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18/EN05/040

MECHATRONICS ENGINEERING.

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MECHATRONICS ENGINEERING.

F12-3

$$v = (4t - 3t^2) \text{ m/s}$$

$$s = \int v = \int (4t - 3t^2) dt$$

$$s = \frac{4t^2}{2} - \frac{3t^3}{3} + c$$

$$s = 2t^2 - \frac{3t^3}{3} + c$$

$$\text{when } t = 0, s = 0$$

$$\therefore 0 = 2(0)^2 - \frac{3(0)^3}{3} + c$$

$$\therefore c = 0$$

$$\therefore s = 2t^2 - \frac{3t^3}{3}$$

$$\text{when } t = 4$$

$$s = \frac{2(4)^2 - 3(4)^3}{3} = \frac{32 - 64}{3}$$

$$\therefore s = -32 \text{ m}$$

\therefore Position is 32m before (to the left of) the origin.

F 12-4

$$v = (0.5t^3 - 8t) \text{ m/s}$$

$$a = \frac{dv}{dt} = \frac{d(0.5t^3 - 8t)}{dt}$$

$$a = 1.5t^2 - 8$$

$$\text{at } t = 2$$

$$a = 1.5(2)^2 - 8$$

$$a = (1.5)4 - 8$$

$$a = 6 - 8$$

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

∴ The particle is undergoing a deceleration of 2 m/s^2

F 12-7

$$a = (4t^2 - 2) \text{ m/s}^2$$

$$s = \int \int a \, dt$$

$$v = \int a = \int (4t^2 - 2) \, dt$$

$$= \frac{4t^3}{3} - 2t + c$$

$$s = \int v = \int \left(\frac{4t^3}{3} - 2t + c \right) \, dt$$

$$s = \frac{4t^4}{3 \times 4} - \frac{2t^2}{2} + ct + z$$

$$s = \frac{t^4}{3} - t^2 + ct + 2$$

when $t = 0$, $s = -2$

$$\therefore 0 = 0 + 0 + 2 + c \cdot 0 - 2$$

$$\therefore 2 = -2$$

when $t = 2$, $s = -20$

$$\therefore \frac{(2)^4}{3} - (2)^2 + 2c + 2 = -20$$

$$\frac{16}{3} - 4 + 2c + 2 = -20$$

$$2c = -20 + 2 + 4 - \frac{16}{3}$$

$$2c = -14 - \frac{16}{3}$$

$$2c = -\frac{58}{3}$$

$$\therefore c = -\frac{29}{3}$$

$$s = \frac{t^4}{3} - t^2 + \left(-\frac{29}{3}\right)t + 2$$

\therefore at $t = 4$,

$$s = \frac{4^4}{3} - 4^2 - \frac{29(4)}{3} + 2$$

$$s = \frac{256}{3} - 16 - \frac{116}{3} + 2$$

$$= 28.67 \text{ m}$$

f 12-8

$$V_s (20 - 0.05 s^2) \text{ m/s}$$
$$\frac{dv}{ds} = -0.1s$$

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

but given $\frac{dv}{ds}$

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

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

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

$$\therefore a = (20 - 0.05 s^2) \times (-0.1s)$$

when $s = 15 \text{ m}$

$$a = (20 - 0.05 (15)^2) \times (-0.1 (15))$$

$$a = (20 - (0.05)(225)) \times (-1.5)$$

$$= (8.75) (-1.5)$$

$$= -13.125 \text{ m/s}^2$$