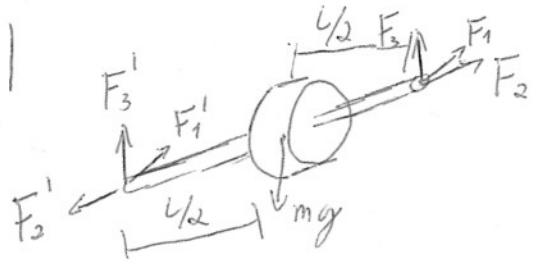
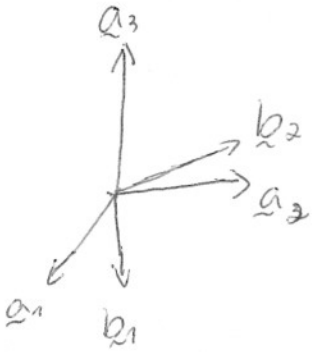
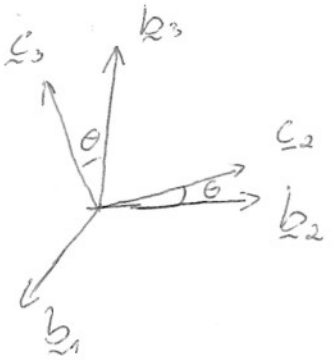
1)







$$\underset{\sim}{\rho}^{CM/O} = \frac{L}{2}\,\underset{\sim}{a}_3$$

$$\overset{R}{v}^{CM} = 0 \qquad \overset{R}{a}^{CM} = 0$$

$$\underset{\sim}{F} = m\,\overset{R}{\underset{\sim}{a}}^{*}$$

$$\underset{\sim}{F} = \begin{bmatrix} -F_1 - F_1' \\ F_2 - F_2' - mg\,\mathrm{sen}\,\theta \\ F_3 + F_3' - mg\cos\theta \end{bmatrix}$$

$$F_1 + F_1' = 0$$

$$F_2 - F_2' - mg\,\mathrm{sen}\,\theta = 0$$

$$F_3 + F_3' - mg\cos\theta = 0$$

$$\underset{\sim}{\omega} = \omega_1\,\underset{\sim}{b}_3 + \dot{\theta}\,\underset{\sim}{b}_1 + \omega_2\,\underset{\sim}{c}_2$$

$$= \omega_1\cos\theta\,\underset{\sim}{c}_3 + \omega_1\,\mathrm{sen}\,\theta\,\underset{\sim}{c}_2 + \dot{\theta}\,\underset{\sim}{c}_1 + \omega_2\,\underset{\sim}{c}_2$$

$$[I^{CM}] = \begin{bmatrix} I_2 & 0 & 0 \\ 0 & I_1 & 0 \\ 0 & 0 & I_2 \end{bmatrix}$$

Segundo a Lei de Euler:

$$M_1 = I_2\,\ddot{\theta} + (I_2 - I_1)(\omega_1\,\mathrm{sen}\,\theta + \omega_2)\,\omega_1\cos\theta$$

$$M_2 = I_1\,\omega_1\,\dot{\theta}\cos\theta + \cancel{(I_2 - I_2)}^{0}\,\dot{\theta}\,\omega_1\cos\theta$$

$$M_3 = -I_2\,\omega_1\,\dot{\theta}\,\mathrm{sen}\,\theta + (I_1 - I_2)\,\dot{\theta}(\omega_2 + \omega_1\,\mathrm{sen}\,\theta)$$

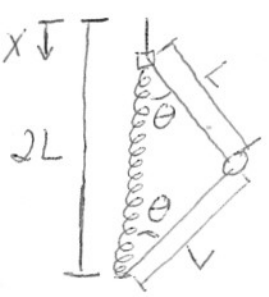
$$M_1 = F_3\frac{L}{2} - F_3'\frac{L}{2} = I_2\,\ddot{\theta} + (I_2 - I_1)(\omega_1\,\mathrm{sen}\,\theta + \omega_2)\,\omega_1\cos\theta$$

$$M_2 = 0 = I_1\,\omega_1\,\dot{\theta}\cos\theta$$

$$M_3 = F_1\frac{L}{2} - F_1'\frac{L}{2} = (I_1 - I_2)\,\dot{\theta}(\omega_2 + \omega_1\,\mathrm{sen}\,\theta) - I_2\,\omega_1\,\dot{\theta}\,\mathrm{sen}\,\theta$$

