FREE BODY

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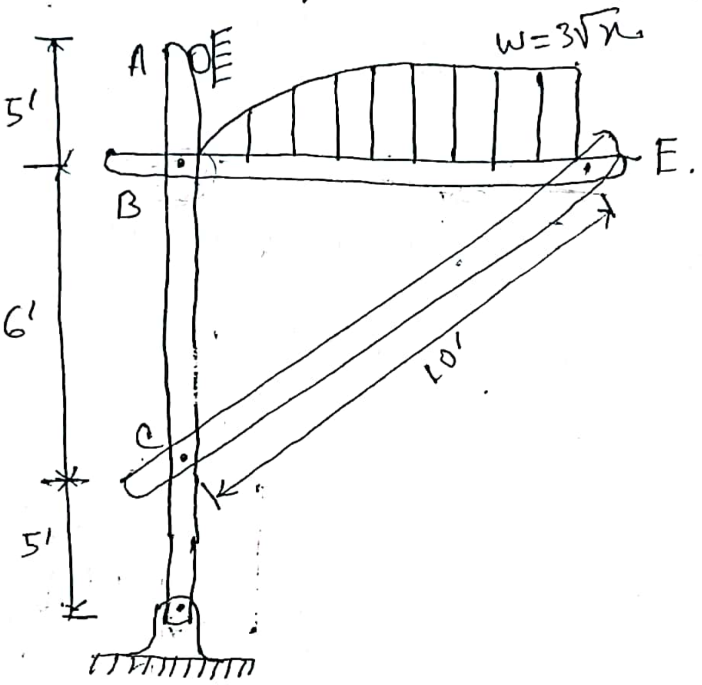
CE 110052.

TAPU

ক্লাস পার্টি তে আসিস ভাই।

5] The total load on the bar BE is 12 kips. The load distribution varies from zero at B to 2 kips per ft. at E, according to the relation $w = 3\sqrt{x}$, where x is measured from B. Determine the force in the strut CE and the total pin reaction at B acting on BE.



$\omega = \sqrt[3]{x}$

$\omega = \sqrt[3]{x}$

Solve: consider the load distribution

$dA = w\,dx$

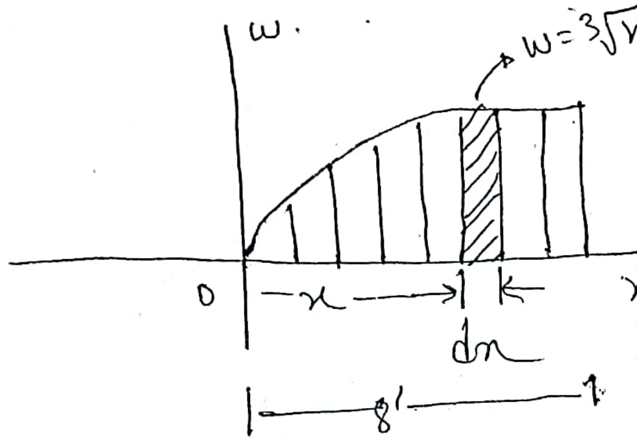
$= \sqrt[3]{x}\,dx$

$\therefore A = \int_0^8 \sqrt[3]{x}\,dx$

$= \left[\frac{x^{4/3}}{4/3}\right]_0^8$

$= \frac{3}{4}\left[8^{4/3} - 0^{4/3}\right]$

$= 12\ ft^2$



$CE = 10'$; $BC = 6$

$BE = \sqrt{10^2 - 6^2}$

$= 8'$

ow, $\int x\,dA = \int_0^8 x\sqrt[3]{x}\,dx$

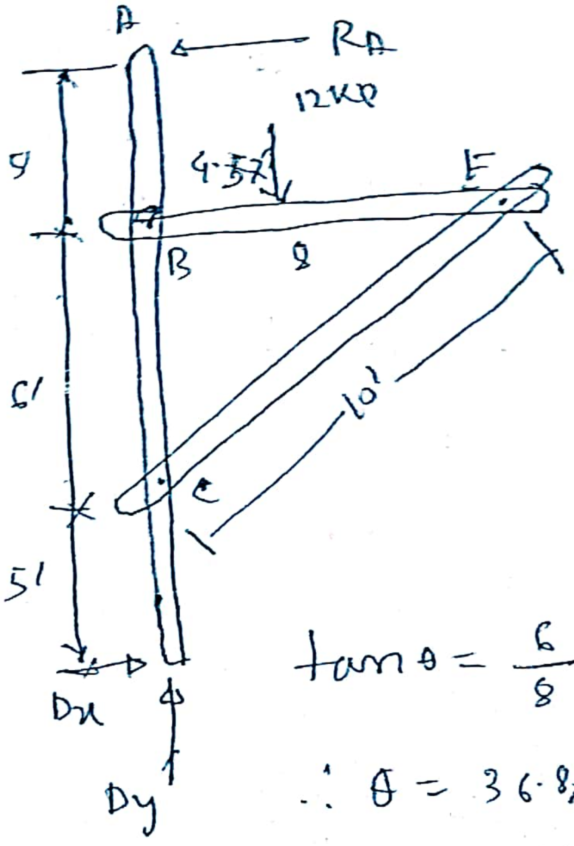
$= \int_0^8 x^{4/3}\,dx$

$= \frac{3}{7}\left[x^{7/3}\right]_0^8 = \frac{3}{7}\left[8^{7/3} - 0^{7/3}\right] = \frac{3}{7}\times 2^7$

$= 54.86\ ft^3.$

$\therefore \bar{x} = \frac{\int x\,dA}{A} = \frac{54.86}{12} = 4.57'$

onsider the free body diagram of the structure



$M_D = 0$

$12\times 4.57 - R_A\times 16 = 0$

$\therefore R_A = 3.4275$ kips

$x = 0$

$D_x - R_A = 0$

$D_x = R_A = 3.4275$ kips

$\tan\theta = \frac{6}{8}$

$\therefore \theta = 36.87°.$

$F_y = 0$

$D_y - 12 = 0$

$\therefore D_y = 12$ kips.

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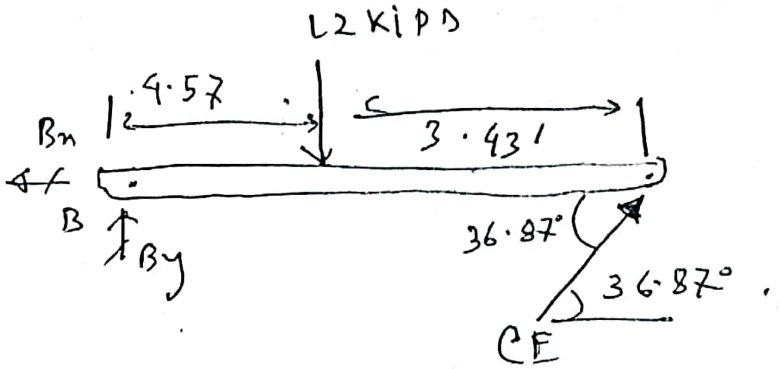
consider free body diagram of BE.



$\Sigma M_B = 0$

$\Rightarrow 12 \times 4.57 - CE \sin 36.87° \times 8 = 0$

$\therefore \; CE = 11.42$

$\Sigma F_x = 0$

$\Rightarrow B_x - CE \cos 36.87° = 0$

$\Rightarrow B_x = 11.42 \cos 36.87°$

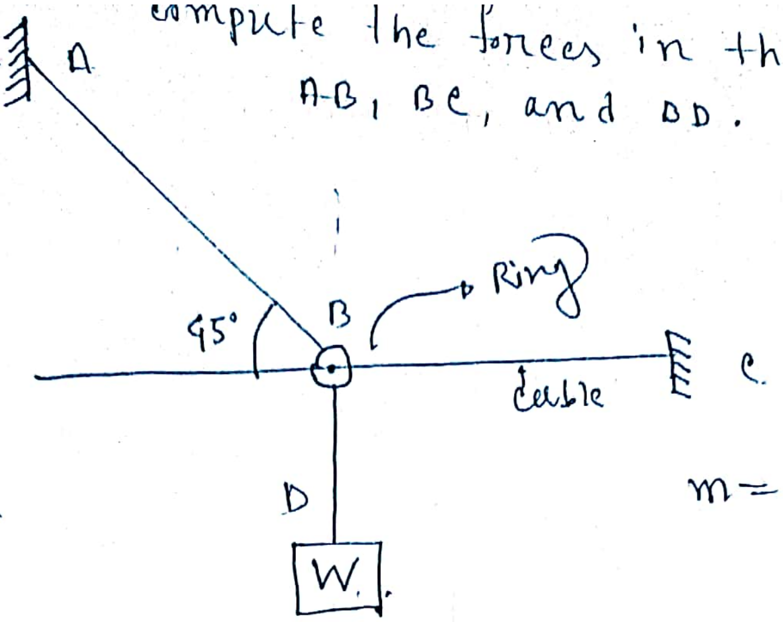
$\therefore B_x = 9.14$ kips

$\Sigma F_y = 0$

$\Rightarrow B_y - 12 - CE \sin 36.87° = 0$

$\therefore \; B_y = 5.15$ kips

compute the forces in the cable AB, BC, and BD.



$m = 10\,kg$.

Ne

$\Sigma F_y = 0$

$T_{BD} - W = 0$

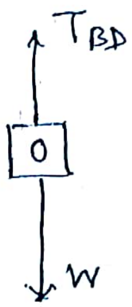
$\Rightarrow T_{BD} = 98.1\ N$

~~W=~~

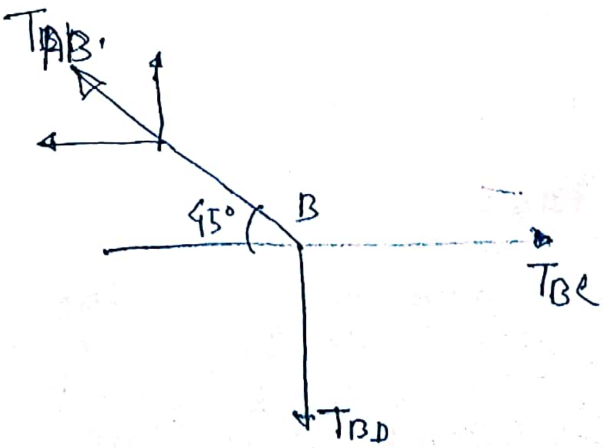
$m = 10\ kg$.

$W = 10 \times 9.8$.

$= 98.1\,N$.



e body diagram of the figure



$F_y = 0$

$T_{BD} - T_{AB} \sin 45° = 0$.

$\therefore T_{AB} = 138.73\ N$.

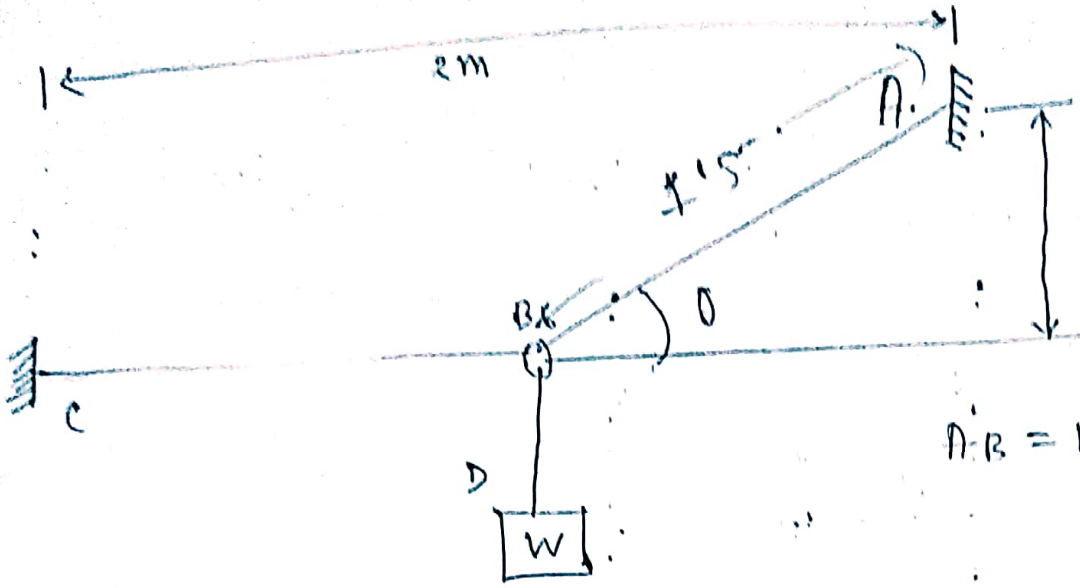
$\Sigma F_x = 0$

$T_{BC} - T_{AB} \cos 45° = 0$

$T_{BC} = 138.73 \times \cos 45° = 98.1\ N$

1. Determine the forces in the cables AB, BC, BD.

$m = 200\,kg$.



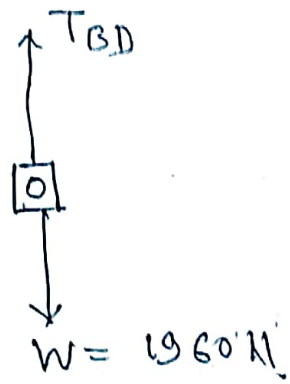
$AB = 1.5$.

Solve: $\Sigma F_y = 0$

$\Rightarrow T_{BD} - W = 0$

$\Rightarrow T_{BD} = W = 1960\,N$.

