18/ENG05/052

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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 $t = 0$.

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

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

$$\int_0^1 ds = \int_0^1 v\,dt$$

$$s\Big|_0^1 = \int_0^4 (4t - 3t^2)\,dt$$

$$s\Big|_0^1 = \frac{4t^2}{2} - \frac{3t^3}{3}$$

$$= 2t^2 - t^3\Big|_0^4 \quad \text{where } t = 4 \text{ and } t = 0$$

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

$$= 32 - 64$$

$$S = 32m$$

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 acceleration

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

where $t = 2$

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

$$1.5 \times 4 - 8$$

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

$$= 3 \times 0.5t^{3-1} - 8$$

$$1.5t^2 - 8$$

$$1.5(2)^2 - 8 = 9.$$

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 $t = 2s$, it is 20m to the left of the origin. determine the position of the particle when $t = 4s$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$c_1 = -9.67$

At $t = 4$ when $C_1 = -9.67$

$C_2 = -2$

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

$$S = \frac{256}{3} - 16 - 38.6668 - 2$$

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

$S = 28.667$ 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 $s = 15$ m

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

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

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

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

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