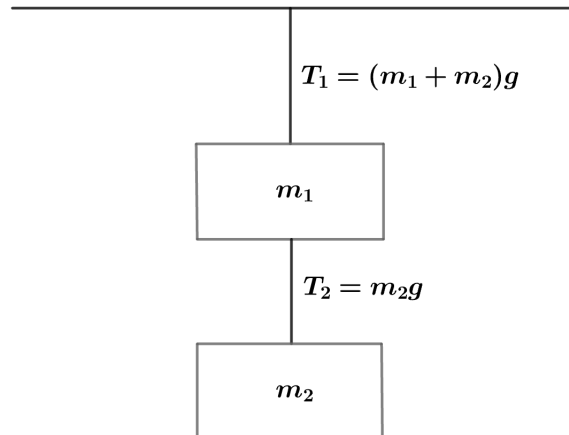# 2016 F=ma Exam: Problem 10

Kevin S. Huang

Initially when the blocks are at rest, the tension T_1 in the top string holds the weight of both blocks while the tension T_2 in the bottom string holds the weight of m_2 so

$$T_1 = (m_1 + m_2)g$$
$$T_2 = m_2 g$$

If the top string is cut at the connection point to m_1, then at that instant m_1 no longer feels an upward tension force. On the other hand, the tension T_2 does not change instantaneously since it is sustained in an elastic string (effectively a spring). It takes time for a spring to change its length and we know the tension is determined by its elongation. Thus, we still have $T_2 = m_2 g$ at that moment.
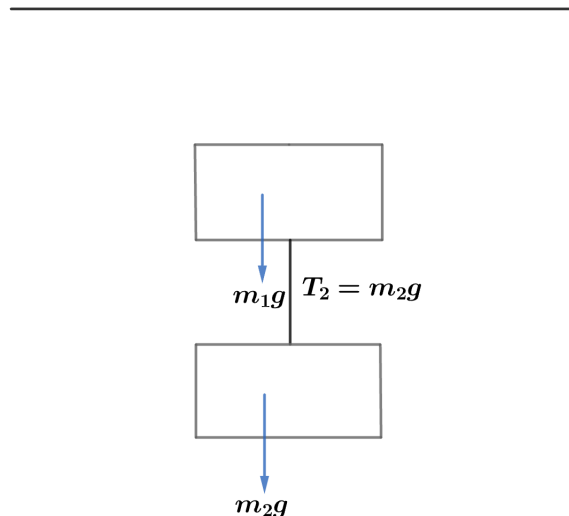
Applying Newton's 2nd law to m_1,

$$m_1 a_1 = m_1 g + T_2 = m_1 g + m_2 g$$

$$a_1 = \left(1 + \frac{m_2}{m_1}\right) g = \left(1 + \frac{4\,\mathrm{kg}}{2\,\mathrm{kg}}\right)(10\,\mathrm{m/s^2}) = 30\,\mathrm{m/s^2}$$

Applying Newton's 2nd law to m_2,

$$m_2 a_2 = m_2 g - T_2 = 0$$

$$a_2 = 0$$

Thus, the answer is $\boxed{\text{D}}$.