

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

$$1. |\vec{F}_A|^2 = |\vec{F}_B|^2 + |\vec{F}_R|^2 - 2 \cdot |\vec{F}_B| \cdot |\vec{F}_R| \cdot \cos(\angle(\vec{F}_B, \vec{F}_R))$$

$$2. \frac{\sin(\angle(\vec{F}_R, \vec{F}_A))}{|\vec{F}_B|} = \frac{\sin(\angle(\vec{F}_B, \vec{F}_R))}{|\vec{F}_A|}$$

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

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

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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