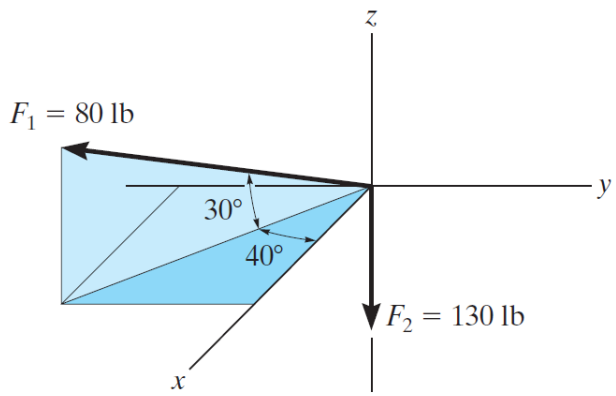
Problem 2-64

Specify the coordinate direction angles of $\mathbf{F}_1$ and $\mathbf{F}_2$ and express each force as a Cartesian vector.



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Solution

Write each of the forces in component form.

$$\mathbf{F}_1 = 80\,\langle \cos 30^\circ \cos 40^\circ, -\cos 30^\circ \sin 40^\circ, \sin 30^\circ \rangle \text{ lb} \approx \langle 53.1, -44.5, 40 \rangle \text{ lb}$$

$$\mathbf{F}_2 = 130\,\langle 0, 0, -1 \rangle \text{ lb} = \langle 0, 0, -130 \rangle \text{ lb}$$

A unit vector in the direction of each force is obtained by dividing by its magnitude.

$$\frac{\mathbf{F}_1}{80 \text{ lb}} = \langle \cos 30^\circ \cos 40^\circ, -\cos 30^\circ \sin 40^\circ, \sin 30^\circ \rangle$$

$$\frac{\mathbf{F}_2}{130 \text{ lb}} = \langle 0, 0, -1 \rangle$$

The direction angles for each of the forces are as follows.

$$\begin{cases} \cos\alpha_1 = \cos 30^\circ \cos 40^\circ \\ \cos\beta_1 = -\cos 30^\circ \sin 40^\circ \\ \cos\gamma_1 = \sin 30^\circ \end{cases} \rightarrow \begin{cases} \alpha_1 \approx 48.4^\circ \\ \beta_1 \approx 124^\circ \\ \gamma_1 = 60^\circ \end{cases}$$

$$\begin{cases} \cos\alpha_2 = 0 \\ \cos\beta_2 = 0 \\ \cos\gamma_2 = -1 \end{cases} \rightarrow \begin{cases} \alpha_2 \approx 90^\circ \\ \beta_2 \approx 90^\circ \\ \gamma_2 = 180^\circ \end{cases}$$