$v = 20 - 0.05s^2$

$\frac{dv}{ds} = -2 \times 0.05s$

$dv = 0.1s\, ds$

$a = v \times \frac{dv}{ds}$ ....(1)

Substitute $v = 20 - 0.05s^2$ and $dv = 0.1s\, ds$ in ~~the~~ eqn (1)

$a = \frac{(20 - 0.05s^2) \times (-0.1s)\, ds}{\cancel{ds}}$

$a = -2s + 0.005s^3$

$\therefore$ when $s = 15m$

$a = -2(15) + 0.005(15)^3$

$a = -13.125 m/s^2$

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

$$-20 = \frac{16}{3} - 4 + 2c_1 - 2$$

$$-20 = \frac{16}{3} - 6 + 2c_1$$

$$-20 - \frac{16}{3} + 6 = 2c_1$$

$$c_1 = -9.70$$

(c)

at $t = 4s$

then

$$S = \frac{1}{3}(4)^4 - (4)^2 + (-2)(4) + (-9.7) = 28.7m$$

4.) A particle moves along a straight line with a velocity of $v = (20 - 0.05s^2)$ m/s, where s is in metres. Determine the acceleration of the particle at $s = 15m$

Solution

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

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

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

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

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

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

$$a = \frac{dv}{dt} = (0.5t^3 - 8t) = (1.5t^2 - 8)$$

when $t = 2$

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

3 A particle moves along a straight line such that it's acceleration is $a = (4t^2 - 2) m/s^2$, 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 $t = 4s$

Solution

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

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

$$\int dv = \int a\, dt$$

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

$$v = \cancel{4t^3}\ \frac{4t^3}{3} - 2t + C_1 \quad \ldots (1)$$

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

$$\int ds = \int v\, dt$$

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

$$s = \frac{t^4}{3} - t^2 + C_1 t + C_2 \quad \ldots (2)$$

at, $t = 0$, $s = -2$

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

$$C_2 = \cancel{0} - 2$$

$a = \frac{v}{t}$ $\quad a = \frac{dv}{dt}$

at $t = 2$, $s = -20$

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

Assignment

1) A particle moves 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 $t = 0$

Solution

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

$V = \frac{ds}{dt}$

$\int ds = \int v\, dt$

$s = \int v\, dt$

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

$s = \left(\frac{4t^2}{2} - \frac{3t^3}{3} \right)_0^4 = 2(4)^2 - 4^3 - 0 - 0 = -32 = 32$

Position of particle = 32.

2. A particle moves along a straight line with a speed $v = (0.5t^3 - 8t)$ m/s where t is in seconds. Determine the acceleration of the particle when $t = 2s$

Solution

$V = (0.5t^3 - 8t)$

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