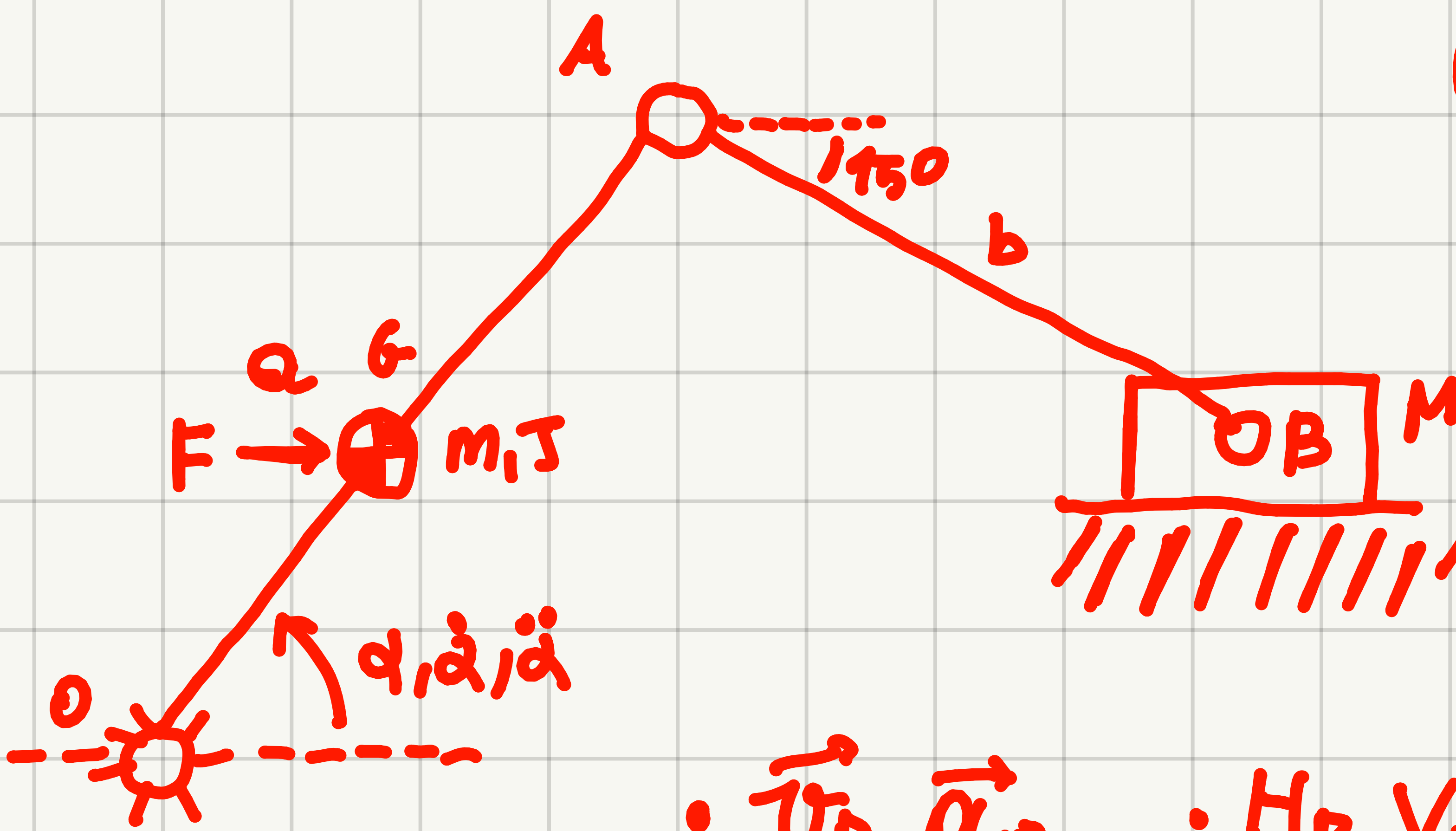


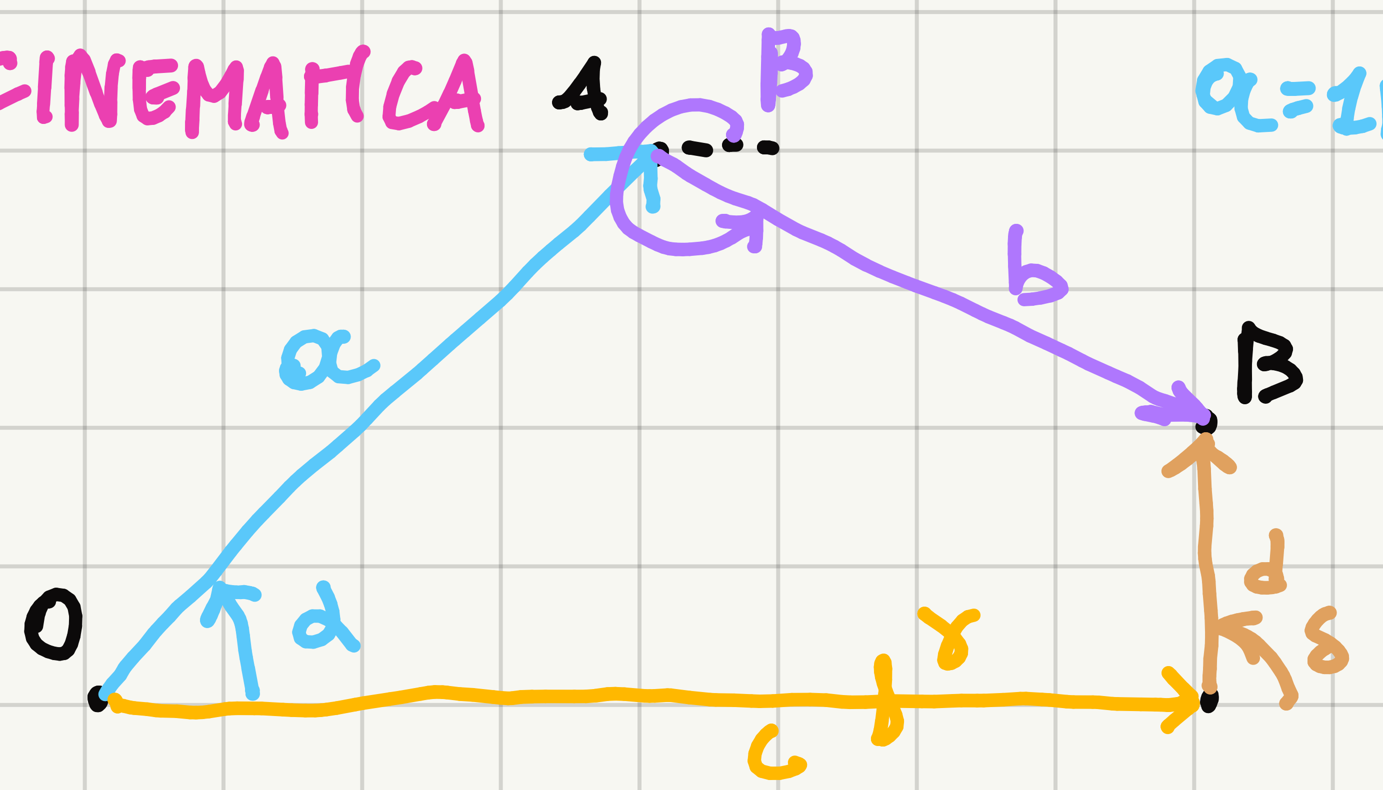
$a = 1m$ $b = 2m$ $m = 2Kg$ $J = 0{,}2\,Kgm^2$

