Week 10 Challenge Homework Solutions

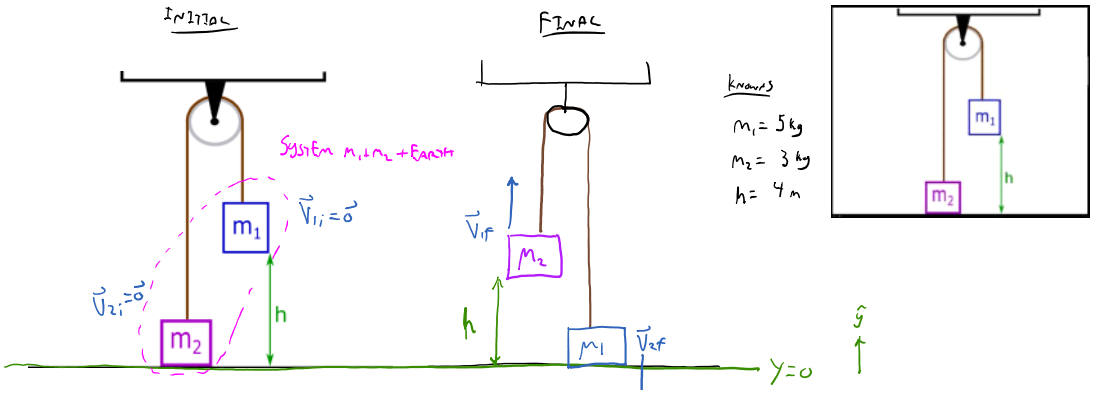
Two masses are connected by a light string passing over a light frictionless pulley. The 5.00 kg mass is released from rest at a height of h = 4.00 m above the horizontal floor below.

(a) (a) Using the law of conservation of energy, determine the speed of the 3.00 kg mass just as the 5.00 kg mass hits the ground.

(b) (b) Use one of the sense-making techniques to analyze your solution to part (a). Clearly state which technique you're using and why it is relevant.

(c) (c) Find the maximum height to which the 3.00 kg mass rises after the 5.00 kg mass hits the ground. The image is not drawn to scale, assume that the 3.00 kg box does not hit the ceiling.

(d) (d) Use a different sense-making technique than you used in part (b) to analyze your solution to part (c). Clearly state which technique you're using and why it is relevant.



a) $KE_{1i} + KE_{2i} + U^g_{1i} + U^g_{2i} + W_{Ext} = KE_{1f} + KE_{2f} + U^g_{1f} + U^g_{2f}$

$U^g_{1i} = KE_{1f} + KE_{2f} + U^g_{2f}$

$m_1 g y_{1i} = \frac{1}{2} m_1 V_{1f}^2 + \frac{1}{2} m_2 V_{2f}^2 + m_2 g y_{2f}$

$V_{1f} = V_{2f} = V_f$

$m_1 g h = \frac{1}{2} m_1 V_f^2 + \frac{1}{2} m_2 V_f^2 + m_2 g h$

$m_1 g h - m_2 g h = \frac{1}{2} V_f^2 (m_1 + m_2)$

$$V_f = \sqrt{\frac{2gh(m_1-m_2)}{(m_1+m_2)}} \approx 4.43\ m/s$$

b)

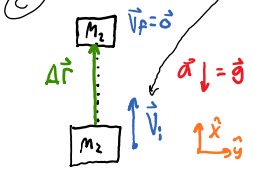
$\sqrt{\frac{2gh(m_1-m_2)}{m_1+m_2}}$

$\sqrt{\frac{m\ m\ kg}{s^2\ kg}}$

$\sqrt{\frac{m^2}{s^2}}$

$\frac{m}{s}$ ☺

c)



KINEMATICS FOR FUN ☺ CAN USE ENERGY TOO

$KE_i = U^g_f$

K	UK
$V_{ix} = 4.43\ m/s$	Δx
$V_{fx} = 0$	
$a_x = -9.8\ m/s^2$	Δt

$V_{fx}^2 = V_{ix}^2 + 2a_x\Delta x$ ✓ ✓ ?

$0 = (4.43)^2 + 2(-9.8)\Delta x$

$\Delta x \approx 1.00\ m$

$h_{max} = \Delta x + h$

$h_{max} \approx 5\ m$

d) $h_{max} \sim 10^0\ m$

w/ $V_{iy} \sim 10^0\ m/s$ ORDER OF MAG. SEEMS REASONABLE ☺