$$V_{\theta\theta} = mgR\cos\theta - kR^2\operatorname{sen}\theta = mgR\cos\theta\left(1 - \frac{kR}{mg}\tan\theta\right) \xrightarrow{\theta_0} mgR\cos\theta\underbrace{\left(1+\frac{k^2R^2}{m^2g^2}\right)}_{\equiv \gamma > 0}$$

$$V_{\varphi\varphi} = mg\frac{L}{2}\cos\varphi \qquad V_{\theta\varphi} = 0$$

$$H(T_1) = \begin{pmatrix} mgR\gamma\cos\theta_0 & 0 \\ 0 & mg\frac{L}{2} \end{pmatrix}$$ INSTABILE $(\cos\theta_0 < 0)$

$$H(T_2) = \begin{pmatrix} mgR\gamma\cos(\theta_0+\pi) & 0 \\ 0 & mg\frac{L}{2} \end{pmatrix}$$ STABILE $\left(\cos(\theta_0+\pi) > 0\right)$

$$H(T_3) = \begin{pmatrix} mgR\gamma\cos\theta_0 & 0 \\ 0 & -mg\frac{L}{2} \end{pmatrix}$$ INSTABILE

$$H(T_4) = \begin{pmatrix} mgR\gamma\cos(\theta_0+\pi) & 0 \\ 0 & -mg\frac{L}{2} \end{pmatrix}$$ 〃

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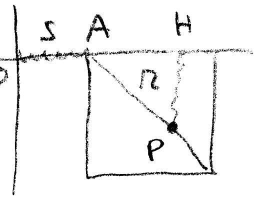
3) $l = 2 \quad q_1 = x_A = s \qquad q_2 = |P-A| = r$




$$T = \frac{1}{2}M\dot{s}^2 + \frac{1}{2}m\left[\left(\dot{s} + \frac{\dot{r}}{\sqrt{2}}\right)^2 + \frac{\dot{r}^2}{2}\right] =$$

$$= \frac{1}{2}(M+m)\dot{s}^2 + \frac{1}{2}m\left[\dot{r}^2 + \sqrt{2}\,\dot{s}\dot{r}\right] \qquad V = -mg\frac{r}{\sqrt{2}} + \frac{1}{2}k\left(s^2 + \frac{r^2}{2}\right)$$

$$\mathcal{L} = T - V \qquad \frac{\partial\mathcal{L}}{\partial\dot{s}} = (M+m)\dot{s} + \frac{\sqrt{2}}{2}m\dot{r}; \qquad \frac{\partial\mathcal{L}}{\partial\dot{r}} = m\dot{r} + \frac{\sqrt{2}}{2}m\dot{s}$$

$$\frac{\partial\mathcal{L}}{\partial s} = -ks \qquad \frac{\partial\mathcal{L}}{\partial r} = \frac{mg}{\sqrt{2}} - \frac{1}{2}kr$$

$$\begin{cases} (M+m)\ddot{s} + \dfrac{m}{\sqrt{2}}\ddot{r} + ks = 0 \\[2ex] m\ddot{r} + \dfrac{m}{\sqrt{2}}\ddot{s} + \dfrac{1}{2}kr = \dfrac{mg}{\sqrt{2}} \end{cases}$$