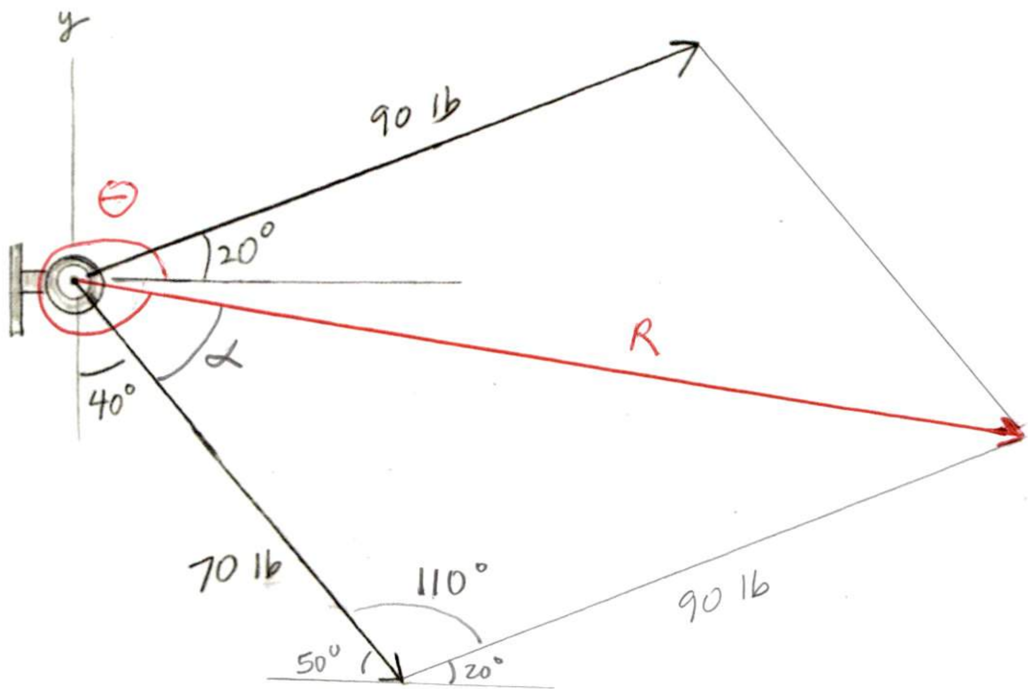
1. Determine the resultant of the two forces acting on the ring using the parallelogram Law or Triangle Rule.



Law of Cosines

$$R = \sqrt{70\,lb^2 + 90\,lb^2 - 2(70\,lb)(90\,lb)\cos 110°}$$

$$= 132\ lb$$

Law of Sines

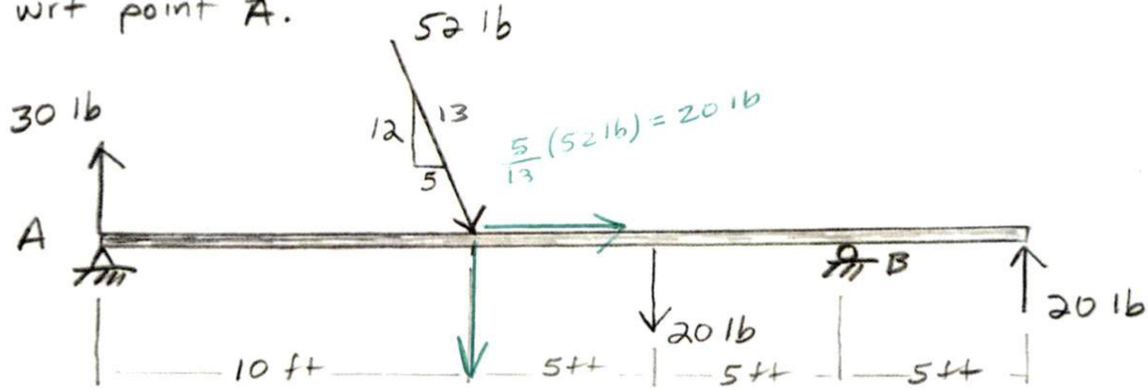
$$\frac{\sin\alpha}{90\,lb} = \frac{\sin 110°}{132\,lb}$$

$$\alpha = \sin^{-1}\left(\frac{90\,lb(\sin 110°)}{132\,lb}\right) = 40°$$

$$\theta = 270° + 40° + 40° = 350°$$

$$\boxed{R = 132\ lb\ \measuredangle\ 350°}$$

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



Solution.

Magnitude

$R_x = \Sigma F_x =$ 20 lb →

$R_y = \Sigma F_y =$ 30 lb − 48 lb − 20 lb + 20 lb = −18 lb = 18 lb ↓

$R = \sqrt{R_x^2 + R_y^2} = \sqrt{20\,lb^2 + 18\,lb^2} = 27\,lb$

Resultant lies in Quad 4.

