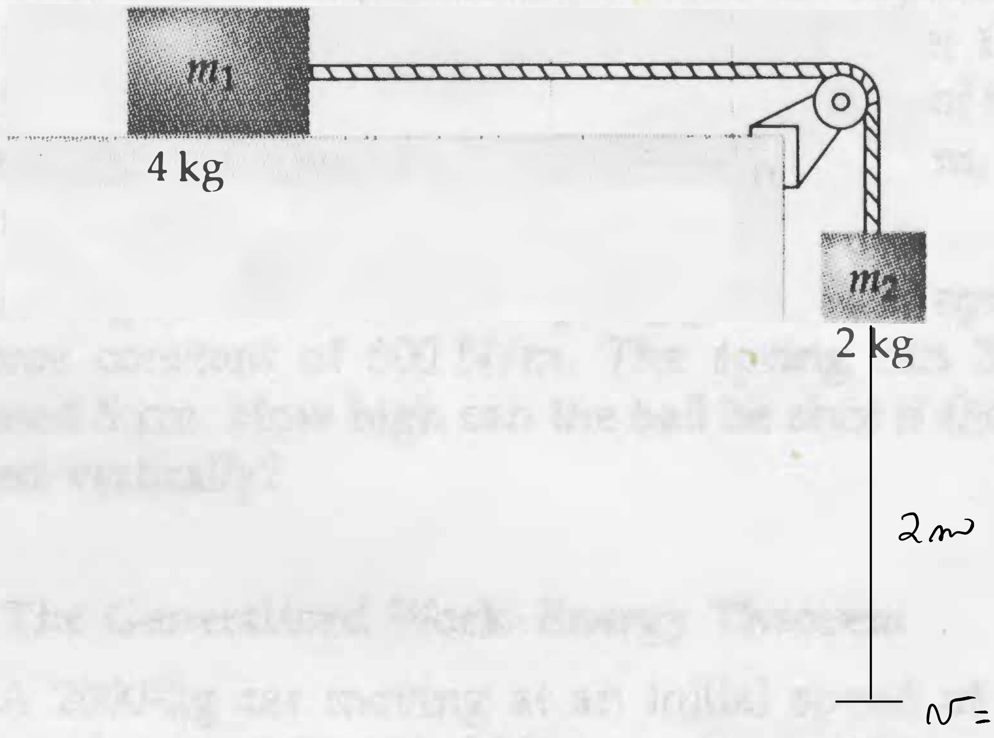
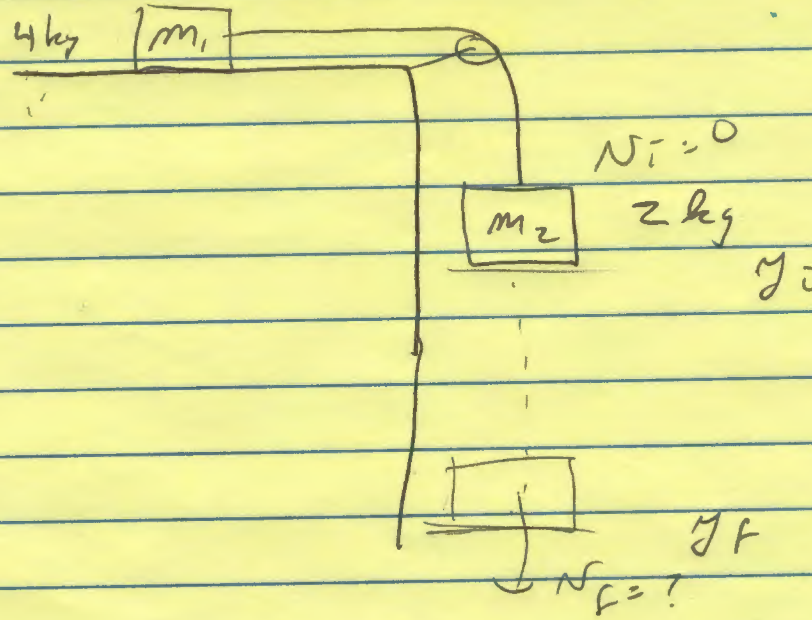
32 In Figure 6-34, the blocks are initially at rest. Choose $U = 0$ at this initial position. (*a*) Write an expression for the total mechanical energy of the system after the 2-kg block has fallen a distance y. (*b*) Find the speed of the 2-kg mass after it has fallen from rest a distance of 2 m, assum-ing no friction.

