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18/ENG06/056
MECHANICAL ENGINEERING

1) A Particle travels along a straight line with a velocity of $v = (4t - 3t^2)$ m/s where t is in seconds. Determine the position of the particle when $t = 4s$. $s = 0$ when $t = 0$.

$v = (4t - 3t^2)$ $t = 4$

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

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

$s|_0^s = \int_0^t (4t - 3t^2)\,dt$

$s|_0^s = \frac{4t^2}{2} - \frac{3t^3}{3}$

$= 2t^2 - t^3 \Big|_0^4$ where $t = 4$ and $t = 0$

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

$= 32 - 64$

$S = 32m$

2) A particle travels along a straight line with a speed of $v = (0.5t^3 - 8t)$ m/s where t is in seconds, determine acceler

$a = \frac{dv}{dt}$ where $t = 2$

$\frac{d}{dt}(0.5t^3 - 8t)$ $\quad 1.5 \times 4 - 8$

$= 3 \times 0.5t^{3-1} - 8$ $\quad = -2\,ms^{-2}$

$1.5t^2 - 8$

$1.5(2)^2 - 8 = 0.$

At $t = 4$ where $C_1 = -7.67$

$C_2 = -2$

$$s = \frac{1}{3}(4)^4 - (4)^2 - 9.67(4) - 2$$

$$s = \frac{256}{3} - 16 - 38.6685 - 2$$

$$s = \frac{256}{3} - 56.6668$$

$s = 28.66 + m$ (Portion of the Particle)

4 $v = (20 - 0.05s^2)$

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

$$\frac{dv}{ds} \times v$$

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

$\frac{dv}{ds} = -0.15$

$\therefore a = (20 - 0.05s^2)(-0.15)$

At $s = 15m$

$a = (20 - 0.05(15)^2)(-0.15)(-0.1(15)$

$a = (20 - 11.25)(-1.5)$

$a = (8.75)(-1.5)$

$a = -15.125\ ms^{-2}$

$a = -13.13\ ms^{-2}$ //

3 A particle moves a straight line such that its acceleration is $a = (4t^2 - 2)\ ms^{-2}$ where t is in seconds. When $t = 0$, the particle is located 2m to the left of the origin and when $t = 2$ s, it is 20m to the left of the origin. Determine the position of the particle when $t = 4$s

$a = (4t^2 - 2)$

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

$\frac{dv}{dt} = (4t^2 - 2)$

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

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

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

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

$\frac{ds}{dt} = \left(\frac{4}{3}t^3 - 2t + c\right)$

$ds = \int \left(\frac{4}{3}t^3 - 2t + c_1\right) dt$

$\int ds = \int \frac{4t^4}{3 \times 4} - \frac{2t^2}{2} + c_1 t + c_2$

$s = \frac{1}{3}t^4 - t^2 + c_1 t + c_2$

At $t = 0$, $s = -2m$

$s = \frac{1}{3}t^4 - t^2 + c_1 t + c_2$

$-2 = \frac{1}{3}(0)^4 - (0)^2 + c_1(0) + c_2$

$\therefore c_2 = -2$

At $t = 2$, $s = 20m$, $c_2 = -2$

$s = \frac{1}{3}t^4 - t^2 + c_1 t + c_2$

$-20m = \frac{1}{3}(2)^4 - (2)^2 + c_1(2) + c_2$

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

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

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

$c_1 = -9.67$