ACTIVE

Date :.....

Page :

1, 2, 3, 4, 5, 6, 9, 11, 12, 13, 14, 15, 17, 18, 19, 20, 21, 22, 23, 25, 24, 26, 27, 29, 32, 33, 34, 37, 38, 42, 46, 50, 52, 53, 54, 69, 68, 72, 73, 74, 75, 77, 81, 88, 107, 108, 109, 102, 113, 140, 145, 148, 174, 230, 294, 295. 157, 184, 205. 112, 110, 248,

$\angle CAA = \cos^{-1}\left(\frac{8}{12}\right) = 48.18°$

AC = 12"
AA = 8"
AB = 12"

$\Sigma F_x = 0$

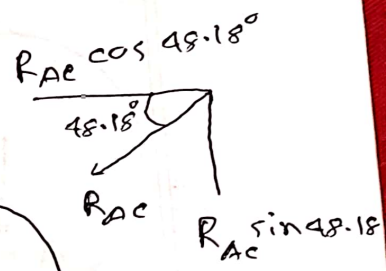
$R_{AC}\cos 48.18° - R_{BC}\cos 48.18° = 0$

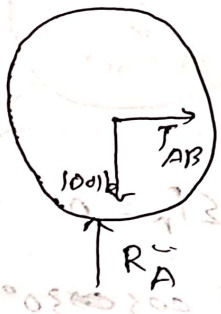
$R_{AC} = R_{BC}$ — (1)

$\Sigma F_y = 0$

$R_{AC}\sin 48.18° + R_{BC}\sin 48.18° - 200 = 0$

$R_{AC} = \frac{200}{2\sin 48.18°} = 134.18$ lb.





$\Sigma F_x = 0$

$T_{AB} - R_{AC}\cos 48.18° = 0$

$T_{AB} = 89.97$ lb

$\Sigma F_y = 0$

$R_A - 100 - R_{AC}\sin 48.18° = 0$

$\therefore R_A = 200$ lb

ACTIVE
Date :
Page :

3)

$\Sigma M_A = 0$

$200 \times 8 + 100 \times 16 - 16 \times R_B = 0$

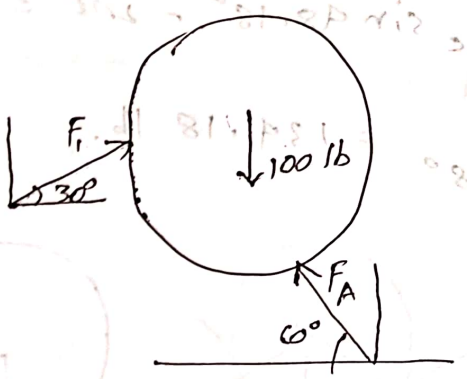
$R_B = 200 \text{ lb}$

$\Sigma F_y = 0$

$R_A + R_B - 100 - 100 - 200 = 0$

$R_A = 200 \text{ lb}.$

4)



$\Sigma F_x = 0$

$F_1 \cos 30° - F_A \cos 60° = 0$

$F_A = \sqrt{3} F_1$

$\Sigma F_y = 0$

$F_1 \sin 30° + F_A \cos 60° - 100 = 0$

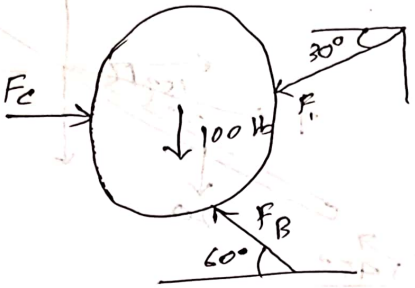
$F_1 = 50$

$F_A = 50\sqrt{3}$

$\approx 86.6 \text{ lb}$

$\Sigma F_x = 0$

$F_c - F_1 \cos 30° - F_B \cos 60° = 0$



$\Sigma F_y = 0$

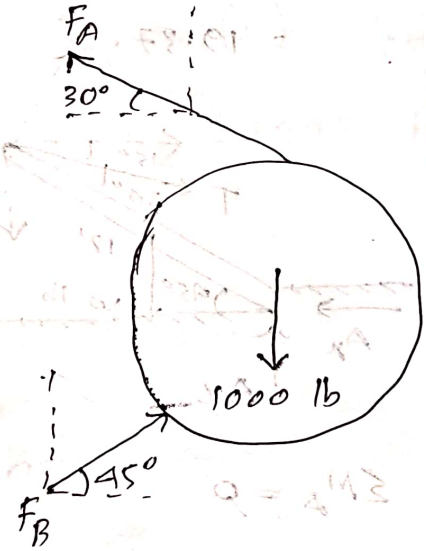
$F_1 \sin 30° + 100 - F_B \sin 60° = 0$

$F_B = 144.3$ lb

$F_c - 50 \cos 30 - 144.3 \cos 60 = 0$

$\therefore F_c = 115.47$ lb.

5/



$\Sigma F_x = 0$

$F_B \cos 45° - F_A \cos 30° = 0$

$F_B \cdot \frac{1}{\sqrt{2}} = F_A \cdot \frac{\sqrt{3}}{2}$

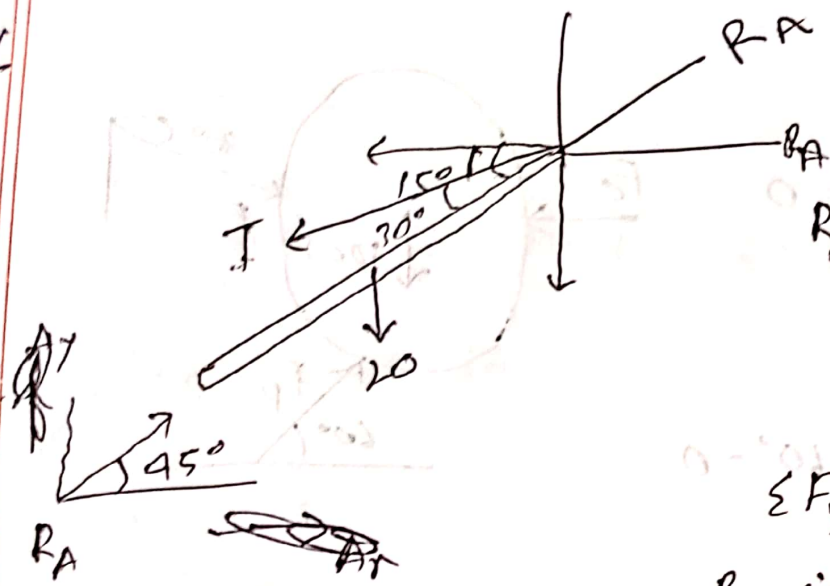
$\Sigma F_y = 0$

$F_A \sin 30° + F_B \sin 45° - 1000 = 0$

$F_A \cdot \frac{1}{2} + F_A \cdot \frac{\sqrt{3}}{2} - 1000 = 0$

$F_A = 732.05$ lb

$F_B = 896.575$ lb. (Ans.)



$\Sigma F_x = 0$

$R_A \cos 45° - T \cos 15° = 0$

$R_A = 1.37\,T$

$\Sigma F_y = 0$

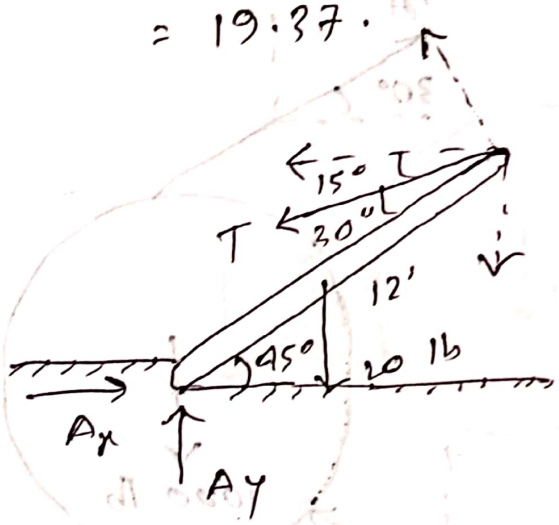
$R_A \sin 45° - T \sin 15° - 20 = 0$

$1.37\,T \sin 45° - T \sin 15° - 20 = 0$

$\therefore T = 14.14$

$R_A = 1.37\,T$

$= 19.37$



$\Sigma M_A = 0$

$-T \sin 30° \times 12 + 20 \times 6 \cos 45° = 0$

$T = 14.14$ lb

$\Sigma F_y = 0$

$A_y - 20\text{ lb} - T \sin 15° = 0$

$A_y = 20 + 14.14 \sin 15°$

$= 23.66$ lb

$\Sigma F_x = 0$

$A_x - T \cos 15° = 0$

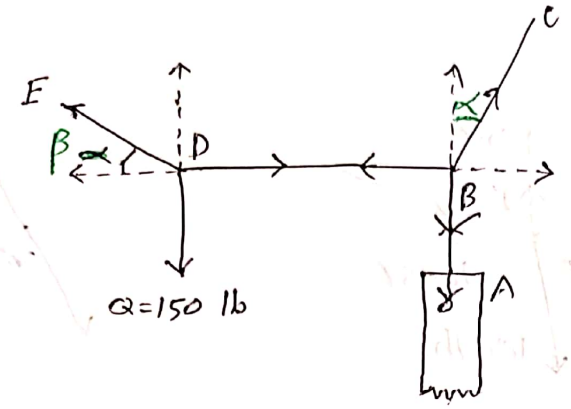
$A_x = 14.14 \cos 15°$

$= 13.66$ lb

$A = \sqrt{(13.66)^2 + (23.66)^2}$

$= 27.32$ lb

9



For D,

$\Sigma F_y = 0$

$T_{DE} \sin(0.1)^{ned} - 150 \text{ lb} = 0$

$T_{DE} = 1502.50 \text{ lb}$

$\Sigma F_x = 0$

$T_{DE} \cos(0.1)^{ned} - T_{DB} = 0$

$T_{DB} = 1495 \text{ lb}$

For, B,

$\Sigma F_x = 0$

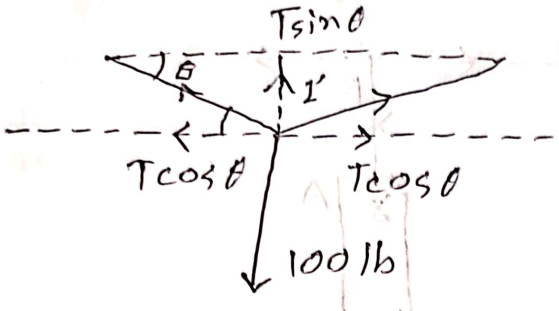
$T_{BC} \sin(0.1)^{ned} - 1495 \text{ lb} = 0$

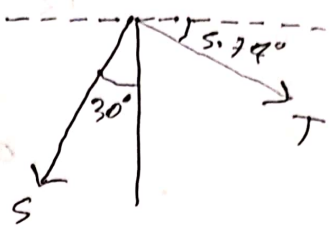
$T_{BC} = 14975 \text{ lb}$

$\Sigma F_y = 0$

$T_{BC} \cos(0.1)^{c} - T_{BA} = 0$

$T_{BA} = 14900 \text{ lb}$





$\sin\theta = \frac{1'}{10'}$

$\theta = 5.74°$

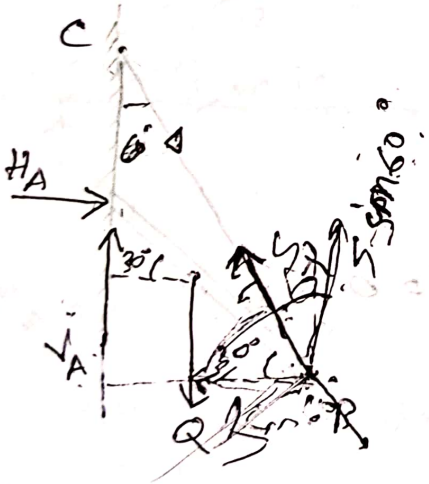
$\Sigma F_y = 0$

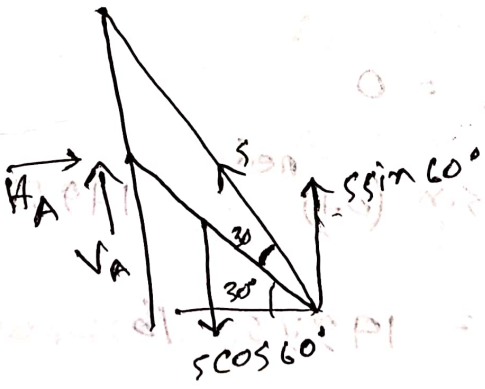
$T\sin 5.74° + T\sin 5.74° - 100 = 0$

$T = 500$ lb

$5\sin 30° - T\cos 5.74° = 0$

$S = 994.98$ lb





$\Sigma M_A = 0$

$Q \times \frac{1}{2}\cos 30° + 5\times\cos 60° \times 1\sin 30° - 5\sin 60° \times 1\cos 30° = 0$

$S = \sqrt{3}$ tons.

