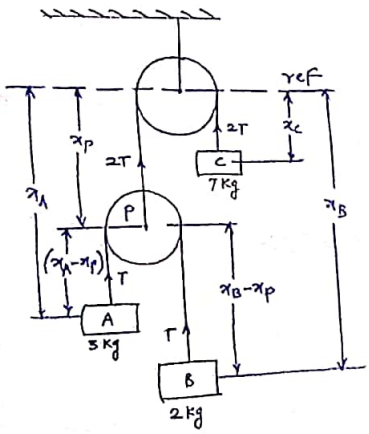


1st string

$L_1 = x_P + x_C$

$0 = V_P + V_C$

$0 = a_P + a_C$

$\boxed{a_P = -a_C}$

2nd string

$L_2 = (x_A - x_P) + (x_B - x_P)$

$L_2 = x_A + x_B - 2x_P$

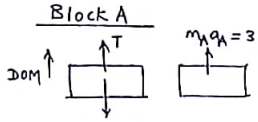
$0 = V_A + V_B - 2V_P$

$0 = a_A + a_B - 2a_P$

$0 = a_A + a_B + 2a_C$

$\boxed{a_C = -\frac{1}{2}a_A - \frac{1}{2}a_B}$

Block A

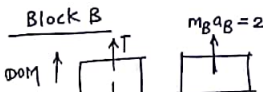


$\Sigma F_y = ma_y$

$T - (3 \times 9.81) = 3a_A$

$T - 3a_A = 3 \times 9.8 \quad$ — (I)

Block B

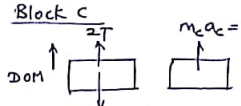


$\Sigma F_y = ma_y$

$T - (2 \times 9.81) = 2a_B$

$T - 2a_B = 2 \times 9.81 \quad$ — (II)

Block C



$\Sigma F_y = ma_y$

$2T - (7 \times 9.81) = 7a_C$

$2T - 7a_C = 7 \times 9.81$

$2T - 7\left(-\frac{1}{2}a_A - \frac{1}{2}a_B\right) = 7 \times 9.81$

$2T + \frac{7}{2}a_A + \frac{7}{2}a_B = 7 \times 9.81 \quad$ — (III)

$T = 27.93$ N

$a_A = -0.498$ m/s²

$a_B = 4.15$ m/s²

$a_C = -\frac{1}{2}(-0.498) - \frac{1}{2}(4.15)$

$a_C = -1.826$ m/s²

$a_A = 0.498$ m/s² (↓)

$a_B = 4.15$ m/s² (↑)

$a_C = 1.826$ m/s² (↓)

$T_1 = 2T = 55.86$ N

$T_2 = T = 27.93$ N

ref

x_c

x_B

1st string

$L_1 = x_p + x_c$

$0 = v_p + v_c$

$0 = a_p + a_c$

$\boxed{a_p = -a_c}$

2nd string

$L_2 = (x_A - x_p) + (x_B - x_p)$

$L_2 = x_A + x_B - 2x_p$

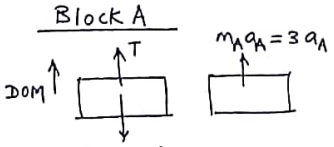
$0 = v_A + v_B - 2v_p$

$0 = a_A + a_B - 2a_p$

$0 = a_A + a_B + 2a_c$

$\boxed{a_c = -\frac{1}{2}a_A - \frac{1}{2}a_B}$

Block A

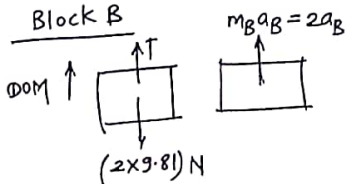


$\Sigma F_y = ma_y$

$T - (3 \times 9.81) = 3a_A$

$T - 3a_A = 3 \times 9.81$ —— (I)

Block B

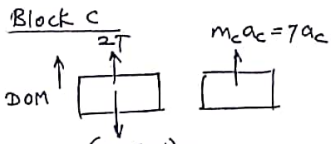


$\Sigma F_y = ma_y$

$T - (2 \times 9.81) = 2a_B$

$T - 2a_B = 2 \times 9.81$ —— (II)

