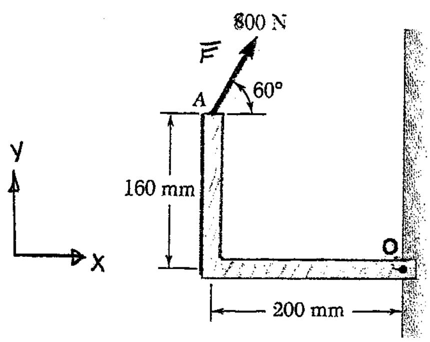
Problem 4A

4A. Using the structure shown below

a. Calculate the moment created about point O by the force shown using the scalar method. Write you answer as a Cartesian vector.
b. Calculate the moment created about point O by the force shown using the vector method (**r** x **F**).



Part a)

$\bar{F} = \bar{F}_x + \bar{F}_y$

$\bar{F}_x = 800 \cos 60° (\bar{i}) = 400N(\bar{i})$

$\bar{F}_y = 800 \sin 60° (\bar{j}) = 693N(\bar{j})$

$\bar{F} = 400(\bar{i}) + 693(\bar{j})$ (N)

$M_o^{Fx} = F_x d_x = 400N(.160m) = 64\,Nm$

$\bar{M}_o^{Fx} = 64\,Nm(-\bar{k})$

$M_o^{Fy} = F_y d_y = 693N(.2m) = 139\,Nm$

$\bar{M}_o^{Fy} = 139\,Nm(-\bar{k})$

$\bar{M}_o = \bar{M}_o^{Fx} + \bar{M}_o^{Fy} = 203\,Nm(-\bar{k})$

$\bar{r}_{OA} = .20m(-\bar{i}) + .16m(\bar{j})$

Part b)

$\bar{M}_o = \bar{r}_{OA} \times \bar{F}$

$$\bar{M}_o = \begin{vmatrix} \bar{i} & \bar{j} & \bar{k} \\ -.2 & .16 & 0 \\ 400 & 693 & 0 \end{vmatrix} \begin{matrix} \bar{i} & \bar{j} \\ -.2 & .16 \\ 400 & 693 \end{matrix}$$

$\bar{M}_o = (-.2)(693)(\bar{k})$

$- (400)(.16)(\bar{k})$

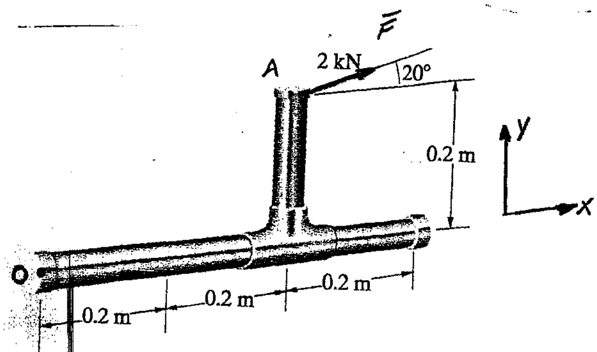
$\bar{M}_o = +139(\bar{k}) - 64(\bar{k})$ Nm

$\bar{M}_o = 203\,Nm(-\bar{k})$

4B. Using the structure shown below

a. Calculate the moment created about point O by the force shown using the scalar method. Write you answer as a Cartesian vector.

b. Calculate the moment created about point O by the force shown using the vector method (**r x F**).



Part a)

$\bar{F} = \bar{F}_x + \bar{F}_y$

$\bar{F}_x = 2KN \cos 20^\circ (\bar{i}) = 1.88 KN (\bar{i})$

$\bar{F}_y = 2KN \sin 20^\circ (\bar{j}) = .684 KN (\bar{j})$

$\bar{F} = 1.88(\bar{i}) + .684(\bar{j})$ (KN)

$M_o^{F_x} = F_x d_x = 1.88KN (.2m) = .376 KNm$

$\bar{M}_o^{F_x} = .376 KNm (-k)$ (clockwise rotation)

$M_o^{F_y} = F_y d_y = .684 KN (.4m) = .274 KNm$

$\bar{M}_o^{F_y} = .274 KNm (\bar{k})$ (counter-clockwise rotation)

$\therefore \bar{M}_o = -.376(\bar{k}) + .274(\bar{k})$ KNm

$\bar{M}_o = -.102 KNm (k)$ or $.102 KNm (-\bar{k})$

Part b) $\bar{r}_{OA} = .4m(\bar{i}) + .2m(\bar{j})$, $\bar{F} = 1.88(\bar{i}) + .684(\bar{j})$ KN

$$\bar{M}_o = \bar{r}_{OA} \times \bar{F} = \begin{vmatrix} \bar{i} & \bar{j} & \bar{k} & \bar{i} & \bar{j} \\ .4 & .2 & 0 & .4 & .2 \\ 1.88 & .684 & 0 & 1.88 & .684 \end{vmatrix}$$

$\bar{M}_o = (.4)(.684)(\bar{k}) - (1.88)(.2)(\bar{k}) = -.102 KN(\bar{k})$

$\bar{M}_o = .102 KNm (-\bar{k})$

4C. Using the structure shown below

a. Calculate the moment created about point O by the 500 N force shown using the vector method (**r** x **F**).

$$\overline{AB} = (0-2)\bar{i} + (5-2)\bar{j} + (2-0)\bar{k} \ (m)$$

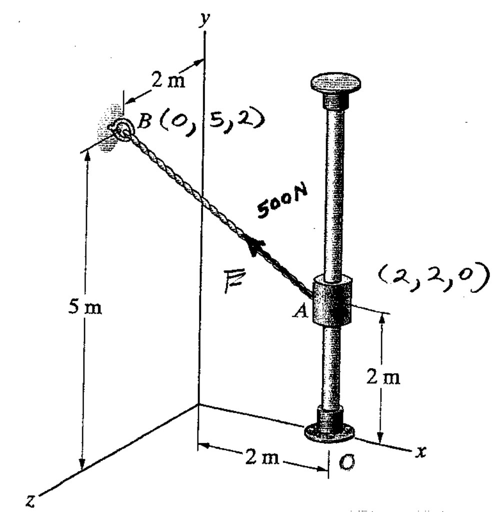
$$\overline{AB} = -2\bar{i} + 3\bar{j} + 2\bar{k} \ (m)$$

$$AB = \sqrt{(2)^2 + (3)^2 + (2)^2} = 4.12\,m$$

$$\bar{u}_{AB} = \frac{\overline{AB}}{AB} = -.485\bar{i} + .728\bar{j} + .485\bar{k}$$

$$\bar{F} = F\bar{u}_{AB} = 500N\,\bar{u}_{AB}$$

$$\bar{F} = -243\bar{i} + 364\bar{j} + 243\bar{k} \ (N)$$



$$\bar{M}_o = \bar{r} \times \bar{F} = \bar{r}_{OA} \times \bar{F}$$

$$\bar{r}_{OA} = 2m\,\bar{j}$$

$$\bar{M}_o = \left|\begin{array}{ccc|cc} \bar{i} & \bar{j} & \bar{k} & \bar{i} & \bar{j} \\ 0 & 2 & 0 & 0 & 2 \\ -243 & 364 & 243 & -243 & 364 \end{array}\right.$$

$$\bar{M}_o = (2)(243)(\bar{i}) - (-243)(2)(\bar{k})$$

$$\bar{M}_o = 486(\bar{i}) + 486(\bar{k}) \ (Nm)$$