Physics 30 - Lesson 3H

1)

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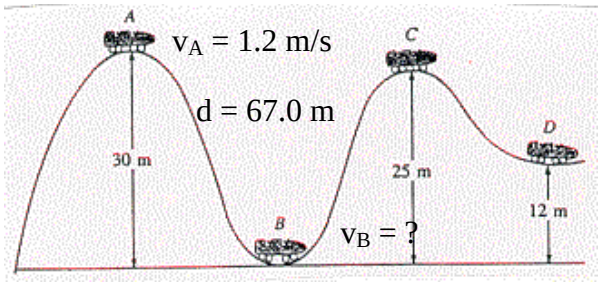

$F_f = 1/5\ F_g = 1/5\ mg$ ✓

initial energy = final energy ✓

$E_{p_A} + E_{k_A} = E_{k_B} + W_f$

$mgh_A + \frac{1}{2}mv_A^2 = \frac{1}{2}mv_B^2 + F_f d$ ✓

$mgh_A + \frac{1}{2}mv_A^2 = \frac{1}{2}mv_B^2 + \frac{1}{5}mgd$ ✓

$gh_A + \frac{1}{2}v_A^2 = \frac{1}{2}v_B^2 + \frac{1}{5}gd$

$v_B = \sqrt{2(\frac{1}{2}v_A^2 + gh_A - \frac{1}{5}gd)}$

$v_B = \sqrt{2(\frac{1}{2}(1.20\,m/s)^2 + (9.81\,m/s^2)(30\,m) - \frac{1}{5}(9.81\,m/s^2)(67.0\,m))}$ ✓

$\boxed{v_B = 18.1\,m/s}$

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2)

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$E_{total} = E_p + W_f = mgh + 800\,J$ ✓

$E_{total} = 3.00kg(9.✓\,m/s^2)(100m) + 800\,J$

$E_{total} = 3743\,J$

with no air resistance

$E_p = E_{total}$ ✓

$mgh = 3743J$

$h = \frac{3743J}{mg} = \frac{3743J}{(3.00kg)(9.81m/s^2)}$

$h = 127\,m$ ✓

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3)

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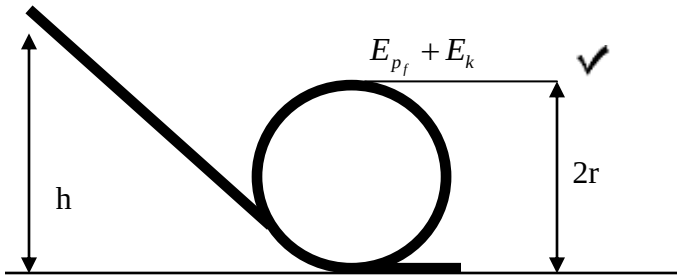
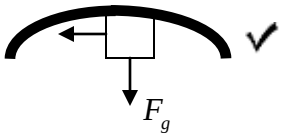


At minimum speed



$F_c = F_g$ ✓

$\frac{mv^2}{r} = mg$ ✓

$v^2 = gr$

$E_{p_i} = E_{p_f} + E_k$

$mgh = mg2r + \frac{1}{2}mv^2$ ✓

$gh = g2r + \frac{1}{2}gr$

$\boxed{h = \frac{5}{2}r}$ ✓

4)

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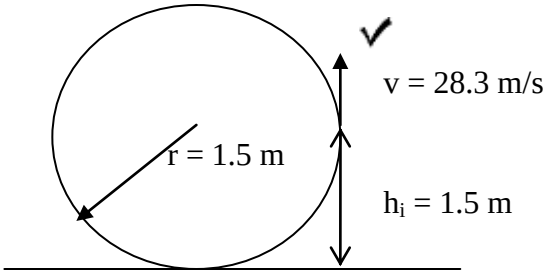
$v = \frac{\Delta d}{\Delta t} = \frac{2\pi r}{T} = \frac{2\pi(1.5m)}{0.\bar{3}s}$ ✓ ✓

$v = 28.3m/s$



$E_{p_f} = E_{p_i} + E_{k_i}$ ✓

$mgh_f = mgh_i + \frac{1}{2}mv_i^2$

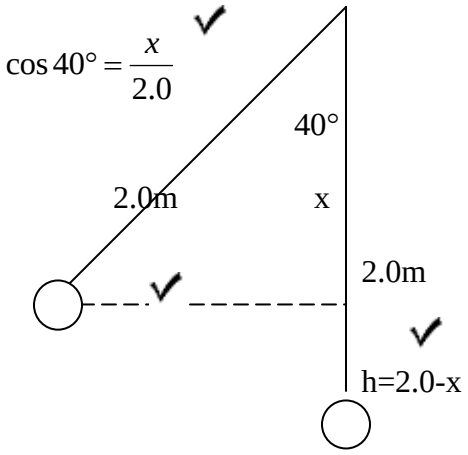
$gh_f = gh_i + \frac{1}{2}v_i^2$ ✓

$h_f = \frac{gh_i + \frac{1}{2}v_i^2}{g}$ ✓

$h_f = \frac{(9.81m/s^2)(1.5m) + \frac{1}{2}(28.3m/s)^2}{9.81m/s^2}$

$\boxed{h_f = 42.2m}$ ✓

5)