Here
$m = 200\,kg$,
$W = 200 \times 9.8$
$= 1960\,N$



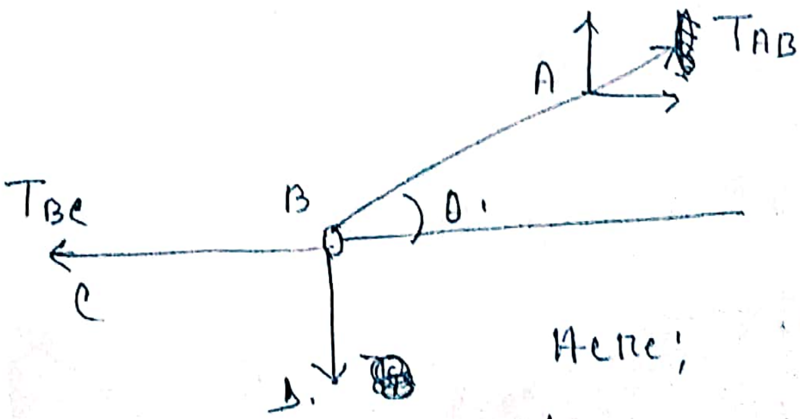
Free body diagram of the figure.

$\Sigma F_y = 0$

$T_{BD} - T_{AB} \sin 30° = 0$

$\Rightarrow T_{AB} = \dfrac{1960}{1/2}$

$= 3920\,N$.



Here;

~~tan θ =~~

$\sin\theta = \dfrac{0.75}{1.5}$

$\therefore \theta = 30°$

$\Sigma F_x = 0$

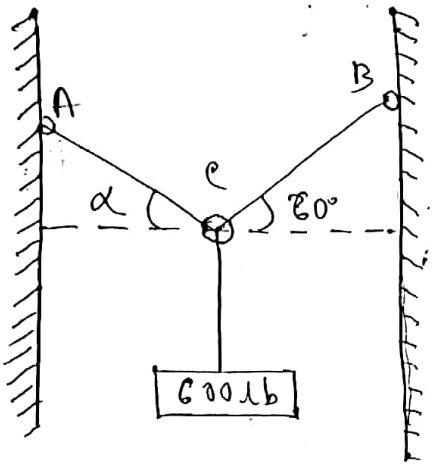
$\Rightarrow T_{BC} - T_{AB}\cos 30° = 0$

$\therefore T_{BC} = 3394.82\,N$

A 600 lb block is supported by the two cables AC and BC.

i) For what value of α is the tension in the cable AC minimum

ii) What are the corresponding values of tension in the cable AC and BC.

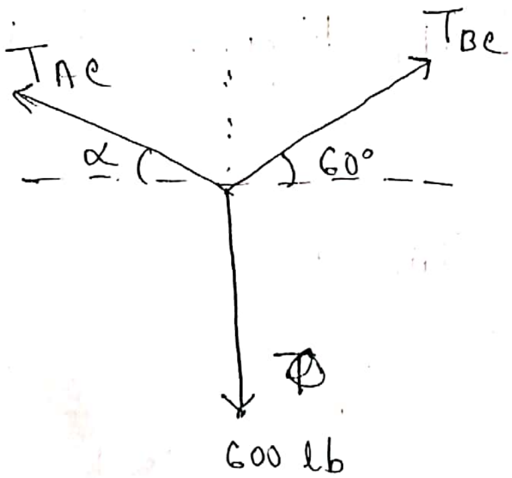


Free body diagram of the figure

$F_y = 0$

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

$T_{AC}\sin\alpha = 600 - T_{BC}\sin 60°$ ...(i)



$F_x = 0$

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

$T_{AC} = T_{BC}\dfrac{\cos 60°}{\cos\alpha}$ ...(ii)

Put the value of T_{AE} in eq (i) $\Rightarrow$.

$$\Rightarrow T_{BE} \frac{\cos 60^\circ}{\cos\alpha} \sin\alpha = 600 - T_{BE}\sin 60^\circ$$

~~Put the val~~

$$\Rightarrow T_{BE} \cos 60^\circ \cdot \sin\alpha = 600 \cos\alpha - T_{BE} \sin 60^\circ \cdot \cos\alpha,$$

$$\Rightarrow T_{BE}(\sin\alpha \cdot \cos 60^\circ + \cos\alpha \cdot \sin 60^\circ) = 600 \cos\alpha$$

$$\Rightarrow \cancel{T_{BE}(} \; T_{BE} \sin(\alpha + 60^\circ) = 600 \times \cos 30^\circ$$

$$\Rightarrow T_{BE} = \frac{600 \times \cos 30^\circ}{\sin 90^\circ}$$

Here;

$\alpha + 60^\circ = 90^\circ$

$\therefore \alpha = 30^\circ$

$$\Rightarrow T_{BE} = 519.61 \text{ lb}.$$

(i) $\Rightarrow$ $$T_{AE} = 519.61 \times \frac{\cos 60^\circ}{\cos 30^\circ}$$

$$\therefore T_{AE} = 300 \text{ lb}$$

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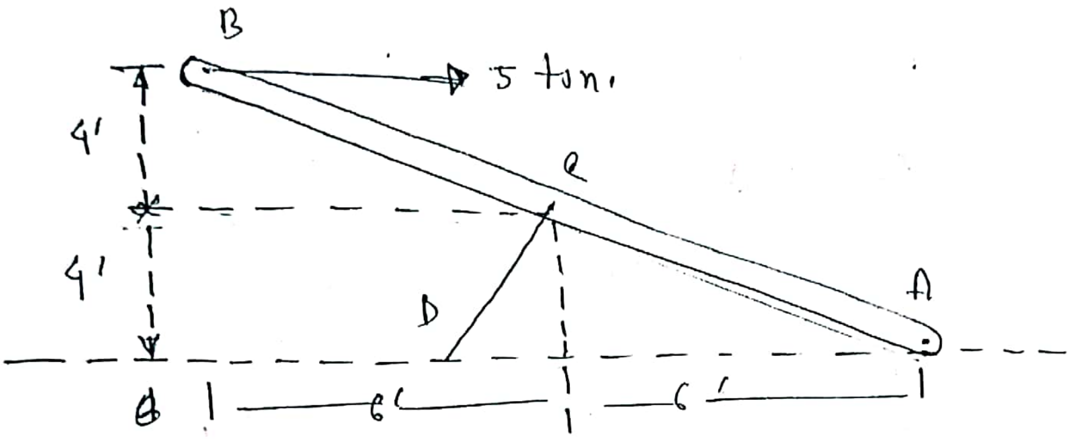
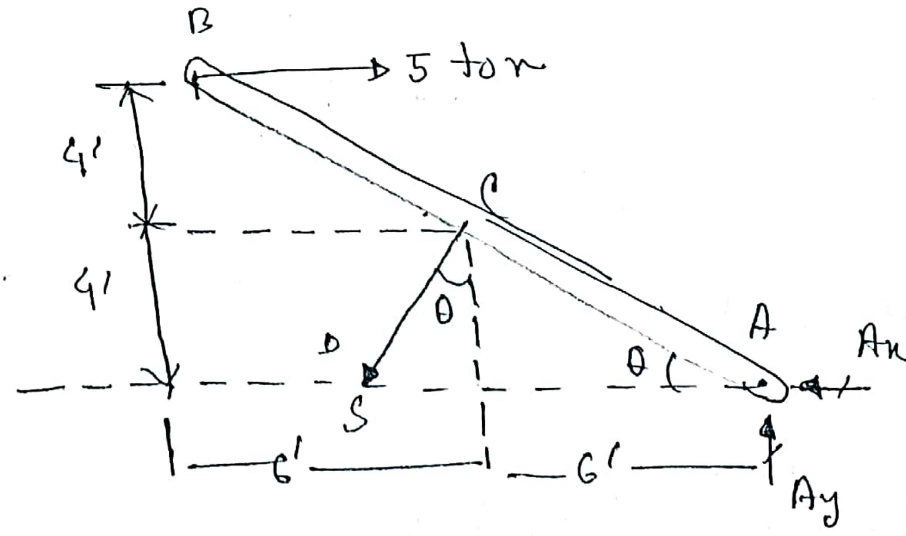
bar AB is hinged to the foundation at A and pported by a strut CD is subjected to a rizontal 5-ton load at B, as shown in the ure. Find the tensile forces S in the strut and e reaction at A.



Free body diagram of the figure.



$M_A = 0$

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

$\therefore S = 5.547$ tons.

$x = 0$

$-A_x - S\sin 33.69^\circ = 0$

$\therefore A_x = 1.92$ tons.

$y = 0$

$y - S\cos 33.69^\circ = 0$

$A_y = 4.62$ tons.

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

$= 5$ tons.

Here; $\tan\theta = \frac{4}{6}$

$\therefore \theta = 33.69^\circ$

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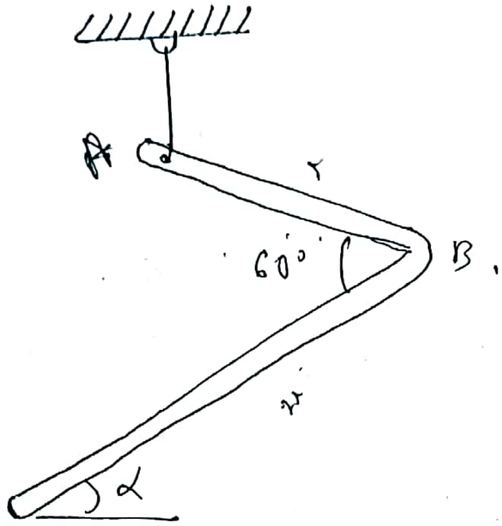
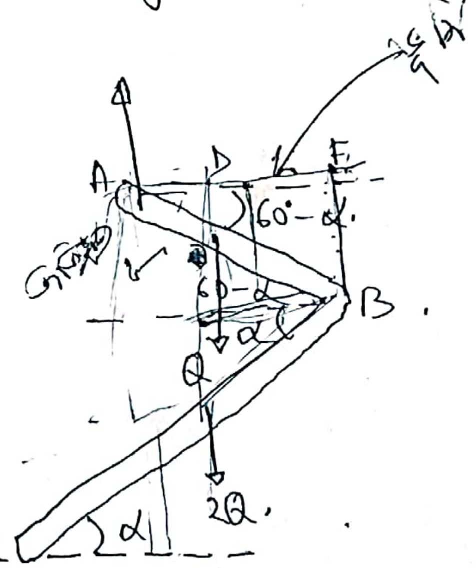
Two ~~prislan~~ prismatic bars AB and BC of length l respectively are rigidly joined at B and suspended by a string AD as shown in figure. Determine the position of equilibrium, as defined by angle α, that the bars will assume under the action of their weights Q and 2Q respectively.



Problem

Solve consider the free body diagram of the figure.



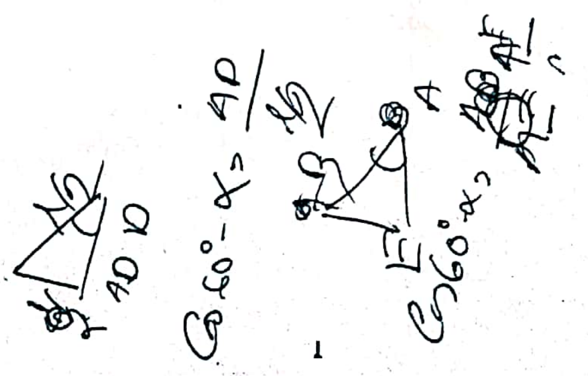
Here;

$$\cos(60°-\alpha) = \frac{AE}{AB}$$

$$\Rightarrow AE = l\cos(60°-\alpha).$$

and $$\cos(60°-\alpha) = \frac{AD}{l/2}$$

$$\Rightarrow AD = \frac{l}{2}\cos(60°-\alpha)$$



$\sum M_A = 0$

$Q \times AD - 2Q \times (l\cos\alpha - AE) = 0$

$\frac{l}{2}\cos(60^\circ - \alpha) - 2\{l\cos\alpha - l\cos(60^\circ - \alpha)\} = 0$

$\Rightarrow \cos(60^\circ - \alpha) - 4\cos\alpha + 4\cos(60^\circ - \alpha) = 0$

$\Rightarrow 5\cos(60^\circ - \alpha) - 4\cos\alpha = 0$

$\Rightarrow 5(\cos 60^\circ \cdot \cos\alpha + \sin 60^\circ \cdot \sin\alpha) - 4\cos\alpha = 0$

$\Rightarrow 5\left(\frac{1}{2}\cos\alpha + \frac{\sqrt{3}}{2}\sin\alpha\right) - 4\cos\alpha = 0.$

$\Rightarrow \frac{5\sqrt{3}}{2}\sin\alpha + \cos\alpha\left(\frac{5}{2} - 4\right) = 0$

$\Rightarrow \frac{5\sqrt{3}}{2}\sin\alpha - \frac{3}{2}\cos\alpha = 0$

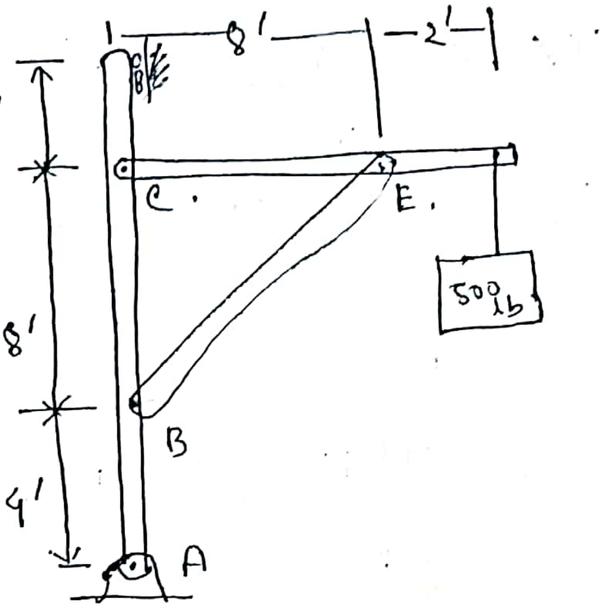
$\Rightarrow \frac{5\sqrt{3}}{2}\sin\alpha = \frac{3}{2}\cos\alpha.$

