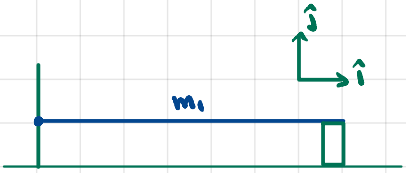
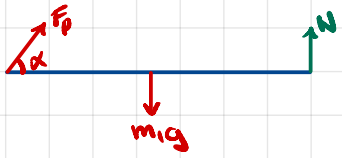
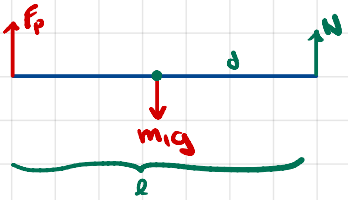




$N + F_p \sin\alpha = m_1 g$

$F_p \cos\alpha = 0 \Rightarrow \alpha = \pi/2$



$\vec{\tau}_{cm} : dN - (\ell - d)F_p = 0$

unknowns: N, F_p

$d \cdot N = (\ell - d)F_p$

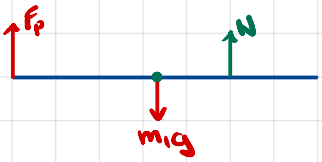
$N + F_p = mg$

$d \cdot N = (\ell - d)(mg - N)$

$= (\ell - d)mg - (\ell - d)N$

$N(\cancel{d} + \ell - \cancel{d}) = (\ell - d)mg$

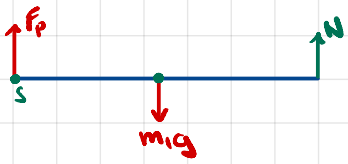
$N = \dfrac{\ell - d}{\ell} mg$



$d = \dfrac{\ell}{4} \Rightarrow N = \dfrac{3}{4} mg$

$d = \dfrac{\ell}{2} \Rightarrow N = \dfrac{mg}{2}$

$d = -\dfrac{1}{4}\ell \Rightarrow N = \dfrac{5}{4} mg$



$\vec{\tau}_S : N d_n - m_1 g d_{cm} = 0$

$N + F_p = m_1 g$

unknowns: N, F_p

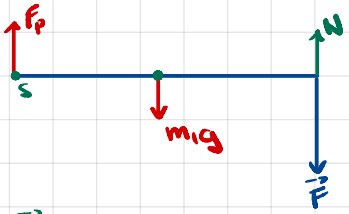
$N d_n = m_1 g d_{cm} \Rightarrow N = \dfrac{m_1 g d_{cm}}{d_n}$

ex: $d_{cm} = \ell/2$, $d_n = \ell$

$N = \dfrac{m_1 g \ell/2}{\ell} = \dfrac{m_1 g}{2}$

$\Rightarrow F_p = N = \dfrac{m_1 g}{2}$

ex: $d_{cm} = \ell/2$ $\quad N = \dfrac{m_1 g \ell}{2 d_n}$



$\vec{\tau}_S : N d_n - m_1 g d_{cm} - F d_F = 0$

$N + F_p = m_1 g + F$

$\Rightarrow N = \dfrac{m_1 g d_{cm} + F d_F}{d_n}$

$F_p = \dfrac{-m_1 g d_{cm} - F d_F + m_1 g d_n + F d_n}{d_n}$

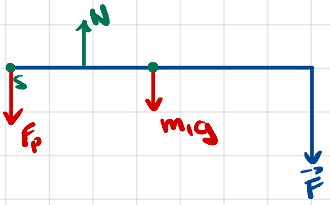
$F_p = \dfrac{m_1 g(d_n - d_{cm}) + F(d_n - d_F)}{d_n}$

ex: $d_{cm} = \ell/2$, $d_F = d_n = \ell$

$\Rightarrow N = \dfrac{m_1 g \frac{\ell}{2} + F\ell}{\ell} = \dfrac{m_1 g + 2F}{2}$

$= F + \dfrac{m_1 g}{2}$

$F_p = \dfrac{m_1 g \frac{\ell}{2} + F \cdot 0}{\ell} = \dfrac{m_1 g}{2}$

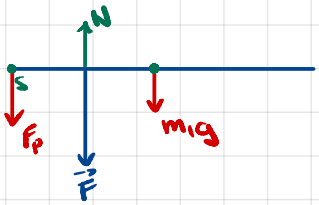


ex: $d_{cm} = \ell/2$, $d_F = \ell$, $d_n = \dfrac{\ell}{4}$

$N = \dfrac{m_1 g \frac{\ell}{2} + F\ell}{\frac{\ell}{4}} = 2(m_1 g + 2F) = 4\left(\dfrac{m_1 g + 2F}{2}\right)$

$F_p = \dfrac{m_1 g(-\frac{\ell}{4}) + F(-\frac{3\ell}{4})}{\frac{\ell}{4}}$

$= -m_1 g - 3F$



$d_{cm} = \ell/2$, $d_F = d_n = \ell/4$

$N = \dfrac{m_1 g \frac{\ell}{2} + F\frac{\ell}{4}}{\ell/4}$

$= 2m_1 g + F$

$F_p = \dfrac{m_1 g(-\frac{\ell}{4}) + F(0)}{\ell/4}$

$= -m_1 g$