Block C



$\Sigma F_y = ma_y$

$2T - (7 \times 9.81) = 7a_c$

$2T - 7a_c = 7 \times 9.81$

$2T - 7\left(-\frac{1}{2}a_A - \frac{1}{2}a_B\right) = 7 \times 9.81$

$2T + \frac{7}{2}a_A + \frac{7}{2}a_B = 7 \times 9.81$ —— (III)

$T = 27.93$ N

$a_A = -0.498$ m/s²

$a_B = 4.15$ m/s²

$a_c = -\frac{1}{2}(-0.498) - \frac{1}{2}(4.15)$

$a_c = -1.826$ m/s²

$a_A = 0.498$ m/s² (↓)

$a_B = 4.15$ m/s² (↑)

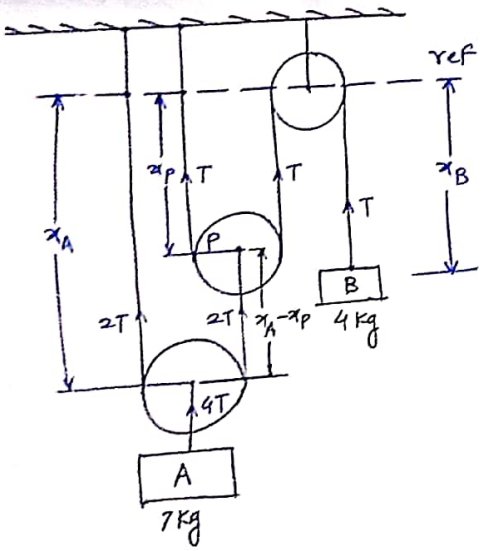
$a_c = 1.826$ m/s² (↓)

