18/ENG06/036
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Mechanical engineering
Mechanics assignment

1. $V = F(t)$ $V = (4t - 3t^2) ms^{-1}$ $t = 4sec$

$V = \frac{ds}{dt} = (4t - 3t^2)$

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

$S = 2t^2 - t^3 /_0^4$

$S = (2(4)^2 - (4)^3) - (0) - (0)$

$S = 32 - 64$

$S = -32$

$S = 32m$

2. $a = (4t^2 - 2) ms^{-2}$ when $t = 0$ $s = 2m$; $t = 2s$ $s = 20m$; $t = 4s$ $s = ?$

Soln

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

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

$V = 4/3 t^3 - 2t + C_1$

$S = \int v\, dt$

$S = \int (4/3 t^3 - 2t + C_1) dt$

$S = \frac{t^4}{3} - t^2 + C_1 t + C_2$

When $t = 0$ $S = 2m$

$\therefore -2 = 0^4/_4 - 0^2 + C_1(0) + C_2$

$-2 = C_2$

When $t = 2$ $S = 20m$

$\therefore -20 = 2^4/_3 - 2^2 + C_1(2) + (-2)$

$-20 = 16/3 - 6 + 2C_1$

Continuation of number 2

$-20 - 16/3 + 6 = 2C_1$

$-58/3 = 2C_1$

$\frac{-58}{6} = C_1$

$C_1 = -9.7$

When $t = 4$

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

$= \frac{256}{3} - 16 - 38.8 - 2$

$S = \frac{256 - 170.4}{3}$

$S = \frac{85.6}{3}$

$S = 28.53m$

3. $V = (0.5t^3 - 8t)$

Find a if $t = 2sec$

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

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

if $t = 2$

$a = 1.5(2)^2 - 8 = -2ms^{-2} = 2ms^{-2}$

$a = 2ms^{-2}$

4. $V = (20 - 0.055^2)\,ms^{-1}$

$S = 15m$ find a

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

$\therefore \frac{V}{ds} = \frac{1}{dt} \Rightarrow dt = \frac{ds}{V}$

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

$\therefore \frac{a}{dv} = \frac{1}{dt} \Rightarrow dt = \frac{dv}{a}$

$dt = dt \quad \therefore \frac{ds}{V} = \frac{dv}{a}$

$ads = vdv \qquad a = \frac{vdv}{ds}$

$\frac{dv}{ds} = \frac{d(20 - 0.055^2)}{ds} = -0.1s$

$dv = -0.1s\,ds$

$a = \frac{vdv}{ds} = \frac{(20 - 0.055^2) \times (-0.1s)\,ds}{ds}$

$a = (20 - 0.055^2) \times (-0.1s)$

$a = -2s + 0.005s^3$

at $s = 15$

$a = -2(15) + 0.005(15)^3$

$a = 13.125\,ms^{-2}$