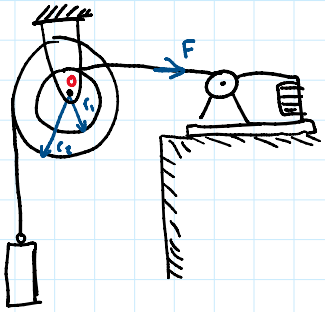
20-R-IM-DK-4

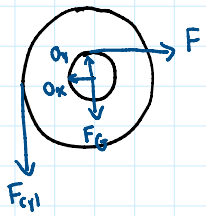
July 2, 2020 2:00 PM

Beginner Principle of Impulse and Momentum

Inspiration: Hibbeler 19.7




An engineering student sets up an experiment to record data such that she may apply her findings to a prototype. Specifically, she is curious about the velocity of an load on a pulley that is attached to motor. The pulley consists of two wheels rigidly attached to another, with a total radius of gyration of ***k_O = 0.110 m*** and a total mass of ***m = 15 kg***. The load, in this case a ***40 kg*** cylinder, is attached to a wire wrapped around the wheel with radius ***r_2 = 0.2 m***, and the motor is attached to a wire wrapped around the wheel with radius ***r_1 = 0.075 m*** of the pulley. The ends of the wire are rigidly attached to the pulley and do not slip as the pulley rotates. Determine the velocity of cylinder if the motor applies a constant tensional force ***F = 2000 N*** after ***t = 3 seconds***. The cylinder is initially at rest.




$I_G = mk_G^2 = 15(0.11^2) = 0.1815$ $\quad v = \omega r$ $\quad \omega = \frac{v}{r} = \frac{v}{0.2} = 5v$

$$(\Sigma \vec{H}_{O\,sys})_{t_1} + \left(\sum \int_{t_1}^{t_2} M_{O\,ext}\, dt\right) = (\Sigma H_{O\,sys})_{t_2}$$

$H_{G\,cylinder} + r_{G/O} \times m\vec{v}$

$$0 + 40(9.81)(0.2)(3) - (2000)(0.075)(3) = -0.1815(\omega) + H_{O\,cylinder}$$

$$-214.56 = -0.1815(5v) + 0 + (-0.2\hat{i}) \times (40v\hat{j})$$

$$-214.56 = -0.1815(5v) - 0.2(40)v$$

$$v = 24.087566 \text{ m/s}$$