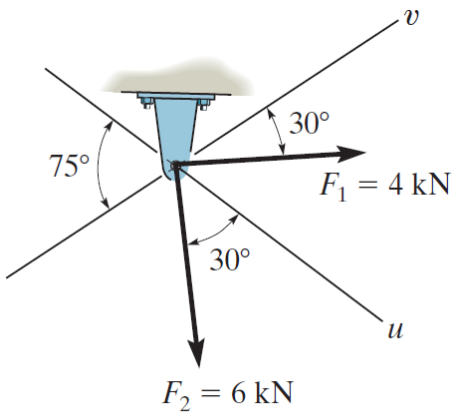
Problem 2-6

Determine the magnitude of the resultant force $\mathbf{F}_R = \mathbf{F}_1 + \mathbf{F}_2$ and its direction, measured clockwise from the positive u axis.



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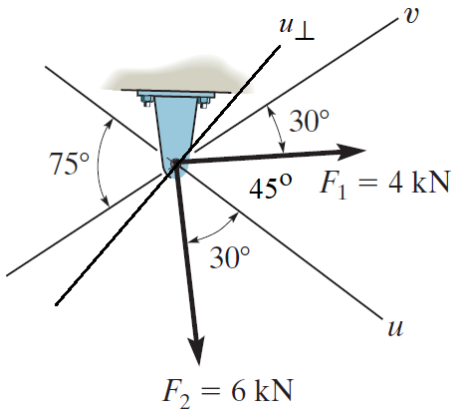
Solution

Use geometry to determine the angle between $\mathbf{F}_1$ and the u-axis.



Write $\mathbf{F}_1$ and $\mathbf{F}_2$ with respect to some basis in the uv-plane, say the direction of u and the direction perpendicular to it, $u_\perp$. Use trigonometry to determine the components along these axes.

$$\mathbf{F}_1 = 4000\langle \cos 45°, \sin 45° \rangle \text{ N}$$

$$\mathbf{F}_2 = 6000\langle \cos 30°, -\sin 30° \rangle \text{ N}$$

Add the vectors together to determine their resultant.

$$\begin{aligned}\mathbf{F}_R &= \mathbf{F}_1 + \mathbf{F}_2 \\ &= \langle 4000\cos 45° + 6000\cos 30°, 4000\sin 45° - 6000\sin 30° \rangle \text{ N} \\ &\approx \langle 8020, -172 \rangle \text{ N}\end{aligned}$$

Its magnitude is

$$|\mathbf{F}_R| = \sqrt{(4000\cos 45^\circ + 6000\cos 30^\circ)^2 + (4000\sin 45^\circ - 6000\sin 30^\circ)^2}\ \text{N} \approx 8000\ \text{N},$$

and the direction counterclockwise from the u-axis that it points in is

$$\tan\phi = \frac{4000\sin 45^\circ - 6000\sin 30^\circ}{4000\cos 45^\circ + 6000\cos 30^\circ} \quad \rightarrow \quad \phi \approx -1.22^\circ.$$

Therefore, the direction of the resultant force measured clockwise from the u-axis is about 1.22°.