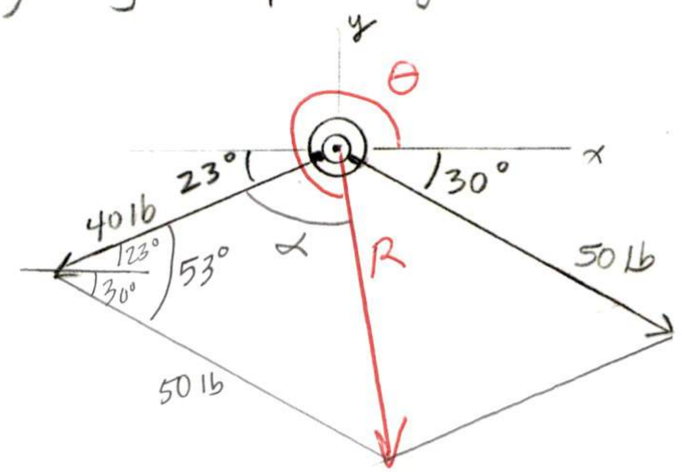
1. Determine the resultant of the two forces acting on the ring using the parallelogram Law or Triangle Rule.



Law of Cosines

$$R = \sqrt{40\,lb^2 + 50\,lb^2 - 2(40\,lb)(50\,lb)\cos 53^\circ}$$

$$= \underline{\underline{41\ lb}}$$

Law of Sines

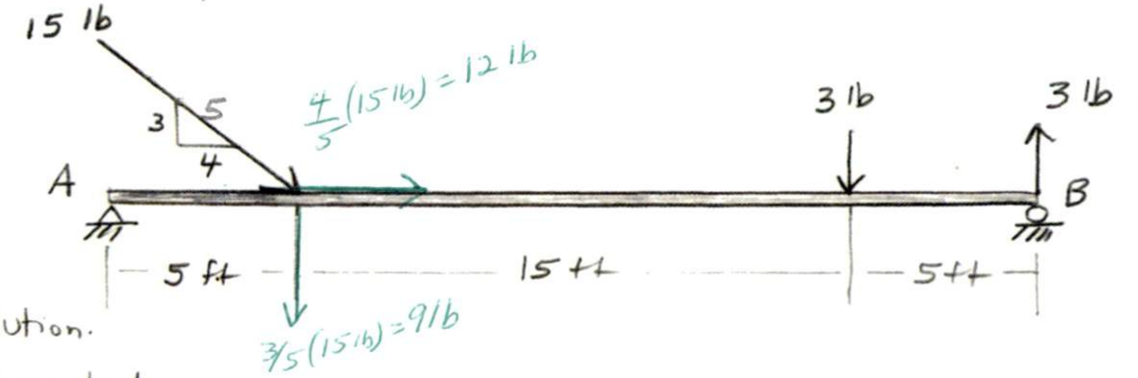
$$\frac{\sin\alpha}{50\,lb} = \frac{\sin 53^\circ}{41\,lb}$$

$$\alpha = \sin^{-1}\left(\frac{50\,lb\,(\sin 53^\circ)}{41\,lb}\right) = 77^\circ$$

$$\theta = 180^\circ + 23^\circ + 77^\circ = 280^\circ$$

$$\boxed{R = 41\ lb \ \angle\ 280^\circ}$$

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 →

$R_y = \Sigma F_y = -9\text{ lb} + 3\text{ lb} - 3\text{ lb} = 9\text{ lb}$ ↓

$R = \sqrt{R_x^2 + R_y^2} = \sqrt{12\text{ lb}^2 + 9\text{ lb}^2} = 15\text{ lb}$

Resultant lies in Quad 4

Direction

$\alpha = \tan^{-1}\left|\frac{R_y}{R_x}\right| = \tan^{-1}\left|\frac{9}{12}\right| = 37°$

