

21-S-4-5-AG-066

A wheel with diameter D_{in} inches is in the y-z plane and it spins on the x axis. A force of $X\hat{i} + Y\hat{j} + Z\hat{k}$ lb is applied on the bottom of the wheel. What is the moment around the wheel's axel?

ANSWER:

First, the diameter must be converted from inches to feet.

$$D_{ft} = D_{in} \cdot \frac{1 \text{ ft}}{12 \text{ in}}$$

The moment can easily be calculated via,

$$\begin{aligned} \mathbf{M}_O &= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ d_x & d_y & d_z \\ F_x & F_y & F_z \end{vmatrix} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 0 & D \\ X & Y & Z \end{vmatrix} = (-D_{ft} \cdot Y)\hat{i} - (-D_{ft} \cdot X)\hat{j} + 0\hat{k} \\ &= -D_{ft}Y\hat{i} + D_{ft}X\hat{j} + 0\hat{k} \end{aligned}$$