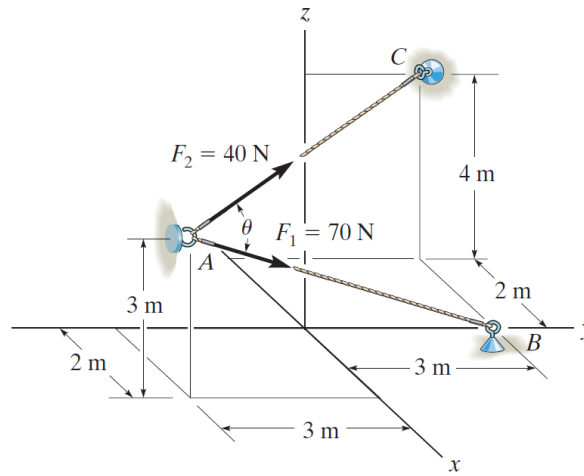


Problem 2-115

Determine the magnitude of the projection of the force \mathbf{F}_1 along cable AC .



Probs. 2-114/115

Solution

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

$$\mathbf{r}_A = \langle 2, -3, 3 \rangle \text{ m}$$

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

$$\mathbf{r}_C = \langle -2, 3, 4 \rangle \text{ m}$$

The unit vector in the direction from A to B is

$$\hat{\mathbf{u}}_{AB} = \frac{\mathbf{r}_B - \mathbf{r}_A}{|\mathbf{r}_B - \mathbf{r}_A|} = \frac{\langle -2, 6, -3 \rangle}{\sqrt{(-2)^2 + (6)^2 + (-3)^2}} = \left\langle -\frac{2}{7}, \frac{6}{7}, -\frac{3}{7} \right\rangle.$$

The unit vector in the direction from A to C is

$$\hat{\mathbf{u}}_{AC} = \frac{\mathbf{r}_C - \mathbf{r}_A}{|\mathbf{r}_C - \mathbf{r}_A|} = \frac{\langle -4, 6, 1 \rangle}{\sqrt{(-4)^2 + (6)^2 + (1)^2}} = \left\langle -\frac{4}{\sqrt{53}}, \frac{6}{\sqrt{53}}, \frac{1}{\sqrt{53}} \right\rangle.$$

Write the force \mathbf{F}_1 acting along cable AB .

$$\mathbf{F}_1 = F_1 \hat{\mathbf{u}}_{AB} = 70 \left\langle -\frac{2}{7}, \frac{6}{7}, -\frac{3}{7} \right\rangle \text{ N} = \langle -20, 60, -30 \rangle \text{ N}$$

Take the dot product of \mathbf{F}_1 with $\hat{\mathbf{u}}_{AC}$ to find the component of \mathbf{F}_1 along cable AC .

$$\mathbf{F}_1 \cdot \hat{\mathbf{u}}_{AC} = \langle -20, 60, -30 \rangle \cdot \left\langle -\frac{4}{\sqrt{53}}, \frac{6}{\sqrt{53}}, \frac{1}{\sqrt{53}} \right\rangle \text{ N} = \frac{410}{\sqrt{53}} \text{ N}$$

Therefore, the magnitude of the projection of the force \mathbf{F}_1 along cable AC is

$$|\mathbf{F}_1 \cdot \hat{\mathbf{u}}_{AC}| = \frac{410}{\sqrt{53}} \text{ N} \approx 56.3 \text{ N}.$$