~~12~~

$\Sigma F_x = 0$

$H_A - 5\cos 60° = 0$

$H_A = \frac{\sqrt{3}}{2}$

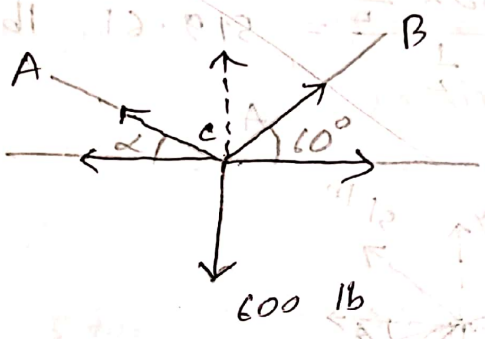
$\Sigma F_y = 0$

$V_A - Q + 5\sin 60° = 0$

$V_A = 2 - \frac{\sqrt{3} \times \sqrt{3}}{2} = 0.5$

$F_A = \sqrt{\frac{3}{4} - \frac{1}{4}} = 0.7071$ tons.

13



a)

$\Sigma F_x = 0$

$T_{AC}\cos\alpha - T_{BC}\cos 60° = 0$

$T_{BC} = \frac{T_{AC}\cos\alpha}{\cos 60°}$ ——— (1)

$\Sigma F_y = 0$

$T_{AC}\sin\alpha + T_{BC}\sin 60° - 600 = 0$

$T_{AC}\sin\alpha + T_{AC}\cos\alpha \tan 60° = 600$

$T_{AC}\left(\sin\alpha\cos 60° + \cos\alpha\sin 60°\right) = 600\cos 60°$

$T_{AC} = \frac{600\cos 60°}{\sin(\alpha + 60°)}$

Now,

When $(\alpha + 60°) = 90°$ the tension will be minimum.

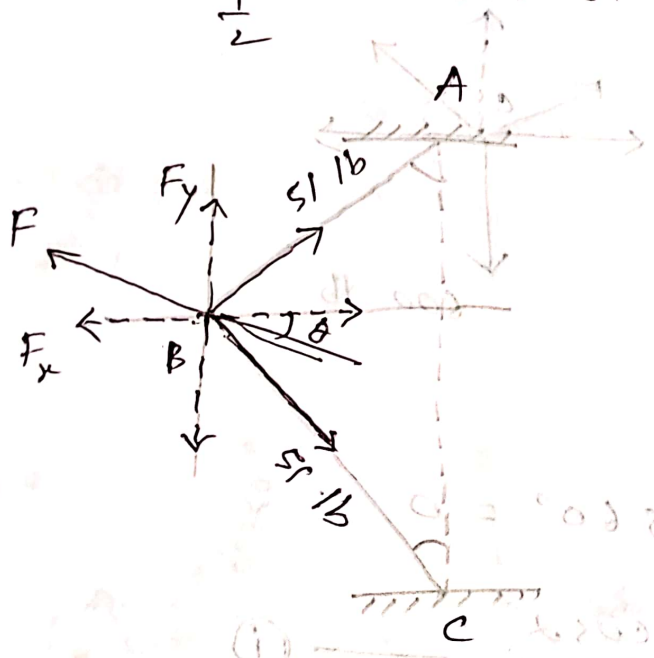
$\alpha + 60° = 90°$

$\alpha = 30°$

b)

$$T_{AC} = \frac{600 \times \frac{1}{2}}{\sin 90°} = 300 \text{ lb}$$

$$T_{BC} = \frac{300 \times \frac{\sqrt{3}}{2}}{\frac{1}{2}} = 519.61 \text{ lb}$$



$\Sigma F_x = 0$

$-F\cos\theta + T_{BA}\cos 45° + T_{BC}\sin 30° = 0$

$F\cos\theta = 6.035$ lb

$\Sigma F_y = 0$

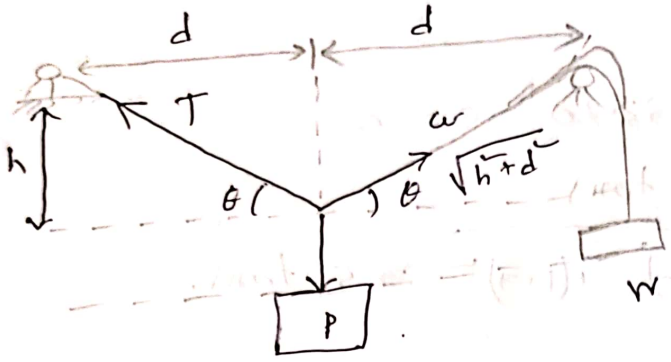
$F\sin\theta + T_{AB}\sin 45° - T_{BC}\cos 30° = 0$

$F\sin\theta = 0.8$

$F = 6.09$ lb

$\theta = \tan^{-1}\frac{0.8}{6.04}$

$= 7.57°$



$\Sigma F_x = 0$

$w\cos\theta - T\cos\theta = 0$

$w = T$

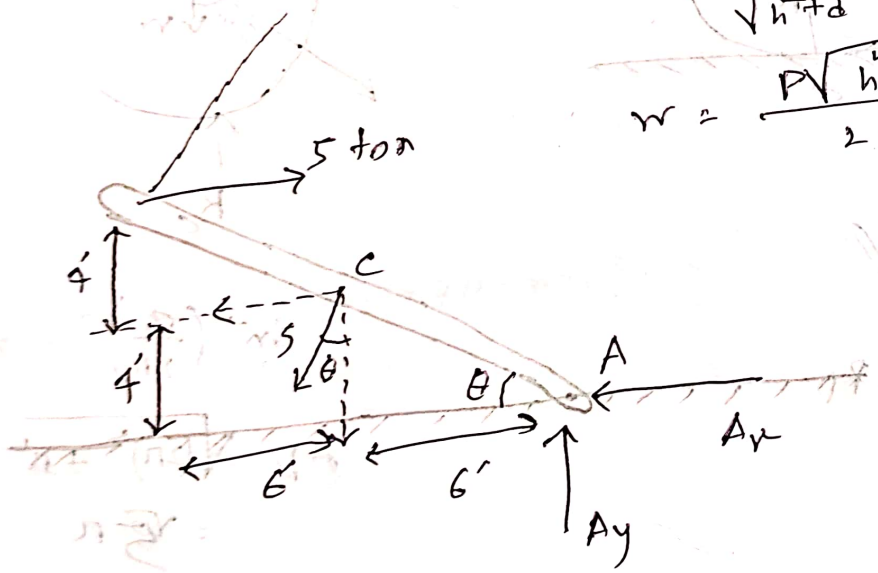
$\Sigma F_y = 0$

$T\sin\theta + w\sin\theta - P = 0$

$2w\sin\theta = P$

$2w \dfrac{h}{\sqrt{h^2+d^2}} = P$

$w = \dfrac{P\sqrt{h^2+d^2}}{2h}$



$\theta = \tan^{-1}\dfrac{4}{6}$

$= 33.70$

$\Sigma M_A = 0$

$5 \times 8 - S \times \left(\sqrt{6^2+4^2}\right) = 0$

$S = 5.547$ tons

$\Sigma F_y = 0$

$A_y - 5\cos\theta = 0$

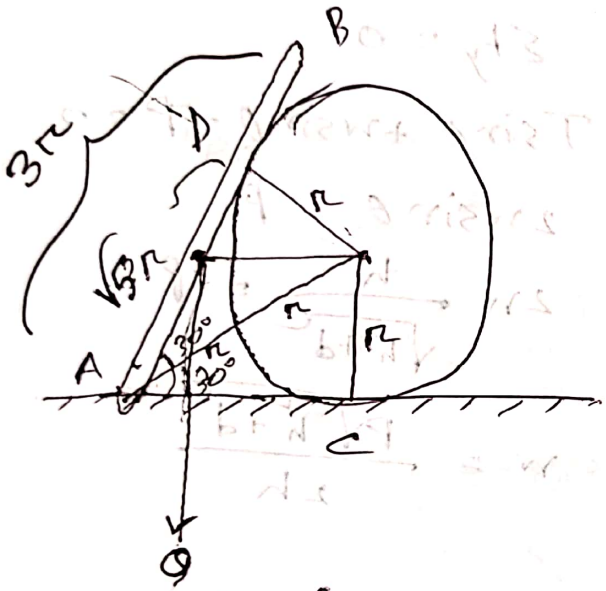
$A_y = 4.62$ tons

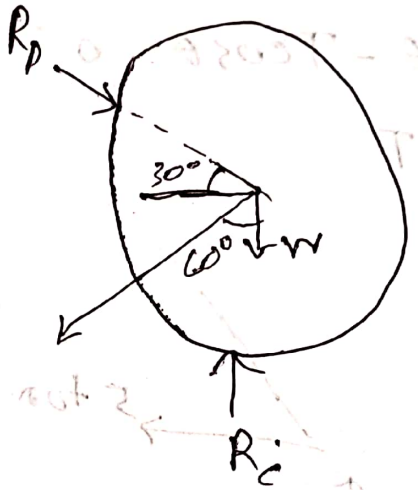
$\Sigma F_x = 0$

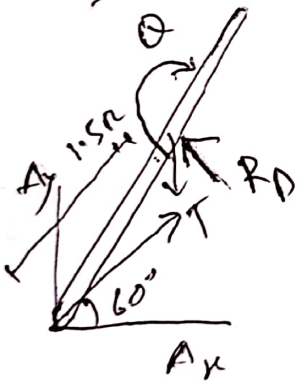
$A_x + 5 \sin 33.70 - 5 = 0$

$A_x = 1.9$ tons

$F_A = \sqrt{(4.62)^2 + (1.9)^2} = 5$ tons.







$\sin^{-1}\left(\frac{r}{2r}\right) = 30°$

$AD = \sqrt{(2r)^2 + r^2}$

$= \sqrt{5}\, r$

$\Sigma M_A = 0$

$R_D \times \sqrt{3}r - 1.5r \cos 60° \times Q = 0$

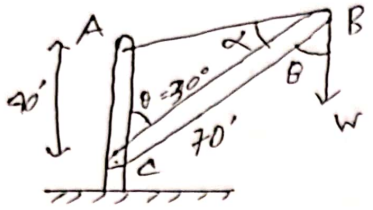
$R_D = \frac{\sqrt{3}}{4} Q$

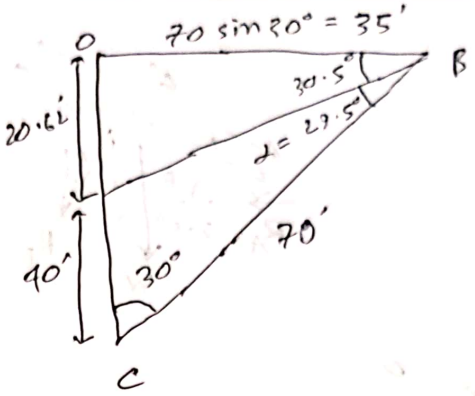
$\Sigma F_x = 0$

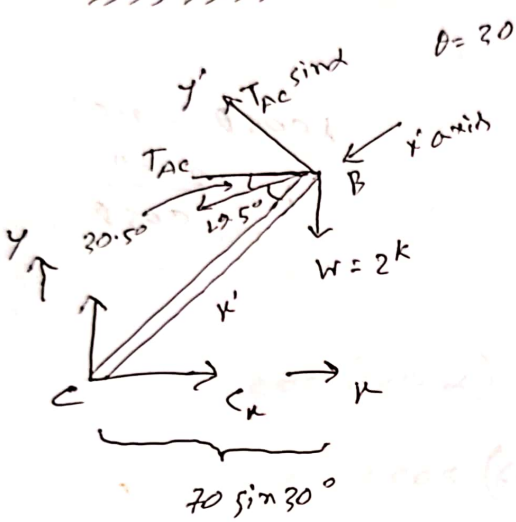
$T \sin 60° - R_D \cos 30° = 0$

$T =$

19







$\Sigma M_C = 0$

$-T_{AC} \sin\alpha \cdot 70 + W \times 70 \sin 30° = 0$

$T_{AC} =$

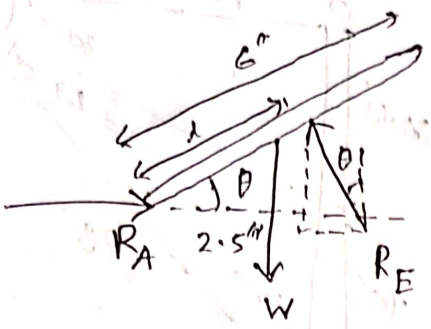
$\Sigma F_x = 0$

$C_x = T_{AC} \cos\beta =$

$\Sigma F_y = 0$

$-T_{AC} \sin\beta - 2 + C_y = 0$

$C_y =$



$l\cos\theta = 2.5''$

$l = \frac{2.5''}{\cos\theta}$

$\Sigma F_x = 0$

$R_A - R_E \sin\theta = 0$

$R_A = R_E \sin\theta$ ——— (1)

