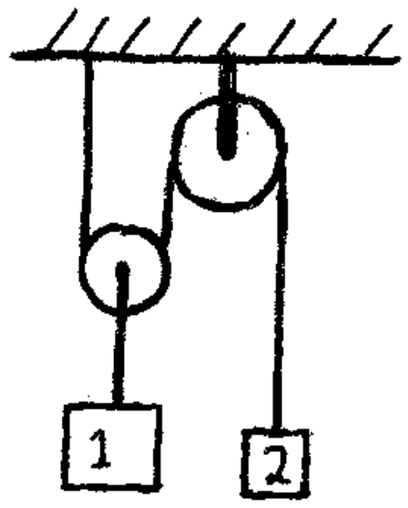
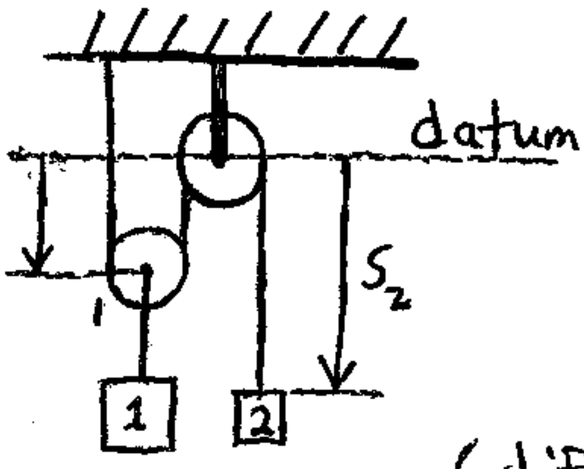
This is a force and motion problem involving pulleys.



In the pulley system shown, block 1 has a mass of 80 kg and block 2 has a mass of 30 kg. If the system is released from rest, what is the speed of block 2 after 1.5 seconds? Neglect the mass of the pulleys and rope.

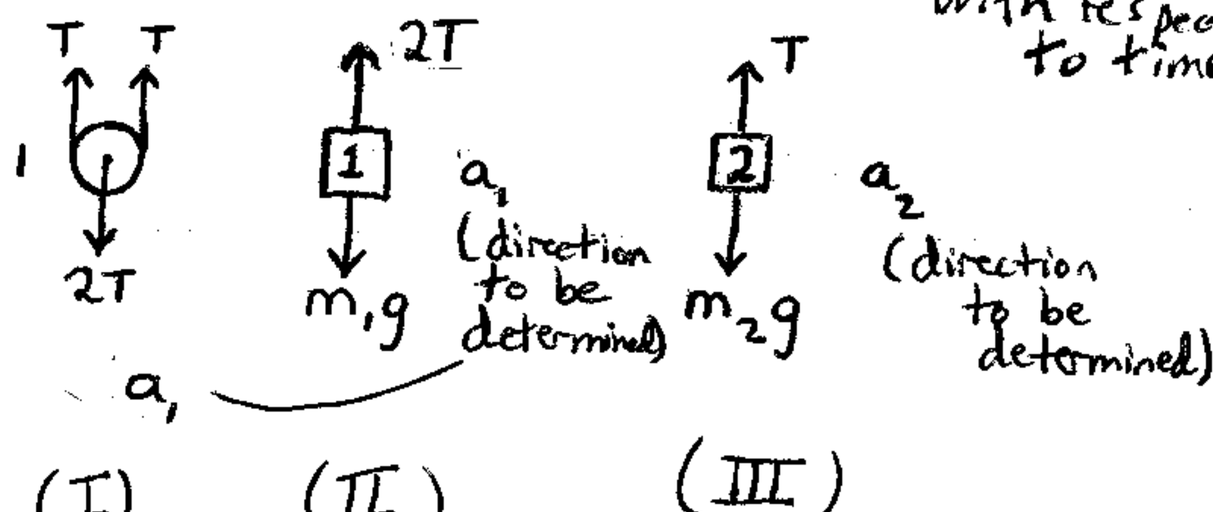
Solution:



$2s_1 + s_2 = L$ (constant length)

(differentiate twice with respect to time) $\longrightarrow$ $2a_1 + a_2 = 0$ (1)

Free-body diagrams



(I) Apply Newton's second law:

$-T - T + 2T = 0\,(a_1)$ (This equation is satisfied)

↑ massless pulley

(II) Apply Newton's second law:

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

(III) Apply Newton's second law:

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

Substitute equation (3) into equation (2):

$$-2(m_2 g - m_2 a_2) + m_1 g = m_1 a_1$$

Substitute equation (1) into above equation:

$$-2(m_2 g - m_2 a_2) + m_1 g = m_1 \left(\frac{-a_2}{2}\right)$$

Solve for a_2:

$$a_2 = \frac{-m_1 g + 2m_2 g}{2m_2 + \frac{m_1}{2}} = -g\frac{(m_1 - 2m_2)}{\frac{m_1}{2} + 2m_2}$$

substitute $m_1 = 80\,kg$ and $m_2 = 30\,kg$ into above equation:

$$a_2 = -1.96\,m/s^2$$

Apply kinematics equation for constant acceleration

$$v_f = v_i + at \Rightarrow v_f = 0 + (-1.96)(1.5) = -2.94\,m/s$$

For block 2, the speed is $2.94\,m/s$ upward. (answer)