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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

$s = 0.5t^3$, $s = 108m$

$t = 6s$ at more velocity

$V = \frac{ds}{dt}$, (when $s = 0.5t^3$)

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

$\cancel{V = \theta s}$ $V = 1.5t^2$

Inputting the of t

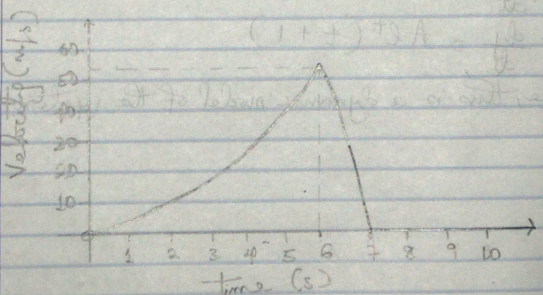
$V = 1.5(6)^2$

$V = 1.5 \times 36 = 54m/s$

Using $V = \frac{ds}{dt}$ (when $s = 108m$)

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

$V = 0$



V-t 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

$v = -4t + 80$, $s = ?$, $a = ?$

$s = 0$, $t = 0$

$v = \frac{ds}{dt}$ (for s)

$\therefore ds = v\,dt$

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

Taking the integral of both sides

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

but $v = (-4t + 80)$

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

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

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

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

$a = \frac{dv}{dt}$ (for a)

$a = \frac{d(-4t+80)}{dt}$ (* Recall the value of v)

$a = -4\,m/s^2$

$0 \leq t \leq 20s$, $s = -2t^2 + 80t$

When $t = 0$, $s = -2(0)^2 + 80(0) = 0$

When $t = 4$, $s = -2(4)^2 + 80(4) = 288m$

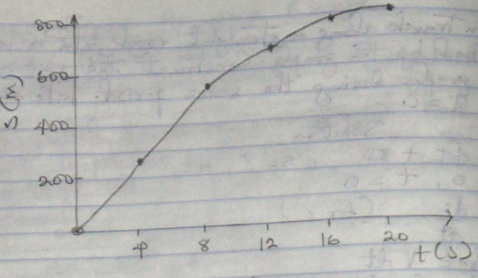
When $t = 8$, $s = -2(8)^2 + 80(8) = 512m$

When $t = 12$, $s = -2(12)^2 + 80(12) = 672m$

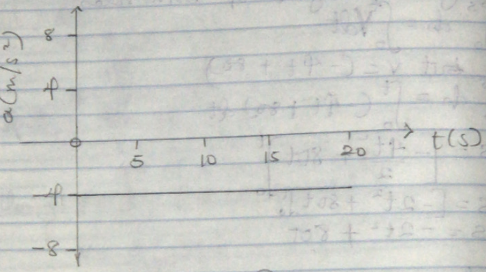
When $t = 16$, $s = -2(16)^2 + 80(16) = 768m$

When $t = 20$, $s = -2(20)^2 + 80(20) = 800m$

2.



s-t graph



a-t graph

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

$v = 0.25 m/s$, $s = 40 m$

$a \, ds = v \, dv$

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

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

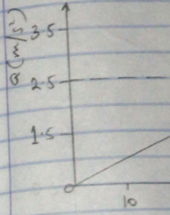
3. $a = 0.25 \cdot 0.2$

~~$a = 0.062$~~

$\therefore$ when $s =$

$a = (0$

$a =$



a

4. The sports c
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$s = 3t^2$

$0 \leq t \leq 5$

for $s = 3t^2$

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

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

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

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

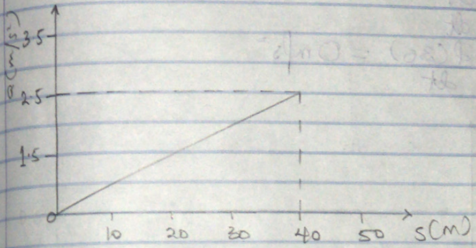
3. $a = 0.25 \cdot 0.25s$

~~$a = 0.0625 m/s^2$~~ $a = (0.0625s) m/s^2$

$\therefore$ when $s = 40m$

$a = (0.0625 \times 40) m/s^2$

$a = 2.5 m/s^2$



a-s 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 $0 \leq t \leq 10s$.

Solution

$s = 3t^2$, $s = 30t - 75$

$0 \leq t \leq 5$, $0 \leq t \leq 10$

for $s = 3t^2$ and $0 \leq t \leq 5$

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

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

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

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

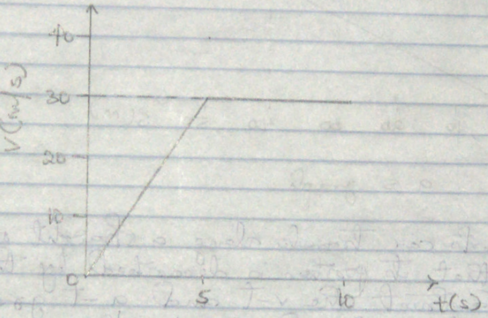
4. for $s = 30t - 75$ and $0 \le t \le 10$

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

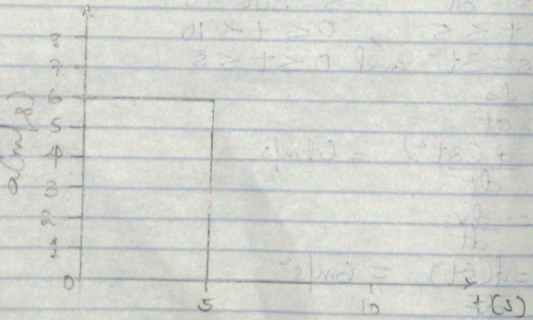
$$v = \frac{d(30t-75)}{dt} = 30 m/s$$

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

$$a = \frac{d(30)}{dt} = 0 m/s^2$$



v-t graph



a-t graph

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.

