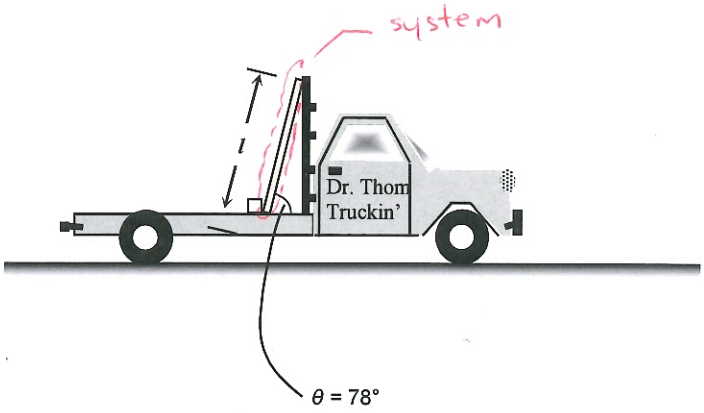
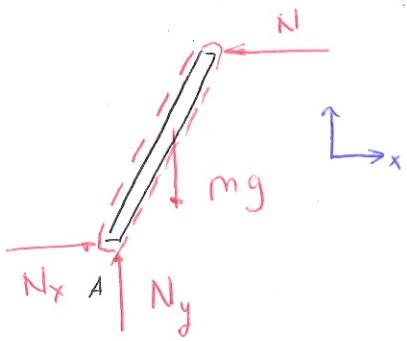
Example

A 6-ft board is placed in a truck with one end resting against a block secured to the floor and the other leaning against a smooth vertical partition. Determine the maximum allowable acceleration of the truck if the board is to remain in the position shown.





CoLM

Closed system

$$\frac{d}{dt}(\vec{P}_{sys}) = \Sigma \vec{F} + \cancel{L_O} - \cancel{L_O}$$

$$\frac{d}{dt}(m\vec{V}_G) = \Sigma \vec{F}$$

x- direction:

$$\frac{d}{dt}(mV_G) = N_x - N$$

$$m\frac{dV_G}{dt} = N_x - N$$

$$m\ddot{x} = N_x - N \quad (1)$$

y - direction

$$\frac{d}{dt}(\cancel{m}\cdot 0) = N_y - mg$$

$$N_y = mg \quad (2)$$

Two equations, Five unknowns!

C.O. AM @ A

Z - direction

Closed system

$$\curvearrowleft + \quad \frac{d}{dt}(\mathbb{L}_{sys,A}) = \Sigma M_A + \cancel{L_O} - \cancel{L_O}$$

$$\frac{d}{dt}\left(-\frac{l}{2}\sin\theta \cdot mV_G\right) = \frac{l}{2}\sin\theta \cancel{N} - \frac{l}{2}\cos\theta\, mg$$

$\cancel{N} \to 0$

For tipping

$$-\frac{l}{2}\sin\theta \cdot m\frac{dV_G}{dt} = -\frac{l}{2}\cos\theta\, mg$$

$$\frac{dV_c}{dt} = \frac{\cos\theta}{\sin\theta} g$$

$$a_x = \cot(\theta)\, g = \cot(78°)\left(32.2 \frac{ft}{s^2}\right)$$

$$= \boxed{6.84\ ft/s^2}$$