$l\cos\alpha$

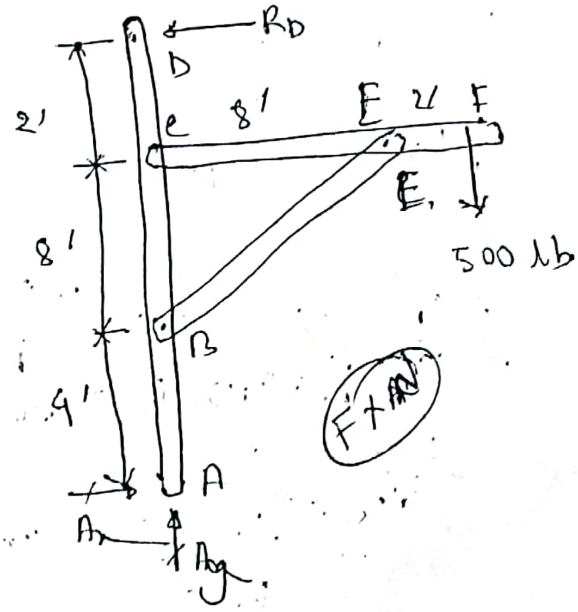
$\Rightarrow \tan\alpha = \frac{3 \times 2}{2 \times 5\sqrt{3}}$

$\therefore \alpha = 19.11^\circ.$

1 Determine the forces which the pins at points B and C exert on member ABCD of the loaded frame shown in the figure



We consider the free body diagram of the figure.



$\Sigma M_A = 0$

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

$\therefore R_D = 357.14$

$F_x = 0$

$A_x - R_D = 0$

$A_x = R_D = 357.14$ lb

$F_y = 0$

$A_y - 500 = 0$

$\therefore A_y = 500$ lb

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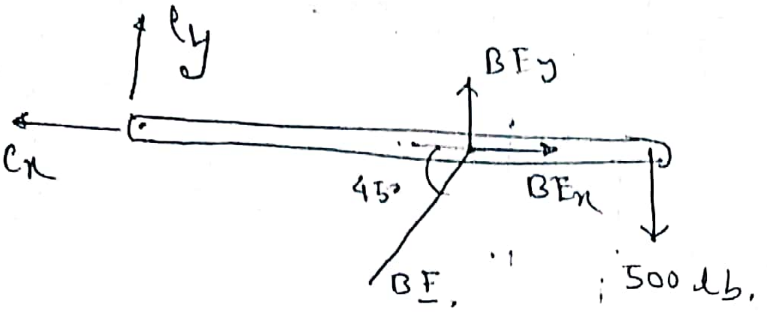
Consider the free body of CF.



~~$M_C = 0$~~

~~$BE_y \times 8 - 500 \times 10 = 0$~~

$\Sigma M_C = 0$

$\Rightarrow 500 \times 10 - BE \sin 45^\circ \times 8 = 0$

$\therefore BE = 883.88$

$\Sigma F_x = 0$

$C_x - BE \cos 45^\circ = 0$

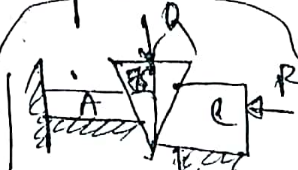
$\therefore C_x = 624.997$

$\Sigma F_y = 0$

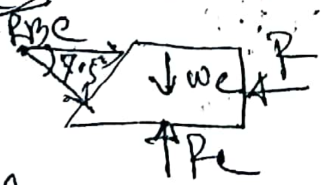
$C_y + BE \sin 45^\circ - 500 = 0$

$\therefore C_y = -124.99$

25) consider the diagram of C.



$W_A = 2000$, $W_B = 2500$, $W_C = 5000$, $R = 8000$ lb



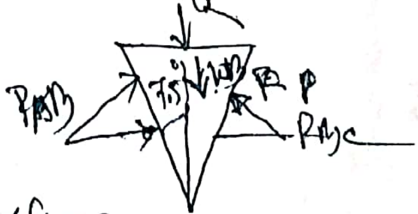
$\Sigma F_x = 0$

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

$\Rightarrow R_{BC} = \frac{R}{\cos 7.5} = \frac{8000}{\cos 7.5}$

$= 8069$ lb

Consider the diagram of B.



$\Sigma F_x = 0$

~~$R_{AB} = R$~~

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

$\Rightarrow R_{AB} = R_{BC}$

$\Sigma F_y = 0$

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

~~consider the free body of A~~

$\Rightarrow Q = 1656.43$

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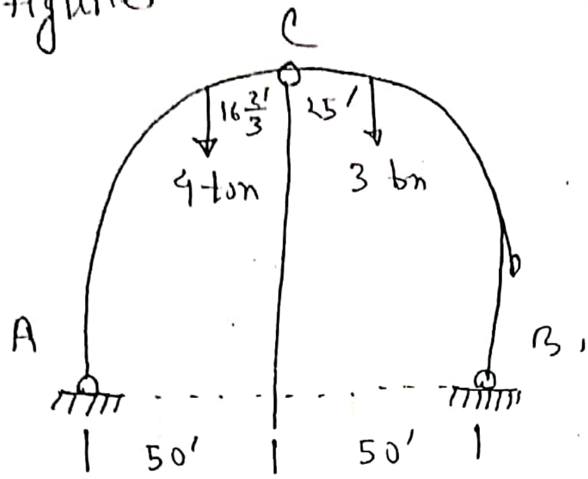
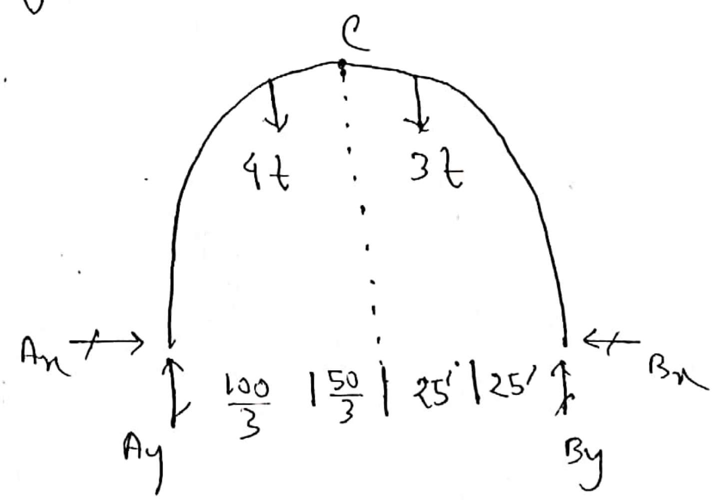
Find the reaction at the support A and B of the semi circular three-hinged arch loaded as shown in the figure.



Solve

Consider the free body diagram of the figure



$\Sigma M_A = 0$

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

$\therefore B_y = 3.58$ tons.

$\Sigma F_y = 0$

$A_y + B_y - 4 - 3 = 0$

$\Rightarrow A_y = 7 - 3.58 = 3.42$ tons.

$\Sigma F_x = 0$

$A_x - B_x = 0$

$\Rightarrow A_x = B_x$ ——— (1)

Consider the free body of AC.

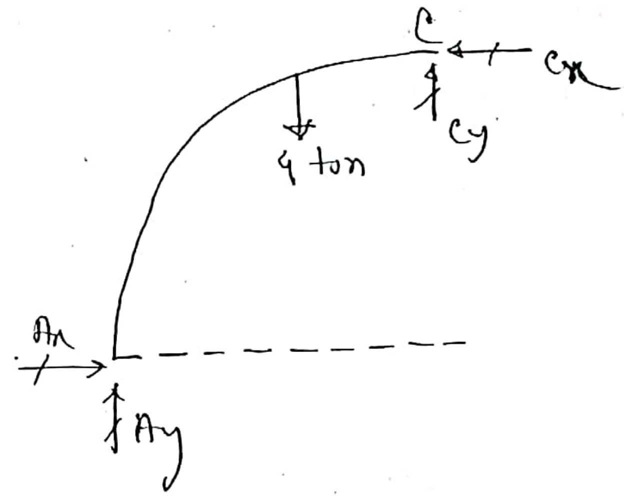
$\Sigma M_C = 0$

~~$A_x \times 50$~~

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

$\Rightarrow 3.42 \times 50 - A_x \times 50 - \frac{4 \times 50}{3} = 0$

$\therefore A_x = 2.087$ tons.



$\Rightarrow \therefore A_x = B_x = 2.087$ tons

$\therefore$ Reaction at A; $R_A = \sqrt{A_x^2 + A_y^2}$

$= 4.01.$

Reaction at B; $R_B = \sqrt{B_x^2 + B_y^2}$

$= 4.14$ tons.

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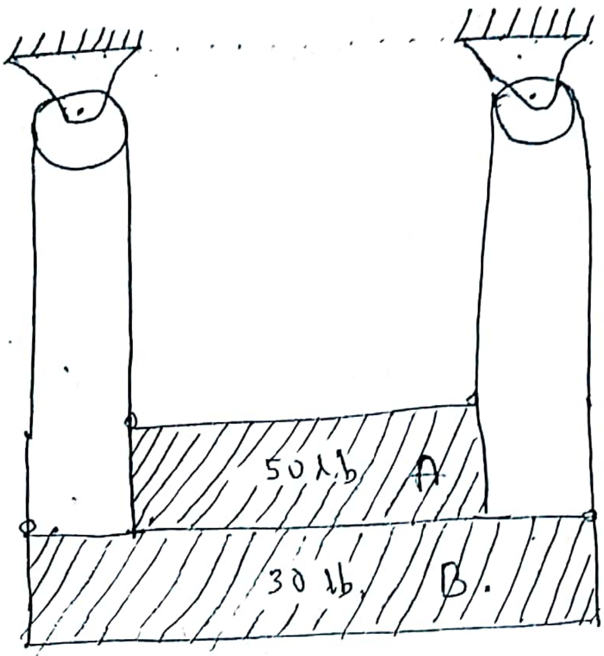
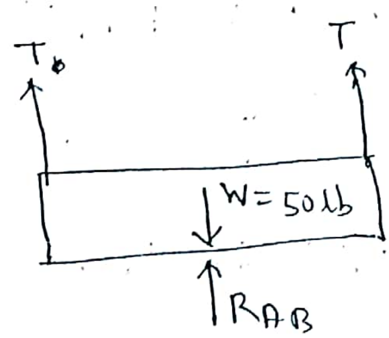
5\] Two blocks A and B are ... If block A weights 50 lb
ceiling by means of two cables. If block A weights 50 lb
and block B weight 30 lb, determine the tension in the
cables and the reactive force which block B exerts on the
block A.



consider the free body diagram of A.

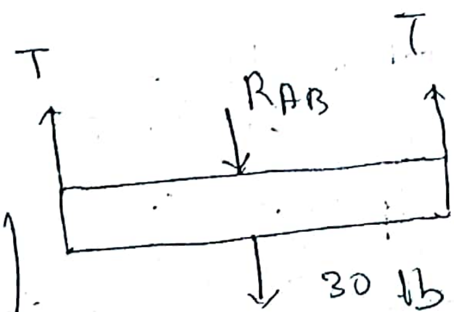


$\Sigma F_y = 0$

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

$\therefore 2T + R_{AB} = 50$ —— (I)

consider the free body diagram of B.



$\Sigma F_y = 0$

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

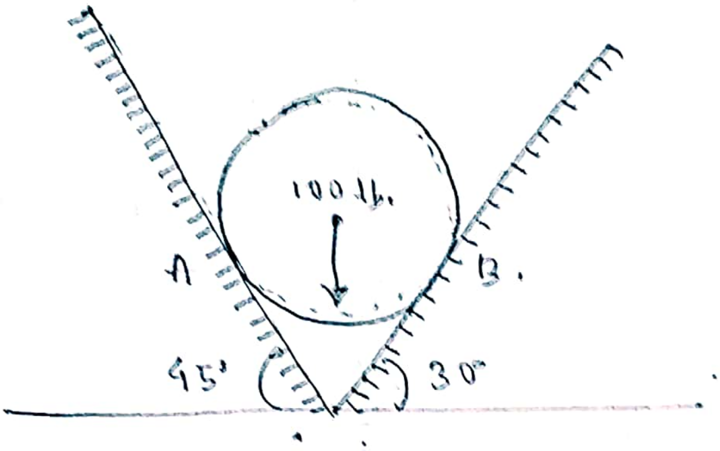
$\Rightarrow 2T - R_{AB} = 30$ —— (II)

from (I) and (II) $\Rightarrow$ $4T = 80$

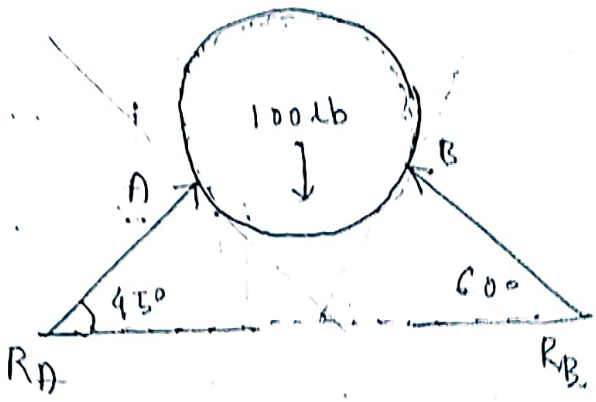
$\therefore T = 20$ lb

(I) $\Rightarrow$ $R_{AB} = 10$ lb

Draw the free body diagram and determine the forces at A and B.



