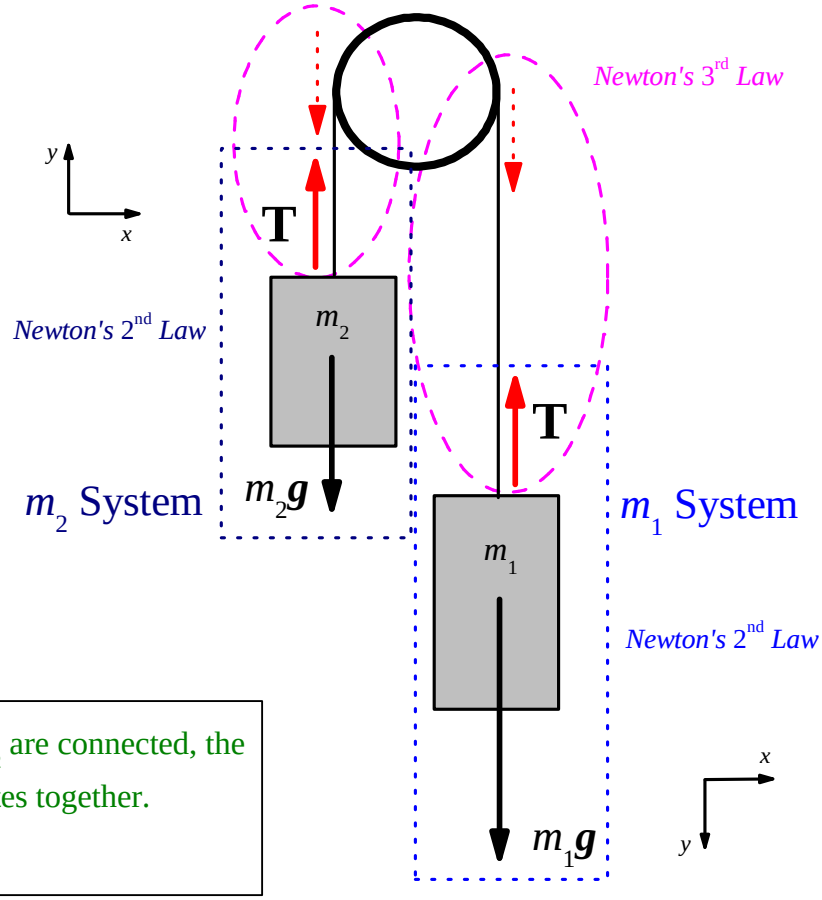
Simple Atwood's Machine

(m_1 - m_2 System)



Since m_1 and m_2 are connected, the system accelerates together.
$|\boldsymbol{a}_1| = |\boldsymbol{a}_2| = a$.

m_2 System:

$$\Sigma F_y = - m_2 g + T = m_2 a_2$$

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

or $T = m_2 a + m_2 g$

m_1 System:

$$\Sigma F_y = m_1 g - T = m_1 a_1$$

$$m_1 g - T = m_1 a$$

or $T = - m_1 a + m_1 g$

Setting the two T expressions equal:

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

Solving for a:

$$a = \left[\frac{m_1 - m_2}{m_1 + m_2} \right] g$$