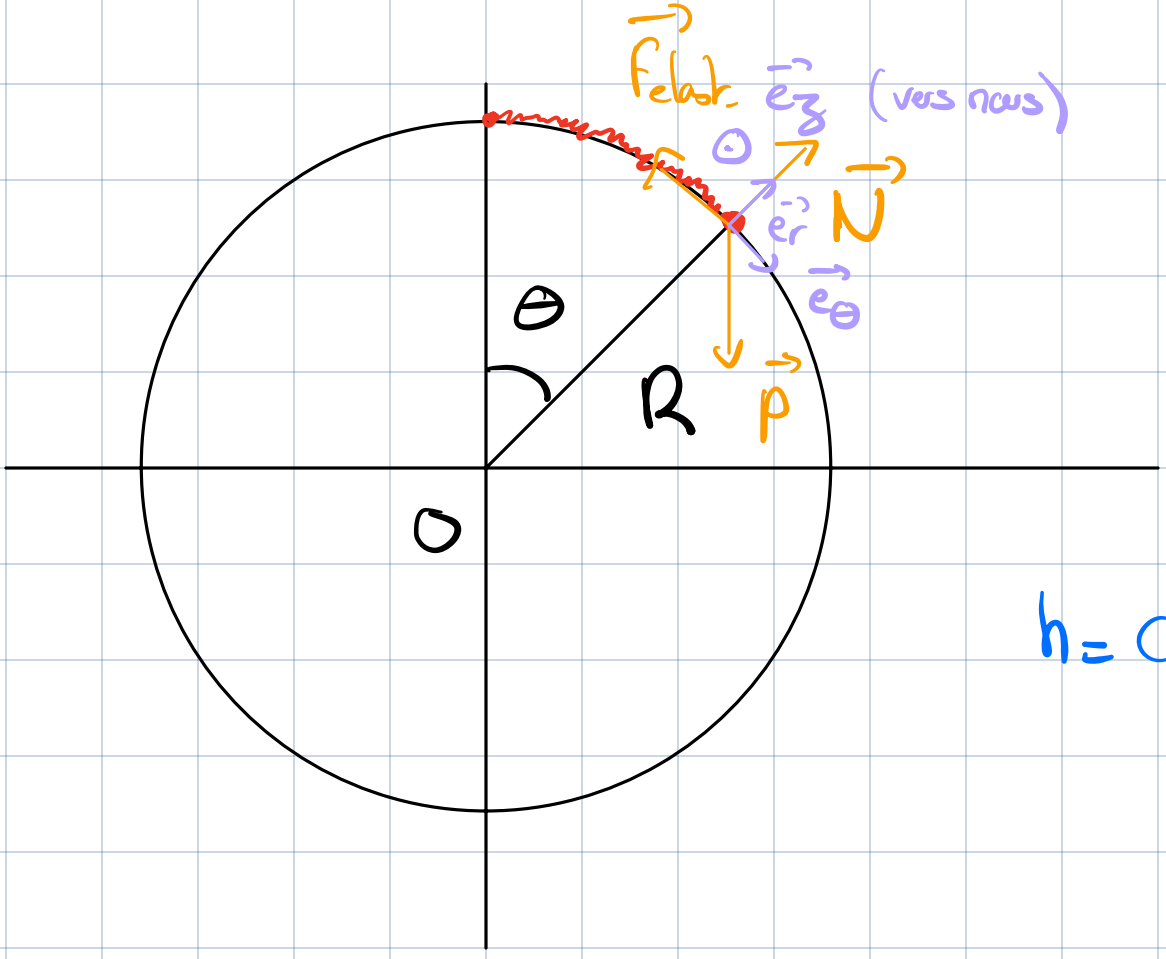
Marked 1

$$\Sigma \vec{F} = \vec{P} + \vec{F}_{elast.} + \vec{N}$$



$$h = \cos\theta \cdot R$$

$$\vec{P} = (-\cos\theta \hat{e}_r + \sin\theta \hat{e}_\theta)\, mg$$

$$\vec{N} = N \vec{e}_r$$

$$\vec{f}_{elast} = -k \Delta L \vec{e}_\theta = -k\theta \cdot R \vec{e}_\theta$$

$\Delta L = \Theta \cdot R$

$$\begin{cases} m(\ddot{\rho} - \rho\dot{\theta}^2) = -\cos\theta\, mg + N \\ m(\rho\ddot{\theta} + 2\dot{\rho}\dot{\theta}) = \sin\theta\, mg - k\Theta R \\ m\ddot{z} = 0 \end{cases}$$

On pose :

- $\rho = R \Rightarrow \dot{\rho} = 0$ et $\ddot{\rho} = 0$.

$$\begin{cases} -mR\dot{\theta}^2 = -\cos\theta\, mg + N \\ mR\ddot{\theta} = \sin\theta\, mg - k\Theta R \\ \ddot{z} = 0 \end{cases}$$

(c) $E_m = \frac{1}{2} m v^2$

$+ \frac{1}{2} k (\theta R)^2$

$+ mgh$

$E_{m_0} = m \cdot g \cdot R$

$E_{mf} = \frac{1}{2} m (\dot{\theta} \cdot R)^2$

$+ \frac{1}{2} k \theta R$

$+ mg \cos\theta R$

$$mgR = \frac{1}{2} m \dot{\theta}^2 R^2 + \frac{1}{2} k (\theta R)^2 + mg \cos\theta R$$

$$\Leftrightarrow \frac{1}{2} m \dot{\theta}^2 R^2 = mgR - \frac{1}{2} k \theta^2 R^2 - mg \cos\theta R$$

$$\Leftrightarrow m \dot{\theta}^2 R = 2mg - k \theta^2 R - 2m g \cos\theta$$

$$-mR\dot{\theta}^2 = -\cos\theta\, mg + N$$

$$\Leftrightarrow -2mg + k\theta^2 R + 2mg\cos\theta = -\cos\theta\, mg + N$$

$$\Leftrightarrow N = 3mg\cos\theta + k\theta^2 R - 2mg$$

$$N \geq 0$$

$$3mg\cos\theta_{max} + k\theta_{max}^2 R - 2mg \geq 0$$

$$k\theta^2 R \geq 2mg - 3mg\cos\theta_{max}$$

$$k \geq \frac{2mg - 3mg\cos\theta_{max}}{R\theta_{max}^2}$$

(d) $\theta = \pi/2$.

$$\frac{2mg}{\theta^2 R} = \frac{2mg\,2^2}{R}$$

$$= \frac{8mg}{\pi^2 R}$$

(c) On pose $V = \dot{\theta} R \simeq 0$

$\Rightarrow \dot{\theta} \simeq 0$ et $\ddot{\theta} \simeq 0$.

seul qu'ici on est pas sûr du signe... ?

$-\cos\theta mg + N = \sin\theta mg - k\theta R$

$\Leftrightarrow N = \sin\theta mg - k\theta R + \cos\theta mg$

On veut $N \geq 0$.

$\sin\theta_{max} mg - k\theta R + \cos\theta_{max} mg \geq 0$

$\sin\theta_{max} mg + \cos\theta_{max} mg \geq k\theta_{max} R$

$\Leftrightarrow k \leq \dfrac{(\sin\theta_{max} + \cos\theta_{max}) mg}{\theta_{max} R}$ $(\theta R > 0)$

(d) On pose $\theta_{max} = \frac{\pi}{2}$.

$$k \leq \frac{mg}{\frac{\pi}{2} \cdot R}$$

$$\Leftrightarrow \quad k \leq \frac{2mg}{\pi R}.$$

(c) et (d) Jaux