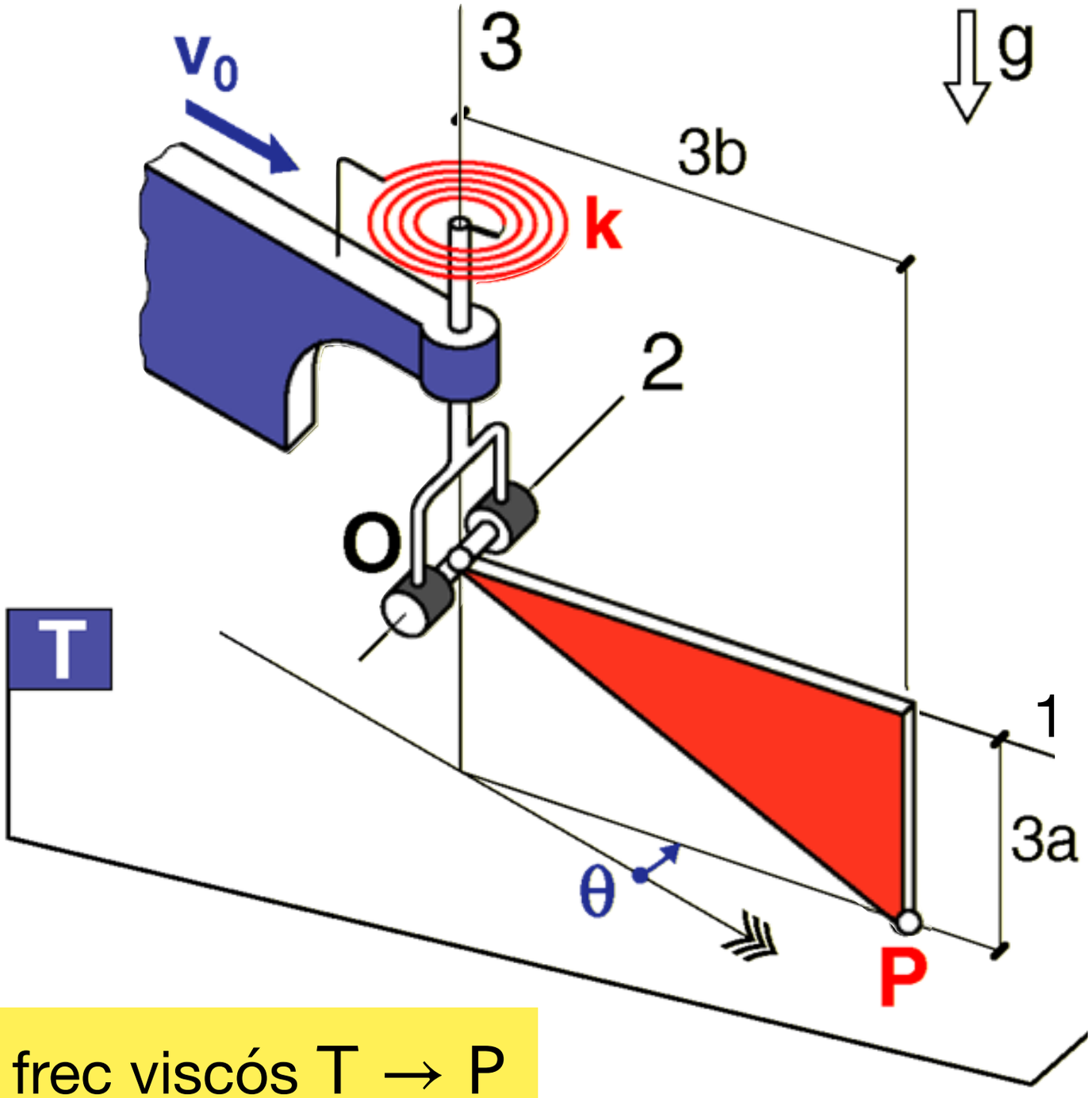
11P

Teoremes vectorials

Exemples 3D



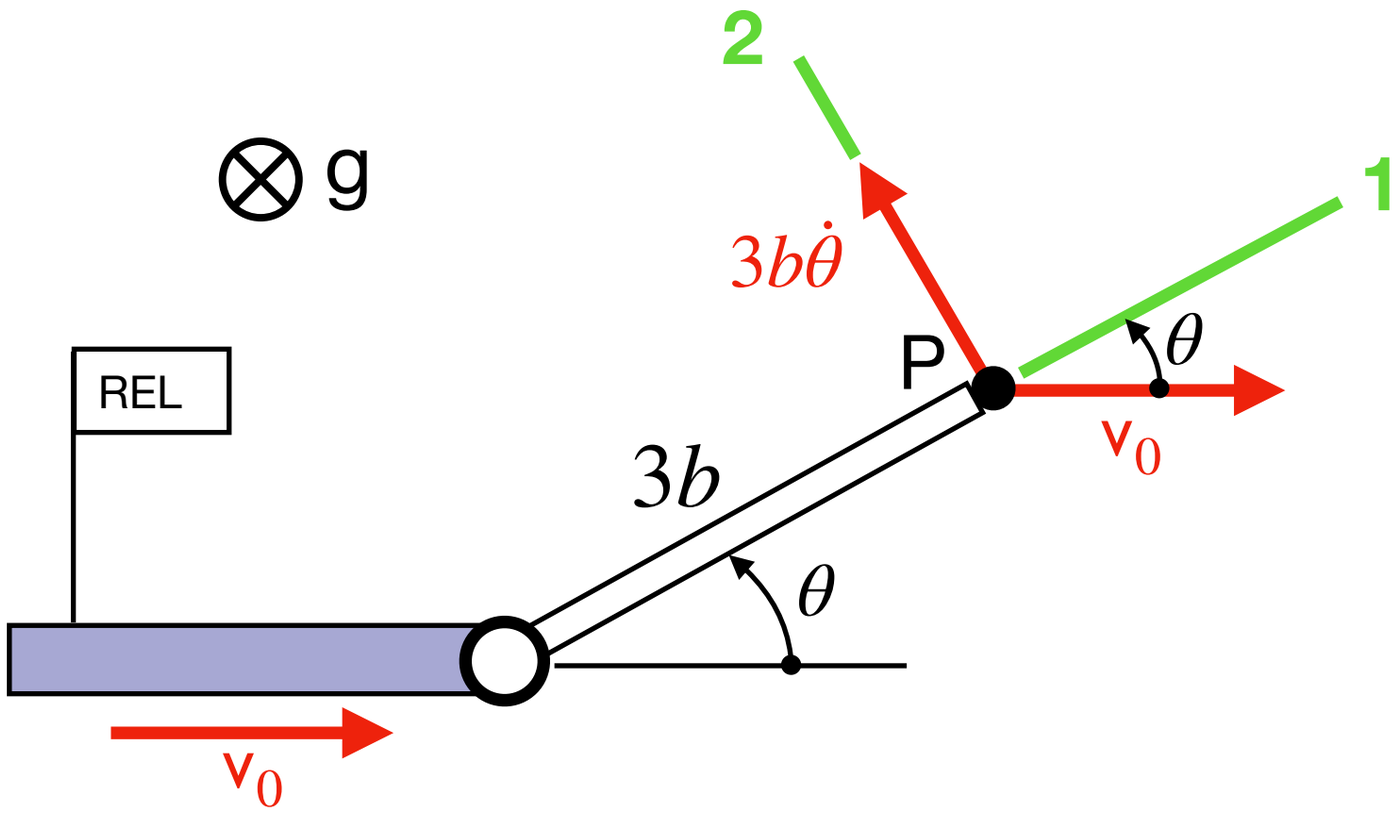
frec viscós T → P
(coef c)

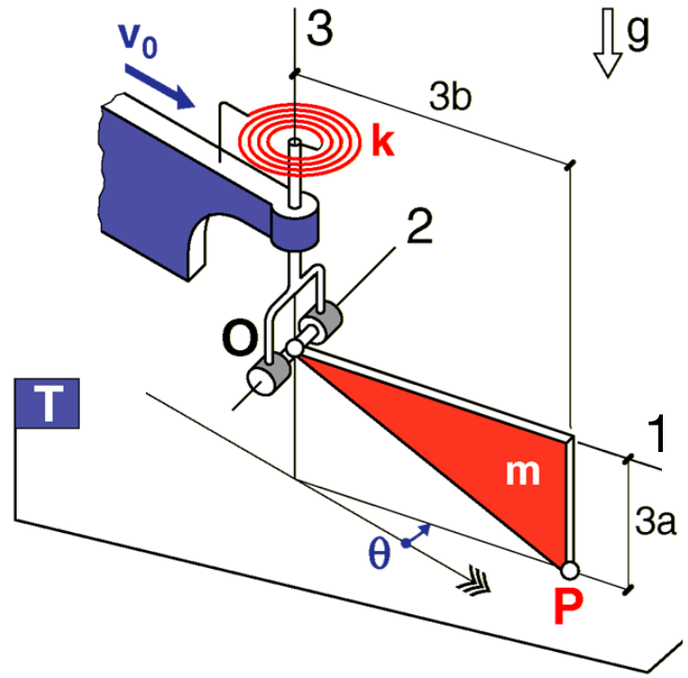
$F_{\text{frec visc}}$ de T → P

Eq. mov. per a θ ?