$T_1 = 2T = 55.86$ N

$T_2 = T = 27.93$ N

ple

0



1st string

$L_1 = 2x_p + x_B$

$0 = 2v_p + v_B$

$0 = 2a_p + a_B$

$$\boxed{a_p = -\frac{a_B}{2}}$$

2nd string

$L_2 = x_A + (x_A - x_p)$

$L_2 = 2x_A - x_p$

$0 = 2v_A - v_p$

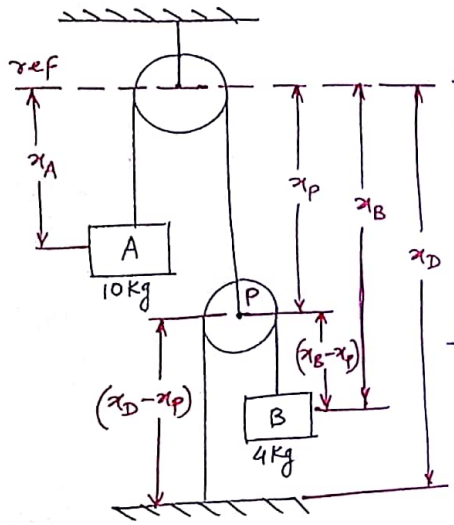
$0 = 2a_A - a_p$

$0 = 2a_A + \frac{a_B}{2}$

$\frac{a_B}{2} = -2a_A$

$$\boxed{a_B = -4a_A}$$

Q. 20)



1st string

$L_1 = x_A + x_p$

$0 = v_A + v_p$

$0 = a_A + a_p$

$\boxed{a_p = -a_A}$

2nd string

$L_2 = (x_D - x_p) + (x_B - x_p)$

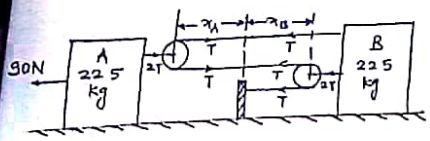
$L_2 = x_D + x_B - 2x_p$

$0 = 0 + v_B - 2v_p$

$0 = a_B - 2a_p$

$2a_p = a_B$

$\boxed{-2a_A = a_B}$



$L = +2x_A - 3x_B$

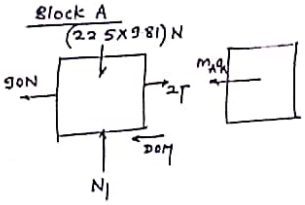
$0 = 2v_A - 3v_B$

$0 = 2a_A - 3a_B$

$3a_B = 2a_A$

$\boxed{a_B = \frac{2}{3} a_A}$

Block A



$\Sigma f_y = ma_y$

$N_1 - (225 \times 9.81) = 0$

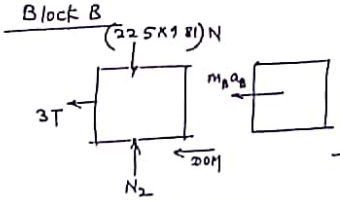
$\boxed{N_1 = 225 \times 9.81 \text{ N}}$

$\Sigma f_x = ma_x$

$-90 + 2T = -m_A a_A$

$2T + 225 a_A = 90$ —— (I)

Block B



$\Sigma f_x = ma_x$

$-3T = -m_B a_B$

$-3T + 225 a_B = 0$

$-3T + 225\left(\frac{2}{3} a_A\right) = 0$

$-3T + 150 a_A = 0$ —— (II)

$T = 1384$ N

$a_A = 2.76$ m/s² (←)

$a_B = \frac{2}{3} \times 2.76 = 1.84$ m/s² (←)

Block A $u = 0$

$v = v$

$s = 2.7$ m

$a = 2.76$ m/s²

$t = t$

$v^2 = u^2 + 2as$

$v^2 = 0 + 2 \times 2.76 \times 2.7$

$\boxed{v = 3.86 \text{ m/s}}$

Curvilinear Motion

Rectangular Component

Position Vector

$$\bar{r} = x\,i + y\,j$$

diff w r t t

$$v_x = \frac{dx}{dt} \qquad v_y = \frac{dy}{dt}$$

$$v = \sqrt{v_x^2 + v_y^2}$$

diff w r t t

$$a_x = \frac{dv_x}{dt} \qquad a_y = \frac{dv_y}{dt}$$

$$a = \sqrt{a_x^2 + a_y^2}$$

Normal & Tangent

$$a_n = \frac{v^2}{\rho}$$

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

(If speed is const then $a_t = 0$)

$$a = \sqrt{a_n^2 + a_t^2}$$

Radius of Curvature: (ρ)

$$\rho = \frac{v^3}{|v_x a_y - a_x v_y|}$$

OR

$$\rho = \frac{\left(1 + \left(\frac{dy}{dx}\right)^2\right)^{3/2}}{\left|\frac{d^2y}{dx^2}\right|}$$

Pg-35)

Q.18,

$\bar{r} = \left(\frac{3}{2}t^2\right)i + \left(\frac{2}{3}t^3\right)j$

Find ρ when $t = 2$ sec

$x = \frac{3}{2}t^2 \qquad y = \frac{2}{3}t^3$

diff w.r.t t

$v_x = 3t \qquad v_y = 2t^2$

When $t = 2$ sec

$\boxed{v_x = 6\ m/s} \quad \boxed{v_y = 8\ m/s}$

$v = \sqrt{v_x^2 + v_y^2} = 10\ m/s$

diff w.r.t t

$a_x = 3 \qquad a_y = 4t$

When $t = 2$ sec

$\boxed{a_x = 3\ m/s^2} \quad \boxed{a_y = 8\ m/s^2}$

$\rho = \frac{v^3}{|v_x a_y - a_x v_y|}$

$= \frac{10^3}{|6 \times 8 - 3 \times 8|}$

$\boxed{\rho = 41.66\ m}$

Q.22) $y = \frac{x^2}{3}$

$v = 8\ m/s$

Q.22)

