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Dept: Mechanical

Course: Mechanics (ENG 232)

Solutions

1 $v = (4t - 3t^2)$ m/s

when $t = 0$ seconds $s = 0$, $t = 45$

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

$$\int_0^s ds = \int_0^4 (4t - 3t^2)\,dt$$

$$s = \left[\frac{4t^2}{2} - \frac{3t^3}{3}\right]_0^4$$

$$s = \left[2t^2 - t^3\right]_0^4$$

$$s = 2(4)^2 - 4^3$$

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

2

2 $v = (0.5t^3 - 8t)\ m/s$

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

$a = (0.5t^3 - 8t)$

$a = 1.5t^2 - 8$

when $t = 2s$

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

$a = -2\ m/s$

retardation of $2\ m/s$

3 $a = (4t^2 - 2)\ m/s$

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

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

when $t = 4s$, $s = ?$

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

$v = \int a\,dt$

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

$v = \frac{4t^2}{3} - 2t + C_1 \quad \cdots (1)$

$s = \int v\,dt$

$s = \frac{4}{3} \cdot \frac{1}{4} t^4 - \frac{2t^2}{2} + C_1 t + C_2$

$s = \frac{1}{3}t^4 - t^2 + C_1 t + C_2 \quad \cdots (2)$

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

$-2 = \frac{1}{3}(0)^4 - (0)^2 + C_1(0) + C_2$

$C_2 = -2$

when $t = 2$ $\quad s = -20$ and $C_2 = 2$

$-20 = \frac{1}{3}(2)^4 - (2)^2 + C_1(2) + (-2)$

$$-20 = \frac{16}{3} - 4 + 2c_1 - 2$$

$$-20 + 2 - \frac{16}{3} + 4 = 2c_1$$

$$-19.33 = 2c_1$$

$$c_1 = \frac{-19.33}{2}$$

$$= -9.67$$

Putting $c_1 = -9.67$

$c_2 = -2m$

$$s \text{ at } t=4 = \frac{1}{3}(4) - 4^2 + (-9.67 \times 4) + (-2)$$

$$s = 85.33 - v + (-38.64) - 2$$

$$s = 28.69m$$

4 $\delta s = v\,dt$

$$dt = \frac{ds}{v} \quad \ldots \text{①}$$

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

$$dt = \frac{dv}{a} \quad \ldots \text{②}$$

equating 1 and 2

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

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

$$dv = (20 - 0.055^2)\,ds$$

$$a = \frac{(20 - 0.055^2)\cdot(-0.15)\,ds}{ds}$$

$$a = -25 + 0.055s^3$$

$a(15) = -2(15) + 0.05(15)^3$

$a = -13.125 m/s^2$