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Mechanical Engineering

1) $V = (4t - 3t^2)\ m/s \qquad t = 0,\ S = 0 \qquad t = 4$

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

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

$\int ds = \int_0^4 (4t - 3t^2)\, dt$

$S = \left[\frac{4t^2}{2} - \frac{3t^3}{3}\right]_0^4$

$S = \left[2t^2 - t^3\right]_0^4$

$S = \left[2t^2 - t^3\right]^4 - \left[2t^2 - t^3\right]^0$

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

$S = 32 - 64$

$S = -32\ m$

$\therefore$ This means the position is to the left of the origin

2) $V = (0.5t^3 - 8t)\ m/s \qquad t = 2\ sec, \quad a = ?$

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

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

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

at $t = 2s$

$= 1.5(2)^2 - 8$

$= (1.5 \times 4) - 8$

$= -2\ m/s^2$

∴ The particle is decelerating.

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

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

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

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

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

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

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

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

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

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

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

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

$C_2 = -2$

At $t = 2$ $\quad s = -20\,m$

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

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

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

$-20 = -\frac{7}{3} + 2C_1$

$2C_1 = -20 + \frac{7}{3}$

$2C_1 = -19.33$

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

$= -9.67$

$\therefore C_1 = -9.67$

$C_2 = -2$

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

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

At $t = 4s$ $\quad s =$

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

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

$s = 28.667\,m$

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

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

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

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

$\frac{dv}{ds} = -0.1s$

$\therefore a = (20 - 0.05s^2)(-0.1s)$

$At\ s = 15m$

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

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

$a = (8.75)(-1.5)$

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

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

$\therefore$