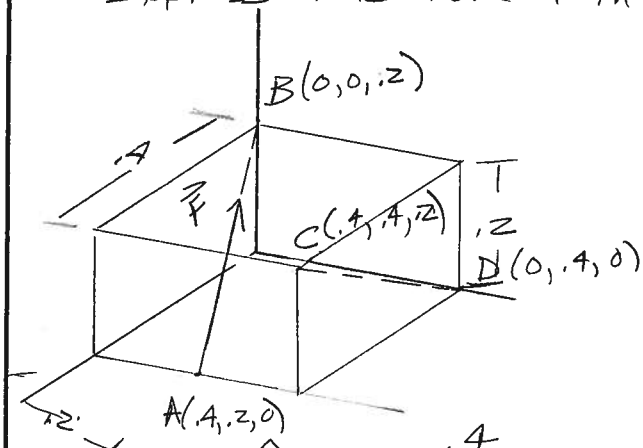
Determine the moment of the 500 N force, F_{AB}, about line CD. Express this moment in rectangular components.



Express $\vec{F}_{AB}$ as a vector

(1) $\overrightarrow{AB} = -.4\hat{i} - .2\hat{j} + .2\hat{k}$

(2) $|\overrightarrow{AB}| = .490$

(3) $\hat{n}_{AB} = -\frac{.4}{.490}\hat{i} - \frac{.2}{.490}\hat{j} + \frac{.2}{.490}\hat{k}$

(4) $\hat{n}_{AB} = -.816\hat{i} - .408\hat{j} + .408\hat{k}$

(5) $\vec{F}_{AB} = 500\,\hat{n}_{AB}$

(6) $\vec{F}_{AB} = -500(.816)\hat{i} - 500(.408)\hat{j} + 500(.408)\hat{k}$

(7) $\vec{F}_{AB} = -408\hat{i} - 204\hat{j} + 204\hat{k}$

Find a unit vector along CD

(8) $\overrightarrow{CD} = -.4\hat{i} + 0\hat{j} - .2\hat{k}$

(9) $|\overrightarrow{CD}| = .447$

(10) $\hat{n}_{CD} = -\frac{.4}{.447}\hat{i} + 0\hat{j} - \frac{.2}{.447}\hat{k}$

(11) $\hat{n}_{CD} = -.895\hat{i} + 0\hat{j} - .447\hat{k}$

Select a vector that connects any point on the line CD with any point along the line of action of $\vec{F}_{AB}$

Choose $\vec{CB}$

(12) $\vec{CB} = -.4\hat{i} - .4\hat{j} + 0\hat{k}$

Then the moment of $\vec{F}_{AB}$ about line CD is given as follows

(13) $\left(\vec{CB} \times \vec{F}_{AB}\right) \cdot \hat{n}_{CD} = \begin{vmatrix} -.895 & 0 & -.447 \\ -.4 & -.4 & 0 \\ -408 & -204 & 204 \end{vmatrix} =$

(14) $= 109.5 \text{ N-m}$ TI-89

Select another vector connecting CD and $\vec{F}_{AB}$

Choose $\vec{DA}$

(15) $\vec{DA} = .4\hat{i} - .2\hat{j} + 0\hat{k}$

Then the moment of $\vec{F}_{AB}$ about line CD is given as follows

(16) $$\left(\vec{DA} \times \vec{F}_{AB}\right) \cdot \hat{n}_{CD} = \begin{vmatrix} -.895 & 0 & -.447 \\ .4 & -.2 & 0 \\ -.408 & -.204 & .204 \end{vmatrix} =$$

(17) $= 109.5$ N-m TI-89

Same Result

Select another vector connecting CD and $\vec{F}_{AB}$

Choose $\vec{DB}$

(18) $\vec{DB} = 0\hat{i} - .4\hat{j} + .2\hat{j}$

Then the moment of $\vec{F}_{AB}$ about line CD is given as follows

(19) $$\left(\vec{DB} \times \vec{F}_{AB}\right) \cdot \hat{n}_{CD} = \begin{vmatrix} -.895 & 0 & -.447 \\ 0 & -.4 & +.2 \\ -408 & -204 & 204 \end{vmatrix} =$$

(20) $$= 109.5 \text{ N-m} \quad TI-89$$

Select another vector connecting CD and $\vec{F}_{AB}$

Choose $\vec{CA}$

(21) $$\vec{CA} = 0\,\hat{i} - .2\,\hat{j} - .2\,\hat{k}$$

Then the moment of $\vec{F}_{AB}$ about line CD is given as follows

(22) $$\left(\vec{CA} \times \vec{F}_{AB}\right) \cdot \hat{n}_{CD} = \begin{vmatrix} -.895 & 0 & -.447 \\ 0 & -.2 & -.2 \\ -408 & -204 & 204 \end{vmatrix} =$$

(23) $$= 109.5 \text{ N-m} \quad TI-89$$

No matter which connection vector is used, the magnitude of the moment is found to be 109.5 N-m

To express this moment in terms of its rectangular components simply pre-multiply the unit vector $\hat{n}_{CD}$ by 109.5 N-m as follows

(24) $$\vec{M}_{CD} = 109.5\left(\hat{n}_{CD}\right)$$

(25) $$\vec{M}_{CD} = (-.895)(109.5)\,\hat{i} + (0)(109.5)\,\hat{j} + (-.447)(109.5)\,\hat{k}$$

(26) $$\vec{M}_{CD} = -98.0\,\hat{i} + 0\,\hat{j} - 48.9\,\hat{k}$$