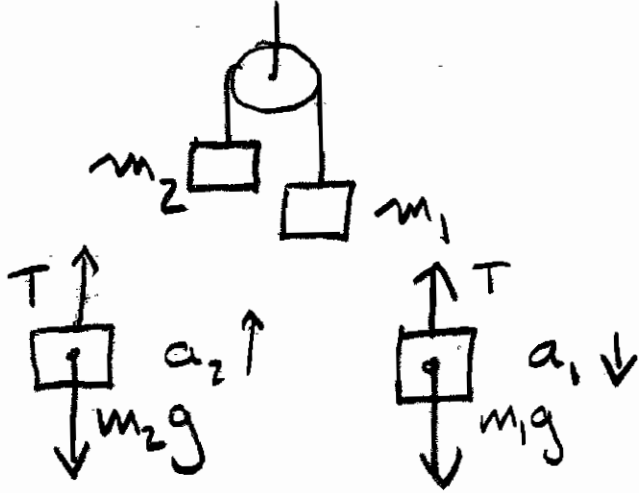


Atwood's machine



$$a_2 = a_1 \quad (1)$$

$$m_1 a_1 = m_1 g - T \quad (2)$$

$$+ m_2 a_2 = T - m_2 g \quad (3)$$

$$(m_1 + m_2) a_1 = (m_1 - m_2) g$$

$$a_1 = \underbrace{\frac{m_1 - m_2}{m_1 + m_2}}_{\text{dimensionless}} g$$

Commentary

goal: find acceleration of m_1
massless pulley

free body diagrams
 T is tension in string
choice of directions for accelerations is arbitrary

length of string does not change

Newton's 2nd Law, twice.

3 eqns / 3 unknowns

eliminate a_2 & T

units: a_1 has units of g

limiting/interesting cases:

$$m_2 = 0 \Rightarrow a_1 = g \checkmark$$

$$m_1 = 0 \Rightarrow a_1 = -g \checkmark$$

$$m_1 = m_2 \Rightarrow a_1 = 0 \checkmark$$

goal? \checkmark