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MECHATRONICS ENGINEERING

MECHANICS

F12-9

①

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

$$s = 0.5t^3 \text{ m}$$

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

$$v = 1.5t^2 \text{ m/s}$$

$$\text{at } t = 6$$

$$v = 1.5(6)^2$$

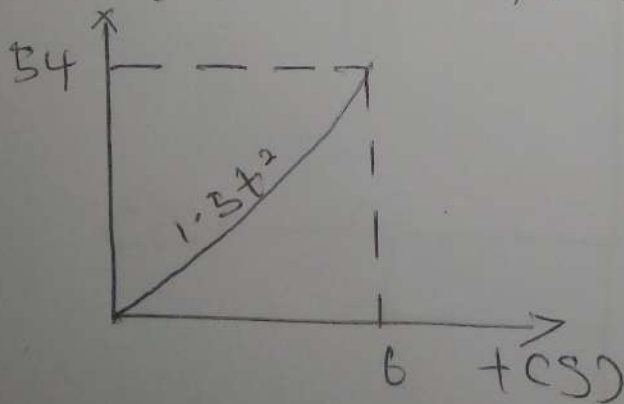
$$v = 36 \times 1.5 = 54 \text{ m/s}$$

$$\text{at } s = 108 \text{ m}$$

$$\frac{ds}{dt} = 0 \text{ m/s}$$

\therefore after 4s, $v = 0 \text{ m/s}$

v-t graph for f12-9)



② F12-10

$$v = (-4t + 80) \text{ ft/s}$$

$$s = \int v dt = \frac{-4t^2}{2} + 80t$$

$$s = (-2t^2 + 80t) \text{ ft}$$

$$\frac{dv}{dt} = a, \quad v = (-4t + 80) \text{ ft/s}$$

$$a = \frac{dv}{dt} = -4 \text{ ft/s}^2$$

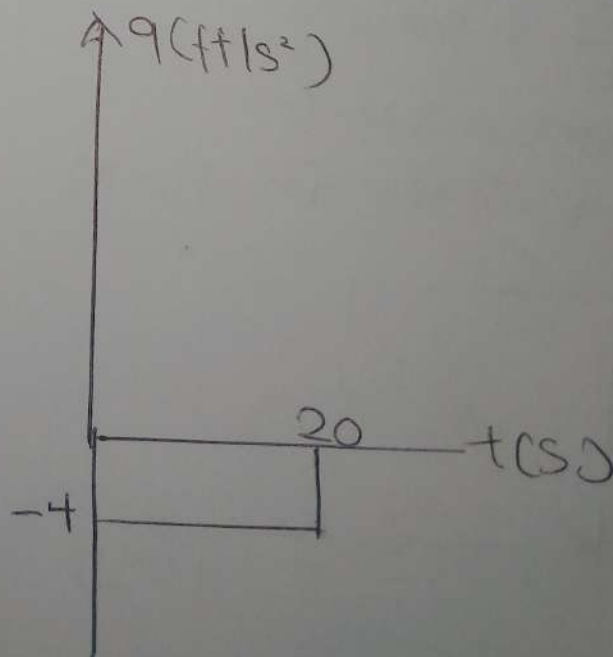
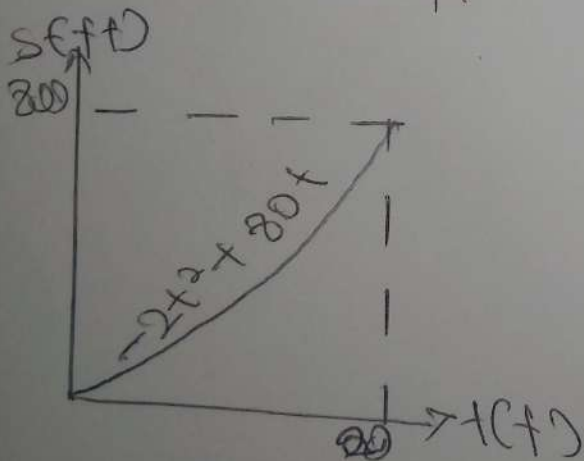
$$s = -2t^2 + 80t$$

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

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

$$= -800 + 1600$$

$$= 800 \text{ ft}$$



③ F12-11

$$a ds = v dv$$

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

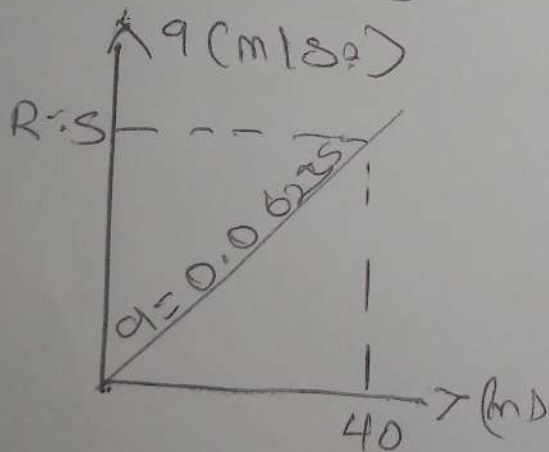
$$a = (0.25s) \left[\frac{d}{dv} (0.25s) \right]$$

$$a = 0.25s \times 0.25$$

$$a = 0.0625s$$

$$a \text{ at } s = 40 = 0.0625(40)$$

$$a = 2.5 \text{ m/s}^2$$



④ F12-12

For $0 \leq t \leq 5\text{ s}$

$$s = 3t^2$$

$$\frac{ds}{dt} = v = 6t \text{ m/s}$$

at $t = 5\text{ s}$

$$v = 6(5) = 30 \text{ m/s}$$

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

$$v = \frac{\Delta s}{\Delta t} = \frac{225\text{ m} - 75\text{ m}}{10\text{ s} - 5\text{ s}} = 30 \text{ m/s}$$