2) $L = K - \phi$

$$K = \frac{1}{2}m\dot{x}^2 + \frac{1}{2}m(\dot{\theta}^2L^2 + \Omega^2L^2\,\mathrm{sen}^2\theta)$$



$$\phi = \frac{1}{2}Kx^2 + mg(2L - x) + mgL\cos\theta$$

$$2L - x = 2L\cos\theta$$

$$x = 2L - 2L\cos\theta$$

$$\dot{x} = 2L\,\dot{\theta}\,\mathrm{sen}\,\theta$$

$$L = 2mL^2\dot{\theta}^2\operatorname{sen}^2\theta + \frac{1}{2}m(\dot{\theta}^2L^2 + \Omega^2L^2\operatorname{sen}^2\theta) - 2KL^2 + 4KL^2\cos\theta -$$

$$-2KL^2\cos^2\theta - 3mgL\cos\theta$$

$$Q_i = 0$$

$$\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{\theta}}\right) = 4mL^2\ddot{\theta}\operatorname{sen}^2\theta + 4mL^2\dot{\theta}^2\operatorname{sen}(2\theta) + mL^2\ddot{\theta}$$

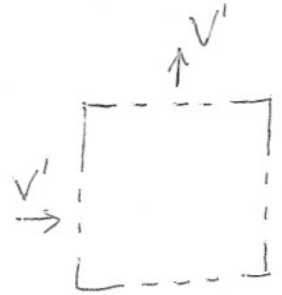
$$\frac{\partial L}{\partial \theta} = 2mL^2\dot{\theta}^2\operatorname{sen}(2\theta) + \frac{1}{2}m\Omega^2L^2\operatorname{sen}(2\theta) - 4KL^2\operatorname{sen}\theta + 2L^2K\operatorname{sen}(2\theta)$$

$$+ 3mgL\operatorname{sen}\theta$$

$$4mL^2\ddot{\theta}\operatorname{sen}^2\theta + 4mL^2\dot{\theta}^2\operatorname{sen}(2\theta) + mL^2\ddot{\theta} - 2mL^2\dot{\theta}^2\operatorname{sen}(2\theta) \quad \frac{1}{2}m\Omega^2L^2\operatorname{sen}(2\theta) +$$

$$+ 4KL^2\operatorname{sen}\theta - 2KL^2\operatorname{sen}(2\theta) - 3mgL\operatorname{sen}\theta$$

3)



$$V' = 10 - (-20) = 30\ m/s$$

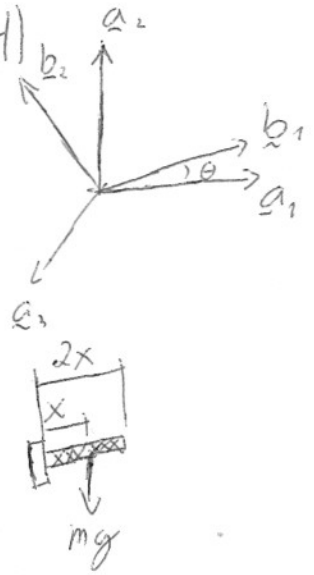
$$F = \dot{m}(V' - V'') \qquad V'' = 0$$

$$F = \dot{m}(V') = \rho\,\pi\frac{D^2}{4}VV'$$

$$= 294{,}52\ N$$

$$\dot{m} = \rho A V = \rho\,\pi\frac{D^2}{4}V$$

4)



$$\rho^{CM}_{O} = x\,\underline{b}_1$$

$$^R v^{CM} = \dot{x}\,\underline{b}_1 + x\Omega\,\underline{b}_2$$

$$^R a^{CM} = \ddot{x}\,\underline{b}_1 + \dot{x}\Omega\,\underline{b}_2 + \dot{x}\Omega\,\underline{b}_2 - x\Omega^2\underline{b}_1$$

$$= (\ddot{x} - x\Omega^2)\underline{b}_1 + 2\dot{x}\Omega\,\underline{b}_2$$

$$F = m\frac{d\vec{V}^{CM}}{dt} + \dot{m}(v - \cancel{v}^{0})$$

$$m = 2x\rho$$

$$\dot{m} = 2\dot{x}\rho$$

$$F = 2x\rho(\ddot{x} - x\Omega^2)\underline{b}_1 + 4x\rho\dot{x}\Omega\,\underline{b}_2 + 2\dot{x}^2\rho\,\underline{b}_1$$

$$\left\{ F = \begin{bmatrix} 2x\rho(\ddot{x} - x\Omega^2) + 2\dot{x}\rho \\ 4x\rho\dot{x}\Omega \end{bmatrix} \right.$$