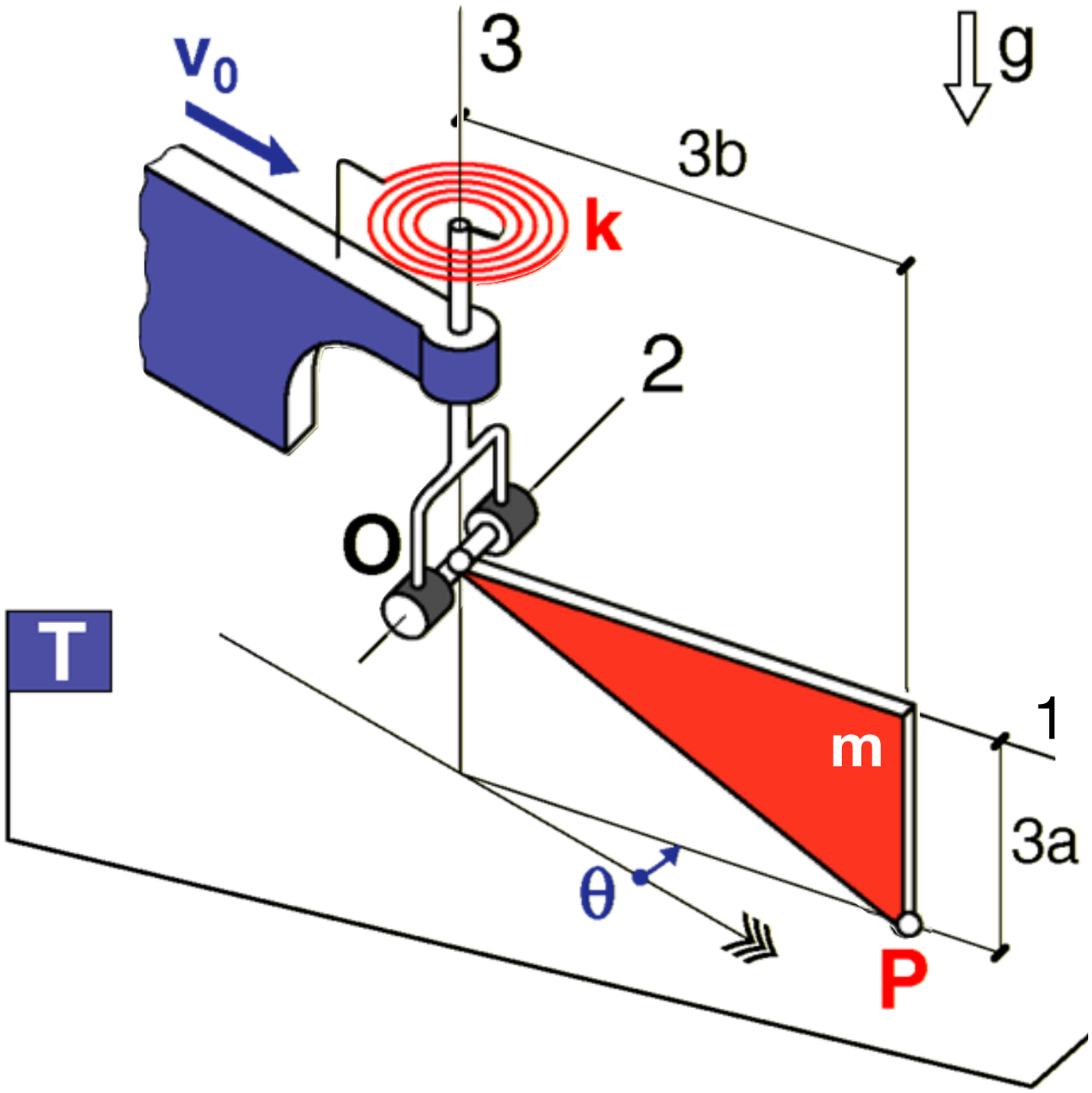
12P

Teoremes vectorials II

Exemples 3D

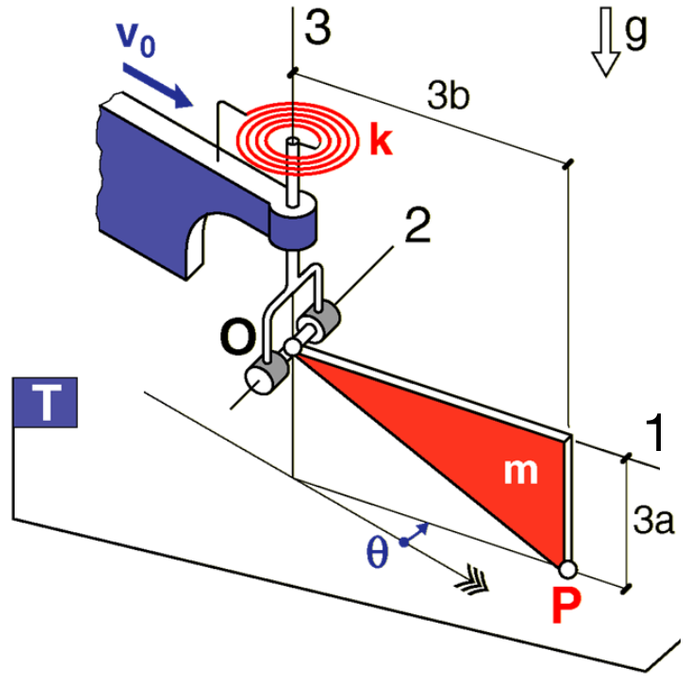


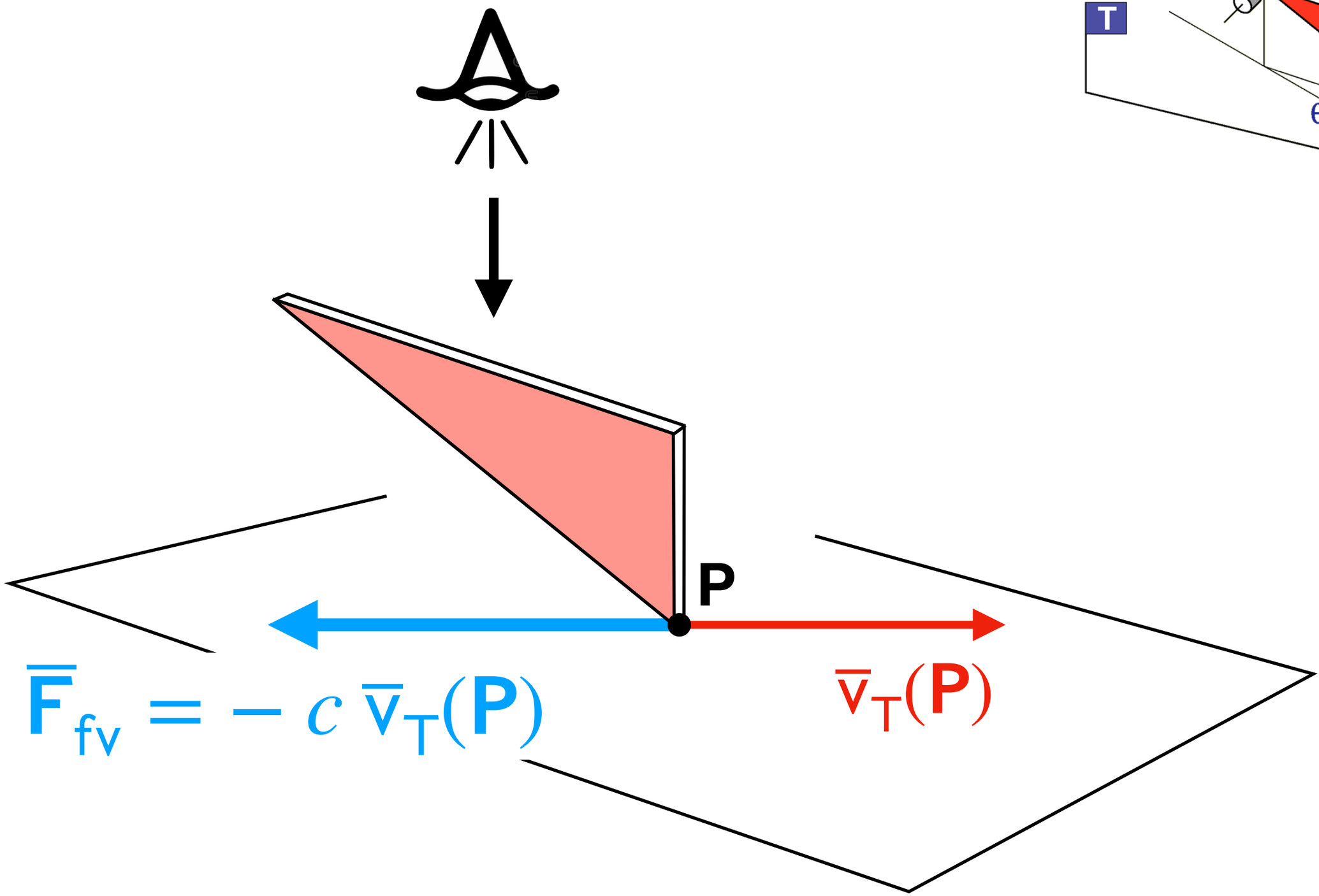
- Eq. mov. per a θ ?
- k_{min} per a que $\theta_{eq} = 0$ sigui **ESTABLE** ?

∃ frec viscós T → **P**
(de coef c)

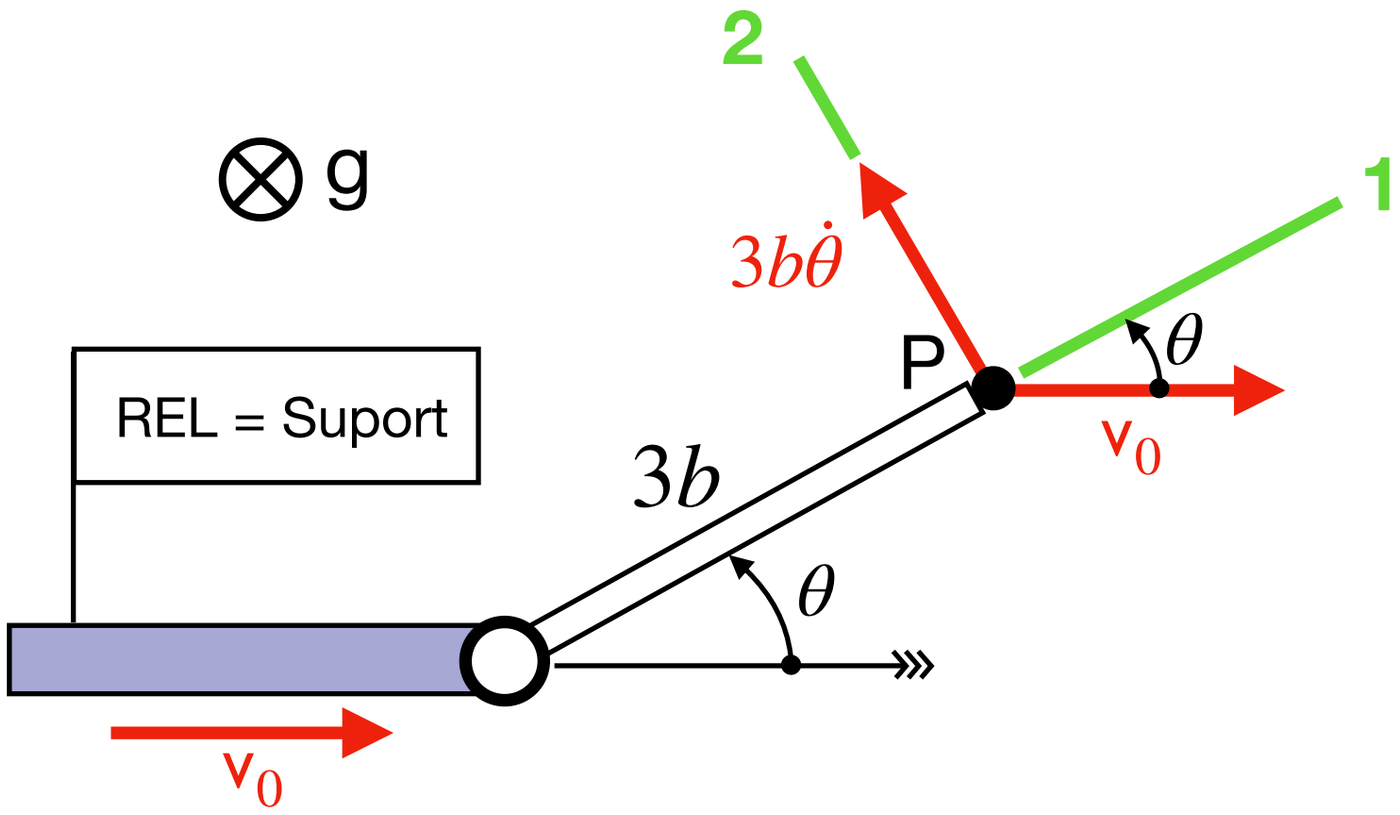
Per $\theta = 0$ la molla **està distesa**