Free body diagram of the figure



$\Sigma F_x = 0$

$R_A \cos 45^\circ - R_B \cos 60^\circ = 0$

$\Rightarrow R_A = R_B \dfrac{\cos 60^\circ}{\cos 45^\circ} \quad \cdots (1)$

$\Sigma F_y = 0$

$R_A \sin 45^\circ + R_B \sin 60^\circ - 100 = 0$

$\Rightarrow R_B \dfrac{\cos 60^\circ}{\cos 45^\circ} \sin 45^\circ + R_B \sin 60^\circ = 100$

$\Rightarrow R_B \cos 60^\circ \cdot \sin 45^\circ + R_B \sin 60^\circ \cdot \cos 45^\circ = 100 \cos 45^\circ$

$\Rightarrow \cancel{R_B(\sin 45^\circ \cdot \cos 60^\circ + \cos 45^\circ \sin 60^\circ) = 100}$

$\cancel{R_B = \dfrac{100}{\sin(45^\circ+60^\circ)}} \Rightarrow \cancel{R_B\left(\dfrac{1}{2}\cdot\dfrac{1}{\sqrt{2}} + \dfrac{\sqrt{3}}{2}\cdot\dfrac{1}{\sqrt{2}}\right) =}$

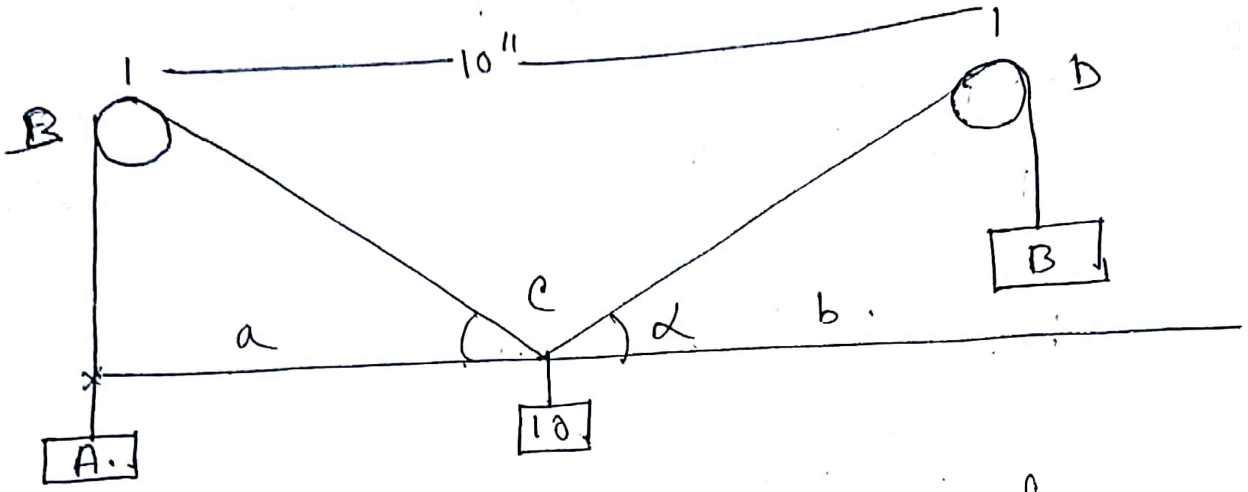
$\Rightarrow R_B \sin(45^\circ + 60^\circ) = 100 \cos 45^\circ$

$\therefore R_B = 73.21 \text{ lb}$

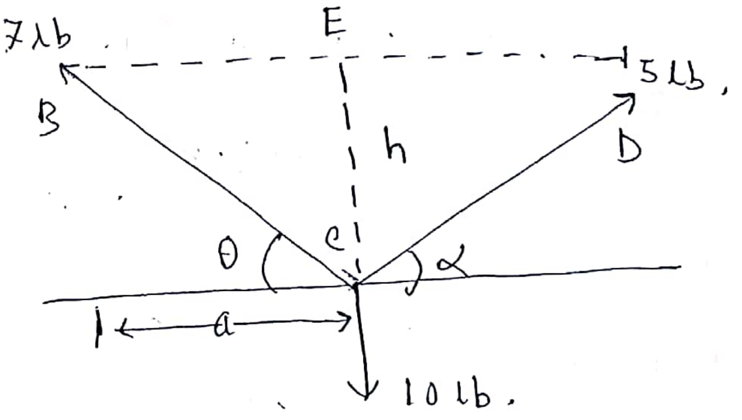
$\therefore R_A = 73.21 \times \frac{1}{2} \times \frac{\sqrt{2}}{1}$

$\therefore R_A = 51.77 \text{ lb}$

A continious string ABCDE passes over smooth pegs at B and D, Determine the distance 'a' and angle α



Solve: consider the free body diagram of the figure.



$\Sigma F_x = 0$

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

$7\cos\theta = 5\cos\alpha \cdots (i)$

$\Sigma F_y = 0$

$5\sin\alpha + 7\sin\theta - 10 = 0$

$7\sin\theta = 10 - 5\sin\alpha \cdots (ii)$

$(i)^2 + (ii)^2 \Rightarrow$

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

$\Rightarrow 49 = 25 + 100 - 100\sin\alpha$

$\therefore \alpha = 49.46°$

(i) $\Rightarrow$

$\cos\theta = \dfrac{5\cos 49.46°}{7}$

$\therefore \theta = 62.34°$

from triangle

4BCE ; $\frac{h}{a} = \tan\theta$.

$\Rightarrow h = a\tan\theta$ ---(iii).

and ΔCDE ;

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

$\Rightarrow h = (10-a)\tan\alpha$ ---(iv).

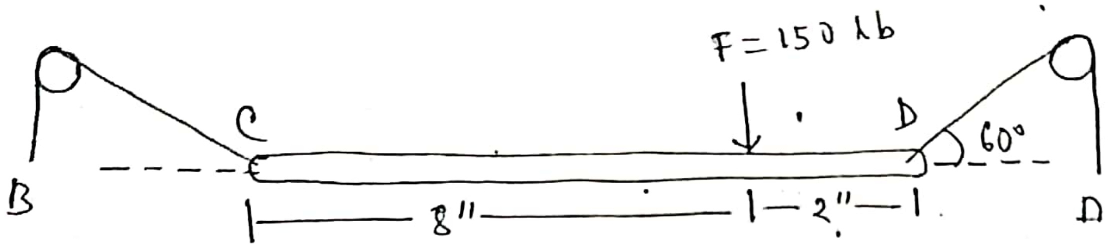
from (iii) and (iv) we get,

$a\tan\theta = (10-a)\tan\alpha$

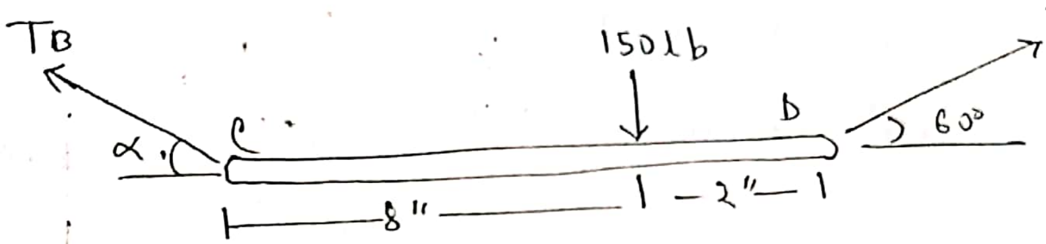
$\Rightarrow a\tan\theta = 10\tan\alpha - a\tan\alpha$

$\Rightarrow a = 3.8''$

27 Determine the weights of A and B if the bodies are in equilibrium and CD remains horizontal.



Solve consider the free body diagram of the figure:



$\Sigma M_C \Rightarrow$

$150 \times 8 - T_A \sin 60° \times 10 = 0$

$\therefore T_A = 138.56$ lb.

$\therefore W_A = 138.56$ lb.

$\Sigma F_y = 0$

$T_B \sin\alpha + T_A \sin 60° - 150 = 0$

$\Rightarrow T_B \sin\alpha = 30 \;\cdots (1).$

$\Sigma F_x = 0$

$T_B \cos\alpha - T_A \sin 60° = 0$

$\Rightarrow T_B \cos\alpha = 69.28 \;\cdots (11).$

$(1) \div (11) \Rightarrow$

$\tan\alpha = \frac{30}{69.28}$

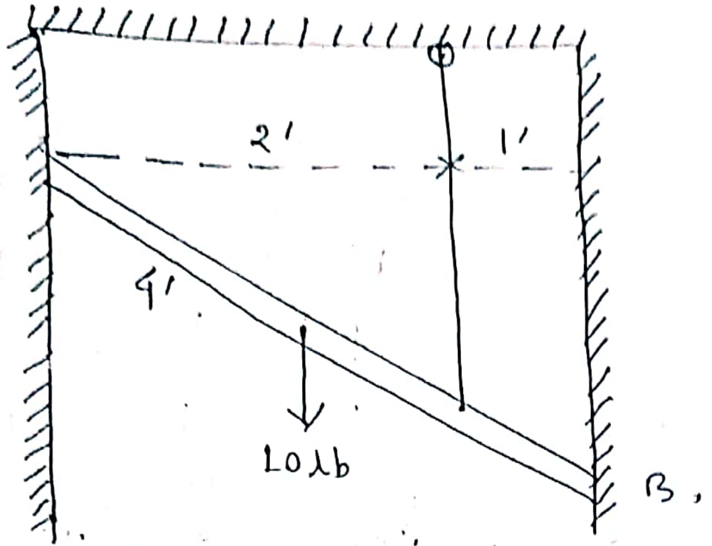
$\therefore \alpha = 23.41°$

$(1) \Rightarrow T_B \sin 23.41° = 30$

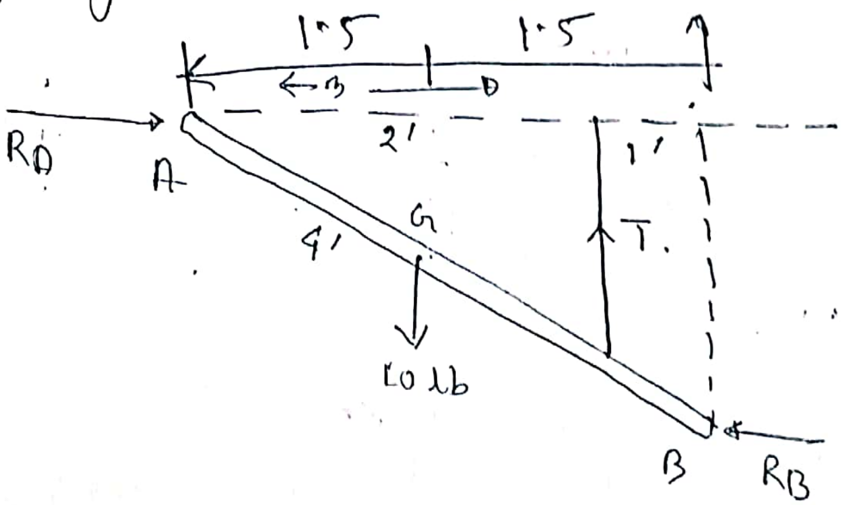
$\therefore T_B = 75.5$ lb.

$\therefore W_b = 75.5$ lb

Determine the reaction excerted by the walls on the ...



$\boxed{\text{Solve}}$ consider the free body diagram of the figure,



$\Sigma F_y = 0$

$T - 10 = 0$

$\therefore T = 10$ lb.

$\Sigma F_x = 0$

$R_A - R_B = 0$

$\Rightarrow R_A = R_B$ --- (1)

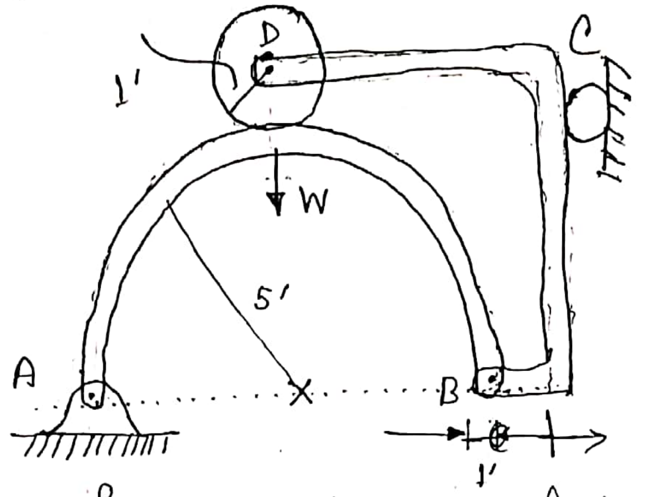
$\Sigma M_B = 0$

$R_A \times \sqrt{4^2 - 3^2} - 10 \times \cancel{1.25}\ 1.5 + T \times 1 = 0$

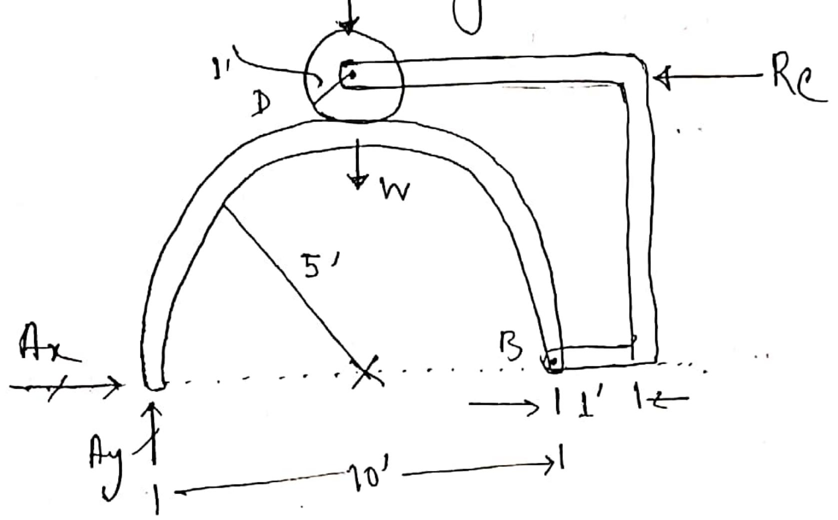
$\therefore R_A = 1.89$ lb.

