

Engineering Calculation Report: Problem 2-2

November 28, 2025

1 Known Variables

Vector	F_x (N)	F_y (N)	$ \vec{F} $ (N)	θ (deg)	Reference
\vec{F}_2	-676.1	-181.2	700.0	15.0	-x
\vec{F}_R	0.0	500.0	500.0	0.0	+y

2 Unknown Variables

Vector	F_x (N)	F_y (N)	$ \vec{F} $ (N)	θ (deg)	Reference
\vec{F}_1	?	?	?	?	+x

3 Equations Used

- $|\vec{F}_1|^2 = |\vec{F}_2|^2 + |\vec{F}_R|^2 - 2 \cdot |\vec{F}_2| \cdot |\vec{F}_R| \cdot \cos(\angle(\vec{F}_2, \vec{F}_R))$
- $\frac{\sin(\angle(\vec{F}_R, \vec{F}_1))}{|\vec{F}_2|} = \frac{\sin(\angle(\vec{F}_2, \vec{F}_R))}{|\vec{F}_1|}$

4 Step-by-Step Solution

Step 1: Solve for $\angle(\vec{F}_2, \vec{F}_R)$

$$\begin{aligned}\angle(\vec{F}_2, \vec{F}_R) &= |\angle(-\vec{x}, \vec{F}_2) + \angle(\vec{x}, \vec{F}_R)| \\ &= |15^\circ + 90^\circ| \\ &= 105^\circ\end{aligned}$$

Step 2: Solve for $|\vec{F}_1|$ using Eq 1

$$\begin{aligned}|\vec{F}_1| &= \sqrt{(700)^2 + (500)^2 - 2(700)(500)\cos(105^\circ)} \\ &= 959.8N\end{aligned}$$

Step 3: Solve for $\angle(\vec{F}_R, \vec{F}_1)$ using Eq 2

$$\begin{aligned}\angle(\vec{F}_R, \vec{F}_1) &= \sin^{-1}\left(700.0 \cdot \frac{\sin(105^\circ)}{959.8}\right) \\ &= 44.8^\circ\end{aligned}$$

Step 4: Solve for $\angle(\vec{x}, \vec{F}_1)$ with respect to $+\mathbf{x}$

$$\begin{aligned}\angle(\vec{x}, \vec{F}_1) &= \angle(\vec{x}, \vec{F}_R) - \angle(\vec{F}_R, \vec{F}_1) \\ &= 90.0^\circ - 44.8^\circ \\ &= 45.2^\circ\end{aligned}$$

5 Summary of Results

Vector	F_x (N)	F_y (N)	$ \vec{F} $ (N)	θ (deg)	Reference
\vec{F}_R	0.0	500.0	500.0	90.0	$+\mathbf{x}$

Disclaimer

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