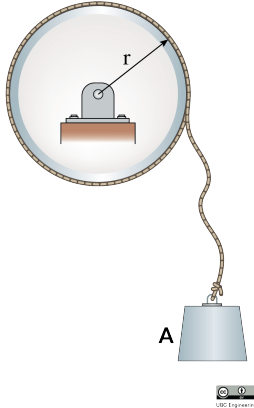


22-R-WE-TW-21



A mass of 20 kg is connected to a pulley of mass 30 kg radius $r = 0.25$ m and radius of gyration of $k = 0.15$ m. The system is initially at rest when the mass is released and the wheel begins to rotate. When the mass travels some distance down, it is moving with a speed of $v = 8$ m/s. How far did the mass move down? (Use $g = 9.81$ m/s²)

Solution:

$$\begin{aligned}
 U_g &= T_{mass} + T_{pulley} \\
 mg\Delta y &= \frac{1}{2}m_mv^2 + \frac{1}{2}I\omega^2 \\
 I &= m_pk^2 = (30)(0.15)^2 = 0.675 \text{ [kg} \cdot \text{m}^2] \\
 v &= \omega r \Rightarrow \omega = \frac{v}{r} \\
 m_m g \Delta y &= \frac{v^2}{2} \left(\frac{I}{r^2} + m_m \right) \\
 \Delta y &= \frac{v^2}{2m_m g} \left(\frac{I}{r^2} + m_m \right) = \frac{8^2}{2(20)(9.81)} \left(\frac{0.675}{0.25^2} + 20 \right) = 5.02 \text{ [m]}
 \end{aligned}$$