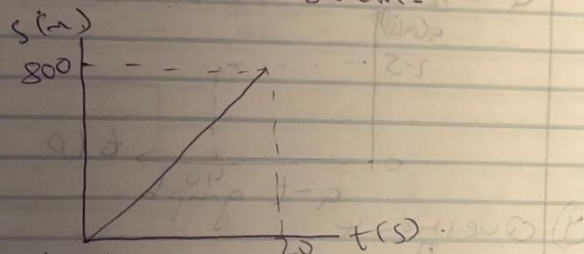


Solution

$$v = \frac{ds}{dt} \quad s = \int v \, dt$$

$$s = \int (-4t + 80) \, dt, \quad s = -\frac{4t^2}{2} + 80t$$

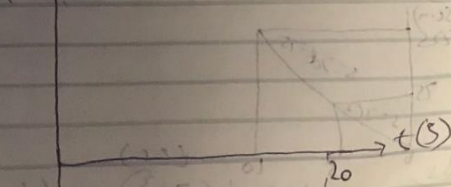
at $t = 20$ s, $s = -2(20)^2 + 80(20)$
 $s = -1600 + 1600 = 0$ m.



$s-t$ graph

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

at $t = 20$ s, $a = -4 \text{ m/s}^2$



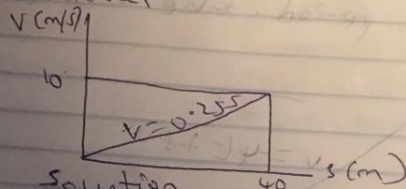
$a-t$ graph.

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(3) Question 3

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



Solution

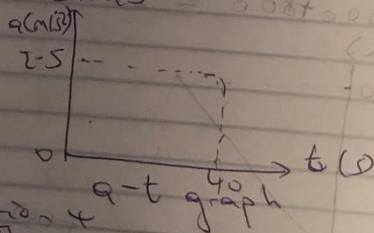
$$v = 0.25t$$

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

$$a = \frac{dv}{ds} \times v \quad \frac{dv}{ds} = 0.25$$

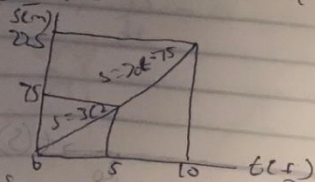
$$a = (0.25s)(0.25) = 0.0625(s)$$

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



(4) Question 4

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

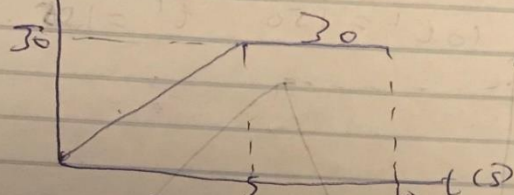
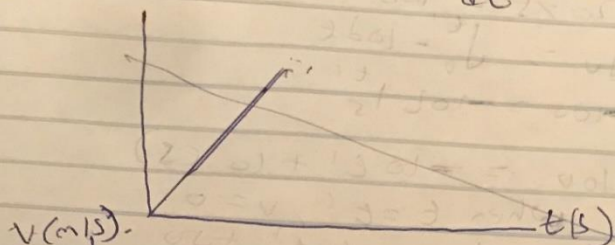


$$v = \frac{ds}{dt} \quad v = \frac{d(3t^2)}{dt} = 6t$$

$$v = bt \quad \text{at } t = 5 \quad v = 6 \times 5 = 30 \text{ m/s}$$

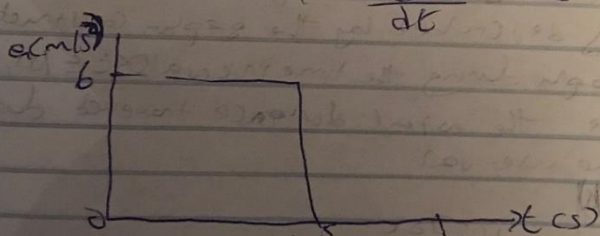
$$s = 30t - 75 \quad v = \frac{d(30t - 75)}{dt}$$

