4-39

Determine the moment of the force **F** about the door hinge at B. Express the result as a Cartesian vector.

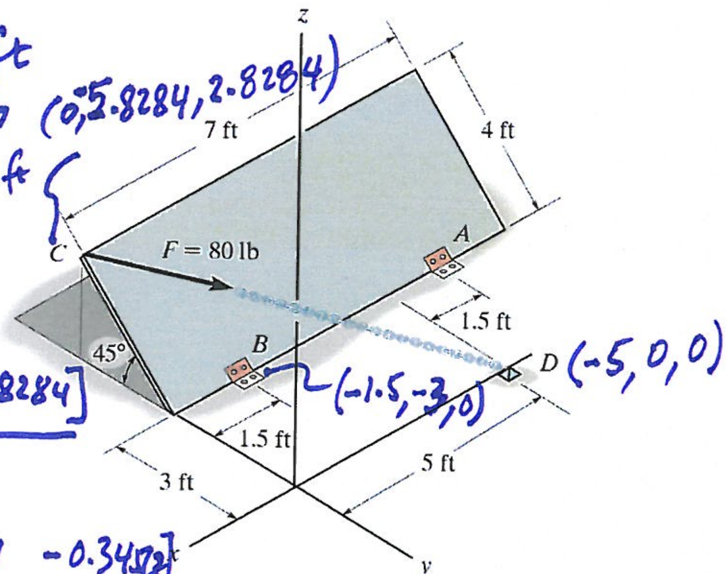
$$\vec{r}_{CD} = [-5 \quad 5.8284 \quad -2.8284]\ ft$$

$$|\vec{r}_{CD}| = \sqrt{(-5)^2 + (5.8284)^2 + (-2.8284)}\ ft$$

$$= 8.1835\ ft$$

$$\hat{u}_{CD} = \frac{\vec{r}_{CD}}{|\vec{r}_{CD}|} = \frac{[-5 \quad 5.8284 \quad -2.8284]}{8.1835}$$

$$= [-0.61099 \quad 0.71221 \quad -0.34562]$$



$$\vec{F} = |\vec{F}|\hat{u}_{CD} = (80\ lb)[-0.61099 \quad 0.71221 \quad -0.34562]$$

$$= [-48.88 \quad 56.98 \quad -27.65]\ lb$$

$$\vec{M}_B = \vec{r}_{BD} \times \vec{F} \qquad \vec{r}_{BD} = [-3.5 \quad 3 \quad 0]\ ft$$

$$= [-3.5 \quad 3 \quad 0]\ ft \times [-48.88 \quad 56.98 \quad -27.65]\ lb$$

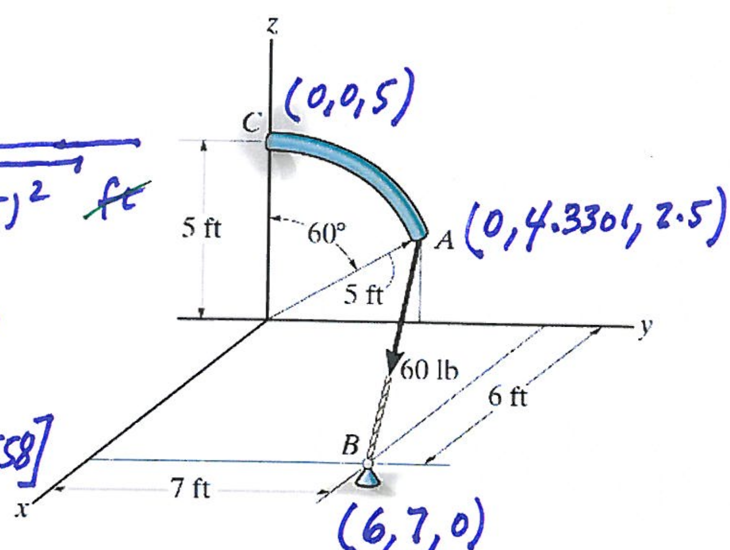
$$= [-82.9 \quad -96.8 \quad -52.8]\ lb.ft$$