$M = 10Kg$ $\mu_d = 0{,}2$ $\alpha = 45°$

$\dot\alpha = -1\,rad/s$ $\ddot\alpha = -1\,rad/s^2$

• $\vec{v}_B, \vec{a}_B$ • H_B, V_B? • F?

CINEMATICA



$a = 1m$ $\alpha = 45°$ $\dot\alpha = -1\,rad/s$ $\ddot\alpha = -1\,rad/s^2$

$b = 2m$ $\beta = 360 - 15 = 345°$ $\dot\beta, \ddot\beta \neq 0$

$c \Rightarrow$ $\dot c, \ddot c \neq 0$ γ COSTANTE d, δ COSTANTI

$$\begin{cases} a\cos\alpha + b\cos\beta = c + d\cos\delta \\ a\sin\alpha + b\sin\beta = d\cos\delta \end{cases}$$

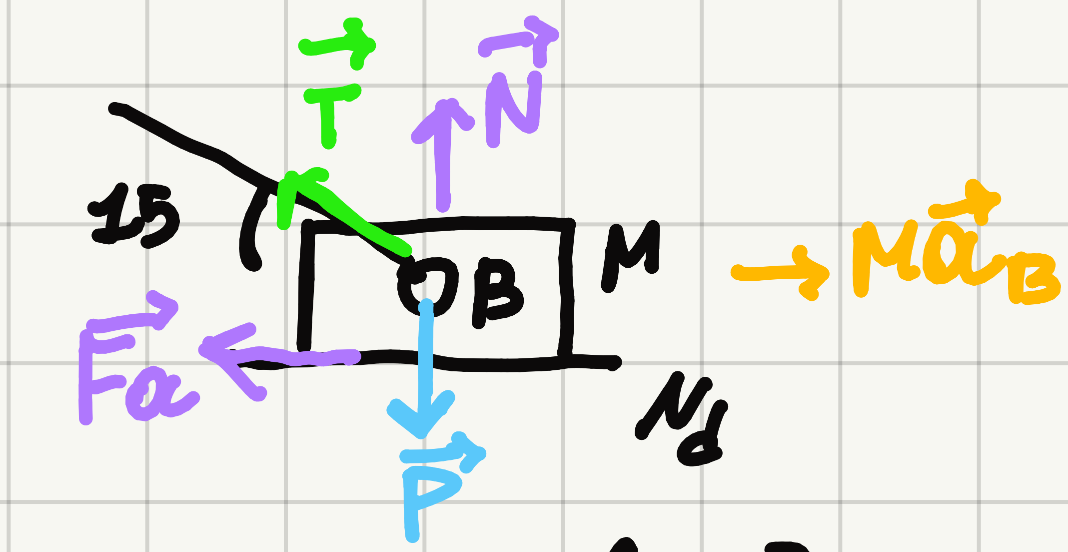
$$\begin{cases} -a\dot\alpha\sin\alpha - b\dot\beta\sin\beta = \dot c & \dot c = 0{,}898\,m/s \\ a\dot\alpha\cos\alpha + b\dot\beta\cos\beta = 0 & \dot\beta = 0{,}37\,rad/s \end{cases}$$

$$\vec{v}_B = (0{,}898\,\hat{i})\,m/s$$

$$\begin{cases} -a\ddot\alpha\sin\alpha - a\dot\alpha^2\cos\alpha - b\ddot\beta\sin\beta - b\dot\beta^2\cos\beta = \ddot c \\ a\ddot\alpha\cos\alpha - a\dot\alpha^2\sin\alpha + b\ddot\beta\cos\beta - b\dot\beta^2\sin\beta = 0 \end{cases}$$

$$\begin{cases} \ddot c = 0{,}09\,m/s^2 \\ \ddot\beta = 0{,}69\,rad/s^2 \end{cases} \Rightarrow \vec{a}_B = (0{,}09\,\hat{i})\,m/s^2$$

