

18/ENG06/007

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Mechanical Engineering

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ENG 234

Assignment

1) $v = (4t - 3t^2) \text{ m/s}$. $t=0, s=0, t=4$
 $v = \frac{ds}{dt} = (4t - 3t^2)$

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

$$s ds = \int^4 (4t - 3t^2) dt$$
$$s = \left[\frac{4t^2}{2} - \frac{3t^3}{3} \right]_0^4$$

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

$$\therefore s = [2t^2 - t^3]_0^4 - [2t^2 - t^3]_0^0$$

$$s = 2(4)^2 - (4)^3 - [0]$$

$$s = 32 - 64$$

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

\therefore The position of the particle is to the left of the origin.

2) $v = (0.5t^3 - 8t) \text{ m/s}$. $t=2 \text{ s}, a=?$
 $a = \frac{dv}{dt} = \frac{d}{dt} (0.5t^3 - 8t)$

$$a = (1.5t^2 - 8) \text{ m/s}^2$$

$$\text{at } t = 2 \text{ s}$$

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

$$= (1.5 \times 4) - 8$$

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

\therefore This means that the particle is decelerating

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

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

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

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

$$v = \left(\frac{4t^3}{3} - 2t + C_1 \right) \text{ m/s}$$

$$\therefore v = \frac{ds}{dt} = \left(\frac{4t^3}{3} - 2t + C_1 \right) \text{ m/s}$$

$$\frac{ds}{dt} = \left(\frac{4}{3}t^3 - 2t + C_1 \right)$$

$$\int ds = \int \left(\frac{4}{3}t^3 - 2t + C_1 \right) dt$$

$$s = \left(\frac{4t^4}{3 \times 4} - \frac{2t^2}{2} + C_1 t + C_2 \right) \text{ m}$$

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

At $t = 0$, $s = -2 \text{ m}$

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

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

$$\therefore C_2 = -2 //$$

At $t = 2$, $s = -20 \text{ m}$

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

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

$$-20 = \frac{16}{3} - 4 + 2C_1 - 2$$

$$-20 = -\frac{2}{3} + 2C_1$$

$$2C_1 = -20 + \frac{2}{3}$$

$$2C_1 = -19.33$$

$$C_1 = \frac{-19.33}{2}$$

$$= -9.67$$

$$\therefore C_1 = -9.67$$

$$C_2 = -2$$

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

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

$$\text{At } t = 4s, S = ?$$

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

$$S = \frac{256}{3} - 16 - 38.668 - 2$$

$$S = \frac{256}{3} - 56.668$$

$$S = 28.667m$$

\therefore The position of the particle is 28.67m

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

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

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

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

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

$$\text{At } s = 15m$$

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

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

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

$$a = -13.125m/s^2$$

$$a = -13.13m/s^2$$

\therefore The acceleration of the particle at $s = 15m$ is $-13.125m/s^2$ which implies that the particle is decelerating.