$\theta = 360° - 37° = 323°$

Location

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

$$= -9\text{ lb}(5\text{ ft}) + 3\text{ lb}(5\text{ ft})$$

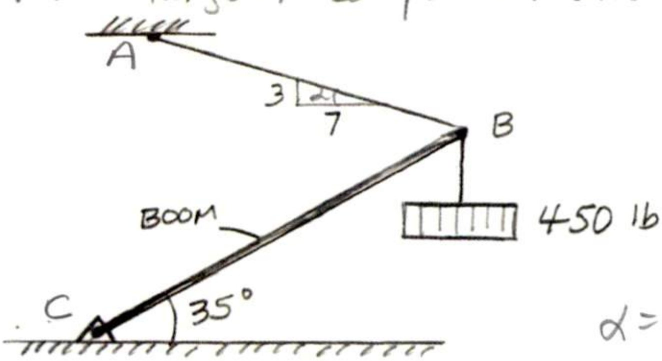
$$= -45\text{ lb}\cdot\text{ft} + 15\text{ lb}\cdot\text{ft}$$

$$\cancel{-}9\text{ lb}\,\bar{x} = \cancel{-}30\text{ lb}\cdot\text{ft}$$

$$\bar{x} = \frac{30\text{ lb}\cdot\text{ft}}{9\text{ lb}} = 3.3\text{ ft}$$ to the right of pt A

Ans. R = 15 lb ⤺ 323° located 3.3 ft to the right of A

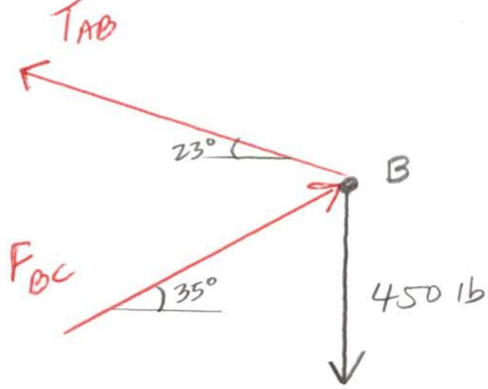
3. Determine the tension in the cable (T_{AB}) and the force in the boom (F_{BC}) using (a) the force-triangle method and (b) rectangular components and equilibrium equations.



$$\alpha = \tan^{-1}\frac{3}{7} = 23°$$

solution.

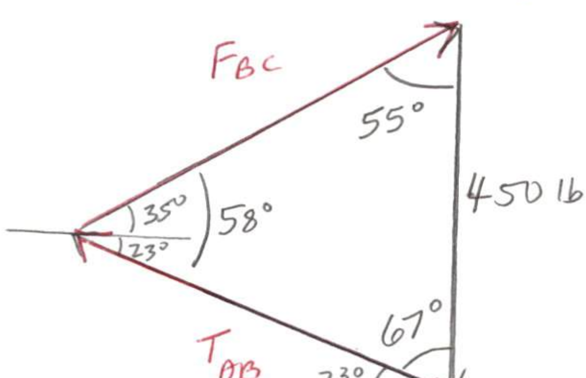
(a) Force-Triangle Method



FBD

Law of Sines

$$\frac{F_{BC}}{\sin 67°} = \frac{T_{AB}}{\sin 55°} = \frac{450 \text{ lb}}{\sin 58°}$$

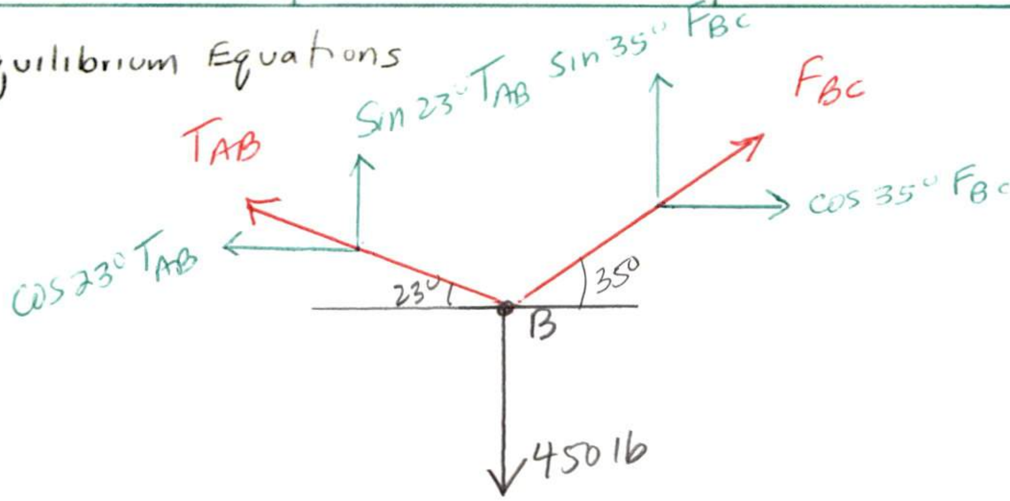


Force-Triangle

$$F_{BC} = \frac{\sin 67° (450 \text{ lb})}{\sin 58°} = \underline{\underline{488 \text{ lb}}}$$

