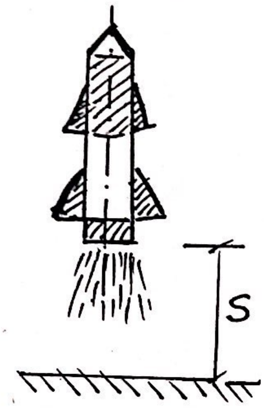
1	A particle is moving a with a velocity of v_0 when s=0 & t=0. If it is subjected to a deceleration of $a= -kv^3$, where k is the constant, determine its velocity and position as function of time. **Ans: $(2kt+(1/v_0^2)^{-1/2}$**
2	The acceleration of a rocket traveling upward is given by a=(6 + 0.02s) m/s^2 where s is in meters. Determine the rockets velocity when s = 2 km & time needed to reach this altitude. Initially, V=0 & s= 0 when t=0. **Ans:** 
3	A particle moving along a straight line such that its acceleration is defined as , a =(-2v) m/s^2, where v is in meter/ seconds. If v = 20m/s when s =0 & t = 0, determine the particle's position, velocity and acceleration as function of time. **Ans: $x=10-(0.5)[e^{(2.995-2t)}]$**
4	If a= (s) m/s^2,where 's' is in meter, determine v when s = 5m if v=0 at s= 4m **Ans:V=3m/s**
5	The acceleration of a particle moving along a straight line is given by the law, a $=3s - 6s^2$. Where 'a' is m/s^2 & 's' is in meter. The particles starts from rest. Find (a)Velocity when the displacement is 3m. (b) the displacement when the velocity is again zero & (c) the displacement at maximum velocity. **Ans: x = 0.5m**
6	The acceleration of a particle is given by $a = -0.02v^{1.75}$ m/s^2 performing rectilinear motion knowing at x= 0, v= 20 m/s. Determine ( ) The position where the velocity is 28m/s &(b) acceleration when x = 200m. **Ans: $a=-0.043m/s^2$**

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① RCH/12-17/pg.632:

$$a = -kv^3 \quad m/s^2 \longrightarrow ①$$

$$a \cdot dx = v \cdot dv$$

$$\therefore -k \cdot v^3 \cdot dx = v \cdot dv$$

$$\therefore -k \cdot v^2 \cdot dx = dv$$

$$\therefore -k \int_0^x dx = \int_{v_0}^{v} \frac{dv}{v^2}$$

$$-k \cdot x = \left[\frac{v^{-1}}{-1}\right]_{v_0}^{v}$$

$$-kx = -\left[\frac{1}{v}\right]_{v_0}^{v}$$

$$kx = \frac{1}{v} - \frac{1}{v_0}$$

$$\boxed{x = \frac{1}{k}\left[\frac{1}{v} - \frac{1}{v_0}\right]} \Rightarrow \boxed{\frac{1}{k}\left[\left(2kt + \frac{1}{v_0^2}\right)^{\frac{1}{2}} - \frac{1}{v_0}\right]}$$

Now, $a = \dfrac{dv}{dt} = -kv^3$

$$-k \int_0^t dt = \int_{v_0}^{v} v^{-3} \cdot dv$$

$$-k \cdot t = \left[\frac{v^{-2}}{-2}\right]_{v_0}^{v} = -\left[\frac{1}{2v^2}\right]_{v_0}^{v}$$

$$kt = \frac{1}{2v^2} - \frac{1}{2v_0^2}$$

$$\frac{1}{2v^2} = \frac{1}{2v_0^2} + kt$$

$$\frac{1}{v^2} = \left(\frac{1}{v_0^2} + 2kt\right)$$

$$\therefore V = \left[\frac{1}{\sqrt{2kt + 1/v_0^2}}\right]$$

Ans:

$$\therefore \boxed{V = \left(2kt + \frac{1}{v_0^2}\right)^{-1/2}}$$

Ans:

(i) $v = \left(2kt + \dfrac{1}{v_0^2}\right)^{-1/2}$

(ii) $x = \dfrac{1}{k}\left[\left(2kt + \dfrac{1}{v_0^2}\right)^{1/2} - \dfrac{1}{v_0}\right]$

② RCH/12.19/pg.632.

$$a = 6 + (0.02)x \quad m/s^2 \longrightarrow ①$$

$$a \cdot dx = v \cdot dv$$

$$\int_0^{2000\,m} [6 + (0.02)x]\,dx = \int_0^{v} v \cdot dv$$

$V = 322.49$ m/s
$t = 19.27$ s

$$\left[6 \cdot x + (0.02)\frac{x^2}{2}\right]_0^{2000} = \frac{v^2}{2}$$

$$\therefore v^2 = 2\left[(6 \times 2000) + 40{,}000\right] = (52{,}000 \times 2)$$

