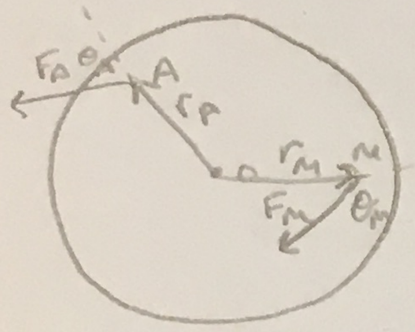
Circular Disk A CD is rotated about an axis O through its center by the application of two forces. Annie and Mikey are fighting over the CD. Annie pushes with a finger and applies a force of magnitude $11N$ is exerted at a distance of $0.34cm$ from the axis and at an angle of $58°$ from a radial line extending from the axis through the point of application A of the force. Mikey applies a second force of magnitude $15N$ is exerted at a distance of $0.26cm$ from the axis and at an angle of $119°$ from a radial line extending from the axis through the point of application M of the force. Determine the net torque on the CD about its center and which way the net torque accelerates the CD.



$\theta_A = 58°$

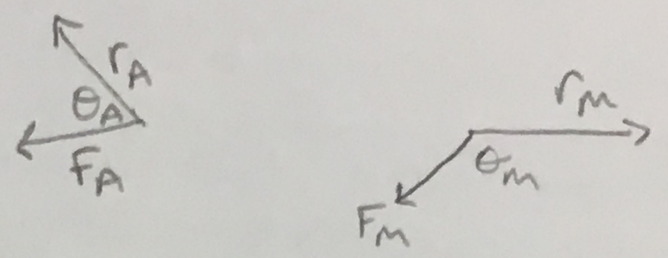
$\theta_M = 119°$

$|r_A| = 0.0034m$

$|r_M| = 0.0026m$

$|F_A| = 11N$

$|F_M| = 15N$



$\tau = \vec{r} \times \vec{F} = |r||F| \sin\theta$

Net Torque: $\Sigma\tau = \overset{ccw}{\tau_A} - \overset{cw}{\tau_M} = 0.032N\cdot m - 0.034N\cdot m$

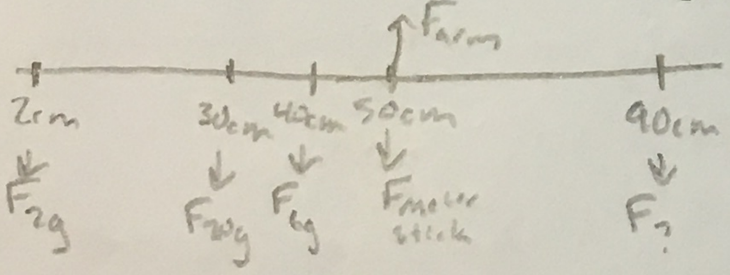
$\tau_A = (0.0034m)(11N)\sin 58° = 0.032N\cdot m$

$\tau_m = (0.0026m)(15N)\sin 119° = 0.034N\cdot m$

$\Sigma\tau = -0.002\ N\cdot m$

clockwise

Tipping Rod Stephanie is playing with a $15g$ meter stick. She balances it on her arm. She then places four weights on it. She puts the first, a $20g$ weight at the $30cm$ mark. The second, a $2g$ weight at the $2cm$ mark. The third, a $6g$ weight at the $40cm$ mark. She places the last weight at the $90cm$ mark. The meter stick remains balanced. How large (in grams) is the last weight?



Since balanced w/out weights:

$F_{arm} = F_{meter\ stick}$

Since balanced w/ weights: $\Sigma\tau = 0$

$\tau = \vec{r} \times \vec{F} = |r||F|\sin\theta$ → all $\perp$ ⇒ $\sin\theta = 1$

for a weight $F = m\cdot g$ (in kg)

$\Sigma\tau = \tau_{2g} + \tau_{20g} + \tau_{6g} - \tau_? = 0$

$\tau_{2g} = (0.48m)(0.002kg \cdot 9.8\frac{m}{s^2}) = 0.0094N\cdot m$

$\tau_{20g} = (0.2m)(0.02kg \cdot 9.8\frac{m}{s^2}) = 0.039N\cdot m$

$\tau_{6g} = (0.1m)(0.006kg \cdot 9.8\frac{m}{s^2}) = 0.0059N\cdot m$

$\tau_? = (0.4m)(?kg\ 9.8\frac{m}{s^2}) = ?kg\ 3.9\frac{m^2}{s^2}$

$0 = 0.0094Nm + 0.039Nm + 0.0059N\cdot m + ?kg\cdot 3.9\frac{m^2}{s^2}$

$0.054N\cdot m = ?kg\ 3.9\frac{m^2}{s^2}$

remember $\vec{r}$ is measured from the pivot pt (50cm)

needs to be in meters

$?kg = 0.0139kg$

Unknown mass = 13.9g

[0]Select problems may be modified from Walsh, Harrison, or the Internet.