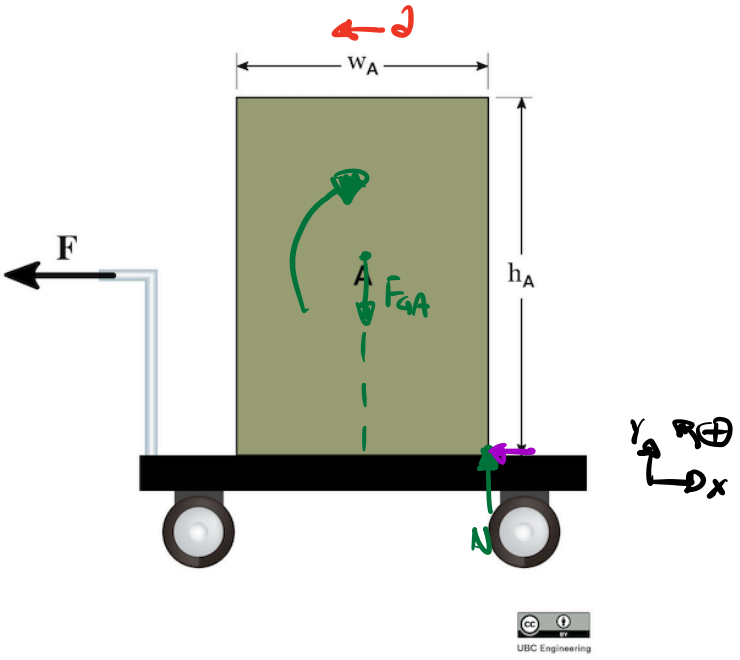
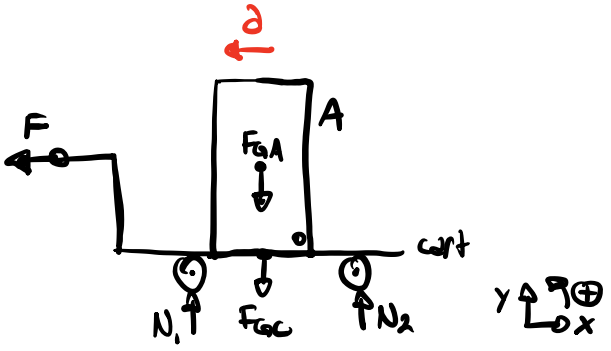
Your very wonderful parents have returned from their vacation from Hawaii while you were studying for midterms. At the airport, you stack their luggage, which can be modelled as box A. Box A has a width $w_A = 0.5m$ and height $h_A = 0.8m$. If box A has a mass $m_A = 50kg$, determine the maximum force F you can apply on the $12kg$ car before tipping their luggage over. Assume slipping does not occur and that box A has uniform density even though clothing is probably stuffed in all sorts of places to save space for souvenirs.

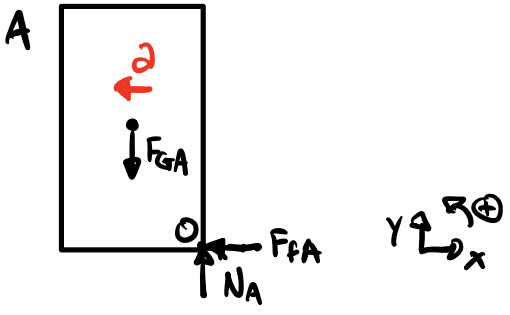


① Diagrams

Cart :



Block :



Cart: $\sum F_x = ma \Rightarrow -F = (m_A + m_{cart})a$

Block: $\sum M_O = mad \Rightarrow mg\frac{w_A}{2} = ma\frac{h_A}{2}$

$$(50\text{kg})(9.81\text{m/s}^2)\left(\frac{0.5\text{m}}{2}\right) = 50\text{kg}\, a\left(\frac{0.8\text{m}}{2}\right)$$

$$\therefore a = 6.131\ \text{m/s}^2$$

$$\therefore -(50\text{kg} + 12\text{kg})(6.131\ \text{m/s}^2) = -380.14\text{N} = F$$

$$\boxed{F = -380.14\text{N}\ \hat{i}}$$