Ans: $\boxed{v = 322.49\ m/s}$

NOW, $v^2 = 12 \cdot x + (0.02)x^2$

$$v = \left[12 \cdot x + (0.02)x^2\right]^{1/2} \xrightarrow[m/s]{} ②$$

$$\therefore \left(\frac{dx}{dt}\right) = \left[12 \cdot x + (0.02)x^2\right]^{1/2}$$

$$\int_0^t dt = \int_0^{2000} \left[12 \cdot x + (0.02)x^2\right]^{-1/2} \cdot dx$$

$$\cancel{t = \frac{1}{2}\left[12 \cdot x + (0.02)x^2\right]^{1/2}(12 + 0.04 \times x)} \longrightarrow ③$$

~~when $x = 2000\,m$~~

$$\cancel{t = \frac{1}{2}(161.245)(92) = 14{,}834.55\ sec}$$

$$\cancel{\frac{v^2}{0.02} = (600)x + x^2}$$

$$\cancel{2v \cdot \frac{dV}{dt} = 12 \cdot v + (0.02)x \cdot v}$$

dV

③ RCH/12.25/pg. 632

$\boxed{a = -2v}$ m/s^2 → ①

At $t=0$, $v = 20$ m/s & $x = 0$

$dv = a \cdot dt$

$dv = -2v \cdot dt$

$$\int \frac{dv}{v} = -2 \cdot \int dt$$

$$\log_e v = -2t + C_1$$

$\ln 20 = 0 + C_1$ $C_1 = 2.995$

$\therefore \log_e v = -2t + 2.995$

$\therefore e^{(2.995-2t)} = v$

$$\boxed{v = e^{(2.995-2t)}} \text{ m/s} \rightarrow ②$$

$$\int dx = \int e^{(2.995-2t)} dt$$

$$x = e^{(2.995-2t)} \times \frac{1}{(-2)} + C_2$$

$\therefore 0 = -(0.5)(20) + C_2$ $\therefore C_2 = 10$

$$\boxed{x = 10 - (0.5)\left[e^{(2.995-2t)}\right]} \rightarrow ③$$

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4 RCH/ P12.1(+)/ pg. [illegible] :

$$a = s = x \ m/s^2 \longrightarrow (1)$$

$$a \cdot dx = v \cdot dv$$

$$\therefore \int x \cdot dx = \int v \cdot dv$$

$$\frac{x^2}{2} + C_1 = \frac{v^2}{2}$$

when $x = 4m$, $v = 0$

$$8 + C_1 = 0$$

$$C_1 = -8$$

$$\therefore \frac{x^2}{2} - 8 = \frac{v^2}{2}$$

$$\therefore v^2 = x^2 - 16 \longrightarrow (2)$$

At $x = 5\,m$,

$$v^2 = 25 - 16 = 09$$

$$\therefore v = 3 \ m/s$$

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(5) RCH/12.13/pg.631 :

$$\boxed{a = 3x - 6x^2} \; m/s^2 \longrightarrow (1)$$

At $t=0$, $v=0$, $s = x = 0$

$a \cdot dx = v \cdot dv$

$$\int (3x - 6x^2)\,dx = \int v \cdot dv$$

$$\left(\frac{3x^2}{2} - 2x^3\right) = \left(\frac{v^2}{2} + c_1\right)$$

$\therefore c_1 = 0$

$\therefore v^2 = 3x^2 - 4x^3$

$$\boxed{v = \sqrt{3x^2 - 4x^3}} \longrightarrow (2)$$

a) At $x = 3m$, $v = \sqrt{27 - 324}$

b) When $v = 0$, $3x^2 - 4x^3 = 0$

$x^2 (3 - 4x) = 0$

$\therefore x = 0$ or $3 - 4x = 0$

$x = 3/4 = 0.75 m$

$$\boxed{x = 0.75 m}$$

c) For V_{max}, $\frac{dv}{dx} = 0 = \frac{1}{2}(3x^2 - 4x^3)^{-1/2} \cdot (6x - 12x^2)$

$$\therefore \left[\frac{3x - 6x^2}{\sqrt{3x^2 - 4x^3}}\right] = 0 \quad \therefore 3x - 6x^2 = 0$$

$\therefore x = 0$ or $x = 0.5$

$$\therefore \boxed{x = 0.5 m}$$

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(6) RCH/12.26/pg.632

$$a = -(0.02) \times v^{1.75} \ m/s^2 \longrightarrow (1)$$

$$a \cdot dx = v \cdot dv$$

$$-(0.02) \cdot v^{1.75} dx = v \cdot dv$$

$$-(0.02) \int dx = \int v^{-0.75} dv$$

$$-(0.02) x = \left(\frac{v^{0.25}}{0.25}\right) + C_1$$

$$-(0.02) x = 4 \cdot v^{1/4} + C_1$$

$$x = -(200) \cdot v^{1/4} + C_1$$

At $x = 0$, $v = 20 \ m/s$

$$0 = -(200)(2.115) + C_1$$

$$C_1 = 422.95$$

$$\boxed{x = -(200) \cdot v^{1/4} + 422.95}$$

<u>Ans</u>: (a) when, $v = 28 \ m/s$

$$x = -37.115 \ m/s$$

(b) when $x = 200 \ m$

$$v = 1.544 \ m/s$$

$$a = -0.043 \ m/s^2$$

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