Valors de v_0 per als que $\theta_{eq} = 0$ és **ESTABLE**

$$\bar{F}_{fv} = -\,c\;\bar{v}_T(P)$$

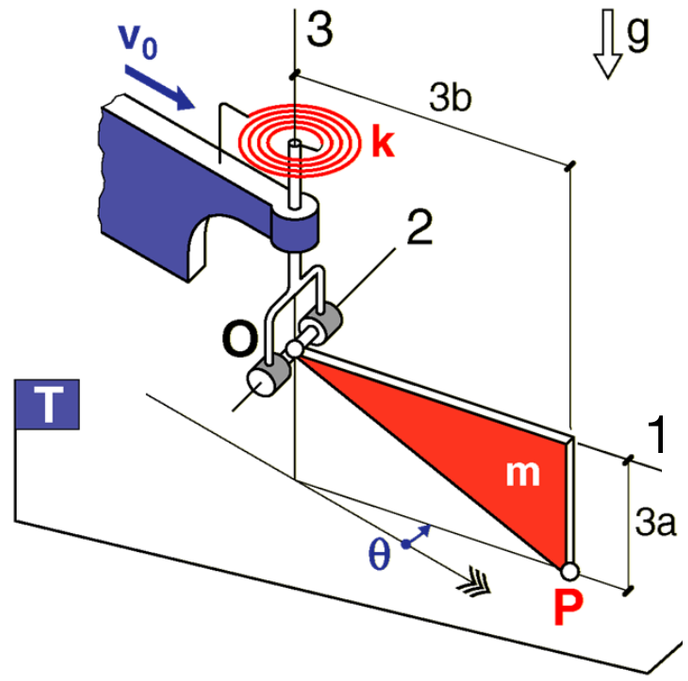


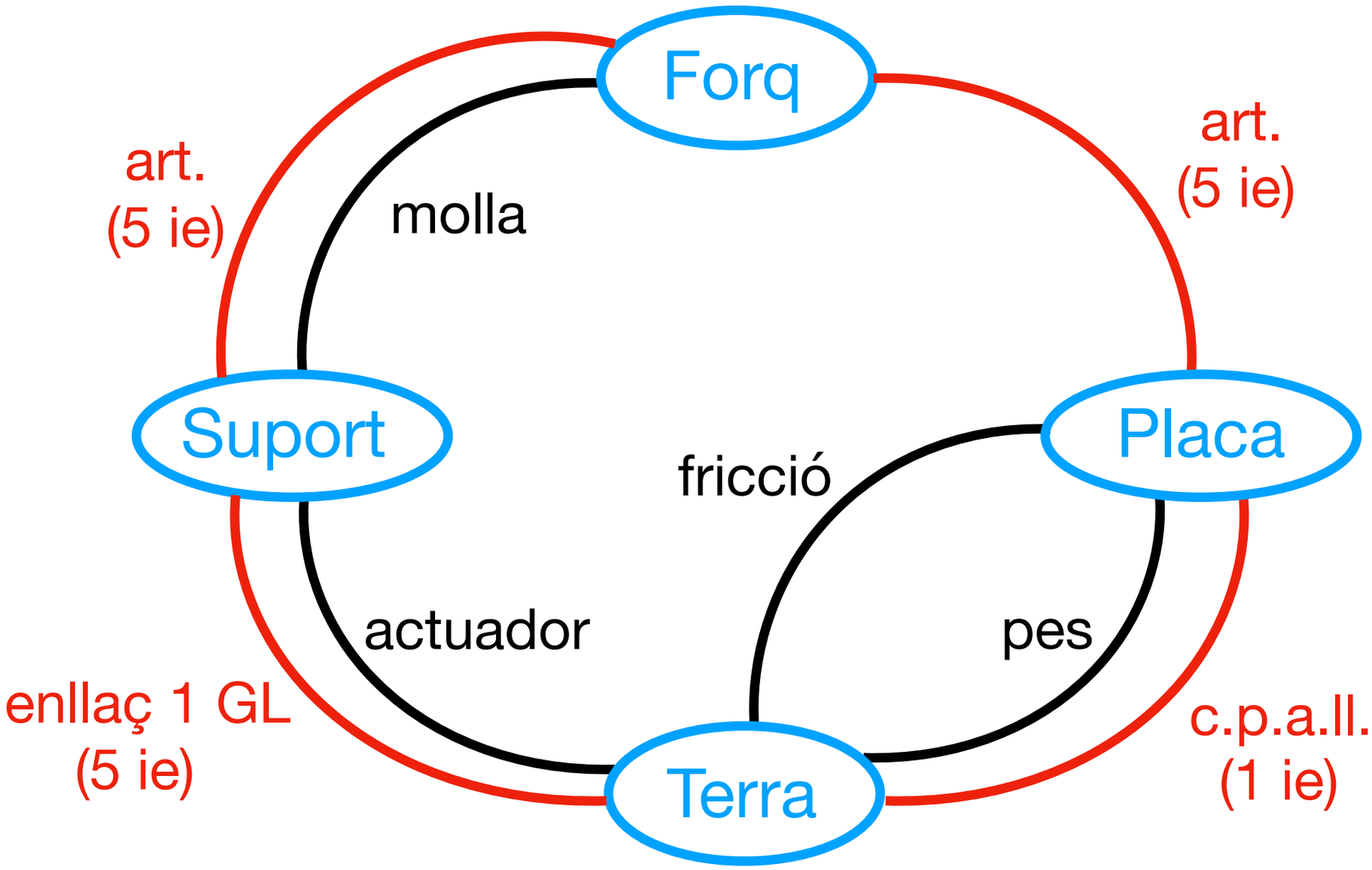


$$\bar{v}_T(P) = \bar{v}_{REL}(P) + \bar{v}_{ar}(P) = \left\{ \begin{array}{c} v_0 \cos\theta \\ -v_0 \sin\theta + 3b\dot{\theta} \\ 0 \end{array} \right\}_{B=(1,2,3)}$$

$$\bar{F}_{fv} = -\,c\;\bar{v}_T(P) = \left\{ \begin{array}{c} -cv_0 \cos\theta \\ cv_0 \sin\theta - 3cb\dot{\theta} \\ 0 \end{array} \right\}_B \begin{array}{l} \rightarrow F_{fv1} \\ \rightarrow F_{fv2} \end{array}$$