Direction

$\alpha = \tan^{-1}\left|\frac{R_y}{R_x}\right| = \tan^{-1}\left|\frac{18}{20}\right| = 42°$

$\theta = 360° - 42° = 318°$

Location

ccw +M ↺
cw −M ↻
"couple"

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

$$\cancel{-}18\,lb\,\bar{x} = -48\,lb(10\,ft) + 20\,lb(10\,ft)$$

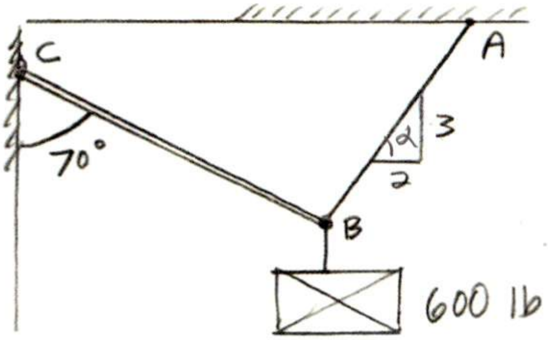
$$= -480\,lb \cdot ft + 200\,lb \cdot ft$$

$$= \cancel{-}280\,lb \cdot ft$$

$$\bar{x} = \frac{280\,lb \cdot ft}{18\,lb} = 15.5\,ft$$ to the right of pt. A

ANS. R = 27 lb ↻ 318° located 15.5 ft to the right of A

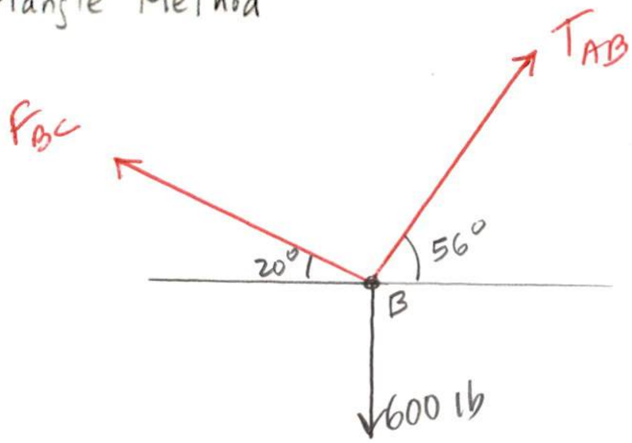
3. Determine the force in the boom and the cable using (a) the force-triangle method and (b) rectangular components and equilibrium equations.



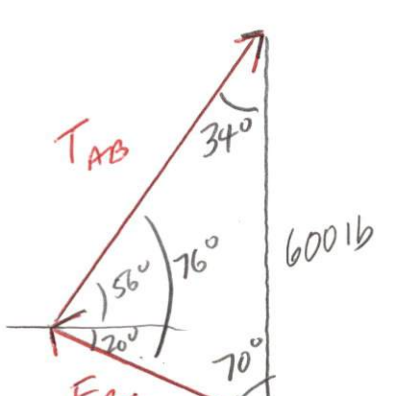
$\alpha = \tan^{-1}\frac{3}{2}$
$= 56°$

Solution.

(a) Force-Triangle Method



FBD



Force-Triangle

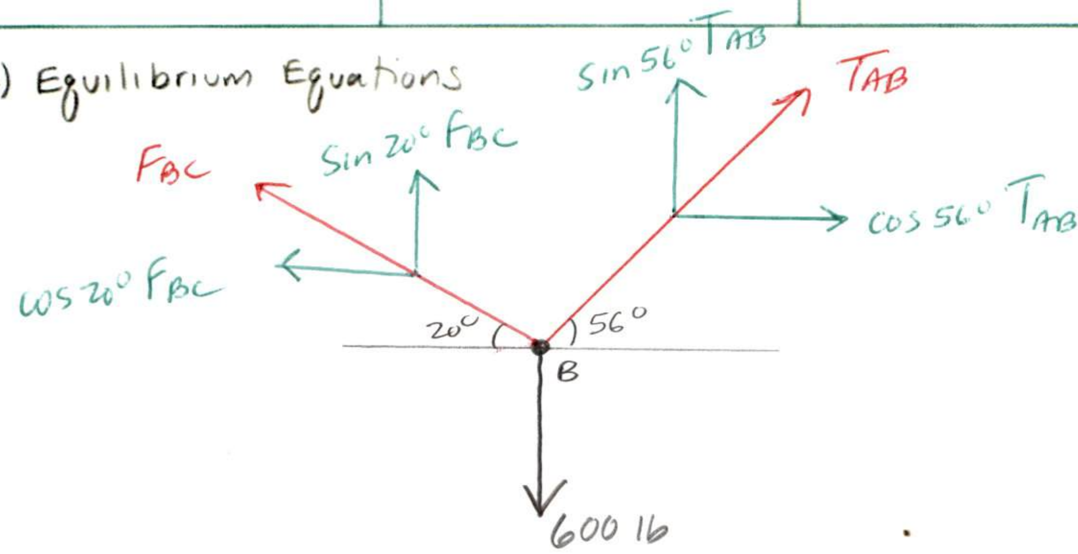
Law of Sines

$$\frac{T_{AB}}{\sin 70°} = \frac{F_{BC}}{\sin 34°} = \frac{600\text{ lb}}{\sin 76°}$$