$\Sigma F_y = 0$

$R_E \cos\theta - W = 0$

$R_E = \frac{W}{\cos\theta}$ ——— (11)

$\Sigma M_p = 0$

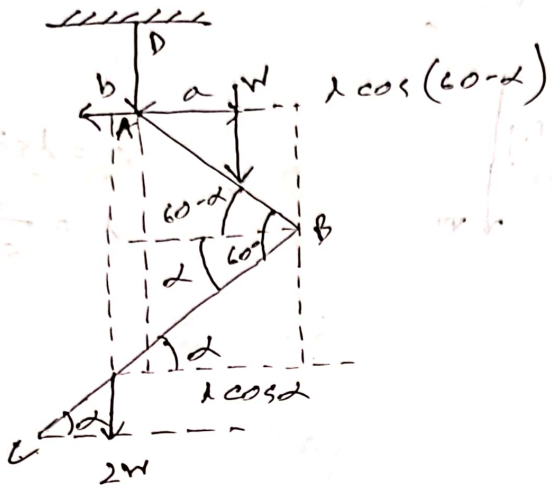
$W \times 3\cos\theta - RE \times l = 0$

$15\cos\theta - \frac{W}{\cos\theta} \times \frac{2.5}{\cos\theta} = 0$

$15\cos^2\theta - 12.5 = 0$

$\theta = 19.85^\circ$

21



$$a = \frac{\lambda}{2}\cos(60°-\alpha)$$

$$b = \lambda\cos\alpha - \lambda\cos(60°-\alpha)$$

$$\Sigma M_A = 0$$

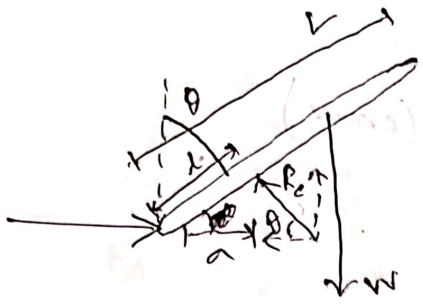
$$W \times a - 2W \times b = 0$$

$$W \times \frac{\lambda}{2}\cos(60°-\alpha) - 2W\left\{\lambda\cos\alpha - \lambda\cos(60°-\alpha)\right\} = 0$$

$$5\lambda\cos(60°-\alpha) - 4\lambda\cos\alpha = 0$$

$$5\cos(60°-\alpha) - 4\cos\alpha = 0$$

$$\alpha = 19.10°$$



$a = l \sin\theta$

$l = \frac{a}{\sin\theta}$

$\Sigma F_y = 0$

$R_c \sin\theta - W = 0$

$R_c = \frac{W}{\sin\theta}$ ——— (1)

$\Sigma M_A = 0$

$W \times \frac{L}{2} \sin\theta - R_c \times l = 0$

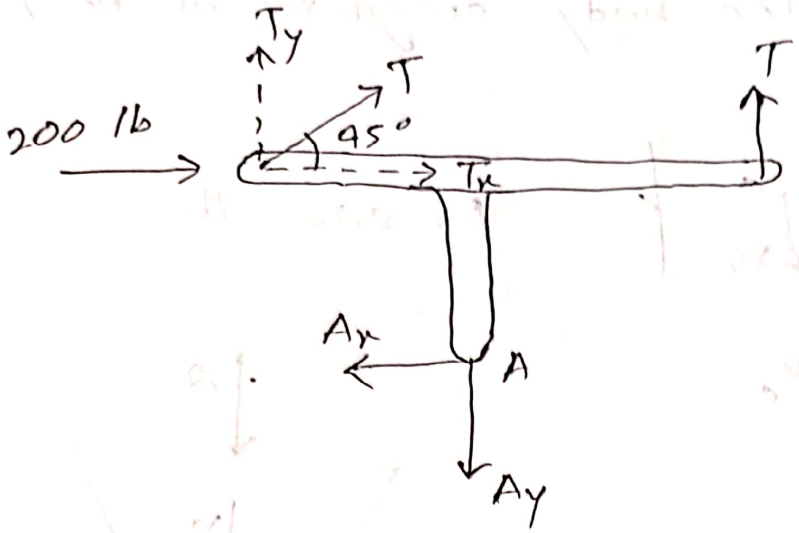
$W \times \frac{L}{2} \sin\theta - \frac{W}{\sin\theta} \times \frac{a}{\sin\theta} = 0$

$\sin^3\theta \times \frac{L}{2} - a = 0$

$\sin^3\theta = \frac{2a}{L}$

$\theta = \sin^{-3} \frac{2a}{L}$

$\theta = \sin^{-1} \sqrt[3]{\frac{2a}{L}}$



$\Sigma M_A = 0$

$200 \times 4 + T_x \times 4 + T_y \times 2 - T \times 6 = 0$

$T_x = T \cos 45°$

$T_y = T \sin 45°$

$200 \times 4 + T\cos 45° \times 4 + T\sin 45° \times 2 - T \times 6 = 0$

$T = 455.23 \text{ lb}$

$\Sigma F_x = 0$

$T\cos 45° + 200 - A_x = 0$

$A_x = 521.89 \text{ lb}$

$\Sigma F_y = 0$

$T + T\sin 45° - A_y = 0$

$A_y = 777.12 \text{ lb}$

$A = \sqrt{A_x^2 + A_y^2}$

$= 936.10 \text{ lb}.$

Consider the free body diagram of body C

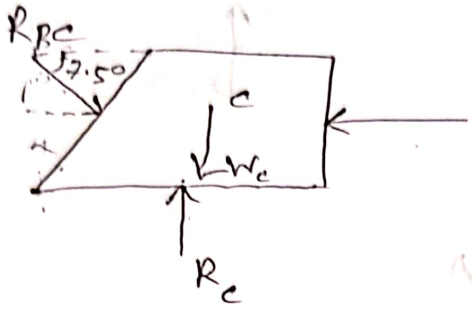


Fig-01

$\Sigma F_x = 0$

$R_{BC} \cos 7.5 - R = 0$

$R_{BC} = 8069.03$ lb

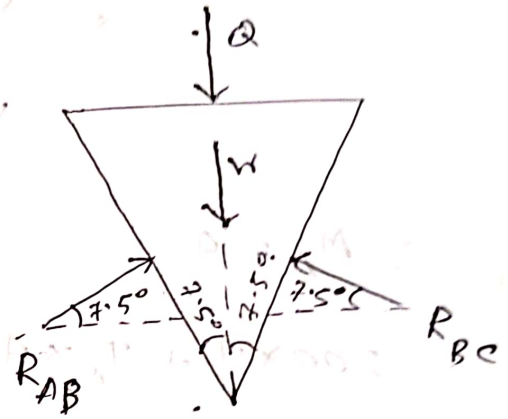


Fig-02

$\Sigma F_x = 0$

$R_{AB} \cos 7.5° - R_{BC} \cos 7.5° = 0$

$R_{AB} = R_{BC}$

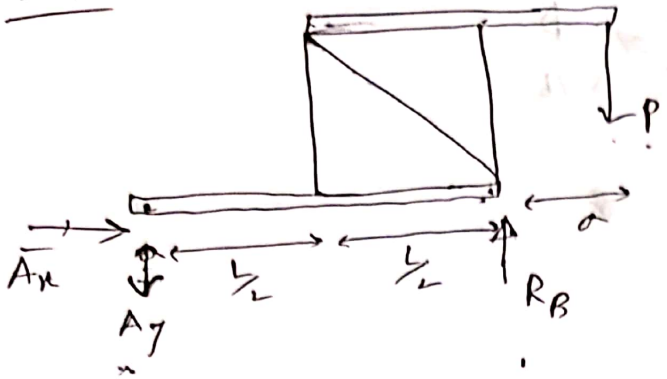
$\Sigma F_y = 0$

$Q + W_B - R_{AB} \sin 7.5° - R_{BC} \sin 7.5° = 0$

$Q = (2 R_{BC} \sin 7.5° - 500)$ lb

$= 1606.93$ lb.

24.



$$\Sigma M_A = 0$$

$$P \times 16 - R_B \times 12 = 0$$

$$R_B = \frac{4P}{3}$$

$$\Sigma F_x = 0$$

$$A_x = 0$$

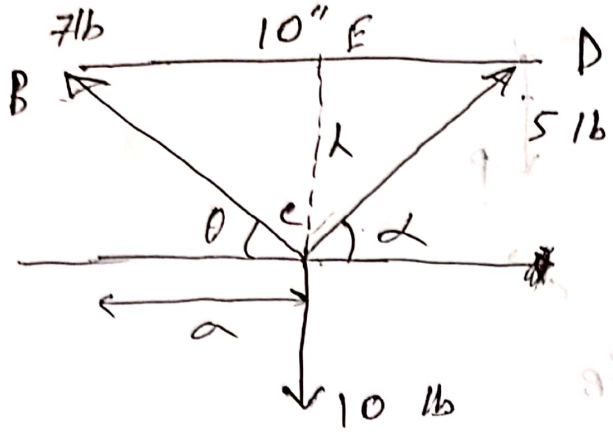
$$\Sigma F_y = 0$$

$$-A_y + R_B - P = 0$$

$$A_y = -P + \frac{4P}{3} = \frac{P}{3}$$

$$R_A = \sqrt{(A_x)^2 + (A_y)^2} = \sqrt{0^2 + \left(\frac{P}{3}\right)^2} = P/3$$

26



$\Sigma F_x = 0$

$5\cos\alpha - 7\cos\theta = 0$

$7\cos\theta = 5\cos\alpha$ ——— (i)

$\Sigma F_y = 0$

$7\sin\theta + 5\sin\alpha - 10 = 0$ ——— (ii)

squaring and adding eqn (i) and (ii) ⇒

$7^2(\sin^2\theta + \cos^2\theta) = 5^2\cos^2\alpha + (100 - 100\sin\alpha + 25\sin^2$

$25\cos^2\alpha + 25\sin^2\alpha - 100\sin\alpha = 49 - 100$

$25 - 100\sin\alpha = -51$

$\sin\alpha = 0.76$

$\alpha = 49.46^\circ$

From eqn (11)

$$\cos\theta = 0.46$$

$$\theta = 62.34^\circ$$

From $\triangle BCE$

$$\frac{h}{a} = \tan\theta$$

$$h = a\tan\theta = a\tan 62.34^\circ = 1.91a$$

From $\triangle CDE$

$$\frac{h}{10-a} = \tan\theta$$

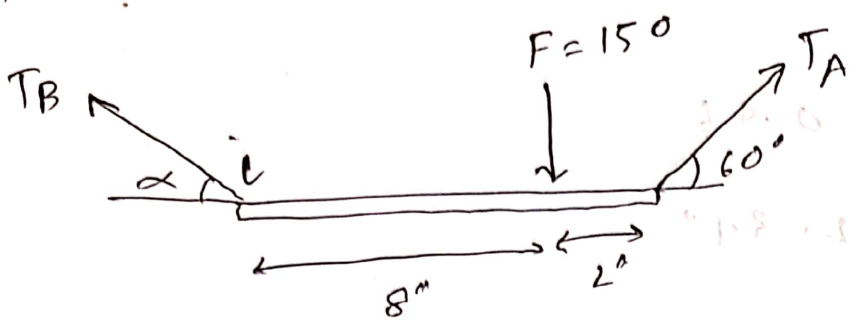
$$h = (10-a)\tan\theta = (10-a)\,1.17$$

$$\therefore \quad 1.91a = (10-a)\,1.17$$

$$3.08a = 10 \times 1.17$$

$$a = 3.8''$$

27/



$\Sigma M_c = 0$

$F \times 8 - T_A \sin 60° \times 10 = 0$

$T_A = 138.56$ lb

$\Sigma F_y = 0$

$T_A \sin 60° + T_B \sin\alpha - F = 0$

$T_B \sin\alpha = 30$ ——— (i)