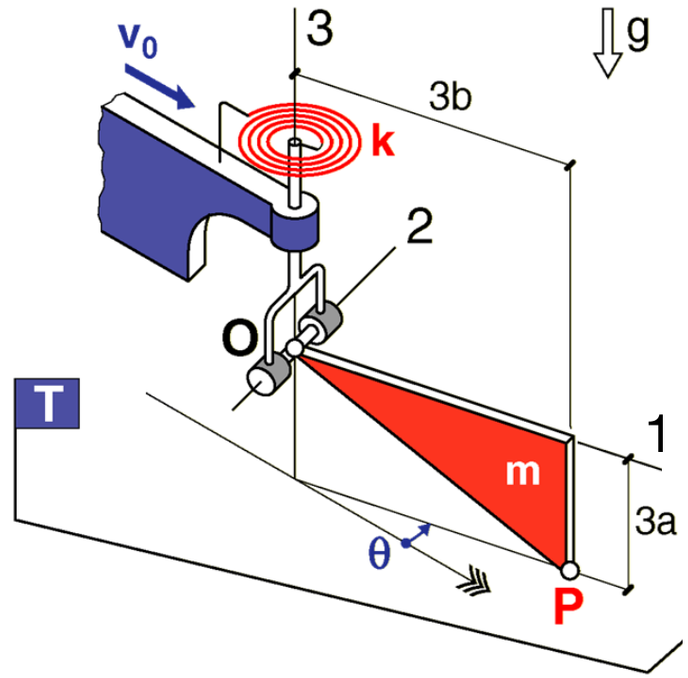
Força de frec viscós T → **P**





Força de frec viscós T → **P**





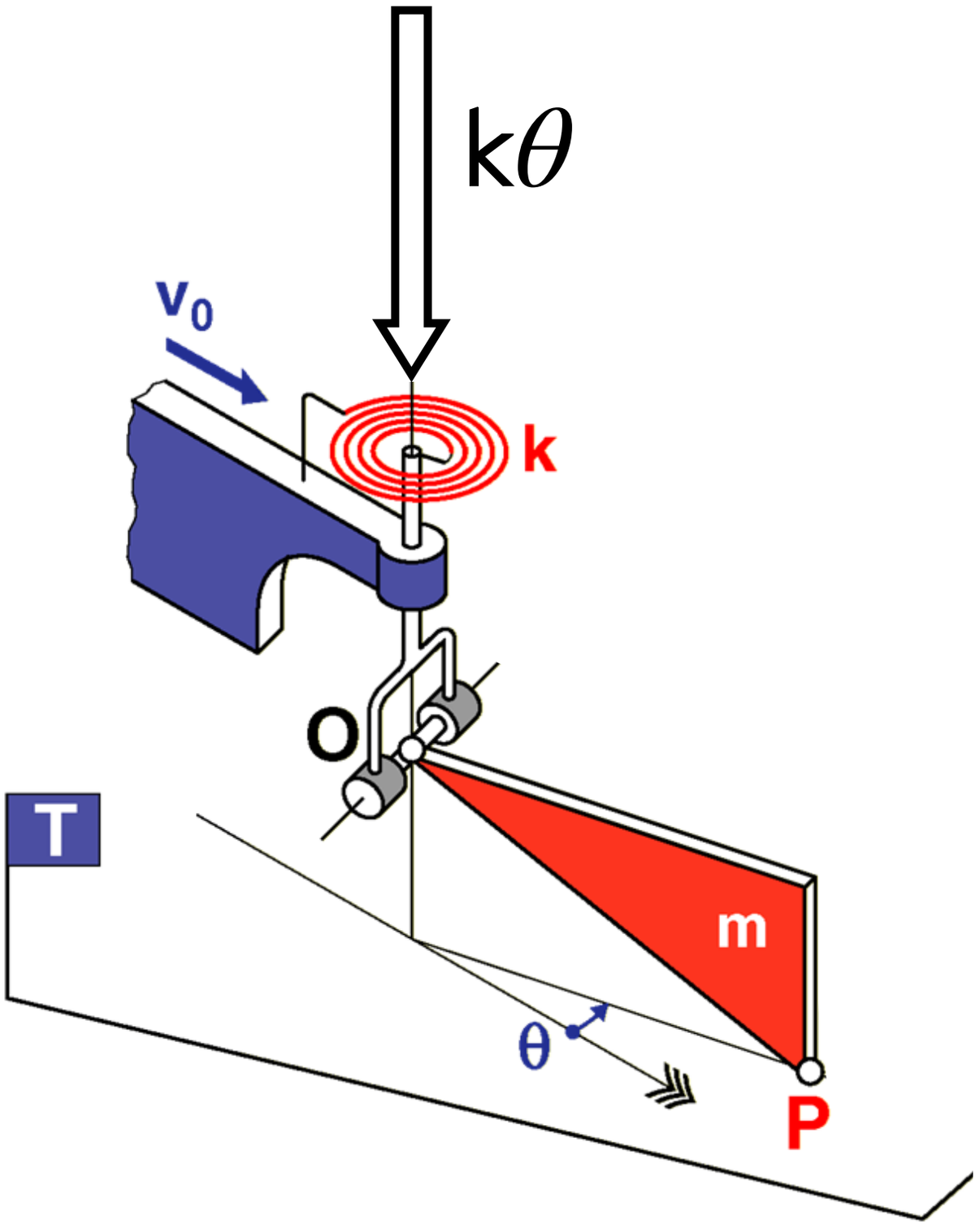
$$\bar{v}_T(\mathbf{P}) = \bar{v}_{REL}(\mathbf{P}) + \bar{v}_{ar}(\mathbf{P}) = \left\{ \begin{array}{c} v_0 \cos\theta \\ -v_0 \sin\theta + 3b\dot{\theta} \\ 0 \end{array} \right\}_{B=(1,2,3)}$$

$$\bar{F}_{fv} = -\, c\, \bar{v}_T(\mathbf{P}) = \left\{ \begin{array}{c} -cv_0 \cos\theta \\ cv_0 \sin\theta - 3cb\dot{\theta} \\ 0 \end{array} \right\}_B$$

