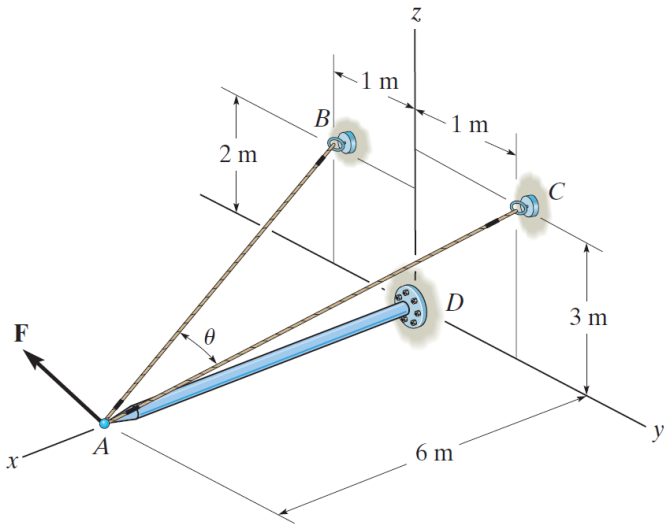
Problem 2-123

Determine the magnitude of the projected component of the force $\mathbf{F} = \{400\mathbf{i} - 200\mathbf{j} + 500\mathbf{k}\}$ N acting along the cable BA.



Probs. 2–122/123/124

Solution

Write the position vectors to the points A, B, and C.

$$\mathbf{r}_A = \langle 6, 0, 0\rangle \text{ m}$$

$$\mathbf{r}_B = \langle 0, -1, 2\rangle \text{ m}$$

$$\mathbf{r}_C = \langle 0, 1, 3\rangle \text{ m}$$

The unit vector going from A to B is

$$\hat{\mathbf{u}}_{AB} = \frac{\mathbf{r}_B - \mathbf{r}_A}{|\mathbf{r}_B - \mathbf{r}_A|} = \frac{\langle -6, -1, 2\rangle}{\sqrt{(-6)^2 + (-1)^2 + (2)^2}}.$$

Take the dot product of $\mathbf{F}$ with this unit vector to find the component of the force along cable AB.

$$\mathbf{F} \cdot \hat{\mathbf{u}}_{AB} = \langle 400, -200, 500\rangle \cdot \frac{\langle -6, -1, 2\rangle}{\sqrt{(-6)^2 + (-1)^2 + (2)^2}} \text{ N} = -\frac{1200}{\sqrt{41}} \text{ N}$$

Therefore, the magnitude of this component is

$$|\mathbf{F} \cdot \hat{\mathbf{u}}_{AB}| = \frac{1200}{\sqrt{41}} \text{ N} \approx 187 \text{ N}.$$