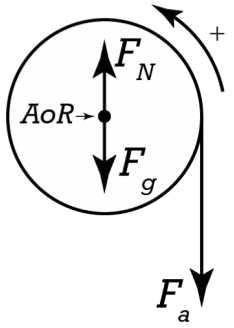
Flipping Physics Lecture Notes:

Introductory Rotational Form of Newton's Second Law Problem

Example: A uniform, solid disk that rotates about a frictionless axle at its center of mass is mounted on a wall so the plane of the disk is parallel to the wall. A string of negligible mass wraps around the disk and is pulled by a force of 11 N. If the radius of the disk is 0.18 m and the mass of the disk is 1.5 kg, what is the angular acceleration of the disk? The rotational inertia of a solid disk about its center of mass equals ½MR^2.

Knowns: $F_a = 11N;\ R_{disk} = 0.18m;\ M_{disk} = 1.5kg;\ \alpha = ?$

$$I_{disk} = \frac{1}{2}MR^2 = \frac{1}{2}(1.5)(0.18)^2 = 0.0243kg \cdot m^2$$



Draw the Free Body Diagram and define the positive torque direction. →

Sum the torques acting on the disk about its axis of rotation.

$$\sum \vec{\tau} = \cancel{\vec{\tau}_{F_N}} + \cancel{\vec{\tau}_{F_g}} - \vec{\tau}_{F_a} = I\vec{\alpha} \Rightarrow -\vec{\tau}_{F_a} = I\vec{\alpha}$$

Note: Because both F_N and F_g act on the axis of rotation, they both have an r value of zero and therefore produce no torque about the axle.

$$\Rightarrow -\vec{r}_{F_a}\vec{F}_a \sin\theta = -RF_a \sin(90) = I\alpha$$

$$\Rightarrow \alpha = -\frac{RF_a}{I} = -\frac{(0.18)(11)}{0.0243} = -81.4815 \approx \boxed{-81\frac{rad}{s^2}}$$