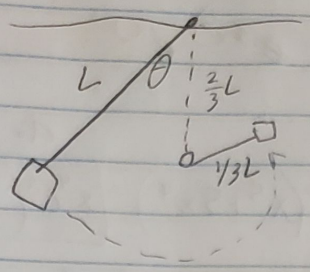
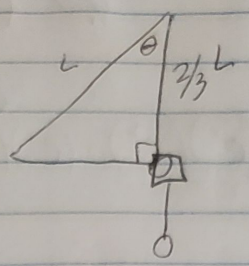
PHYS 407

1.





Energy is conserved

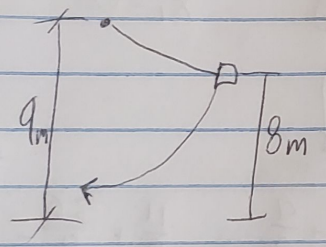
L=1

$L^2 = \frac{2}{3}L^2 + b^2 \qquad b^2 = L^2 - \frac{2}{3}L^2 \qquad b = \sqrt{\left(L^2 - \frac{2}{3}L^2\right)}$

$b = 0.75\,L$

$\theta = 48.37°$ $\qquad \tan^{-1}\left(\frac{0.75}{2/3}\right)$

2.



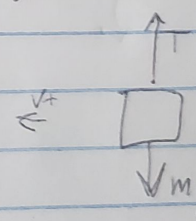
$h_1 = 8m \qquad v_1 = 0\ m/s$

$h_f = 0m \qquad v_f =$

$mgh_1 + \frac{1}{2}mv_1^2 = mgh_f + \frac{1}{2}mv_f^2$

$mgh_1 = \frac{1}{2}mv_f^2 \qquad v = \sqrt{2gh_1} = 12.52\ m/s$

$F = ma \qquad a = \frac{v^2}{r} \qquad r = 9m \qquad T_{max} = 800N$



$\Sigma F_y = T - mg = \frac{mv^2}{r} \qquad T = \frac{mv^2}{r} + mg$

$+mg \qquad +mg$

$m_1 = 28, \quad m_2 = 32, \quad m_3 = 20, \quad m_4 = 50$

pass fail pass fail

mg exceeds the maximum tension on the rope

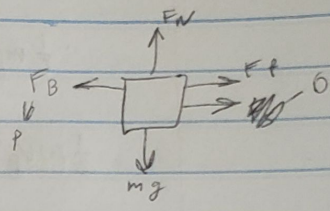
3. safe: Kenny, Kyle
unsafe: Stan, Cartman

PHYS 407

8. $M = 0.5\,kg$ $m = 0.005\,kg$ $\mu = 0.3$ $k = 400\,N/m$

$x = 0.15\,m$ $W_{NC} + mgh_i + \frac{1}{2}mv_i^2 = mgh_f + \frac{1}{2}mv_f^2$

$W_{NC} = Fx$ $m_B = 0.505\,kg$



$\Sigma F_x = F_B - F_f - F_s = \mu(mg)$

$\Sigma F_y = F_N - m_B g = 0$ $F_N = m_B g$

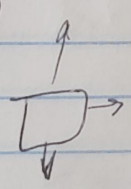
$W_{NC} + \frac{1}{2}mv_i^2 = \frac{1}{2}mv_f$ $W_{NC} = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$W_{NC} = -\frac{1}{2}mv_i^2$ $\frac{-2W_{NC}}{m} = v_i^2$

$v_i = \sqrt{\frac{-2W_{NC}}{m}}$ $W = (-0.15)F$

$\frac{1}{2}kx^2$

$W_{NC} = 0.22$ $F = \mu m_B g$



$Fd + \frac{1}{2}mv_i^2 + \frac{1}{2}kx_i^2 = \frac{1}{2}mv_f^2 + \frac{1}{2}kx_f^2$

$\frac{1}{2}mv_i^2 = \frac{1}{2}kx_f^2 - Fd$ $Fd + \frac{1}{2}mv_i^2 = \frac{1}{2}kx_f^2$

$v_i^2 = \frac{2\left(\frac{1}{2}kx_f^2 - Fd\right)}{m}$ $v_i = \sqrt{\frac{2\left(\frac{1}{2}kx_f^2 - Fd\right)}{m}}$ $\sqrt{\frac{2\left(\frac{1}{2}(400)^{0.15^2} + 0.22\right)}{0.505}}$

$= 562.88\,m/s$

3.06 m

$mv_{bullet} + Mv_{wi} = mv_f + Mv_f$

$\frac{mv_i}{m} = \frac{mv_f + Mv_f}{m}$ $v_i = \frac{v_f(m+M)}{m}$

$309.06\,m/s$