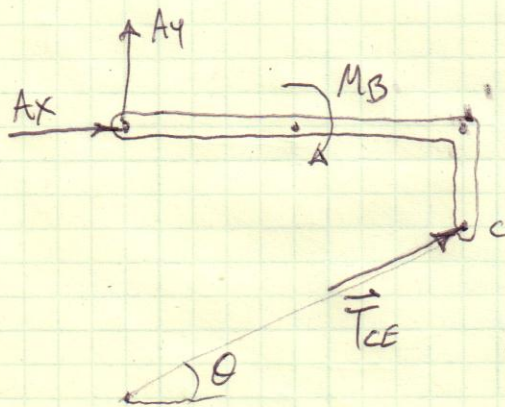


FIND REACTIONS AT A AND E FOR A CLOCKWISE COUPLE AT
 a) POINT B; b) POINT D OF $36 \text{ N}\cdot\text{m}$

a) $M_B = -36 \text{ N}\cdot\text{m}$

FBD: WITH THE COUPLE AT B, MEMBER CDE IS A TWO-FORCE MEMBER.



$$\theta = \tan^{-1}\left(\frac{240}{480}\right) = 26.56^\circ$$

$$\vec{T}_{CE} = (T \cdot \cos 26.56^\circ) \hat{i} + (T \cdot \sin 26.56^\circ) \hat{j}$$

$$\vec{T}_{CE} = (0.8944T) \hat{i} + (0.4471T) \hat{j} \text{ N}$$

$$\sum F_x = 0: A_x + 0.8944T = 0$$

$$\sum F_y = 0: A_y + 0.4471T = 0$$

$$\sum M_A = 0 \uparrow: (-36 \text{ N}\cdot\text{m}) + (0.8944T)(0.16 \text{ m}) + (0.4471T)(0.48 \text{ m}) = 0$$

$$T = 100.6 \text{ N}$$

$$A_x = -0.8944(100.6) = -90 \text{ N} \leftarrow$$

$$A_y = -0.4471(100.6) = -45 \text{ N} \downarrow$$

REACTION AT E:

$$\vec{T}_{CE} = [(0.8944)(100.6)] \hat{i} + [(0.4471)(100.6)] \hat{j}$$

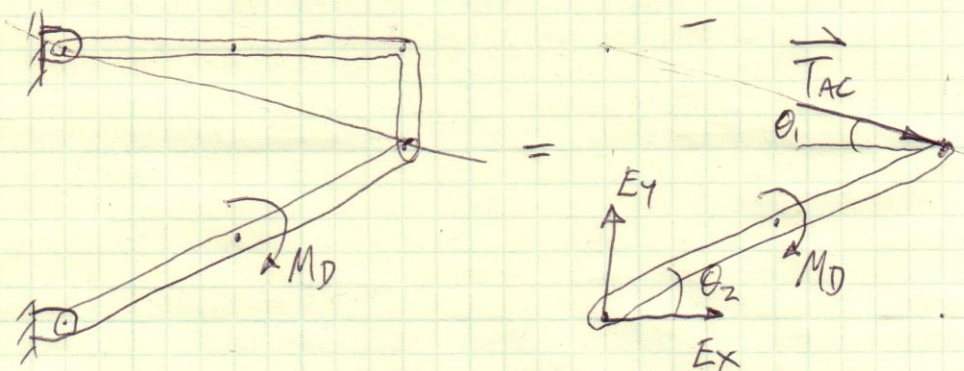
$$\vec{T}_{CE} = (90) \hat{i} + (45) \hat{j} \text{ N}$$

AT POINT E,

$$\vec{E} = -\vec{T}_{CE} = (-90) \hat{i} + (-45) \hat{j} \text{ N}$$

$$b) M_D = -36 \text{ N}\cdot\text{m}$$

FBD: WITH COUPLE AT D, MEMBER ABC IS A TWO-FORCE MEMBER.



$$\theta_1 = \tan^{-1}\left(\frac{160}{480}\right) = 18.43^\circ, \quad \theta_2 = \tan^{-1}\left(\frac{240}{480}\right) = 26.56^\circ$$

$$\vec{T}_{AC} = (T \cdot \cos 18.43^\circ) \hat{i} + (-T \cdot \sin 18.43^\circ) \hat{j}$$

$$\vec{T}_{AC} = (0.9487T) \hat{i} + (-0.3161T) \hat{j} \text{ N}$$

$$\sum F_x = 0: 0.9487T + E_x = 0$$

$$\sum F_y = 0: E_y - 0.3161T = 0$$

$$\sum M_E = 0:$$

POSITION VECTOR FROM E TO C:

$$dx = x_c - x_e = 480 \text{ mm} = 0.48 \text{ m}$$

$$dy = y_c - y_e = 240 \text{ mm} = 0.24 \text{ m}$$

$$\vec{r} = (0.48) \hat{i} + (0.24) \hat{j} \text{ m}$$

$$\vec{r} \times \vec{T}_{AC} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0.48 & 0.24 & 0 \\ 0.9487T & -0.3161T & 0 \end{vmatrix}$$

$$= [(0.48)(-0.3161T) - (0.24)(0.9487T)] \hat{k} = (-0.3794T) \hat{k} \text{ N}\cdot\text{m}$$

$$-0.3794T - 36 = 0 \Rightarrow T = -94.88 \text{ N}$$

$$E_x = -0.9487(-94.88) = 90 \text{ N}$$

$$E_y = 0.3161(-94.88) = -30 \text{ N}$$

$$\vec{T}_{AC} = [0.9487(-94.88)]\hat{i} + [-0.361(-94.88)]\hat{j}$$

$$\vec{T}_{AC} = (-90)\hat{i} + (30)\hat{j} \text{ N}$$

AT POINT A,

$$\vec{A} = -\vec{T}_{AC} = (90)\hat{i} + (-30)\hat{j} \text{ N}$$

