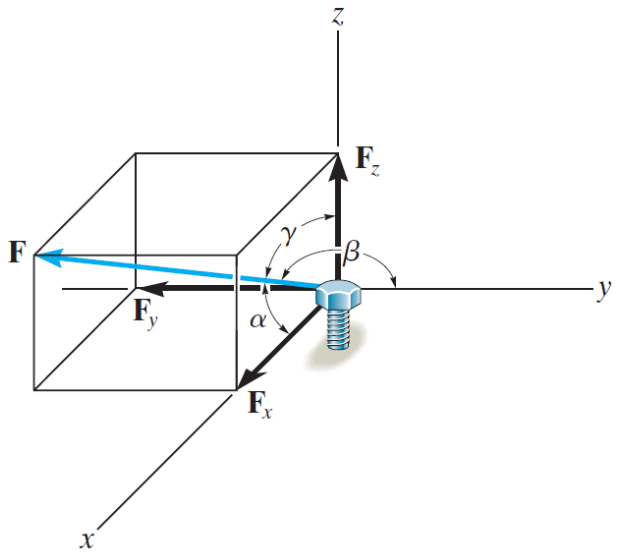
Problem 2-61

The bolt is subjected to the force **F**, which has components acting along the x, y, z axes as shown. If the magnitude of **F** is 80 N, and $\alpha = 60°$ and $\gamma = 45°$, determine the magnitudes of its components.



Prob. 2–61

Solution

The angles that **F** makes with the positive x- and z-axes are known, so the components of **F** in these directions can be found.

$$F_x = F\cos\alpha = 80\cos 60°\text{ N} = 40\text{ N}$$

$$F_z = F\cos\gamma = 80\cos 45°\text{ N} \approx 56.6\text{ N}$$

Use the fact that the sum of the squares of the direction cosines adds to 1 to determine β, the angle that **F** makes with the positive y-axis.

$$\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$$

$$\cos^2\beta = 1 - \cos^2\alpha - \cos^2\gamma$$

$$\cos\beta = \pm\sqrt{1 - \cos^2\alpha - \cos^2\gamma}$$

$$\beta = \{60°, 120°\}$$

We choose $\beta = 120°$ since the angle has to be between 90° and 180°. Therefore, the component along the y-axis is

$$F_y = F\cos\beta = 80\cos 120°\text{ N} = -40\text{ N}.$$

The magnitude of this component is $|F_y| = 40$ N.