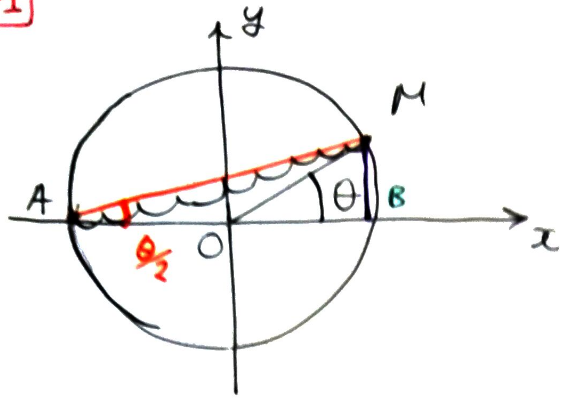
$\boxed{4/1}$



$$E_p(M) = E_{p_p} + E_{p_e}$$
$$= mgy + \frac{1}{2}k(AM - l_0)^2 + \text{const}$$

avec $y = a \cdot \sin\theta$

$AM = 2a \cdot \cos\frac{\theta}{2}$

$$E_p = mg\sin\theta + \frac{1}{2}k\left(2a\cos\frac{\theta}{2} - l_0\right)^2 + \text{const}$$

$\boxed{4/2}$

$$E_p(\theta) = mg\ a\sin\theta + 2ka^2\cos^2\frac{\theta}{2}$$

En position d'éq. $\Leftrightarrow \left(\frac{dE_p}{d\theta}\right)_{\theta_e} = 0$

$$\frac{dE_p}{d\theta} = mga\cdot\cos\theta + \cancel{2}ka^2\,2\cos\frac{\theta}{2}\cdot\left(-\frac{1}{\cancel{2}}\sin\frac{\theta}{2}\right)$$
$$= mg\,a\cdot\cos\theta - ka^2\sin\theta$$

$$\left(\frac{dE_p}{d\theta}\right)_{\theta_e} = 0 \Leftrightarrow mg\,a\cos\theta_e - ka^2\sin\theta_e = 0$$
$$\Leftrightarrow \tan\theta_e = \frac{mg}{ka}$$
$$\Leftrightarrow \begin{cases} \theta_e = \arctan\frac{mg}{ka} & (*) \\ \text{ou} & \\ \theta_e = \arctan\frac{mg}{ka} + \pi & (**) \end{cases}$$

$$\left(\frac{d^2E_p}{d\theta^2}\right)_{\theta_e} = -mg\cdot a\cdot\sin\theta_e - ka^2\cos\theta_e$$
$$= -ka^2\cos\theta_e\left(1 + \frac{mg}{ka}\tan\theta_e\right)$$
$$= -ka^2\cos\theta_e\left(1 + \frac{mg}{ka}\,\frac{mg}{ka}\right)$$

$\Rightarrow (*) \Rightarrow < 0$ et $(**) \Rightarrow > 0$

unstable stable