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



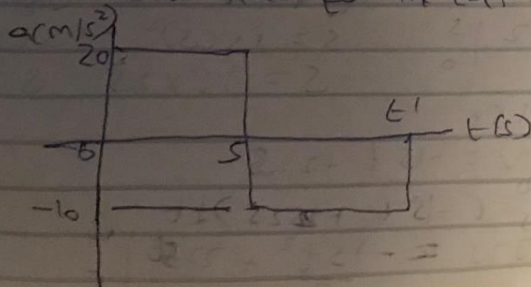
(ii) $a = \frac{dv}{dt}$ $v-t$ graph. $v = bt$ $a = \frac{d(6t)}{dt}$ $a = 6 \text{ m/s}^2$

at $v = 30$, $a = \frac{d(30)}{dt} = 0 \text{ m/s}^2$.



Question 5

The dragster starts from rest & ends with an acceleration described by the graph. Construct the time interval $v-t$ graph for the time interval $0 \leq t \leq t'$ where t' is the time for the car to come to rest.



Solution - 2) $v = 20t$

$$v = \int a dt \quad v = \int 20 dt$$

$$v = 20t \quad \text{at } t = 5s$$

$$v = 20 \times 5 = 100 \text{ m/s} \quad 85 \leq t$$

$$\int_{10}^v dv = \int_0^{t'} -10 dt$$

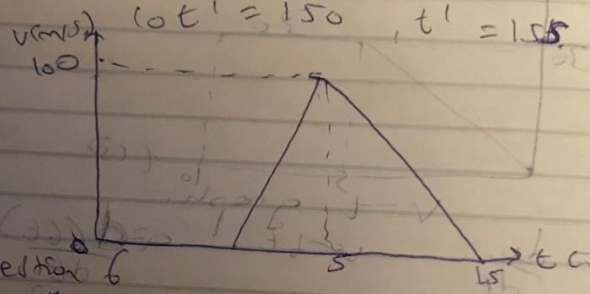
$$v - 100 = -10t \Big|_5^{t'}$$

$$v = 100 = -10t' + 10(5)$$

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

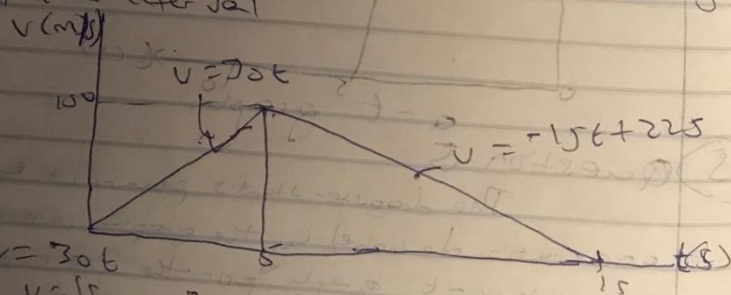
$$0 - 100 = 10t' + 50 \quad (1) \quad v$$

$$10t' = 150, \quad t' = 15s$$



⑥ Question 6

The dragonfly starts from rest and has a velocity described by the graph - construct the $s-t$ graph during the time interval $0 \leq t \leq 15$. Also determine the total distance travelled during this time interval



$$v = 20t$$

$$v = 15$$

$$s = \int_0^5 v dt = \int_0^5 20t dt = 10t^2 \Big|_0^5 = 10(5)^2 = 250$$

$$5 \leq t \leq 15$$

$$v = -15t + 225$$

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

$$s = 375 = -\frac{15t^2}{2} + 225t \Big|_5^{15}$$

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$$S - 375 = \left[\frac{-15 \pm \sqrt{15^2 + 22500}}{2} \right] - \left[\frac{-15 \pm \sqrt{15^2 + 22500}}{2} \right]$$

$$S - 375 = \frac{(-15 \times 225 + 375)}{2} - \frac{(-15 \times 225 + 1125)}{2}$$

$$S - 375 = 1687.5 - 937.5$$

$$S - 375 = 750$$

$$S = 750 + 375, S = 1125 \text{ m}$$

