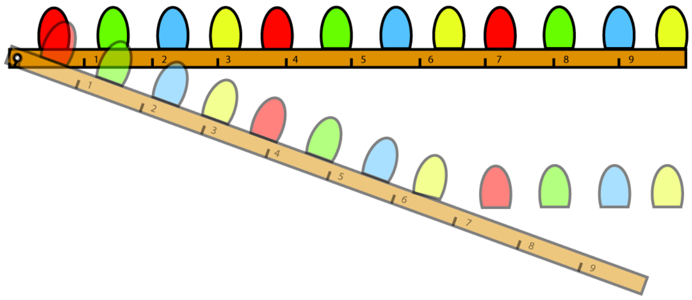
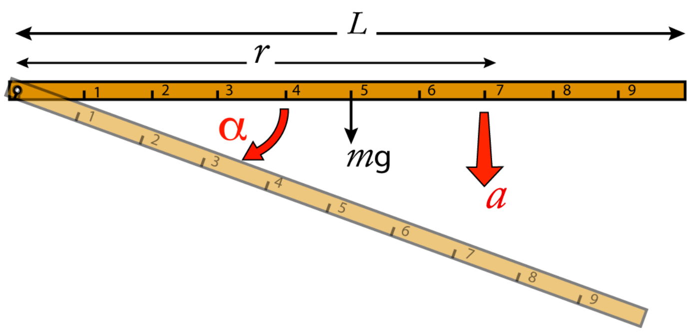
11-26-2015
Tohei Moritani

Falling Rod - 1



Analysis



Rotational Equation of Motion $\tau = I\,\alpha$ (1)

Moment of Inertia for a Rod $I = \frac{1}{3}\,m\,L^2$ (2)

Torque by Gravity $\tau = \frac{L}{2}\,m\,g$ (3)

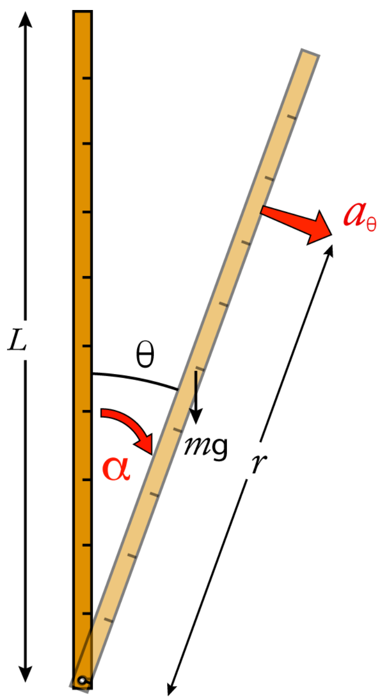
Linear and Angular Acceleration $a = r\,\alpha$ (4)

From (1) ~ (4)

$$a = r\,\alpha = r\,\frac{\tau}{I} = \frac{\frac{L}{2}mg}{\frac{1}{3}mL^2} = \frac{3\,r}{2\,L}\,g \qquad (5)$$

If $r > \frac{2}{3}\,L$, then $a > g$

Falling Rod -2



Rotational Equation of Motion $\tau = I\,\alpha$ (1)

Moment of Inertia for a Rod $I = \frac{1}{3}\,m\,L^2$ (2)

Torque by Gravity $\tau = \frac{L}{2}\,m\,g\sin\theta$ (3)

Linear and Angular Acceleration $a_\theta = r\,\alpha$ (4)

From (1) ~ (4)

$$a_\theta = r\,\alpha = r\,\frac{\tau}{I} = \frac{\frac{L}{2}mg\sin\theta}{\frac{1}{3}mL^2} = \frac{3\,r}{2\,L}\,g\sin\theta \qquad (5)$$

If $r > \frac{2}{3}\,L,$ then $a_\theta > g\sin\theta$