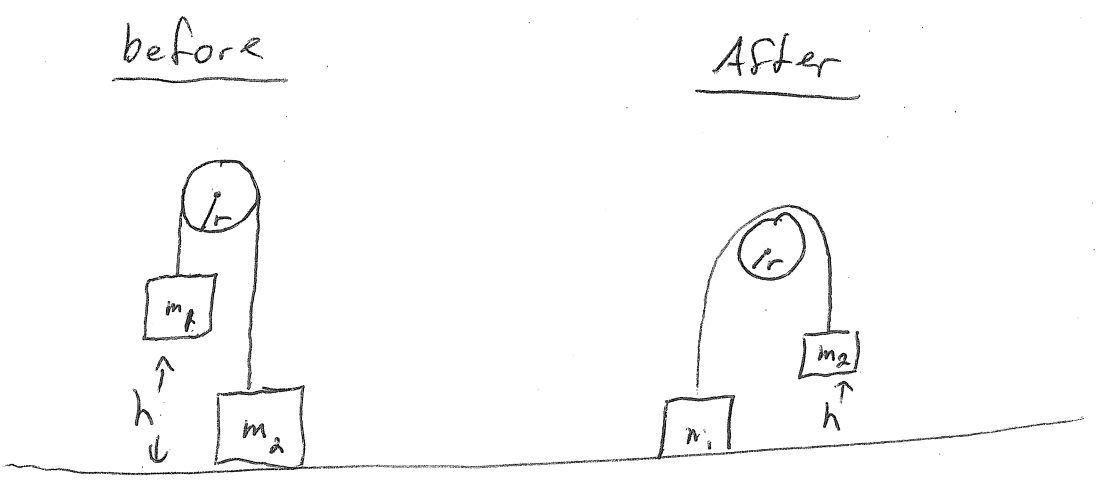
Two masses ($m_1 = 5.0\,kg$ and $m_2 = 3.0\,kg$) are released from rest, with m_1 at height of $0.75\,m$ above the floor. When m_1 hits the ground its speed is $1.8\,m/s$.

(pulley is a uniform disk $r = 12\,cm$)

Determine the mass of the pulley.



- Masses will move together with velocity v.
- Rope will spin pulley at v on outer rim.
- Energy Conservation

$$\Delta E = 0 = E_f - E_i$$

$$E_f = E_i$$

$$E_{k_T} + E_{k_R} + E_{g_{m_2}} = E_{g_{m_1}}$$

$$\frac{1}{2} m_s v^2 + \frac{1}{2} I \omega^2 + m_2 g h = m_1 g h$$

$$\omega = \frac{v}{r} \qquad I = \frac{1}{2} m r^2$$

$$\frac{1}{2} I \omega^2 = \frac{1}{2}\left(\frac{1}{2} m r^2\right)\left(\frac{v^2}{r^2}\right)$$

$$= \frac{1}{4} m_p v^2$$

$$\frac{1}{2} m_s v^2 + \frac{1}{4} m_p v^2 + m_2 g h = m_1 g h$$

$$m_p = \frac{m_1 g h - \frac{1}{2} m_s v^2 - m_2 g h}{\frac{1}{4} v^2}$$

$$= \frac{5.0\,kg\left(9.81\,m/s^2\right)(.75\,m) - \frac{1}{2}(8.0\,kg)(1.8\,m/s)^2 - 3.0\,kg\ 9.81(.75}{\frac{1}{4}(1.8\,m/s)^2}$$

$$= 2.17\,kg$$

$$\boxed{2.2\,kg}$$