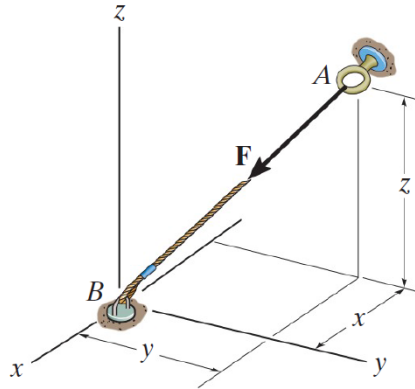


Problem 2-89

If $\mathbf{F} = \{350\mathbf{i} - 250\mathbf{j} - 450\mathbf{k}\}$ N and cable AB is 9 m long, determine the x , y , z coordinates of point A .



Prob. 2-89

Solution

Write the position vectors to points A and B in component form.

$$\mathbf{r}_A = \langle -x, y, z \rangle$$

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

The position vector from A to B is then

$$\begin{aligned} \mathbf{r}_{AB} &= \mathbf{r}_B - \mathbf{r}_A \\ &= \langle x, -y, -z \rangle, \end{aligned}$$

and its magnitude is

$$\begin{aligned} |\mathbf{r}_{AB}| &= \sqrt{(x)^2 + (-y)^2 + (-z)^2} \\ &= \sqrt{x^2 + y^2 + z^2} \\ &= 9 \text{ m}. \end{aligned}$$

The unit vector in the direction from A to B is

$$\hat{\mathbf{u}}_{AB} = \frac{\mathbf{r}_{AB}}{|\mathbf{r}_{AB}|} = \frac{\langle x, -y, -z \rangle}{9 \text{ m}},$$

so the force is

$$\begin{aligned} \mathbf{F} &= F\hat{\mathbf{u}}_{AB} \\ \langle 350, -250, -450 \rangle \text{ N} &= \left[\sqrt{(350)^2 + (-250)^2 + (-450)^2} \text{ N} \right] \frac{\langle x, -y, -z \rangle}{9 \text{ m}}. \end{aligned}$$

Solve for $\langle x, -y, -z \rangle$.

$$\begin{aligned}\langle x, -y, -z \rangle &= \frac{9 \text{ m}}{\sqrt{(350)^2 + (-250)^2 + (-450)^2}} \langle 350, -250, -450 \rangle \text{ N} \\ &= \left\langle \frac{63}{\sqrt{155}}, -\frac{9\sqrt{5}}{\sqrt{31}}, -\frac{81}{\sqrt{155}} \right\rangle \text{ m}\end{aligned}$$

Therefore,

$$\begin{cases} x = \frac{63}{\sqrt{155}} \text{ m} \approx 5.06 \text{ m} \\ y = \frac{9\sqrt{5}}{\sqrt{31}} \text{ m} \approx 3.61 \text{ m} \\ z = \frac{81}{\sqrt{155}} \text{ m} \approx 6.51 \text{ m} \end{cases} .$$