PHYS 2211 Homework 9
Chap. 9 # 7, 52, 68, 71, 75

Tuesday, November 02, 2010
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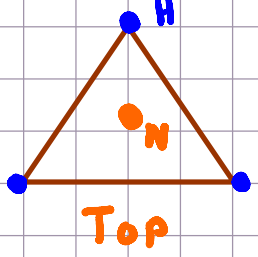

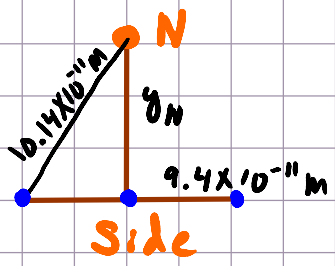

By Symmetry CM of H's are below N.

so $X_{cm} = 0$

$$y_N = \sqrt{(10.14\times10^{-11}\,m)^2 - (9.4\times10^{-11}\,m)^2}$$

$$y_N = 3.83\times10^{-11}\,m$$

$$y_{cm} = \frac{\Sigma m_i y}{\Sigma m_i}$$

$$y_{cm} = \frac{m_1 y_1 + m_2 y_2}{m_1 + m_2} = \frac{(31)(0) + (3.83\times10^{-11}\,m)(13.9)}{(3\cdot1) + (13.9)}$$

$$y_{cm} = 3.15\times10^{-11}\,m$$

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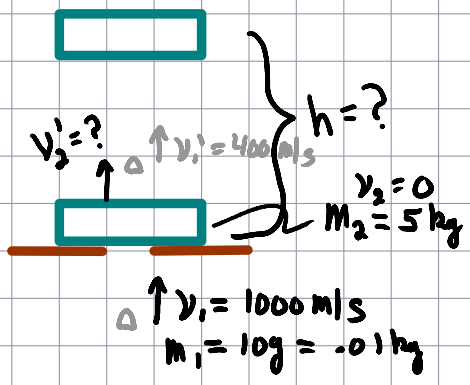

$P_i = m_1 v_1$ $\qquad$ $P_f = m_1 v_1' + m_2 v_2'$

$m_1 v_1 = m_1 v_1' + m_2 v_2'$

$v_2' = \frac{m_1(v_1 - v_1')}{m_2} = \frac{(.01kg)(1000m/s - 400m/s)}{5kg}$

$v_2' = 1.2 m/s$

for Block $\Delta KE + \Delta PE = 0$

$KE_f - KE_i + PE_f - PE_i = 0$

$-\frac{1}{2} m v_i^2 + mgh = 0$

$h = \frac{v_i^2}{2g} = \frac{(1.2 m/s)^2}{2(9.8 m/s^2)} = .073 m$ //

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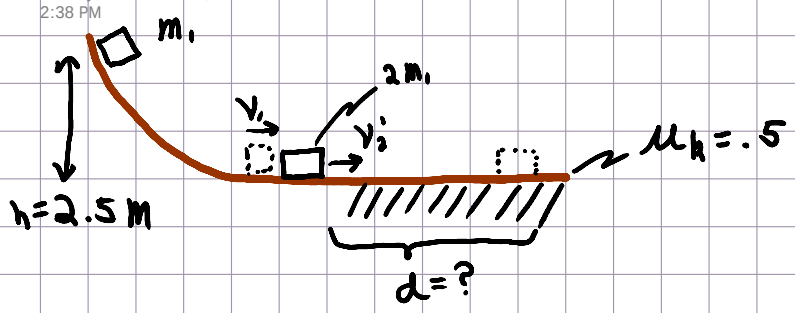

find v_1:

$\Delta PE + \Delta KE = 0$

$PE_f - PE_i + KE_f - KE_i = 0$

$-mgh + \frac{1}{2}mv_f^2 = 0$

$v_f = v_1 = \sqrt{2gh}$

find v_2':

$p_i = m_1 v_1 \qquad p_f = m_1 v_1' + m_2 v_2'$

$KE_i = \frac{1}{2}m_1 v_1^2 \qquad KE_f = \frac{1}{2}m_1 v_1'^2 + \frac{1}{2}m_2 v_2'^2$

$m_1 v_1 = m_1 v_1' + m_2 v_2' \Rightarrow m_1 v_1 - m_1 v_1' = m_2 v_2' \quad (2)$

$\frac{1}{2}m_1 v_1^2 = \frac{1}{2}m_1 v_1'^2 + \frac{1}{2}m_2 v_2'^2 \qquad m_1 v_1^2 - m_1 v_1'^2 = m_2 v_2'^2 \quad (1)$

$\frac{(1)}{(2)} \Rightarrow v_1 + v_1' = v_2'$ or $v_1' = -v_1 + v_2'$

(1) becomes $m_1 v_1 = m_1[-v_1 + v_2'] + m_2 v_2'$

$2m_1 v_1 = (m_1 + m_2) v_2'$

$v_2' = \frac{2m_1}{m_1 + m_2} v_1 = \frac{2m_1}{m_1 + 2m_1}(\sqrt{2gh}) = \frac{2}{3}(\sqrt{2gh})$

for d:

$\Delta KE + \Delta PE = W_f$

$KE_f - KE_i = F_f d \cos(180)$

$+\frac{1}{2}m v_2'^2 = +\mu_k m g d$

$d = \frac{v_2'^2}{2\mu_k g} = \frac{\frac{4}{9}(2gh)}{2\mu_k g} = \frac{8(2.5\,m)}{2(.5)\,9} = 2.22\,m$

b) find v_2' $\qquad p_i = m_1 v_1 \qquad p_f = (m_1 + m_2) v$

$v = \frac{m_1}{m_1 + m_2} v_1 = \frac{m_1}{m_1 + 2m_1} v_1 = \frac{1}{3} v_1 = \frac{1}{3}\sqrt{2gh}$

so $d = \frac{v^2}{2\mu_k g} = \frac{\frac{1}{9}(2gh)}{2\mu_k g} = \frac{h}{9\mu_k} = \frac{2.5\,m}{9(.5\,m)} = .556\,m$

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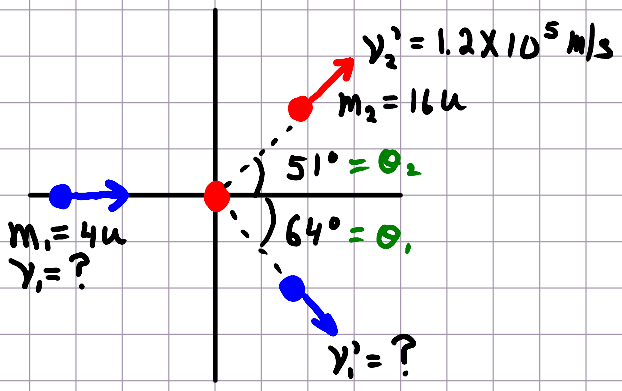

$P_{x_i} = m_1 v_1$ $\quad P_{x_f} = m_1 v_1' \cos\theta_1 + m_2 v_2' \cos\theta_2$

$P_{y_i} = 0$ $\quad P_{y_f} = -m_1 v_1' \sin\theta_1 + m_2 v_2' \sin\theta_2$

$m_1 v_1 = m_1 v_1' \cos\theta_1 + m_2 v_2' \cos\theta_2$

$0 = -m_1 v_1 \sin\theta_1 + m_2 v_2' \sin\theta_2$

$$v_1' = \frac{m_2 v_2' \sin\theta_2}{m_1 \sin\theta_1} = \frac{16u\,(1.2\times10^5 \text{ m/s})\sin(51°)}{4u\sin(64°)}$$

$v_1' = 4.15 \times 10^5$ m/s

$v_1 = v_1' \cos\theta_1 + \frac{m_2}{m_1} v_2' \cos\theta_2$

$v_1 = (4.15\times10^5 \text{ m/s})\cos(64°) + \frac{16u}{4u}(1.2\times10^5 \text{ m/s})\cos(51°)$

$v_1 = 4.84 \times 10^5$ m/s //

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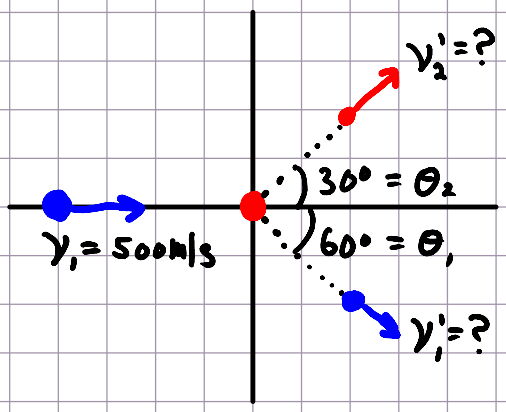

$P_{xi} = mv_1 \qquad P_{xf} = mv_1' \cos\theta_1 + mv_2' \cos\theta_2$

$P_{yi} = 0 \qquad P_{yf} = -mv_1' \sin\theta_1 + mv_2' \sin\theta$

$mv_1 = mv_1' \cos\theta_1 + mv_2' \cos\theta_2$

$0 = -mv_1' \sin\theta_1 + mv_2' \sin\theta$

$$v_1' = v_2' \frac{\sin\theta_2}{\sin\theta_1}$$

$$v_1 = v_2' \frac{\sin\theta_2}{\sin\theta_1} \cos\theta_1 + v_2' \cos\theta_2$$

$$v_2' = \frac{v_1}{\frac{\sin\theta_2}{\sin\theta_1}\cos\theta_1 + \cos\theta_2}$$

$$v_2' = \frac{500\ m/s}{\frac{\sin 30°}{\sin 60°}\cos(60) + \cos(30)}$$

$$v_2' = 433\ m/s$$

$$v_1' = (433\ m/s)\frac{\sin(30)}{\sin(60)} = 250\ m/s \ //$$