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18/ENG05/048.
Mechatronics Eng.

F12-9

$S_1 = 0.5t^3$

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

$V = (1.5t^2) ms^{-1}$

at $t = 6s$

$V = 54 ms^{-1}$
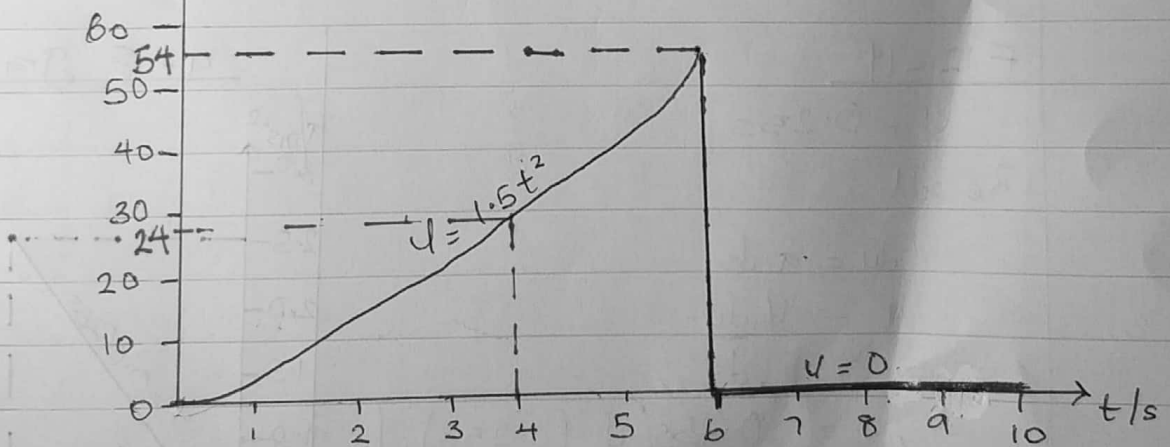
$S_2 = 108 m$

$V = \dfrac{ds}{dt} = 0 ms^{-1}$

V at time $= 4s$

$V/ms^{-1} = 24 m$

F12-10

$V = (-4t + 80) fts^{-1}$

$S = \int V dt$

$= \int_0^{20} (-4t + 80) dt$

$= [-2t^2 + 80t]_0^{20}$
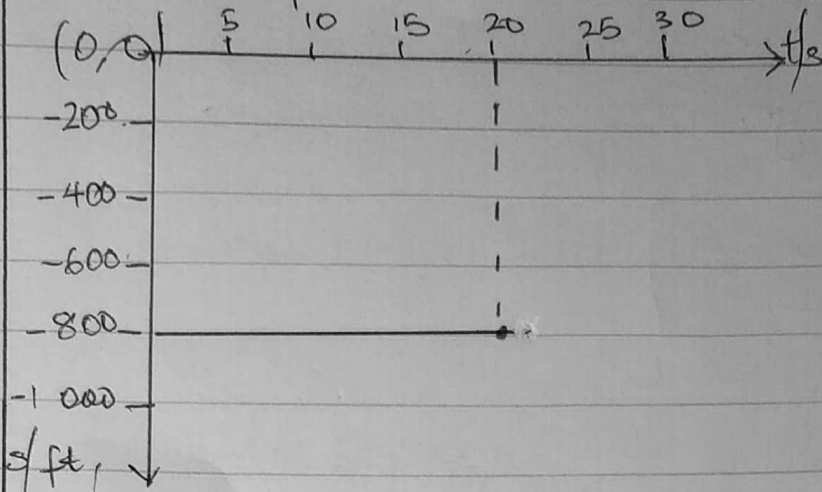
$= -2(20^2) + 80(20)$