For $a-t$ graph

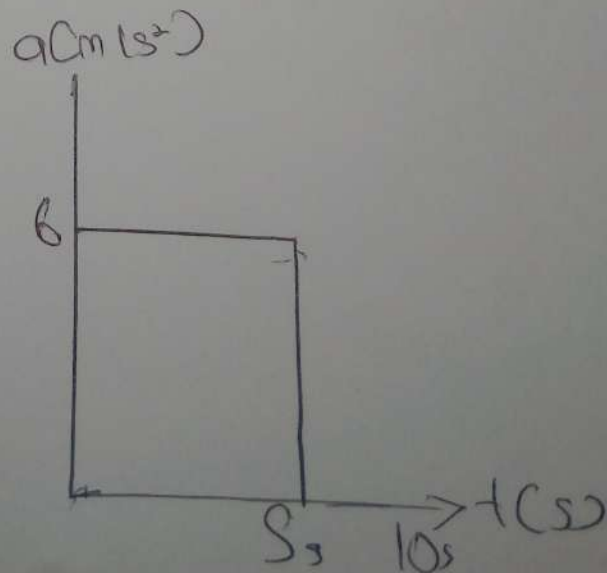
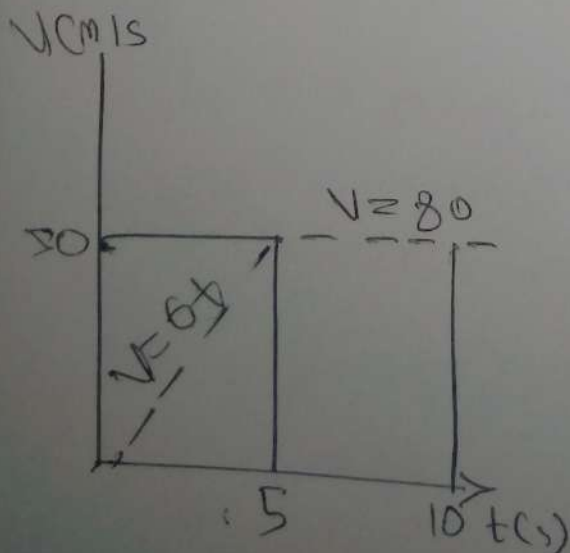
$0 \leq t \leq 5\text{ s}$ $v = 6t \text{ m/s}$

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

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

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

$$a = \frac{dv}{dt} = 0 \text{ m/s}^2$$



5) F12-13

20 m/s^2 . For $t \leq t_1$
 accelerates at 10 m/s^2

$$dv = a dt$$

at $v=0$ and $t=0$

$$0 \leq t \leq t_1,$$

$$a = 20 \text{ m/s}^2$$

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

$$\therefore v = 20t$$

When $t = t_1,$

$$v = 20(t_1) = 100 \text{ m/s}$$

$$t_1 < t \leq t'$$

$$\int_{100 \text{ m/s}}^v dv = \int_{t_1}^t (-10) dt$$

$$v = C - 10t + 150 \text{ m/s}$$

$$v = -10t + 150 \text{ m/s}$$

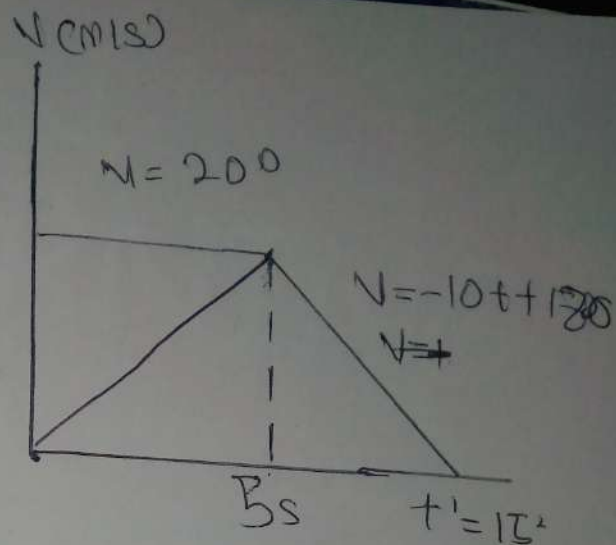
$$0 = A_1 + A_2 = \Delta v$$

$$0 = (20 \text{ m/s})(t_1) + (-10)(t' - t_1)$$

$$0 = 100 + [-10t' + 50]$$

$$t' = \frac{-150}{-10}$$

$$t' = 15 \text{ s}$$



⑥ F12-14

$$0 \leq t \leq 15 \text{ s}$$

$$v = 30 + 10t \text{ m/s}$$

$$\int_0^t ds = \int_0^t 30 + 10t \, dt,$$

$$s = 15t^2 + 30t \text{ m}$$

$$\text{When } t = 3 \text{ s, } s = 15(3)^2$$

$$= 135 \text{ m}$$

$$3 \text{ s} \leq t \leq 15 \text{ s};$$

$$v = (-10t + 225) \text{ m/s}$$

$$\int_{375}^s ds = \int_{3 \text{ s}}^t (-10t + 225) dt$$

$$s - 375 = -\frac{10t^2}{2} + 225t$$

$$\left[-187.5 + 1125 \right]$$

$$s - 375 = -7.5t^2 + 225t$$

$$+ 187.5 - 1125 + 375$$

$$= (-7.5t^2 + 225t - 562.5) \text{ m}$$

$$\text{When } t = 15 \text{ s,}$$

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

$$s = -1087.5 + 3375 - 562.5$$

$$s = 1125 \text{ m}$$