$\therefore \cancel{R_A}\ R_B = R_A = 1.89$ lb

[48] Determine the horizontal and vertical reactions at the pin
B and the reaction of the roller C.



Solve consider the free body diagram of the whole.



weight of the arch AB $= \frac{1}{2} \times 2\pi r \times 20$

$= 314.16$ lb.

$\Sigma M_A = 0$

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

$\therefore R_C = 303.47$ lb.

$\Sigma F_x = 0$

$\Rightarrow A_x - R_C = 0$

$\Rightarrow A_x = R_C = 303.47$ lb

$\Sigma F_y = 0$

$\Rightarrow A_y - 50 - 314.16 = 0$

$\Rightarrow A_y = 364.16$ Lb

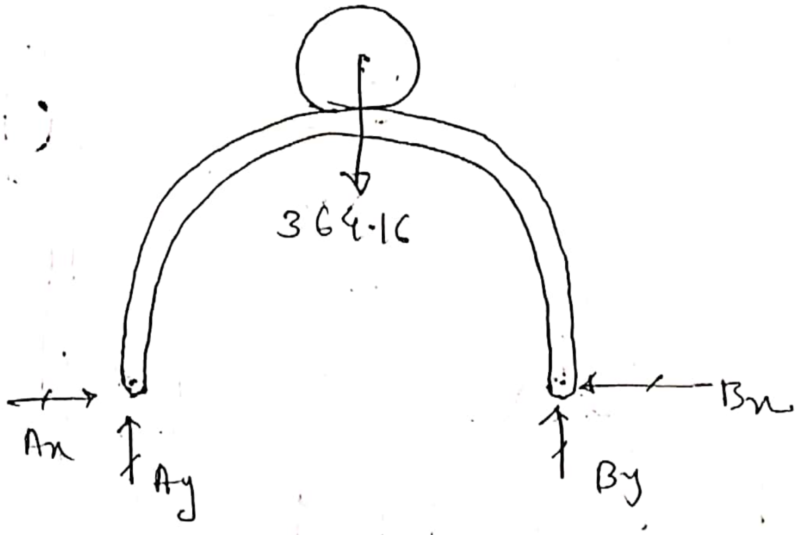
Consider the free body diagram of arch A-B.

$\sum F_x = 0$

$A_x - B_x = 0$

~~$A_x = B_x$~~

$B_x = A_x = 303.97$ lb.



$\sum M_A = 0$

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

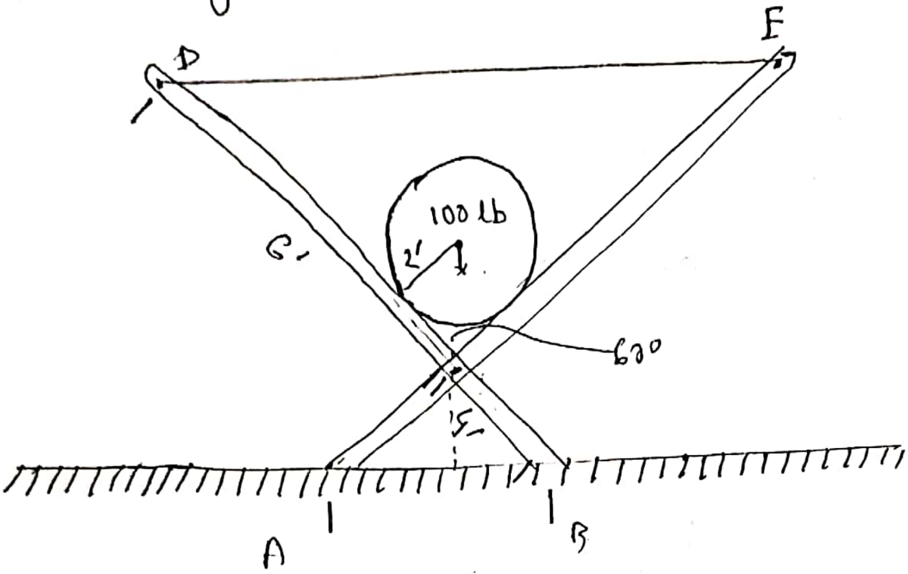
$\Rightarrow B_y = 182.08$ lb.

$\sum F_y = 0$

$B_y + A_y - 364.16 = 0$

$\therefore A_y = 182.08$ lb

[1] Determine the tension in the horizontal rope DE assuming a smooth floor



Solve consider the free body diagram of the whole body.

$\Sigma M_A = 0$

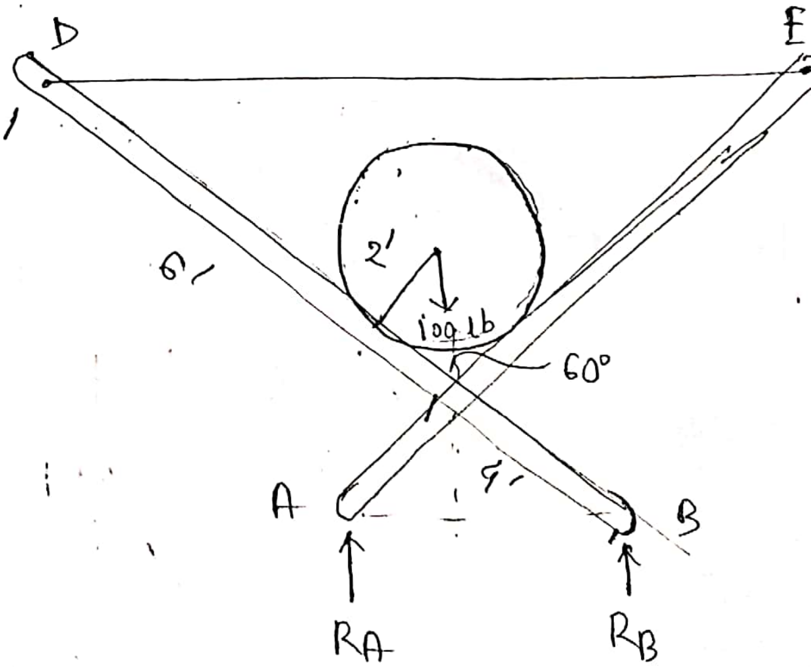
$\Rightarrow 100 \times 4\sin 30^\circ - R_B \times 2 \times 4\sin 30^\circ = 0$

$\therefore R_B = 50$ lb.

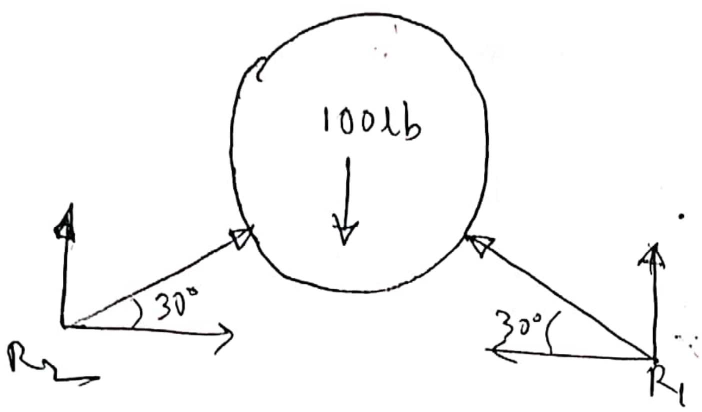
$\Sigma F_y = 0$

$\Rightarrow R_A + R_B - 100 = 0$

$\therefore R_A = 50$ lb.



...der the free body diagram of the cylinder



$\Sigma F_x = 0$

$\Rightarrow R_2 \cos 30° - R_1 \cos 30° = 0$

$\therefore R_1 = R_2$ —— (1)

$\Sigma F_y = 0$

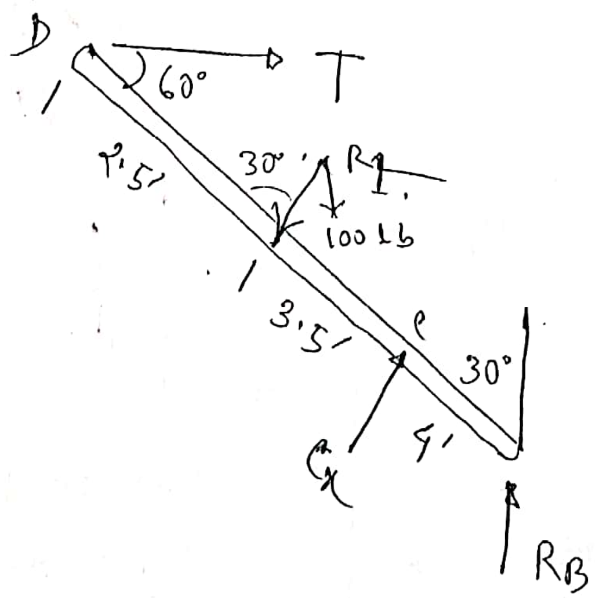
$\Rightarrow R_2 \sin 30° + R_1 \sin 30° - 100 = 0$

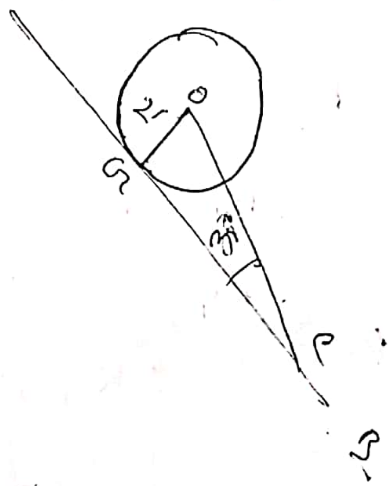
$\Rightarrow 2R_2 \sin 30° = 100$

$\therefore R_2 = 100$ lb.

$\therefore R_1 = 100$ lb.

...sider the free body diagram of body





$\tan 30° = \frac{OG}{CG}$

$\therefore CG = \frac{2}{\tan 30°}$

$= 3.5.$

...= 0

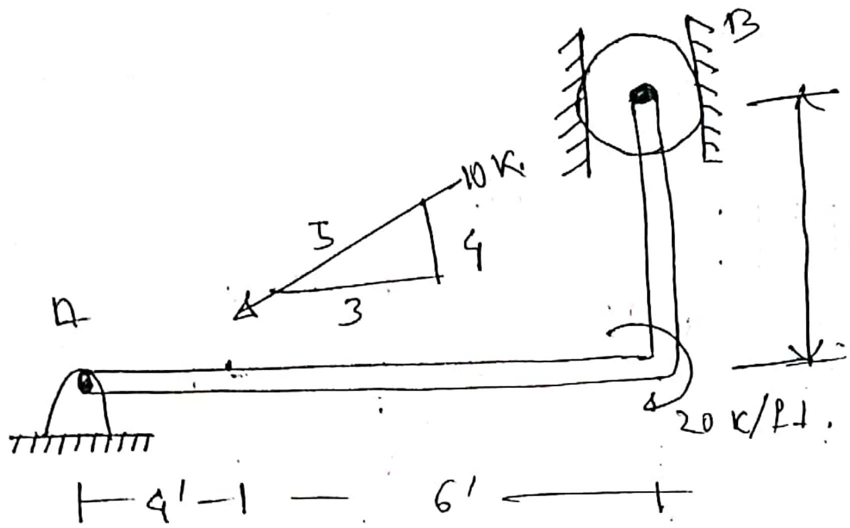
~~T × 6 cos 60°~~

...s 60° × 6 − 100 × 3.5 − $R_B \sin 30° \times 4 = 0$

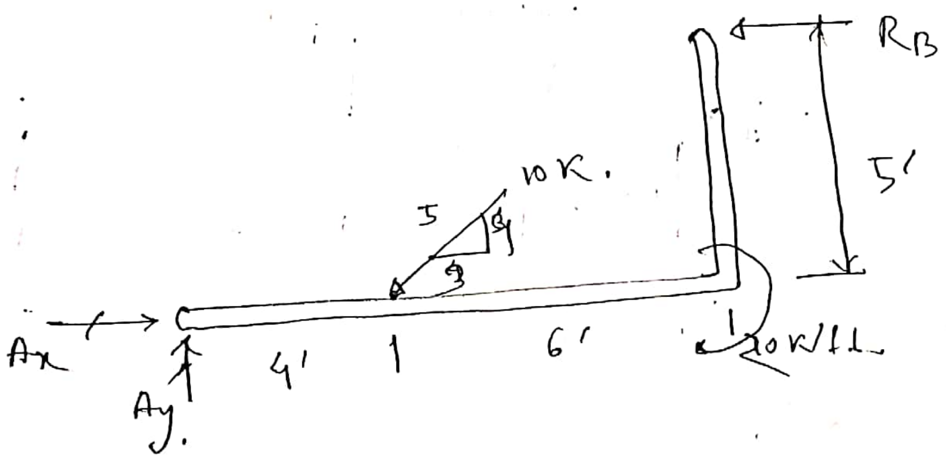
$\therefore T = 150$

$\therefore T = DE = 150$ lb

02. Find the reaction at A and B.



Solve: consider the free body diagram of the body.



