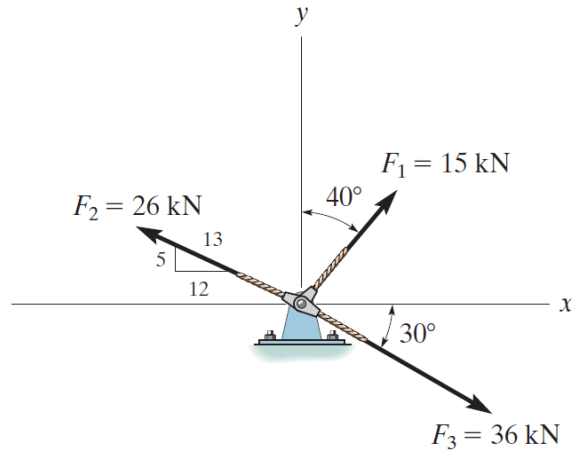


Problem 2-51

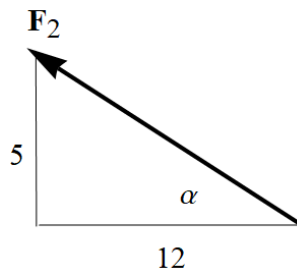
Determine the magnitude of the resultant force and its direction, measured counterclockwise from the positive x axis.



Probs. 2-50/51

Solution

Begin by finding the angle α that \mathbf{F}_2 makes with the x -axis.



$$\tan \alpha = \frac{5}{12} \quad \rightarrow \quad \alpha = \tan^{-1} \left(\frac{5}{12} \right) \approx 22.6^\circ$$

Write each of the forces in component form.

$$\mathbf{F}_1 = 15 \langle \sin 40^\circ, \cos 40^\circ \rangle \text{ kN}$$

$$\mathbf{F}_2 = 26 \langle -\cos \alpha, \sin \alpha \rangle \text{ kN} = 26 \left\langle -\frac{12}{13}, \frac{5}{13} \right\rangle \text{ kN} = \langle -24, 10 \rangle \text{ kN}$$

$$\mathbf{F}_3 = 36 \langle \cos 30^\circ, -\sin 30^\circ \rangle \text{ kN}$$

Add these three forces to get the resultant.

$$\begin{aligned} \mathbf{F}_R &= \mathbf{F}_1 + \mathbf{F}_2 + \mathbf{F}_3 \\ &= \langle 15 \sin 40^\circ - 24 + 36 \cos 30^\circ, 15 \cos 40^\circ + 10 - 36 \sin 30^\circ \rangle \text{ kN} \\ &\approx \langle 16.8, 3.49 \rangle \text{ kN} \end{aligned}$$

Its magnitude is

$$\begin{aligned} |\mathbf{F}_R| &= \sqrt{(15 \sin 40^\circ - 24 + 36 \cos 30^\circ)^2 + (15 \cos 40^\circ + 10 - 36 \sin 30^\circ)^2} \text{ kN} \\ &\approx 17.2 \text{ kN}, \end{aligned}$$

and the direction it points in counterclockwise from the positive x -axis is

$$\tan \theta = \frac{15 \cos 40^\circ + 10 - 36 \sin 30^\circ}{15 \sin 40^\circ - 24 + 36 \cos 30^\circ} \rightarrow \theta \approx 11.7^\circ.$$