Chapter 10 Problem 77

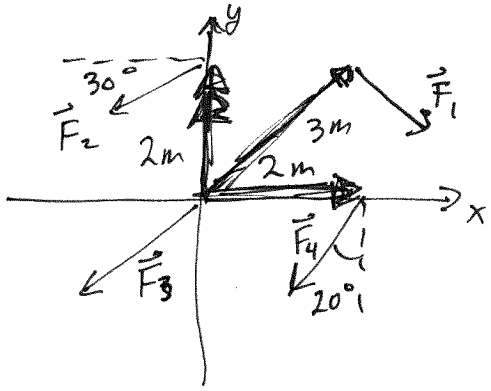
$F_1 = 3N$

$F_2 = 2N$

$F_3 = 3N$

$F_4 = 1.8N$

$\tau = r F \sin\theta$

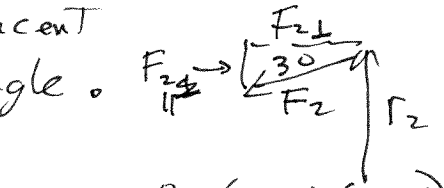


From the diagram

$\vec{F}_1 \rightarrow$ Although it is not clear from the diagram, it appears that $\vec{r}_1 \perp \vec{F}_1$ (perpendicular)

$\therefore \tau_1 = r_1 F_1 \sin 90 = (3m)(3N)(1) = -9\ N\cdot m$ (cause clockwise rotation)

$\vec{F}_2 \rightarrow$ For F_2, the portion of the force perpendicular to r_2 is adjacent to the given angle.



Therefore

$\tau_2 = r_2 F_2 \cos 30° = (2m)(2N)\cos 30° = +3.46\ N\cdot m$ (cause counter-clockwise rotation)

$\vec{F}_3 \rightarrow$ For F_3, the force arm $\vec{r}_3 = 0$

$\therefore \tau_3 = (0)(3N) = 0\ N\cdot m$

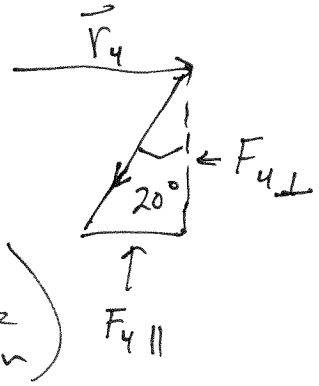
$\vec{F}_4 \rightarrow$ For F_4, the portion of the force $\perp$ to r_4 is adjacent to the given angle.

Therefore,

$\tau_4 = r_4 F_4 \cos 20°$

$= (2m)(1.8N)\cos 20°$

$= -3.38\ N\cdot m$ (cause clockwise rotation)



$\tau_{tot} = -9\ N\cdot m + 3.46\ N\cdot m + 0 - 3.38\ N\cdot m$

$= \boxed{-8.92\ N\cdot m}$