$\tan\theta = \frac{4}{3}$

$\therefore \theta = 53.13°$

$\Sigma M_A = 0$

$\Rightarrow 10 \sin 53.13° \times 4 + 20 - R_B \times 5 = 0$

$\therefore R_B = 10.39$ K.

~~$\Sigma F_x = 0$~~

~~$\Rightarrow A_x - R_B = 0$~~

~~$\therefore R_B = A_x = 10.39$ K~~

$\Sigma F_x = 0$

$A_x - R_B - 10 \cos 53.13 = 0$

$\therefore A_x = 16.39$ K

$\Sigma F_y = 0$

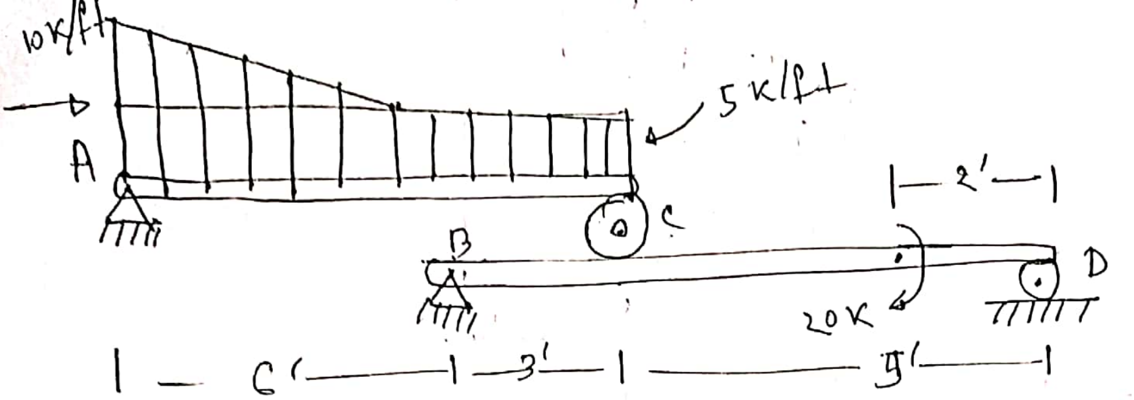
$A_y - 10 \sin 53.10° = 0$

$\therefore A_y = 7.99$ K

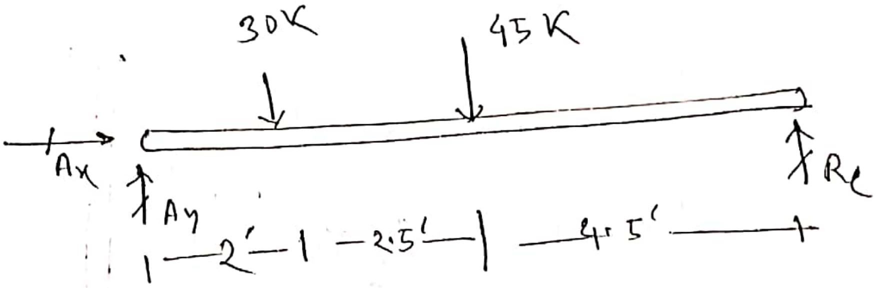
$R_A = \sqrt{A_x^2 + A_y^2}$

$= 18.23$ K.

ompute the reaction at support A, B, C and D in the compound beam.



Sol consider the free body diagram of beam AC,



$\Sigma M_A = 0$

$30 \times 2 + 45 \times 4.5 - R_C \times 9 = 0$

$\therefore R_C = 29.167\ K$

$\Sigma F_x = 0$

$A_x = 0$

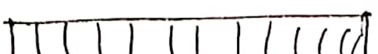
$\Sigma F_y = 0$

$\Rightarrow A_y + R_C - 30 - 45 = 0$

$\therefore A_y = 45.83\ K$

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

$= 45.83\ K$



Total load

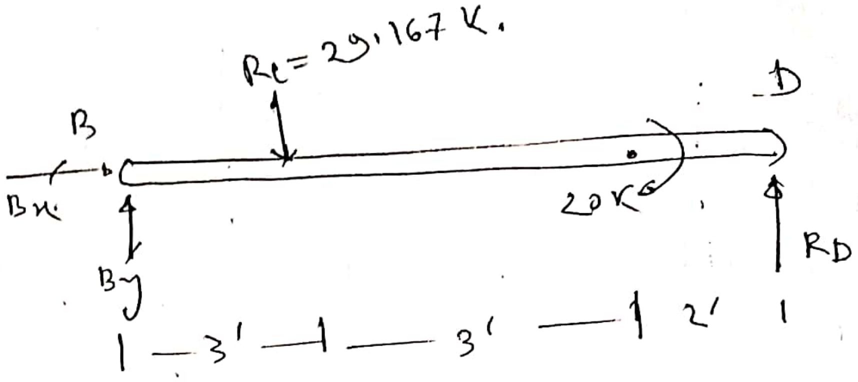
$= 5 \times 9$

$= 45 K$

Total load

$\frac{1}{2} \times 6 \times 10 = 30 K$

consider the free body diagram of the beam BD.



$\Sigma M_B = 0$

$\Rightarrow 29.167 \times 3 + 20 - R_D \times \cancel{8}\, 8 =$

$\therefore R_D = 13.44$ K.

$\Sigma F_x = 0$

$B_x = 0$

$\Sigma F_y = 0$

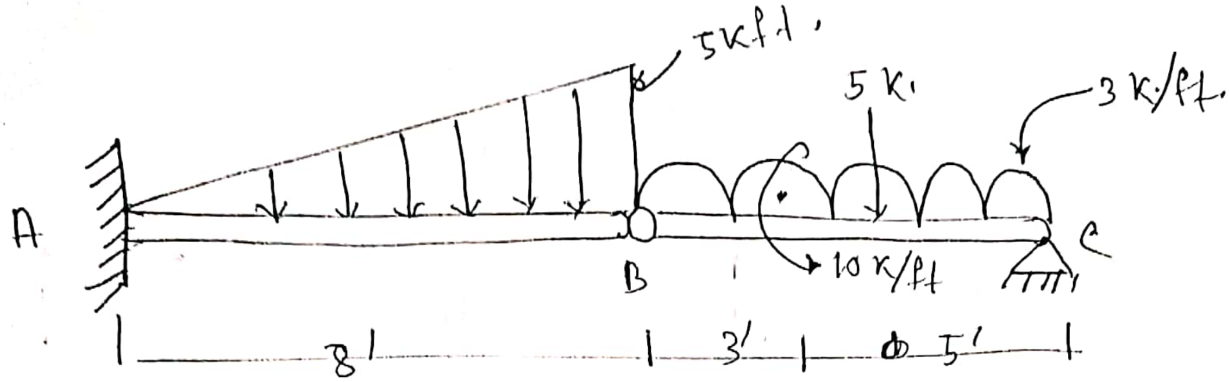
$\Rightarrow B_y + R_D - R_C = 0$

$\Rightarrow B_y = 29.167 - 13.44 = 15.73$ K

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

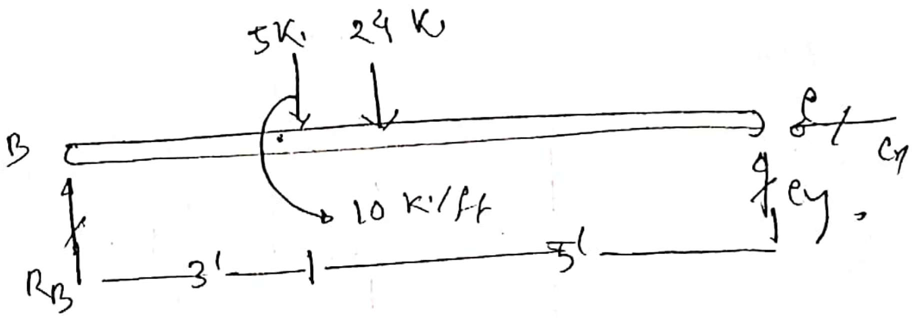
$= 15.73$ K

Find the reaction at A, B and C



Sol^n

consider the free body diagram of BC.



$\Sigma M_C = 0$

$R_B \times 8 - 5\times5 - 24\times4 - 10 = 0$

$\therefore R_B = 16.3$ K.

$\Sigma F_x = 0$

$\therefore C_x = 0$

$\Sigma F_y = 0$

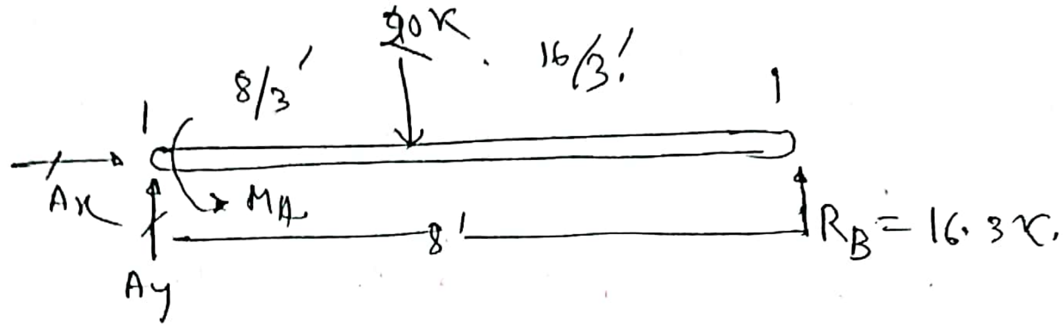
$\Rightarrow R_B + C_y - 5 - 24 = 0$

$\therefore C_y = 12.7$ k.

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

$= 12.7$ k.

consider the free body diagram of AB.



$\Sigma M_A = 0$

$\Rightarrow M_A - 20 \times \frac{8}{3} - R_B \times 8 = 0$

$\therefore M_A = 183.73$.

$\Sigma F_x = 0$

$\therefore A_x = 0$

$\Sigma F_y = 0$

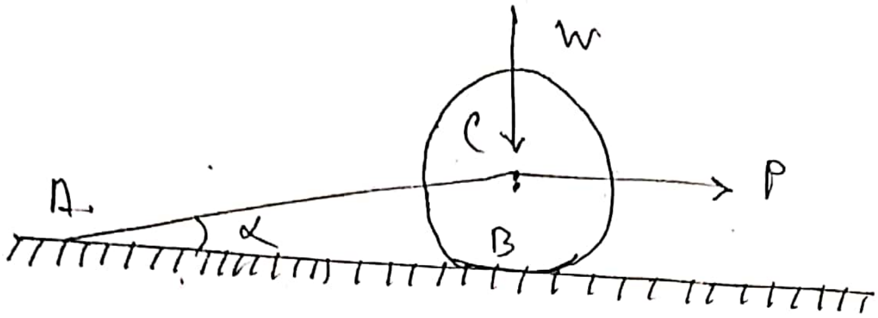
$\therefore A_y + R_B - 20 = 0$

$\therefore A_y = 3.7$.

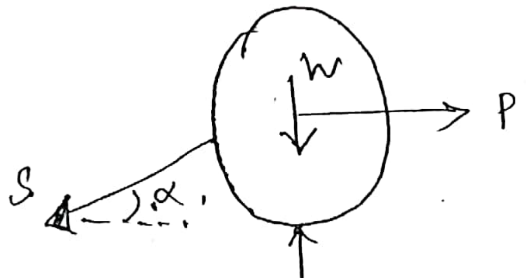
$\therefore$

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

$= 3.7K$



Ans - consider the free body diagram of the figure



$\Sigma F_x = 0$

$S\cos\alpha - P = 0$

$S = \frac{P}{\cos\alpha} = P\sec\alpha$

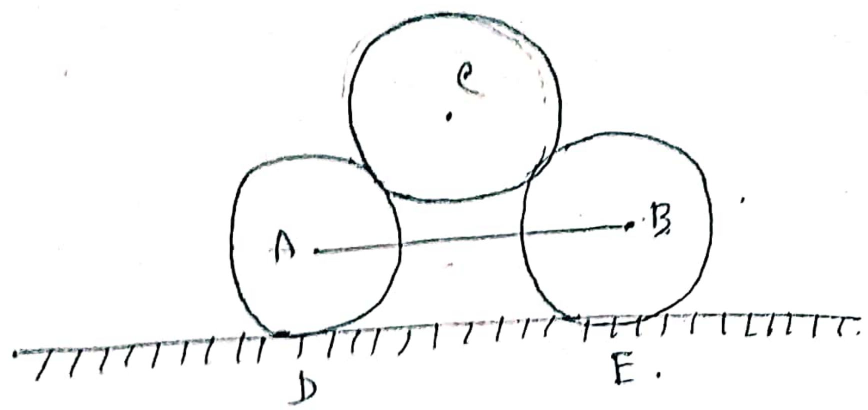
$\Sigma F_y = 0$

$R_B - W - S\sin\alpha = 0$

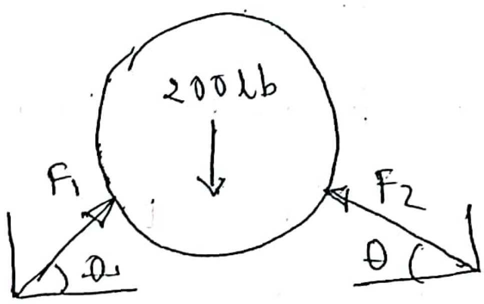
$\Rightarrow R_B = W + S\sin\alpha = W + P\sec\alpha \cdot \sin\alpha$

$= (W + P\tan\alpha)$

$\boxed{3}$.