$= -800 + 1600$

$S = -800 ft$
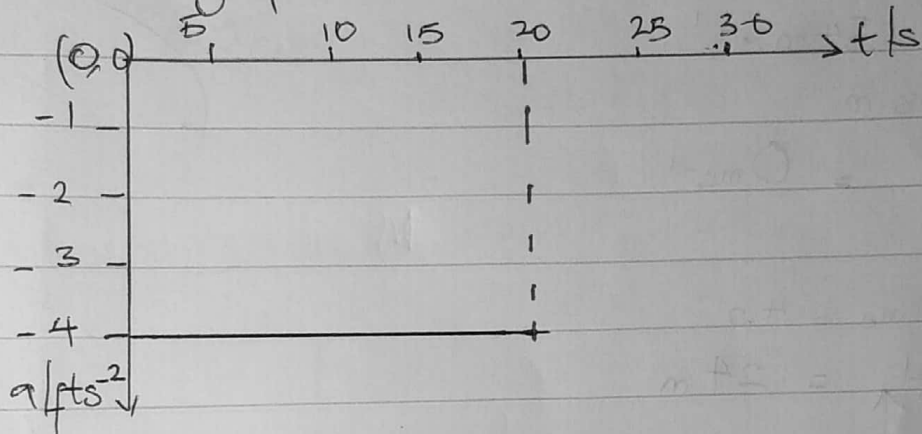
$a = \dfrac{dV}{dt}$

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

$= -4 fts^{-2}$

F12-10

S-t Graph

a-t graph

F12-11

$v = 0.25s$

Recall

$v\,dv = a\,ds$

$a = v\dfrac{dv}{ds}$

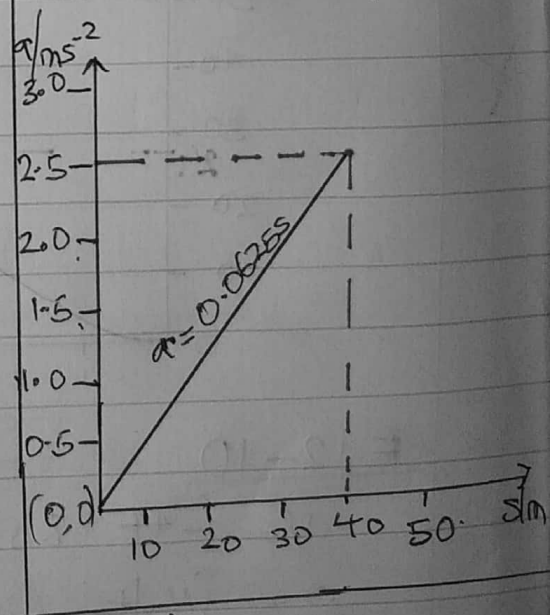$\quad = 0.25s\left[\dfrac{d}{ds}(0.25s)\right]$