DGI = Diagrama general d'interaccions

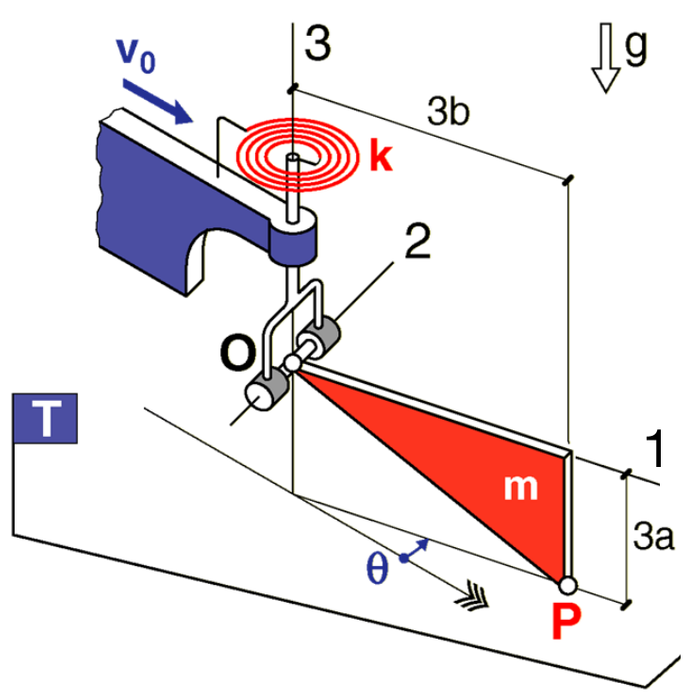


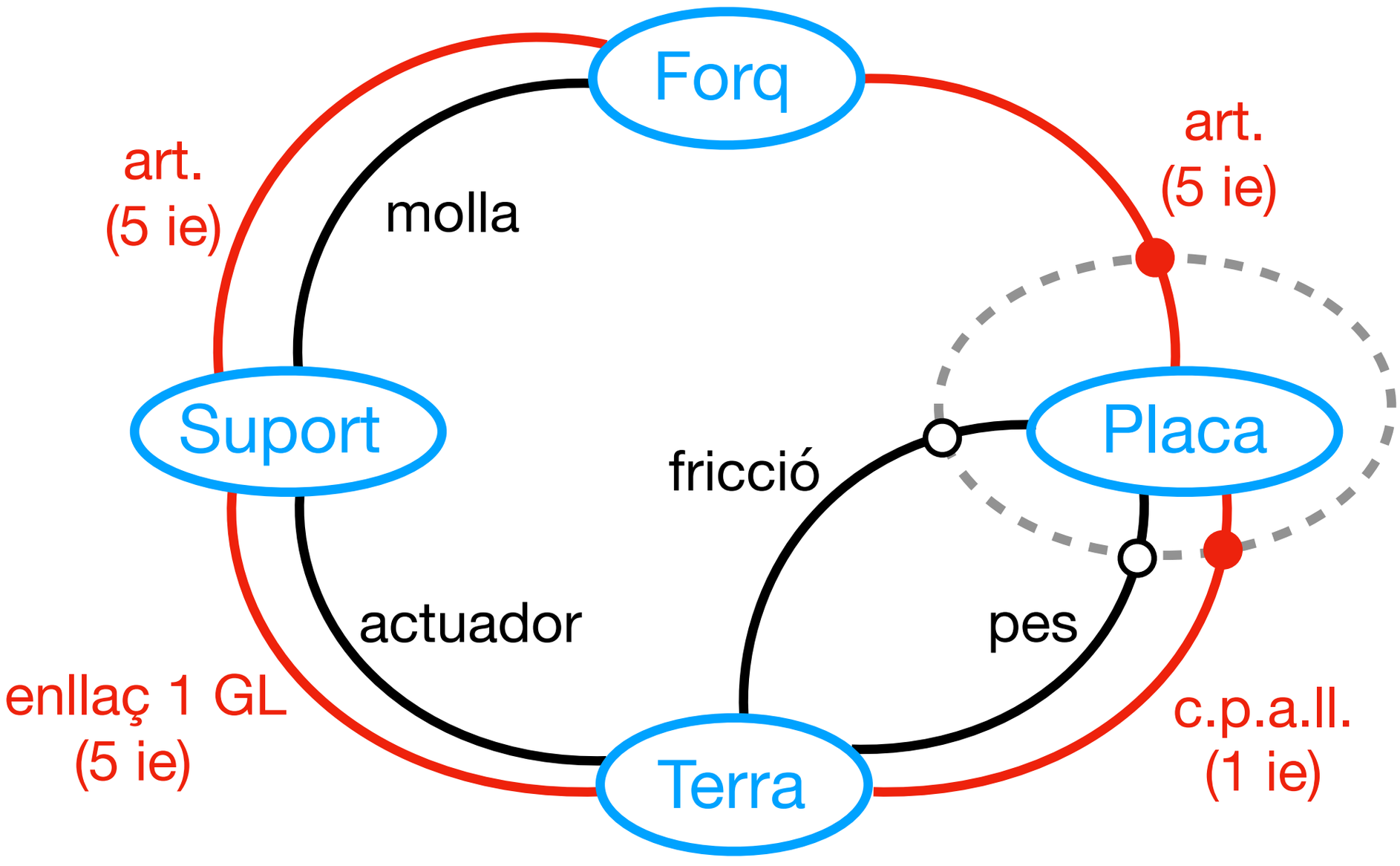


INDET

Sist = Placa

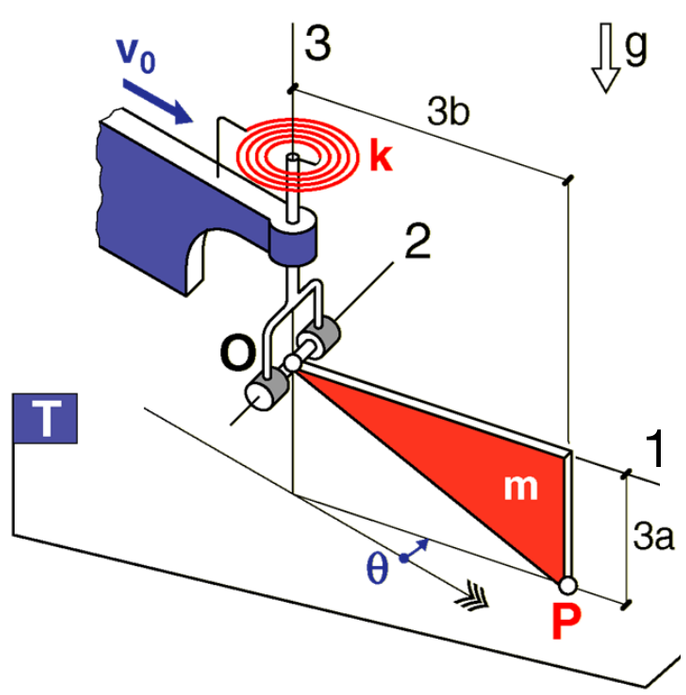
6 ie + $\ddot{\theta}$ = **7 incòg**

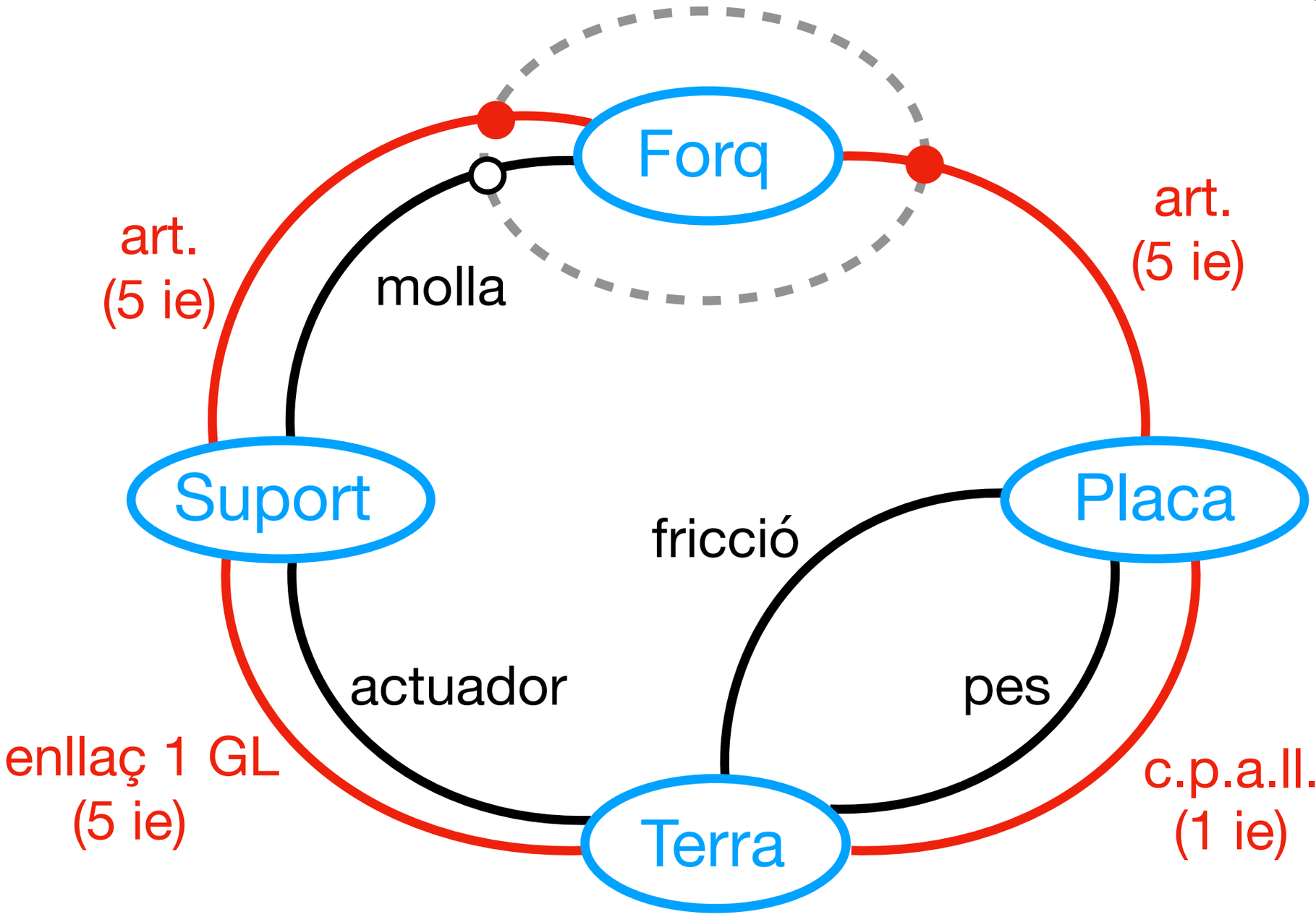




INDET

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

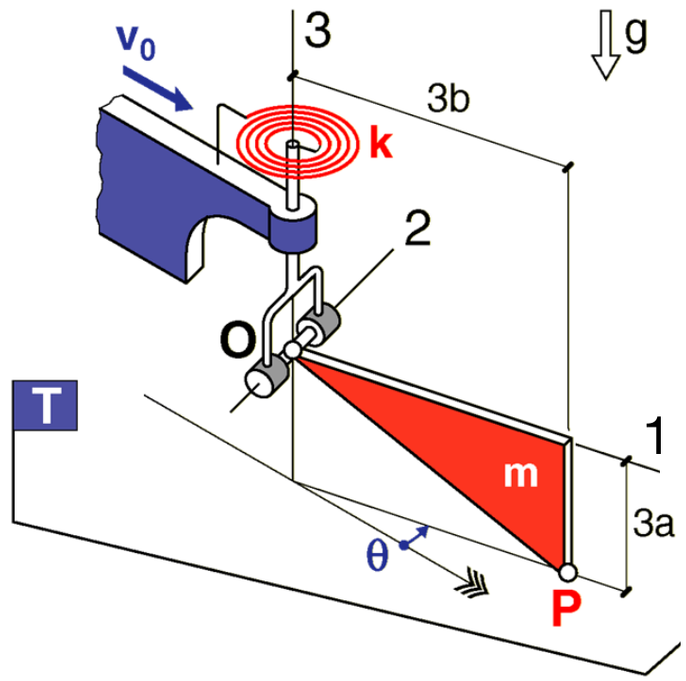


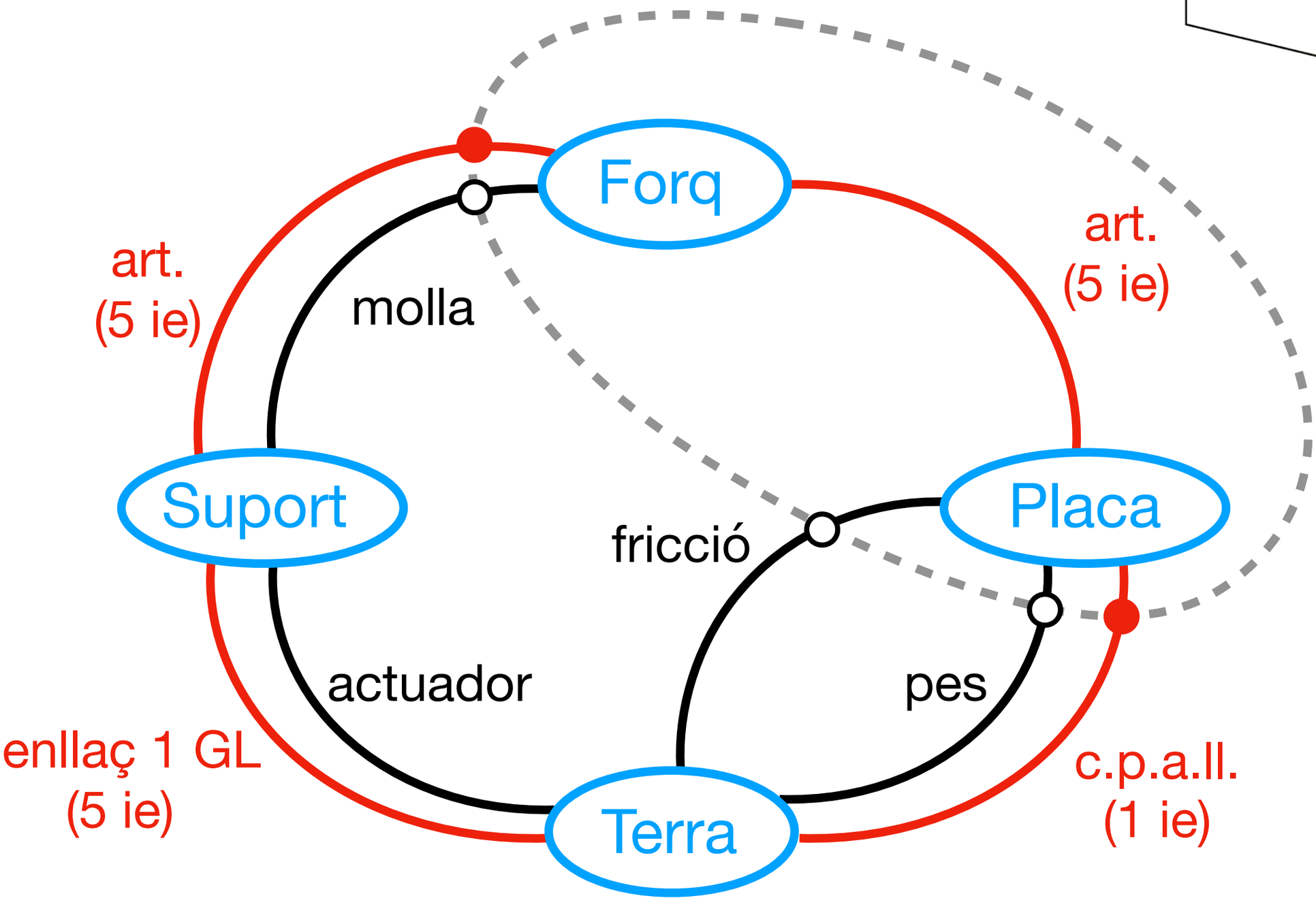


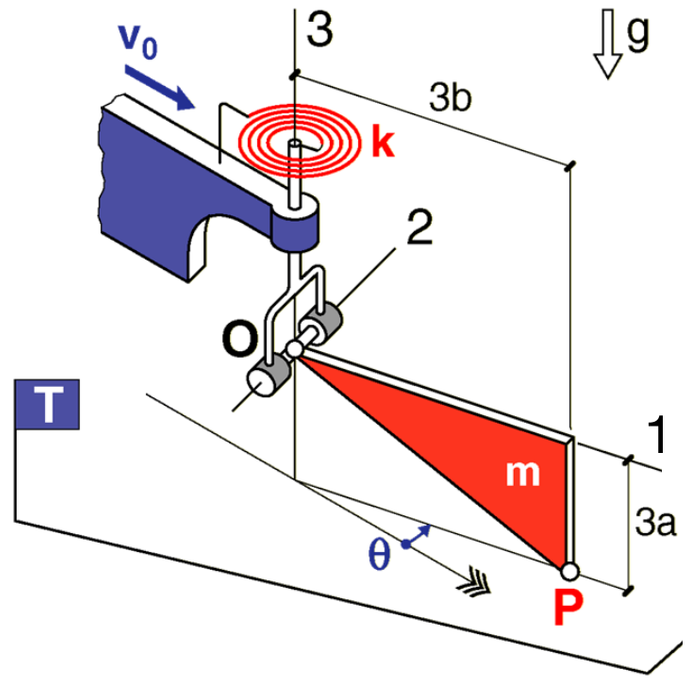
INDET

Sist = Placa + Forq

6 ie + $\ddot{\theta}$ **= 7 incòg**

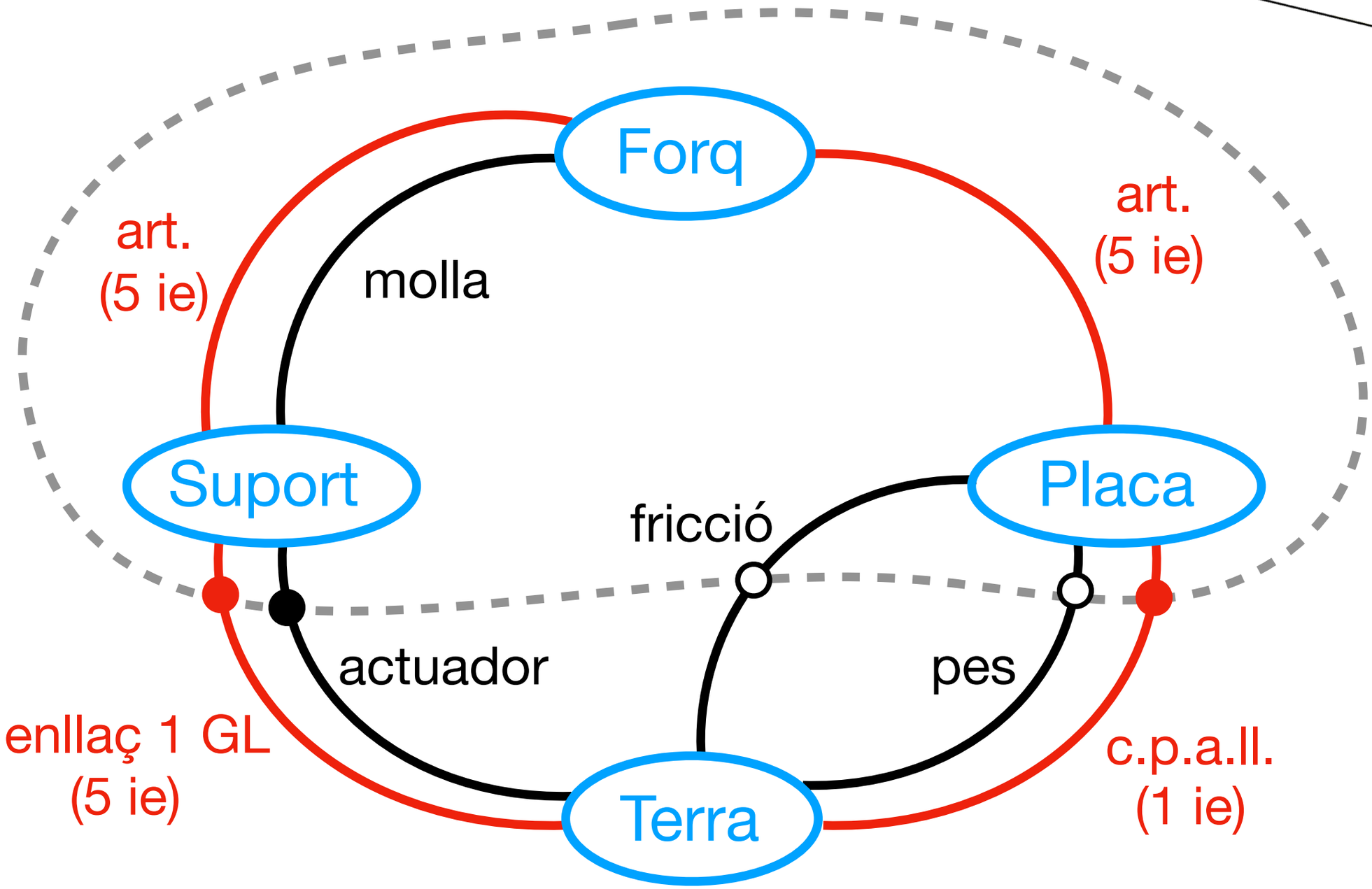




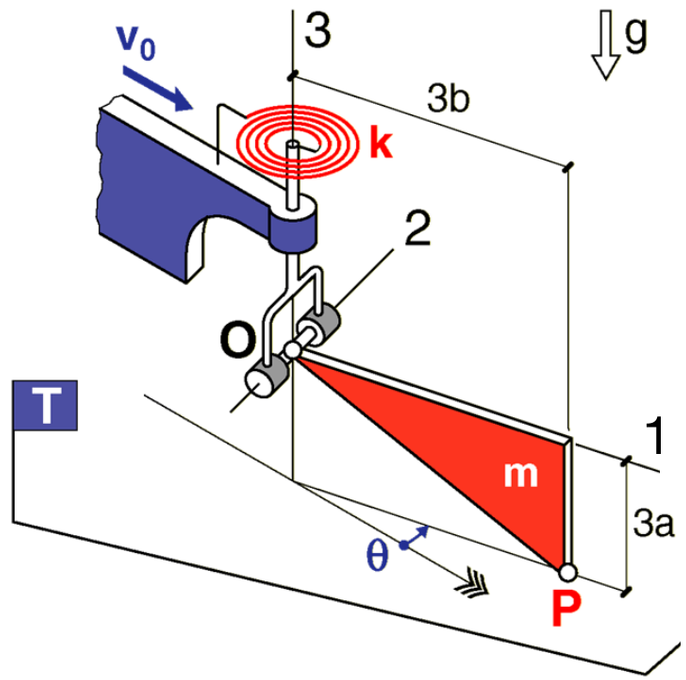


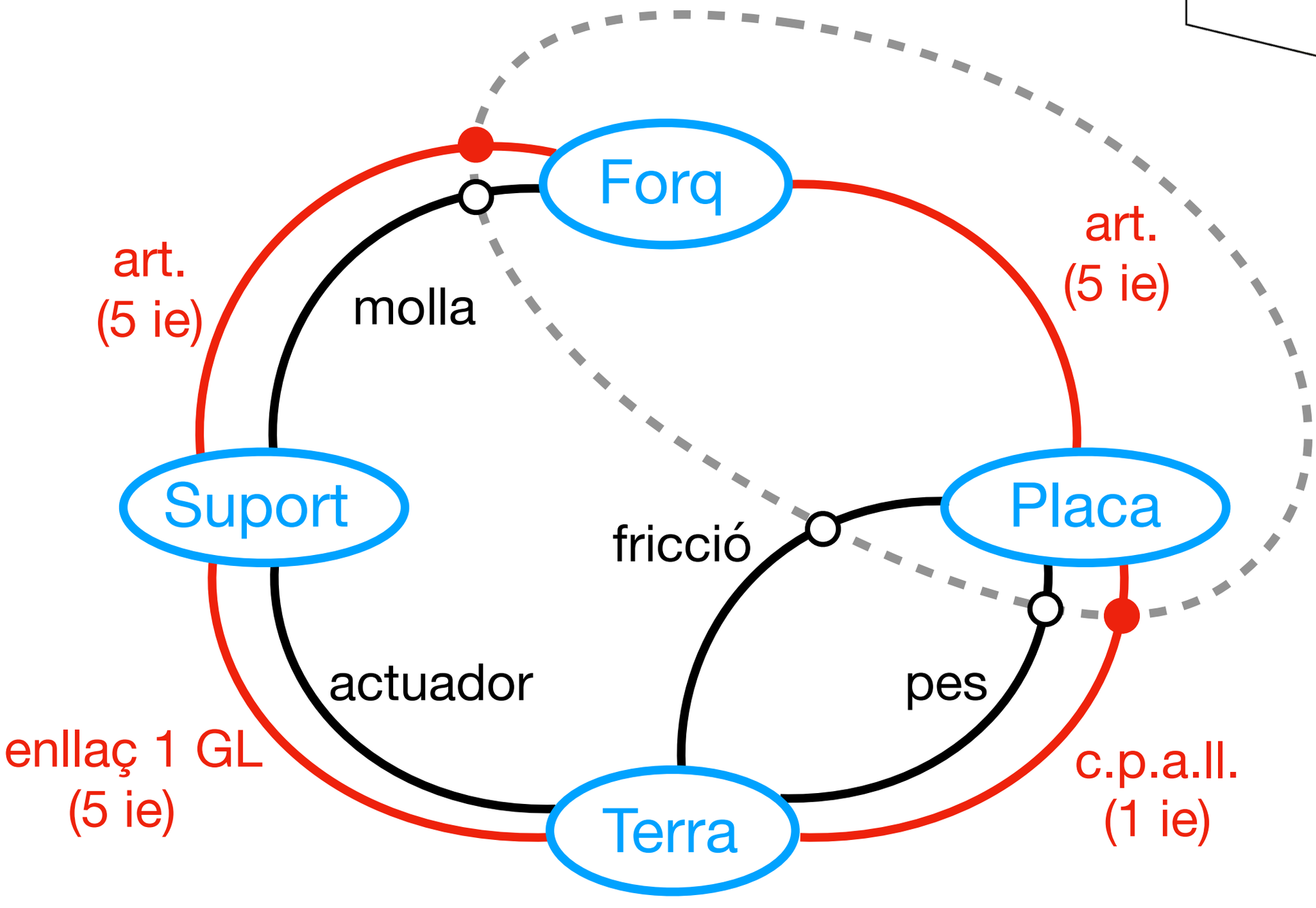
INDET Sist = Placa + Forq + Sup