$\Sigma F_x = 0$

$T_A \cos 60 - T_B \cos\alpha = 0$

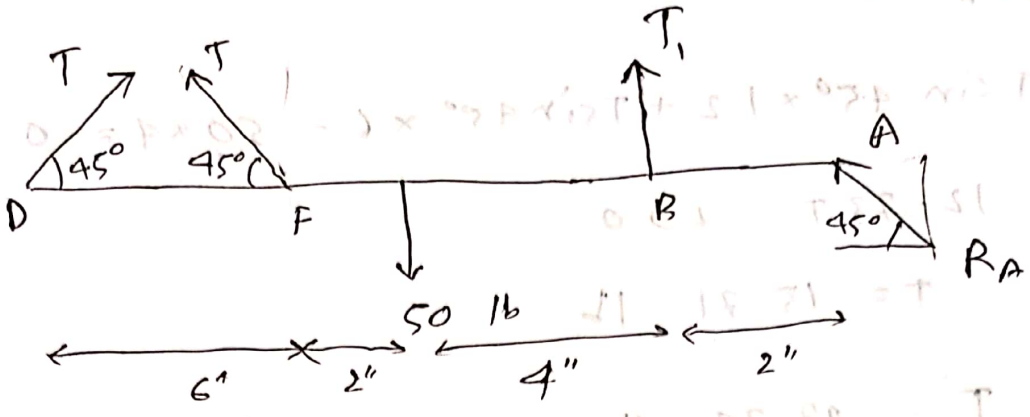
$T_B \cos\alpha = 69.25$ ——— (ii)

squaring and adding

$T_B^2 = 5699.72$

$T_B = 75.5$ lb

$W_B = 75.5$ lb



$\Sigma F_x = 0$

$T\cos 45° - T\cos 45° - R_A \cos 45° = 0$

$R_A = 0$

$\Sigma F_y = 0$

$T\sin 45° + T\sin 45° - 50 + T_1 = 0$

$2\frac{T}{\sqrt{2}} = 50 - T_1$

$T_1 = (50 - \sqrt{2}T)$

$\Sigma M_D = 0$

$-T\sin 45° \times 6 + 50 \times 8 - T_1 \times 12 = 0$

$\frac{T}{\sqrt{2}} 6 + 12T_1 = 400$

$\frac{T}{\sqrt{2}} 6 + 12(50 - \sqrt{2}T) = 400$

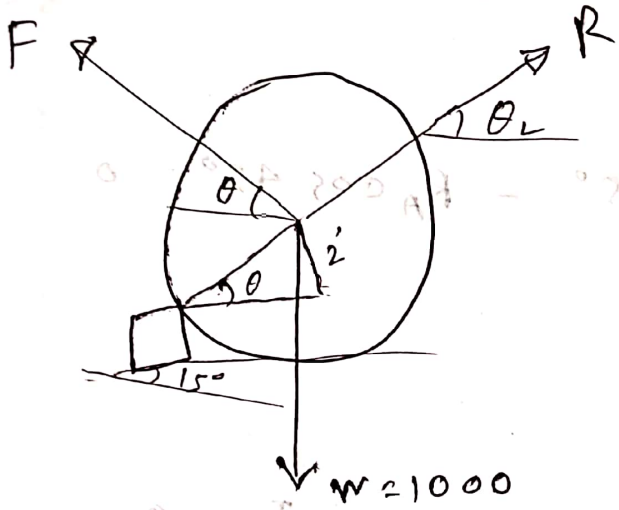
$\Sigma M_B = 0$

$T \sin 45^\circ \times 12 + T \sin 45^\circ \times 6 - 50 \times 4 = 0$

$12.73\,T = 200$

$T = 15.71$ lb

$T_1 = 27.78$ lb



$\theta_1 = \sin^{-1} \frac{2}{3}$

$= 41.81$

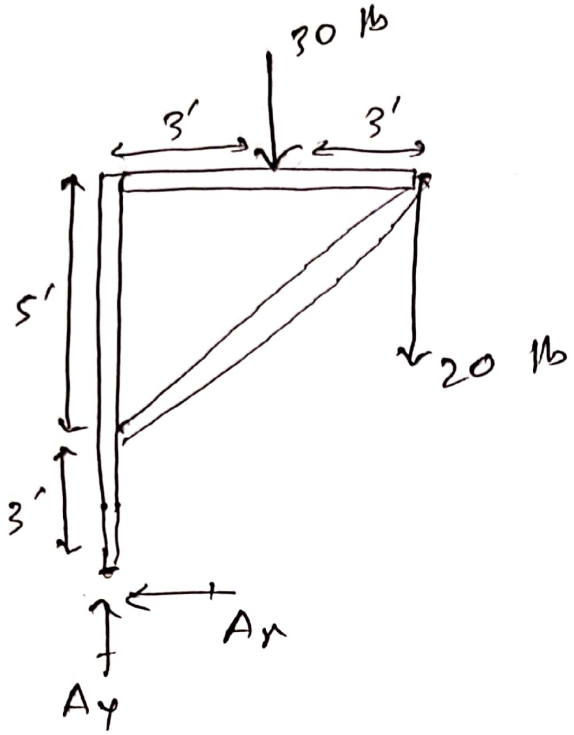
$\theta_2 = 41.81 + 15$

$= 56.81^\circ$

$\Sigma F_x = 0$

$F \cos\theta = R \cos\theta_2$

$F \cos\theta =$



$\Sigma F_x = 0$

$A_x = 0$

$\Sigma F_y = 0$

$A_y - 30 - 20 = 0$

$A_y = 50$

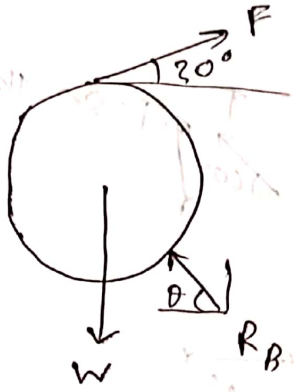
$\Sigma M_A = 0$

$-M_A + 30 \times 3 + 20 \times 6 = 0$

$M_A = 210 \quad lb\,ft$

Reaction, A ; $R_A = \sqrt{A_x^2 + A_y^2} = 50 \; lb$

39



$\theta = \sin^{-1}\frac{2}{3}$

$= 41.81°$

$\Sigma F_x = 0$

$F\cos 30° = R_B \cos 41.81°$

$\therefore F = 0.86\, R_B$

Since the wheel is moving, $R_c = 0$

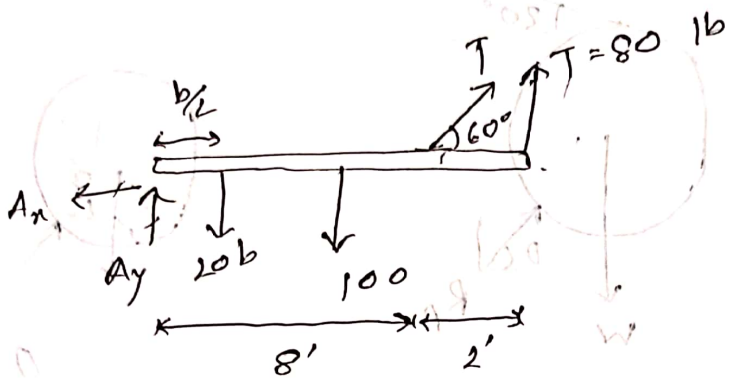
$\Sigma F_y = 0$

$F\sin 30° + R_B \sin 41.81° - W = 0$

$R_B = 455.79$

$\therefore F = 391.98$ lb.

37



$\Sigma F_x = 0$

$T\cos 60° - A_x = 0$

$A_x = 40$ lb

$\Sigma M_A = 0$

$20b \times \frac{b}{2} + 100 \times 5 - 80 \times 8 \sin 60° - 80 \times 10 = 0$

$10 b^2 = 554.26$

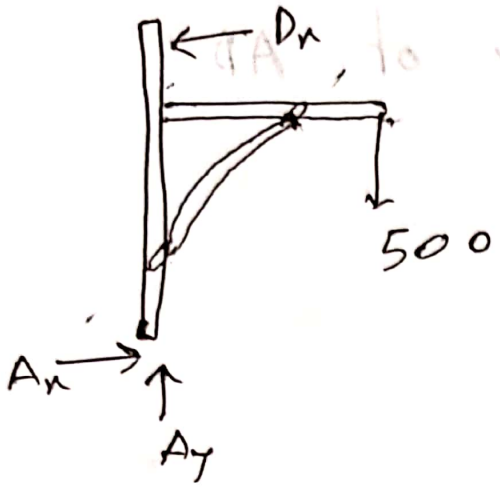
$b = 9.24$ ft

$\Sigma F_y = 0$

$A_y - 20b - 100 + 80 \sin 60° + 80 = 0$

$A_y = 135.57$

$\therefore R_A = \sqrt{A_x^2 + A_y^2} = 141.35$ lb.



$\Sigma M_A = 0$

$500 \times 10 - D_x \times 14 = 0$

$D_x = 357.14$

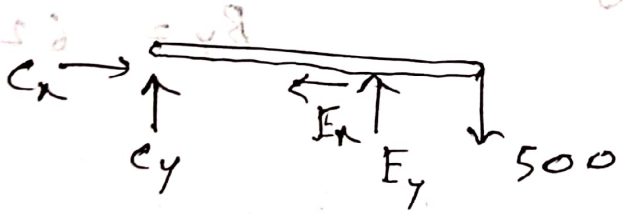
$\Sigma F_x = 0$

$A_x = D_x = 357.14$

$\Sigma F_y = 0$

$A_y = 500$

Consider the free body of CE



$\Sigma M_c = 0$

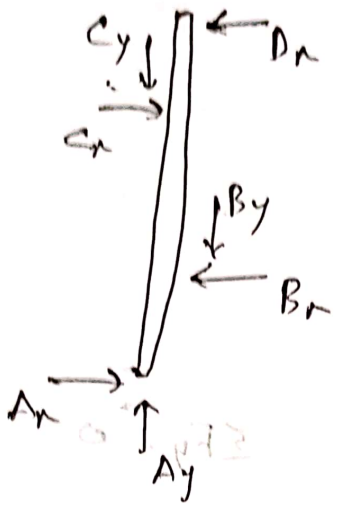
$500 \times 10 - E_y \times 8 = 0$

$E_y = 625$

$\Sigma F_x = 0$

$C_x = E_x$ ——— (1)

Consider the free body of AD.



$\Sigma M_B = 0$

$-A_x \times 4 + C_x \times 8 - D_x \times 10 = 0$

$C_x = 625$

$\Sigma F_x = 0$

$A_x + C_x - B_x - D_x = 0$

$B_x = 625$

$\Sigma F_y = 0$

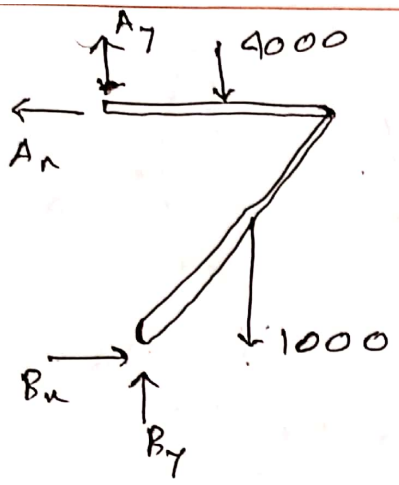
$A_y - B_y - C_y = 0$

$B_y = 625$

$\therefore R_B = \sqrt{B_x^2 + B_y^2} = 883.88$

$R_c = \sqrt{C_x^2 + C_y^2} = 637.38$ lb

42



$\theta = \cos^{-1}\left(\frac{4}{10}\right)$

$= 66.42°$

$\Sigma M_B = 0$

$1000 \times 6\cos 66.42° + 4000 \times 2 - A_x \times 10\sin 66.42° = 0$

$A_x = 1134.77 = 1.13$ kip

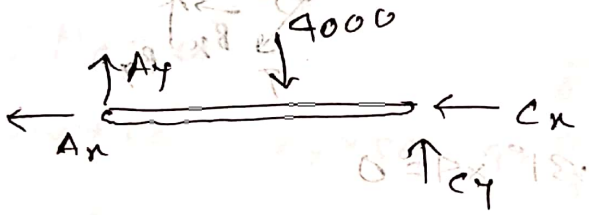
$\Sigma F_x = 0$

$B_x = A_x = 1.13$ kip

$\Sigma F_y = 0$

$A_y + B_y - 4000 - 1000 = 0$

$A_y + B_y = 5000$ — (1)



$\Sigma M_C = 0$

$A_y \times 4 - 4000 \times 2 = 0$

$A_y = 2000$

$\Sigma F_y = 0$

$A_y + C_y - 4000 = 0$

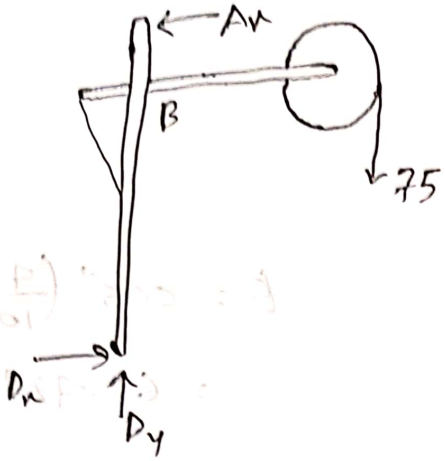
$C_y = 2000$

$\Sigma F_x = 0$

$-A_x - C_x = 0$

$C_x = -1134.77$

$\therefore C_x = 1134.77 (\rightarrow)$



$\Sigma M_B = 0$

$75 \times 12 - A_x \times 15 = 0$

$A_x = 60$

$\Sigma F_x = 0$

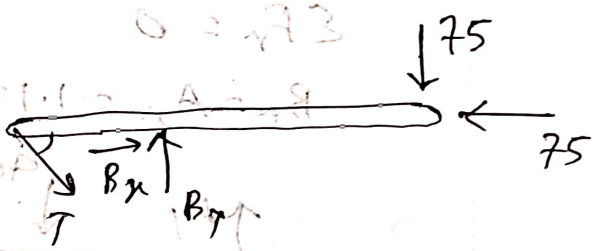
$D_x = 60 = A_x$

$\Sigma F_y = 0$

$D_y = 75$

$\theta = \tan^{-1}\left(\frac{6}{9}\right) = 56.31$

Consider EF



$\Sigma M_B = 0$

$75 \times 10 - T \sin 56.31° \times 9 = 0$

$T = 225.35$

$\Sigma F_x = 0$

$B_x + T \cos 56.31° - 75 = 0$

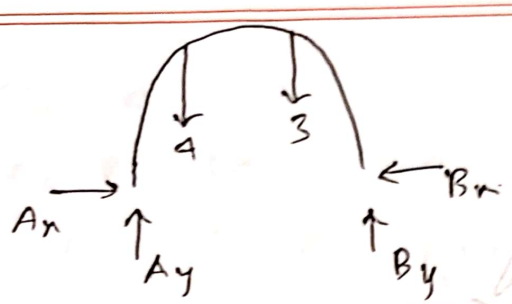
$B_x = 50$

$\Sigma F_x = 0$

$B_y - T \sin 56.31° - 75 = 0$

$B_y = 262.5$ lb.

