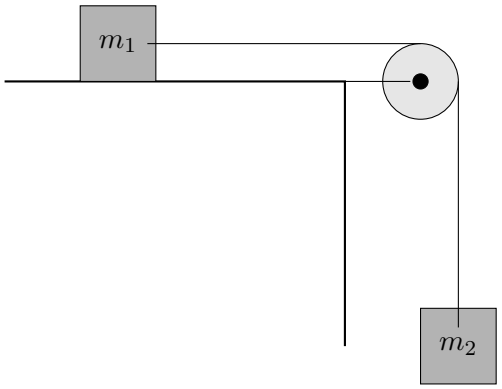
Problem 4: (20 pts.) A block of mass $m_1 = 8.00\,\text{kg}$ is on a horizontal table. The coefficient of kinetic friction μ_k between m_1 and the table is unknown. The block is attached to a string that passes over a pulley and is attached to a hanging mass $m_2 = 6.00\,\text{kg}$. The pulley is frictionless, and both the pulley and string are massless. Initially, both blocks are moving with a speed of $0.900\,\text{m/s}$. (m_1 is moving to the right, and m_2 is moving downward.) The blocks come to rest after moving $2.00\,\text{m}$. What is μ_k?



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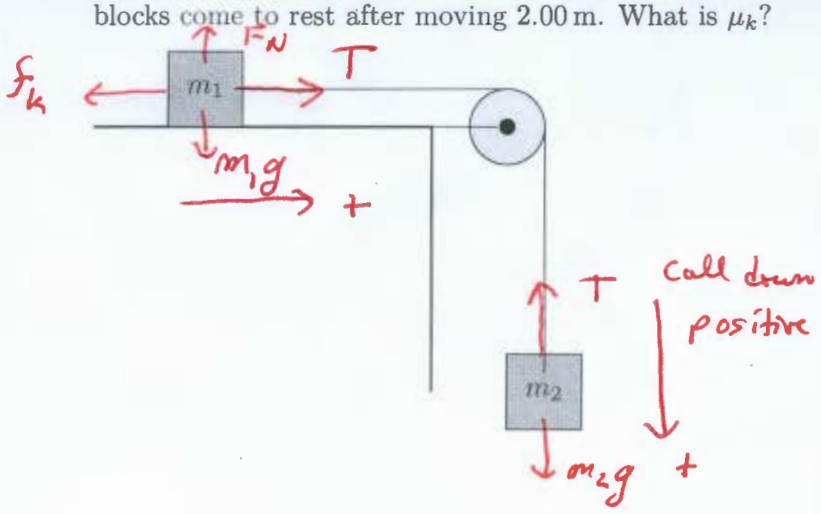

To solve with $\Sigma \vec{F} = m\vec{a}$

1st: find a_1

$$v_{1f}^2 = v_{1i}^2 + 2a_1\Delta x$$

$$a_1 = \frac{v_{1f}^2 - v_{1i}^2}{2\Delta x}$$

$$a_1 = \frac{0 - (0.900\,\text{m/s})^2}{2(2.00\,\text{m})}$$

$$a_1 = -0.2025\,\text{m/s}^2$$

Block 1:

$$\Sigma F_{1x} = m_1 a_{1x} \qquad \Sigma F_{1y} = m_1 a_{1y}$$

$$T - f_k = m_1 a_1 \qquad F_N - m_1 g = 0$$

$$T - \mu_k F_N = m_1 a_1 \qquad F_N = m_1 g$$

$$T - \mu_k m_1 g = m_1 a_1$$

Block 2:

call down positive so $a_1 = a_2$

$$m_2 g - T = m_2 a_2$$

$$T = m_2 g - m_2 a_1 \quad \text{use } a_1 = a_2$$

plug in

$$m_2 g - m_2 a_1 - \mu_k m_1 g = m_1 a_1$$

$$\frac{m_2(g - a_1) - m_1 a_1}{m_1 g} = \mu_k$$

$$\frac{(6\,\text{kg})(9.8 + 0.2025)\,\text{m/s}^2 - (8\,\text{kg})(-0.2025\,\text{m/s}^2)}{(8\,\text{kg})(9.8\,\text{m/s}^2)} = \mu_k$$

$$\boxed{0.786 = \mu_k}$$