6 ie + força actuador + $\ddot{\theta}$ **= 8 incòg**

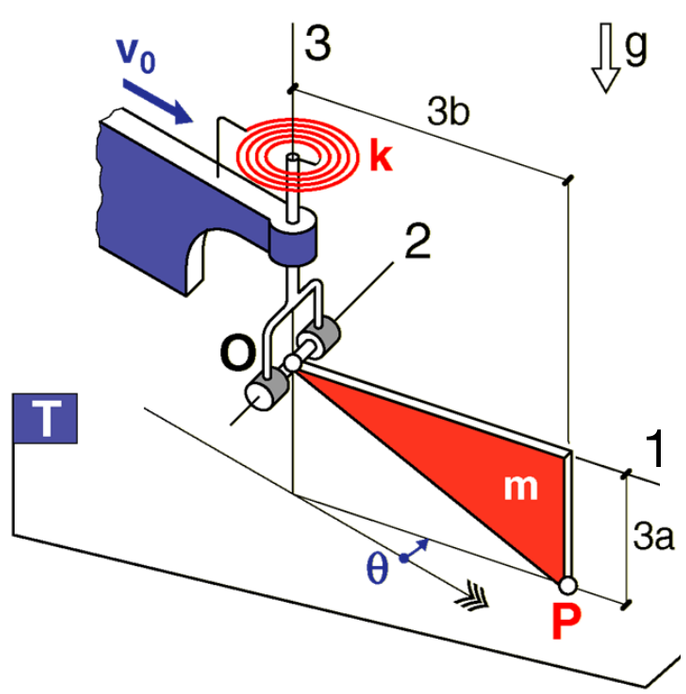


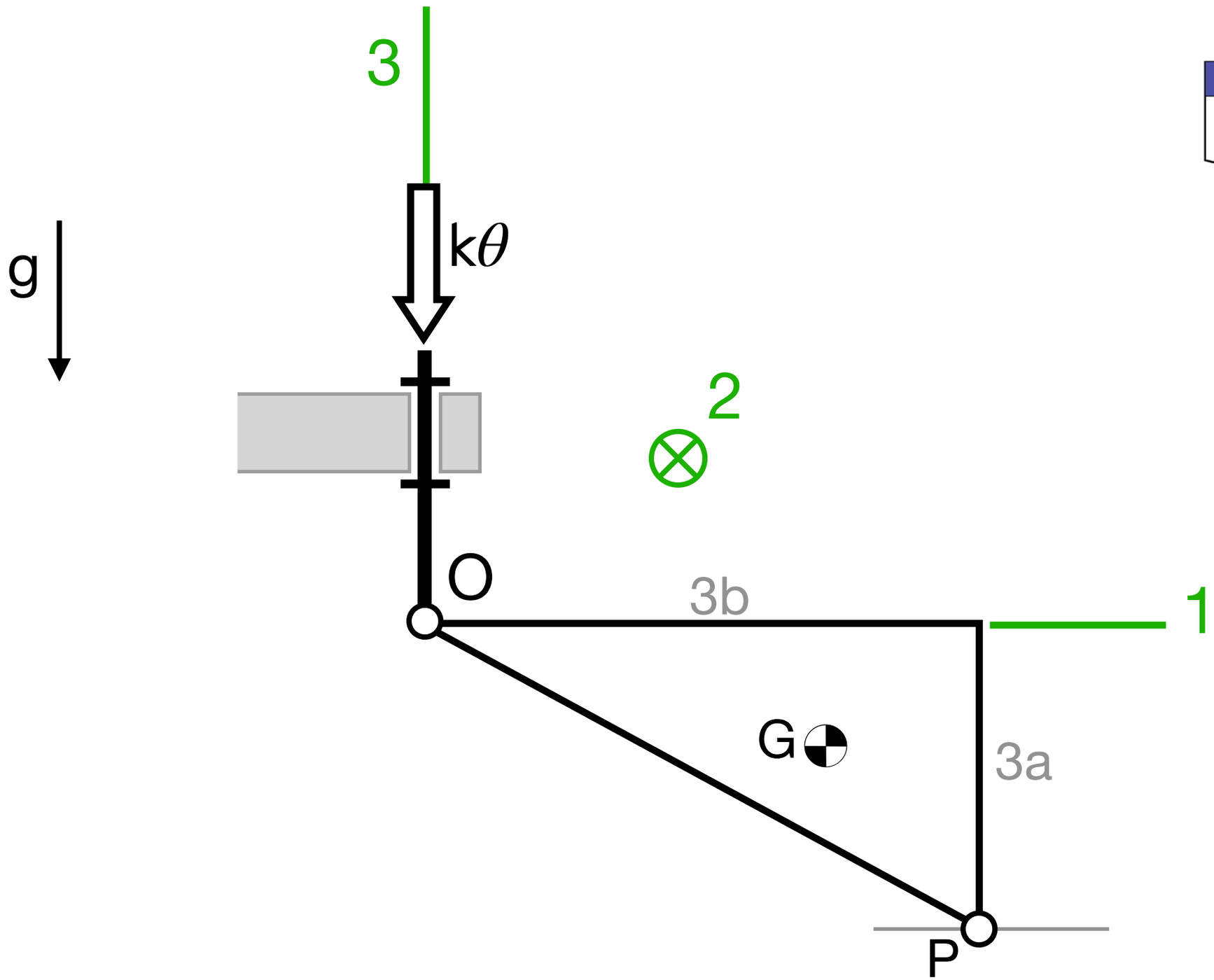
Sist = Placa + Forq



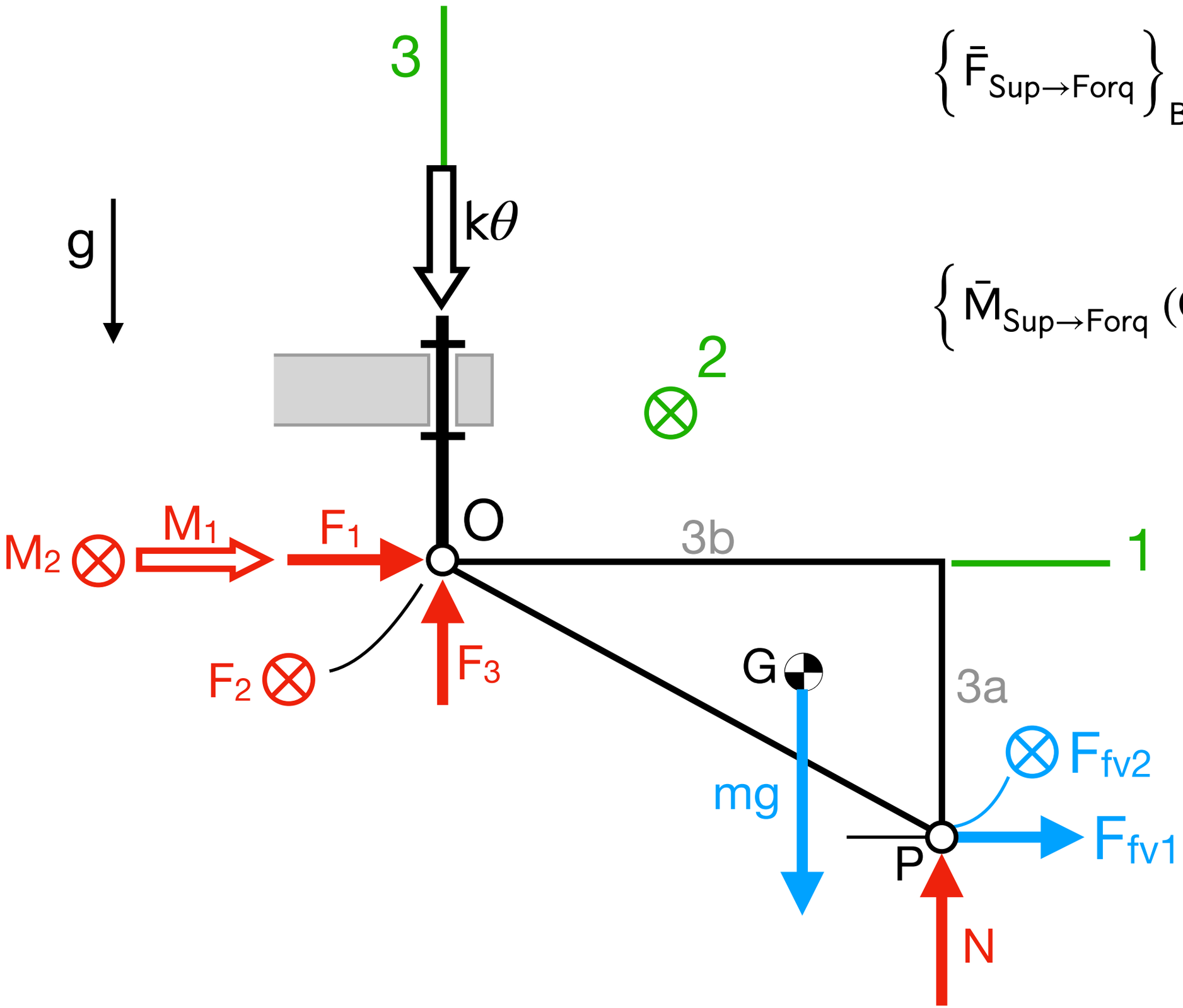


Forces sobre Sist = "Forq + Placa"





Forces sobre Sist = "Forq + Placa"



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

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

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

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

Obtenim EDO de l'error ε

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

en aquest exemple

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

La linealitzem

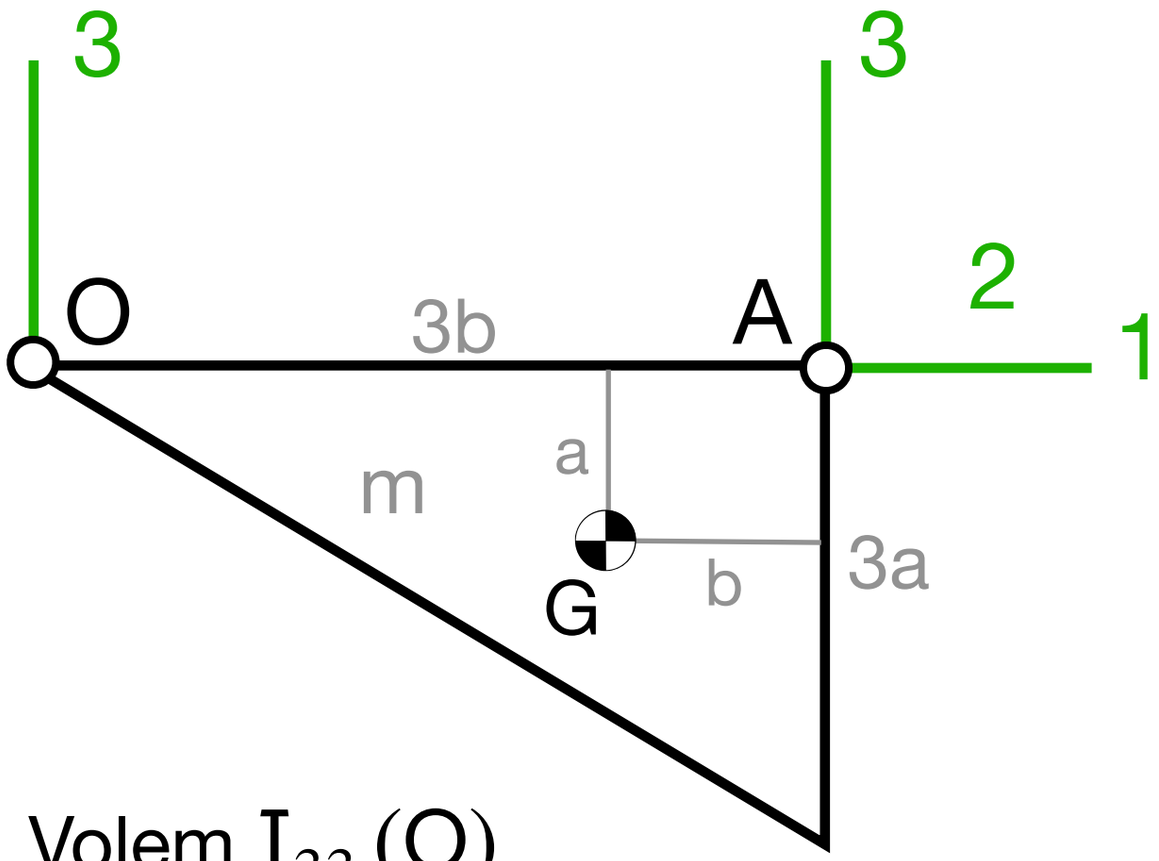