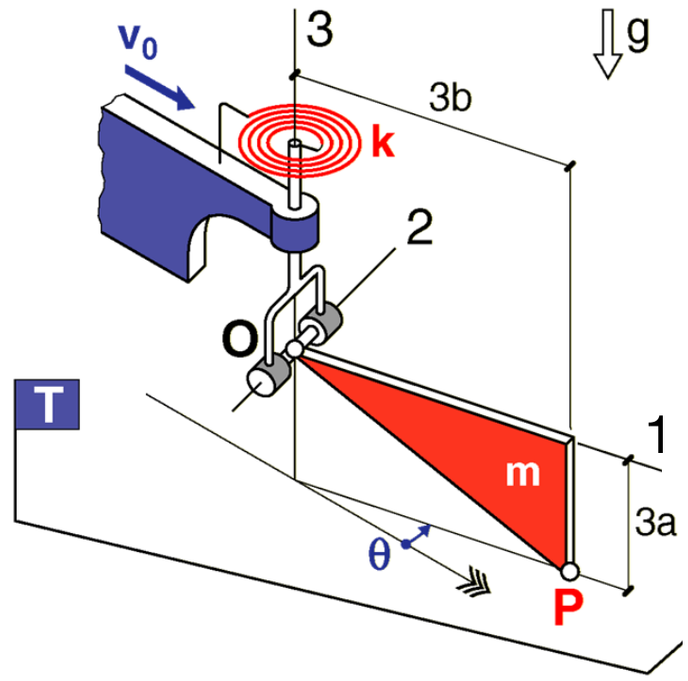
F_{fv1}

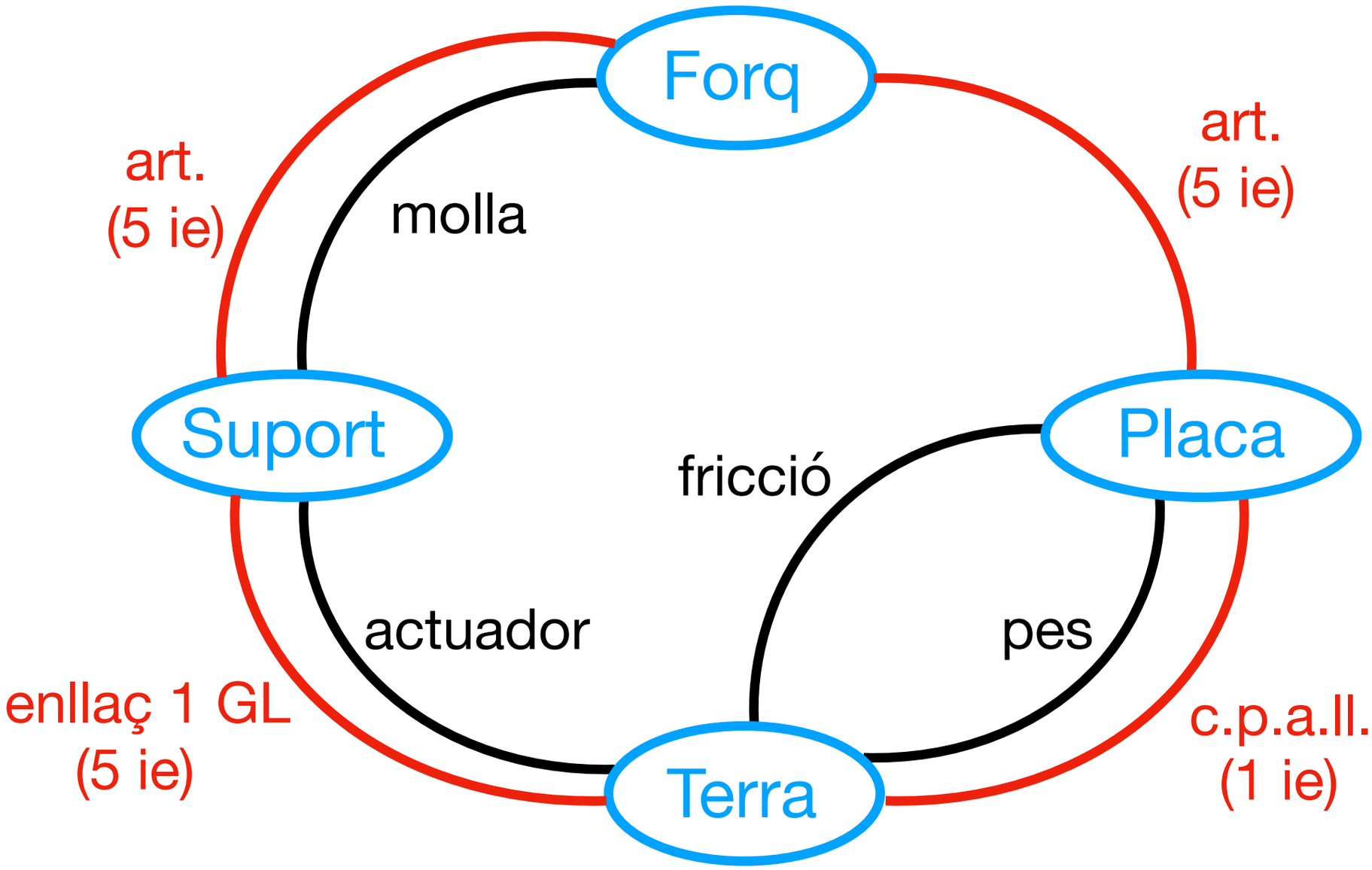
F_{fv2}

Parell molla torsional → forq



DGI = Diagrama general d'interaccions

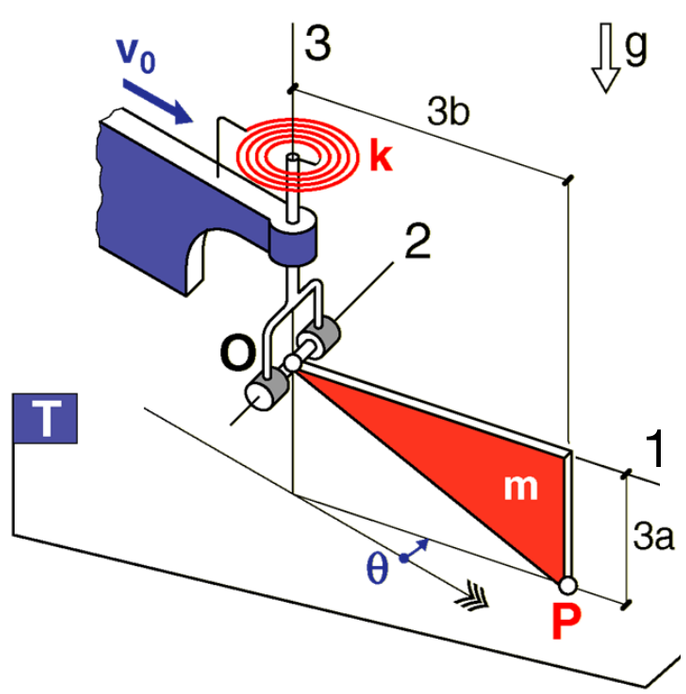


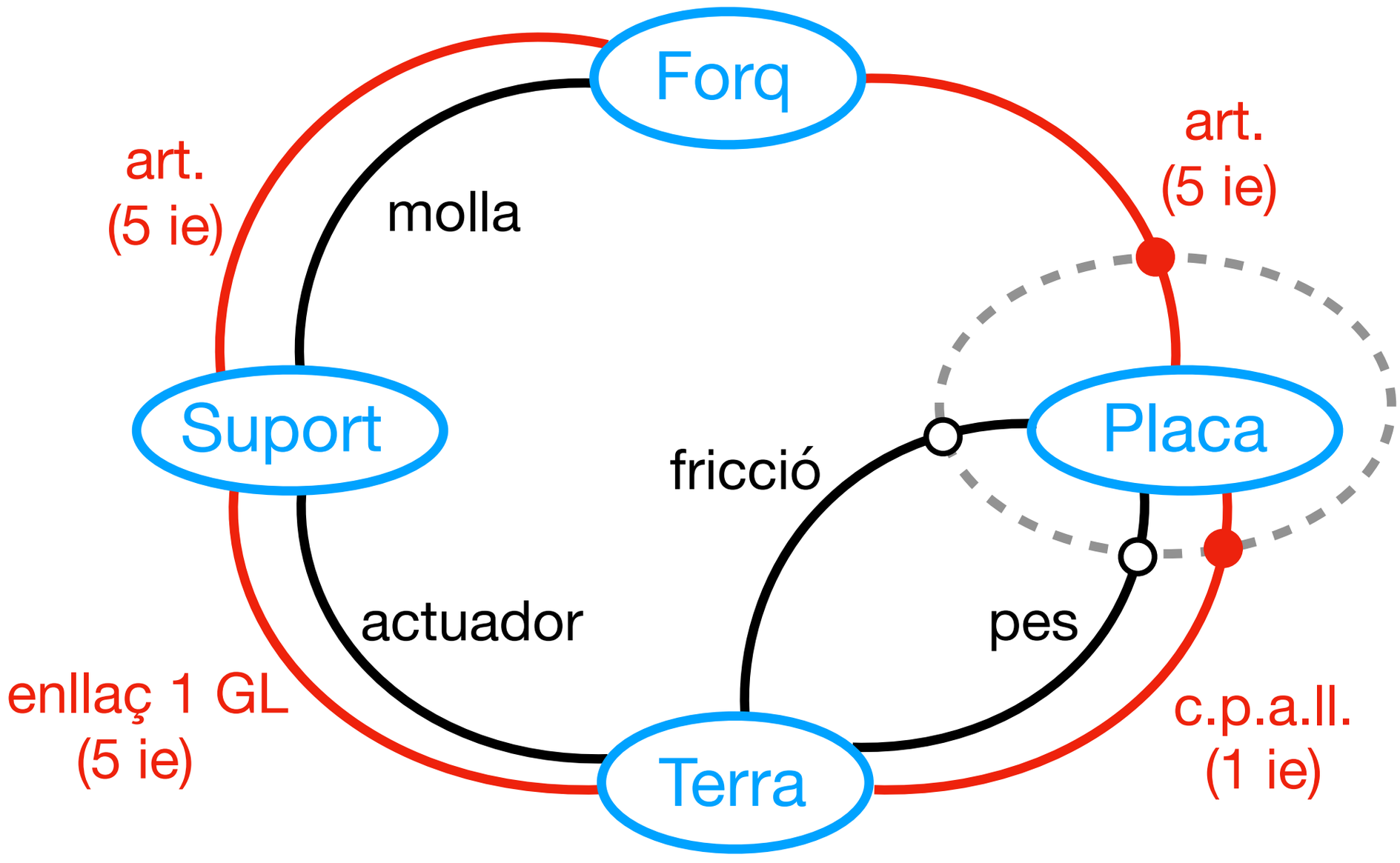


INDET

Sist = Placa

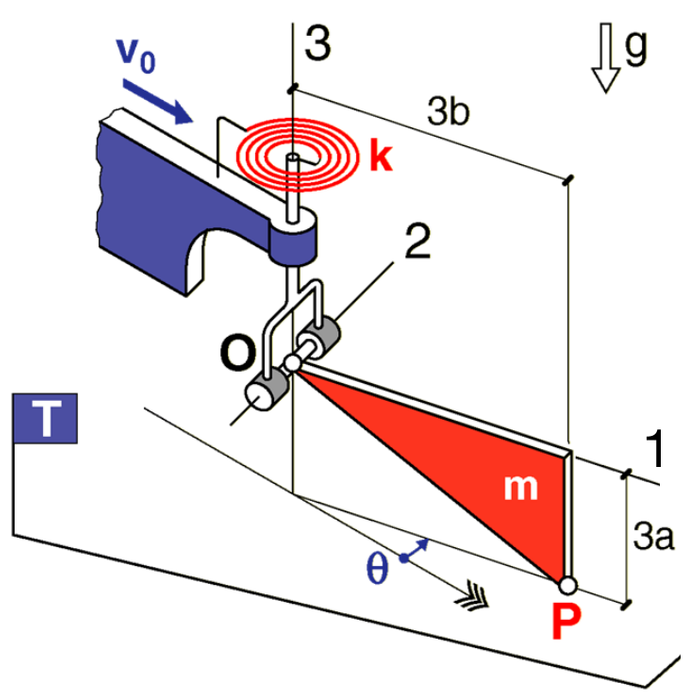
6 ie + $\ddot{\theta}$ = **7 incòg**

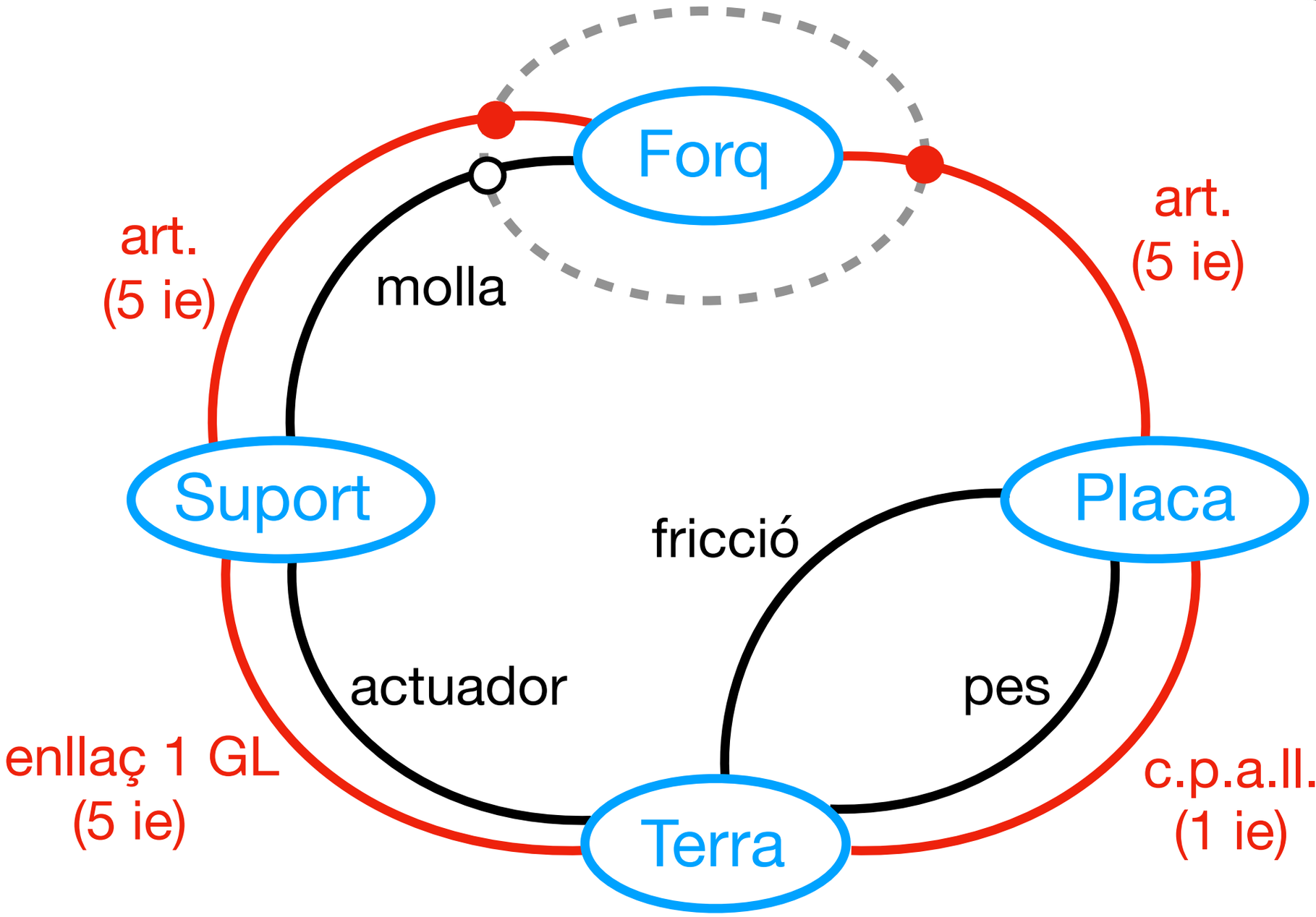




INDET

$$\left\{\begin{array}{l}\text{Sist} = \text{Forq} \\ 10\ \text{ie} + \ddot{\theta} = \textbf{11 incòg}\end{array}\right.$$