50



$\Sigma M_A = 0$

$4 \times \frac{100}{3} + 3 \times 75 - B_y \times 100 = 0$

$B_y = 3.58$ tons

$\Sigma F_y = 0$

$A_y + B_y - 3 - 4 = 0$

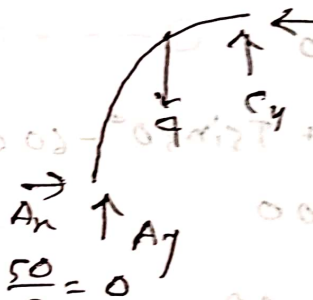
$A_y = 3.42$

$\Sigma F_x = 0$

$A_x - B_x = 0$

$A_x = B_x$ ——— (1)

consider AC,



$\Sigma M_C = 0$

$A_y \times 50 - A_x \times 50 - 4 \times \frac{50}{3} = 0$

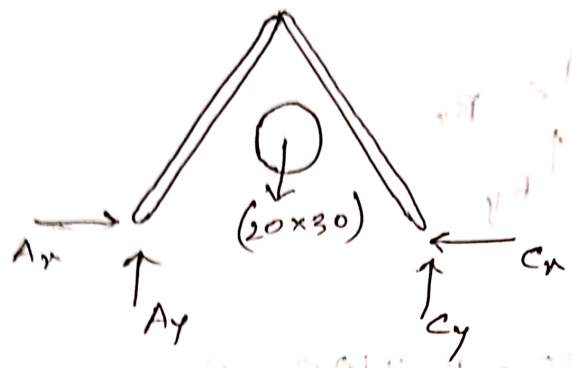
$A_x = 2.087$ tons.

$\therefore B_x = 2.087$ tons.

$R_A = \sqrt{A_x^2 + B_x^2} = 4.01$

$R_B = \sqrt{B_x^2 + B_y^2}$

52.



$\Sigma M_C = 0$

$A_y \times 10 - 600 \times 5 = 0$

$A_y = 300$

$\Sigma F_x = 0$

$A_x = C_x$ —— (1)

$\Sigma F_y = 0$

$A_y + C_y - 600 = 0$

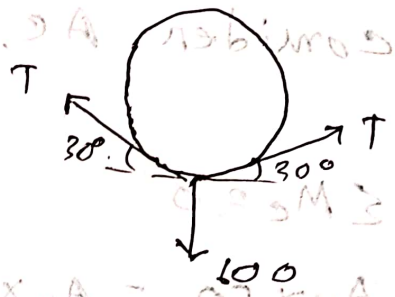
$A_y + C_y = 600$

$C_y = 300$

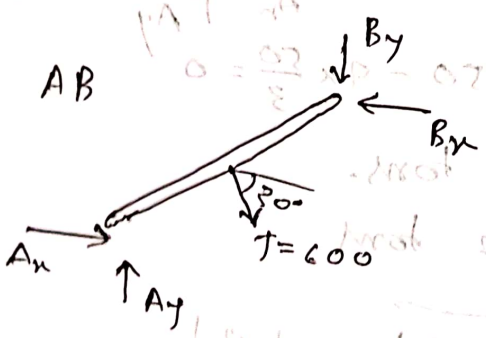
$\Sigma F_y = 0$

$T \sin 30° + T \sin 30° - 600 = 0$

$T = 600$



Consider AB



$\Sigma M_B = 0$

$A_y \times 5 - A_x \times \sqrt{10 - 5} = 0$

$A_x = 173.2$

$\therefore C_x = 173.2$

$\Sigma F_x = 0$

$A_x - B_x + T\cos 30° = 0$

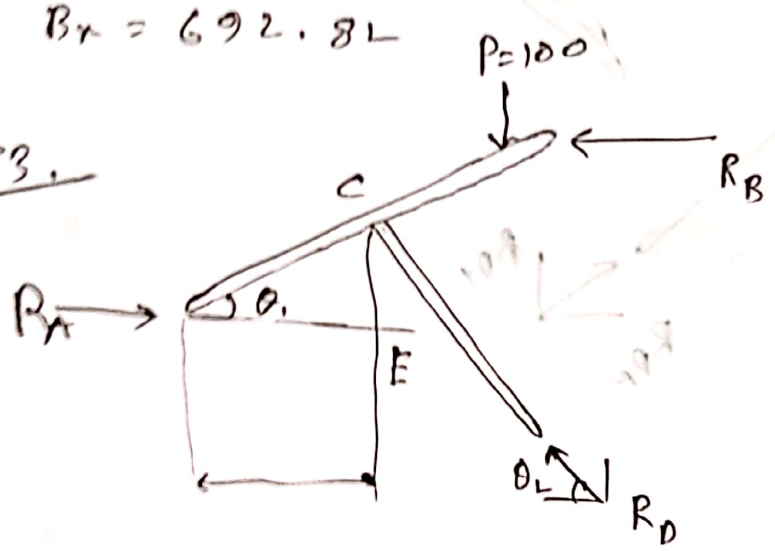
$B_x = 692.8L$

$\Sigma F_y = 0$

$A_y - B_y - T\sin 30° = 0$

$B_y = 0$

53.



$\theta_1 = \tan^{-1}\frac{5}{12}$

$= 33.69°$

$CE = 4\tan 33.69°$

$= 2.67$

$\theta_2 = \tan^{-1}\frac{6.67}{8}$

$= 39.8L$

$\Sigma M_C = 0$

$100\times 2 - R_A \times 2.67 - R_B \times 5.33 = 0$

$2.67R_A + 5.33R_B = 600$ ——— (1)

$\Sigma M_D = 0$

$R_A \times 4 - 100\times 2 - R_B \times 12 = 0$

$R_A - 3R_B = 50$ ——— (II)

$\therefore R_A = 154.9$ $R_B = 34.97$

$\Sigma F_y = 0$

$R_{Dy} - 100 = 0$

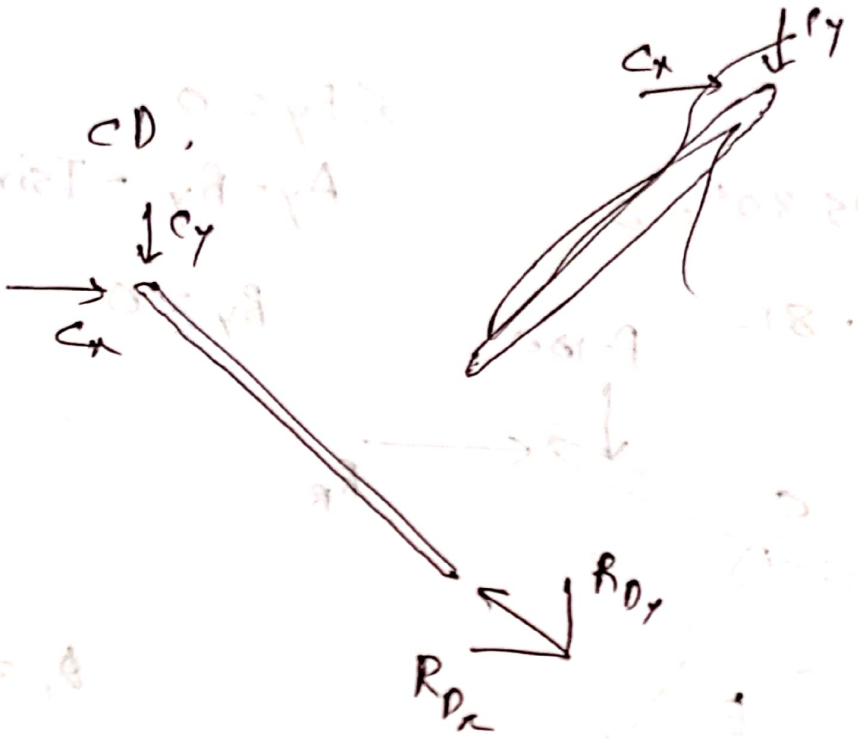
$R_{Dy} = 100$

$\Sigma F_x = 0$

$R_A - R_B - R_{Dx} = 0$

$R_{Dx} = 119.93$

Consider CD.



$\Sigma F_x = 0$

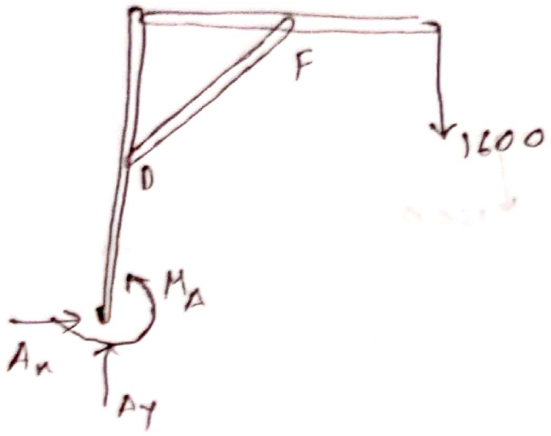
$C_x - R_{Dx} = 0$

$C_x = R_{Dx} = 119.93$

$\Sigma F_y = 0$

$R_{Dy} - C_y = 0$

$C_y = R_{Dy} = 100$



$\Sigma M_A = 0$

$-M_A + 1600 \times 6 = 0$

$M_A = 9600$ lb ft

$\Sigma F_x = 0$

$A_x = 0$

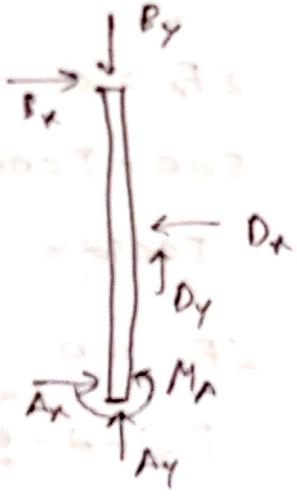
$\Sigma F_y = 0$

$A_y - 1600 = 0$

$A_y = 1600$

$\therefore$ Reaction of A, $= R_A = \sqrt{A_x^2 + A_y^2} = 1600$

Consider AB



$\Sigma M_B = 0$

$A_x \times 8 - D_x \times 3 + M_A = 0$

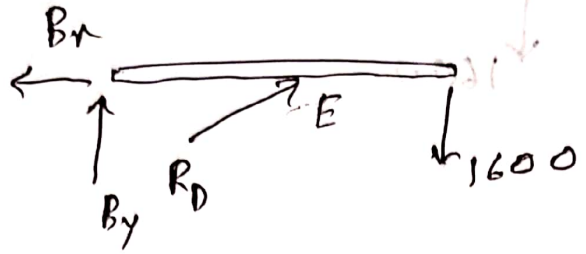
$\therefore D_A = \frac{M_A}{3} = 3200$

$\Sigma F_y = 0$

$A_y + D_y - B_y = 0$

$B_y - D_y = 1600$

Consider. BC



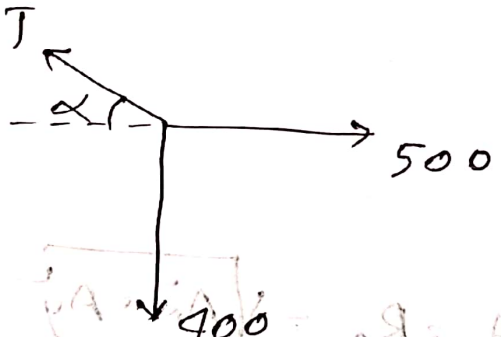
$\Sigma M_E = 0$

$1600 \times 3 + B_y \times 3 = 0$

$B_y = -1600$

$\therefore D_y = 3200 \ (\downarrow)$

69.



