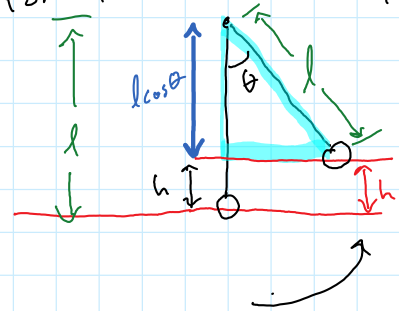
Phy 2A Review 6/16

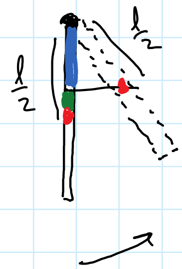
Friday, June 16, 2017 10:03 AM

pendulum height and angle

For the end of the pendulum:



For the center of mass:



$$h + l\cos\theta = l$$

$$h = l - l\cos\theta$$

$$h + \frac{l}{2}\cos\theta = \frac{l}{2}$$

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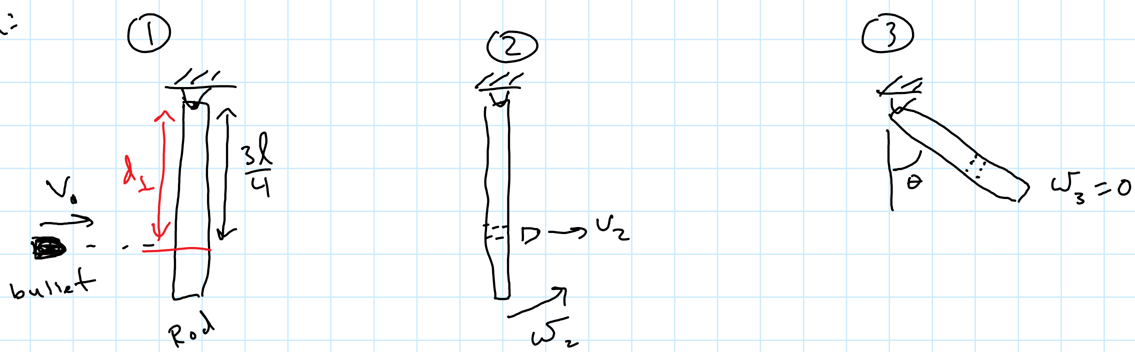
problem:



given: $v_1 = 100\,\frac{m}{s}$

$m_b = 0.02$ kg

$m_R = 0.4$ kg

$l = 1.2$

$v_2 = \frac{1}{2} v_1$

find: θ (max angle the rod makes)

$L_1 = L_2$ → at to find ω_2

$$(L_1)_b + (L_1)_R = (L_2)_b + (L_2)_R$$

$$m_b v_1 d_\perp + 0 = m_b v_2 d_\perp + I_R \omega_2$$

object moving in a straight line — object that is Rotating

$$d_\perp = \frac{3l}{4}$$

$$m_b v_1 \frac{3l}{4} = m_b \frac{v_1}{2} \frac{3l}{4} + \left(\frac{1}{3} m_R l^2\right) \omega_2$$

$$(0.02)(100)\left(\frac{3}{4}\right)(1.2) = (0.02)(50)\,\frac{3}{4}(1.2) + \frac{1}{3}(0.4)(1.2)^2\,\omega_2$$

$$\omega_2 = 4.69 \ \frac{rad}{s}$$

$E_2 = E_3$ for the rod to find θ_{max}

$$(K_2)_R = (U_g)_3$$

$$\frac{1}{2} I \omega_2^2 = m_R g h$$

(h ← distance the center of mass goes up)