$$T_{AB} = \frac{\sin 70° (600 \text{ lb})}{\sin 76°} = \underline{\underline{581 \text{ lb}}}$$

$$F_{BC} = \frac{\sin 34° (600 \text{ lb})}{\sin 76°} = \underline{\underline{346 \text{ lb}}}$$

(b) Equilibrium Equations



FBD

Equilibrium Equations

$[\Sigma F_x = 0] \qquad -\cos 20^\circ F_{BC} + \cos 56^\circ T_{AB} = 0 \qquad (1)$

$[\Sigma F_y = 0] \qquad \sin 20^\circ F_{BC} + \sin 56^\circ T_{AB} - 600\text{ lb} = 0 \qquad (2)$

From (1) $\quad T_{AB} = \dfrac{\cos 20^\circ F_{BC}}{\cos 56^\circ} \qquad (3)$

Subst (3) into (2)

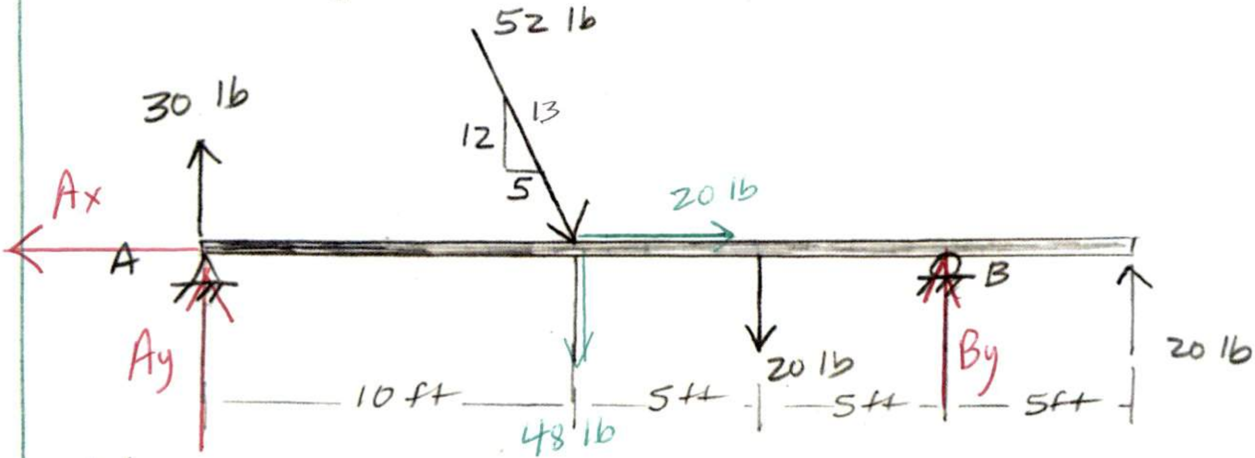
$$\sin 20^\circ F_{BC} + \sin 56^\circ \left(\frac{\cos 20^\circ F_{BC}}{\cos 56^\circ} \right) = 600\text{ lb}$$

$$F_{BC} = \frac{600\text{ lb}}{\left(\sin 20^\circ + \dfrac{\sin 56^\circ \cos 20^\circ}{\cos 56^\circ} \right)} = \underline{\underline{346}}\text{ lb}$$

From (3)

$$T_{AB} = \frac{\cos 20^\circ (346\text{ lb})}{\cos 56^\circ} = \underline{\underline{581}}\text{ lb}$$

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



Solution.

FBD

Equilibrium Equations

ccw + M
cw − M

$[\Sigma F_x = 0] \quad -A_x + 20\text{ lb} = 0$

$A_x = 20\text{ lb} \leftarrow$

"couple"

$[\Sigma M_A = 0] \quad -48\text{ lb}\,(10\text{ ft}) + 20\text{ lb}\,(10\text{ ft}) + B_y\,(20\text{ ft}) = 0$

$B_y = \dfrac{280\text{ lb}\cdot\text{ft}}{20\text{ ft}} = 14\text{ lb} \uparrow$

$[\Sigma F_y = 0] \quad A_y + 30\text{ lb} - 48\text{ lb} - 20\text{ lb} + 20\text{ lb} + B_y = 0$

$A_y = 48\text{ lb} - 30\text{ lb} - 14\text{ lb} = 4\text{ lb} \uparrow$