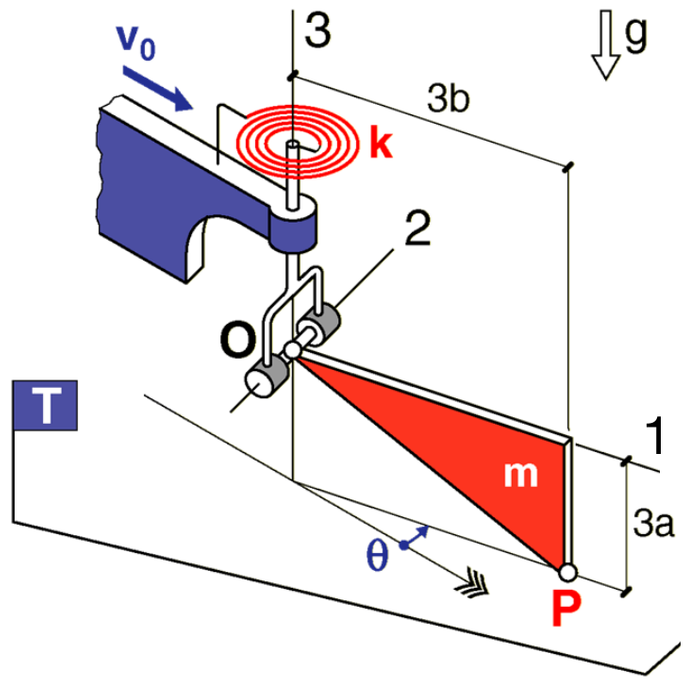


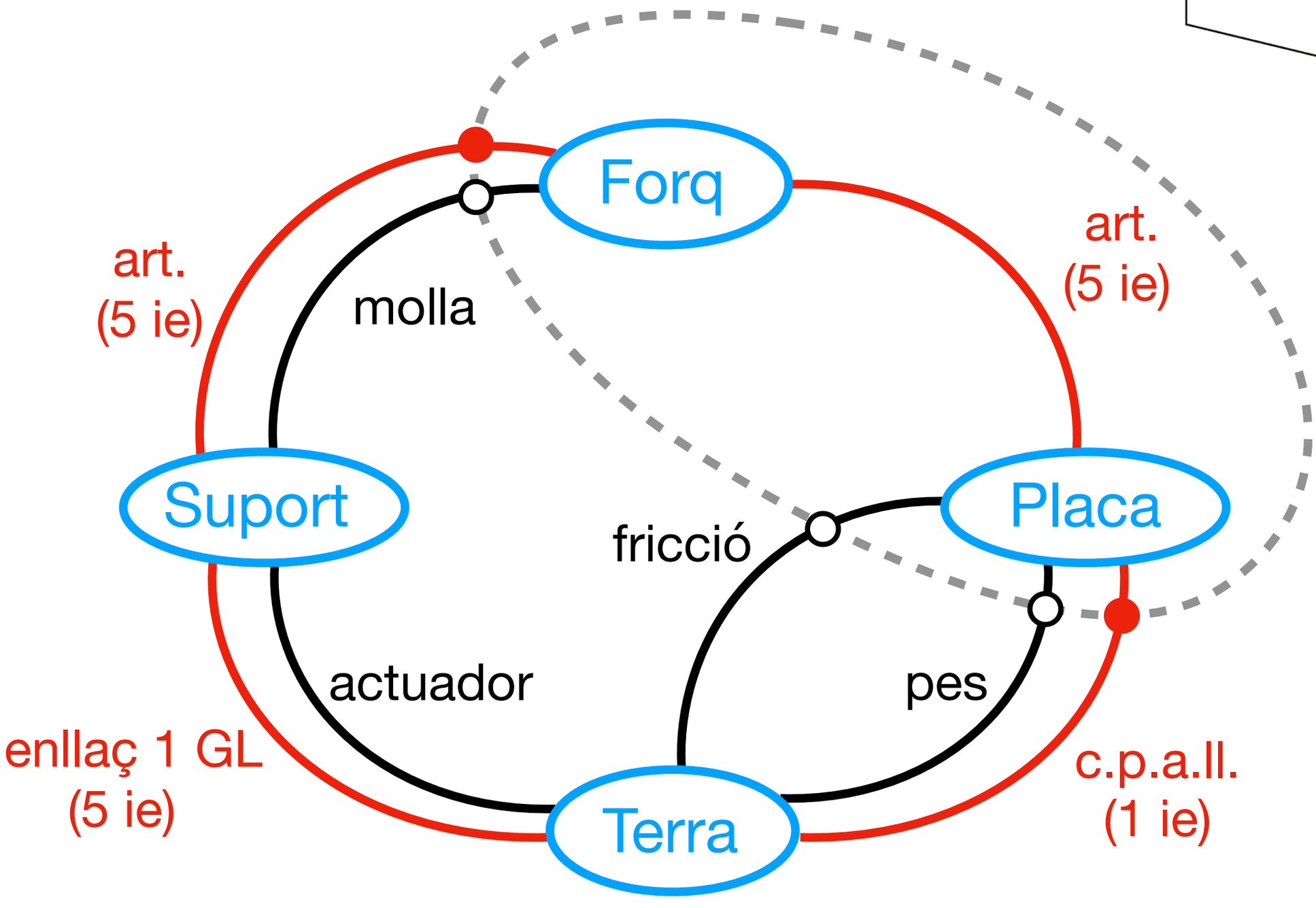


INDET

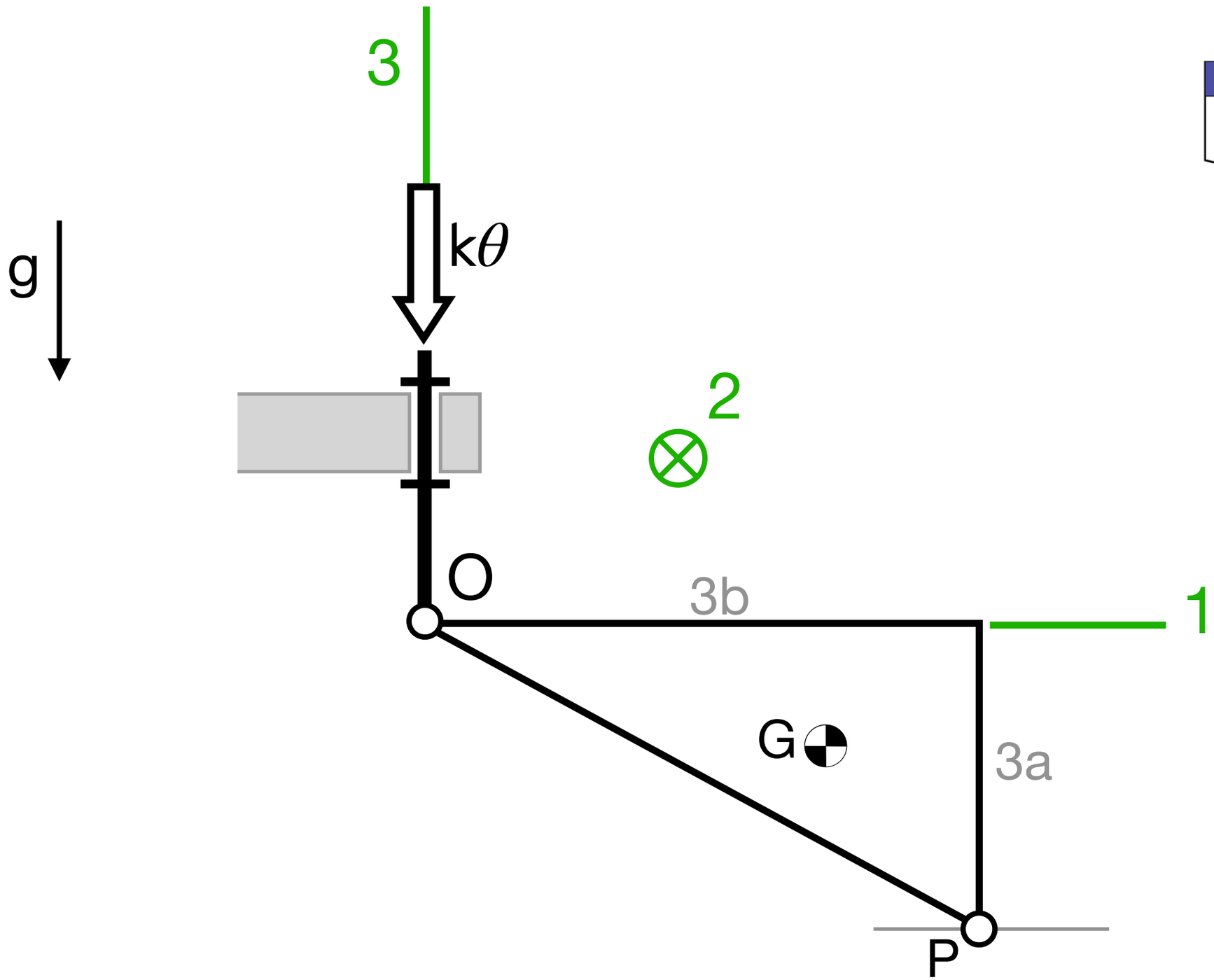
Sist = Placa + Forq

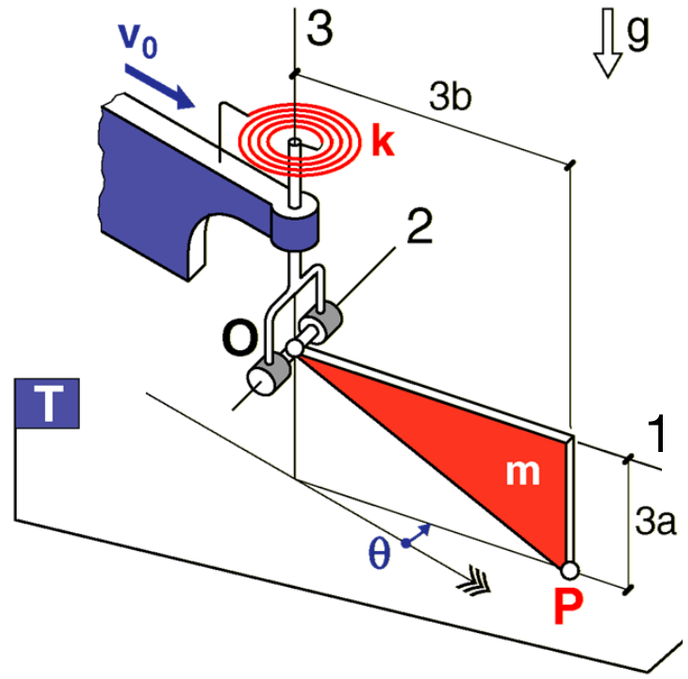
6 ie + $\ddot{\theta}$ **= 7 incòg**



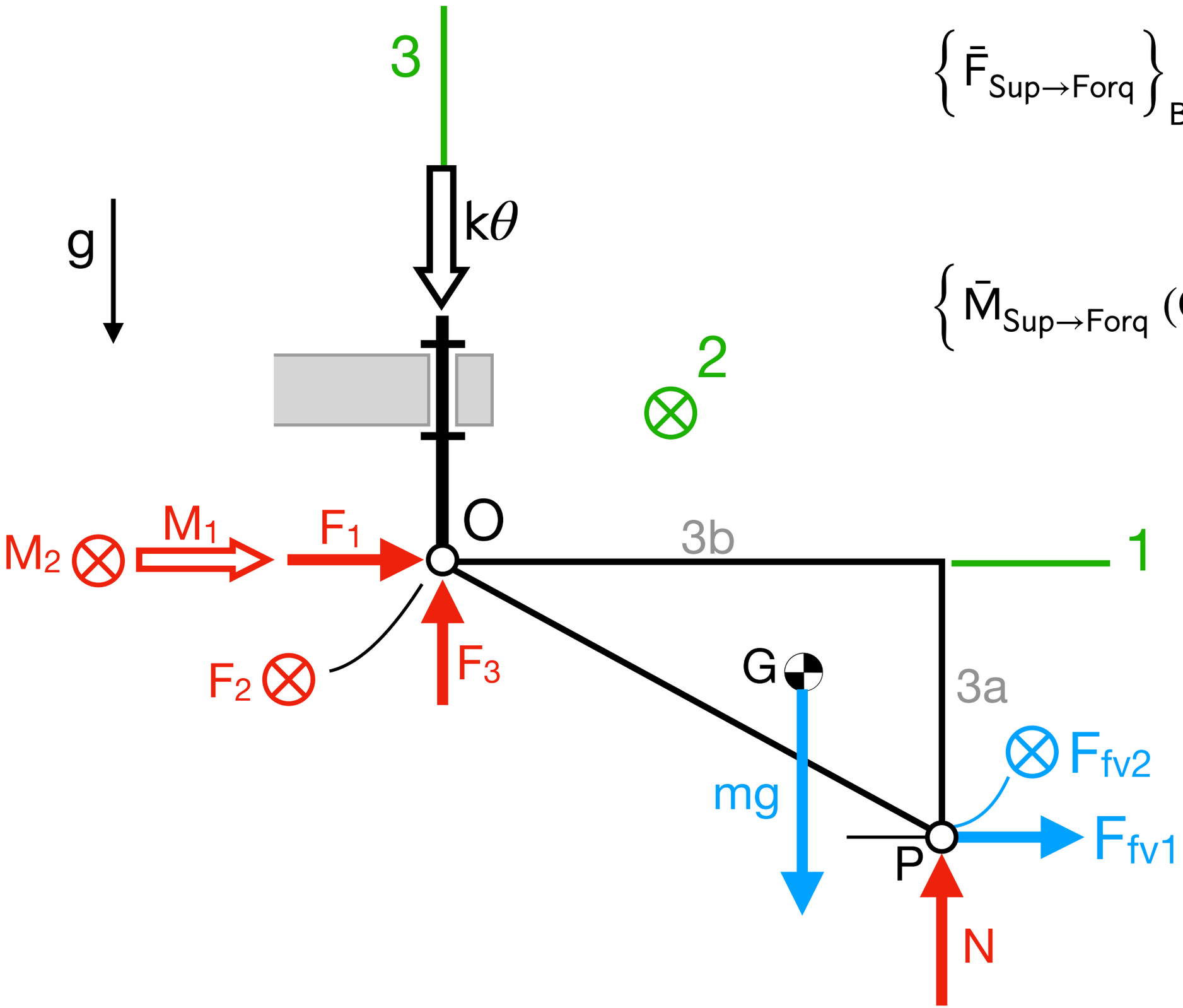


Forces sobre "Placa + Forq"





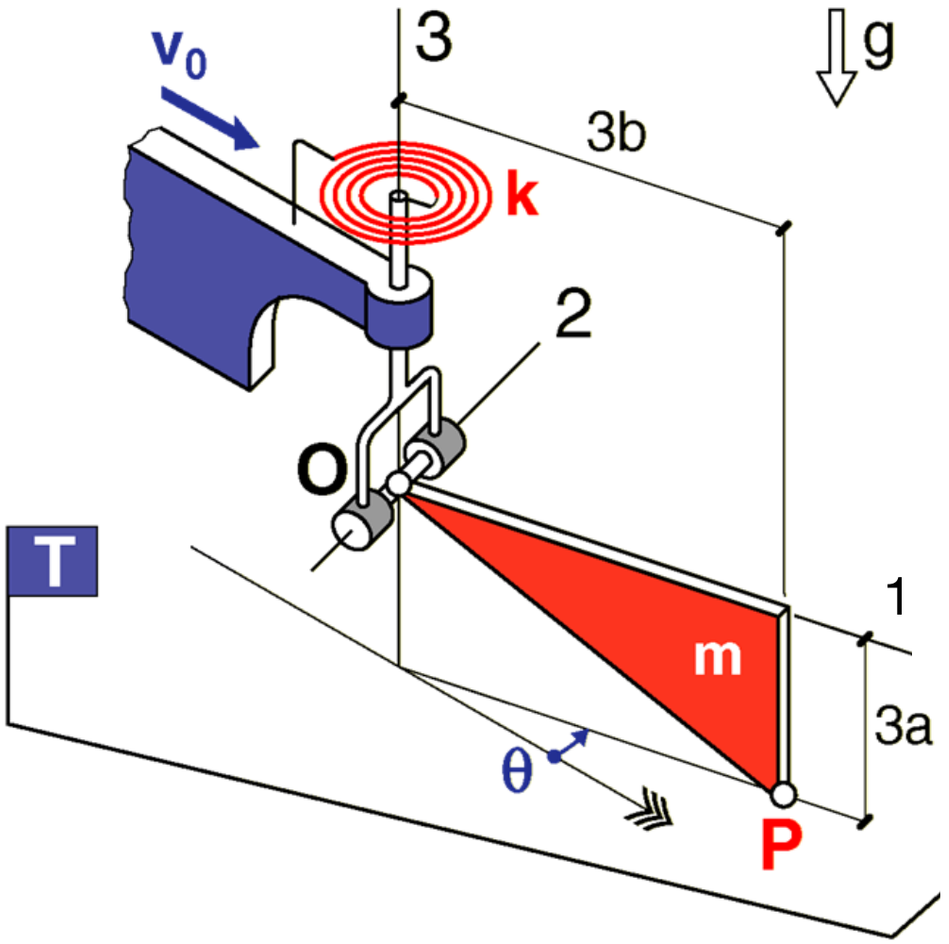
Forces sobre "Placa + Forq"