$\boxed{\text{Solve}}$ consider the free body diagram of the cylinder C



$\Sigma F_x = 0$

$\Rightarrow F_1 \cos\theta - F_2 \cos\theta = 0$

$\Rightarrow F_1 = F_2 \quad \cdots (1)$

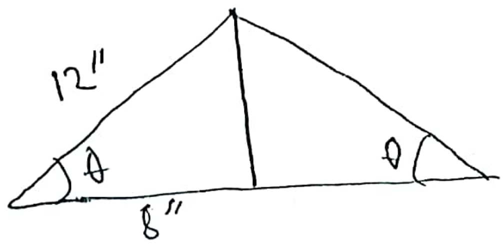
$\Sigma F_y = 0$

$F_1 \sin 48.19^\circ + F_2 \sin 48.19^\circ - 200 = 0$

$2F_2 \sin 48.19^\circ = 200$

$\Rightarrow F_2 = 134.16 \text{ lb.}$

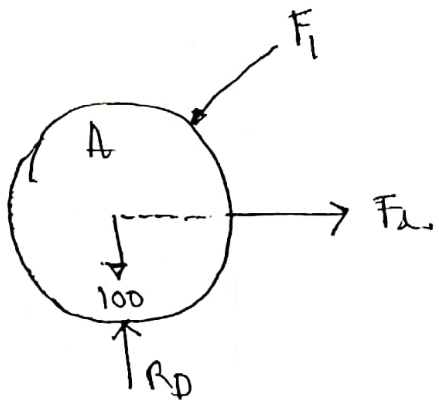
$\therefore F_2 = 134.16 \text{ lb}$



$\cos\theta = \dfrac{8}{12}$

$\therefore \theta = 48.19^\circ$

...en the free body diagram of A.



$\Sigma F_x = 0$

$F_L - F_1 \cos 48.19^\circ = 0$

$F_L = 134.16 \times \cos 48.19^\circ$

$\therefore F_L = 89.44$ lb.

$\Sigma F_y = 0$

$R_D - 100 - F_1 \sin 48.19^\circ = 0$

$\therefore R_D = 200$ lb

Since A and B identical.

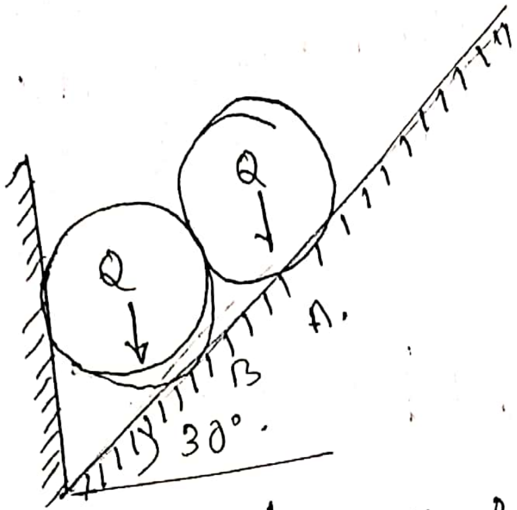
$F_D = F_E$

$\therefore F_D = F_E = 200$ lb.

$\therefore S = F_L = 89.44$ lb

$Q = 100$ lb.

4

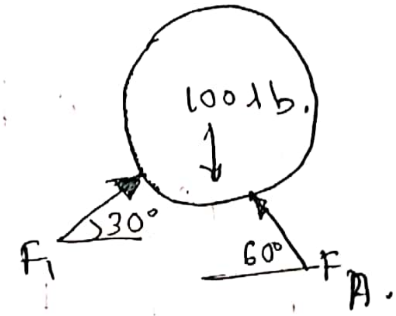


consider the free body diagram of upper roller.

$\Sigma F_x = 0$

$F_1 \cos 30° - F_A \cos 60° = 0$

$\Rightarrow F_A = F_1 \frac{\sqrt{3}}{2} \cdot \frac{2}{1} = \sqrt{3} F_1$ --(I)



$\Sigma F_y = 0$

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

$\Rightarrow F_1 \cdot \frac{1}{2} + \sqrt{3} F_1 \frac{\sqrt{3}}{2} = 100$

$\therefore F_1 = 50$ lb

$\therefore F_A = \sqrt{3} \times 50$

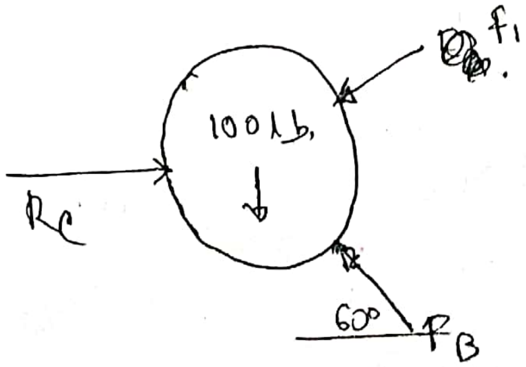
$= 86.60$ lb

consider the free body diagram of the lower roller.

$\Sigma F_x = 0$

$\Rightarrow R_C - F_1 \cos 30° - F_B \cos 60° = 0$

$\Rightarrow R_C = F_B \cdot \frac{1}{2} + 50 \cdot \frac{\sqrt{3}}{2}$ --(II).



$\Sigma F_y = 0$

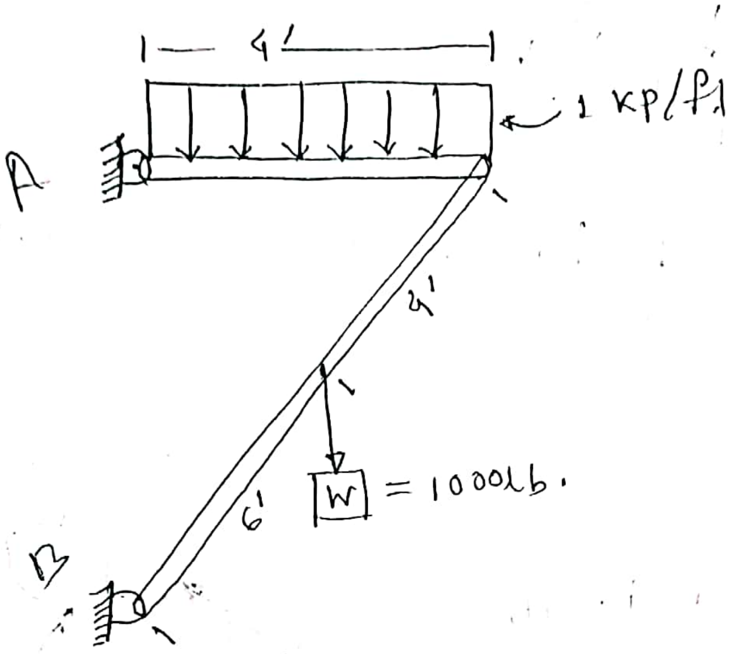
$\Rightarrow F_B \sin 60° - F_1 \sin 30° - 100 = 0$

$\Rightarrow F_B = 144.34$ lb

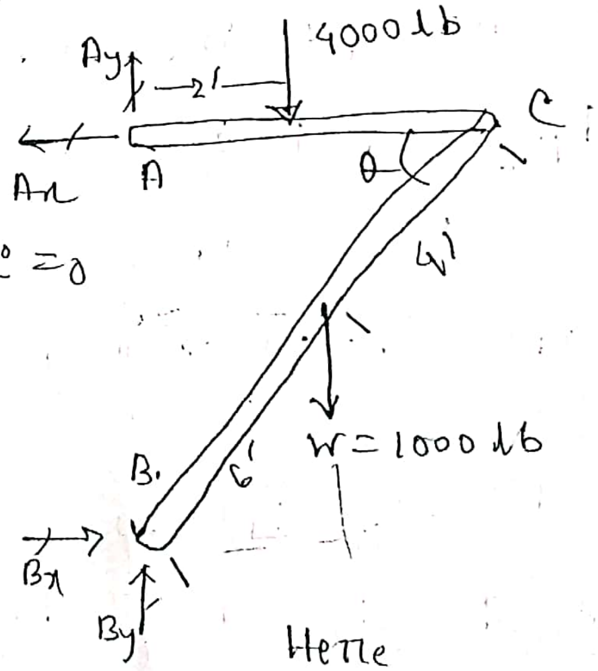
(II) $\Rightarrow$

$R_C = 115.47$ lb

Determine the horizontal and vertical components
the forces developed at pin connections A, B, and C for
the two member frame.



Solve: consider the free body diagram of the frame



$M_B = 0$

$\underline{000 \times 6 \cos 66.42°}$

$00 \times 6 \cos 66.42° + 4000 \times 2 - A_x \times 10 \sin 66.42° = 0$

$A_x = 1134.77\ lb = 1.134\ kip.$

Here

$\cos\theta = \frac{4}{10}$

$\therefore \theta = 66.42°$

$F_x = 0$

$A_x - B_x = 0$

$\therefore B_x = A_x = 113.77\ lb.$

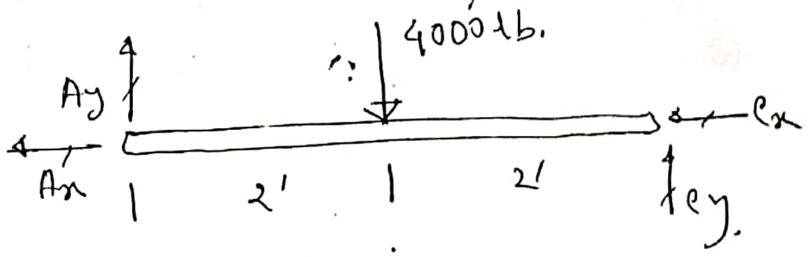
$F_y = 0$

$A_y + B_y - 4000 - 1000 = 0$

$A_y + B_y = 5000 \longleftarrow (1)$

Scanned by CamScanner

consider the free body diagram of AC



$\Sigma M_C = 0$

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

$\therefore A_y = 2000$ lb.

(1) $\Rightarrow A_y + B_y = 5000 \Rightarrow B_y = 3000$ lb.

$\Sigma F_y = 0$

$\Rightarrow A_y + C_y - 4000 = 0$

$\Rightarrow C_y = 2000$ lb

$\Sigma F_x = 0$

$\Rightarrow A_x + C_x = 0$

$\Rightarrow A_x = -C_x = -1134.77$ lb.

$= 1134.77$ lb $(\rightarrow)$.

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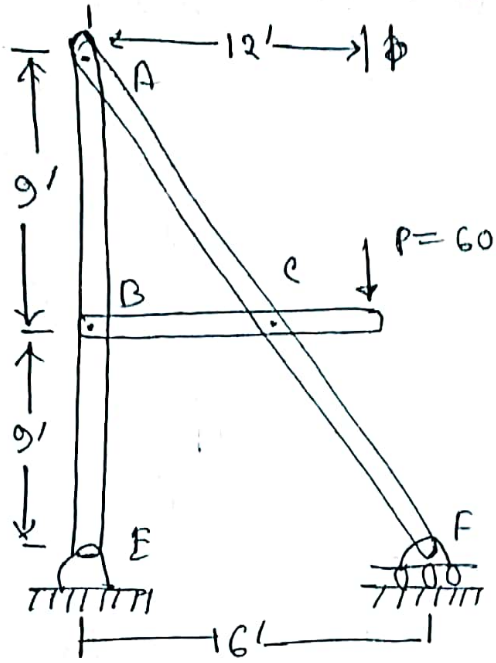
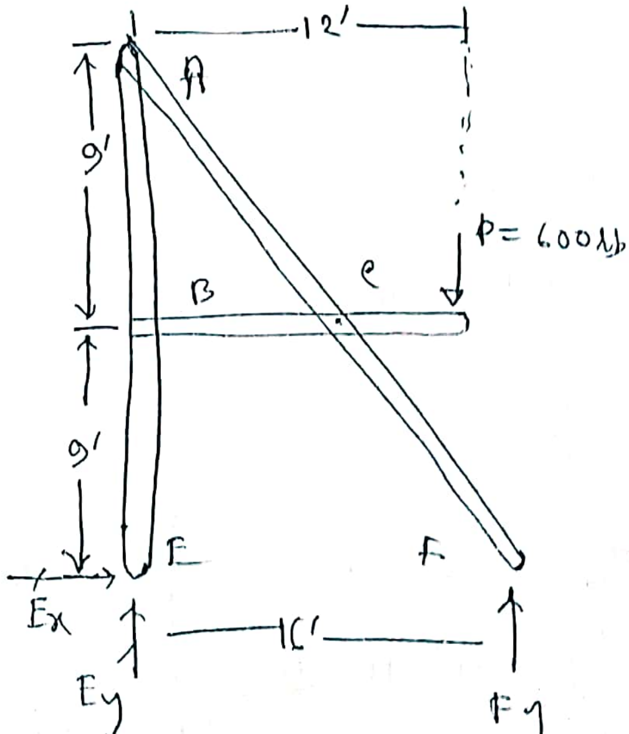
Determine the components of the force acting on each member of the frame shown



Solve] consider the free body diagram of the frame



$\Sigma M_E = 0$

$600 \times 12 - F_y \times 16 = 0$

$\therefore F_y = 450$ lb.

