

Engineering Calculation Report: Problem 2-9

November 29, 2025

1 Known Variables

Vector	F_x (lbf)	F_y (lbf)	$ \vec{F} $ (lbf)	θ (deg)	Reference
\vec{F}_B	779.4	-450.0	900.0	60.0	-y
\vec{F}_R	1200.0	0.0	1200.0	0.0	+x

2 Unknown Variables

Vector	F_x (lbf)	F_y (lbf)	$ \vec{F} $ (lbf)	θ (deg)	Reference
\vec{F}_A	?	?	?	?	+x

3 Equations Used

- $|\vec{F}_A|^2 = |\vec{F}_B|^2 + |\vec{F}_R|^2 - 2 \cdot |\vec{F}_B| \cdot |\vec{F}_R| \cdot \cos(\angle(\vec{F}_B, \vec{F}_R))$
- $\frac{\sin(\angle(\vec{F}_R, \vec{F}_A))}{|\vec{F}_B|} = \frac{\sin(\angle(\vec{F}_B, \vec{F}_R))}{|\vec{F}_A|}$

4 Step-by-Step Solution

Step 1: Solve for $\angle(\vec{F}_B, \vec{F}_R)$

$$\begin{aligned}\angle(\vec{F}_B, \vec{F}_R) &= |\angle(-\vec{y}, \vec{F}_B) - \angle(\vec{x}, \vec{F}_R)| \\ &= |60^\circ - 0^\circ| \\ &= 30^\circ\end{aligned}$$

Step 2: Solve for $|\vec{F}_A|$ using Eq 1

$$\begin{aligned}|\vec{F}_A| &= \sqrt{(900)^2 + (1200)^2 - 2(900)(1200)\cos(30^\circ)} \\ &= 615.9 \text{ lbf}\end{aligned}$$

Step 3: Solve for $\angle(\vec{F}_R, \vec{F}_A)$ using Eq 2

$$\begin{aligned}\angle(\vec{F}_R, \vec{F}_A) &= \sin^{-1}\left(900.0 \cdot \frac{\sin(30^\circ)}{615.9}\right) \\ &= 46.9^\circ\end{aligned}$$

Step 4: Solve for $\angle(\vec{x}, \vec{F}_A)$ with respect to $+x$

$$\begin{aligned}\angle(\vec{x}, \vec{F}_A) &= \angle(\vec{F}_R, \vec{F}_A) \text{ (since } F_R \text{ is along } +x) \\ &= 46.9^\circ\end{aligned}$$

5 Summary of Results

Vector	F_x (lbf)	F_y (lbf)	$ \vec{F} $ (lbf)	θ (deg)	Reference
\vec{F}_A	420.6	450.0	615.9	46.9	$+x$

Disclaimer

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