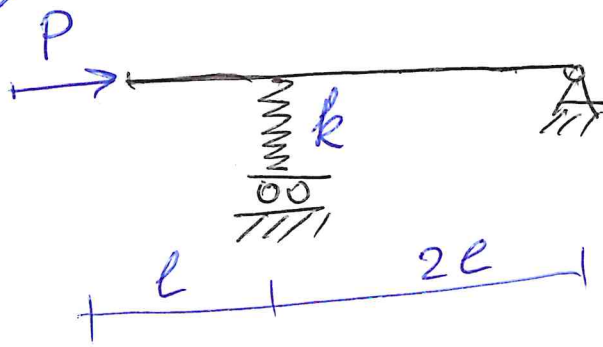


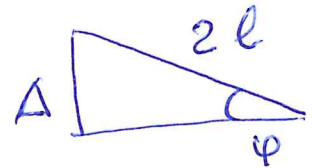
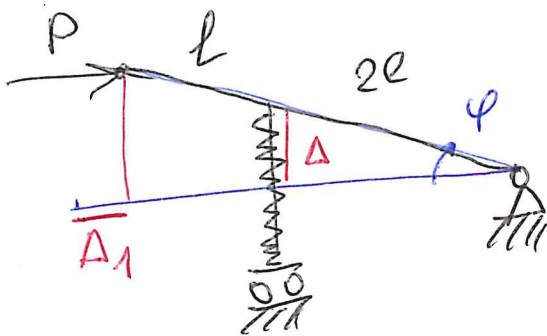
① Problems.



$\left\{ \begin{array}{l} P_c - ? \\ \text{Postbuckling} \end{array} \right.$

il criterio energetico

$$\Pi = U - V, \quad \delta \Pi = 0, \quad \delta^2 \Pi \geq 0$$



$$U = \frac{1}{2} k \Delta^2,$$

$$\Delta = 2l \sin \varphi$$

$$V = P \Delta_1,$$

$$\Delta_1 = 3l - 3l \cos \varphi$$

$$\Pi = \frac{1}{2} k \Delta^2 - P \Delta_1$$

$$\Pi = \frac{1}{2} k (2l \sin \varphi)^2 - P \cdot 3l (1 - \cos \varphi)$$

$$\Pi = 2 k l^2 \sin^2 \varphi - 3 P l (1 - \cos \varphi)$$

①

$$\Pi = \Pi(\varphi) \Rightarrow \delta \Pi = 0$$

$$\frac{d\Pi}{d\varphi} = 0$$

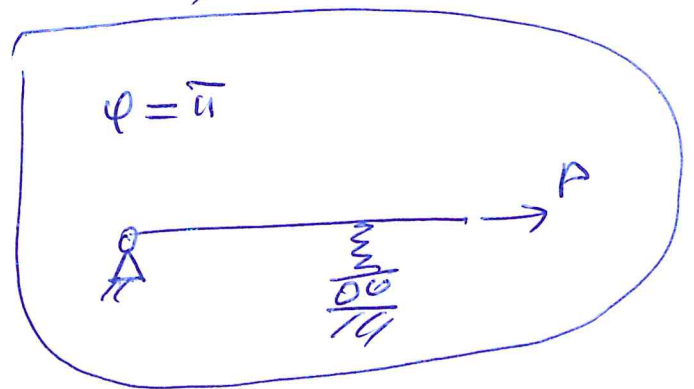
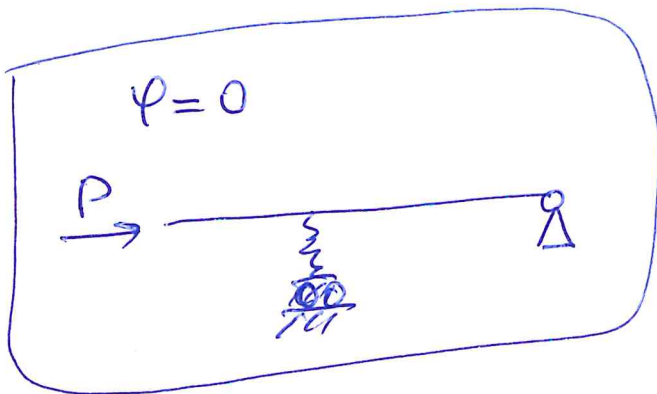
$$\frac{d\Pi}{d\varphi} = 2kl^2 \frac{2\sin\varphi \cos\varphi}{\sin 2\varphi} - 3Pl \sin\varphi$$