DINAMICA



$$\begin{cases} -T\cos(15) - F_a = M a_B \\ T\sin(15) + N - Mg = 0 \end{cases}$$

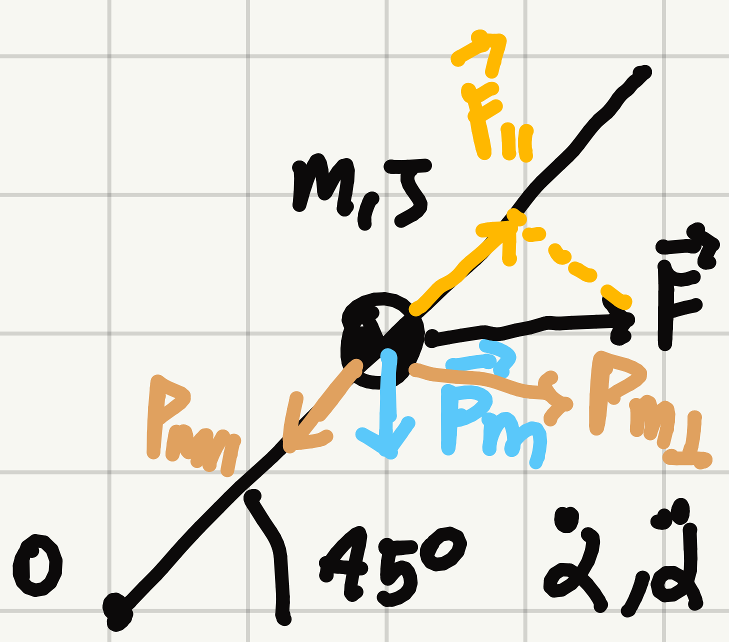
$F_a = \mu_d N$

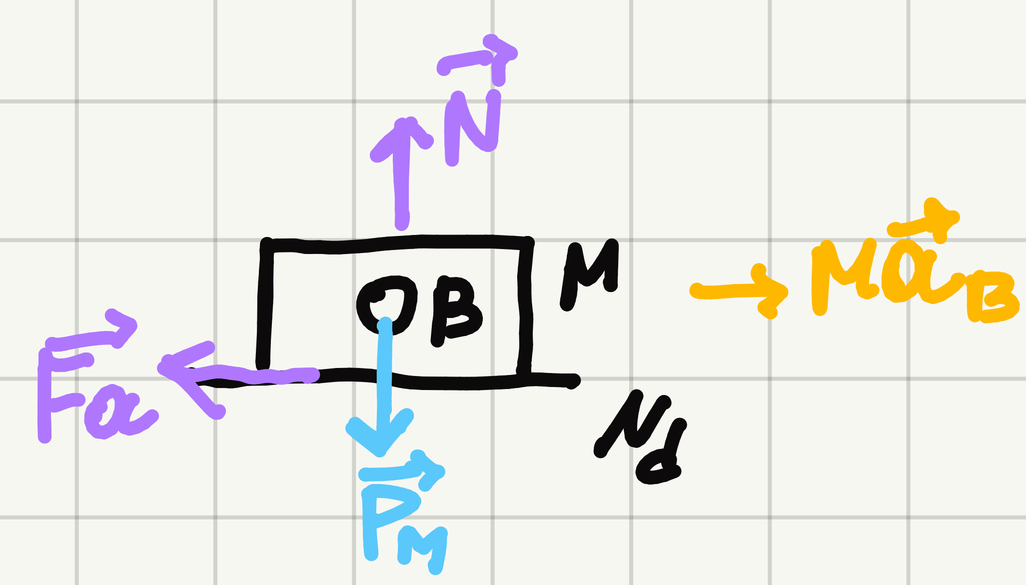
$$\begin{cases} -T\cos(15) - \mu_d N = M a_B \\ N = Mg - T\sin(15) \end{cases}$$

$$-T\cos(15) - \mu_d (Mg - T\sin(15)) = M a_B \implies T = -24{,}9\,N$$

$N = 104{,}5\,N$

BILANCIO DI POTENZE: $\sum P = \frac{d}{dt}K$





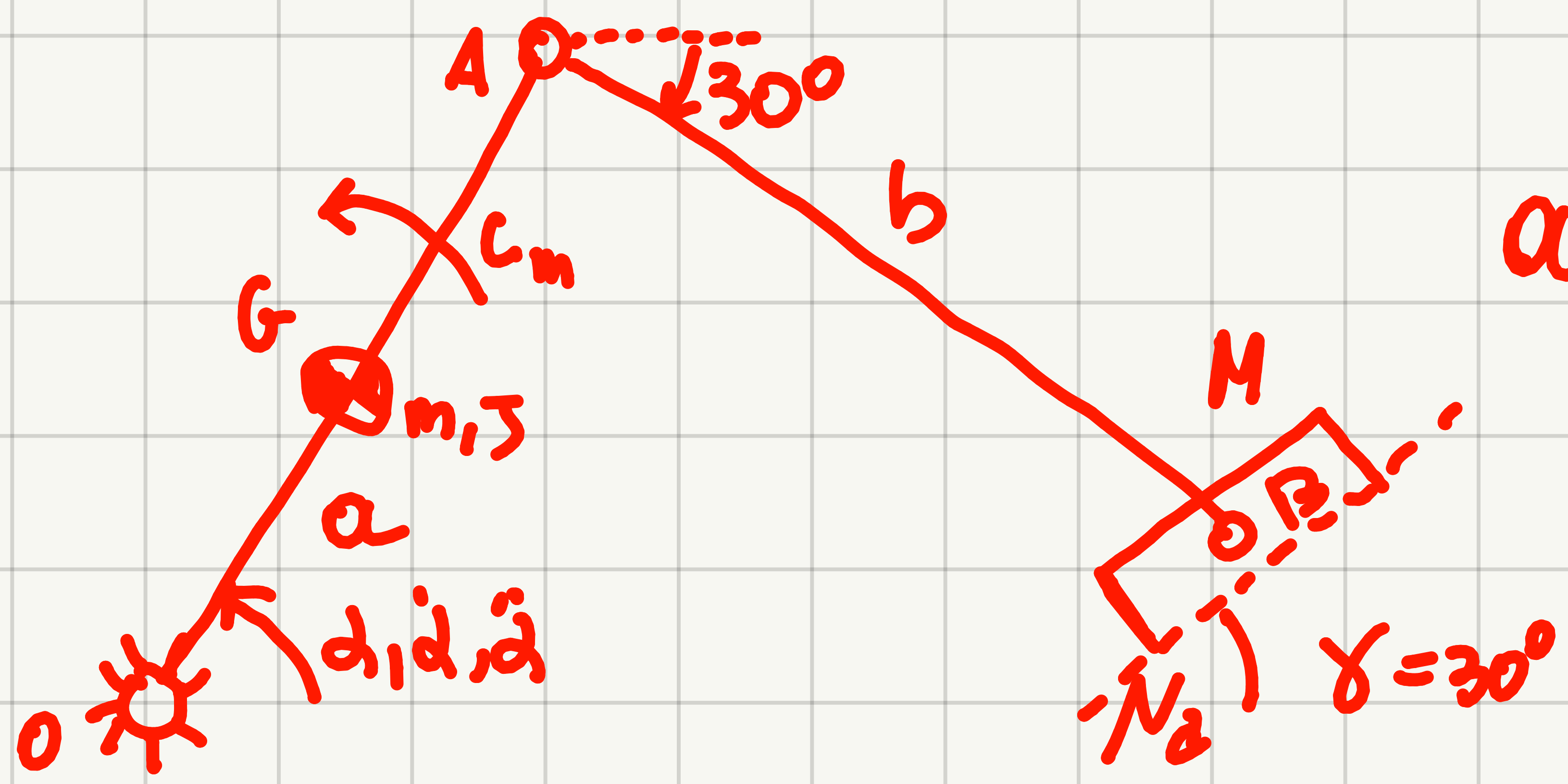
$$\frac{d}{dt}K = (m v_G a_G^{(t)} + J\dot{\alpha}\ddot{\alpha}) + (M v_B a_B)$$

$$\vec{v}_G = \cancel{\vec{v}_O} + \dot{\alpha}\hat{k} \times \frac{a}{2}(\cos(45)\hat{i} + \sin(45)\hat{j}) \qquad |\vec{v}_G| = 0{,}5\,m/s$$

$$\vec{a}_G = \cancel{\vec{a}_O} + \underbrace{\ddot{\alpha}\hat{k} \times \frac{a}{2}(\cos(45)\hat{i} + \sin(45)\hat{j})}_{t} \underbrace{- \dot{\alpha}^2 \frac{a}{2}(\cos(45)\hat{i} + \sin(45)\hat{j})}_{n}$$

$$|\vec{a}_G^{(t)}| = 0{,}5\,m/s^2 \qquad \frac{d}{dt}K = 1{,}51\,W$$

$$\sum P = (-P_{\parallel} + F_{\parallel})v_G - F_a v_B = -mg\cos(45)v_G + F\cos(45)v_G - \mu_d N v_B = 1{,}51\,W \implies F = 38{,}5\,N$$



