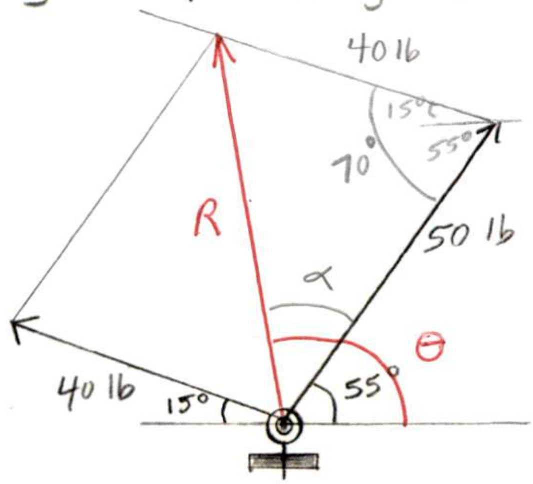
1. Determine the resultant of the two forces acting on the ring using the parallelogram Law or Triangle Rule.



Law of Cosines

$$R = \sqrt{40\text{ lb}^2 + 50\text{ lb}^2 - 2(40\text{ lb})(50\text{ lb})\cos 70^\circ}$$
$$= 52\text{ lb}$$

Law of Sines

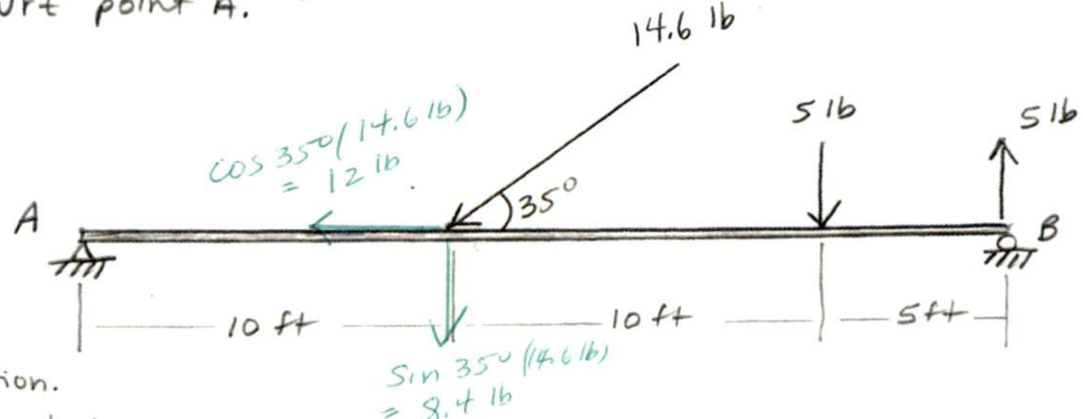
$$\frac{\sin\alpha}{40\text{ lb}} = \frac{\sin 70^\circ}{52\text{ lb}}$$

$$\alpha = \sin^{-1}\left(\frac{40\text{ lb}(\sin 70^\circ)}{52\text{ lb}}\right) = 46^\circ$$

$$\theta = 55^\circ + 46^\circ = 101^\circ$$

$$\boxed{R = 52\text{ lb} \angle 101^\circ}$$

2. Determine the magnitude, direction, and Location for the forces acting on the beam. Locate the resultant wrt point A.



solution.

Magnitude

$R_x = \Sigma F_x = $ 12 lb ←

$R_y = \Sigma F_y = $ 8.4 lb ↓

Resultant lies in Quad 3.

$R = \sqrt{R_x^2 + R_y^2} = \sqrt{12\ \text{lb}^2 + 8.4\ \text{lb}^2} = 14.6\ \text{lb}$

Direction

$\alpha = \tan^{-1}\left|\frac{R_y}{R_x}\right| = \tan^{-1}\left|\frac{8.4}{12}\right| = 35°$

$\Theta = 180° + 35° = 215°$

Location

$R_y \bar{x} = \Sigma M_A$

CCW +M ↺
CW −M ↻
"couple"

$-8.4\ \text{lb}\ \bar{x} = -8.4\ \text{lb}(10\ \text{ft}) + 5\ \text{lb}(5\ \text{ft})$

