



On cherche v_0 tq T soit toujours > 0 ($T = \|\vec{T}\|$)

$$\text{Pfd} \begin{cases} \text{sur } \vec{r}: & -m l \ddot{\theta}^2 = -T + mg \cos \theta & (a) \\ \text{sur } \vec{v}_\theta: & m l \ddot{\theta} = -mg \sin \theta & (b) \end{cases}$$

Intégrons (b)

$$m l \ddot{\theta} \dot{\theta} = -mg \sin \theta \dot{\theta}$$

$$\frac{d}{dt} \left(\frac{1}{2} l \dot{\theta}^2 \right) = - \frac{d}{dt} (-g \cos \theta)$$

$$\Rightarrow \left[\frac{1}{2} l \dot{\theta}^2 \right]_{t=0}^t = \left[g \cos \theta \right]_{t=0}^t$$

$$\frac{1}{2} l \dot{\theta}^2 - \frac{1}{2} \frac{v_0^2}{l} = g \cos \theta - g \quad \text{car } v_0 = l \dot{\theta}(t=0)$$

$$\Rightarrow l \dot{\theta}^2 = 2g \cos \theta - 2g + \frac{v_0^2}{l} \quad (*)$$

On injecte (*) dans (a):

$$-2mg \cos \theta + 2mg - m \frac{v_0^2}{l} = -T + mg \cos \theta$$

$$\Rightarrow T = 3mg \cos \theta - 2mg + m \frac{v_0^2}{l}$$

La corde sera toujours tendue si $T > 0$ quand $\theta = \pi$.

$$T(\theta = \pi) > 0 \Rightarrow -3mg - 2mg + m \frac{v_0^2}{l} > 0$$

$$\Rightarrow v_0 > \sqrt{5lg}$$