Esercitazione 12 -

Esercizio di statica potenziale

$$V = E_p = -V$$

$$\frac{\partial E_p^{TOT}}{\partial \theta} = 0$$

$$E_{p,m} = mgh$$

$$E_{p,F} = -F \cdot y$$

$$E_{p,c} = -c\theta$$

$$E_{p,k} = \frac{1}{2} k \Delta \ell^2$$

$$h = \frac{\ell}{2} \sin\theta$$

$$y = \ell \sin\theta$$
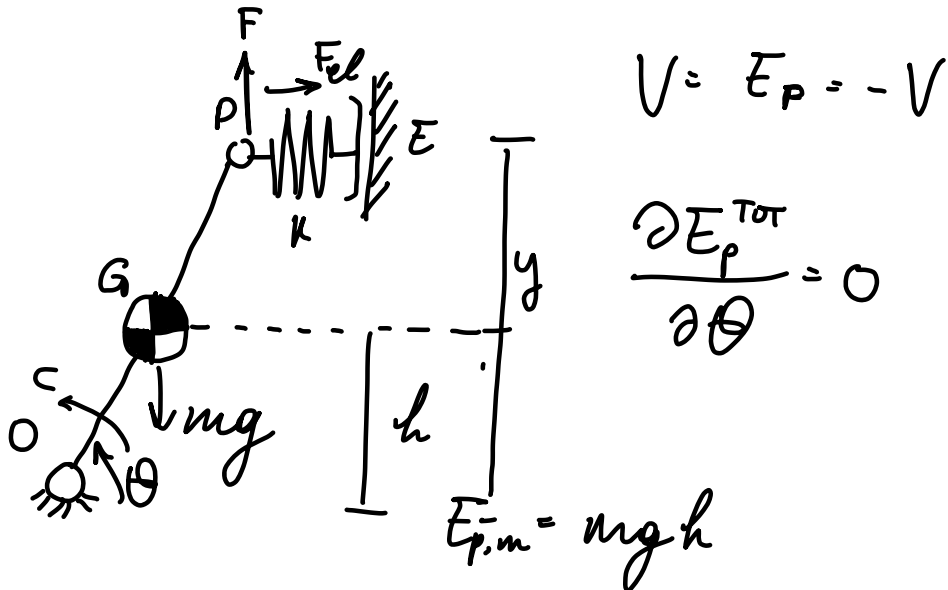
$$\Delta \ell = \ell - \ell_0 = L - L\cos\theta$$

$$E_{p,TOT} = \sum E_p = E_{p,c} + E_{p,m} + E_{p,F} + E_{p,k}$$

$$= -c\theta + mg\frac{L}{2}\sin\theta - FL\sin\theta + \frac{1}{2}kL^2(1-\cos\theta)^2$$

$$\frac{\partial E_{TOT}}{\partial \theta} = -c + Mg\frac{L}{2}\cos\theta - FL\cos\theta + kL^2(1-\cos\theta)\sin\theta$$

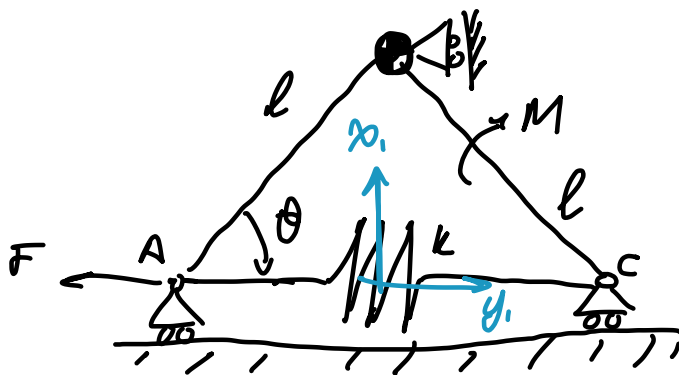$$\Rightarrow \text{Ricavo } k(\theta_{eq})$$

Principalmente ci viene chiesto il PLV quindi
ci concentriamo su quello.

