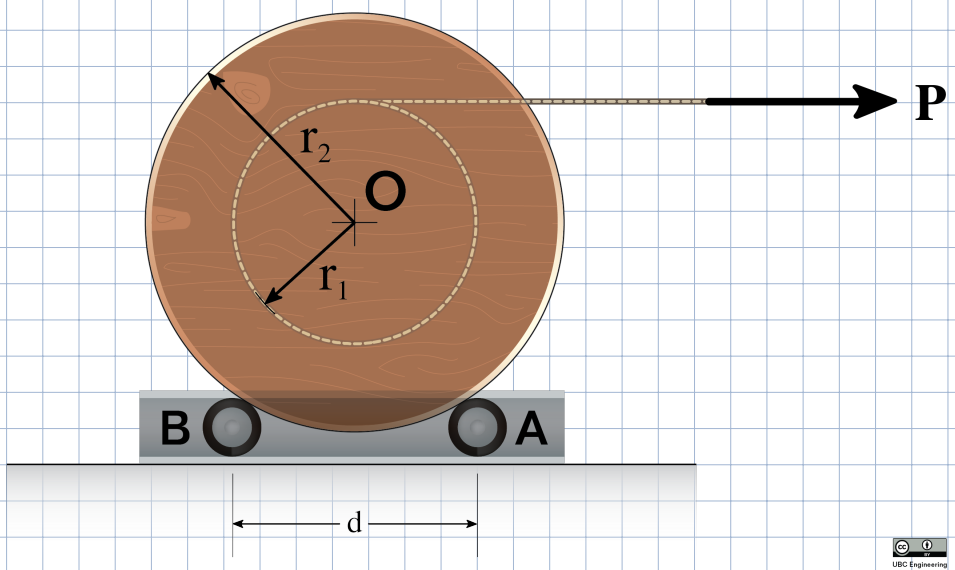
A reel of mass 15 kg, resting on two rollers is initially at rest when a force of P = 400 N is applied to a rope attached to the reel. Given that $r_1 = 0.2$ m, $r_2 = 1$ m, and the radius of gyration of the reel is 0.6 m, how many revolutions must the wheel complete to achieve a final angular velocity of 30 rad/s? (Assume no energy is lost due to friction and neglect the mass of the rope and the two rollers)



$d = 2\pi r_1 n \ [m] = 1.257 n \ [m]$

$T_1 + W_{1\to 2} = T_2$

$W_{1\to 2} = P \cdot d = (400N)(1.257 n \ [m]) \ [J]$

$T = \frac{1}{2} I \omega^2 \qquad I = mK^2 = (15kg)(0.6m)^2 = 5.4 \ kgm^2$

$T_2 = \frac{1}{2} I \omega_2^2 = \frac{1}{2}(5.4 \ kgm^2)(30 \ rad/s)^2$

$\therefore (400N)(1.257 n \ m) = \frac{1}{2}(5.4 \ kgm^2)(30 \ rad/s)^2$

$\therefore$ **$n = 4.83$ revolutions**