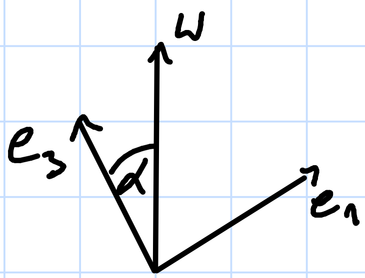
1)



$$\vec{w}_e = (\overset{w_1}{w\,\text{sen}(\alpha)}, \overset{w_2}{0}, \overset{w_3}{w\cos(\alpha)})$$

$$\dot{\vec{w}}_e = 0$$

$$I_1 = I_2 = \frac{1}{4}MR^2 \,,\quad I_3 = \frac{1}{2}MR^2$$

$$\Rightarrow \tau_1 = \tau_3 = 0 \;(\rightarrow w_2 = 0) \;\wedge\; \tau_2 = w_{e_1} w_{e_2} (I_3 - I_1)$$

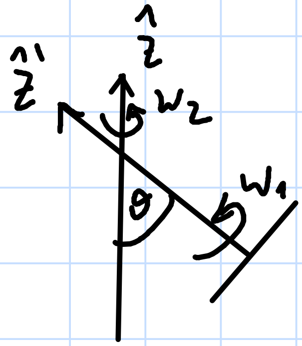
$$\tau_2 = w^2 \text{sen}(\alpha)\cos(\alpha)\frac{MR^2}{4}$$

$$\vec{\tau} = \vec{r} \times \vec{F} = d\hat{y} \times -F\hat{x} + -d\hat{y} \times F\hat{x} = 2dF\hat{z}$$

$$|\vec{\tau}| = |\tau_2| \Rightarrow 2dF = w^2 \text{sen}(\alpha)\cos(\alpha)\frac{MR^2}{4}$$

$$\Rightarrow F = \frac{w^2 \text{sen}(\alpha)\cos(\alpha) MR^2}{8d} = \frac{MR^2 w^2 \text{sen}(2\alpha)}{16d}$$

2)



$$\vec{W}_1 = W_1 \hat{z}'$$

$$\vec{W}_2 = W_2 \operatorname{sen}(\theta)\hat{y}' + W_2\cos(\theta)\hat{z}'$$

$$\vec{\Omega} = W_2 \operatorname{sen}(\theta)\hat{y}' + (W_1 + W_2\cos(\theta))\hat{z}'$$

$$I_{cm} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 2 \end{pmatrix} \frac{MR^2}{4}$$

Usando steiner $I_p = \begin{pmatrix} 4L^2+R^2 & 0 & 0 \\ 0 & 4L^2+R^2 & 0 \\ 0 & 0 & 2R^2 \end{pmatrix} \frac{M}{4}$

Luego $\vec{l}_p = \vec{I}_p \vec{\Omega} =$

$$\vec{l}_p = \frac{M}{4}\left((4L^2+R^2)W_2\operatorname{sen}(\theta)\hat{y}' + 2R^2(W_1 + W_2\cos(\theta))\hat{z}'\right)$$

Dado que el sistema solo rota podemos dejar la derivada del momento angular como

$$\dot{\vec{l}}_p = W_2 \times \vec{l}_p$$

$$\Rightarrow \dot{\vec{l}}_p = \vec{\omega}_2 \times \frac{M}{4}\left(\left(4L^2+R^2\right)\omega_2 \operatorname{sen}(\theta)\,\hat{y}' + 2R^2\left(\omega_1+\omega_2\cos(\theta)\right)\hat{z}'\right)$$

$$\dot{\vec{l}}_p = -\left(ML^2+\frac{MR^2}{4}\right)\omega_2^2 \operatorname{sen}(\theta)\cos(\theta)\,\hat{x} + 2R^2\left(\omega_1+\omega_2\cos(\theta)\right)\omega_2 \operatorname{sen}(\theta)\,\hat{x}$$

Luego, el torque se produce unicamente por el peso

$$\vec{\tau} = M(-L\hat{z}') \times (g\cos(\theta)\hat{z}' + g\operatorname{sen}(\theta)\hat{y}')$$
$$\vec{\tau} = -MLg\operatorname{sen}(\theta)\,\hat{x}$$

Luego $\dot{\vec{l}}_p = \vec{\tau}$ (ver diferentes valores de θ y ω)

Ver que este metodo es equivalente a haber usado Euler ($\dot{\vec{l}} = \vec{\tau} = $ Euler)