Engineering Calculation Report: Problem 2-9

November 29, 2025

1 Known Variables

Vector	F_x (lbf)	F_y (lbf)	$\lvert\vec{F}\rvert$ (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)	$\lvert\vec{F}\rvert$ (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. $\dfrac{\sin(\angle(\vec{F_R}, \vec{F_A}))}{|\vec{F_B}|} = \dfrac{\sin(\angle(\vec{F_B}, \vec{F_R}))}{|\vec{F_A}|}$

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

$$\angle(\vec{F_R}, \vec{F_A}) = \sin^{-1}(900.0 \cdot \frac{\sin(30°)}{615.9})$$
$$= 46.9°$$

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

$$\angle(\vec{x}, \vec{F_A}) = \angle(\vec{F_R}, \vec{F_A}) (\text{since } F_R \text{ is along +x})$$
$$= 46.9°$$

5 Summary of Results

Vector	F_x (lbf)	F_y (lbf)	$\lvert\vec{F}\rvert$ (lbf)	θ (deg)	Reference
$\vec{F_A}$	420.6	450.0	615.9	46.9	+x

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