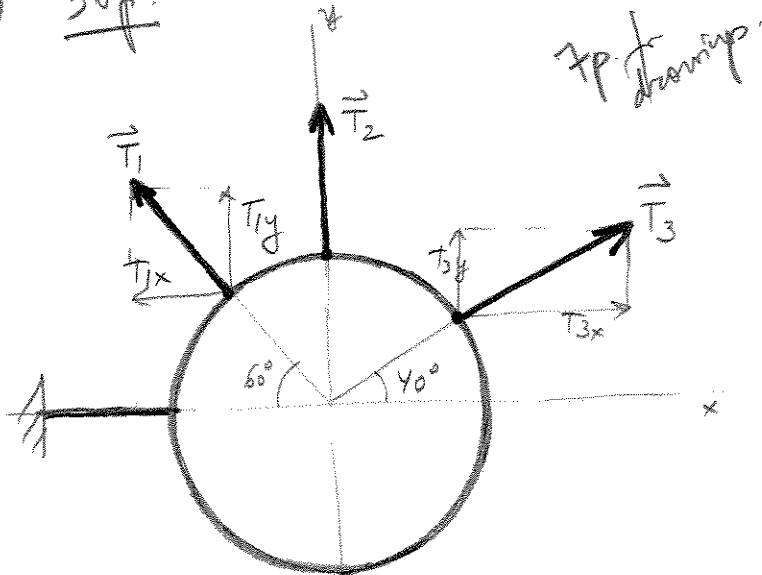


① 30 p.



$$\vec{R} = \vec{T}_1 + \vec{T}_2 + \vec{T}_3$$

$$\vec{R} = 180 \hat{j} \text{ lb.}$$

$$T_3 = 40 \text{ lb}$$

$$T_1, T_2 = ?$$

$$\vec{R} : \begin{cases} R_x = 0 \\ R_y = 180 \text{ lb.} \end{cases}$$

$$\vec{R} = \vec{T}_1 + \vec{T}_2 + \vec{T}_3 \Rightarrow \begin{cases} R_x = T_{1x} + T_{2x} + T_{3x} \\ R_y = T_{1y} + T_{2y} + T_{3y} \end{cases} \quad (1)$$

$$\vec{T}_1 : \begin{cases} T_{1x} = -T_1 \cos 60^\circ \\ T_{1y} = T_1 \sin 60^\circ \end{cases}$$

$$\vec{T}_2 : \begin{cases} T_{2x} = 0 \text{ lb.} \\ T_{2y} = T_2 \end{cases}$$

$$\vec{T}_3 : \begin{cases} T_{3x} = T_3 \cos 40^\circ \\ T_{3y} = T_3 \sin 40^\circ \end{cases}$$

( $T_3 = 40 \text{ lb}$ )

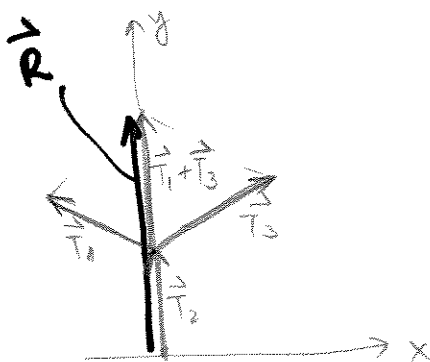
Replace into (1):

$$\begin{cases} 0 = -T_1 \cos 60^\circ + 40 \cos 40^\circ & (2) \\ 180 = T_1 \sin 60^\circ + T_2 + 40 \sin 40^\circ & (3) \end{cases}$$

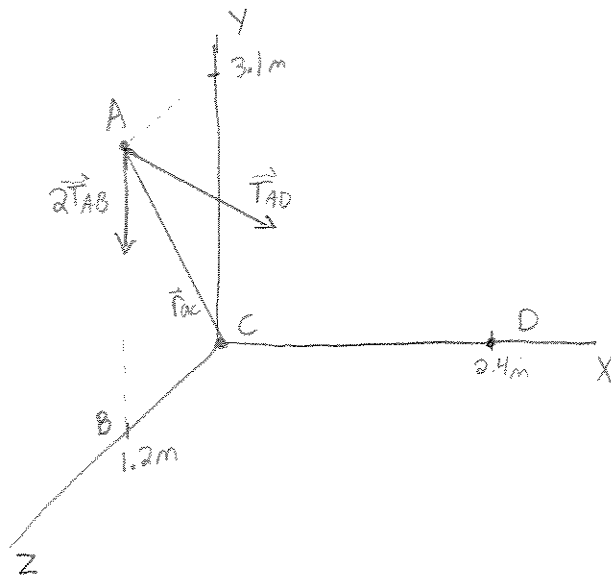
(1-2 p. for wrong answer)

From (2)  $\Rightarrow T_1 = \frac{40 \cos 40^\circ}{\cos 60^\circ} \Rightarrow \boxed{T_1 = 61.3 \text{ lb}}$  1 p. (units & significant digits).