$\Sigma F_x = 0$

$500 - T\cos\alpha = 0$

$T\cos\alpha = 500$

$\Sigma F_y = 0$

$T\sin\alpha - 400 = 0$

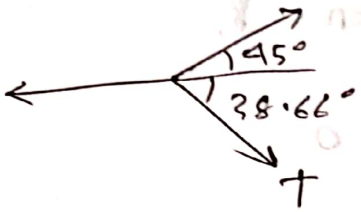
$T\sin\alpha = 400$

$T^2 = 500^2 + 400^2$

$T = 640.31$

$\tan\alpha = \frac{400}{500}$

$\alpha = 38.66°$

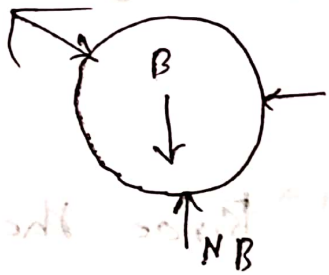


$\Sigma F_y = 0$

$T_{BC} \sin 45° - T \sin 38.66° = 0$

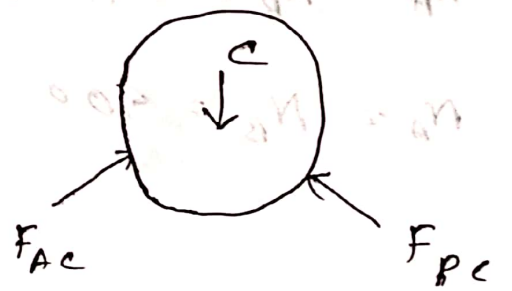
$T_{BC} = 565.69$ lb.

68.



$\theta = \cos^{-1} \frac{.85}{.95}$

$= 38.94°$



Consider C,

$\Sigma F_x = 0$

$F_{AC} \cos 38.94° - F_{BC} \cos 38.94° = 0$

$\therefore F_{AC} = F_{BC}$

$\Sigma F_y = 0$

$F_{AC} \sin 38.94° + F_{BC} \ 38.94° - 400 = 0$

$F_{AC} = F_{BC} = 318.21 \ kg$

Consider B,

$\Sigma F_x = 0$

$F_{BC} \cos 38.94° - R_B = 0$

$R_B = 247.51 \ kg$

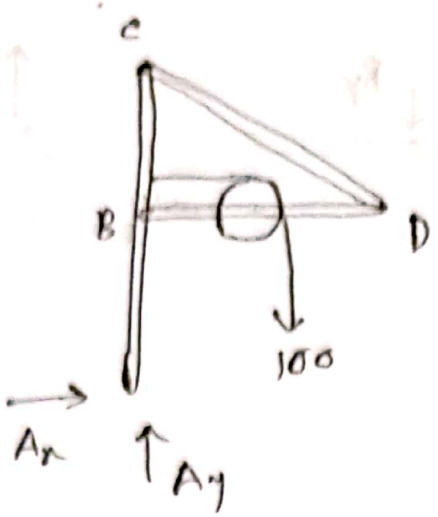
$\Sigma F_y = 0$

$N_B - 200 - F_{BC} \sin 38.94° = 0$

$N_B = 400 \ kg$

$\therefore R_A = R_B = 247.51 \ kg$ [Since the cylinder A and B are identical]

$N_A = N_B = 400 \ kg$



$\Sigma F_x = 0$

$A_x = 0$

$\Sigma F_y = 0$

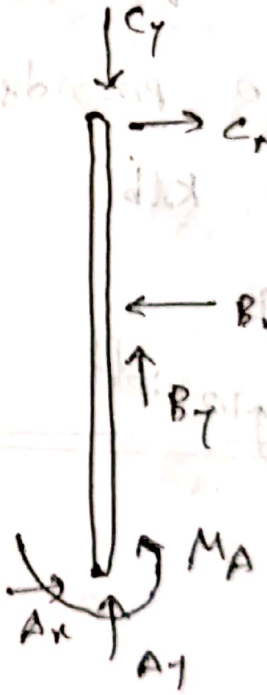
$A_y = 100$ lb

$\Sigma M_A = 0$

$-M_A + 100 \times 9 = 0$

$M_A = 900$

Consider A'C



$\Sigma M_B = 0$

$C_x \times 5 - A_x \times 6 - M_A + 100 \times 1 = 0$

$C_x = 60$ lb

$\Sigma F_x = 0$

$C_x - B_x + A_x = 0$

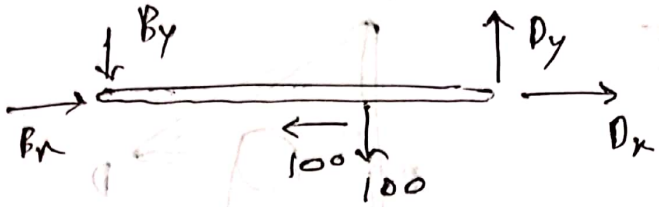
$C_x = B_x = 60$ lb

$\Sigma F_y = 0$

$A_y + B_y - C_y = 0$

$C_y = 100 + B_y$

Comider BD



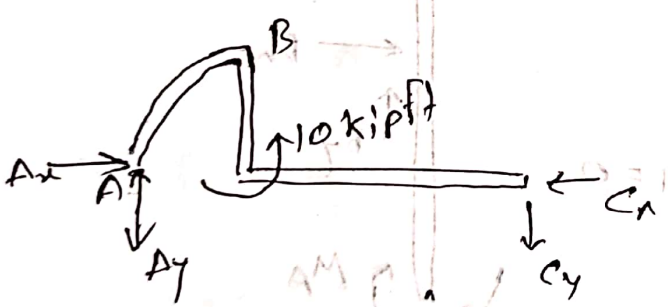
$\Sigma M_D = 0$

$-B_y \times 5 - 100 \times 2 = 0$

$B_y = -40$

$c_y = 100 - 40 = 60$

kip is a US castomary untill of fonce. It equals 100 pounds-fonce. It symbols kip, on less fnequently klb



$\Sigma M_A = 0$

$-c_y \times 6 - 10 = 0$

$c_y = -1.67$ kip

$\Sigma F_x = 0$

$A_x - c_x = 0$

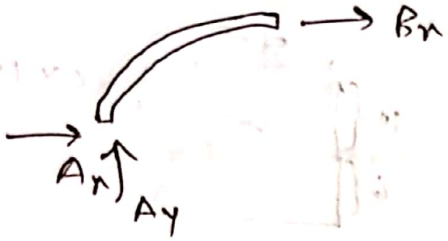
$A_x = c_n$

$\Sigma F_y = 0$

$A_y + c_y = 0$

$A_y = -c_y$

$= 1.67$ kip

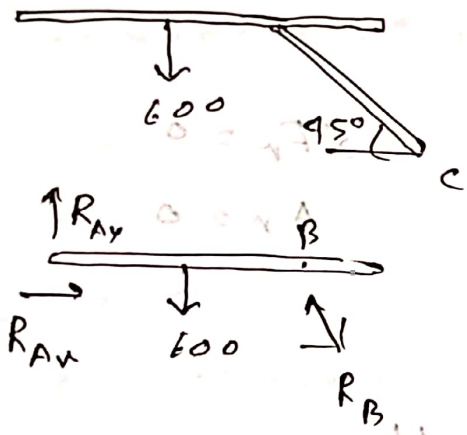


$\Sigma M_B = 0$

$A_y \times 2 - A_x \times L = 0$

$A_x = 1.67$ kip

$C_x = 1.67$ kip



$\Sigma F_x = 0$

$R_{Ax} - R_B \cos 45° = 0$

$R_{Ax} = 300$

$\Sigma M_A = 0$

$600 \times 4 - R_B \sin 45° \times 8 = 0$

$R_B = 424.26$ lb

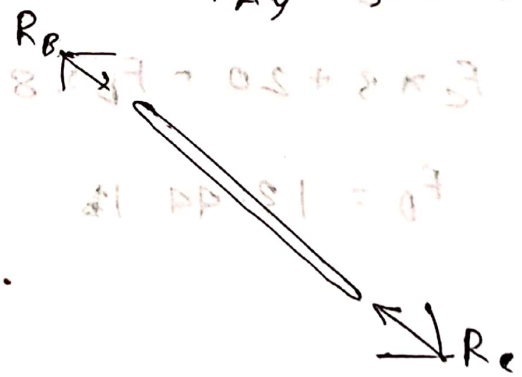
$\Sigma F_y = 0$

$R_{Ay} + R_B \sin 45° - 600 = 0$

$R_{Ay} = 300$ lb

$\therefore R_A = \sqrt{300^2 + 300^2}$

$= 424.26$ lb



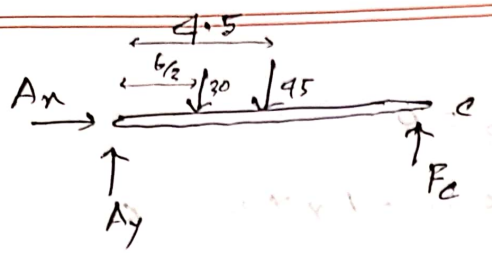
$\Sigma F_x = 0$

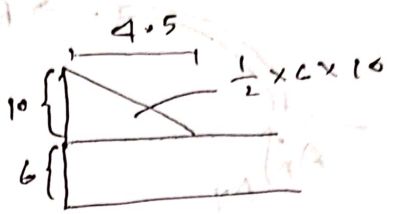
$R_B \cos 45° - R_c \cos 45°$

$\therefore R_B = R_c = 424.26$ lb

(*)

75





$\Sigma M_A = 0$

$\frac{6}{3} \times \left(\frac{1}{2} \times 10 \times 2\right) + 45 \times 4.5 - F_c \times 9 = 0$

$F_c = 29.1\ lb$

$\Sigma F_y = 0$

$A_y - 30 - 45 + F_c = 0$

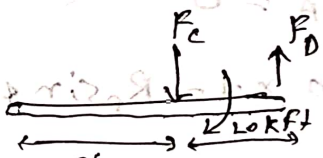
$A_y = 45.8$

$\Sigma F_x = 0$

$A_x = 0$

$R_A = \sqrt{A_x^2 + A_y^2} = 45.8\ lb$

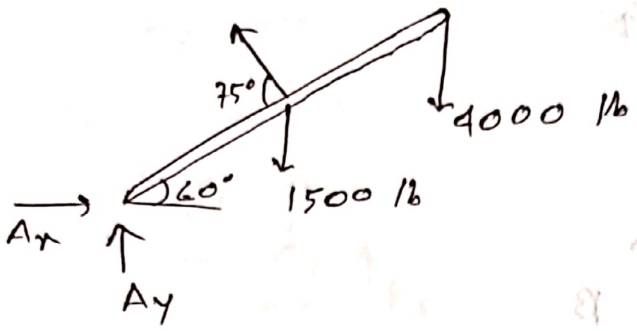
Comider BD,



$\Sigma M_B = 0$

$F_c \times 3 + 20 - F_D \times 8 = 0$

$F_D = 13.44\ lb$



$\Sigma M_A = 0$

$1500 \times 25\cos 60° + 4000 \times 50\cos 60° - 2T\cos 75 \times 35 = 0$

$T =$

$\Sigma F_x = 0$

$A_x - 2T\cos 15° = 0$

$A_x =$

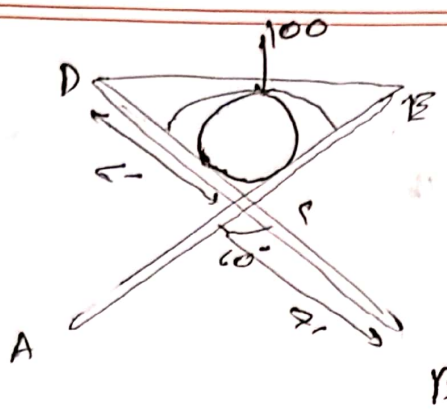
$\Sigma F_y = 0$

$A_y - 1500 - 4000 + 2T\sin 15° = 0$

$A_y =$

$\therefore R_A = \sqrt{A_x^2 + A_y^2}$

81.