$\Sigma F_y = 0$

$E_y + F_y - 600 = 0$

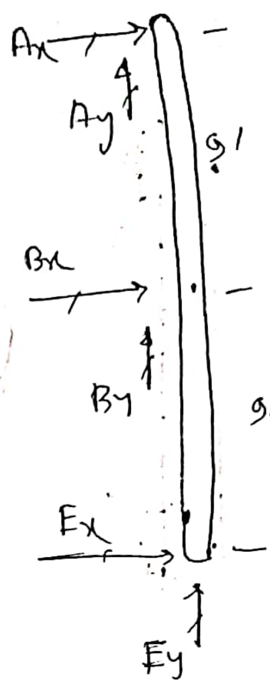
$\therefore E_y = 150$ lb.

$\Sigma F_x = 0$

$\therefore E_x = 0.$

Scanned by CamScanner

consider the free body diagram of AE.



$\Sigma M_B = 0$

$\Rightarrow A_x \times 9 + E_x \times 9 = 0$

$\therefore A_x = 0$

$\Sigma F_x = 0$

$\Rightarrow A_x + B_x + E_x = 0$

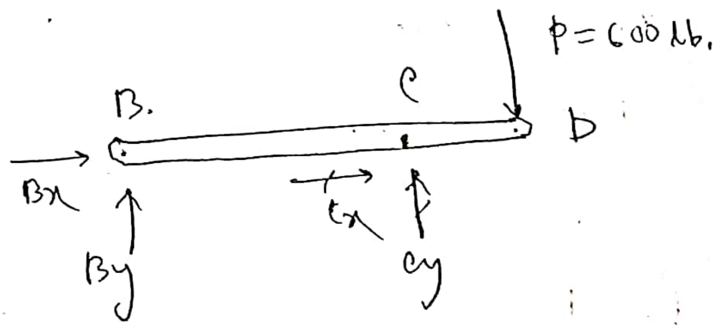
$\therefore B_x = 0.$

$\Sigma F_y = 0$

$\Rightarrow A_y + B_y + E_y = 0$

$\Rightarrow A_y + B_y = -150$ --(1).

consider the free body diagram of BD.



$\Sigma M_C = 0$

$600 \times 4 - B_y \times 8 = 0$

$\therefore B_y = 300$ lb.

(1) $\Rightarrow$

$A_y = -150 - 300$

$\Rightarrow A_y = -450$ lb

$\therefore A_y = 450$ lb $(\downarrow)$

$\Sigma F_x = 0$

$\Rightarrow C_x - B_x = 0$

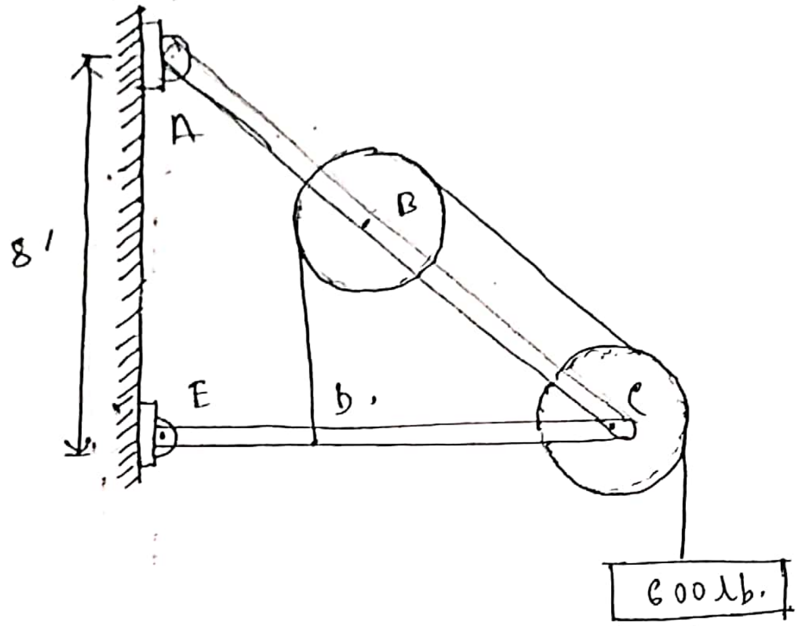
$\therefore C_x = B_x = 0$

$\Sigma F_y = 0$

$\Rightarrow C_y + B_y - 600 = 0$

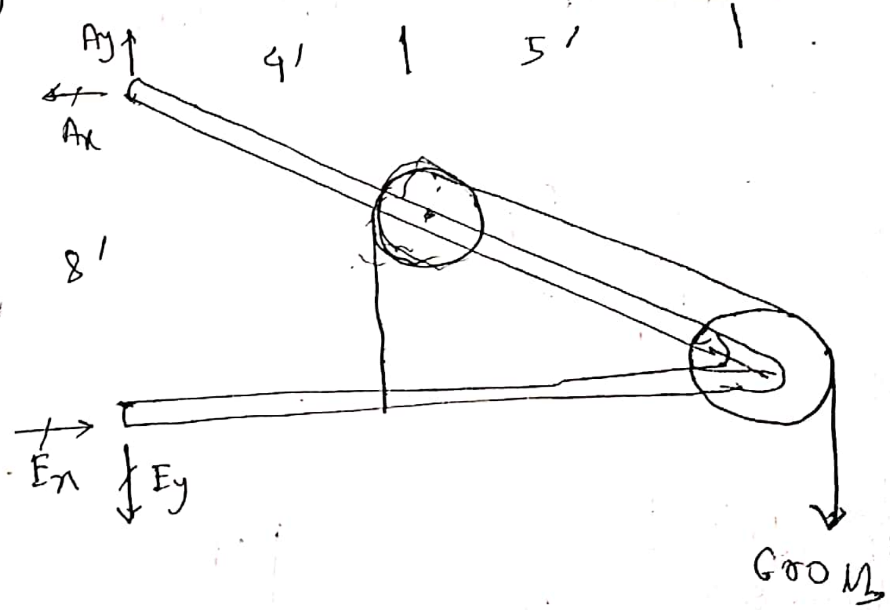
$\therefore C_y = 300$ lb

Determine that each pulley has radius of 1 ft; determine the components of the reactions at A and E.



ive

onsider the free body diagram of the frame



$M_E = 0$

$x \times 8 - 600 \times 10 = 0$

$\therefore A_x = 750$ lb.

$F_x = 0$

$A_x - E_x = 0$

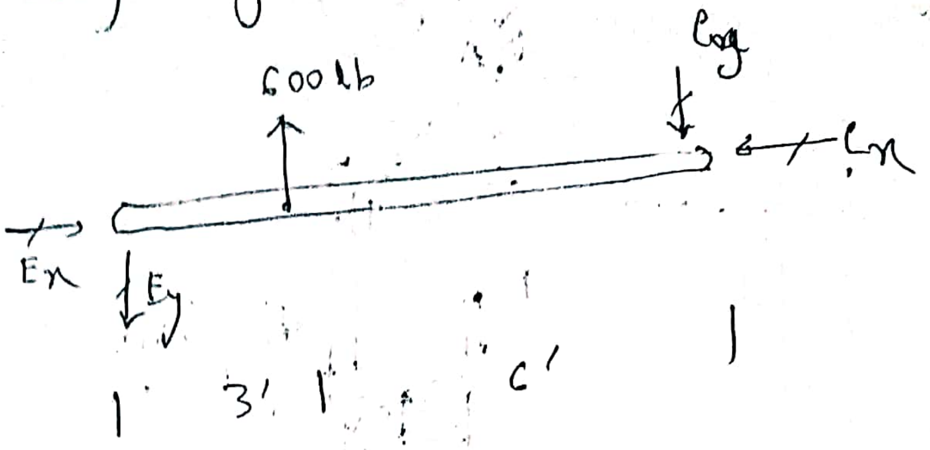
$A_x = E_x = 750$ lb.

$\Sigma F_y = 0$

$A_y - E_y - 600 = 0$

$A_y - E_y = 600$ —— (1).

consider the free body diagram of EC.



$\Sigma M_C = 0$

$\Rightarrow E_y \times 9 - 600 \times 6 = 0$

$\therefore E_y = 400\,lb$

$\Sigma F_y = 0 \Rightarrow$

$A_y - 400 = 600$

$\therefore A_y = 1000\,lb.$

$\therefore$ Reaction at A; $R_A = \sqrt{A_x^2 + A_y^2}$

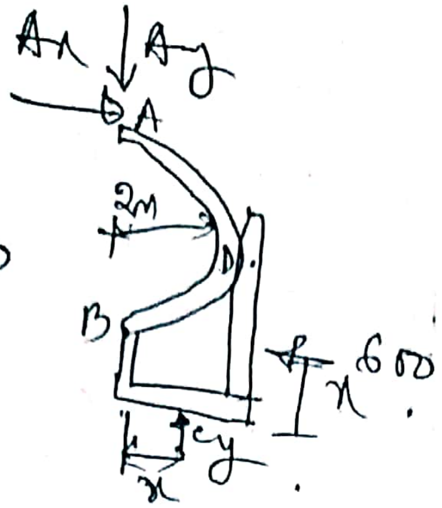
$= 1250\,lb.$

Reaction at C $R_E = \sqrt{E_x^2 + E_y^2}$

$= 850\,lb$

112 2015

$a = 150$



$\Sigma M_A = 0.$

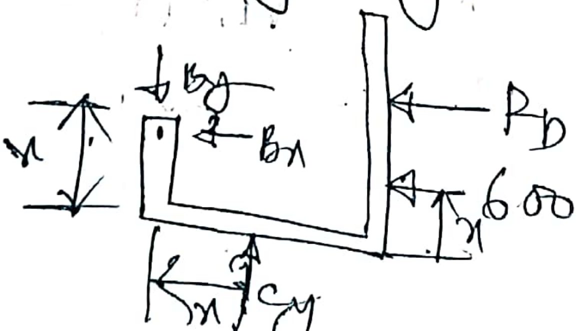
$600 \times 4x - c_y \times x = 0$

$\Sigma F_x = 0.$

$A_x - 600 = 0$

$\Sigma F_y = 0, \; A_y - c_y = 0.$

~~Again~~,



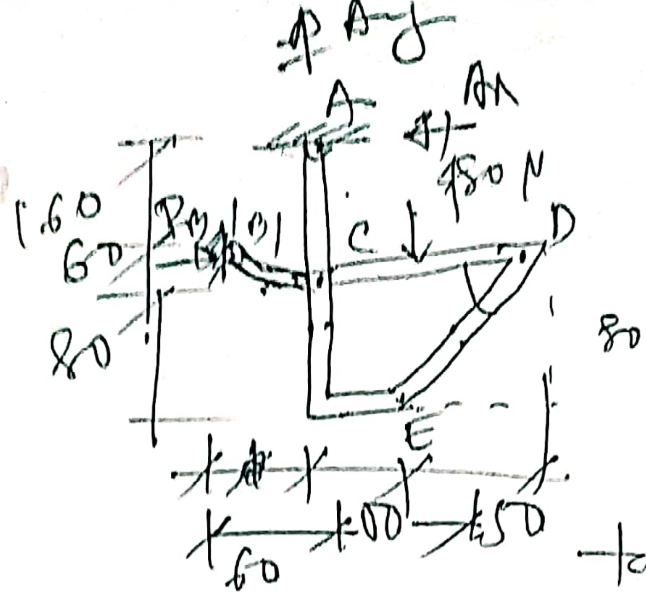
$\Sigma M_B = 0.$

$R_D \times 2x - c_y = 0.$

$\Sigma F_x = 0$

$\Sigma y = 0$

266:—



$\tan\alpha = \frac{80}{150}$

Sol^n:—

$\Sigma M_A = 0$

$480 \times 100 - R_B \times 160 = 0$

$\Rightarrow R_B = 300$

$\Rightarrow \theta = 28.07°$

$\Sigma F_x = 0.$

$R_B - A_x = 0.$

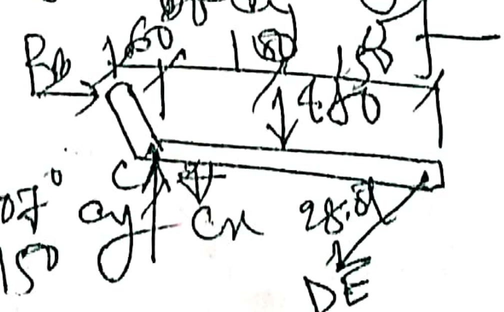
$\Rightarrow A_x = R_B = 300$

$\Sigma F_y = 0.$

$-A_y + 480 = 0$

$\Rightarrow A_y = 480.$

consider the free body BCD



$\Sigma M_C = 0$

$R_B \times 60 + 480 \times 100$
$- DE \sin 28.07° \times 150$

$\Rightarrow DE = 561$

$\Sigma F_x = 0$

$R_B + DE \cos 28.07° - C_x = 0$

$C_x = ?.$

$\Sigma F_y = 0$
$C_y - 480$
$+ DE \sin 28.07$

$C_y = ?$

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