$a = 1m \quad b = 2m \quad \mu_d = 0,2$

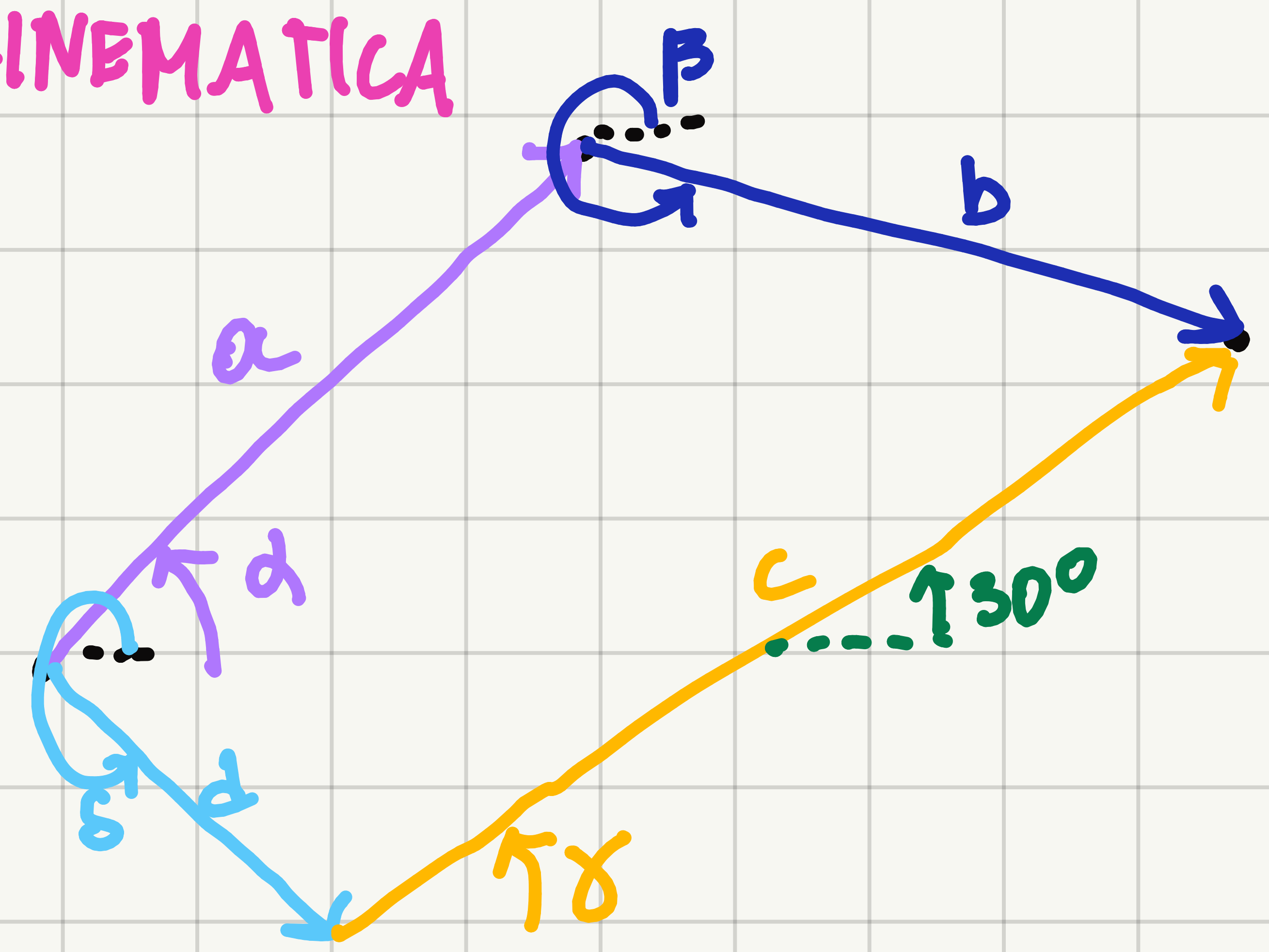
$J = 0,2\ Kg\, m^2 \quad m = 2Kg$

$M = 10\ Kg \quad \alpha = 45° \quad \dot{\alpha} = -1\ rad/s$

$\ddot{\alpha} = -1\ rad/s^2$

$\vec{v}_B, \vec{a}_B$? REAZIONI VINCOLARI B? C_m?

CINEMATICA



$a = 1m \quad \alpha = 45°$

$\dot{\alpha} = -1\ rad/s \quad \ddot{\alpha} = -1\ rad/s^2$

$b = 2m \quad \beta = 330° \quad \dot{\beta}, \ddot{\beta} \neq 0$

c $\quad \gamma = 30°$ FISSO

d, δ FISSI

$$\begin{cases} a\cos\alpha + b\cos\beta = c\cos\gamma + d\cos\delta \\ a\sin\alpha + b\sin\beta = c\sin\gamma + d\sin\delta \end{cases}$$

$$\begin{cases} -a\dot{\alpha}\sin\alpha - b\dot{\beta}\sin\beta = \dot{c}\cos\gamma \\ a\dot{\alpha}\cos\alpha + b\dot{\beta}\cos\beta = \dot{c}\sin\gamma \end{cases}$$

$$\begin{cases} b\dot{\beta}\sin\beta + \dot{c}\cos\gamma = -a\dot{\alpha}\sin\alpha \\ b\dot{\beta}\cos\beta - \dot{c}\sin\gamma = -a\dot{\alpha}\cos\alpha \end{cases}$$

$$\begin{vmatrix} b\sin\beta & \cos\gamma \\ b\cos\beta & -\sin\gamma \end{vmatrix} \cdot \begin{vmatrix} \dot{\beta} \\ \dot{c} \end{vmatrix} = \begin{vmatrix} -a\dot{\alpha}\sin\alpha \\ -a\dot{\alpha}\cos\alpha \end{vmatrix}$$

$$\begin{vmatrix} -1 & 0,866 \\ 1,732 & -0,5 \end{vmatrix} \cdot \begin{vmatrix} \dot{\beta} \\ \dot{c} \end{vmatrix} = \begin{vmatrix} 0,707 \\ 0,707 \end{vmatrix} \qquad \begin{cases} \dot{\beta} = 0,97\ rad/s \\ \dot{c} = 1,93\ m/s \end{cases}$$