$$\frac{d\Pi}{d\varphi} = 0,$$

$$2kl^2 2\sin\varphi \cos\varphi - 3Pl \sin\varphi = 0$$

$$(4kl \cos\varphi - 3P) \sin\varphi = 0$$

$$\Rightarrow 1) \sin\varphi = 0 \Rightarrow \varphi = 0, \varphi = \pi$$

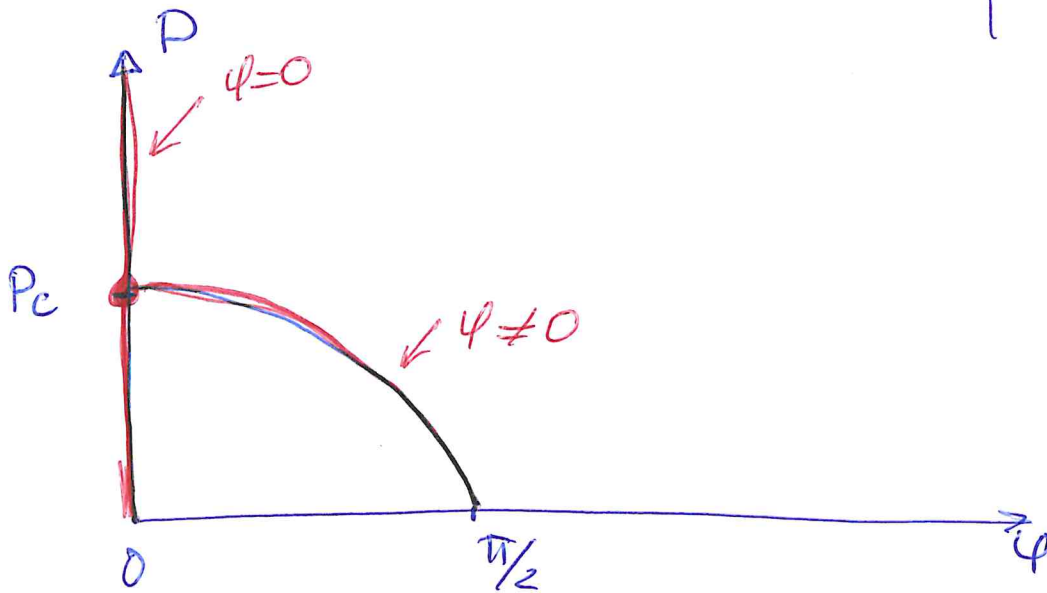
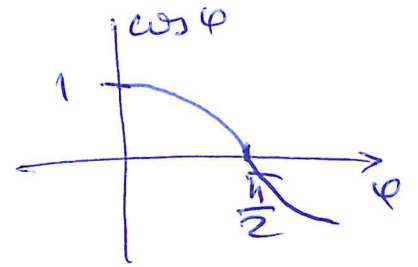


$$2. \quad 4kl \cos\varphi - 3P = 0$$

$$P = \frac{4}{3} kl \cos\varphi$$

non-banale

$$P = \frac{4}{3} kl \cos \varphi$$



$$\varphi = 0, \quad \underline{P = \frac{4}{3} kl = \underline{P_c}}$$

$$\frac{d^2 \Pi}{d\varphi^2} \gtrless ?$$

$$\frac{d^2 \Pi}{d\varphi^2} = \frac{d}{d\varphi} [2kl^2 \sin 2\varphi - 3Pl \sin \varphi] =$$

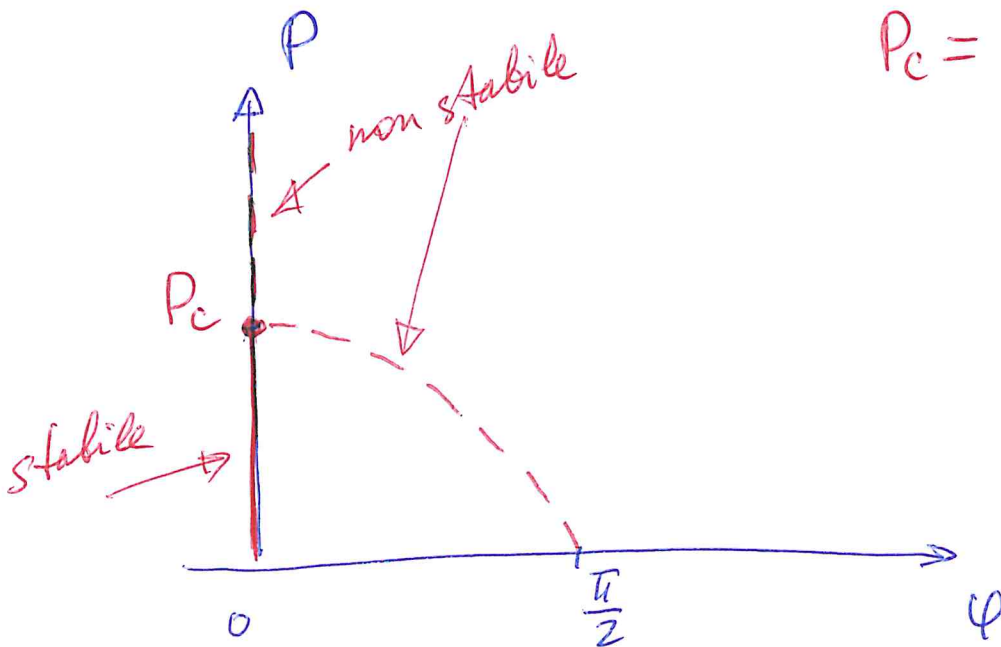
$$= 4kl^2 \cos 2\varphi - 3Pl \cos \varphi$$

$$1. \quad \varphi = 0 \quad \frac{d^2 \Pi}{d\varphi^2} = 4kl^2 - 3Pl$$

$$\Rightarrow \frac{d^2 \Pi}{d\varphi^2} \begin{cases} > 0, & P < \frac{4}{3} kl \equiv P_c \\ < 0, & P > P_c \end{cases}$$

(3)

$$P_c = \frac{4}{3} kl$$



$$2. \quad \varphi \neq 0 \quad \frac{d^2 \Pi}{d\varphi^2} = 4kl^2 \cos 2\varphi - 3Pl \cos \varphi$$

$$P = \frac{4}{3} kl \cos \varphi$$

$$\frac{d^2 \Pi}{d\varphi^2} = 4kl^2 \cos 2\varphi - 3l \cos \varphi \frac{4}{3} kl \cos \varphi =$$

$$= 4kl^2 [\cos 2\varphi - \cos^2 \varphi] =$$

$$= 4kl^2 [\cos^2 \varphi - \sin^2 \varphi - \cos^2 \varphi] =$$

$$= -4kl^2 \sin^2 \varphi < 0$$

(4)