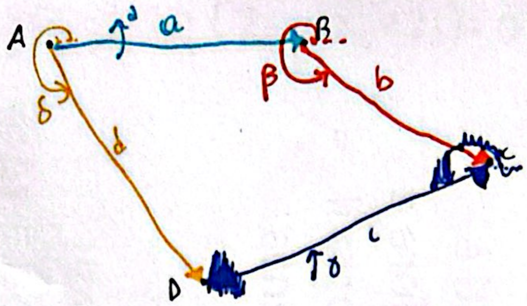


$a = 2m$ $\alpha = 0°$ $\dot{\alpha} = 1\,rad/s$ $\ddot{\alpha} = 1\,rad/s^2$

$b = 1m$ $\beta = 315°$ $\dot{\beta}, \ddot{\beta} \neq 0$

d, δ FISSI

$c = 1{,}5m$ $\gamma = 30°$ $\dot{\gamma}, \ddot{\gamma} \neq 0$

OBIETTIVI: $\dot{\gamma}, \ddot{\gamma} = \omega_{disco}, \dot{\omega}_{disco}$

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

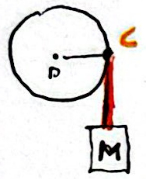
$$\begin{cases} b\dot{\beta}\sin\beta - c\dot{\gamma}\sin\gamma = -a\dot{\alpha}\sin\alpha \\ b\dot{\beta}\cos\beta - c\dot{\gamma}\cos\gamma = -a\dot{\alpha}\cos\alpha \end{cases} \quad \begin{vmatrix} b\sin\beta & -c\sin\gamma \\ b\cos\beta & -c\cos\gamma \end{vmatrix} \cdot \begin{vmatrix} \dot{\beta}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

$$\begin{vmatrix} -0{,}707 & -0{,}75 \\ 0{,}707 & -1{,}299 \end{vmatrix} \cdot \begin{vmatrix} \dot{\beta} \\ \dot{\gamma} \end{vmatrix} = \begin{vmatrix} 0 \\ -2 \end{vmatrix} \Rightarrow \dot{\beta} = -1{,}04\,rad/s \quad \dot{\gamma} = 0{,}976\,rad/s$$

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

$\ddot{\beta} = -0{,}432\,rad/s^2$ $\ddot{\gamma} = 2{,}14\,rad/s^2$

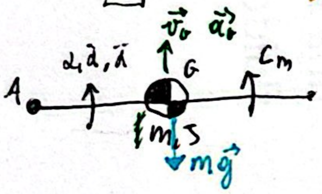
$$\begin{vmatrix} -0{,}707 & -0{,}75 \\ 0{,}707 & -1{,}299 \end{vmatrix} \cdot \begin{vmatrix} \ddot{\beta} \\ \ddot{\gamma} \end{vmatrix} = \begin{vmatrix} -1{,}527 \\ -3{,}479 \end{vmatrix}$$

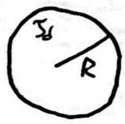


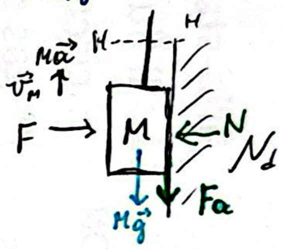
FILO INESTENSIBILE $\vec{v}_M = \vec{v}_C^{(c)}$ $\vec{a}_M = \vec{a}_C^{(c)}$ $(C-D) = R\hat{\imath}$

$$\vec{v}_M = \cancel{\vec{v}_D} + \vec{\dot{\gamma}} \times (C-D) = \dot{\gamma}R\hat{k}\times\hat{\imath} = (0{,}39\hat{\jmath})\,m/s$$

$$\vec{a}_M^{(c)} = \cancel{\vec{a}_D} + \vec{\ddot{\gamma}} \times (C-D) = \ddot{\gamma}R\hat{\jmath} = (0{,}976\hat{\jmath})\,m/s^2$$







$\Sigma P_y = 0$

$N = F$

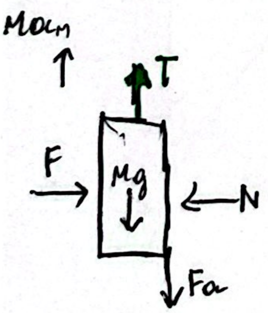
BILANCIO DI POTENZE: $\frac{d}{dt}K = \Sigma P$

$$\vec{v}_G = \vec{v}_A + \vec{\dot{\alpha}} \times (G-A) = \frac{a\dot{\alpha}}{2}\hat{k}\times\hat{\imath} = (1\hat{\jmath})\,m/s \qquad \vec{a}_G^{(t)} = \vec{a}_A + \vec{\ddot{\alpha}} \times (G-A) = \frac{a\ddot{\alpha}}{2}\hat{k}\times\hat{\imath} = (1\hat{\jmath})\,m/s^2$$

$$\frac{d}{dt}K = (m v_G a_G + J\dot{\alpha}\ddot{\alpha}) + (J_d\dot{\gamma}\ddot{\gamma}) + (M v_M a_M) = 4{,}19W$$

$$\Sigma P = (m\vec{g}\cdot\vec{v}_G + \vec{C}_m\cdot\vec{\dot{\alpha}}) + (0) + (M\vec{g}\cdot\vec{v}_M + \vec{F}_a\cdot\vec{v}_M)$$

$$= -mg v_G + C_m\dot{\alpha} - Mg v_M - N_d \overset{F}{N} v_M \quad \Rightarrow C_m = 36{,}13Nm$$