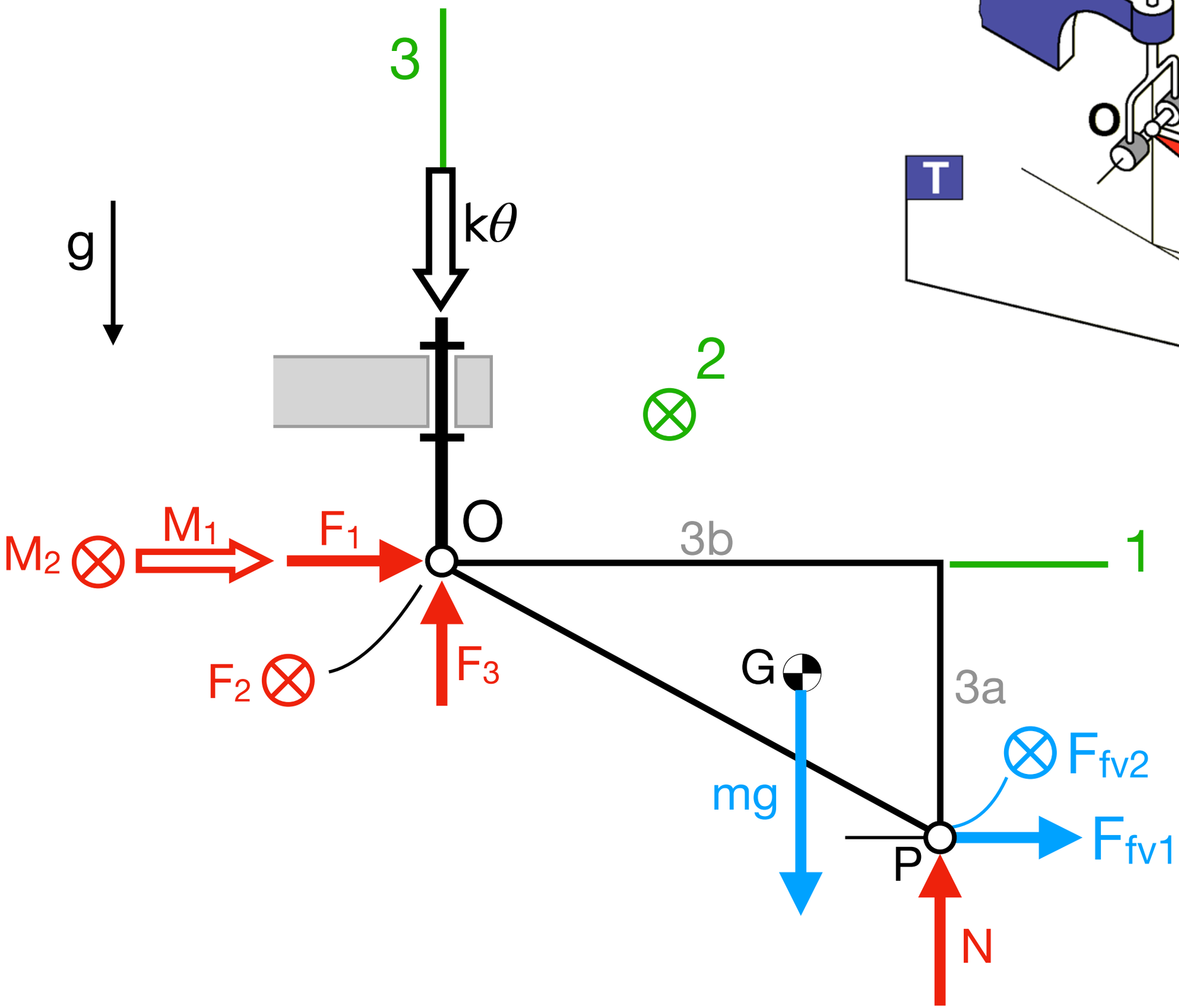


$$\left\{ \bar{F}_{Sup \to Forq} \right\}_B = \begin{Bmatrix} F_1 \\ F_2 \\ F_3 \end{Bmatrix}$$

$$\left\{ \bar{M}_{Sup \to Forq}\,(O) \right\}_B = \begin{Bmatrix} M_1 \\ M_2 \\ 0 \end{Bmatrix}$$

Forces sobre "Placa + Forq"





Anàlisi de l'estabilitat de $\theta_{eq} = 0$

3 passos

com al pèndol simple

$$I_{33}\,\ddot{\theta} + 9cb^2\,\dot{\theta} + k\,\theta - 3bc\mathrm{v}_0\,\sin\theta = 0$$

Obtenim EDO de l'error ε

$$\theta = \theta_{eq} + \varepsilon = \varepsilon$$
$$\dot{\theta} = \dot{\varepsilon}$$
$$\ddot{\theta} = \ddot{\varepsilon}$$

en aquest exemple

$$I_{33}\,\ddot{\varepsilon} + 9cb^2\,\dot{\varepsilon} + k\,\varepsilon - 3bc\mathrm{v}_0\,\sin\varepsilon = 0$$

La linealitzem

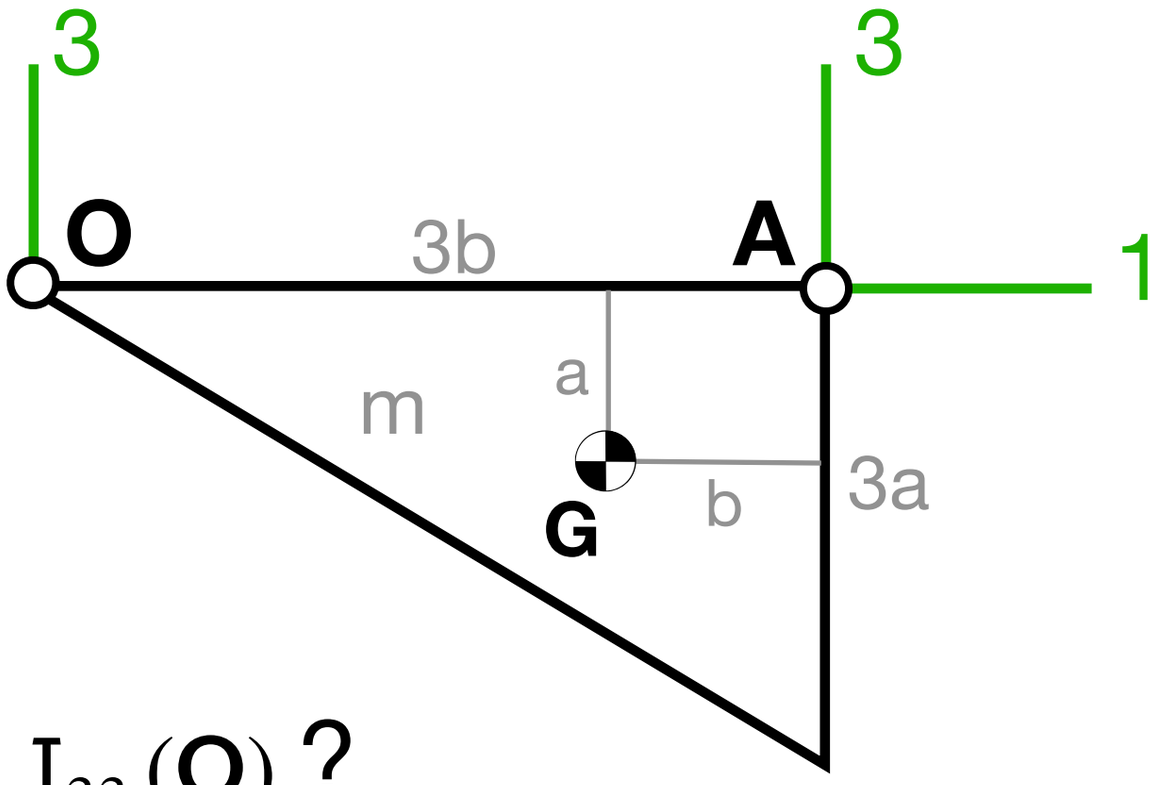
$$\sin\varepsilon \approx \varepsilon$$

$$I_{33}\,\ddot{\varepsilon} + \underbrace{9cb^2}_{A}\,\dot{\varepsilon} + \underbrace{(k - 3bc\mathrm{v}_0)}_{B}\,\varepsilon = 0$$

$$\ddot{\varepsilon} = -\underbrace{\frac{B}{I_{33}}}_{K}\varepsilon - \underbrace{\frac{A}{I_{33}}}_{C>0}\dot{\varepsilon}$$

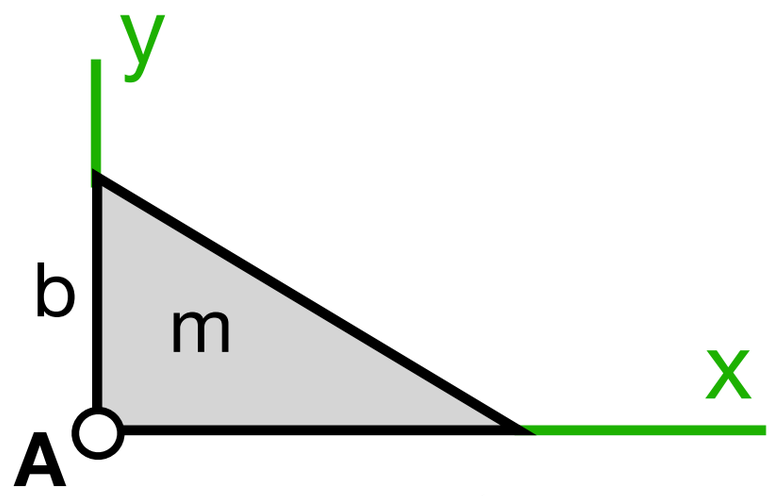
K > 0?

$$\mathrm{K} > 0 \iff \mathrm{B} > 0 \iff k > 3bc\mathrm{v}_0$$



$I_{33}(\mathbf{O})$?

Taules



$$I_{xx}(\mathbf{A}) = \frac{1}{6} m b^2$$

$I_{33}(\mathbf{A})$ de taules + **doble Steiner** per passar a **O**:

$$(a) \qquad I_{33}(\mathbf{O}) = I_{33}(\mathbf{G}) + I^{\oplus}_{33}(\mathbf{O})$$

$$(b) \qquad I_{33}(\mathbf{A}) = I_{33}(\mathbf{G}) + I^{\oplus}_{33}(\mathbf{A})$$

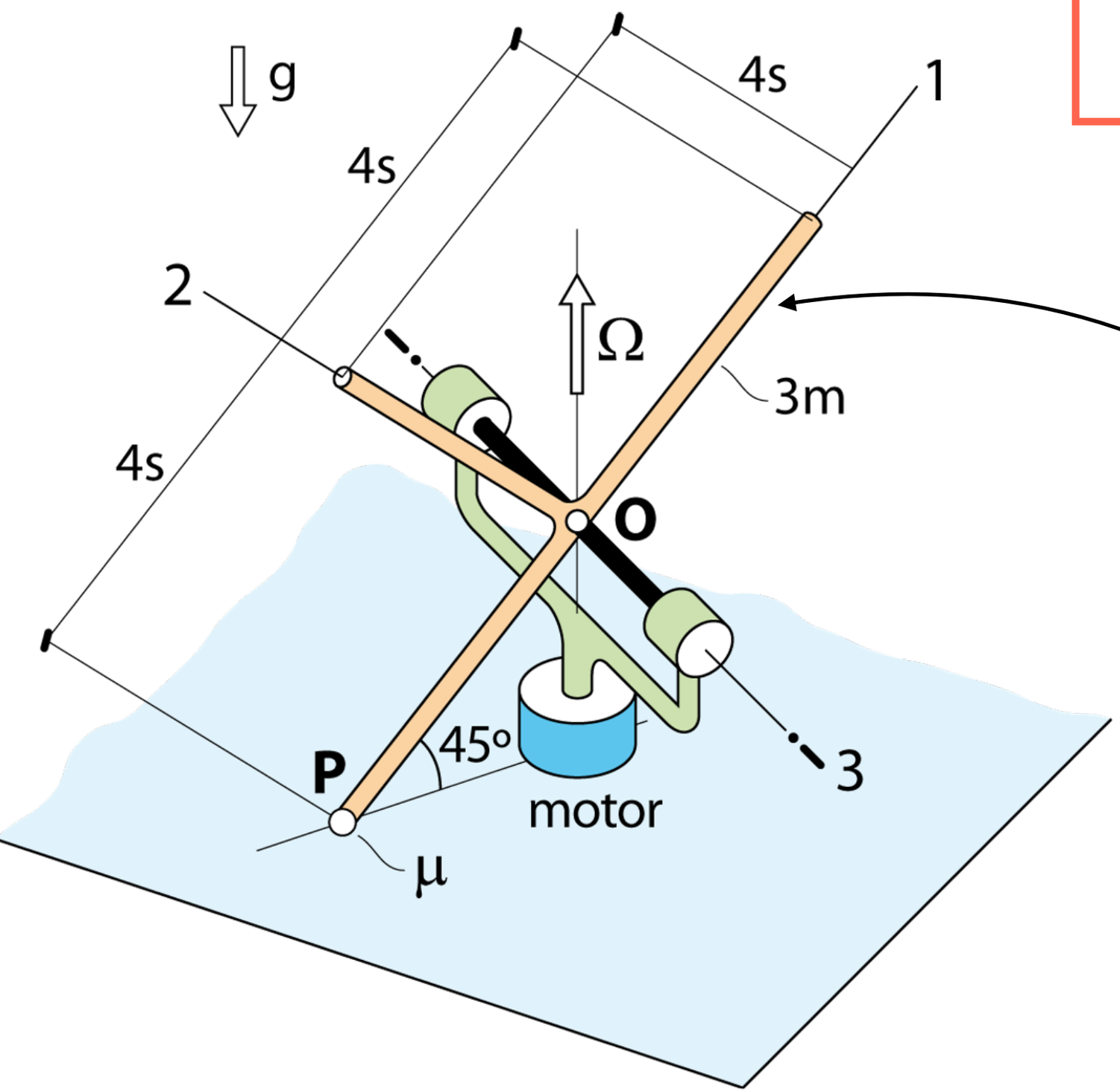
$$(a-b) \qquad I_{33}(\mathbf{O}) = I_{33}(\mathbf{A}) + I^{\oplus}_{33}(\mathbf{O}) - I^{\oplus}_{33}(\mathbf{A})$$

$$I_{33}(\mathbf{O}) = \frac{1}{6} m(3b^2) + m(2b)^2 - mb^2 = \frac{9}{2} mb^2$$

$\Omega = ct$

$\Omega_{critica}$ pèrdua contacte a P?