$y = \frac{x^2}{3}$

$v = 8$ m/s

v_x & v_y when $x = 3$m

$a = ?$

$y = \frac{x^2}{3}$

diff w.r.t. x

$\frac{dy}{dx} = \frac{2x}{3}$

$dy = \frac{2x}{3} dx$

divide by dt on both side

$\frac{dy}{dt} = \frac{2x}{3} \frac{dx}{dt}$

$v_y = \frac{2x}{3} v_x$

When $x = 3$m

$v_y = \frac{2 \times 3}{3} v_x$

$\boxed{v_y = 2 v_x}$

$v = \sqrt{v_x^2 + v_y^2}$

$8 = \sqrt{v_x^2 + 4 v_x^2}$

$\boxed{v_x = 3.57 \text{ m/s}}$

$v_y = 2 \times 3.57$

$\boxed{v_y = 7.14 \text{ m/s}}$

$a_n = \frac{v^2}{\rho}$

$\frac{dy}{dx} = \frac{2x}{3}$

$\frac{d^2y}{dx^2} = \frac{2}{3}$

when $x = 3$m

$\frac{dy}{dx} = 2$ $\quad \frac{d^2y}{dx^2} = \frac{2}{3}$

$\rho = \frac{(1 + (2)^2)^{3/2}}{\left|\frac{2}{3}\right|}$

$\boxed{\rho = 16.77 \text{ m}}$

$a_n = \frac{v^2}{\rho} = 3.81 \text{ m/s}^2$

$a_t = 0$ (speed is const)

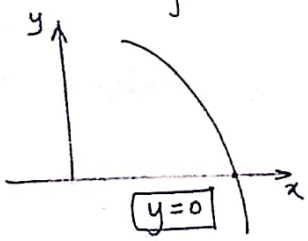
$a = \sqrt{a_n^2 + a_t^2}$

$\boxed{a = a_n = 3.81 \text{ m/s}^2}$

$\bar{r} = (3t)\,i + (4t - 3t^2)\,j$

$\bar{r} = x\,i + y\,j$

$x = 3t \qquad y = 4t - 3t^2$



$y = 4t - 3t^2$

$0 = 4t - 3t^2$

$3t^2 = 4t$

$\boxed{t = \frac{4}{3} \text{ sec}}$

$x = 3t \qquad y = 4t - 3t^2$

$V_x = 3 \qquad V_y = 4 - 6t$

When $t = \frac{4}{3}$ sec

$\boxed{V_x = 3 \text{ m/s}} \quad \boxed{V_y = -4 \text{ m/s}}$

$V = \sqrt{3^2 + (-4)^2} = 5 \text{ m/s}$

$a_x = 0 \qquad a_y = -6$

When $t = \frac{4}{3}$ sec

$\boxed{a_x = 0} \quad \boxed{a_y = -6}$

$a = \sqrt{a_x^2 + a_y^2} = 6$

$\rho = \dfrac{5^3}{|3x - 6 - 0x - 4|}$

$\boxed{\rho = 6.94 \text{ m}}$

$a_n = \dfrac{V^2}{\rho} = \dfrac{5^2}{6.94}$

$\boxed{a_n = 3.6 \text{ m/s}^2}$

$a = \sqrt{a_n^2 + a_t^2}$

$6 = \sqrt{3.6^2 + a_t^2}$

$\boxed{a_t = 4.8 \text{ m/s}^2}$

$$= \frac{53}{|3X-6-0X-4|}$$

$$\boxed{\rho = 6.94\ m}$$

$$a_n = \frac{v^2}{\rho} = \frac{5^2}{6.94}$$

$$\boxed{a_n = 3.6\ m/s^2}$$

$$a = \sqrt{a_n^2 + a_t^2}$$

$$6 = \sqrt{3.6^2 + a_t^2}$$

$$\boxed{a_t = 4.8\ m/s^2}$$

$\rho = 300\ m$

$v = 90\ kmph = 25\ m/s$

$-1.3\ m/s^2$

total acceleration (a)

$$a_n = \frac{v^2}{\rho} = \frac{25^2}{300}$$

$$\boxed{a_n = 2.08\ m/s^2}$$

$$a = \sqrt{a_n^2 + a_t^2}$$

$$= \sqrt{2.08^2 + (-1.3)^2}$$

$$\boxed{a = 2.45\ m/s^2}$$