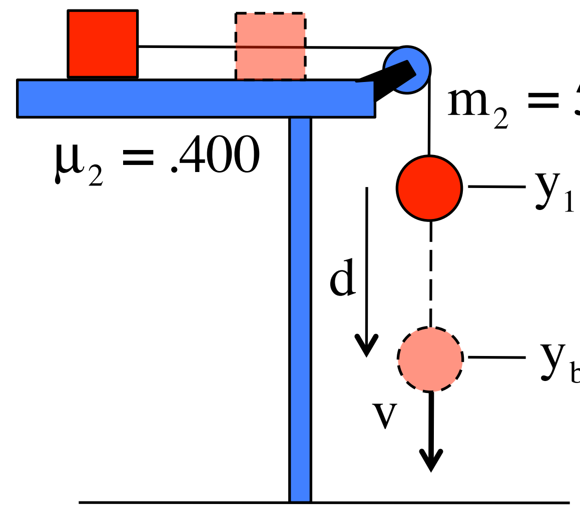
Problem 8.22



This is a classic *Modified Conservation of Energy* problem. Here are the things to remember:

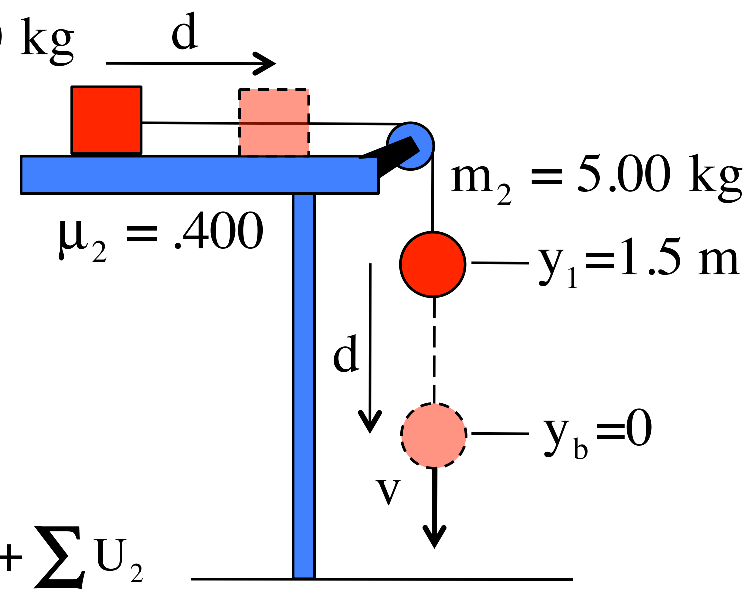
--To calculate *gravitational potential energy*, we would normally assume a "y = 0" level for each individual mass. But as the mass on the table has no work done to it by gravity (it doesn't move upward or downward during the interval), we can ignore it and focus only on the hanging mass.

--By now you should be able to see by inspection that N.S.L. yields "$N = m_1 g$" so that friction will do *extraneous work* in the amount:

$$\vec{f} \bullet \vec{d} = |\vec{f}||\vec{d}|\cos 180^\circ = -(\mu_k N)d = -(\mu_k (mg))d$$

where $d = |y_b - y_1| = 1.5 \text{ m}.$

With all of that, the Modified Conservation of Energy relationship becomes:



$$\sum KE_1 + \sum U_1 + \sum W_{ext} = \sum KE_2 + \sum U_2$$

$$0 + m_2 g y_1 + \left(\vec{f} \bullet \vec{d}\right) = \left(\frac{1}{2}m_1 v^2 + \frac{1}{2}m_2 v^2\right) + \cancelto{0}{m_2 g y_b}$$

$$\Rightarrow \quad m_2 g y_1 + \left(-\left(\mu_k m_1 g\right)d\right) = \left(\frac{1}{2}m_1 v^2 + \frac{1}{2}m_2 v^2\right)$$

$$\Rightarrow \quad v = \left[\frac{2\left(m_2 g y_1 - \left(\mu_k m_1 g\right)d\right)}{m_1 + m_2}\right]^{1/2}$$

$$\Rightarrow \quad v = \left[\frac{2(5.00\text{ kg})(9.8\text{ m/s}^2)(1.50\text{ m}) - 2(.400)(3.00\text{ kg})(9.8\text{ m/s}^2)(1.50\text{ m})}{(3.00\text{ kg}) + (5.00\text{ kg})}\right]^{1/2}$$

$$= 3.74\text{ m}$$