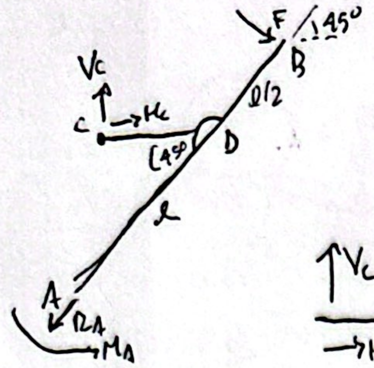
$$\Sigma F_y = Ma_M$$

$$T - Mg - N_d F = Ma_M$$

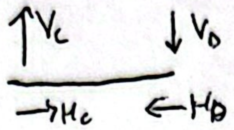
$$T = M(a_M + g) + N_d F = 31{,}79\,N$$

$n = 3\cdot 2 - (2_A + 2_C + 2_D) = 0$

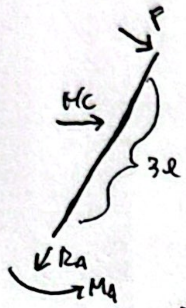
$l/2 = \overline{CD}\cdot\cos(45) \rightarrow \overline{CD} = \frac{\sqrt{2}}{2} l$



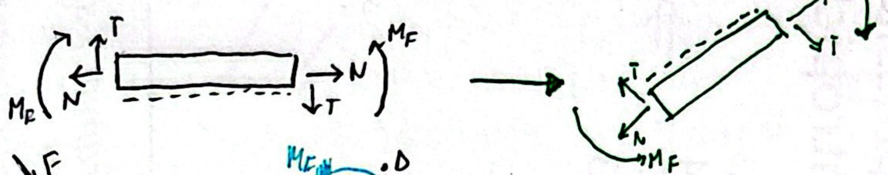
$$\begin{cases} F\cos(45) + H_C - R_A\cos(45) = 0 \\ -F\sin(45) + V_C - R_A\sin(45) = 0 \\ D\ \ -V_C\cdot\overline{CD} - F\,l/2 + M_A = 0 \end{cases}$$

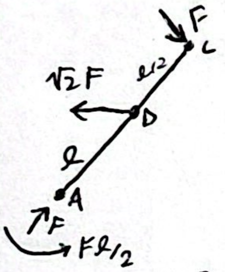


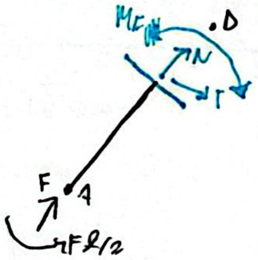
$$\begin{cases} H_C = H_D \\ V_C = V_D \\ D\ \ -V_C\cdot\overline{CD} = 0 \end{cases} \qquad V_C = 0 \qquad V_D = 0$$



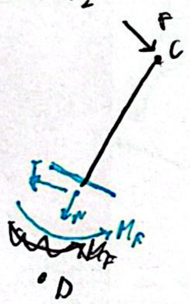
$$\begin{cases} F\cos(45) + H_C - R_A\cos(45) = 0 \\ -F\sin(45) - R_A\sin(45) = 0 \\ A\ \ -H_C\,l - F\cdot 3l + M_A = 0 \\ \quad -H_C\, l\sin(45) \end{cases} \qquad \begin{cases} H_C = -F\sqrt{2} \\ R_A = -F \\ M_A = F\,l/2 \end{cases}$$





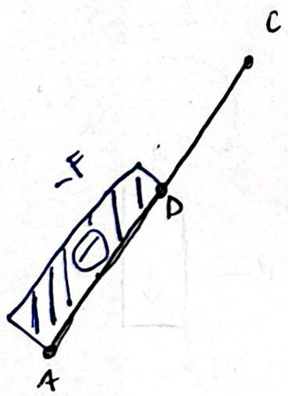


$$\begin{cases} N = -F \\ T = 0 \\ M_F = F\,l/2 \end{cases}$$

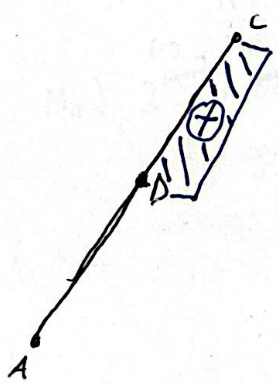


$$\begin{cases} N = 0 \\ T = F \\ M = Fx \qquad M(0) = 0 \qquad M(l/2) = F\,l/2 \end{cases}$$