$a = 0.0625\,s$

at $s = 0$ $a = 0\,ms^{-2}$

at $s = 40$, $a = 0.0625(40)$

$\qquad\qquad\qquad = 2.5\,ms^{-2}$

a - s graph

F 12-12

For $0 \leq t \leq 5$

$S = 3t^2$

$Y = \dfrac{ds}{dt}$

$V = \dfrac{d}{dt}(3t^2) = 6t$

$t = 5s$

$V = 30 \, ms^{-1}$

For $5 \leq t \leq 10$

$S = 30t - 75$

$V = \dfrac{ds}{dt} = \dfrac{d}{dt}(30t - 75)$

$\quad = 30 \, ms^{-1}$

V - t Graph

A - t

For $0 \leq t \leq 5$

$Y = 6t$

$a = \dfrac{dy}{dt} = \dfrac{d}{dt}(6t) = 6 \, ms^{-1}$

For $5 \leq t \leq 10$

$V = 30$

$a = \dfrac{dy}{dt} = 0 \, ms^{-2}$

a - t graph

$a = 6$

$a = 0$
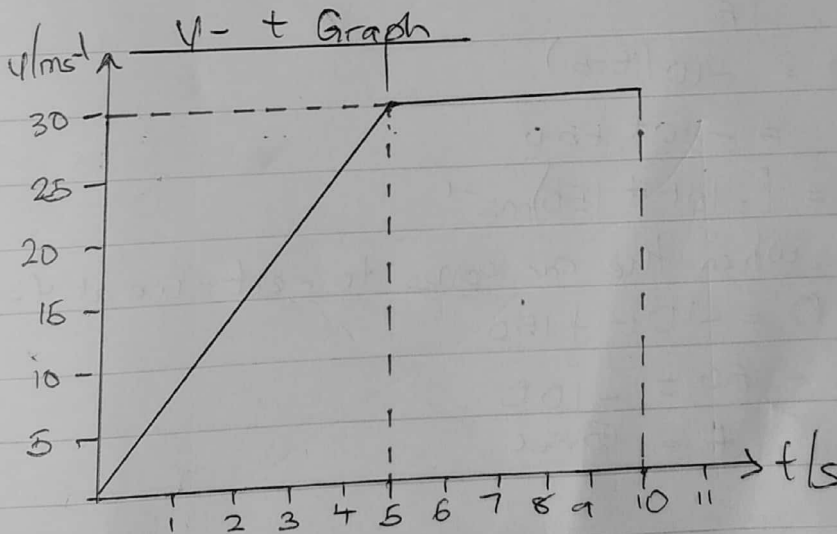
F 12-13

For $0 \le t \le 5s$

$a = 20 \, ms^{-2}$

$v = \int a \, dt$

$= \int 20 \, dt$

$v = 20t$

$t = 5s \therefore v = 100 \, ms^{-1}$

For $5 \le t \le t'$

$a = -10 \, ms^{-2}$

$v = \int a \, dt$

$= \int -10 \, dt$

$\int_{100}^{v} dv = \int_{5}^{t} -10 \cdot dt$
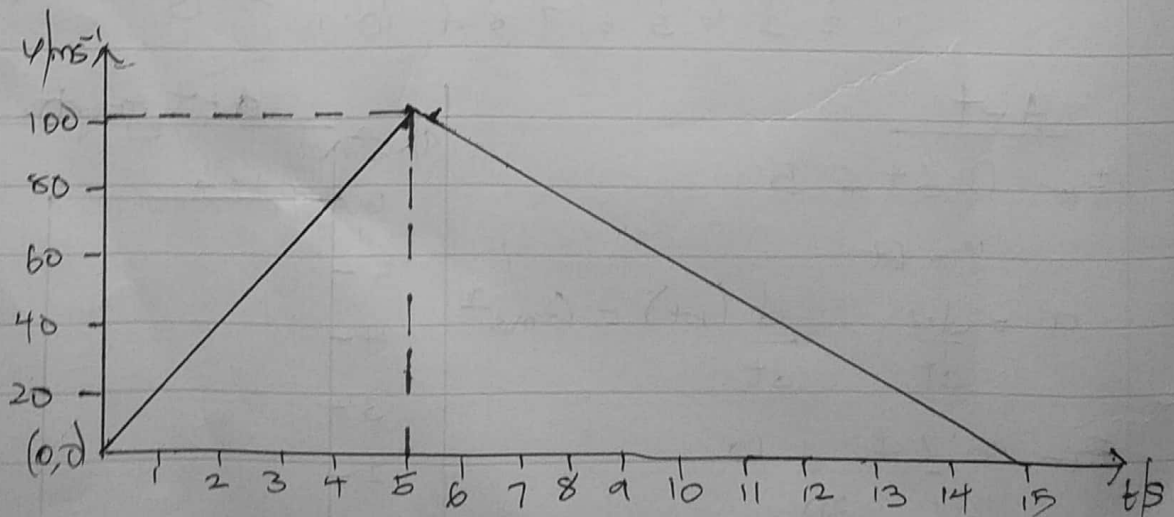
$v - 100 = -10(t-5)$

$v - 100 = -10t + 50$

$v = (-10t + 150) \, ms^{-1}$

$\therefore$ when the car comes to rest i.e at $v = 0 ms^{-1}$

$0 = -10t + 150$

$-150 = -10t$

$t = 15 \, sec$

12-14

For $v = (30t) \, ms^{-1}$

$\int ds = \int v \, dt$

$S = (15t^2) \, m$

at time $t = 5s$

$S = 15(5)^2 = 375m$

for $5 \leq t \leq 15$

$V = -15t + 225$

$S = \int v \, dt$

$= \int -15t + 225 \, dt$

$S = -7.5t^2 + 225t + C$

Recal $S'_{at \, t=5} = 375m$

$375 = -7.5(5)^2 + 225(5) + C$

$C = -562.5$

From $5 \leq t \leq 15$

$S = -7.5t^2 + 225t - 562.5$

$\Sigma S|_{5 \leq 15} = \left[-7.5t^2 + 225t - 562.5 \right]_5^{15}$

$= 750m$

∴ Total distance from $0 \leq t \leq 15$

$\Rightarrow 375 + 750$

$= 1,125m$

S-t Graph