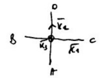

1) $\underset{G}{I}^{OA}_{ij} = diag\left(\frac{ml^2}{3}, 0, \frac{ml^2}{3}\right)$

$\underset{G}{I}^{BC}_{ij} = diag\left(0, \frac{ml^2}{3}, \frac{ml^2}{3}\right)$

$\underset{G}{I}^{OA+BC}_{ij} = diag\left(\frac{ml^2}{3}, \frac{ml^2}{3}, \frac{2ml^2}{3}\right)$ $\qquad \underset{O}{I}^{OA+BC}_{ij} = \underset{G}{I}^{OA+BC}_{ij} + diag\left(2ml^2, 0, 2ml^2\right)$

$\underset{O}{I}^{OA+BC}_{ij} = diag\left(\frac{7}{3}ml^2, \frac{ml^2}{3}, \frac{8}{3}ml^2\right)$

2) $T^{OA+BC} = \frac{1}{2}\bar{\omega}\cdot\underset{O}{I}(\bar{\omega}) = \frac{1}{2}\underset{O}{I}_{33}\omega_3^2 = \frac{4}{3}ml^2\dot{\theta}^2$ $\qquad \bar{\omega} = \dot{\theta}\,\bar{k}_3$

$T^P = \frac{1}{2}2m\,v_P^2$

$\bar{x}_P = (l\,\mathrm{sen}\,\theta + s\cos\theta)\,\bar{e}_1 + (-l\cos\theta + s\,\mathrm{sen}\,\theta)\,\bar{e}_2$

$\bar{v}_P = [(l\cos\theta - s\,\mathrm{sen}\,\theta)\dot{\theta} + \dot{s}\cos\theta]\,\bar{e}_1 + [(l\,\mathrm{sen}\,\theta + s\cos\theta)\dot{\theta} + \dot{s}\,\mathrm{sen}\,\theta]\,\bar{e}_2$

$v^2 = \dot{s}^2 + l^2\dot{\theta}^2 + s^2\dot{\theta}^2 + 2l\dot{s}\dot{\theta}$ $\qquad T^P = m(\dot{s}^2 + l^2\dot{\theta}^2 + s^2\dot{\theta}^2 + 2l\dot{s}\dot{\theta})$

$T = T^{OA+BC} + T^P = m\left[\dot{s}^2 + \left(\frac{7}{3}l^2 + s^2\right)\dot{\theta}^2 + 2l\dot{s}\dot{\theta}\right]$

$V = 2mg\,y_G + 2mg\,y_P + \frac{k}{2}(P-O)^2 = -2mgl\cos\theta - 2mgl\cos\theta + 2mgs\,\mathrm{sen}\,\theta + \frac{k}{2}(l^2+s^2)$

$V = -4mgl\cos\theta + 2mg\,s\,\mathrm{sen}\,\theta + \frac{mg}{4l}s^2 + cost$

$L = T - V = m\left[\dot{s}^2 + \left(\frac{7}{3}l^2 + s^2\right)\dot{\theta}^2 + 2l\dot{s}\dot{\theta}\right] + 4mgl\cos\theta - 2mg\,s\,\mathrm{sen}\,\theta - \frac{mg}{4l}s^2$

$\frac{d}{dt}\frac{\partial L}{\partial \dot{s}} - \frac{\partial L}{\partial s} = 0$ $\qquad 2\ddot{s} + 2l\ddot{\theta} - 2s\dot{\theta}^2 + 2g\,\mathrm{sen}\,\theta + \frac{g}{2l}s = 0$

$\frac{d}{dt}\frac{\partial L}{\partial \dot{\theta}} - \frac{\partial L}{\partial \theta} = 0$ $\qquad 2\left(\frac{7}{3}l^2 + s^2\right)\ddot{\theta} + 2l\ddot{s} + 2s\dot{s}\dot{\theta} + 4gl\,\mathrm{sen}\,\theta + 2gs\cos\theta = 0$

3) $V_s = \frac{mg}{2l}s + 2mg\,\mathrm{sen}\,\theta = 0$ $\qquad V_\theta = 4mgl\,\mathrm{sen}\,\theta + 2mgs\cos\theta = 0$

$s = -4l\,\mathrm{sen}\,\theta$ $\qquad 4\,\mathrm{sen}\,\theta(1 - 2\cos\theta) = 0 \Rightarrow$ $\mathrm{sen}\,\theta = 0,\ s = 0$; $\cos\theta = \frac{1}{2},\ s = \mp 2l$

$V_{ss} = \frac{mg}{2l} > 0$ $\qquad V_{\theta\theta} = 4mgl\cos\theta - 2mg\,s\,\mathrm{sen}\,\theta$

$V_{s\theta} = 2mg\cos\theta$ $\qquad H = mg\begin{pmatrix} \frac{1}{2l} & 2\cos\theta \\ 2\cos\theta & 4l\cos\theta - 2s\,\mathrm{sen}\,\theta \end{pmatrix} = 2\cos\theta - \frac{s}{l}\mathrm{sen}\,\theta - 4\cos^2\theta$

a) $\theta = 0,\ s = 0$ $\quad H < 0$ inst. $\qquad$ b) $\theta = \pi,\ s = 0$ $\quad H < 0$ inst.

c) $\theta = \frac{\pi}{3}$ $\quad s = -2l$ $\quad H > 0$ stab. $\qquad$ d) $\theta = \frac{2\pi}{3}$ $\quad s = 2l$ $\quad H > 0$ stab.

4) $\bar{L}_O = \underset{O}{I}(\bar{\omega}) + 2m\,\bar{x}_P \wedge \bar{v}_P = \frac{8}{3}ml^2\dot{\theta}\,\bar{e}_3 + 2m(l^2+s^2)\dot{\theta}\,\bar{e}_3 + 2ml\dot{s}\,\bar{e}_3$

$= \left[\left(\frac{14}{3}ml^2 + 2ms^2\right)\dot{\theta} + 2ml\dot{s}\right]\bar{e}_3$