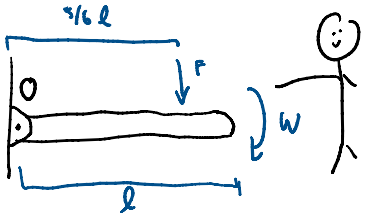
20-R-KIN-DK-20

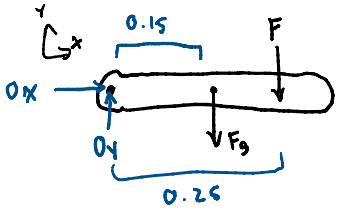
July 22, 2020 9:43 AM

20-R-KIN-DK-20 Beginner Rotation (RBK)

Inspiration: Hibbeler pg. 445



Kronk is asked to pull the lever. He applies a force of ***40 N***, causing the ***10 kg*** lever to have an angular velocity of ***3 rad/s***. Determine the angular acceleration of the lever and the reaction forces at O. Assume the lever is a slender rod and that the lever was originally propped up to be level horizontally. The prop was removed at the instant Kronk applied the force.
Kronk applies the force at a length 5/6l and the lever has length ***l = 0.3 m***.



$\Sigma F_x = O_x = ma_{Gx}$ $\quad \Sigma F_y = O_y - F_g - F = ma_{Gy}$

$\Sigma M_G = -O_y(0.15) - F(0.1) = I_G\alpha = \frac{1}{12}(10)(0.3)^2\alpha$

$a_G = \vec{a}_O + \vec{\alpha} \times \vec{r}_{G/O} - \omega^2 \vec{r}_{G/O}$
$= 0 + \alpha\hat{k} \times (0.15\hat{i}) - 9(0.15\hat{i})$
$= 0.15\alpha\hat{j} - 1.35\hat{i}$

$a_{Gx} = -1.35$
$a_{Gy} = 0.15\alpha$

$O_x = 10(-1.35) = \boxed{-13.5\ N}$

$O_y - 10(9.81) - 40 = 10(0.15)\alpha$
$O_y = 1.5\alpha + 138.1$
$O_y = -30_y - 80 + 138.1$
$40_y = 58.1$
$\boxed{O_y = 14.525}$

$-0.15O_y - 4 = 0.075\alpha$
$-2O_y - \frac{160}{3} = \alpha$
$\boxed{\alpha = -82.3833\ rad/s^2}$