(11/12/2023)

Phys-g1102, août, 20223, Q3

1). $\vec{F} = \vec{N}_1 + \vec{N}_2 + \vec{N}_3 + m\vec{g} + M\vec{g}$

Immobile $\Rightarrow \vec{F} = \vec{0}$

$$\vec{N}_1 + \vec{N}_2 + \vec{N}_3 = -(m+M)\vec{g}$$

$\vec{N}_1 + \vec{N}_2 + \vec{N}_3 = -\vec{P}_{cheval} - \vec{P}_{cavalier}$ $\quad a(0,0,1) = (0,0,a)$

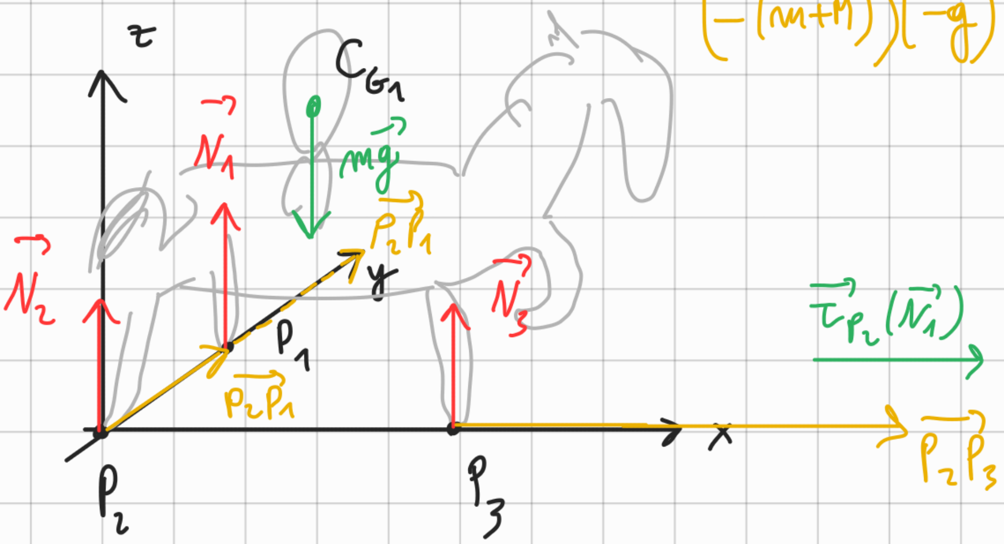
avec $\vec{P}_{cheval} = M\vec{g}$ et $\vec{P}_{cavalier} = m\vec{g}$

$\vec{g} = (0, 0, -g)$ $\quad -(m+M)\vec{g} = -(m+M)(0,0,-g)$

$\Rightarrow \vec{N}_1 + \vec{N}_2 + \vec{N}_3 = (m+M)g\,(0,0,1) = (m+M)(0,0,g)$

$(-(m+M))(-g)(0,0,1)$

2).



$\vec{\tau}_{P_2}(\vec{N}_2) = \overrightarrow{P_2P_2} \times \vec{N}_2 = \vec{0}$ car $\overrightarrow{P_2P_2} = \vec{0}$.

$$\vec{\tau}_{P_2}(\vec{N_1}) = \overrightarrow{P_2P_1} \times \vec{N_1}$$

Direction : x positifs.

Norme : $$\|\vec{\tau}_{P_2}(\vec{N_1})\| = \|\overrightarrow{P_2P_1}\| \, \|\vec{N_1}\| \underbrace{\sin\theta}_{1}$$

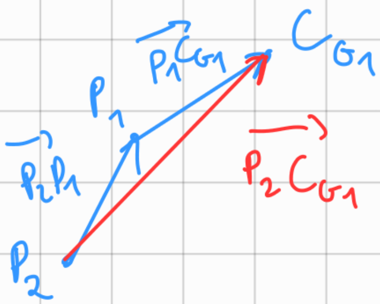
$$= d\, N_1$$

$$\vec{\tau}_{P_2}(\vec{N_1}) = (d N_1, 0, 0)$$

$$\vec{\tau}_{P_2}(\vec{N_3}) = \overrightarrow{P_2P_3} \times \vec{N_3} = (0, -L N_3, 0)$$

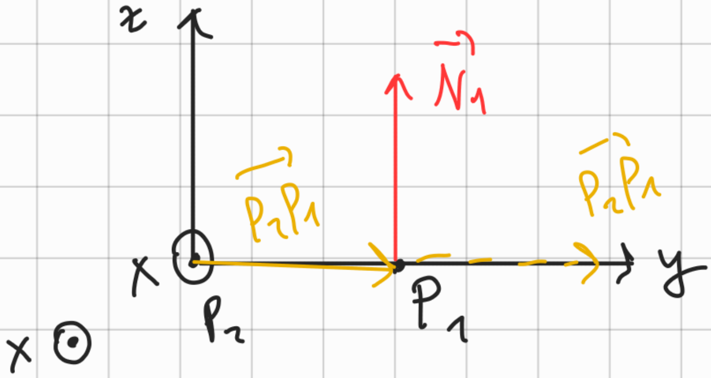
3). $$\vec{\tau}_{P_2}(m\vec{g}) = \overrightarrow{P_2 C_{G_1}} \times (m\vec{g})$$

$$\overrightarrow{P_2 C_{G_1}} = \overrightarrow{P_2P_1} + \overrightarrow{P_1 C_{G_1}}$$



$$\overrightarrow{P_2P_1} = (0, d, 0)$$

$$\overrightarrow{P_1 C_{G_1}} = \left(\frac{3L}{8}, -\frac{d}{2}, \frac{3h}{2}\right)$$