$\vec{v}_M = \dot{c}\hat{c} = (1{,}93\,\hat{c})\,m/s$

$= \dot{c}(\cos(30)\hat{\imath} + \sin(30)\hat{\jmath}) = (1{,}67\hat{\imath} + 0{,}97\hat{\jmath})\,m/s$

$$\begin{cases} b\ddot{\beta}\sin\beta + b\dot{\beta}^2\cos\beta + \ddot{c}\cos\gamma = -a\ddot{\alpha}\sin\alpha - a\dot{\alpha}^2\cos\alpha \\ b\ddot{\beta}\cos\beta - b\dot{\beta}^2\sin\beta - \ddot{c}\sin\gamma = -a\ddot{\alpha}\cos\alpha + a\dot{\alpha}^2\sin\alpha \end{cases}$$

$$\begin{vmatrix} b\sin\beta & \cos\gamma \\ b\cos\beta & -\sin\gamma \end{vmatrix} \cdot \begin{vmatrix} \ddot{\beta} \\ \ddot{c} \end{vmatrix} = \begin{vmatrix} -a\ddot{\alpha}\sin\alpha - a\dot{\alpha}^2\cos\alpha - b\dot{\beta}^2\cos\beta \\ -a\ddot{\alpha}\cos\alpha + a\dot{\alpha}^2\sin\alpha + b\dot{\beta}^2\sin\beta \end{vmatrix}$$

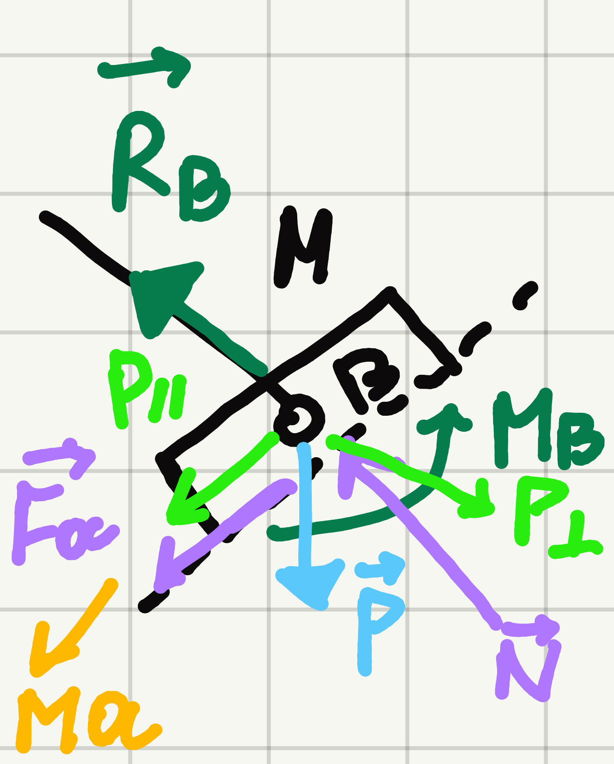
$$\begin{vmatrix} -1 & 0{,}866 \\ 1{,}732 & -0{,}5 \end{vmatrix} \cdot \begin{vmatrix} \ddot{\beta} \\ \ddot{c} \end{vmatrix} = \begin{vmatrix} -1{,}63 \\ 0{,}473 \end{vmatrix} \qquad \begin{cases} \ddot{\beta} = -0{,}41\,rad/s^2 \\ \ddot{c} = -2{,}35\,m/s^2 \end{cases}$$

$\vec{a}_M = \ddot{c}\hat{c} = (-2{,}35\,\hat{c})\,m/s^2$

$= \ddot{c}(\cos(30)\hat{\imath} + \sin(30)\hat{\jmath}) = (-0{,}303\hat{\imath} - 0{,}175\hat{\jmath})\,m/s$

! È CHIARO CHE, ESSENDO UN MOTO RETTILINEO, $\vec{a}_M^{(n)} = 0$

DINAMICA



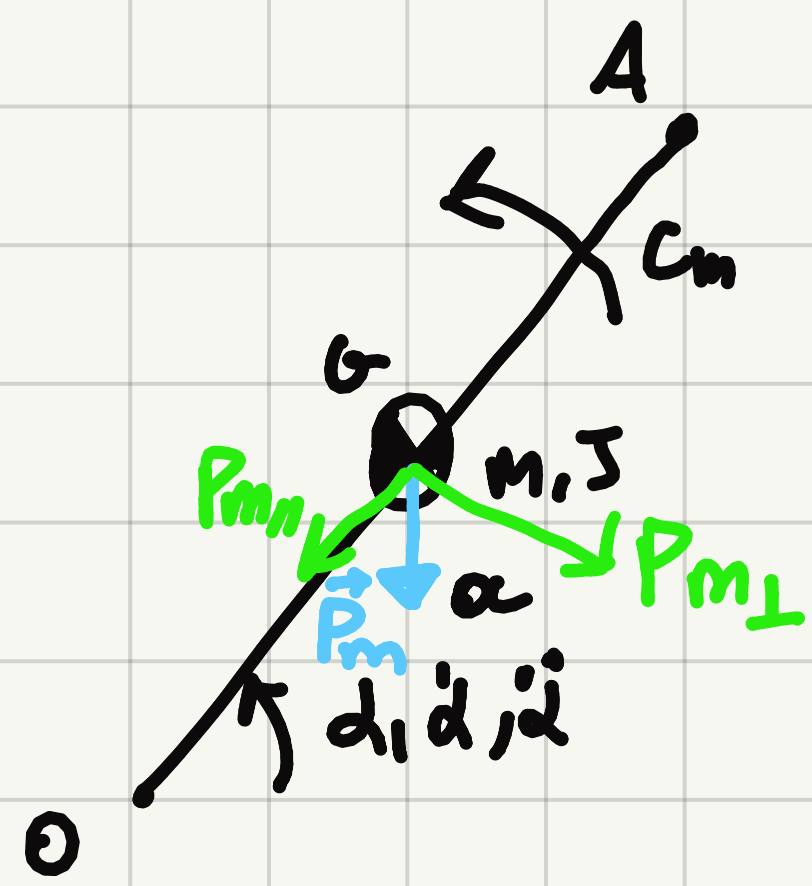
$$\begin{cases} -R_B\cos(\underbrace{90-\gamma}_{60}) - Mg\sin(30) - F_a - Ma = 0 \\ N + R_B\sin(60) - Mg\cos(30) = 0 \\ M_B = 0 \end{cases}$$