$$\sin\varepsilon \approx \varepsilon$$

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

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

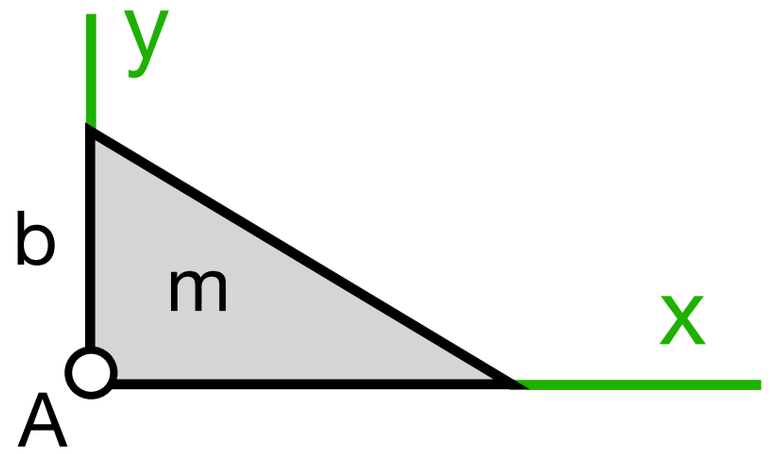
K > 0?

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



Volem $I_{33}(O)$

Taules



$$I_{xx}(A) = \frac{1}{6}mb^2$$

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

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

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

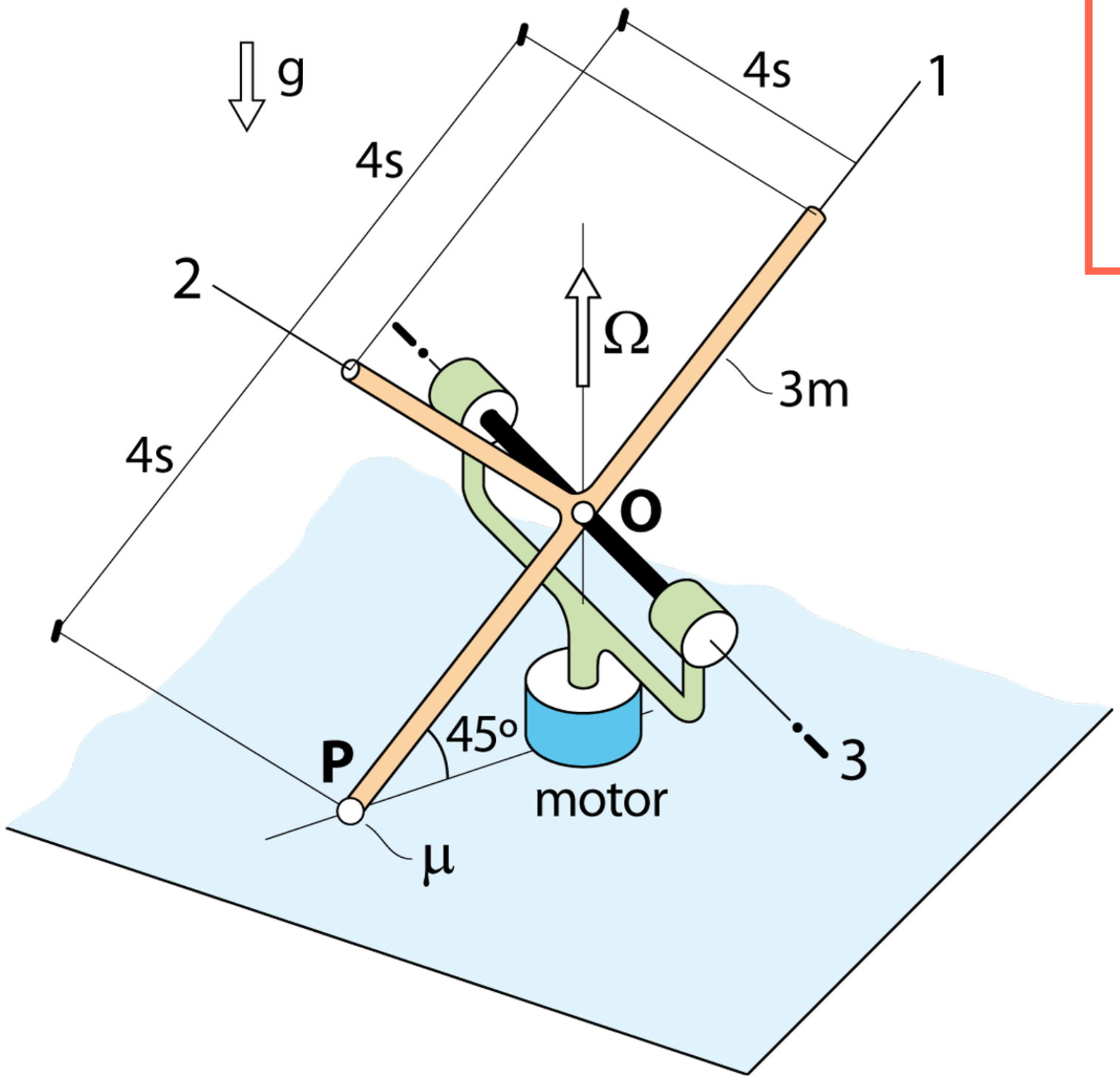
$$(a-b) \qquad I_{33}(O) = I_{33}(A) + I^{\oplus}_{33}(O) - I^{\oplus}_{33}(A)$$

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

DEURES

Valor de la normal N en funció de θ i θ ?

