Lecture Quiz #11, Monday May 5.

Notice the freedom to choose different coordinate system for each mass.

(assume \(m_2 > m_1\))

For the pulley: \(\sum \text{Torque} = I \alpha\) calculating torques and moment of inertia about the center of mass:

\[
T_2 R - T_1 R = I_{\text{cm}} \alpha \\
(T_2 - T_1) R = \frac{1}{2} MR^2 \alpha
\]

\[\Rightarrow T_2 - T_1 = \frac{1}{2} MR \alpha \]

For object 1: \(\sum \text{Force} = m_1 a\)

\[T_1 - m_1 g = m_1 a\]

For object 2: \(\sum \text{Force} = m_2 a\)

\[m_2 g - T_2 = m_2 a\]

Note that \(\alpha\) is related to \(\alpha\) as \(\alpha = R \omega\).

You know why, right?

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\[ T_2 - T_1 = \frac{1}{2} M \alpha \frac{R}{R} \]

\[ T_1 - m_1 g = m_1 a \Rightarrow T_1 = m_1 g + m_1 a \]

\[ m_2 g - T_2 = m_2 a \Rightarrow T_2 = m_2 g - m_2 a \]

Substituting \((m_2 g - m_2 a) - (m_1 g + m_1 a) = \frac{1}{2} M a\)

\[ m_2 g - m_1 g = \frac{1}{2} (M + m_1 + m_2) a \]

\[ a = \frac{m_2 g - m_1 g}{2(M + m_1 + m_2)} \]

\[ a = \frac{(m_2 - m_1) g}{2(M + m_1 + m_2)} \]

*Note that if \( M = 0 \), then we go back to the result you would've gotten back in the earlier part of the semester when we didn't have to worry about the rotation of the pulley.*

*Also, in that case \( T_1 \) would be equal to \( T_2 \).*