

Problem 4-41

The pole supports a traffic light of weight W . Using Cartesian vectors, determine the moment of the weight of the traffic light about the base of the pole at A .

Given:

$$W = 22 \text{ lb} \quad a = 12 \text{ ft} \quad \theta = 30 \text{ deg}$$

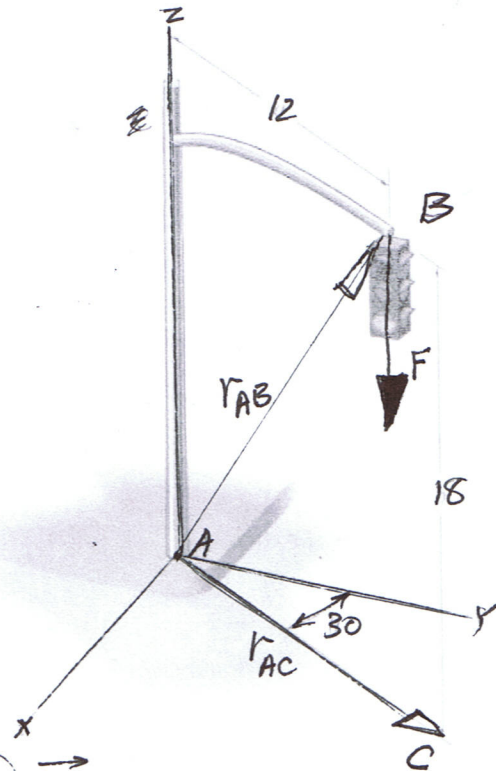
Solution:

$$\mathbf{r} = \begin{bmatrix} (a)\sin(\theta) \\ (a)\cos(\theta) \\ 0 \end{bmatrix}$$

$$\mathbf{F} = \begin{pmatrix} 0 \\ 0 \\ -W \end{pmatrix}$$

$$\mathbf{M}_A = \mathbf{r} \times \mathbf{F}$$

$$\mathbf{M}_A = \begin{pmatrix} -229 \\ 132 \\ 0 \end{pmatrix} \text{ lb}\cdot\text{ft}$$



\mathbf{r} can be either \vec{r}_{AB} or \vec{r}_{AC}

$$\begin{cases} \vec{r}_{AB} = 12 \sin 30^\circ \hat{i} + 12 \cos 30^\circ \hat{j} + 18 \hat{k} \text{ ft} \\ \text{or } \vec{r}_{AC} = 12 \sin 30^\circ \hat{i} + 12 \cos 30^\circ \hat{j} \text{ ft} \end{cases}$$

F is along negative z axis, so $F = -22 \hat{k} \text{ lb}$

$$\vec{M}_A = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 6 & 10.392 & 18 \\ 0 & 0 & -22 \end{vmatrix} \quad \text{or} \quad \vec{M}_A = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 6 & 10.392 & 0 \\ 0 & 0 & -22 \end{vmatrix}$$

$$\vec{M}_A \approx -229 \hat{i} + 132 \hat{j} \text{ lb}\cdot\text{ft}$$