$$T_{AB} = \frac{\sin 55° (450 \text{ lb})}{\sin 58°} = \underline{\underline{435 \text{ lb}}}$$

(b) Equilibrium Equations



FBD

Equilibrium Equations

$[\Sigma F_x = 0]$ $\quad -\cos 23°\, T_{AB} + \cos 35°\, F_{BC} = 0 \quad (1)$

$[\Sigma F_y = 0]$ $\quad \sin 23°\, T_{AB} + \sin 35°\, F_{BC} - 450\text{ lb} = 0 \quad (2)$

From (1) $\quad F_{BC} = \dfrac{\cos 23°\, T_{AB}}{\cos 35°} \quad (3)$

subst. into (2)

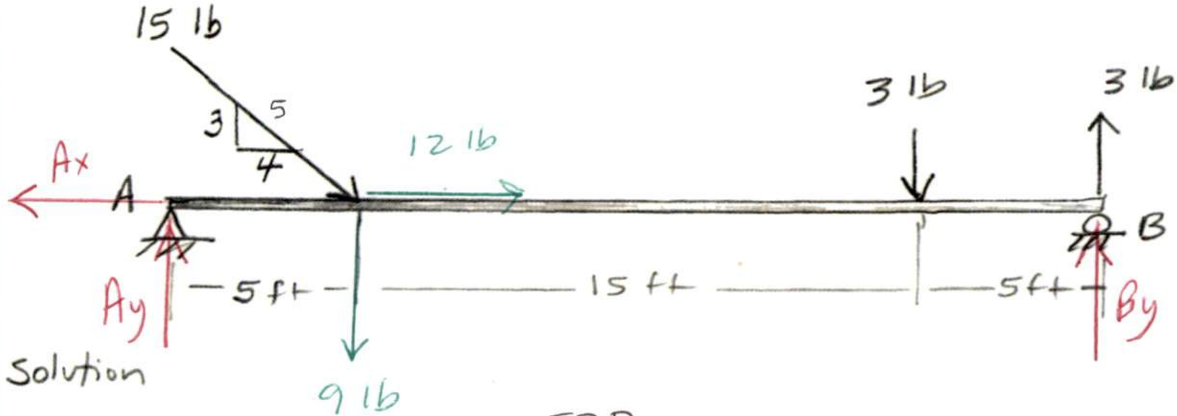
$$\sin 23°\, T_{AB} + \sin 35° \left(\frac{\cos 23°\, T_{AB}}{\cos 35°} \right) = 450\text{ lb}$$

$$T_{AB} = \frac{450\text{ lb}}{\left(\sin 23° + \dfrac{\sin 35° \cos 23°}{\cos 35°} \right)} = \underline{\underline{435}}\text{ lb}$$

From (3)

$$F_{BC} = \frac{\cos 23° \,(435\text{ lb})}{\cos 35°} = \underline{\underline{488}}\text{ lb}$$

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



Solution

FBD

CCW +M

CW −M

Equilibrium Equations

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

$$A_x = \underline{\underline{12\text{ lb}}} \leftarrow$$

$[\Sigma M_A = 0]$ $\quad -9\text{ lb}(5\text{ ft}) + 3\text{ lb}(5\text{ ft}) + B_y(25\text{ ft}) = 0$

$$B_y = \frac{30\text{ lb-ft}}{25\text{ ft}} = \underline{\underline{1.2\text{ lb}}} \uparrow$$

$[\Sigma F_y = 0]$ $\quad A_y - 9\text{ lb} - 3\text{ lb} + 3\text{ lb} + B_y = 0$

$$A_y = 9\text{ lb} - 1.2\text{ lb} = \underline{\underline{7.8\text{ lb}}} \uparrow$$