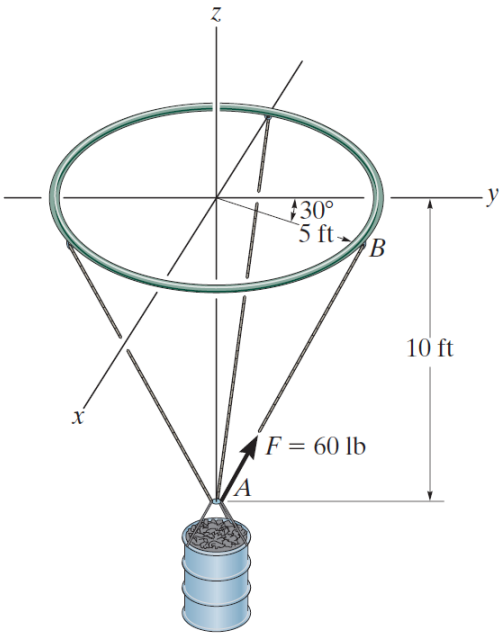
Problem 2-99

The load at A creates a force of 60 lb in wire AB. Express this force as a Cartesian vector acting on A and directed toward B as shown.



Prob. 2–99

Solution

Write the position vectors to the points A and B.

$$\mathbf{r}_A = \langle 0, 0, -10 \rangle \text{ ft}$$

$$\mathbf{r}_B = 5 \langle \sin 30°, \cos 30°, 0 \rangle \text{ ft}$$

The position vector going from A to B is

$$\begin{aligned} \mathbf{r}_{AB} &= \mathbf{r}_B - \mathbf{r}_A \\ &= \langle 5 \sin 30°, 5 \cos 30°, 10 \rangle \text{ ft}. \end{aligned}$$

Its magnitude is

$$\begin{aligned} |\mathbf{r}_{AB}| &= \sqrt{(5 \sin 30°)^2 + (5 \cos 30°)^2 + (10)^2} \text{ ft} \\ &= 5\sqrt{5} \text{ ft}. \end{aligned}$$

Divide $\mathbf{r}_{AB}$ by its magnitude to get a unit vector in the same direction.

$$\hat{\mathbf{u}}_{AB} = \frac{\mathbf{r}_{AB}}{|\mathbf{r}_{AB}|} = \frac{\langle 5 \sin 30°, 5 \cos 30°, 10 \rangle}{5\sqrt{5}}$$

The force $\mathbf{F}$ can now be written.

$$\mathbf{F} = F \hat{\mathbf{u}}_{AB} = 60 \frac{\langle 5 \sin 30°, 5 \cos 30°, 10 \rangle}{5\sqrt{5}} \text{ lb} \approx \langle 13.4, 23.2, 53.7 \rangle \text{ lb}$$