(3)  $\Rightarrow T_2 = 180 - T_1 \sin 60^\circ - 40 \sin 40^\circ \Rightarrow \boxed{T_2 = 101.2 \text{ lb}}$  1 p.



2)



$$T_{ABAD} = 369 \text{ N}$$

$$\vec{T}_{AB} = -T_{ABAD} \hat{j} = -369 \text{ N} \hat{j}$$

$$\vec{T}_{AD} = T_{ABAD} \frac{\vec{AD}}{|\vec{AD}|} = \frac{(369 \text{ N}) (2.4 \text{ m} \hat{i} - 3.1 \text{ m} \hat{j} - 1.2 \text{ m} \hat{k})}{\sqrt{(2.4 \text{ m})^2 + (-3.1 \text{ m})^2 + (-1.2 \text{ m})^2}}$$

$$\vec{T}_{AD} = 216 \text{ N} \hat{i} - 279 \text{ N} \hat{j} - 108 \text{ N} \hat{k}$$

$$\vec{R}_A = 2\vec{T}_{AB} + \vec{T}_{AD} = 216 \text{ N} \hat{i} - 1017 \text{ N} \hat{j} - 108 \text{ N} \hat{k}$$

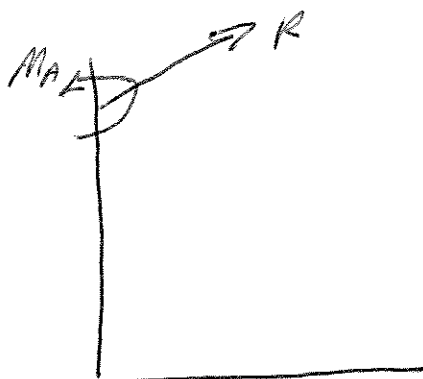
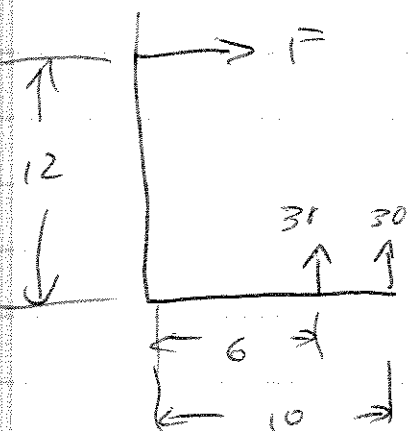
$$\vec{r}_{AC} = 3.1 \text{ m} \hat{j} + 1.2 \text{ m} \hat{k}$$

$$\vec{M}_C = \vec{r}_{AC} \times \vec{R}_A$$

$$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 \text{ m} & 3.1 \text{ m} & 1.2 \text{ m} \\ 216 \text{ N} & -1017 \text{ N} & -108 \text{ N} \end{vmatrix}$$

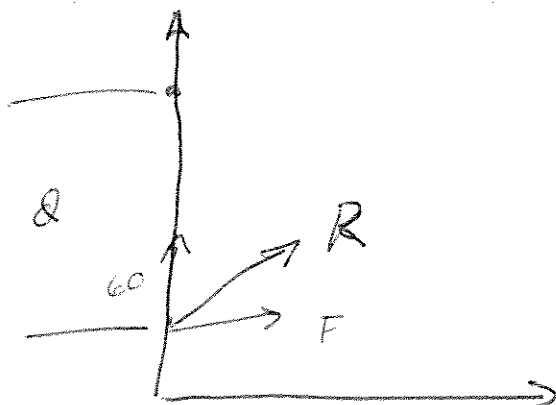
$$\vec{M}_C = 886 \text{ N}\cdot\text{m} \hat{i} + 259 \text{ N}\cdot\text{m} \hat{j} - 670 \text{ N}\cdot\text{m} \hat{k}$$

35 pts



$$R = F\hat{i} + 60\hat{j}$$

$$M_A = 30(6) + 30(10) \\ = 480$$



$$M_A = R d$$

$$480 = F d$$

$$\text{For point O} \rightarrow d = 12$$

$$F = \frac{480}{12}$$

$$\boxed{F = 40 \text{ lb}}$$

Sketches  
7pts

(-5)  $\rightarrow$  (-7)  
For  $\Sigma M = 0$  if  
assumption not  
~~made~~ listed