

# Engineering Calculation Report: Problem 2-6

2025-12-08

## 1 Known Variables

Vector	$ \vec{F} $ (N)	$\theta$ (deg)	Reference
$\vec{F}_1$	4000.0	-30.0	+v
$\vec{F}_2$	6000.0	-30.0	+u

## 2 Unknown Variables

Vector	$ \vec{F} $ (N)	$\theta$ (deg)	Reference
$\vec{F}_R$	?	?	+u

## 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  $\angle(\vec{F}_1, \vec{F}_2)$

$$\begin{aligned}\angle(\vec{F}_1, \vec{F}_2) &= |\angle(+x, \vec{F}_1) - \angle(+x, \vec{F}_2)| \\ &= |45^\circ - -30^\circ| \\ &= 105^\circ\end{aligned}$$

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

$$\begin{aligned}|\vec{F}_R| &= \sqrt{(4000.0 \text{ N})^2 + (6000.0 \text{ N})^2 - 2(4000.0 \text{ N})(6000.0 \text{ N}) \cos(105.0^\circ)} \\ &= 8026.4 \text{ N}\end{aligned}$$

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

$$\begin{aligned}\angle(\vec{F}_1, \vec{F}_R) &= \sin^{-1}(6000.0 \text{ N} \cdot \frac{\sin(105.0^\circ)}{8026.4 \text{ N}}) \\ &= 46.2^\circ\end{aligned}$$

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

$$\begin{aligned}\angle(\vec{u}, \vec{F}_R) &= \angle(\vec{u}, \vec{F}_1) - \angle(\vec{F}_1, \vec{F}_R) \\ &= 45.0^\circ - 46.2^\circ \\ &= -1.2^\circ\end{aligned}$$

## 5 Summary of Results

Vector	$ \vec{F} $ (N)	$\theta$ (deg)	Reference
$\vec{F}_R$	8026.4	-1.2	+u

## Disclaimer

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