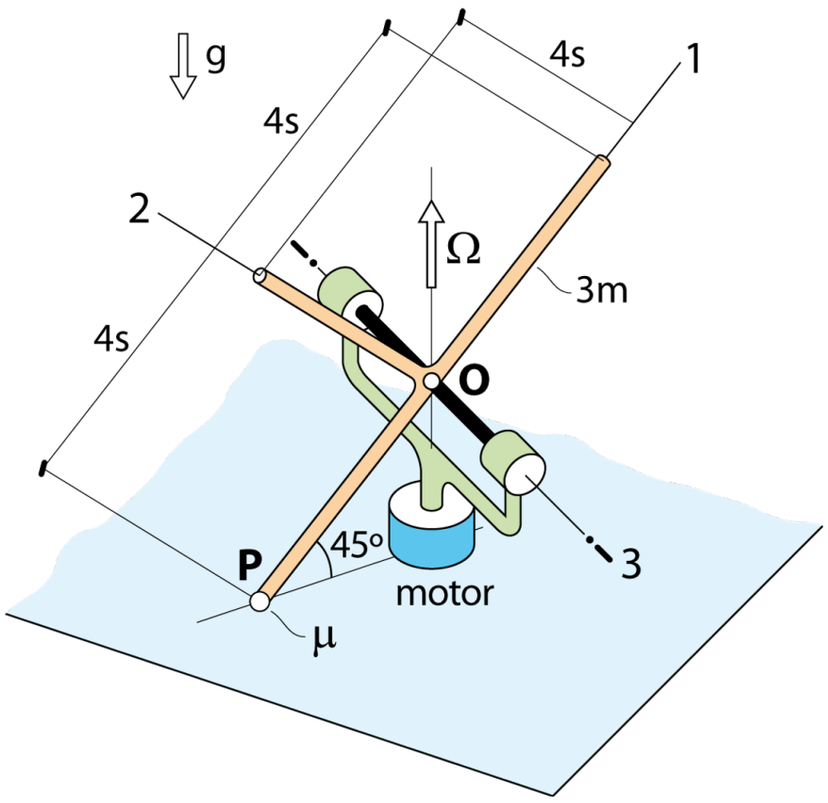
Equació del mov. quan
$\Omega > \Omega_{critica}$



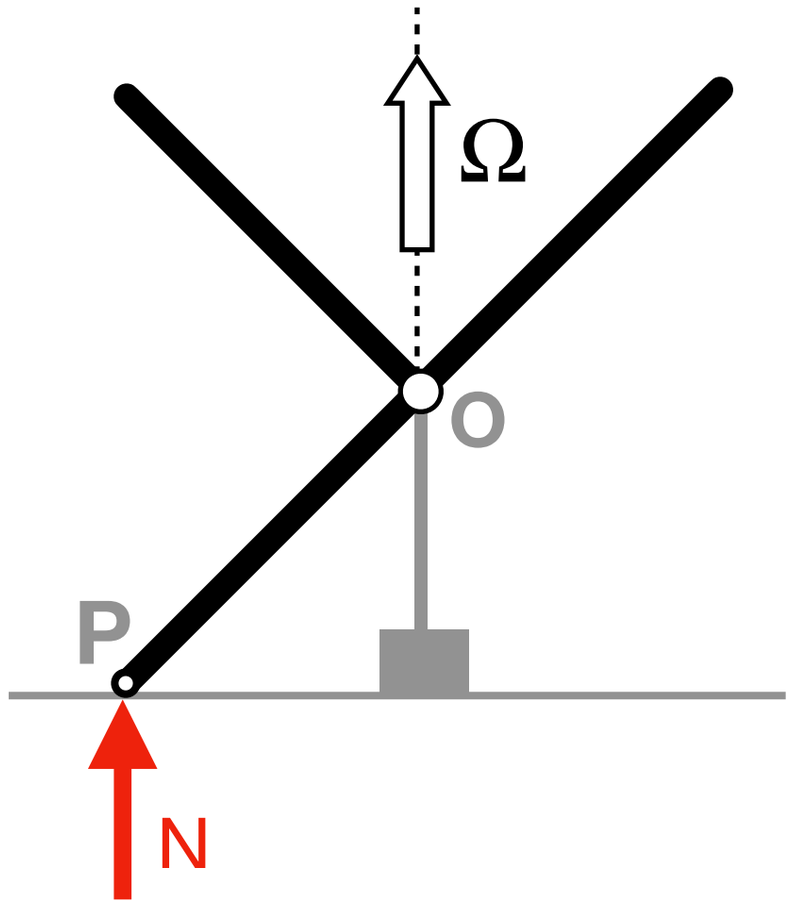
"Peça"

GL?

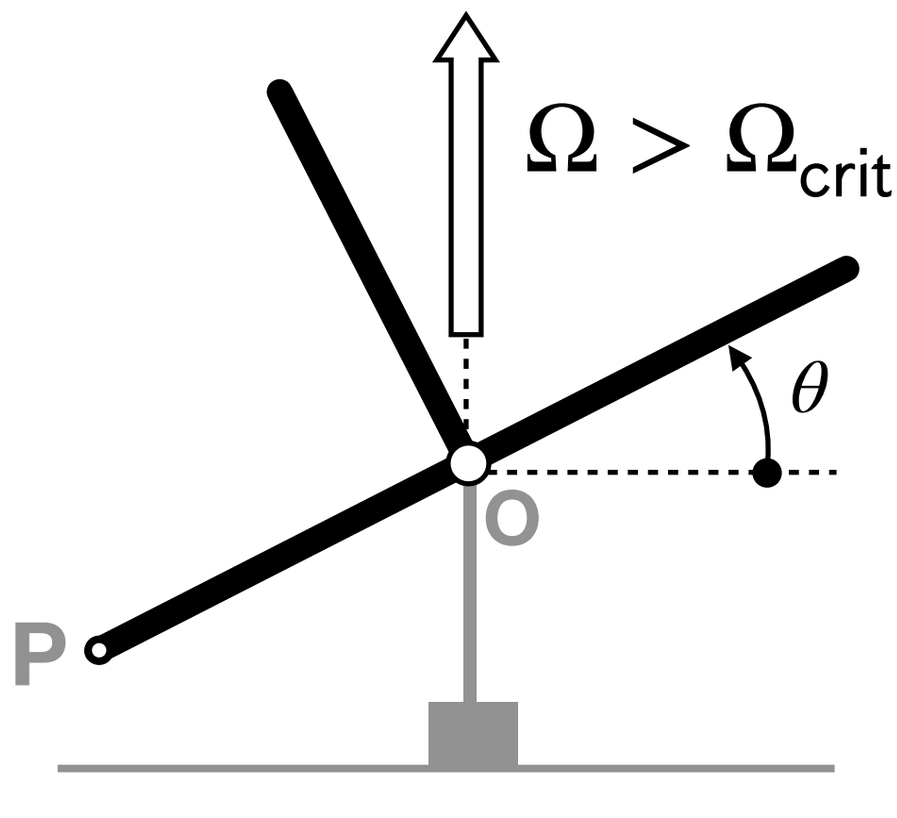
2 situacions!

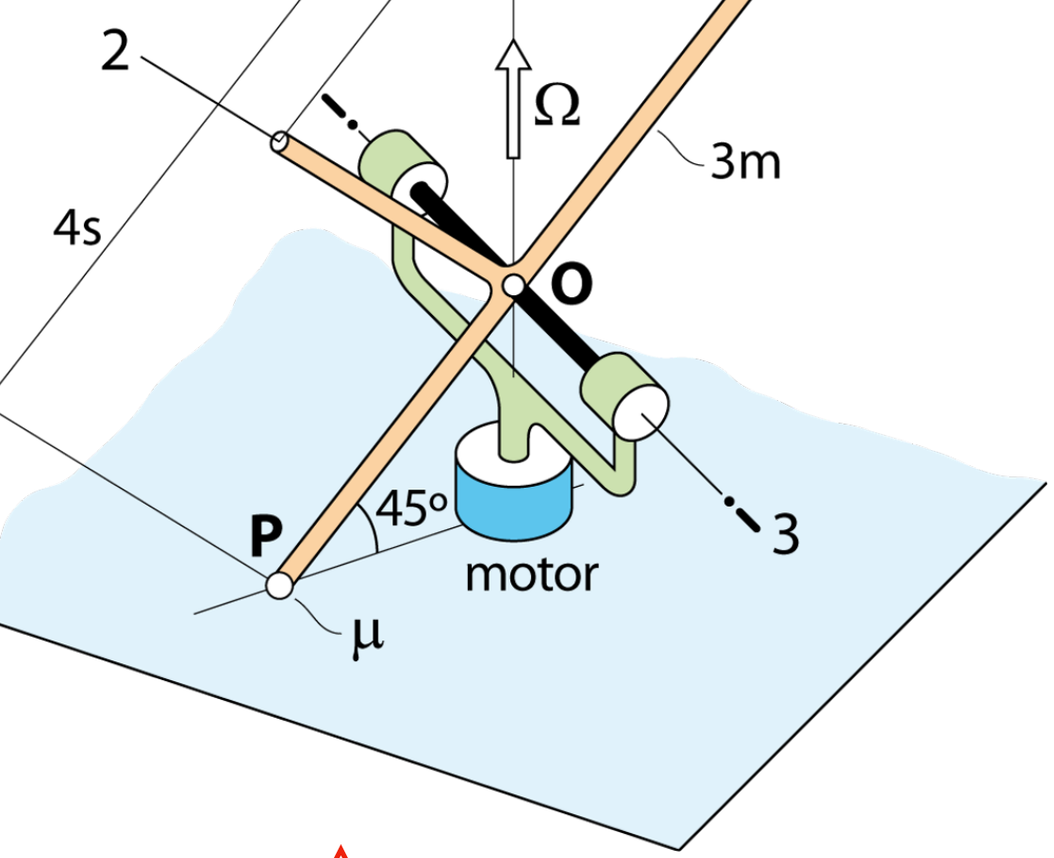


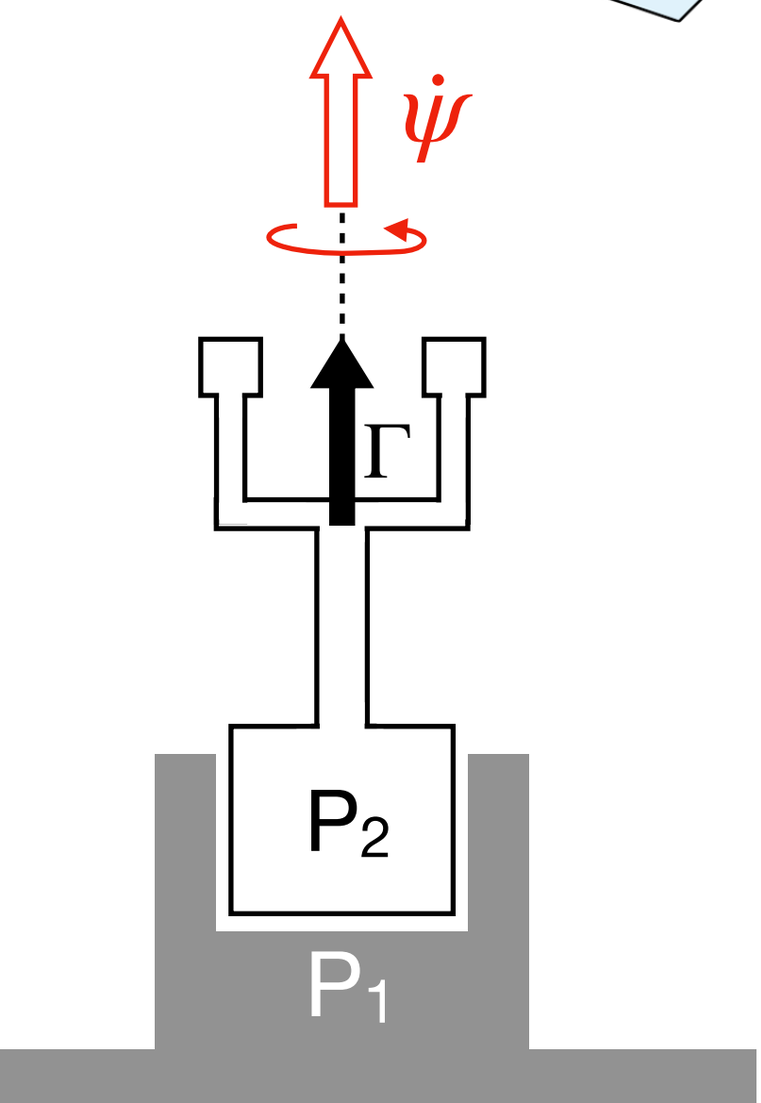
P manté contacte amb T



Contacte perdut







Recordeu

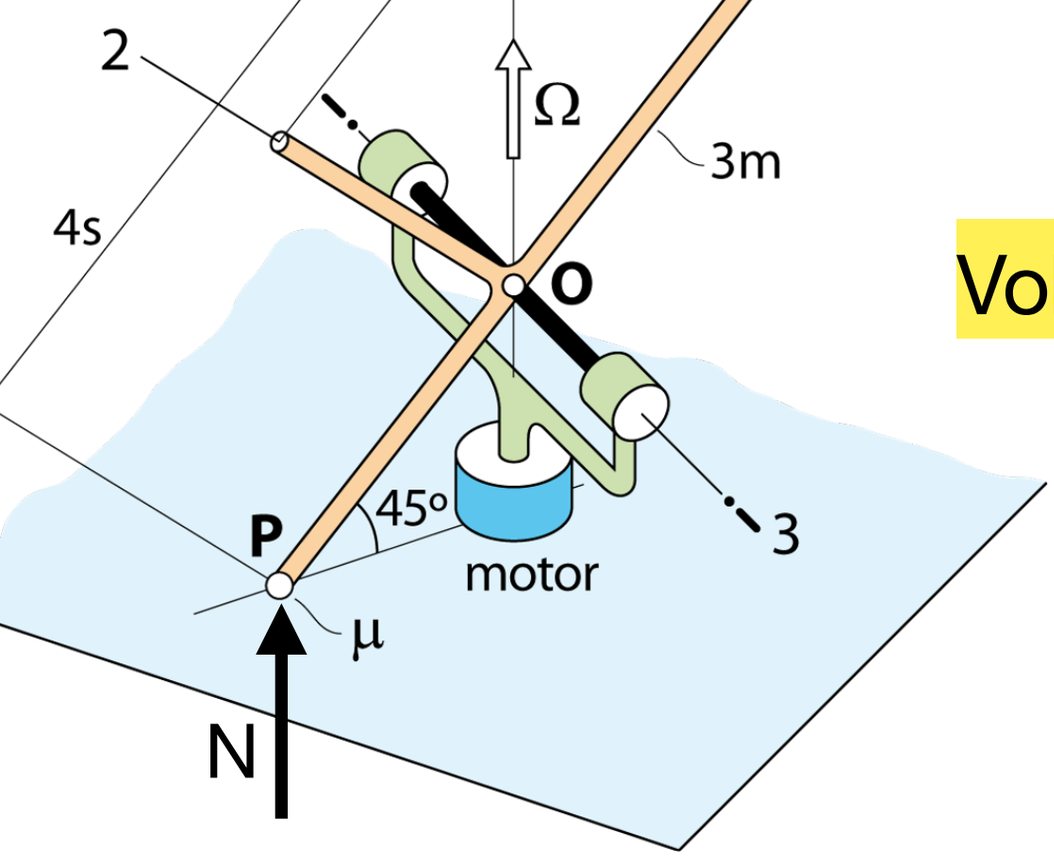
Γ conegut $\Rightarrow$ $\ddot{\psi}$ és incògnita

