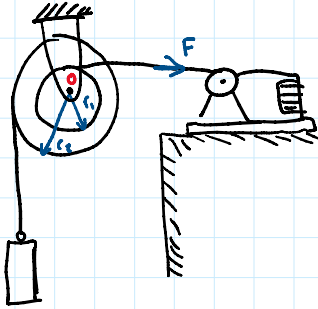


# Beginner Principle of Impulse and Momentum

Inspiration: Hibbeler 19.7

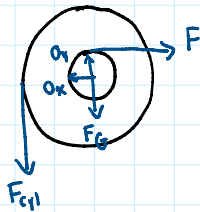


An engineering student sets up an experiment to record data such that she may apply her findings to a prototype. Specifically, she is curious about the velocity of an load on a pulley that is attached to motor. The pulley consists of two wheels rigidly attached to another, with a total radius of gyration of  $k_O = 0.110 \text{ m}$  and a total mass of  $m = 15 \text{ kg}$ . The load, in this case a  $40 \text{ kg}$  cylinder, is attached to a wire wrapped around the wheel with radius  $r_2 = 0.2 \text{ m}$ , and the motor is attached to a wire wrapped around the wheel with radius  $r_1 = 0.075 \text{ m}$  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  $F = 2000 \text{ N}$  after  $t = 3 \text{ seconds}$ . The cylinder is initially at rest.

$$I_G = mk_G^2 = 15(0.11^2) = 0.1815$$

$$v = \omega r \quad \omega = \frac{v}{r} = \frac{v}{0.2} = 5v$$

$$(\sum \vec{H}_O)_{t_1} + (\sum_{t_1}^{t_2} M_O \text{ ext } dt) = (\sum H_O)_{t_2}$$



$$0 + 40(9.81)(0.2)(3) - (2000)(0.075)(3) = -0.1815(\omega) + H_{O_{\text{cylinder}}} + H_{G_{\text{cylinder}}} + r_{G/O} \times m\vec{v}$$

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

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

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