$$\frac{1}{2}(0.192)(4.69)^2 = (0.4)(9.8)\,h$$

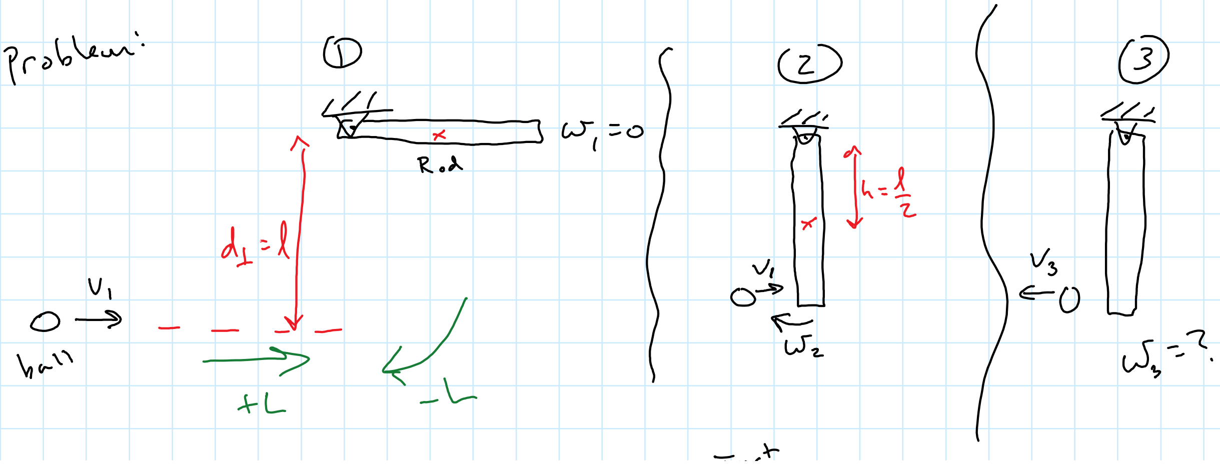
$$h = 0.539 \ m$$

$$h = \frac{l}{2} - \frac{l}{2}\cos\theta \quad \text{(see above)}$$

$$\cos\theta = 0.1022$$

$$\theta = 84.1^\circ$$

Problem:



$+L$ $-L$ ω_3

find : ω_3 for the rod just after the collision

given: $m_b = 0.2$ kg
$V_1 = 3$ m/s
$m_R = 0.4$ kg
$V_3 = \frac{1}{2} V_1$
$l = 1.2$ m

$E_1 = E_2$ for the rod to find ω_2

$$m_R g h = \frac{1}{2} I_R \omega_2^2$$

distance the c of m goes down (h) $h = \frac{l}{2}$

$$m_R g \frac{l}{2} = \frac{1}{2}\left(\frac{1}{3} m_R l^2\right)\omega_2^2$$

$$\frac{3g}{l} = \omega_2^2$$

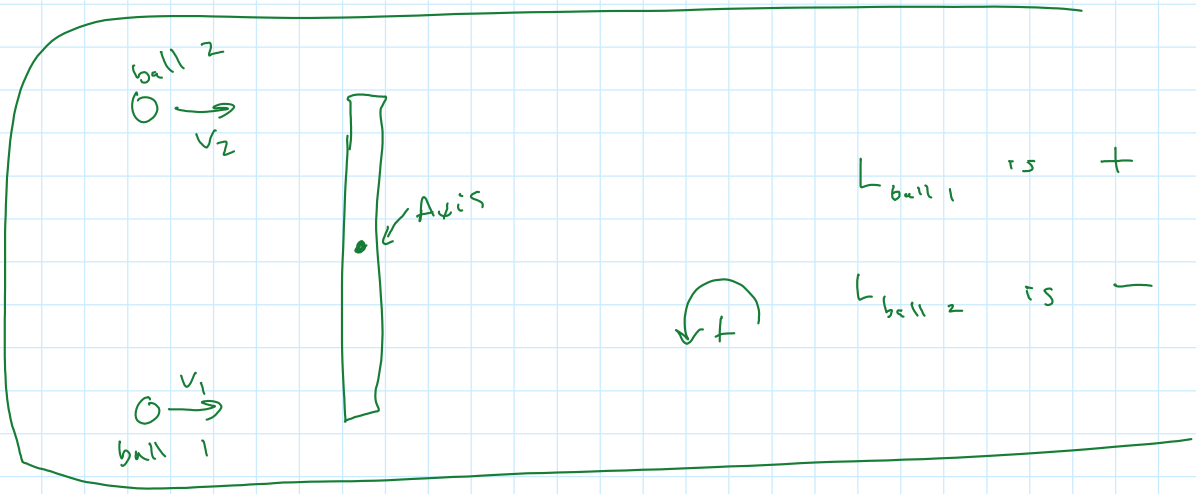
$$\omega_2 = \sqrt{\frac{3(9.8)}{1.2}} = 4.95 \frac{\text{rad}}{\text{s}}$$

$L_2 = L_3$ ↺+ to find ω_3 for the rod just after the collision

$$(L_2)_b + (L_2)_R = (L_3)_b + (L_3)_R$$

assume + and solve for ω_3

$$+m_b v_1 d_\perp - I_{rod}\omega_2 = -m_b V_3 d_\perp + I_{rod}\omega_3$$



$$m_b V_1 l - \left(\frac{1}{3} m_R l^2\right)\omega_2 = -m_b \frac{V_1}{2} l + \left(\frac{1}{3} m_R l^2\right)\omega_3$$

$$(0.2)(3)(1.2) - \left[\frac{1}{3}(0.4)(1.2)^2\right](4.95) = -(0.2)(1.5)(1.2) + \left[\frac{1}{3}(0.4)(1.2)^2\right]\omega_3$$

$$0.72 - 0.950 = -0.36 + (0.192)\,\omega_3$$

$$\omega_3 = +0.675 \ \frac{rad}{s}$$