$\ddot{\psi}$ coneguda $\Rightarrow$ Γ és incògnita

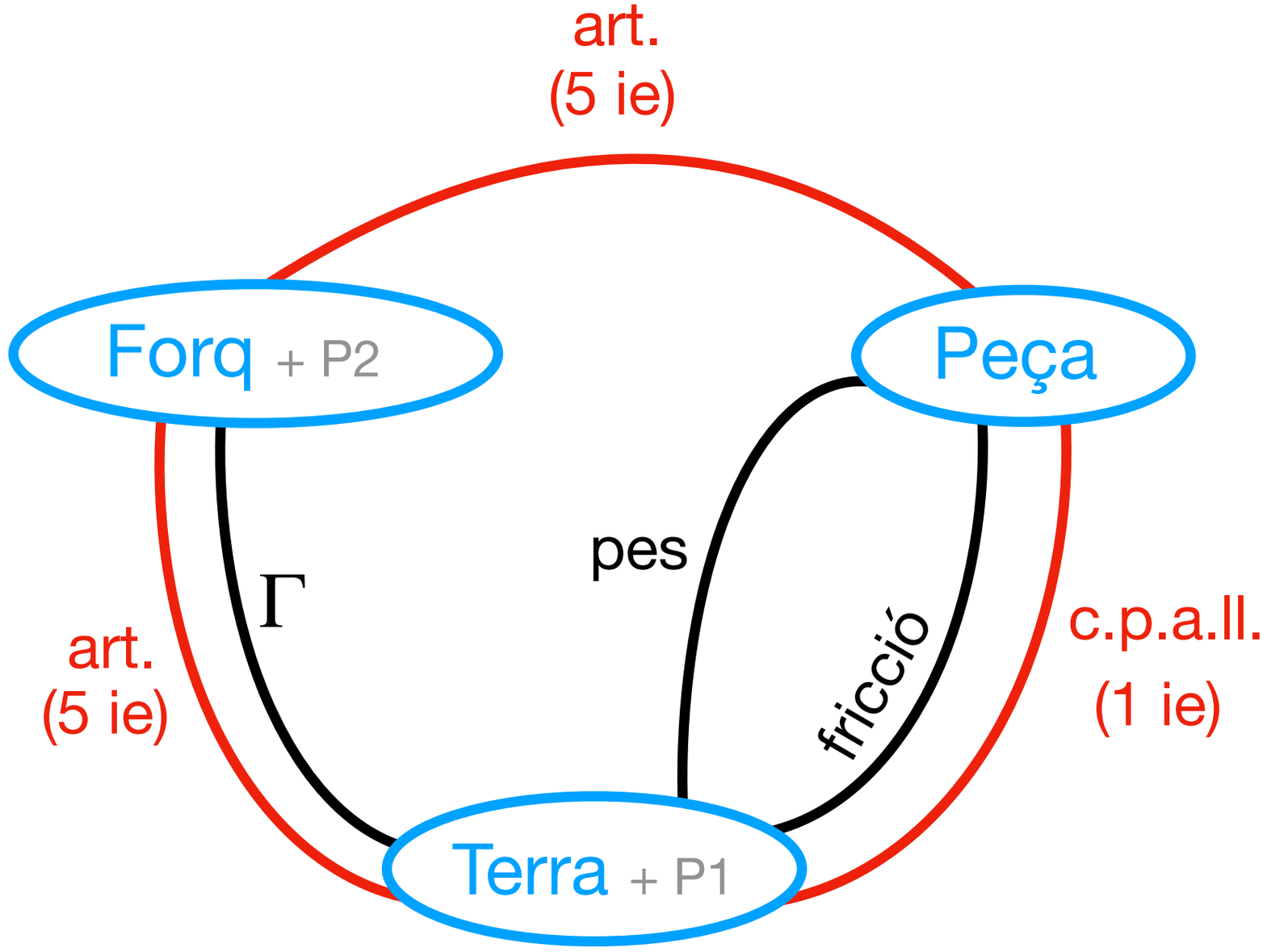
En aquest exercici

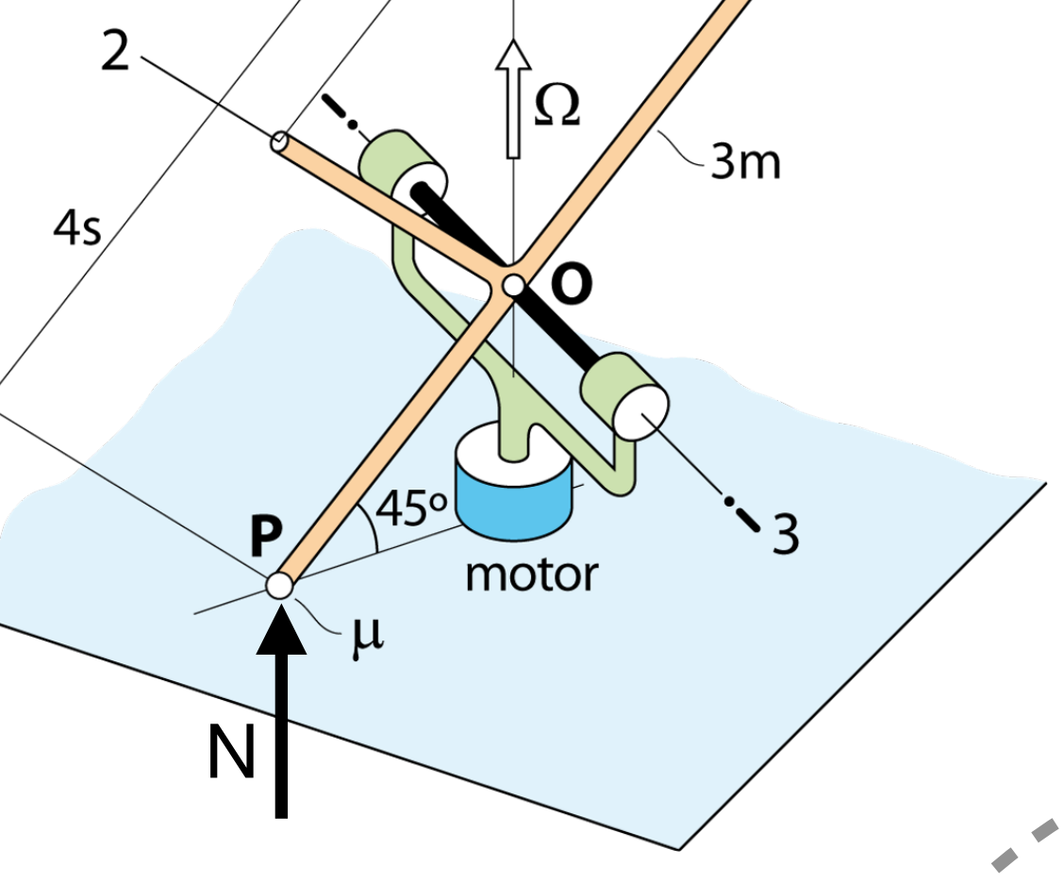
$\dot{\psi} = \Omega = ct \quad \Rightarrow \quad \ddot{\psi} = 0$ (coneguda)

