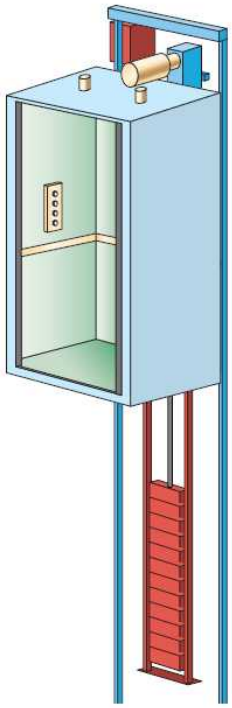
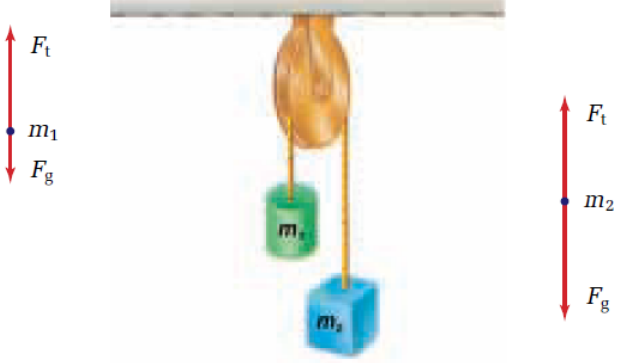
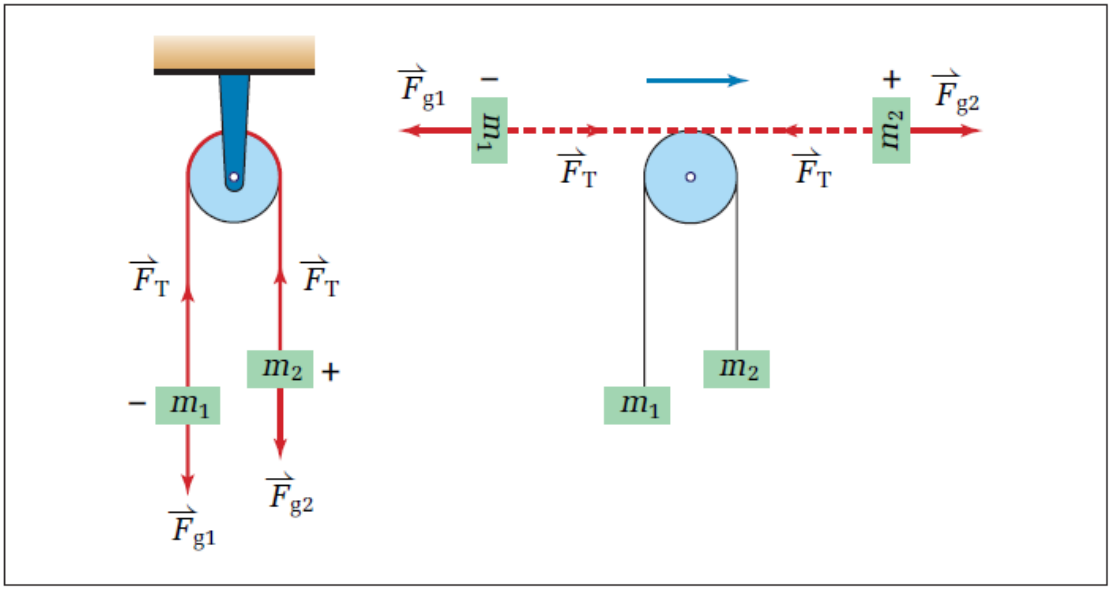
Connected Objects





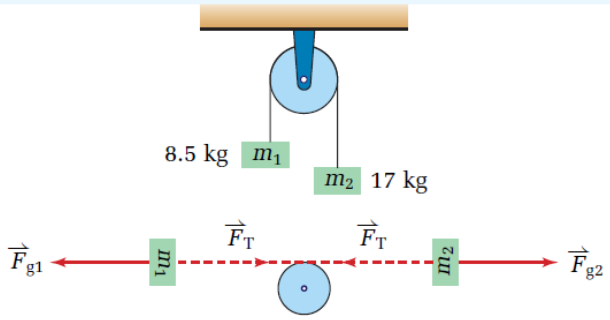


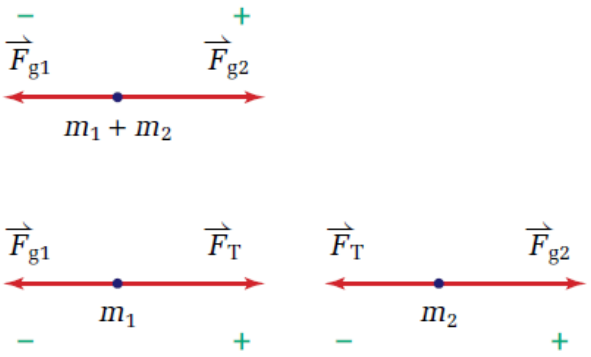
Motion of Connected Objects

An Atwood machine is made of two objects connected by a rope that runs over a pulley. The object on the left (m_1) has a mass of 8.5 kg and the object on the right (m_2) has a mass of 17 kg.

(a) What is the acceleration of the masses?

(b) What is the tension in the rope?





Calculations

$$\vec{F} = m\vec{a}$$

$$\vec{F}_{g1} + \vec{F}_{g2} = (m_1 + m_2)\vec{a}$$

$$-m_1 g + m_2 g = (m_1 + m_2)\vec{a}$$

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

$$\vec{a} = \frac{(17\text{ kg} - 8.5\text{ kg})9.81\ \frac{\text{m}}{\text{s}^2}}{8.5\text{ kg} + 17\text{ kg}}$$

$$\vec{a} = 3.27\ \frac{\text{m}}{\text{s}^2}$$

$$\vec{a} \cong 3.3\ \frac{\text{m}}{\text{s}^2}\text{[to the right]}$$

$$\vec{F} = m\vec{a}$$

$$\vec{F}_{g1} + \vec{F}_T = m_1\vec{a}$$

$$-m_1 g + \vec{F}_T = m_1\vec{a}$$

$$\vec{F}_T = m_1 g + m_1\vec{a}$$

$$\vec{F}_T = (8.5\text{ kg})\left(9.81\ \frac{\text{m}}{\text{s}^2}\right) + (8.5\text{ kg})\left(3.27\ \frac{\text{m}}{\text{s}^2}\right)$$

$$\vec{F}_T = 111.18\ \frac{\text{kg}\cdot\text{m}}{\text{s}^2}$$

$$\vec{F}_T \cong 1.1 \times 10^2\text{ N}$$