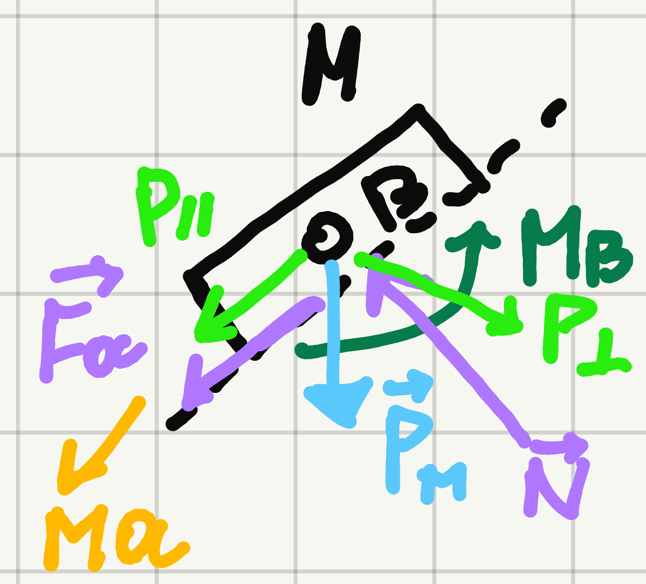
$-R_B\sin(60)) - Ma = 0$

$$\begin{cases} -R_B\cos(60) - Mg\sin(30) - \mu_d(Mg\cos(30) - \\ N = Mg\cos(30) - R_B\sin(60) \end{cases}$$

$\Rightarrow R_B = -130{,}2\,N \qquad N = 197{,}7\,N$

BILANCIO DI POTENZE: $\sum P = \frac{d}{dt} K$





$$\frac{d}{dt}K = (m v_G a_G^{(t)} + J \dot{\alpha} \ddot{\alpha}) + (M v_B a_B^{(t)})$$

$$\vec{v}_G = \cancel{\vec{v}_0} + \dot{\alpha} \hat{k} \times \frac{a}{2}(\cos(\alpha)\hat{i} + \sin(\alpha)\hat{j}) \qquad |\vec{v}_G| = \left|\frac{a\dot{\alpha}}{2}\right| = 0{,}5 \, m/s$$

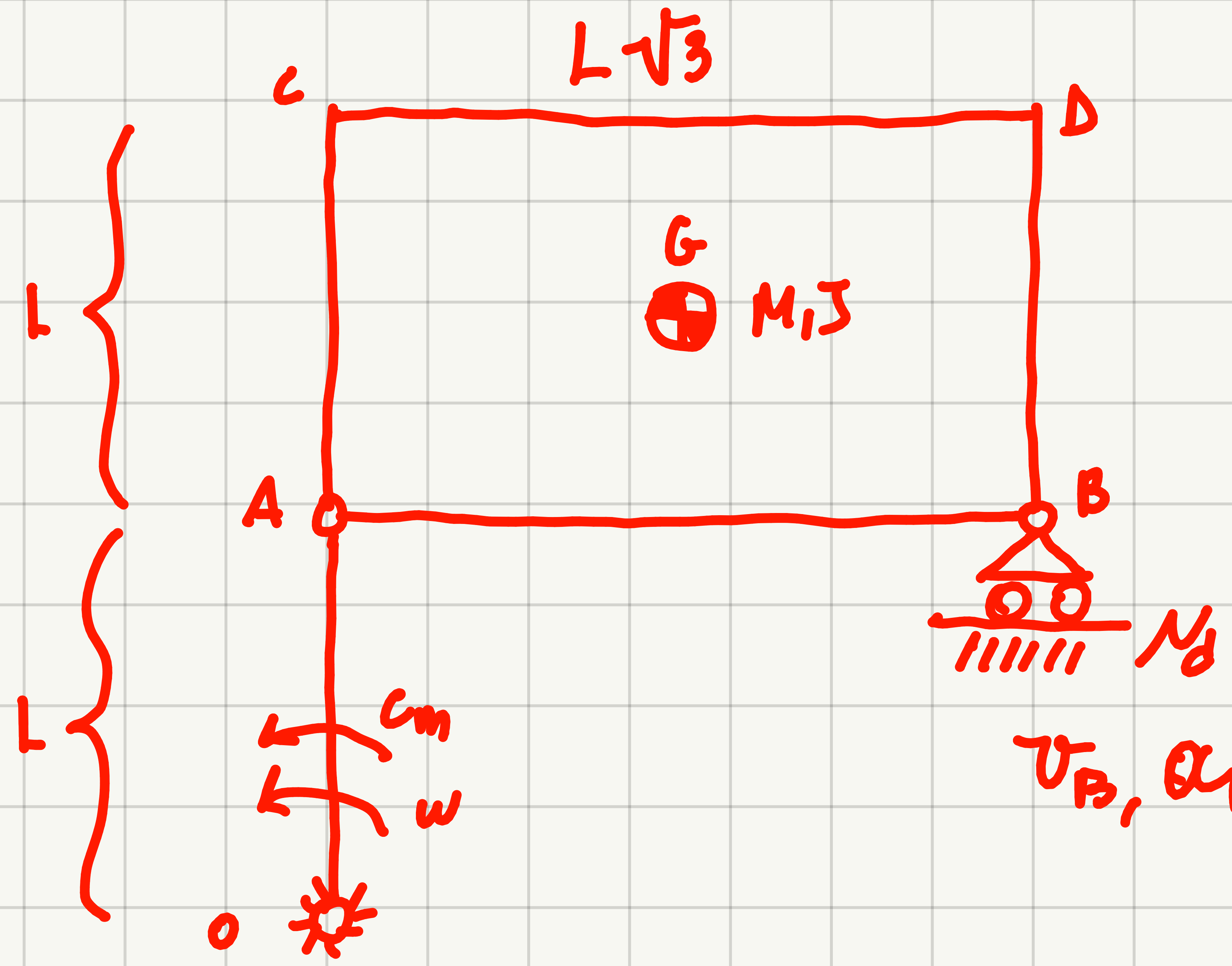
$$\vec{a}_G = \cancel{\vec{a}_0} + \ddot{\alpha} \hat{k} \times \frac{a}{2}(\cos(\alpha)\hat{i} + \sin(\alpha)\hat{j}) - \dot{\alpha}^2 (\cos(\alpha)\hat{i} + \sin(\alpha)\hat{j})$$

