

Engineering Calculation Report: Problem 2-1

2025-12-08

1 Known Variables

Vector	$ \vec{F} $ (N)	θ (deg)	Reference
\vec{F}_1	450.0	60.0	+x
\vec{F}_2	700.0	15.0	-x

2 Unknown Variables

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

3 Equations Used

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

4 Step-by-Step Solution

Step 1: Solve for $\angle(\vec{F}_1, \vec{F}_2)$

$$\begin{aligned}\angle(\vec{F}_1, \vec{F}_2) &= |\angle(+x, \vec{F}_1) - \angle(+x, \vec{F}_2)| \\ &= |60^\circ - 195^\circ| \\ &= 45^\circ\end{aligned}$$

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

$$\begin{aligned}|\vec{F}_R| &= \sqrt{(450.0 \text{ N})^2 + (700.0 \text{ N})^2 - 2(450.0 \text{ N})(700.0 \text{ N}) \cos(45.0^\circ)} \\ &= 497.0 \text{ N}\end{aligned}$$

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

$$\begin{aligned}\angle(\vec{F}_1, \vec{F}_R) &= \sin^{-1}(700.0 \text{ N} \cdot \frac{\sin(45.0^\circ)}{497.0 \text{ N}}) \\ &= 95.2^\circ\end{aligned}$$

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

$$\begin{aligned}\angle(\vec{x}, \vec{F}_R) &= \angle(\vec{x}, \vec{F}_1) + \angle(\vec{F}_1, \vec{F}_R) \\ &= 60.0^\circ + 95.2^\circ \\ &= 155.2^\circ\end{aligned}$$

5 Summary of Results

Vector	$ \vec{F} $ (N)	θ (deg)	Reference
\vec{F}_R	497.0	155.2	$+x$

Disclaimer

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