Esercizio 1,3 Tot E 11/9/18

Dati $\theta_0 = 0$

M, F

Trovare θ_{eq}

Legami Cinematici

$$\vec{S}_B = \ell\sin\theta(-\hat{j})$$

$$\vec{S}_A = \ell\cos(-\hat{i})$$

$$\vec{\theta}_{BC} = |\theta|(\hat{u})$$

$$\Delta \ell = \ell_0 - \ell = 2\ell\cos\theta_0 - 2\ell\cos\theta = 2\ell - 2\ell\cos\theta$$
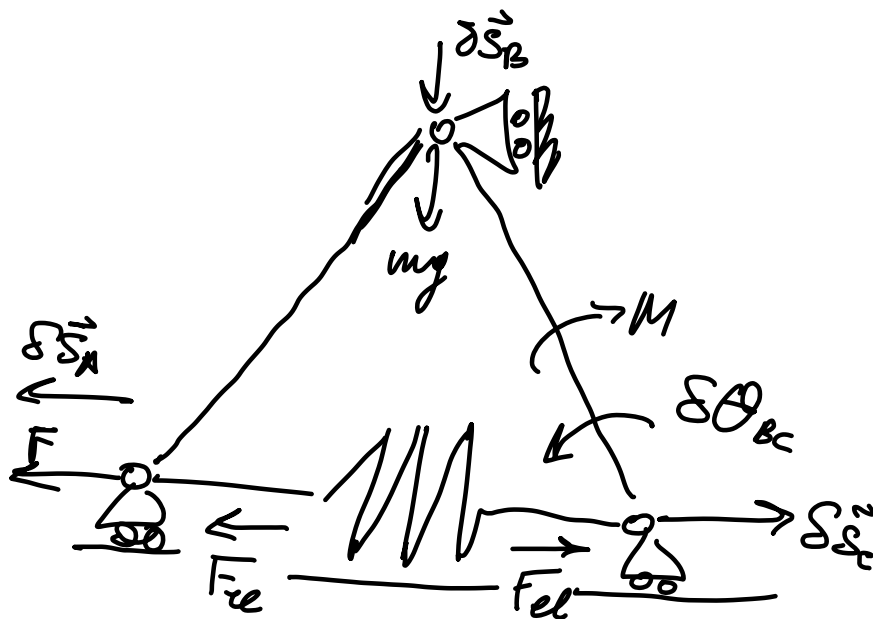
$$\vec{S}_c = \ell\cos\theta \, (\hat{\imath})$$

$$\delta\vec{S}_B = \frac{\partial |\vec{S}_B|}{\partial\theta}\,\delta\theta = \ell\cos\theta\,\delta\theta\,(-\hat{\jmath})$$

$$\delta\vec{\theta}_{Bc} = \frac{\partial|\theta_{Bc}|}{\partial\theta}\,\delta\theta = \delta\theta\,(\hat{h})$$

$$\delta\vec{S}_A = \frac{\partial s_A\,\delta\theta}{\partial\theta} = \ell\sin\theta\,(-\hat{\imath})\,\delta\theta$$

$$\delta S_c = \frac{\partial S_c}{\partial\theta}\,\delta\theta = \ell\sin\theta\,(\hat{\imath})\,\delta\theta$$

6) PLV

$$\delta L = 0 = mg\,(-\hat{\jmath})\cdot\ell\cos\theta\,(\hat{\jmath})\,\delta\theta +$$

$$\underbrace{M(-\hat{k})\cdot\delta\theta(+\hat{k})}_{F_P} + \underbrace{F(-\hat{i})\cdot \ell\sin\theta(-\hat{i})\,\delta\theta + k(2\ell-2\ell\cos\theta)(\hat{i})}_{\delta\vec{s}_B}$$
$$\cdot\delta\theta\cdot \ell\sin\theta(-\hat{i})$$
$$+ k(2\ell-2\ell\cos\theta)(\hat{i})\cdot \ell\sin\theta(\hat{i})\,\delta\theta = 0$$

$$mgh\cos\theta\,\delta\theta - M\delta\theta + F\ell\sin\theta\,\delta\theta + k(2\ell-2\ell\cos\theta)\ell\sin\theta\,\delta\theta$$
$$+ k(2\ell-2\ell\cos\theta)\ell\sin\,\delta\theta = 0$$

