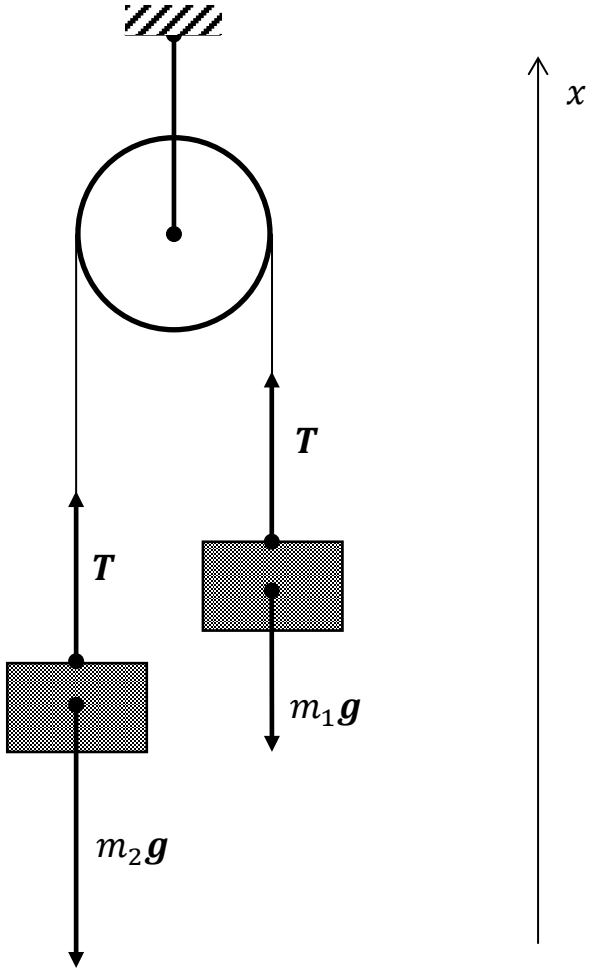
Answer on Question#51954 – Physics – Other

A $m_1 = 2$ kg and a $m_2 = 4$ kg hang freely at opposite ends of a light inextensible string which passes over a small and light pulley fixed to a rigid support. Calculate the acceleration of the system.

Solution:



Let's first apply Newton's second law to mass m_1 (projection on the axis x)

$$m_1 a = T - m_1 g$$

Let's now apply Newton's second law to mass m_2 (projection on the axis x)

$$-m_2 a = T - m_2 g$$

(the acceleration of the second mass has the opposite direction)

Expressing T from the first equation we obtain

$$T = m_1 a + m_1 g$$

Substituting this into the second equation we obtain

$$-m_2 a = m_1 a + m_1 g - m_2 g$$

And finally

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

If we take the acceleration of the free fall g to be equal $9.8 \frac{\text{m}}{\text{s}^2}$, then we obtain

$$a = \frac{m_2 - m_1}{m_1 + m_2} g = \frac{4\text{kg} - 2\text{kg}}{2\text{kg} + 4\text{kg}} 10 \frac{\text{m}}{\text{s}^2} = 3.26 \frac{\text{m}}{\text{s}^2}$$

Answer: $a = \frac{m_2 - m_1}{m_1 + m_2} g = 3.26 \frac{\text{m}}{\text{s}^2}$.