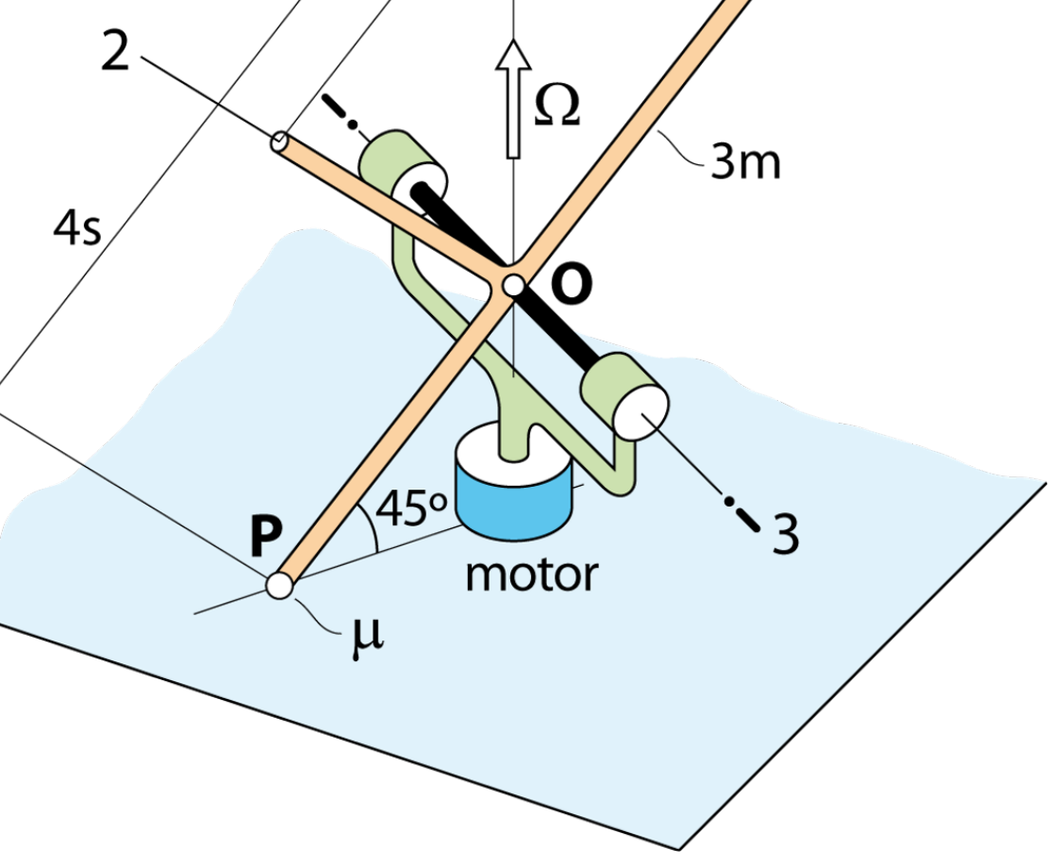
$\Omega = ct$

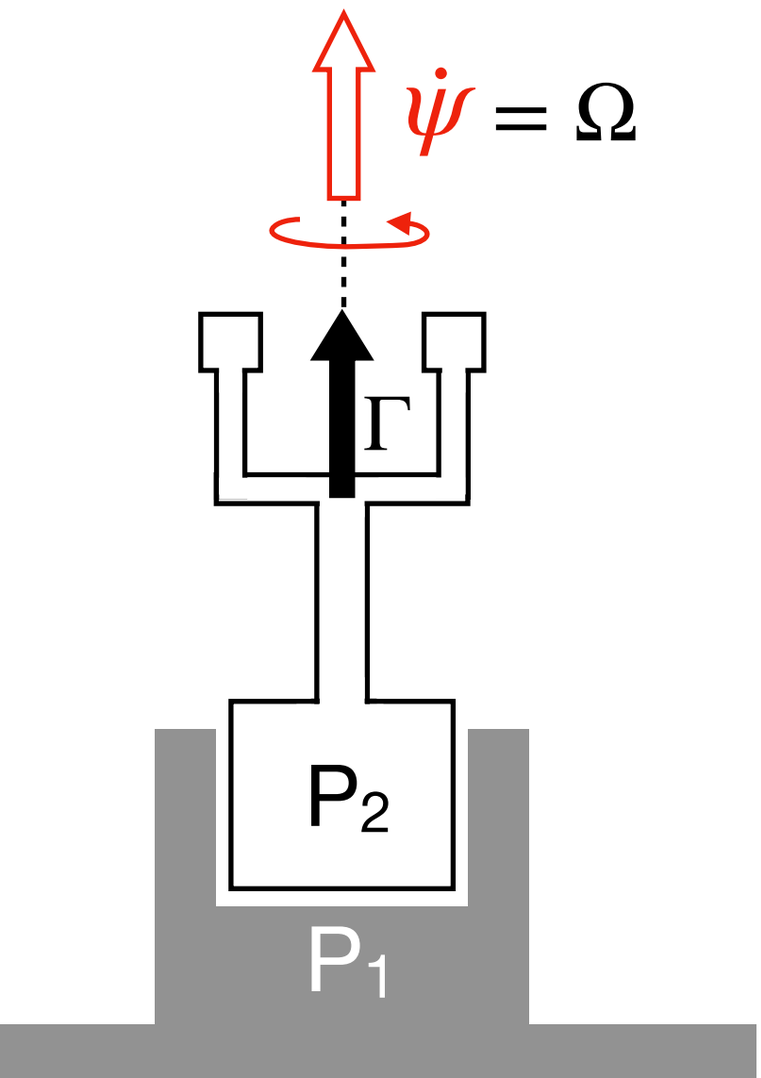


N que rep el sòlid a P?

$\Omega_{Critica}$ en què es perd contacte a P?

Parell motor Γ per garantir $\Omega = ct$?





En general

En un motor:

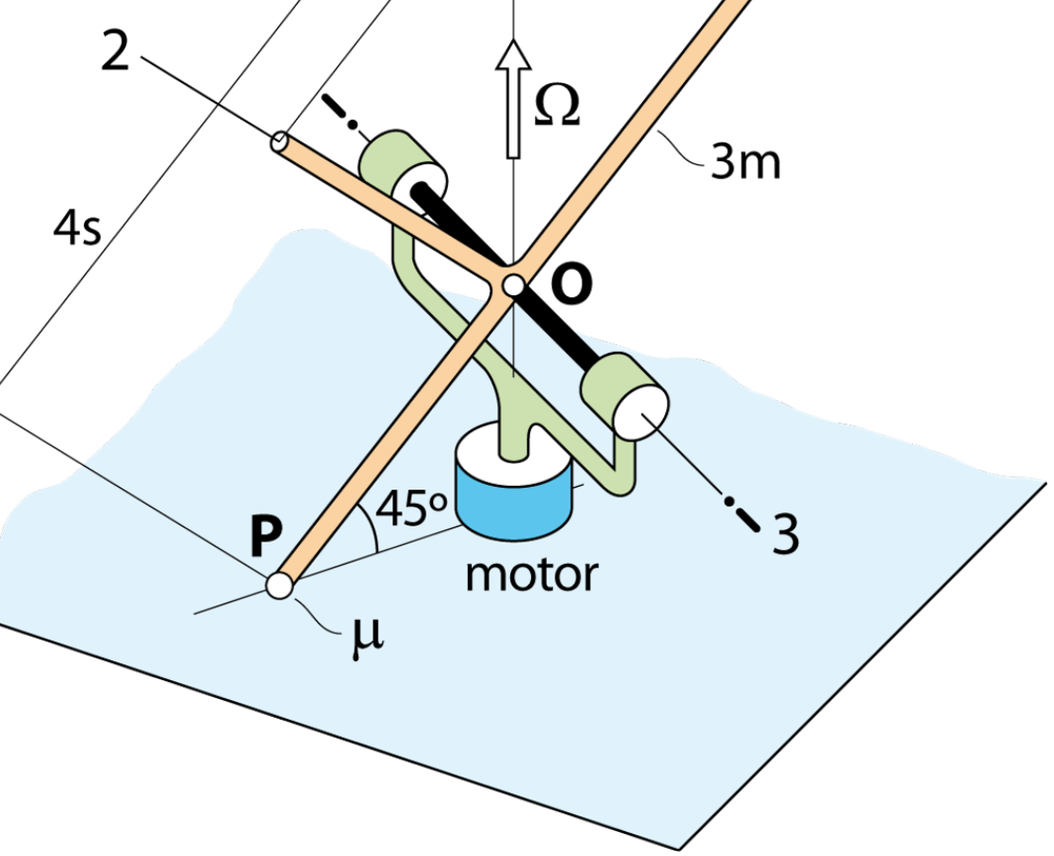
O bé sabrem Γ, i $\ddot{\psi}$ serà incògnita

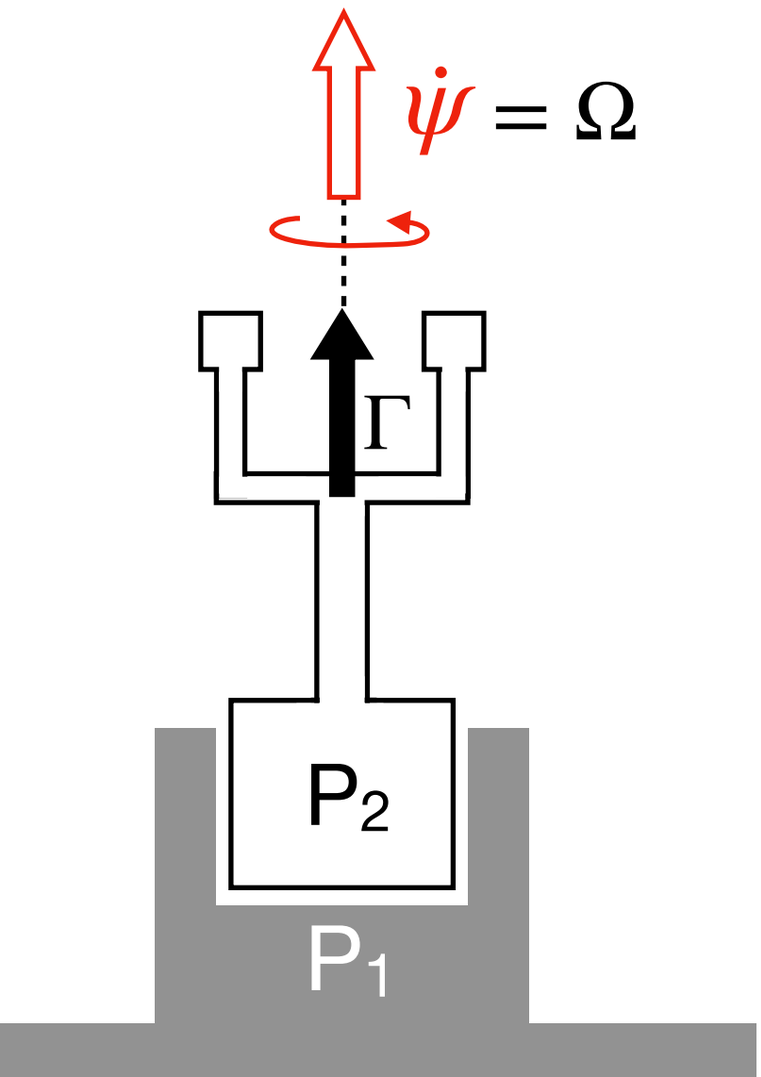
O bé sabrem $\ddot{\psi}$, i Γ serà incògnita