$$\Rightarrow \text{Ricavo } \theta_{eq}$$

Esercizio 1.5   TdE   5/7/2023

Dati
$k_1 = 0$
$L = 0,5$
$R = 0,$

Trovare
F_{eq}

a) Legami Cinematici

$$\vec{S}_{Gy} = L \sin \alpha (-\hat{j})$$

$$\vec{S}_{cx} = 2L \cos \alpha (\hat{i})$$

$$\vec{\theta}_{Gc} = \alpha (\hat{k})$$

$$\vec{S}_{By} = 2L \sin \alpha (-\hat{j})$$

$$\vec{\theta}_{DISCO} = \frac{|\vec{S}_c|}{R}(-\hat{k}) = \frac{2L \cos \alpha}{R}(-\hat{k})$$

$$\vec{S}_F = |\vec{\theta}_{DISCO}| 2R (\hat{i}) = 4L \cos \alpha (\hat{i})$$

$$\delta S_{Gy} = L \cos \alpha \, \delta\alpha (-\hat{j})$$

$$\delta S_c = 2L \sin \alpha \, \delta\alpha (+\hat{i})$$
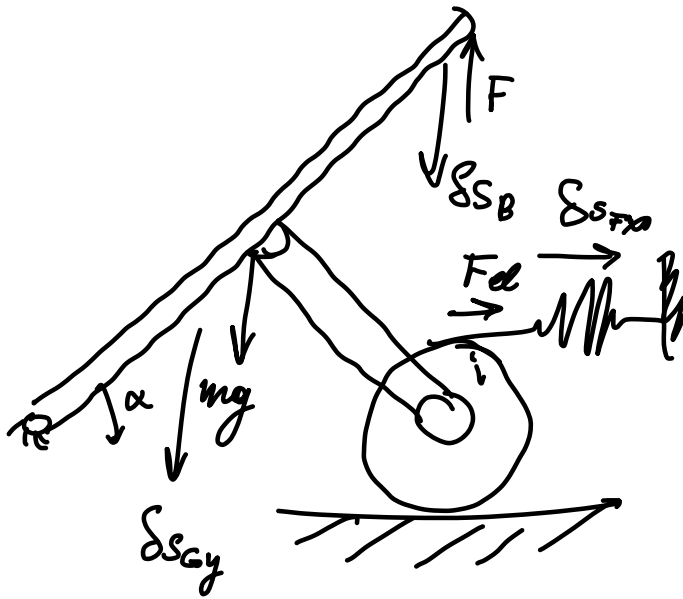
$$\delta \vec{S}_{By} = 2L \cos \alpha \, \delta\alpha (-\hat{j})$$

$$\delta S_F = 4L \sin \alpha \, \delta\alpha (\hat{i})$$

$$\Delta l = l - l_0 = (S\overline{O}_x - 2R\theta_{DISCO}) - (SO_x -$$

$$- \cancel{SO_x} - 2\cancel{R}\frac{L \cos \alpha_0}{R} - \cancel{SO_x} + 2\cancel{R}\frac{L \cos \alpha}{R}$$

$$= 4L - 4L \cos \alpha$$

b) Applico PLV $\delta L = 0$

$$mg(-\hat{j}) \cdot L\cos\alpha \, \delta\alpha \overset{(-\hat{j})}{} + F(+\hat{j}) \cdot 2L\cos\alpha \, \delta\alpha (-\hat{j}) + k(4L-4L\cos\alpha)(\hat{i}) \cdot 4L\sin\theta \, \delta\alpha$$
$$(\hat{i}) = 0$$

$$mgL\cos\alpha\,\delta\alpha - F \cdot 2L\cos\alpha\,\delta\alpha + k(4L-4L\cos\alpha) \cdot 4L\sin\theta\,\delta\alpha = 0$$

$$\hookrightarrow \text{Ricavo } F(\alpha_{eq})$$

Esercizio 1.3   11/9/18

$$\begin{cases} E_{pM} = -M\theta \\ E_{pm} = mgh = mg\,L\sin\theta \end{cases} \qquad \begin{cases} E_{pm} = mg\,l\sin\theta \end{cases}$$

$$E_{p,k} = \tfrac{1}{2}k\,\Delta\ell^2 = \tfrac{1}{2}k\left(2L - 2L\cos\theta\right)^2$$

$$\Delta\ell = 2L - 2L\cos\theta$$

$$E_{p,F} = FL\cos\theta$$

$$\overline{E}_{p,\text{Tot}} = -M\theta + mg\,l\sin\theta + \tfrac{1}{2}k\left(2L - 2L\cos\theta\right)^2 + FL\cos\theta$$

$$M\ \text{per}\ \theta_{eq}$$