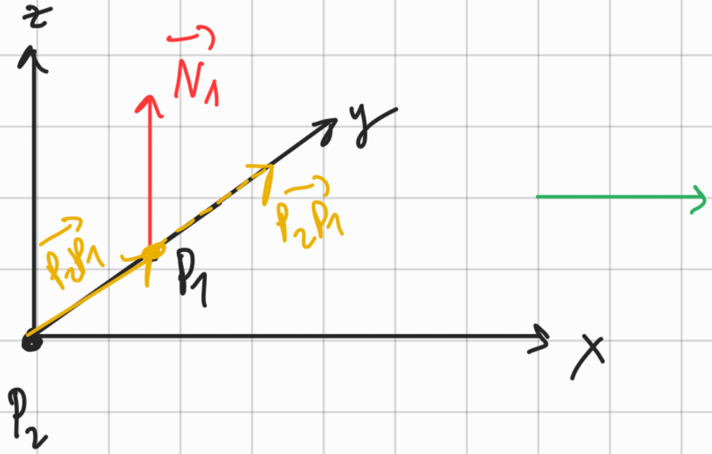


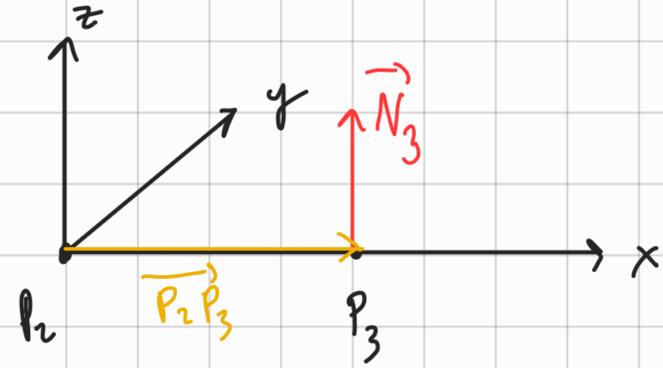
$\overrightarrow{P_2P_1} \times \overrightarrow{N_1}$:

a) x positif. ⊙

b) $\|\overrightarrow{P_2P_1}\| N_1 = d N_1$

$$\overrightarrow{P_2P_1} \times \overrightarrow{N_1} = (d N_1, 0, 0).$$ [équivalent à a) et b)].

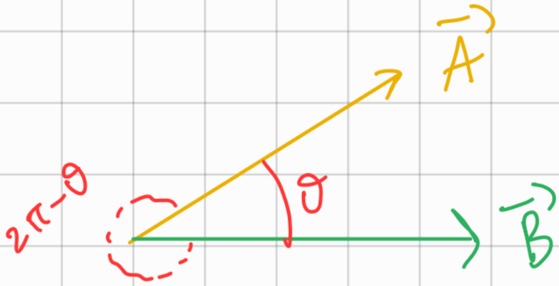




$\overrightarrow{P_2P_3} \times \overrightarrow{N_3}$: a). y négatifs b). $L N_3$

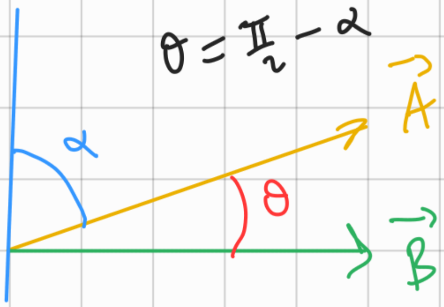
$$\overrightarrow{P_2P_3} \times \overrightarrow{N_3} = \left(0, -LN_3, 0\right)$$

$$\left\| \overrightarrow{P_2P_3} \times \overrightarrow{N_3} \right\| = \underbrace{\left\|\overrightarrow{P_2P_3}\right\|}_{L} \underbrace{\left\|\overrightarrow{N_3}\right\|}_{N_3} \underbrace{\sin\theta}_{1}$$



$$\vec{A} \cdot \vec{B} = AB\cos\theta \qquad \left\|\vec{A} \times \vec{B}\right\| = AB\sin\theta$$

$$\theta = \frac{\pi}{2} - \alpha$$



$$\sin\theta = \cos\alpha$$

$$\left\|\vec{A} \times \vec{B}\right\| = AB\cos\alpha = AB\underbrace{\sin\left(\frac{\pi}{2} - \alpha\right)}_{\sin\theta}$$

avec $\theta = \frac{\pi}{2} - \alpha$.