$$|a_G^{(t)}| = \left|\frac{a\ddot{\alpha}}{2}\right| = 0{,}5 \, m/s^2 \Rightarrow \frac{d}{dt}K = -44{,}7 \, W$$

$$\sum P = \vec{P} \cdot \vec{v}_G + C_m \dot{\alpha} + \vec{P}_M \cdot \vec{v}_M - F_a v_M$$

$$= -mg \, v_G \cos(45) + C_m \dot{\alpha} - Mg \, v_M \sin(30) - \mu_d N v_M$$

$$\Rightarrow C_m = -133{,}22 \, Nm$$



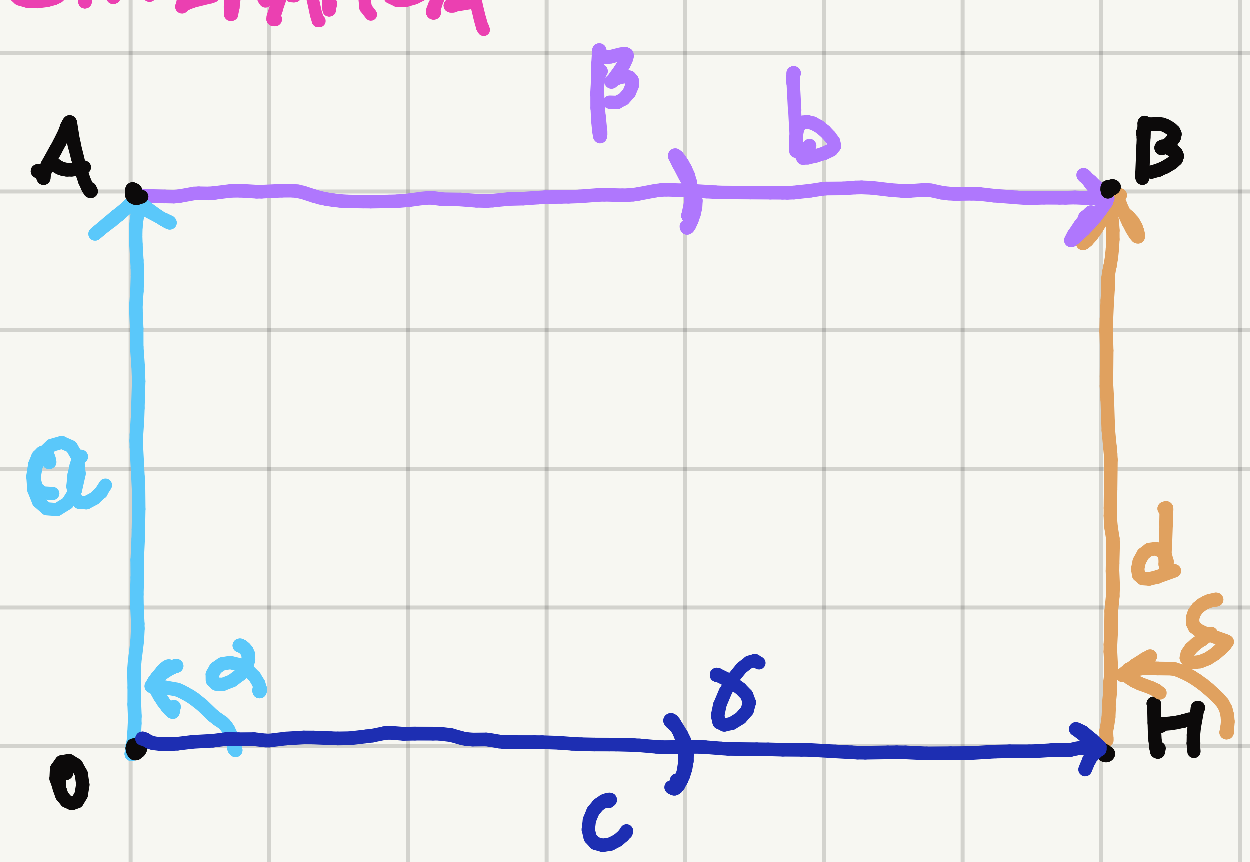
$M=10kg \quad J=1kgm^2$

$L=0,5m \quad \omega=10\, rad/s$

$\dot{\omega}=0\, rad/s^2 \quad \mu_d=0,4$

$v_B, a_B, \omega_{ABCD}, \dot{\omega}_{ABCD}, v_G, a_G, C_m$?

CINEMATICA



$a=0,5m \quad \alpha=90° \quad \dot{\alpha}=10\, rad/s \quad \ddot{\alpha}=0\, rad/s^2$

$b=0,866m$ FISSO $\beta=0° \quad \dot{\beta}, \ddot{\beta} \neq 0$

$c=0,866m \quad \dot{c}, \ddot{c} \neq 0 \quad \gamma=0°$ FISSO

d, δ FISSI

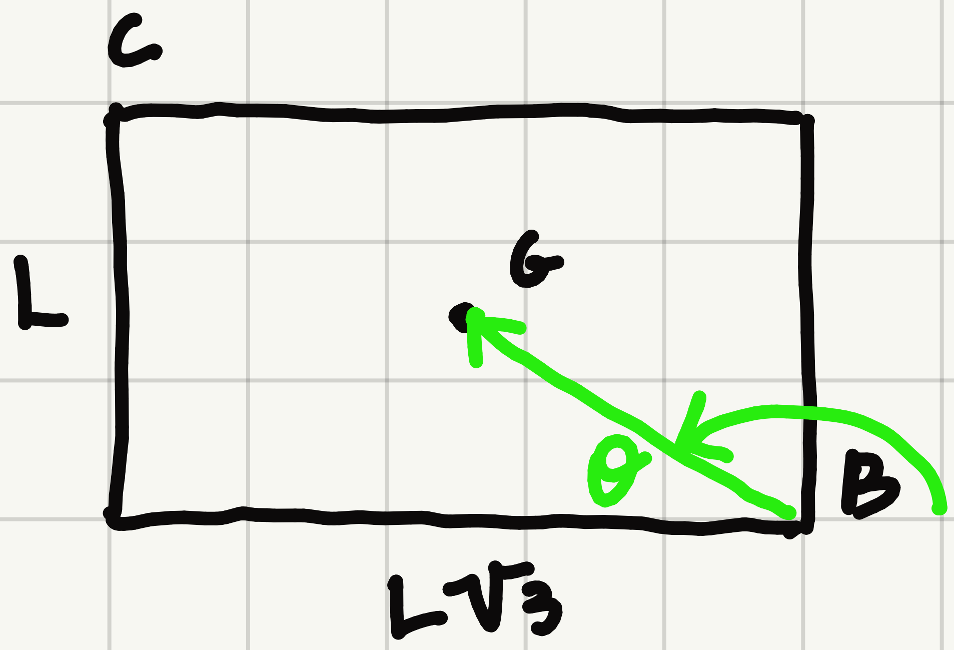
$$\begin{cases} a\cos\alpha + b\cos\beta = c + d\cos\delta \\ a\sin\alpha + b\sin\beta = d\sin\delta \end{cases}$$

$$\begin{cases} -a\dot{\alpha}\sin\alpha - b\dot{\beta}\sin\beta = \dot{c} \\ a\dot{\alpha}\cos\alpha + b\dot{\beta}\cos\beta = 0 \end{cases} \Rightarrow \begin{cases} \dot{c} = -5m/s \\ \dot{\beta} = 0 \end{cases}$$

