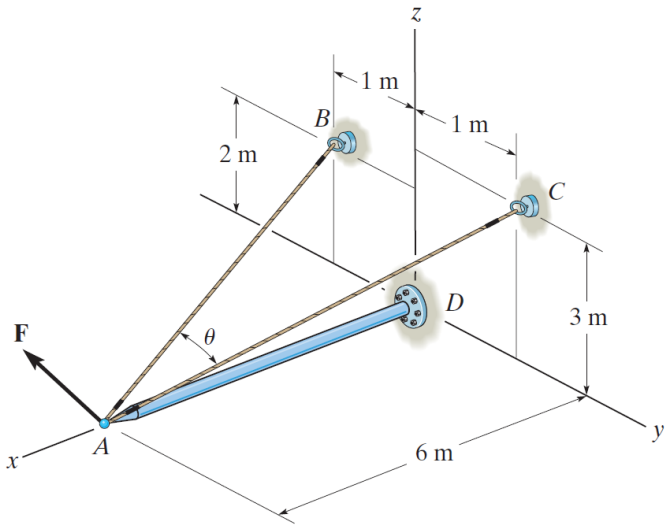
Problem 2-124

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 CA.



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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 C is

$$\hat{\mathbf{u}}_{AC} = \frac{\mathbf{r}_C - \mathbf{r}_A}{|\mathbf{r}_C - \mathbf{r}_A|} = \frac{\langle -6, 1, 3\rangle}{\sqrt{(-6)^2 + (1)^2 + (3)^2}}.$$

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

$$\mathbf{F} \cdot \hat{\mathbf{u}}_{AC} = \langle 400, -200, 500\rangle \cdot \frac{\langle -6, 1, 3\rangle}{\sqrt{(-6)^2 + (1)^2 + (3)^2}} = -550\sqrt{\frac{2}{23}} \text{ N}$$

Therefore, the magnitude of this component is

$$|\mathbf{F} \cdot \hat{\mathbf{u}}_{AC}| = 550\sqrt{\frac{2}{23}} \text{ N} \approx 162 \text{ N}.$$