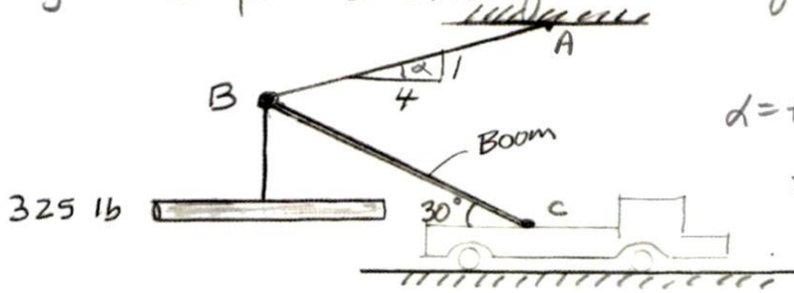
$= -84\ \text{lb}\cdot\text{ft} + 25\ \text{lb}\cdot\text{ft}$

$= -59\ \text{lb}\cdot\text{ft}$

$\bar{x} = \frac{59\ \text{lb ft}}{8.4\ \text{lb}} = 7\ \text{ft}$ to the right of A

ANS $R = 14.6$ lb ⦨ 215° located 7 ft to the right of A

3. Determine the tension in the cable (T_{AB}) and the force in the boom (F_{BC}) using (a) the force-triangle method and (b) rectangular components and equilibrium equations.

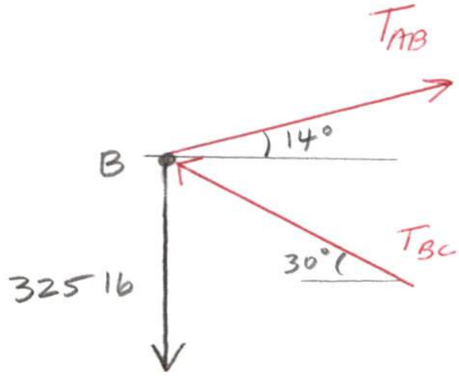


$\alpha = \tan^{-1}\frac{1}{4}$

$= 14°$

Solution.

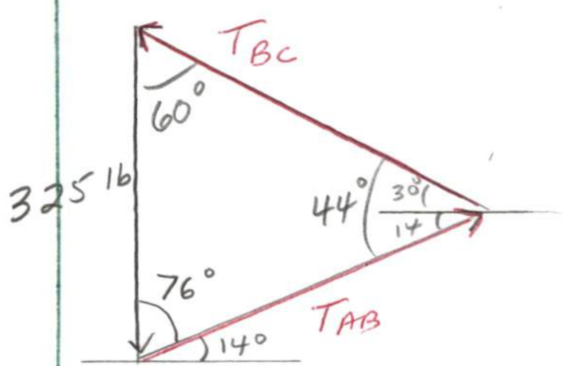
(a) Force-Triangle Method



FBD

Law of Sines

$$\frac{T_{BC}}{\sin 76°} = \frac{T_{AB}}{\sin 60°} = \frac{325\text{ lb}}{\sin 44°}$$

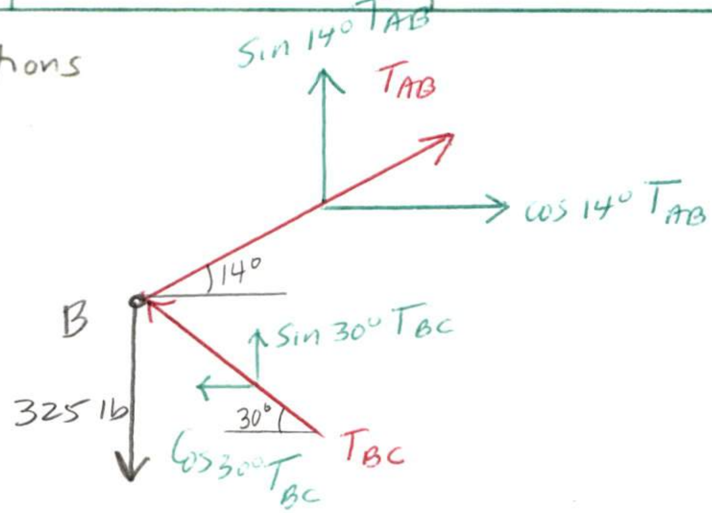


$$T_{BC} = \frac{\sin 76° (325\text{ lb})}{\sin 44°} = 454\text{ lb}$$

$$T_{AB} = \frac{\sin 60° (325\text{ lb})}{\sin 44°} = 405\text{ lb}$$

Force-Triangle

(b) Equilibrium Equations



FBD

Equilibrium Equations

$[\Sigma F_x = 0]$ $\quad -\cos 30° \, T_{BC} + \cos 14° \, T_{AB} = 0$ (1)