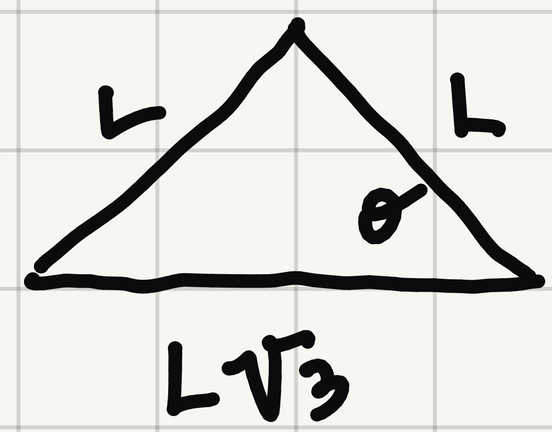
$\vec{v}_B = (-5\hat{i})m/s \quad \omega_{ABCD}=0$

$$\begin{cases} -a\dot{\alpha}^2\cos\alpha - b\ddot{\beta}\sin\beta - b\dot{\beta}^2\cos\beta = \ddot{c} \\ -a\dot{\alpha}^2\sin\alpha + b\ddot{\beta}\cos\beta - b\dot{\beta}^2\sin\beta = 0 \end{cases} \quad \begin{cases} \ddot{c} = 0 \\ \ddot{\beta} = 57,7\, rad/s^2 \end{cases}$$

$\vec{a}_B = 0 \quad \dot{\omega}_{ABCD} = (57,7\hat{k})\, rad/s^2$



$$BG = BC/2 = \frac{1}{2}\sqrt{L^2+3L^2} = L$$



$$L = \sqrt{L^2+3L^2-2L^2\sqrt{3}\cos\theta}$$

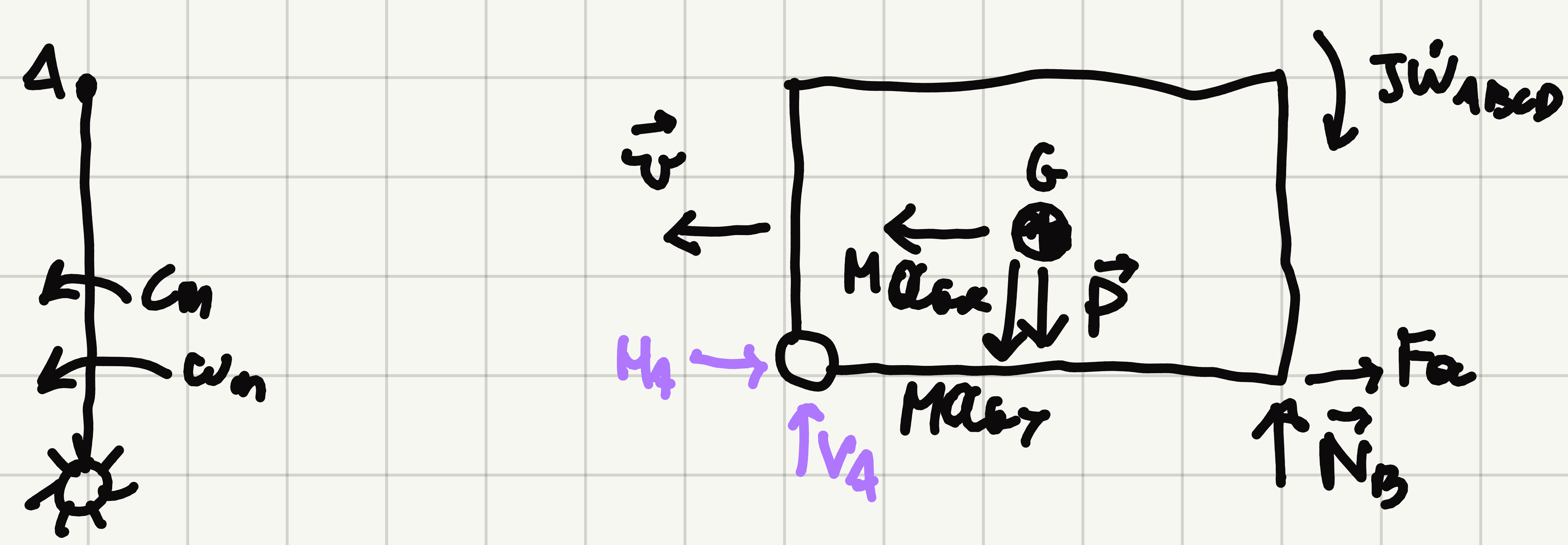
$$\Rightarrow \theta = 30^\circ$$

$$(G-B) = L\left(\cos(\pi-\theta)\,\hat{i} + \sin(\pi-\theta)\,\hat{j}\right) = L\left(-\frac{\sqrt{3}}{2}\hat{i} + \frac{1}{2}\hat{j}\right)$$

$$\vec{v}_G = \vec{v}_B + \cancel{\vec{\omega}_{ABCD} \times (G-B)} = (-5\,\hat{i})\ m/s$$

$$\vec{a}_G = \cancel{\vec{a}_B} + \vec{\dot{\omega}}_{ABCD} \times (G-B) \cancel{- \omega^2 (G-B)} = (-14{,}43\,\hat{i} - 25\,\hat{j})\ m/s^2$$

DINAMICA



$$\frac{d}{dt}K = (0) + M\vec{v}_G \cdot \vec{a}_G = M v_G a_{Gx} = 721{,}5\ W$$

$$\Sigma P = (C_m \omega) + (-M a_{Gx} - F_a) \qquad F_a = \mu_d N$$

$$\Sigma M_A = 0 \qquad -J\dot{\omega}_{ABCD} + N_B \cdot L\sqrt{3} + L M a_{Gy} \sin(60) - M g L \sin(60) -$$

$$- M a_x L \sin(30) = 0 \rightarrow N_B = 28{,}2 N$$

$C_m = 78{,}2 Nm$