Figure 6-34 Problems 32 and 38.



old #32. (HRW?)



$m_1 = 4\,kg$ $\quad v_{1i} = v_{2i} = 0$

$m_2 = 2\,kg$ $\quad v_{1f} = v_{2f} = ?$

$y_{2i} = 2.0\,m$

$y_{2f} = 0.0\,m.$

$$E_i = E_f$$

$$K_i + U_i = K_f + U_f$$

$$K_{1i} + K_{2i} + U_{1i} + U_{2i} = K_{1f} + K_{2f} + U_{1f} + U_{2f}$$

$$0 + 0 + m_1 g y_{1i} + m_2 g y_{2i}$$

$$= \frac{1}{2} m_1 v_f^2 + \frac{1}{2} m_2 v_f^2$$

$$+ m_1 g y_{1f} + m_2 g y_{2f}$$

$$m_2 g (y_{2i} - y_{2f}) = \frac{1}{2}(m_1 + m_2) v_f^2$$

$$v_f = \sqrt{\frac{2 m_2}{m_1 + m_2} g (y_{2i} - y_{2f})}$$

$$\boxed{v_f = 3.61\,m/s}$$

what if there is friction on the top table?

$$K_i + U_i + W_{fr} = K_f + U_f$$

$\uparrow$

$$-f_k(y_{2i} - y_{2f})$$

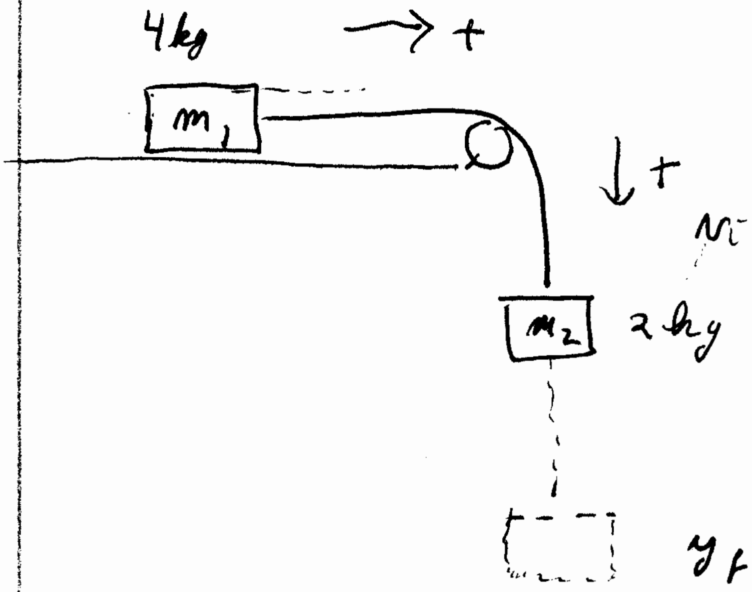
$$-\mu_k m_1 g (y_{2i} - y_{2f})$$

proceed as before.

what if the pulley has mass?

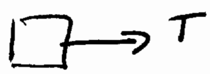
Add in $K_{rot} = \frac{1}{2} I \omega^2$, where

$$\omega = v/R$$



$m_1 = 4\,kg$
$m_2 = 2\,kg$
$y_i = 0.0\,m$
$y_f = 2.0\,m$
$v_i = 0$
$v_f = \ ?$

Use $\Sigma F = ma$:

Block 1 

$T = m_1 a$

Block 2 

$m_2 g - T = m_2 a$

} Note signs — call ↓ positive motion.

Note same T and a.

Combine: $m_2 g - m_1 a = m_2 a$

$m_2 g = (m_1 + m_2)\, a$

$a = \dfrac{m_2}{m_1 + m_2}\, g$.

Then, motion with constant acceleration:

$v_f^2 = v_i^2 + 2a\,(\Delta y)$ → watch sign! I called down positive!

$v_f^2 = \dfrac{2 m_2 g}{m_1 + m_2}\,(y_f - y_i)$

$v_f = 3.61\ m/s$