$[\Sigma F_y = 0]$ $\quad \sin 30° \, T_{BC} + \sin 14° \, T_{AB} - 325 \text{ lb} = 0$ (2)

Cramer's Rule

$$D = \begin{vmatrix} -\cos 30° & \cos 14° \\ \sin 30° & \sin 14° \end{vmatrix} = -0.694658$$

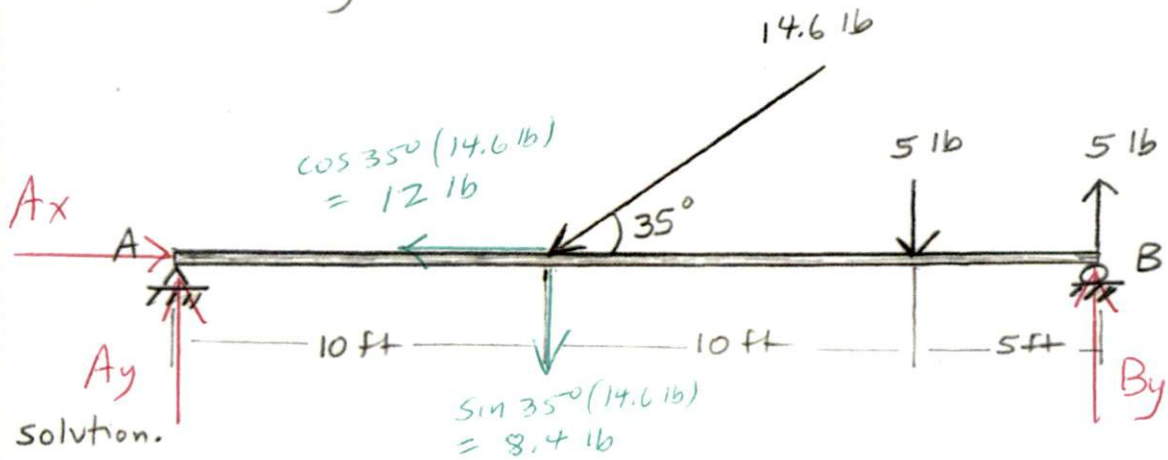
$$D_x = \begin{vmatrix} 0 & \cos 14° \\ 325 \text{ lb} & \sin 14° \end{vmatrix} = -315 \text{ lb}$$

$$D_y = \begin{vmatrix} -\cos 30° & 0 \\ \sin 30° & 325 \text{ lb} \end{vmatrix} = -281 \text{ lb}$$

$$T_{BC} = \frac{-315 \text{ lb}}{-0.694658} = \underline{\underline{454}} \text{ lb}$$

$$T_{AB} = \frac{-281 \text{ lb}}{-0.694658} = \underline{\underline{405}} \text{ lb}$$

4. Determine the reactions at the supports for the forces acting on the beam.



solution.

FBD

ccw +M
cw −M

Equilibrium Equations

$[\Sigma F_x = 0]$ $\quad A_x - 12\text{ lb} = 0$

$$A_x = 12\text{ lb} \rightarrow$$

$[\Sigma M_A = 0]$ $\quad -8.4\text{ lb}(10\text{ ft}) + 5\text{ lb}(5\text{ ft}) + B_y(25\text{ ft}) = 0$

$$B_y = \frac{59\text{ lb}\cdot\text{ft}}{25\text{ ft}} = 2.4\text{ lb} \uparrow$$

$[\Sigma F_y = 0]$ $\quad A_y - 8.4\text{ lb} - 5\text{ lb} + 5\text{ lb} + B_y = 0$

$$A_y = 8.4\text{ lb} - 2.4\text{ lb} = 6\text{ lb} \uparrow$$