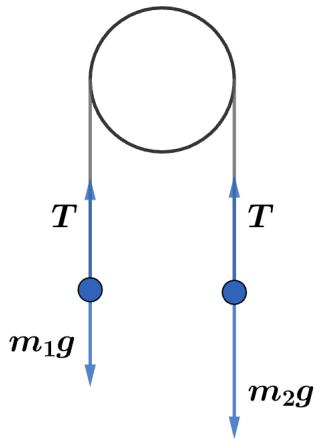


2017 F=ma Exam: Problem 13

Kevin S. Huang



Recall the acceleration of a simple Atwood machine with masses m_1, m_2 is

$$a = \frac{m_2 - m_1}{m_2 + m_1} g$$

The tension is

$$\begin{aligned} m_2g - T &= m_2a \\ T &= m_2(g - a) = m_2 \left(\frac{m_2 + m_1}{m_2 + m_1} g - \frac{m_2 - m_1}{m_2 + m_1} g \right) = \frac{2m_2m_1}{m_2 + m_1} g \end{aligned}$$

In our case, $m_1 = M$, $m_2 = M + m$ so

$$T = \frac{2M(M + m)}{2M + m} g$$

When $m \rightarrow 0$,

$$T \rightarrow \frac{2M^2}{2M} g = Mg$$

When $m \rightarrow \infty$,

$$T \rightarrow \frac{2Mm}{m} g = 2Mg$$

so the answer is D.