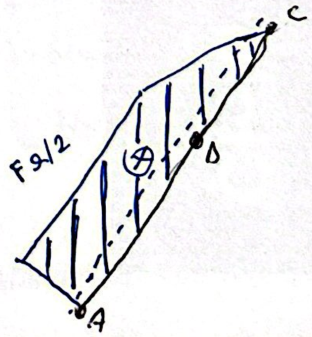
N



T



M_F



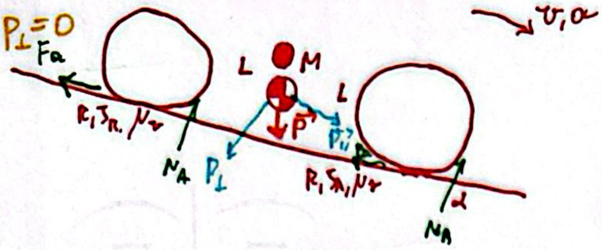
$\omega_v = \tau\omega_m \qquad \dot\omega_v = \tau\dot\omega_m$

$v = \cancel{v_{CR}} + R\omega_v = \tau R\omega_m$

$a = \tau R\dot\omega_m$

$\Sigma F_y = 0$

$N_A + N_B - P_\perp = 0$



BILANCIO DI POTENZE: $P_1 + P_2 + P_r = 0$

$P_1 = C_m\omega_m - J_m\dot\omega_m\omega_m$

$P_2 = \Sigma P^{(e)} - \frac{d}{dt}K^{(e)}$

- $\Sigma P^{(e)} = (P_\parallel - Fa_A - Fa_B)\,v = \tau R(Mg\sin\alpha - f_v\underbrace{(N_A+N_B)}_{Mg\cos\alpha})\,\omega_m = 3{,}39\,\omega_m$
- $\frac{d}{dt}K^{(e)} = Mva + 2J_R\dot\omega_v\omega_v = \tau^2(R^2M + 2J_R)\,\dot\omega_m\omega_m = 0{,}048\,\dot\omega_m\omega_m$

$C_m\omega_m - J_m\dot\omega_m\omega_m + 3{,}39\,\omega_m - 0{,}048\,\dot\omega_m\omega_m + P_r = 0$

CASO 1) REGIME C_m, ω_m?

$C_m\omega_m + 3{,}39\,\omega_m + P_r = 0 \qquad P_1 = C_m\omega_m \gtrless 0\,? \qquad P_2 = 3{,}39\,\omega_m > 0 \Rightarrow$ MOTO RETROGRADO

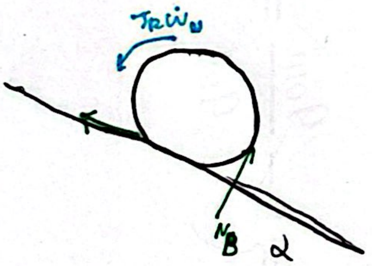
$P_r = -(1-\eta_r)\cdot 3{,}39\,\omega_m \qquad C_m\omega_m + 3{,}39\,\omega_m - (1-\eta_r)\cdot 3{,}39\,\omega_m = 0 \qquad C_m = -2{,}71\,Nm$

$C_m = 60 - \frac{60}{3000}\frac{Nm}{rpm}\,\omega_s = 60 - 0{,}02\,\omega_m \qquad \omega_s = 3136\ rpm$

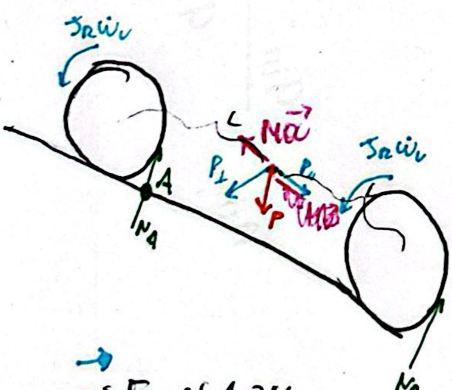
CASO 2) $a = 1{,}5\ m/s^2 \qquad C_m$? $\qquad \dot\omega_m = 100\ rad/s^2$

$(C_m - 50)\,\omega_m + (-1{,}41)\,\omega_m + P_r = 0 \qquad P_1 = C_m\omega_m \gtrless 0\,? \qquad P_2 < 0 \Rightarrow$ MOTO DIRETTO

$P_r = -(1-\eta_d)(C_m - 50)\,\omega_m \qquad (C_m - 50)\,\omega_m + (-1{,}41)\,\omega_m - (1-\eta_d)(C_m-50)\,\omega_m = 0 \qquad C_m = 51{,}57\,Nm$



$M)\ J_R\dot\omega_v + \cancel{MAR}\ f_v N_B R - F_a L = 0$



$M_A)\ 2J_R\dot\omega_v + (M\ddot x - Mg\sin\alpha)\,R -$

$- Mg\cos\alpha\,(L - f_v R) + N_B\cdot 2L = 0$

$\rightarrow N_A = 709{,}8\,N \qquad N_B = P_\perp - N_A$

$\rightarrow F_a = 64{,}2\,N$

$F_{a,lim} = f_s N_B = 567{,}8\,N \qquad F_a \le F_{a,lim} \Rightarrow$ ADERENZA VERIFICATA