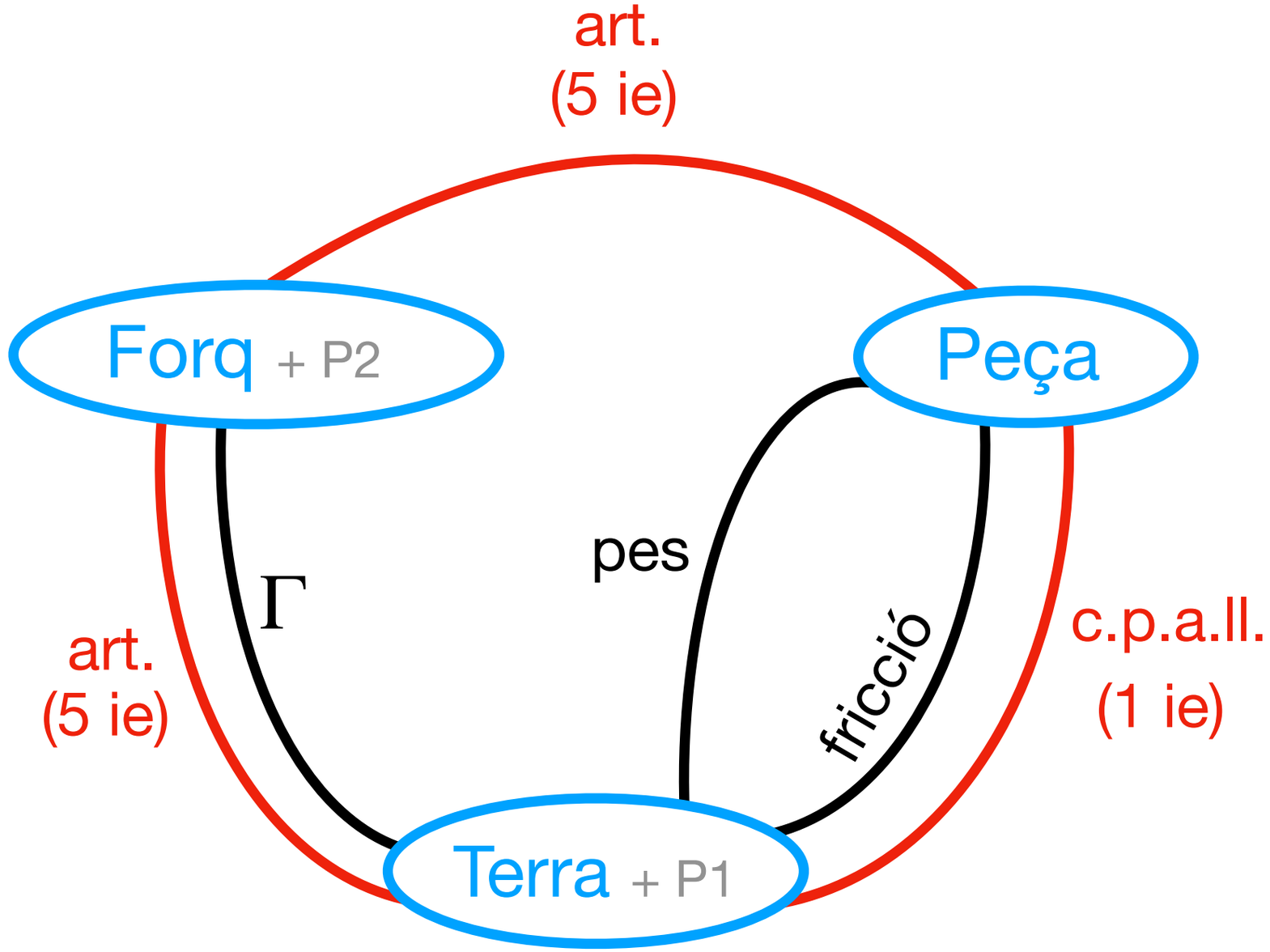
En aquest exercici

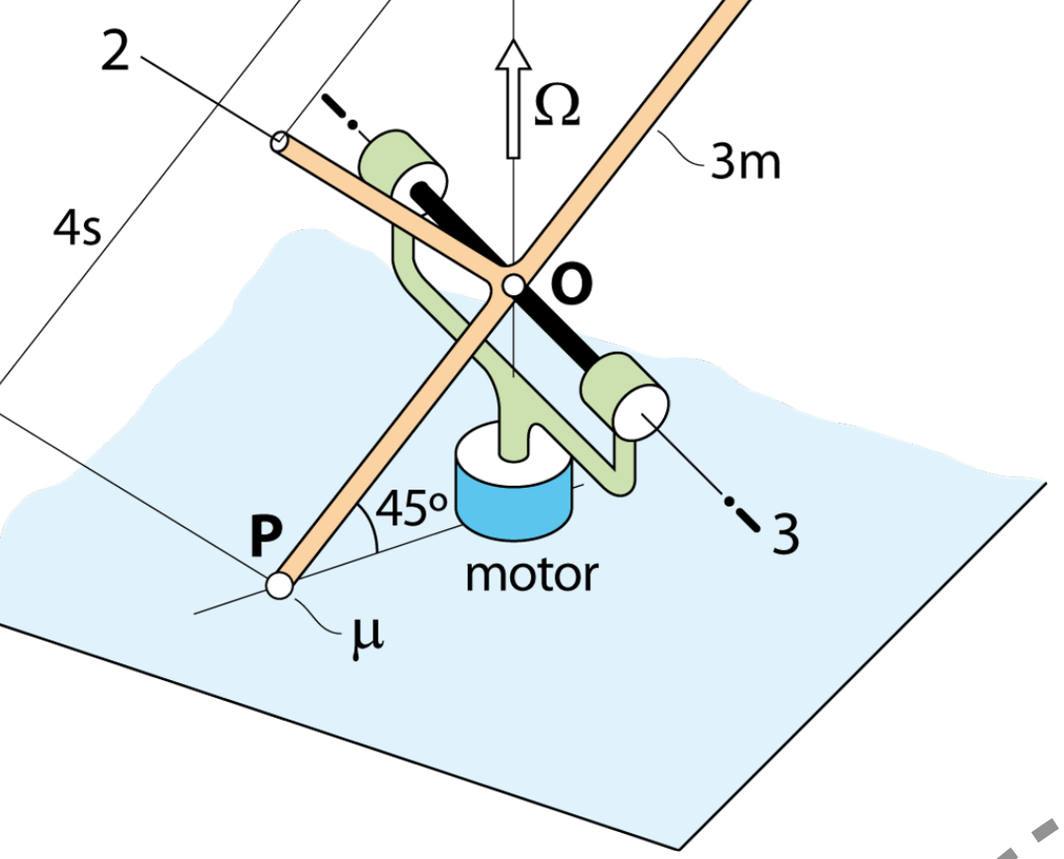
$\dot{\psi} = \Omega = ct \implies \ddot{\psi} = 0$ (coneguda)

