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18/engo/005
CHEMICAL ENGINEERING
ENG. MECHANICS

1) $v = (4t - 3t^2)\,m/s$
integrating $\int v$
$= \int 4t - 3t^2\,dv$
$s = [2t^2 - \frac{3}{3}t^3] = [2t^2 - t^3]$
when $t = 4$ and $t = 0$ $s = 0$
$s = [2t^2 - t^3]_0^4$
$s = [2(4)^2 - (4)^3] - [2(0)^2 - (0)^3]$
$s = 32 - 64 = -32m$
∴ The negative means that the position of the particle is to the left of the origin.

2) $v = (0.5t^3 - 8t)\,m/s$
∴ finding acceleration we differentiate velocity dv/dt
acceleration $= \frac{dv}{dt} = (1.5t^2 - 8)\,m^4/s^2$
when $t = 2$ seconds
∴ $a = 1.5(2)^2 - 8$
$a = 6 - 8 = -2m/s^2$
∴ the negative sign shows that the particle is decelerating.

(3)
$a = (4t^2 - 2)\,m/s^2$
integrating acceleration
$v = \frac{4}{3}t^3 - 2t + c_1$
differentiating velocity
$s = \frac{1}{3}t^4 - t^2 + c_1t + c_2$
$t = 0$ sec $s = -2m$
$\therefore -2 = \frac{1}{3}0^4 - 0^2 + c_1(0) + c_2$
$-2 = c_2 \quad \therefore c_2 = -2$
CC is the Constant from integration
i.e C_1 and C_2)
ii) At $t = 2s$; $s = -20m$
$-20 = \frac{1}{3}(2)^4 - (2)^2 + c(2) - 2$
$-20 = \frac{16}{3} - 4 + 2C_1 - 2$
$-20 + 6 - \frac{16}{3} = 2C_1$
$-14 - \frac{16}{3} = 2C_1$
$-19.333 = \frac{2C_1}{2}$
$C_1 = -9.67$
∴ At $t = 4s$ $s = ?$
$s = \frac{1}{3}(4)^4 - (4)^4 - 9.67(4) - 2$
$s = \frac{256}{3} - 16 - 38.69 - 2$
$s = 28.66m$ At $t = 4$ secs

(4)

velocity $= (20 - 0.05s^2)$ m/s

differentiating velocity to acceleration

$\frac{dv}{ds} = a = (-0.1s)$ m/s^2 ∴ At $s = 15$m

$\frac{dv}{ds} = -0.1 \times 15$

$\frac{dv}{ds} = -1.5$ m/s^2

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

$a = (20 - 0.05s^2)(-1.5)$

At $s = 15$

$a = (20 - 0.05(15)^2)(-1.5)$ ↘

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

$= 8.75 \times -1.5$

$a = -13.125$ m/s^2

∴ it is negative because the particle is deaccelerating.