$\Sigma M_A = 0$

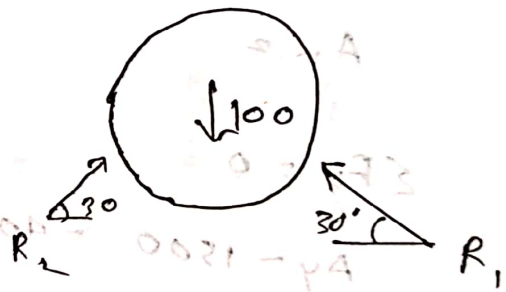
$100 \times 4\cos 60° - R_B \times 2 \times 4\cos 60° = 0$

$R_B = 50$ lb

$\Sigma F_y = 0$

$R_A + R_B - 100 = 0$

$R_A = 50$ lb



$\Sigma F_x = 0$

$R_2 \cos 30 - R_1 \cos 30° = 0$

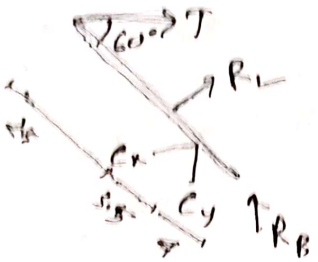
$R_1 = R_2$

$\Sigma F_y = 0$

$R_2 \sin 30° + R_1 \sin 30° - 100 = 0$

$R_1 = 100$ lb

$R_2 = 100$ lb

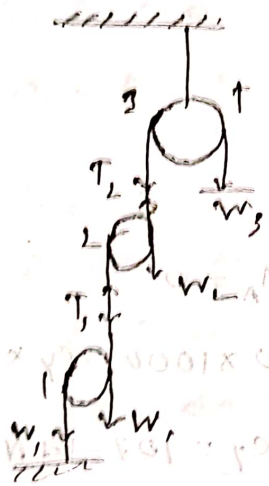


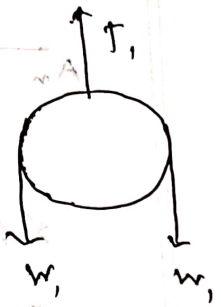
$\Sigma M_c = 0$

$T \sin 60 \times 6 - R_L \times 3.5 - R_B \sin 70° \times 4 = 0$

$T = 86.6$ lb

88

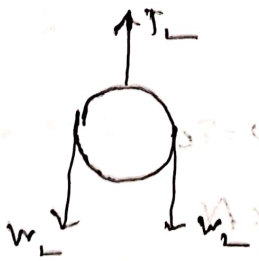




$\Sigma F_y = 0$

$T_1 - W_1 - W_1 = 0$

$T_1 = 2W_1 = 20$ lb $= W_2$



$\Sigma F_y = 0$

$W_2 + W_2 - T_2 = 0$

$T_2 = 2 \times 40 = 80$ lb

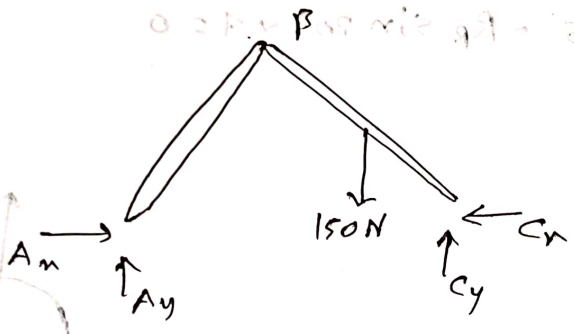
$T_L = W_3 = 40$ lb

$\Sigma F_y = 0$

$T - W_3 - T_L = 0$

$T = T_L + W_3 = 40 + 40 = 80$ lb

107



$\Sigma M_B = 0$

$A_y \times 400 - A_x \times 500 = 0$

$A_x = 0.8 A_y$

$\Sigma F_y = 0$

$A_y + C_y - 1500 = 0$

$A_y = 42.86$ N

$A_x = 34.288$ N $= C_x$

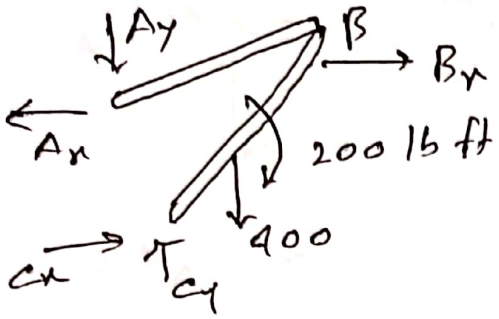
$R_A = 54.89$ N

$R_C = \sqrt{C_x^2 + C_y^2} = 112.49$ N

$\Sigma M_A = 0$

$150 \times 1000 - C_y \times 1400 = 0$

$C_y = 107.14$ N



$\Sigma M_c = 0$

$400 \times 9 - A_x \times 18 + 200 = 0$

$A_x = 211.11$ lb

$\Sigma F_x = 0$

$C_x - A_x = 0$

$C_x = A_x = 211.11$ lb

$\Sigma F_y = 0$

$C_y - A_y - 400 = 0$

$C_y - A_y = 400$

$\Sigma M_B = 0$

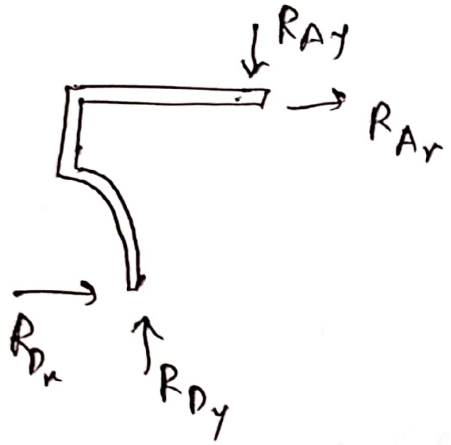
$A_x \times 6 - A_y \times 18 = 0$

$A_y = 70.37$

$C_y = 400 + 70.37$ lb

$R_A = \sqrt{A_x^2 + A_y^2} = 222.53$ lb

$R_c = \sqrt{C_x^2 + C_y^2} = 515.573$ lb



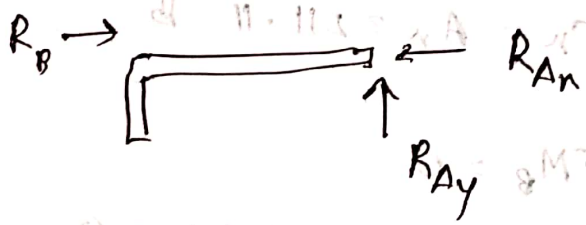
$\Sigma F_x = 0$

$R_{Ax} = R_{Dx}$

$\Sigma F_y = 0$

$R_{Dy} - R_{Ay} - 300 = 0$

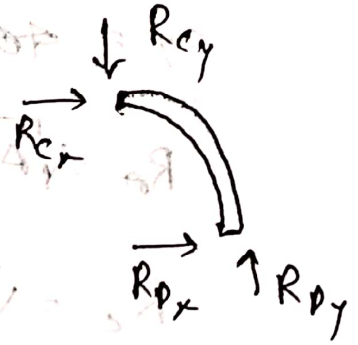
$R_{Dy} = R_{Ay} + 300$



$\Sigma M_B = 0$

$300 \times 400 - R_{Ay} \times 1200 = 0$

$R_{Ay} = 150\,N = R_{Dy}$



$\Sigma F_x = 0$

$R_{cx} = -R_{Dx}$

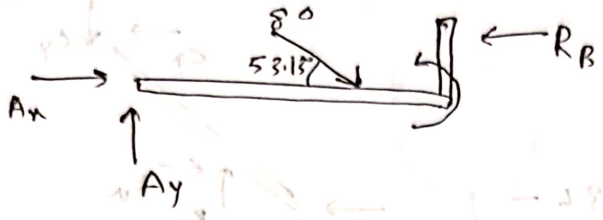
$\Sigma F_y = 0$; $R_{Dy} = R_{cy} = 150$

$\Sigma M_D = 0$; $R_{cx} \times 600 - R_{cy} \times 600 = 0$

$R_{cx} = -R_{cy} = -150$

$\therefore R_A = 212.13\,N$ $\therefore R_c = 212.13$

102



$\Sigma M_A = 0$

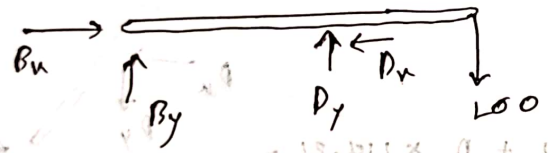
$80 \sin 53.13 \times 2 - 40 - R_B \times 0.6 = 0$

$0.6 R_B = 88$

$R_B = 146.67$ lb

Right surface of the groove hoards this rollen against.

