Engineering Calculation Report: Problem 2-2

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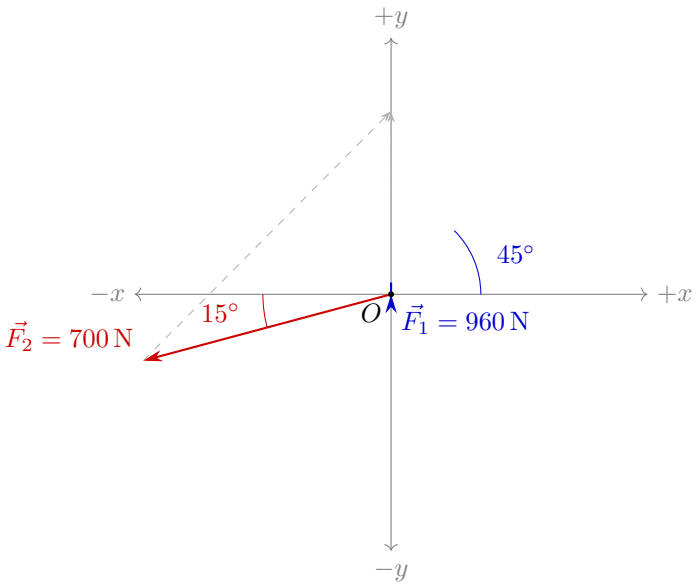
Problem Setup

Vector	$\lvert\vec{F}\rvert$ (N)	θ (deg)	Ref
$\vec{F}_2$	700.0	15.0	$-x$
$\vec{F}_R$	500.0	0.0	$+y$
$\vec{F}_1$	?	?	$+x$



Equations Used

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

(2) $\dfrac{\sin(\angle(\vec{F}_1, \vec{F}_R))}{|\vec{F}_2|} = \dfrac{\sin(\angle(\vec{F}_1, \vec{F}_2))}{|\vec{F}_1|}$

Solution

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

$\angle(\vec{F}_2, \vec{F}_R) = |\angle(+x, \vec{F}_2) - \angle(+x, \vec{F}_R)| = |195° - 90°| = 105°$

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

$|\vec{F}_1| = \sqrt{(700.0\ \text{N})^2 + (500.0\ \text{N})^2 - 2(700.0\ \text{N})(500.0\ \text{N})\cos(105.0°)} = 959.8\ \text{N}$

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

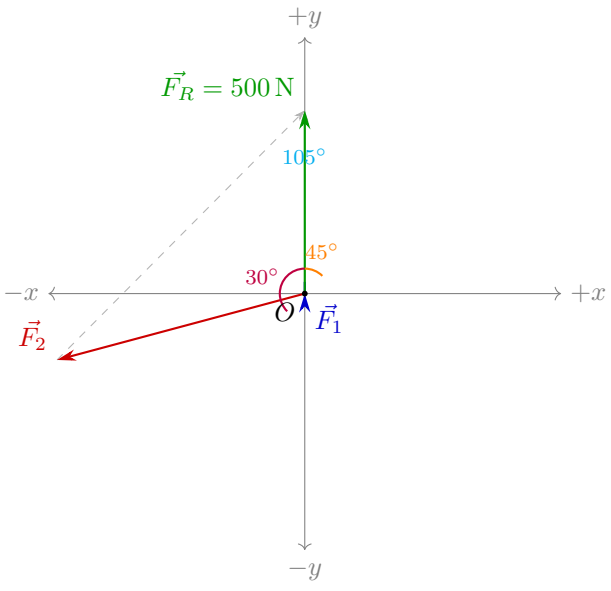
$\angle(\vec{F}_1, \vec{F}_R) = \sin^{-1}(700.0\ \text{N} \cdot \frac{\sin(105.0°)}{959.8\ \text{N}}) = 44.8°$

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

$\angle(\vec{x}, \vec{F}_1) = \angle(\vec{x}, \vec{F}_R) - \angle(\vec{F}_1, \vec{F}_R) = 90.0° - 44.8° = 45.2°$

Results

Vector	$\lvert\vec{F}\rvert$ (N)	θ (deg)	Ref
$\vec{F}_1$	959.8	45.2	$+x$



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