3. Falling ball:

(a) $e = \frac{V_2 - V_1}{u_2 - u_1}$ $\qquad u_1 = V_1 = 0 \rightarrow$ Paredes

$\frac{1}{2} m v^2 = mgh$ $\qquad$ • $V_2 \Rightarrow \frac{1}{2} m V_2^2 = mgh_1$

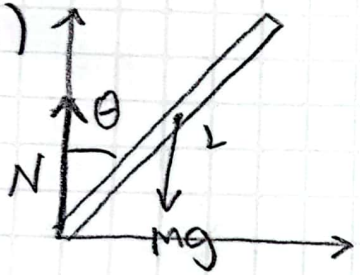
$V_2 = \sqrt{2gh_1}$

• $u_2 \Rightarrow u_2 = \sqrt{2gh_0}$

$e = \frac{\sqrt{2gh_1} - 0}{\sqrt{2gh_0} - 0} = \sqrt{\frac{2gh_1}{2gh_0}} = \sqrt{\frac{h_1}{h_0}}$

4. Falling rod:

(a)



ΣF_y: $N - mg = ma = m\ddot{y}$

(b) $I_{cm}\ddot{\theta} = \Sigma \tau$ $\qquad \tau = F d_{cm} \operatorname{sen}\theta$

$I_{cm}\ddot{\theta} = \tau_N + \tau_{mg} = N\frac{L}{2}\operatorname{sen}\theta + \cancel{mg(0)\operatorname{sen}\theta}^{0}$

$I_{cm}\ddot{\theta} = N\frac{L}{2}\operatorname{sen}\theta$

c) $\ddot{y} = -L/2 \cos\theta$

$-m\frac{L}{2}\cos\theta = N - mg$

$N = mg - m\frac{L}{2}\cos\theta$

$I\ddot{\theta} = (mg - m\frac{L}{2}\cos\theta)\frac{L}{2}\sin\theta$

$\ddot{\theta} = \frac{12}{1}\frac{L}{2}\frac{\sin\theta\,(mg - m\frac{L}{2}\cos\theta)}{mL^2}$

$\ddot{\theta} = \frac{6}{L}\sin\theta\,(g - \frac{L}{2}\cos\theta)$

$\dot{\theta}^2 = \frac{2g}{L} - \dot{\theta}\cos\theta$

$\ddot{\theta} = \sin\theta\,(\frac{6g}{L} - \frac{\cos\theta}{3})$

$\frac{6g}{L} - \frac{\cos\theta}{3} = \frac{\frac{2g}{L} - \dot{\theta}^2\cos\theta}{1/3 + \sin^2\theta}$

$\ddot{\theta} = \frac{(\frac{2g}{L} - \dot{\theta}^2\cos\theta)\sin\theta}{\frac{1}{3} + \sin^2\theta}$