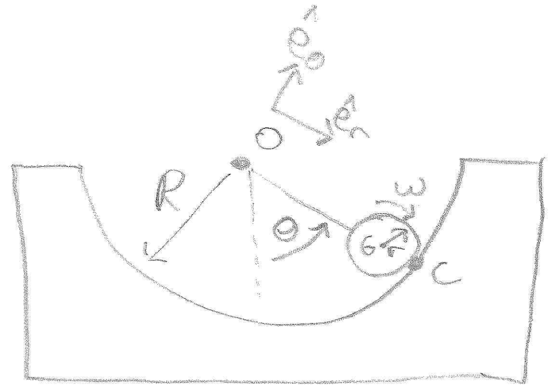
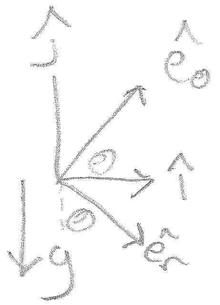
26.





Find the non-linear ODEs

$\vec{V}_G = \vec{V}_G$

$\hat{j} = -\cos\theta\,\hat{e}_r + \sin\theta\,\hat{e}_\theta$

$\dot\theta(R-r)\,\hat{e}_\theta = -\omega r\,\hat{e}_\theta$

$\dot\theta(R-r) = -\omega r \rightarrow \boxed{\dot\omega = -\frac{\ddot\theta(R-r)}{r}}$ $\boxed{I^G = \frac{mr^2}{2}}$

AMB/c

$\sum M_{/c} = \dot{\vec{H}}_{/c} \rightarrow -r\hat{e}_r \times -mg\hat{j} = \vec{r}_{G/c} \times m\vec{a}_G + I^G\dot\omega\hat{k}$

$-mgr\sin\theta\,\hat{k} = -r\hat{e}_r \times m\left[(R-r)\ddot\theta\,\hat{e}_\theta - (R-r)\dot\theta^2\hat{e}_r\right] + I^G\dot\omega\hat{k}$

$mgr\sin\theta\,\hat{k} = -mr(R-r)\ddot\theta\,\hat{k} - \frac{mr^2\ddot\theta(R-r)}{2r}\hat{k}$

$mgr\sin\theta = -\frac{3}{2}r(R-r)\ddot\theta$

$\boxed{\frac{-2g\sin\theta}{3(R-r)} = \ddot\theta}$ Good

- Are these the same as for a regular pendulum?

as $r \to 0$ $\quad \ddot{\Theta} = \frac{-2g}{3R}\sin\Theta \neq \frac{-g}{R}\sin\Theta$. The difference is the result of rolling, which slows acceleration.

- Linearize about $\Theta = 0$ & determine ω_n

$$\boxed{\ddot{\Theta} \approx \frac{-2g\Theta}{3(R-r)}} \checkmark \rightarrow \boxed{\omega_n = \sqrt{\frac{2g}{3(R-r)}}}$$