Note: The door will rotate about line BA due to a Moment equal to 82.9 lb.ft causing an increase of the 45° angle

One may also use $\vec{M}_B = \vec{r}_{BC} \times \vec{F}$

4-40

The curved rod has a radius of 5 ft. If a force of 60 lb acts at its end as shown, determine the moment of this force about point C.



$$\vec{r}_{AB} = [6 \quad 2.6699 \quad -2.5]\ ft$$

$$\hat{u}_{AB} = \frac{[6 \quad 2.6699 \quad -2.5]\ \cancel{ft}}{\sqrt{(6)^2 + (2.6699)^2 + (-2.5)^2}\ \cancel{ft}} = \frac{[6 \quad 2.6699 \quad -2.5]}{7.027}$$

$$= [0.8538 \quad 0.3799 \quad -0.3558]$$

$$\vec{F} = (60\ lb)[0.8538 \quad 0.3799 \quad -0.3558]$$

$$= [51.228 \quad 22.794 \quad -21.346]\ lb$$

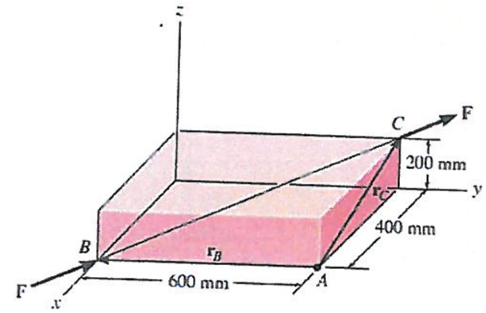
$$\vec{M}_c = \vec{r}_{CB} \times \vec{F} = [6 \quad 7 \quad -5] \times [51.228 \quad 22.794 \quad -21.346]\ lb.ft$$

or $$\vec{M}_c = \vec{r}_{CA} \times \vec{F} = [0 \quad 4.3301 \quad -2.5] \times [51.228 \quad 22.794 \quad -21.346]\ lb.ft$$

$$\therefore \vec{M}_c = [-35.4 \quad -128.0 \quad -222]\ lb.ft$$

4-47
~~4-38.~~

A force **F** having a magnitude of $F = 100$ N acts along the diagonal of the parallelepiped. Determine the moment of **F** about point A, using $\mathbf{M}_A = \mathbf{r}_B \times \mathbf{F}$ and $\mathbf{M}_A = \mathbf{r}_C \times \mathbf{F}$.



SOLUTION

C @ (0 0.6 0.2)

B @ (0.4 0 0)

$$\vec{BC} = ((0-0.4)(0.6-0)(0.2-0)) = (-0.4\ \ 0.6\ \ 0.2)\ \text{m}$$

$$\vec{u}_{BC} = \frac{(-0.4\ 0.6\ 0.2)}{\sqrt{0.4^2+0.6^2+0.2^2}} = (-.535\ \ .802\ \ .267)$$

$$\vec{F} = 100(-.535\ \ .802\ \ .267) = (-53.5\ \ 80.2\ \ 26.7)\ \text{N}$$

$$\vec{r}_B = \vec{r}_{AB} = (0\ \ -0.6\ \ 0) \qquad \vec{r}_C = \vec{r}_{AC} = (-0.4\ \ 0\ \ 0.2)$$

$$\vec{M}_A = \vec{r}_B \times \vec{F} = (0\ \ -0.6\ \ 0) \times (-53.5\ \ 80.2\ \ 26.7)$$

$$\underline{\vec{M}_A = (-16\ \ 0\ \ -32.1)\ \text{N}\cdot\text{m}}$$

$$\vec{M}_A = \vec{r}_C \times \vec{F} = (-0.4\ \ 0\ \ 0.2) \times (-53.5\ \ 80.2\ \ 26.7)$$

$$\underline{\vec{M}_A = (-16\ \ 0\ \ -32.1)\ \text{N}\cdot\text{m}}$$