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 19/ENG06/063  
 MECHANICAL ENGINEERING

1) Fig 12.3(i)  
 $a = (4t - 3t^2)$

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

$$(4t - 3t^2) dt = ds$$

$$\int_{t_1}^{t_2} (4t - 3t^2) dt$$

$$= \int_{s_1}^{s_2} ds$$

$$\left[ 4 \times \frac{t^2}{2} - \frac{3t^3}{3} \right]_{t_1}^{t_2} = \left[ s \right]_{s_1}^{s_2}$$

$$(2t^2 - t^3) \Big|_0^4 = s_2 - 0$$

$$s_2 = (2 \times 4^2 - 4^3) + 0$$

$$s_2 = 32 \text{ m}$$

2) Fig 12.4

$$y = 0.5t^3 - 8t$$

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

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

$$t = 2$$

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

3) Fig 12.7

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

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

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

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

$$s = \frac{1}{3}t^4 - \frac{2}{2}t^2 + C_1t + C_2$$

$$\text{at } t = 0, s = -2 = C_2$$

$$\text{at } t = 2, s = -20, C_1 = -9.7$$

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

$$s(4) = \frac{1}{3}(4)^4 - \frac{1}{2}(4)^2 + (-9.7)(4)$$

$$+ (-9.7)$$

$$= 28.7 \text{ m}$$

4) Fig 12.8

$$v = (20 - 0.05v^2) \text{ m/s}$$

$$dt = \frac{ds}{v} \text{ and } dt = \frac{dv}{a}$$

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

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

$$dv = -2 \times 0.05 v ds$$

$$= -0.1 ds$$

$$a = (20 - 0.05v^2) \cdot (-0.1) ds$$

$$a \cdot (v=15) = -2 \times 15 + 0.05 \times 15^3$$

$$a = 13.125 \text{ m s}^{-1}$$