Γ serà incògnita

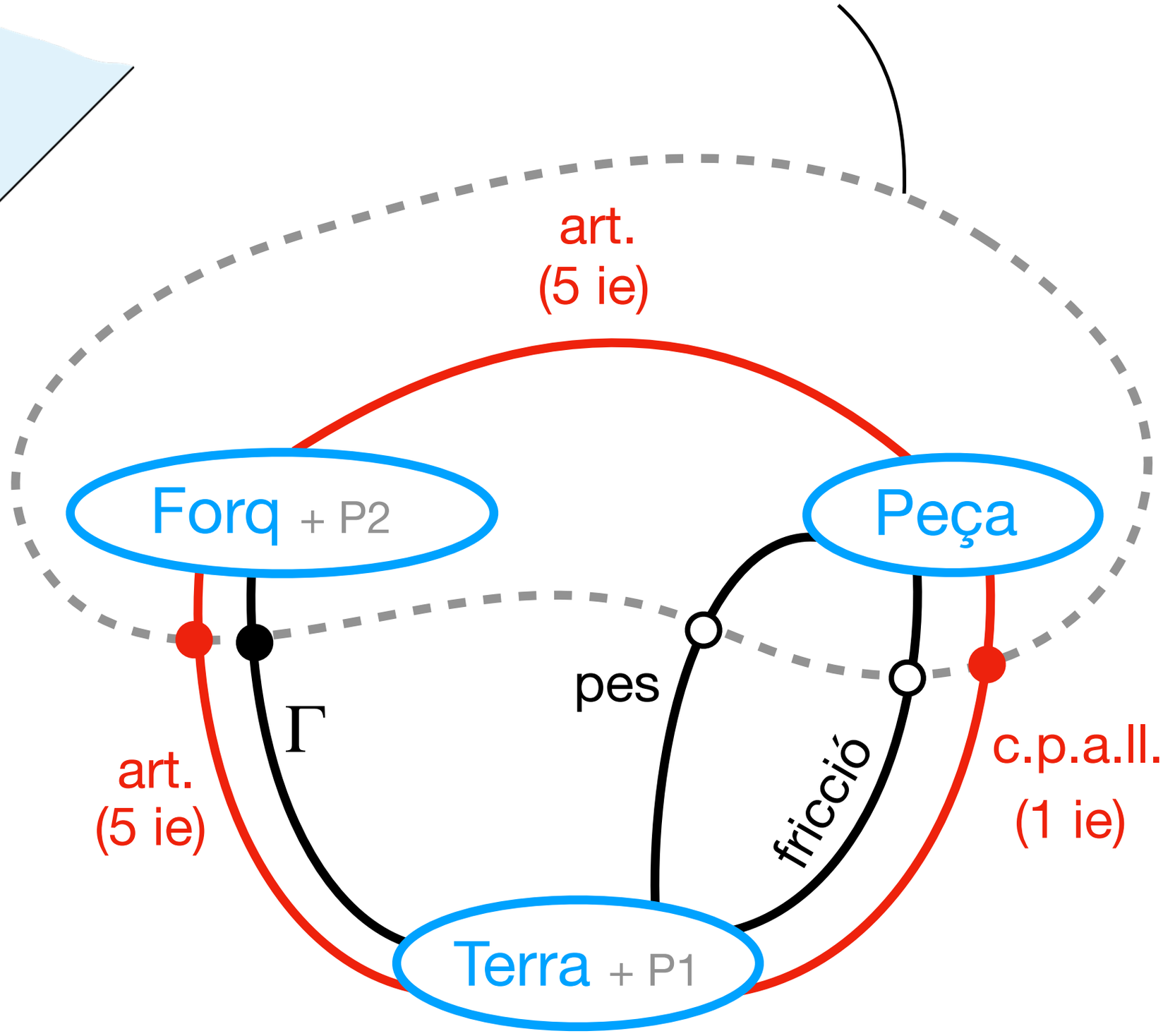


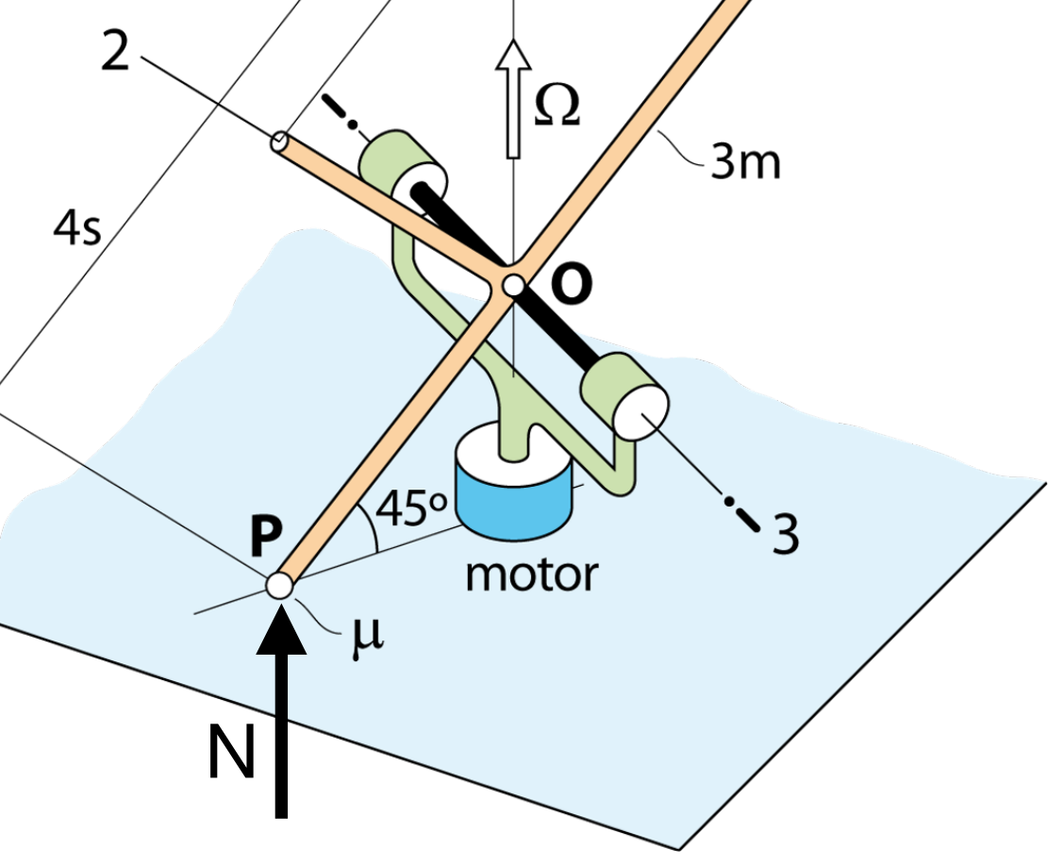
Volem N $\Longrightarrow$ SIST ha d'incloure la peça!



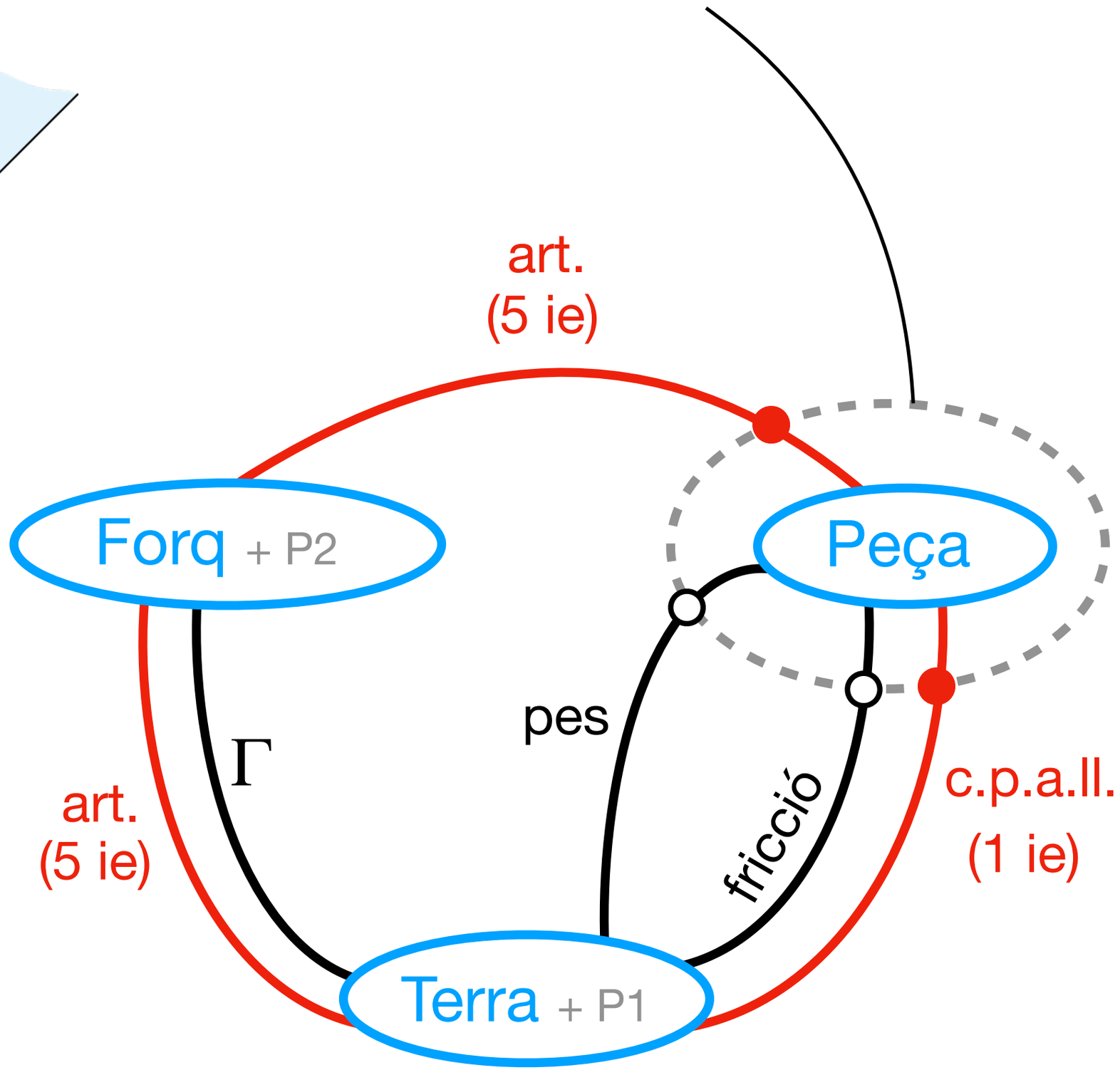


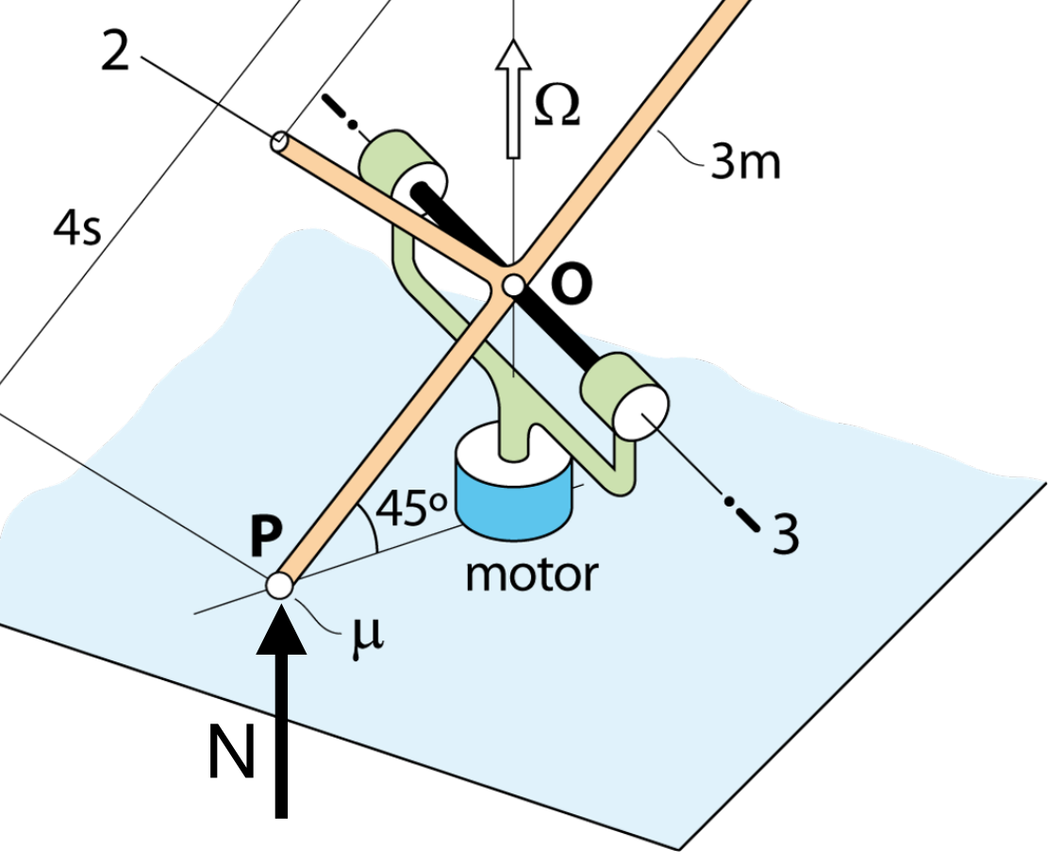
$6\ \text{ie} + \Gamma \Longrightarrow$ **INDETERMINAT**





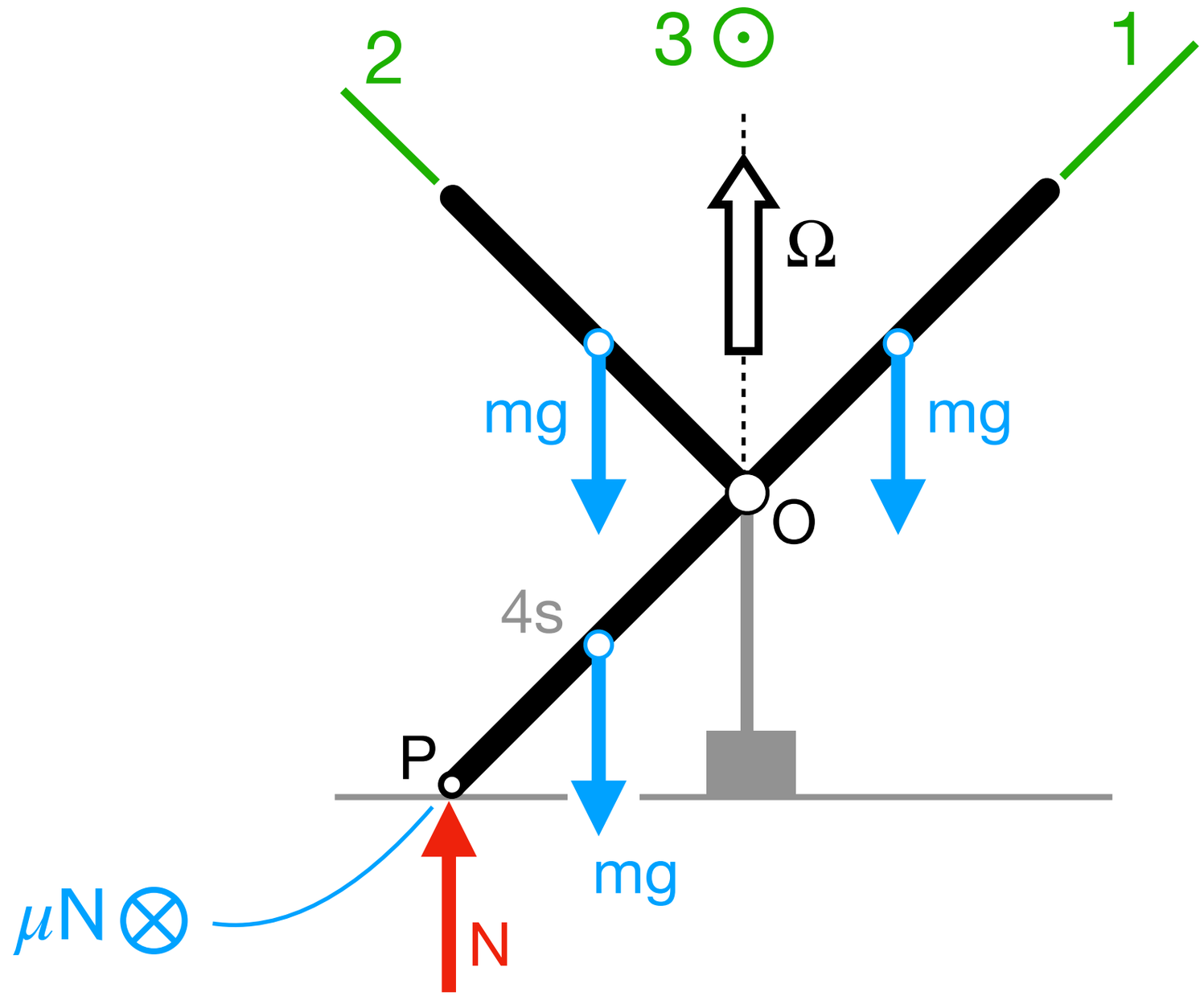
6 ie $\Longrightarrow$ **DETERMINAT**





$$\left\{ \bar{F}_{Forq \rightarrow Peça} \right\}_B = \begin{Bmatrix} F_1 \\ F_2 \\ F_3 \end{Bmatrix}$$

$$\left\{ \bar{M}_{Forq \rightarrow Peça}\,(O) \right\}_B = \begin{Bmatrix} M_1 \\ M_2 \\ 0 \end{Bmatrix}$$



DEURES

Determineu

- Parell motor Γ per mantenir $\Omega = ct$
- Eq. mov. per al cas en que el contacte a P ja s'ha perdut ($\Omega > \Omega_{\text{critica}}$)