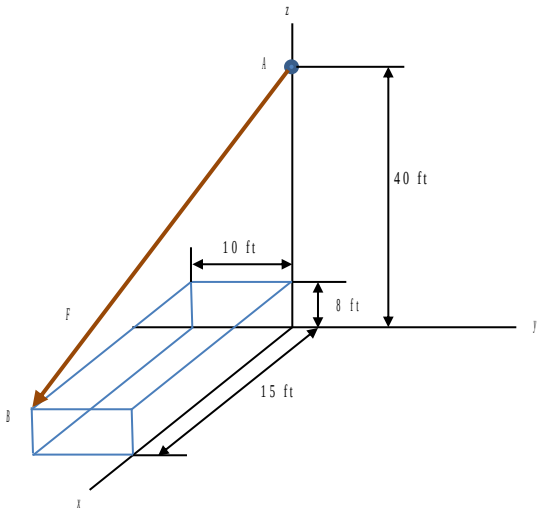
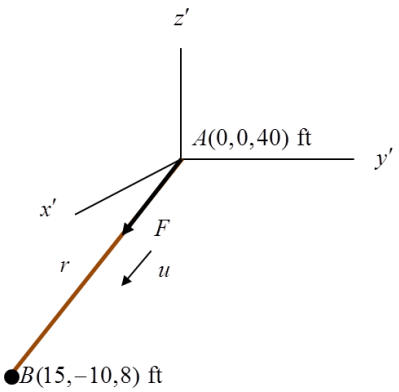
12. A force $F \sim \mathrm{N}(80, 3^2)$ lb acts at point $A$ as shown. Determine the mean and standard deviation of this force acting at $A$ using its $x$, $y$, and $z$ components.




**Solution**

Force $F$ is shown in the following figure.




The direction of this $F$ vector, **u**, is determined from the position vector **r**, which extends from $A$ to $B$. The position vector **r** is given by

$$\mathbf{r} = (15-0)\mathbf{i} + (-10-0)\mathbf{j} + (8-40)\mathbf{k} = \{15\mathbf{i} - 10\mathbf{j} - 32\mathbf{k}\}\ \text{ft}$$

The magnitude of **r**, which represents the cord length $AB$, is

$$r = \sqrt{15^2 + 10^2 + 32^2} = 36.73\ \text{ft}$$

The unit vector is then

$$\mathbf{u} = \frac{\mathbf{r}}{r} = \frac{15}{36.73}\mathbf{i} - \frac{10}{36.73}\mathbf{j} - \frac{32}{36.73}\mathbf{k}$$

We know $F \sim \mathrm{N}(80, 3)$ lb , then

$$\boldsymbol{\mu}_{\mathbf{F}} = \mu_F \mathbf{u} = 80\left(\frac{15}{36.73}\mathbf{i} - \frac{10}{36.73}\mathbf{j} - \frac{32}{36.73}\mathbf{k}\right) = \left\{32.67\mathbf{i} - 21.78\mathbf{j} - 69.70\mathbf{k}\right\} \text{ lb} \quad \textbf{Ans.}$$

$$\boldsymbol{\sigma}_{\mathbf{F}} = \sigma_F \boldsymbol{\sigma} = 3\left(\frac{15}{36.73}\mathbf{i} - \frac{10}{36.73}\mathbf{j} - \frac{32}{36.73}\mathbf{k}\right) = \left\{1.23\mathbf{i} - 0.82\mathbf{j} - 2.61\mathbf{k}\right\} \quad \textbf{Ans.}$$