113



$\Sigma M_B = 0$

$200 \times 828.72 - D_y \times 428.72 = 0$

$D_y = 386.6$

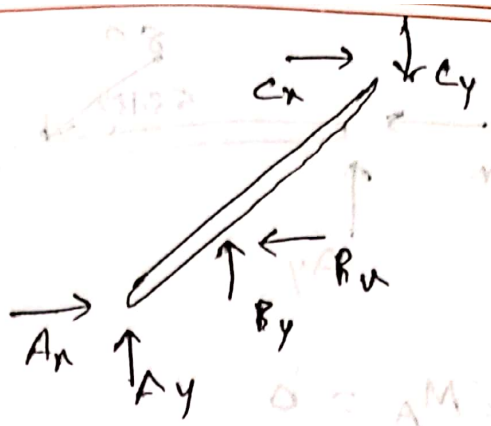
$\Sigma F_y = 0$

$D_y - B_y - 200 = 0$

$B_y = 186.6$ N

$\Sigma F_x = 0$

$D_x = B_x$



$\Sigma M_C = 0$

$B_x \times 800 + B_y \times 214.36 - A_x \times 1600 - A_y \times 428.72 = 0$

$B_x - 2A_x = 26.8$

$\Sigma F_x = 0$

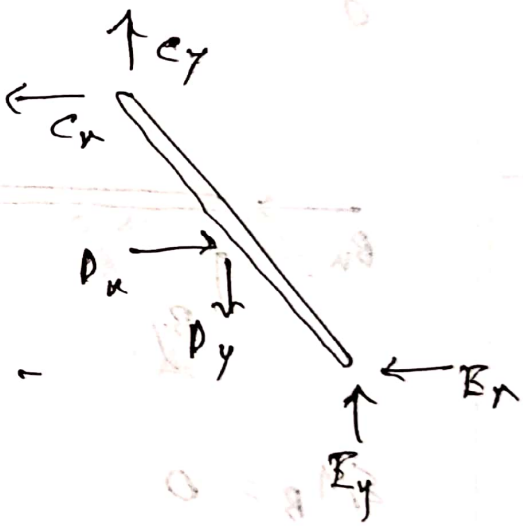
$A_x + C_y - B_x = 0$

$\Sigma F_y = 0$

$A_y + C_y - B_y$

$C_y = 193.3\ N$

~~$\Sigma f_y = 0$~~

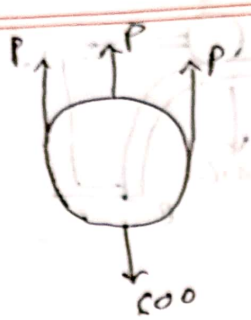


$\Sigma M_C = 0$

$E_x \times 1600 - E_y \times 425.72 + D_y \times 214.36 - D_x \times 800 = 0$

$-B_x + 2A_x = 26.8$

140



$\Sigma F_y = 0$

$3P - 600 = 0$

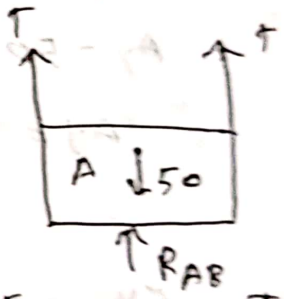
$P = 200$

$\Sigma F_y = 0$

$T - P - P = 0$

$T = 400$

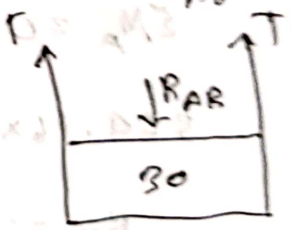
145



$\Sigma F_y = 0$

$T + T + 50 + R_{AB} = 0$

$2T + R_{AB} = 50$



$\Sigma F_y = 0$

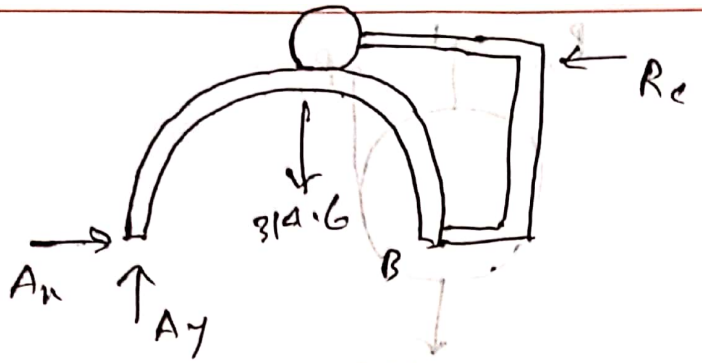
$T + T - R_{AB} - 30 = 0$

$2T - R_{AB} = 30$

$4T = 80$

$T = 20$

$R_{AB} = 10$



weight of arch, AB = $\frac{1}{2} \times 2\pi \times 10 \times 20$

= 314.16

$\Sigma M_A = 0$

$(314.16 + 50) \times 5 - R_c \times 6 = 0$

$R_c = 303.5$

$\Sigma F_y = 0$

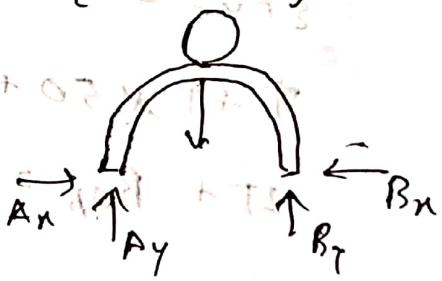
$A_y - 50 - 314.16 = 0$

$A_y = 364.16$

$\Sigma F_x = 0$

$A_x - R_c = 0$

$A_x = R_c = 303.5$



$\Sigma M_A = 0$

$364.16 \times 5 - B_y \times 10 = 0$

$B_y = 182.08$

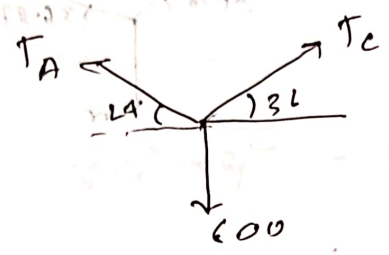
$\Sigma F_x = 0$

$A_x - B_x = 0$

$B_x = A_x = 303.5$

179

comider ABC



$\Sigma F_x = 0$

$T_c \cos 36° - T_A \cos 49° = 0$

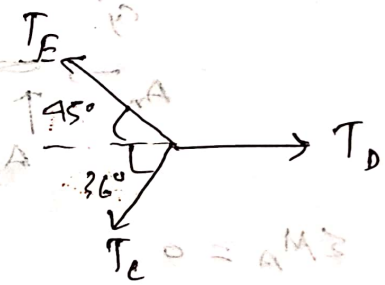
$T_A = 0.886\ T_c$

$\Sigma F_y = 0$

$T_A \sin 49° + T_c \sin 36° - 6000 = 0$

$\therefore T_c = 6315.8$

Comsider ECD



$\Sigma F_y = 0$

$T_E \sin 45° - T_c \sin 36° = 0$

$T_E = 5250$

$\Sigma F_x = 0$

$T_D - T_E \cos 45° - T_c \cos 36° = 0$

$T_D = 8822$ lb

230

$T_{AC} = T_{BC} = 650$

$\theta_1 = \tan^{-1}\frac{6}{8}$

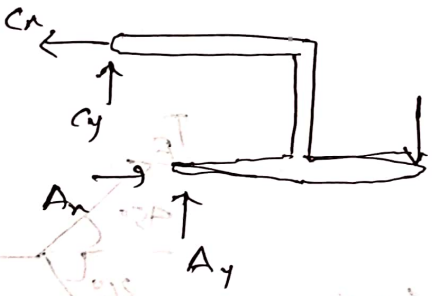
$\theta_2 = \tan^{-1}\frac{12}{5}$

$\Sigma F_y = 0$

$T_{AC} \sin 67.38 + T_{BC} \sin 36.87° - W = 0$

$W = 990$ lb

294

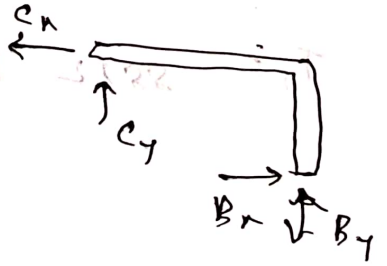


$\Sigma M_A = 0$

$C_y \times 1 - C_x \times 3 + 40 \times 8 = 0$

$C_y - 3C_x = -320$

Consider BC



$\Sigma M_B = 0$

$C_y \times 4 - C_x \times 3 = 0$

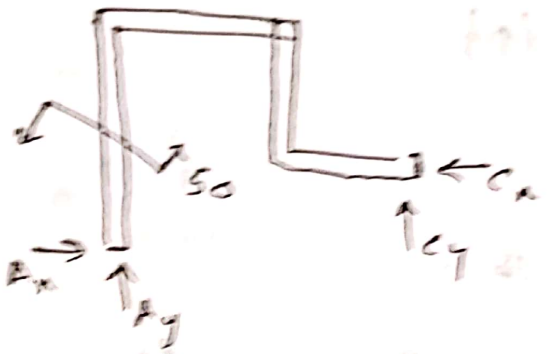
$3C_x = 4C_y$

$\therefore C_y = 106.67$

$C_x = 142.22$

$F_c = \sqrt{C_x^2 + C_y^2} = 177.78$

295.



$\Sigma M_B = 0$

$-C_x \times \frac{7}{12} - C_y \times \frac{10}{12} - 50 = 0$

$7C_x + 10C_y + 600 = 0$

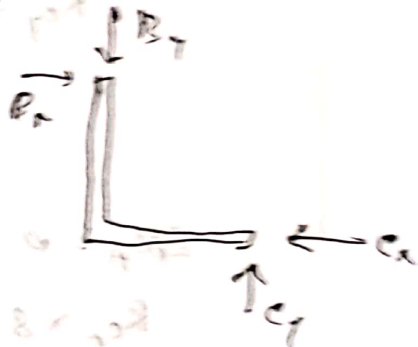
$\Sigma F_x = 0$

$A_x = C_x$

$\Sigma F_y = 0$

$A_y = -C_y$

Consider BC_2



$\Sigma M_B = 0$

$C_x \times 5 - C_y \times 5 = 0$

$C_x = C_y$

$17 C_x = -600$

$C_x = -35.29 = 35.29 (\rightarrow)$

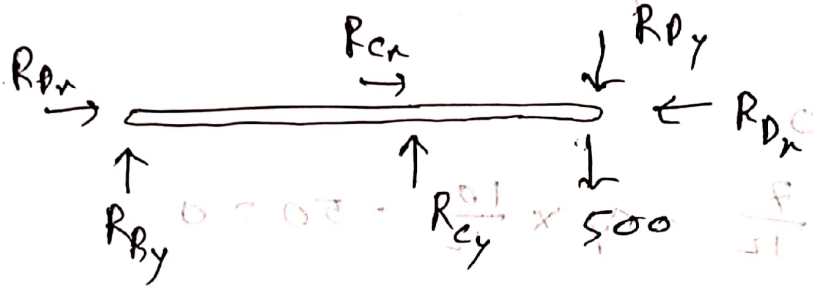
$C_y = 35.29$

$A_x = 35.29 (\leftarrow)$

$A_y = 35.29 (\uparrow)$

$F_A = 49.9$

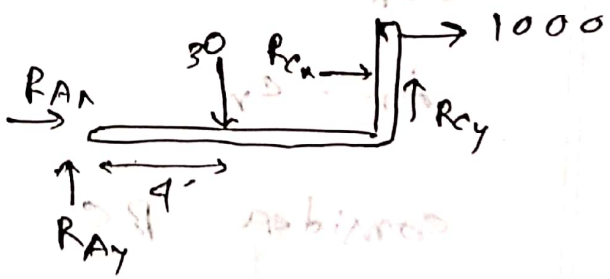
$F_L = 49.9$ lb.



$\Sigma M_B = 0$

$R_{C_y} \times 12 + 1500 \times 20 = 0$

$R_{C_y} = 2500$



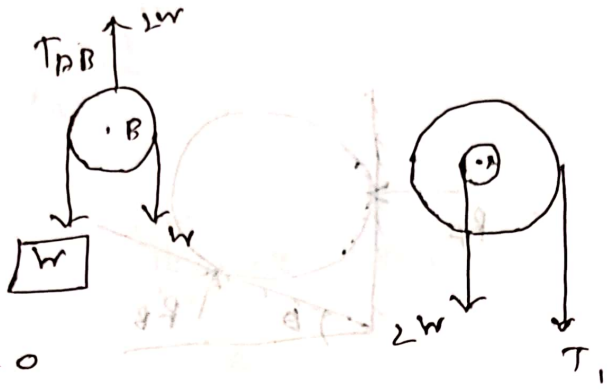
$\Sigma M_A = 0$

$R_{C_x} \times 8 + (R_{C_y} \times 12) + 1000 \times 10 + 30 \times 9 = 0$

$\therefore R_{C_x} = 5015$

$\therefore R_C = 5603.59$ lb

184



$\Sigma F_y = 0$

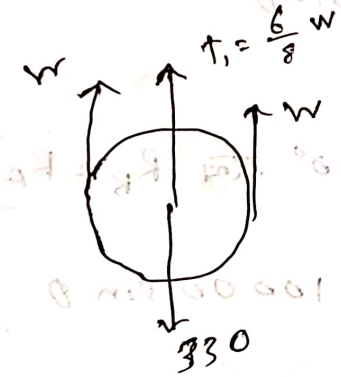
$T_{AB} - 2W = 0$

$T_{AB} = 2W$

$\Sigma M_A = 0$

$(2W \times 3) - T_1 \times 8 = 0$

$T_1 = \frac{6W}{8}$

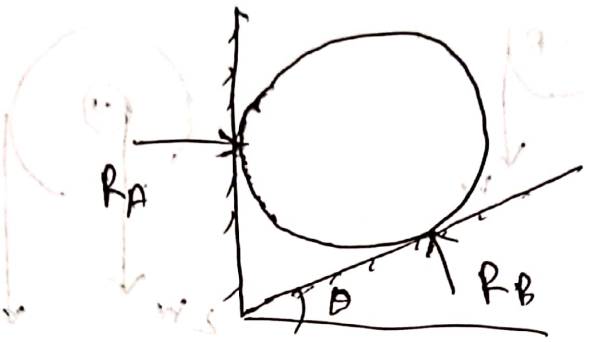


$\Sigma F_y = 0$

$T_1 + 2W - 330 = 0$

$\frac{6}{8}W + 2W = 330$

$W = 120.$



$\Sigma F_x = 0$

$R_A = R_B \cos(90-\theta) = R_B \sin\theta$

$R_B = \dfrac{R_A}{\sin\theta}$ ↓ 10000

[$\theta = 90°$ 일때 $R_B = R_A$]

$R_A = 10000 \sin\theta$

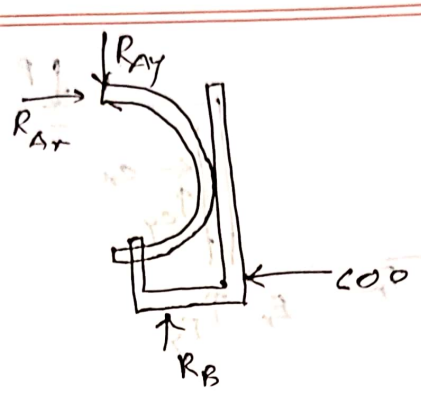
$\Sigma F_y = 0$

$5000 - 10000 \times \sin(90-\theta) = 0$

$\cos\theta = 0.5$

$\theta = 60°$

112



$\Sigma F_x = 0$

$R_{Ax} = 600$

$\Sigma F_y = 0$

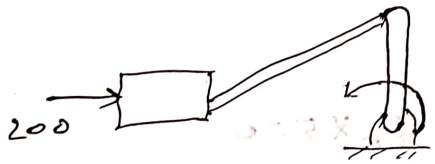
$R_{Ay} = R_B$

$\Sigma M_A = 0$

$-R_B \times 150 + 600 \times 600 = 0$

$R_{Ay} = R_B = 2400.$

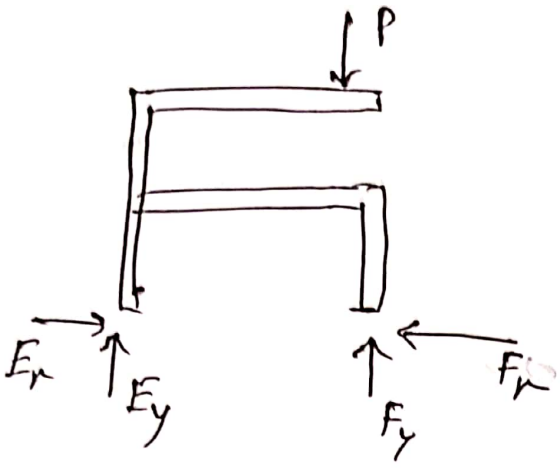
110



$\Sigma M_B = 0$

$-200 \times 0.1 + M = 0$

$M = 20 \text{ Nm}.$



$\Sigma M_F = 0$

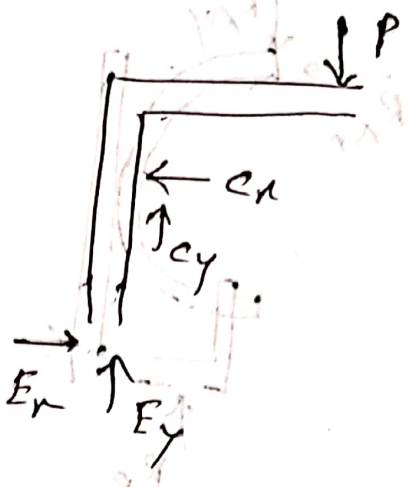
$E_y \times 12 = 0$

$E_y = 0$

$\Sigma F_y = 0$

$E_y + F_y = 180$

$F_y = 180$



$\Sigma F_x = 0$

$E_x = C_x$

$\Sigma F_y = 0$

$E_y + C_y = 180$

$C_y = 180$

$\Sigma M_C = 0$

$180 \times 12 - E_x \times 5 = 0$

$E_x = C_x = 432$