$a = 20\,m/s^2$, $0 \leq t \leq 5s$, $a = -10\,m/s^2$, $5s \leftrightarrow t'$

$a = \frac{dv}{dt}$ (for $a = 20$)

$dv = a \cdot dt$

$\therefore$ Taking the integral of both sides

$\int_0^v dv = \int_0^t a \cdot dt$

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

$[v]_0^v = [20t]_0^t$

$v - 0 = 20t - 0$

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

when $t = 5s$

$\therefore v = (20 \times 5)\,m/s$

$v = 100\,m/s$

for $a = -10$

$dv = a \cdot dt$

$\int_0^v dv = \int_5^{t'} a \cdot dt$

$\int_{100}^v dv = \int_5^{t'} -10\,dt$

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

$v - 100 = (-10t' + 50)\,m/s$

~~$v - 100 = -10t'$~~ $v = (-10t' + 50 + 100)\,m/s$

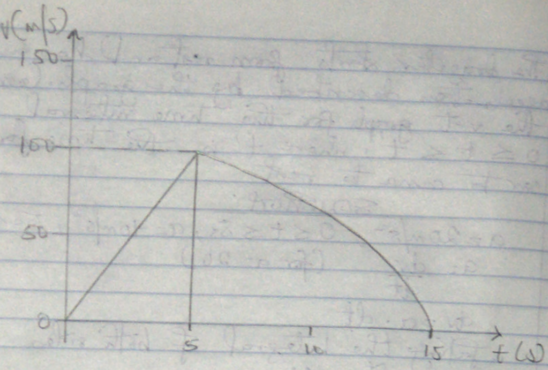
$v = (-10t' + 150)\,m/s$

when $v = 0$

$0 = -10t' + 150$

$10t' = 150$

$t' = 15s$



v-t graph

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

Solution.

$v = 30t$, $v = -15t + 225$

$0 \leq t \leq 5s$, $0 \leq t \leq 15s$

for $v = 30t$, $0 \leq t \leq 5s$

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

$ds = v.dt$

$ds = 30t \, dt$

Taking the integral of both sides

$\int ds = \int v.dt$

$\int ds = \int 30 \, dt$

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

$s = (15t^2) m$

When $t = 5s$

$s = 15 \times (5)^2$

$s = 15 \times 25 = 375\,m$

for $v = -15t + 225$, $0 \le t \le 15s$

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

$ds = v \cdot dt$

Taking the integral of both sides

$\int ds = \int v \cdot dt$

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

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

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

$s - 375 = \left(\frac{-15}{2}t^2 + 225t - 937.5\right) m$

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

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

When $t = 15s$

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

$s = 1125\,m$

$\cancel{0 \le t \le 15s}$, $s = (-7.5t^2 + \cancel{225t - 562.5})\,m$

$\cancel{\text{When } t = 0}, s = -7.5(0)^2 + \cancel{225(0)} - 562.5 = 0$

~~When~~

$0 \le t \le 15s$, $s = (15t^2)\,m$

When $t = 0$, $s = 15(0)^2 = 0$

When $t = 3$, $s = 15(3)^2 = 135$

When $t = 6$, $s = 15(6)^2 = 540$

$\cancel{\text{When } t = 9, s = 15(9)^2}$

$\cancel{\text{When } t = 12, s = 15(12)^2}$

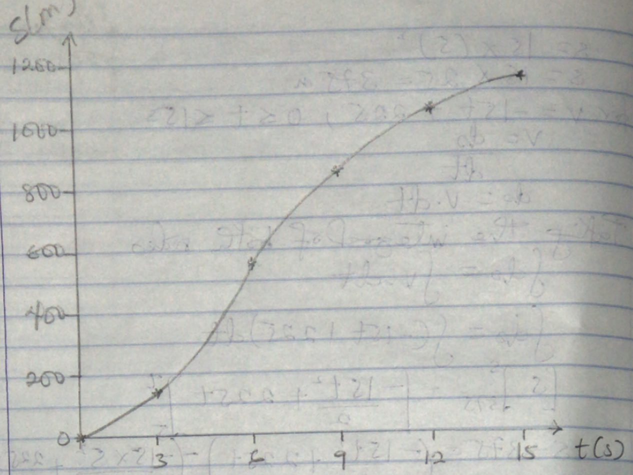
$\cancel{\text{When } t = 15, s = 15(15)^2}$

$0 \le t \le 15s$, $s = (-7.5t^2 + 225t - 562.5)\,m$

When $t = 9$, $s = (-7.5(9^2) + (225 \times 9) - 562.5) = 855\,m$

When $t = 12$, $s = (-7.5(12^2) + (225 \times 12) - 562.5) = 1057.5\,m$

When $t = 15$, $s = (-7.5(15^2) + (225 \times 15) - 562.5) = 1125\,m$



s-t graph