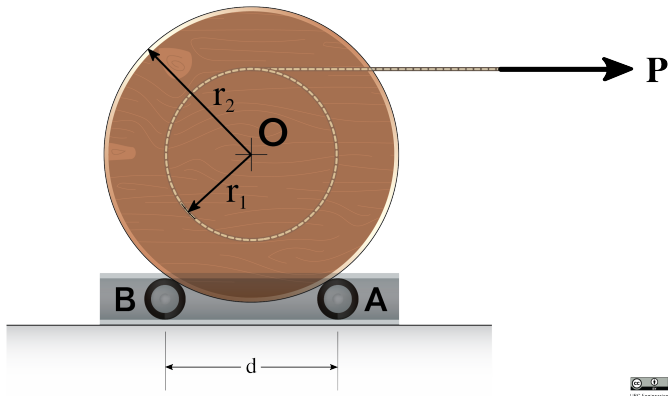


22-R-WE-TW-22



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, what is the angular velocity of the reel after it completes one full rotation? (Assume no energy is lost due to friction and neglect the mass of the rope and the two rollers)

Solution:

Let state 1 be when the reel is initially at rest and state 2 be after the reel has completed one rotation.

$$s = 2\pi r_1 = 2\pi(0.2) = 1.257 \text{ [m]}$$

$$U_{1 \rightarrow 2} = Ps = (400)(1.257) = 502.7 \text{ [N]}$$

$$U_{1 \rightarrow 2} = T_{1 \rightarrow 2} = T_{rot,2} = \frac{1}{2}I_O\omega_2^2$$

$$I_O = mk^2 = (15)(0.6)^2 = 5.4 \text{ [kg} \cdot \text{m}^2]$$

$$\omega_2 = \sqrt{\frac{2U_{1 \rightarrow 2}}{I_O}} = \sqrt{\frac{2(502.7)}{5.4}} = 13.6 \text{ [rad/s]}$$