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$x = 2.0\cos 40° = 1.53m$

$h = 2.0m - 1.53m$

$\boxed{h = 0.47m}$

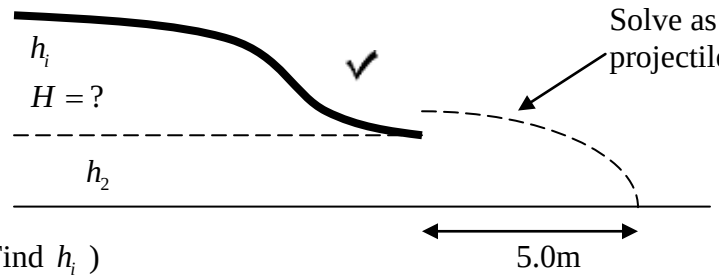
$E_p = E_k$

$mgh = \frac{1}{2}mv^2$

$v = \sqrt{2gh} = \sqrt{(2)(9.81m/s^2)(0.47m)}$

$\boxed{v = 3.0m/s}$

6)



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Find h_i)

$E_p = E_k$

$mgh_i = \frac{1}{2}mv^2$

$h_i = \frac{\frac{1}{2}v^2}{g} = \frac{\frac{1}{2}(10m/s)^2}{9.81m/s^2}$

$h_i = 5.10m$

$H = 5.10m + 1.23m$

$\boxed{H = 6.32m}$

$V_H = \frac{d}{t} = \frac{5.00m}{0.500s} = 10m/s$

find h_2)

$v_i = 0$

$a = 9.81m/s^2$

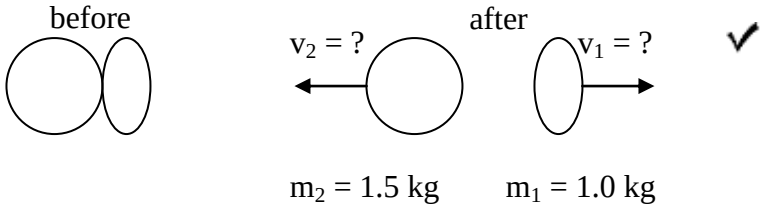
$\Delta t = 0.500s$

$\Delta d = ?$

$\Delta d = v_i t + \frac{1}{2}at^2$

$\Delta d = \frac{1}{2}(9.81)(0.500s)^2$

$\Delta d = h_2 = 1.23m$

7) 

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momentum

$\Sigma\vec{p}_i = \Sigma\vec{p}_f$ ✓

$0 = m_1\vec{v}_1 + m_2\vec{v}_2$

$0 = 1.0\vec{v}_1 + 1.5\vec{v}_2$ ✓

$\vec{v}_1 = -1.5\vec{v}_2$

$\vec{v}_1 = -1.5\vec{v}_2$ ✓

$\vec{v}_1 = -1.5(-28.3m/s)$

$\boxed{\vec{v}_1 = +42.4m/s}$ ✓

Energy

initial energy = final energy ✓

$0.30(5000J) = \frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2$

$1500 = \frac{1}{2}(1.0)v_1^2 + \frac{1}{2}(1.5)v_2^2$ ✓

$1500 = 0.50v_1^2 + 0.75v_2^2$

$1500 = 0.50(-1.5v_2)^2 + 0.75v_2^2$ ✓

$1500 = 1.125v_2^2 + 0.75v_2^2$

$1500 = 1.875v_2^2$

$v_2 = \pm\sqrt{\frac{1500}{1.875}}$

$\boxed{\vec{v}_2 = -28.3m/s}$ ✓

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8) /8

momentum

$\Sigma\vec{p}_i = \Sigma\vec{p}_f$ ✓

$m\vec{v}_1 + m\vec{v}_2 = m\vec{v}_1' + m\vec{v}_2'$

$7.0 - 4.0 = \vec{v}_1' + \vec{v}_2'$ ✓

$3.0 = \vec{v}_1' + \vec{v}_2'$

$\vec{v}_1' = 3.0 - \vec{v}_2'$

$\vec{v}_1' = 3.0 - \vec{v}_2'$ ✓

$\vec{v}_1' = 3.0 - 7.0$

$\boxed{\vec{v}_1' = -4.0m/s}$ ✓

Energy

initial energy = final energy ✓

$\frac{1}{2}mv_1^2 + \frac{1}{2}mv_2^2 = \frac{1}{2}mv'^2_1 + \frac{1}{2}mv'^2_2$

$(7.0)^2 + (4.0)^2 = v'^2_1 + v'^2_2$ ✓

$65 = v'^2_1 + v'^2_2$

$65 = (3.0 - v'_2)^2 + v'^2_2$ ✓

$65 = 9.0 - 6.0v_2' + v'^2_2 + v'^2_2$

$65 = 9.0 - 6.0v'_2 + 2v'^2_2$

$0 = 2v'^2_2 - 6.0v'_2 - 56$

$0 = v'^2_2 - 3.0v'_2 - 28$ ✓

$0 = (v'_2 - 7.0)(v'_2 + 4.0)$

$\boxed{v'_2 = +7.0m/s}$ $v'_2 = -4.0m/s$ (*not possible*)

See Mr. Licht for the answers to 9, 10 and 11.

9)

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10)

/11

11)

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