Γ serà incògnita

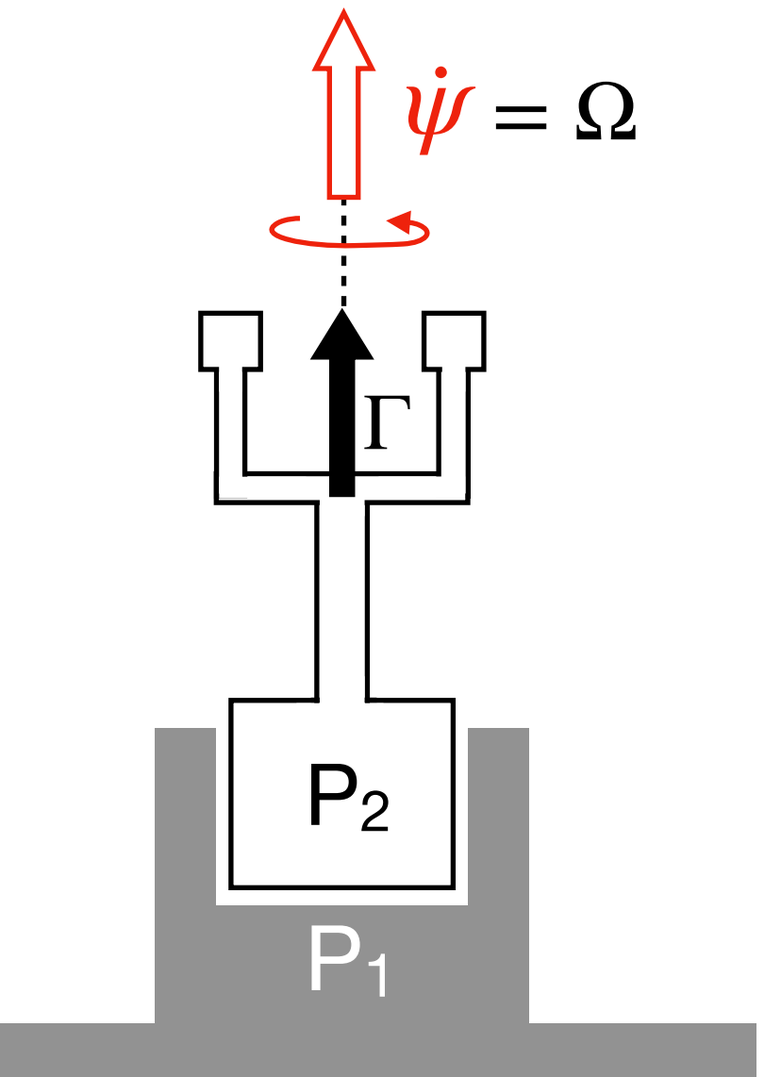

2
Ω
3m
4s
O
P
45º
motor
3
μ

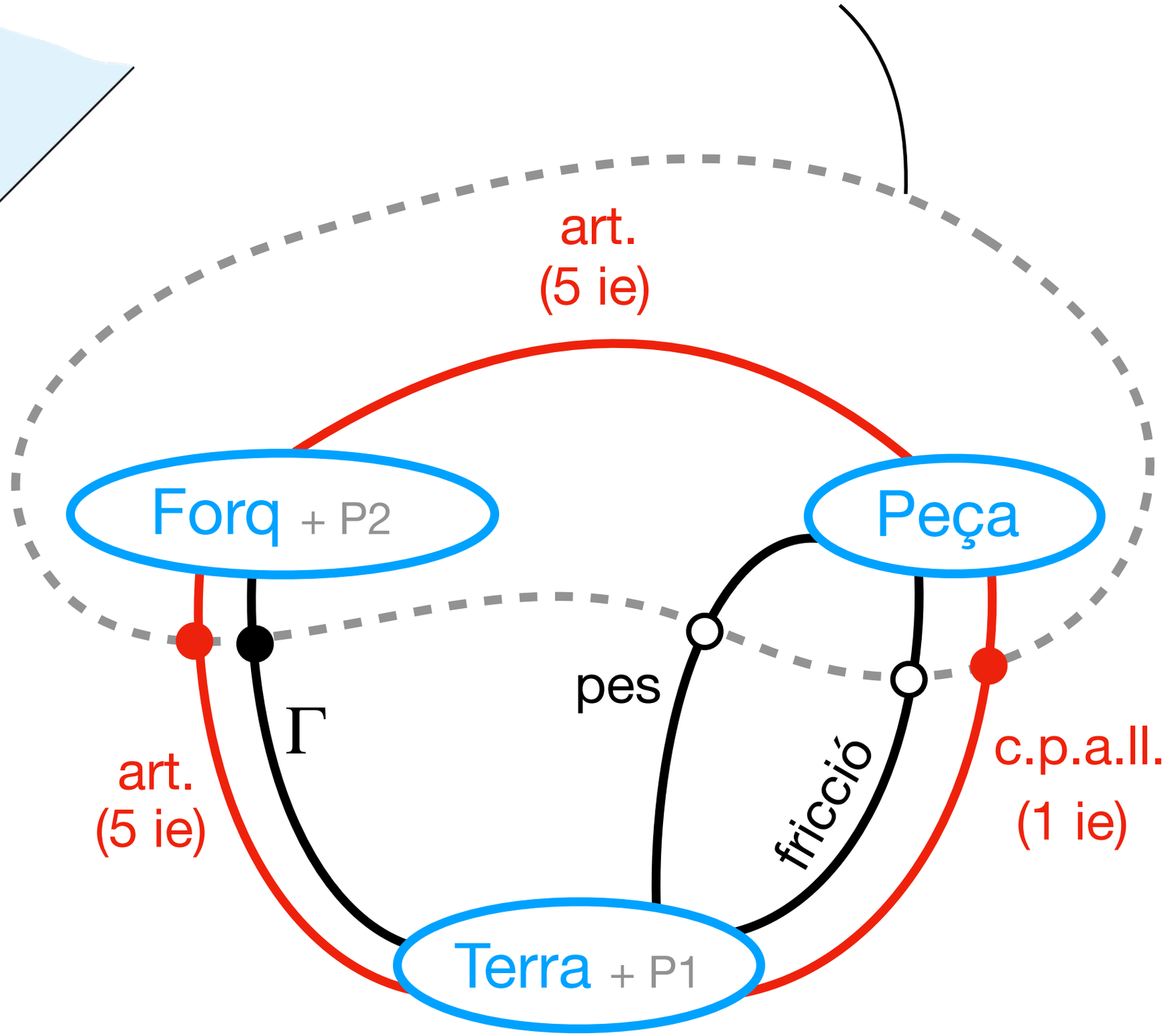

$\dot{\psi} = \Omega$
Γ
P_2
P_1

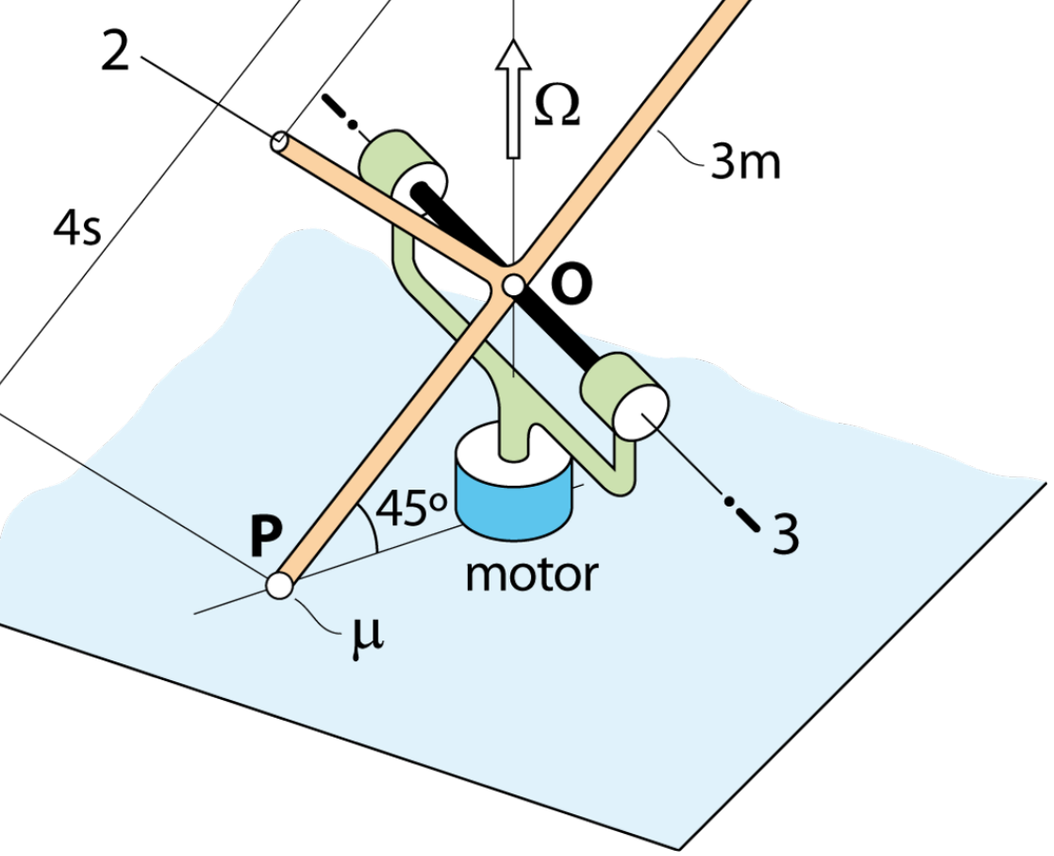

art.
(5 ie)
Forq + P2
Peça
pes
Γ
fricció
art.
(5 ie)
c.p.a.ll.
(1 ie)
Terra + P1



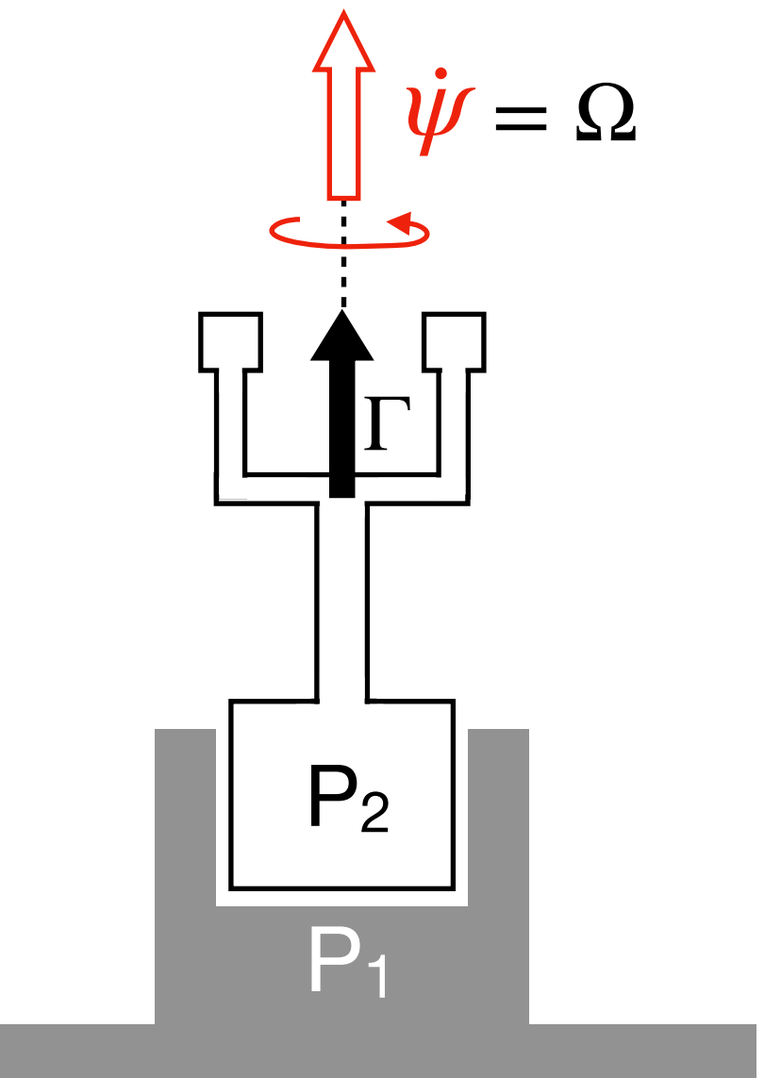
$$6\ \text{ie} + \Gamma \Longrightarrow \textbf{INDETERMINAT}$$

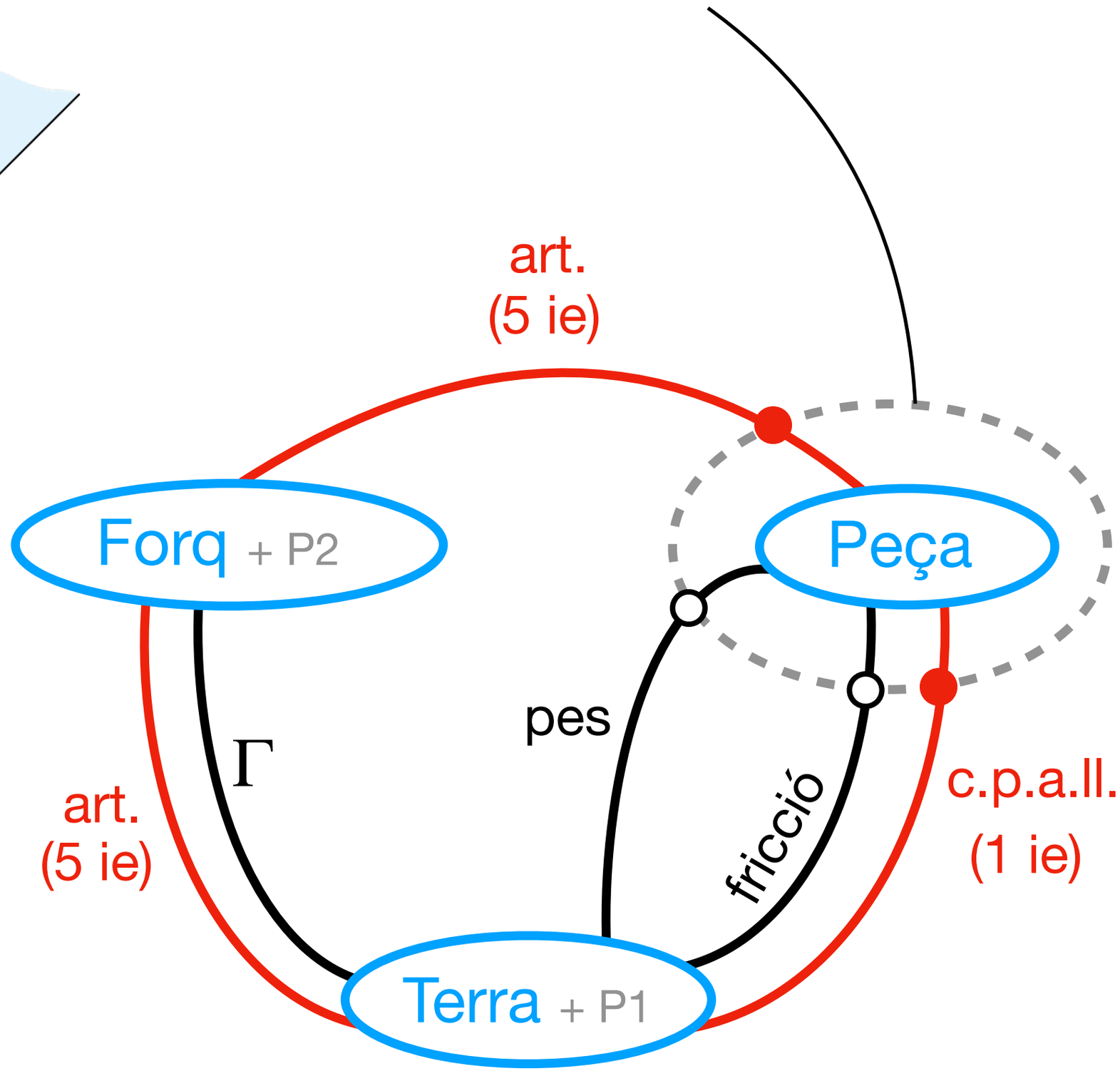






6 ie $\Longrightarrow$ **DETERMINAT**





DEURES

Determineu

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