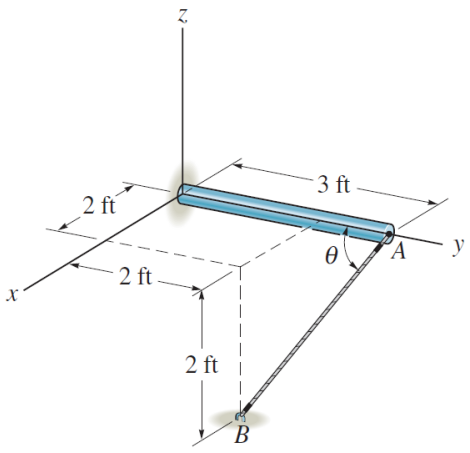
Problem 2-116

Determine the angle θ between the y axis of the pole and the wire AB.



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Solution

Write the position vectors to the points A and B.

$$\mathbf{r}_A = \langle 0, 3, 0 \rangle \text{ ft}$$

$$\mathbf{r}_B = \langle 2, 2, -2 \rangle \text{ ft}$$

The unit vector in the direction from A to B is

$$\hat{\mathbf{u}}_{AB} = \frac{\mathbf{r}_B - \mathbf{r}_A}{|\mathbf{r}_B - \mathbf{r}_A|} = \frac{\langle 2, -1, -2 \rangle}{\sqrt{(2)^2 + (-1)^2 + (-2)^2}} = \left\langle \frac{2}{3}, -\frac{1}{3}, -\frac{2}{3} \right\rangle.$$

The unit vector in the direction from A to the origin is $\langle 0, -1, 0 \rangle$. Take the dot product of these two unit vectors.

$$\cos\theta = \hat{\mathbf{u}}_{AB} \cdot \langle 0, -1, 0 \rangle = \left\langle \frac{2}{3}, -\frac{1}{3}, -\frac{2}{3} \right\rangle \cdot \langle 0, -1, 0 \rangle = \frac{1}{3}$$

Therefore, the angle θ between the y-axis and the wire AB is

$$\theta = \cos^{-1}\left(\frac{1}{3}\right) \approx 70.5°.$$