

Engineering Calculation Report: Problem 2-12

November 29, 2025

1 Known Variables

Vector	F_x (N)	F_y (N)	$ \vec{F} $ (N)	θ (deg)	Reference
\vec{F}_B	3856.7	-4596.3	6000.0	40.0	-y

2 Unknown Variables

Vector	F_x (N)	F_y (N)	$ \vec{F} $ (N)	θ (deg)	Reference
\vec{F}_A	?	?	8000.0	?	+y
\vec{F}_R	?	?	?	0.0	+x

3 Equations Used

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

4 Step-by-Step Solution

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

$$\begin{aligned}\angle(\vec{F}_B, \vec{F}_R) &= \angle(-\vec{y}, \vec{x}) - \angle(-\vec{y}, \vec{F}_B) \\ &= 90^\circ - 40^\circ \\ &= 50^\circ\end{aligned}$$

Step 2: Solve for $\angle(\vec{F}_R, \vec{F}_A)$ using Eq 1

$$\begin{aligned}\angle(\vec{F}_R, \vec{F}_A) &= \sin^{-1}\left(6000 \cdot \frac{\sin(50^\circ)}{8000}\right) \\ &= 35.1^\circ\end{aligned}$$

Step 3: Solve for $\angle(+\vec{y}, \vec{F}_A)$

$$\begin{aligned}
\theta &= 90^\circ - \angle(\vec{F}_R, \vec{F}_A) \\
&= 90^\circ - 35.1^\circ \\
&= 54.9^\circ
\end{aligned}$$

Step 4: Solve for $\angle(\vec{F}_A, \vec{F}_B)$

$$\begin{aligned}
\angle(\vec{F}_A, \vec{F}_B) &= 180^\circ - \angle(\vec{F}_R, \vec{F}_A) - \angle(\vec{F}_B, \vec{F}_R) \\
&= 180^\circ - 35.1^\circ - 50^\circ \\
&= 94.9^\circ
\end{aligned}$$

Step 5: Solve for $|\vec{F}_R|$ using Eq 2

$$\begin{aligned}
|\vec{F}_R| &= \sqrt{(8000)^2 + (6000)^2 - 2(8000)(6000)\cos(94.9^\circ)} \\
&= 10404.6 \text{ N}
\end{aligned}$$

5 Summary of Results

Vector	F_x (N)	F_y (N)	$ \vec{F} $ (N)	θ (deg)	Reference
\vec{F}_A	6547.8	4596.3	8000.0	35.1	+y
\vec{F}_R	10 404.6	0.0	10 404.6	0.0	+x

Disclaimer

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