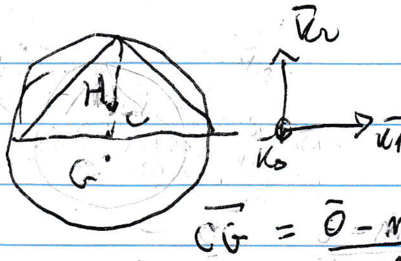
1)  $A^T = R^2 \quad A^D = \pi R^2 \quad A^L = A^D - A^T = (\pi-1)R^2$

$m^T = \frac{m}{\pi-1} \qquad m^D = \frac{\pi m}{\pi-1} \qquad \overline{CH} = \frac{R}{3}\bar{K}_2$

$\overline{CG} = \frac{\bar{0} - m^T\,\overline{CH}}{m} = \frac{-R}{3(\pi-1)}\bar{K}_2$

$I_C^D = \frac{\pi m}{\pi-1}\,\mathrm{diag}\left(\frac{R^2}{4},\frac{R^2}{4},\frac{R^2}{2}\right) \qquad I_C^T = \frac{m}{\pi-1}\,\mathrm{diag}\left(\frac{R^2}{24},\frac{R^2}{24},\frac{R^2}{12}\right)$

$I_C^L = I_C^D - I_C^T = \frac{mR^2}{\pi-1}\,\mathrm{diag}\left(\frac{6\pi-1}{24},\frac{6\pi-1}{24},\frac{6\pi-1}{12}\right)$

$I_G^L = I_C^L - mR^2\,\mathrm{diag}\left(\frac{1}{9},0,\frac{1}{9}\right) = \mathrm{diag}\left(5\frac{2\pi+1}{72(\pi-1)},\frac{6\pi-1}{24(\pi-1)},\frac{14\pi+1}{36(\pi-1)}\right)mR^2$

2) $T = \frac{1}{2}I_0^A\omega^2 + \frac{1}{2}I_G^L\omega^2 + \frac{1}{2}m v_G^2 \qquad I_0^A = \frac{36mR^2}{12} = 3mR^2$

$\overline{OG} = \left(s\cos\theta + \frac{R}{3(\pi-1)}\operatorname{sen}\theta\right)\bar{e}_1 + \left(s\operatorname{sen}\theta - \frac{R}{3(\pi-1)}\cos\theta\right)\bar{e}_2$

$v_G = \left(\dot{s}\cos\theta - s\operatorname{sen}\theta\,\dot\theta + \frac{R}{3(\pi-1)}\cos\theta\,\dot\theta\right)\bar{e}_1 + \left(\dot{s}\operatorname{sen}\theta + s\cos\theta\,\dot\theta + \frac{R}{3(\pi-1)}\operatorname{sen}\theta\,\dot\theta\right)\bar{e}_2$

$v_G^2 = \dot{s}^2 + s^2\dot\theta^2 + \frac{R^2}{9(\pi-1)^2}\dot\theta^2 + \frac{R}{3(\pi-1)}\dot{s}\dot\theta$

$T = \frac{3}{2}mR^2\dot\theta^2 + \frac{1}{2}I\dot\theta^2 + \frac{1}{2}m\left(\dot{s}^2 + s^2\dot\theta^2 + \frac{R^2}{9(\pi-1)^2}\dot\theta^2 + \frac{R}{3(\pi-1)}\dot{s}\dot\theta\right) \qquad I = \frac{14\pi+1}{36(\pi-1)}mR^2$

3) $V = mg\,y_G + \frac{K}{2}|OC|^2 = mg\left(s\operatorname{sen}\theta - \frac{R}{3(\pi-1)}\cos\theta\right) + \frac{3(\pi-1)}{4R}mg\,s^2$

$\frac{\partial V}{\partial s} = mg\operatorname{sen}\theta + \frac{3(\pi-1)}{2R}mg\,s \qquad s = \frac{-2R}{3(\pi-1)}\operatorname{sen}\theta$

$\frac{\partial V}{\partial \theta} = mg\left(s\cos\theta + \frac{R}{3(\pi-1)}\operatorname{sen}\theta\right) \rightarrow \operatorname{sen}\theta\,(-2\cos\theta+1) = 0$

$\operatorname{sen}\theta = 0$: $\theta = 0 \quad s = 0$; $\theta = \pi \quad s = 0$ $\qquad \cos\theta = \frac{1}{2}$: $\theta = \frac{\pi}{3} \quad s = -\frac{\sqrt{3}R}{3(\pi-1)}$; $\theta = -\frac{\pi}{3} \quad s = \frac{\sqrt{3}R}{3(\pi-1)}$

$\frac{\partial^2 V}{\partial s^2} = \frac{3(\pi-1)mg}{2R} > 0 \qquad \frac{\partial^2 V}{\partial\theta^2} = mg\left(-s\operatorname{sen}\theta + \frac{R}{3(\pi-1)}\cos\theta\right) \qquad \frac{\partial^2 V}{\partial\theta\partial s} = mg\cos\theta$

se $\operatorname{sen}\theta = 0$ $\mathcal{H} < 0$ INST. $\qquad$ se $\cos\theta = \frac{1}{2}$ $\mathcal{H} > 0$ STAB.

4) $T \sim \frac{m}{2}\left[\dot{s}^2 + \frac{R}{3(\pi-1)}\dot{s}\dot\theta + \left(3R^2 + \frac{I}{m} + \frac{4R^2}{9(\pi-1)^2}\right)\dot\theta^2\right]$

$A = \begin{pmatrix} m & \frac{mR}{6(\pi-1)} \\ \frac{mR}{6(\pi-1)} & I + 3mR^2 + \frac{4mR^2}{9(\pi-1)^2} \end{pmatrix} \qquad C = \begin{pmatrix} \frac{3(\pi-1)mg}{2R} & \frac{mg}{2} \\ \frac{mg}{2} & \frac{2mgR}{3(\pi-1)} \end{pmatrix} \qquad \det(\lambda A - C) = 0$

5) $L_0 = I_0(\bar\omega) + \bar{r}_G \times v_G + I_G(\bar\omega)$