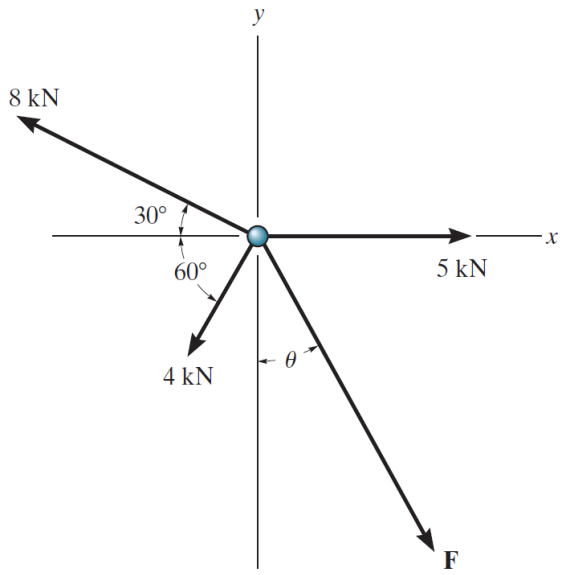
# Problem 3-3

Determine the magnitude and direction $\theta$ of **F** so that the particle is in equilibrium.




**Prob. 3–3**

---

**Solution**

In order for the particle to be in equilibrium, the sum of the forces in each direction must be zero.

$$\sum F_x = 0: \qquad 5000 + F\sin\theta - 8000\cos 30^\circ - 4000\cos 60^\circ = 0$$

$$\sum F_y = 0: \qquad 8000\sin 30^\circ - 4000\sin 60^\circ - F\cos\theta = 0$$

Solve for the terms with $F$.

$$F\sin\theta = 8000\cos 30^\circ + 4000\cos 60^\circ - 5000 \tag{1}$$

$$F\cos\theta = 8000\sin 30^\circ - 4000\sin 60^\circ \tag{2}$$

Square both sides of each equation and then add them respectively to eliminate $\theta$.

$$F^2(\sin^2\theta + \cos^2\theta) = (8000\cos 30^\circ + 4000\cos 60^\circ - 5000)^2 + (8000\sin 30^\circ - 4000\sin 60^\circ)^2$$

$$F^2(1) = (8000\cos 30^\circ + 4000\cos 60^\circ - 5000)^2 + (8000\sin 30^\circ - 4000\sin 60^\circ)^2$$

$$F = \sqrt{(8000\cos 30^\circ + 4000\cos 60^\circ - 5000)^2 + (8000\sin 30^\circ - 4000\sin 60^\circ)^2}$$

$$\approx 3.96 \times 10^3 \text{ N}$$

Plug this value for $F$ back into equation (1) and solve for $\theta$.

$$\sin\theta = \frac{8000\cos 30^\circ + 4000\cos 60^\circ - 5000}{F} \quad \rightarrow \quad \theta \approx 82.2^\circ$$