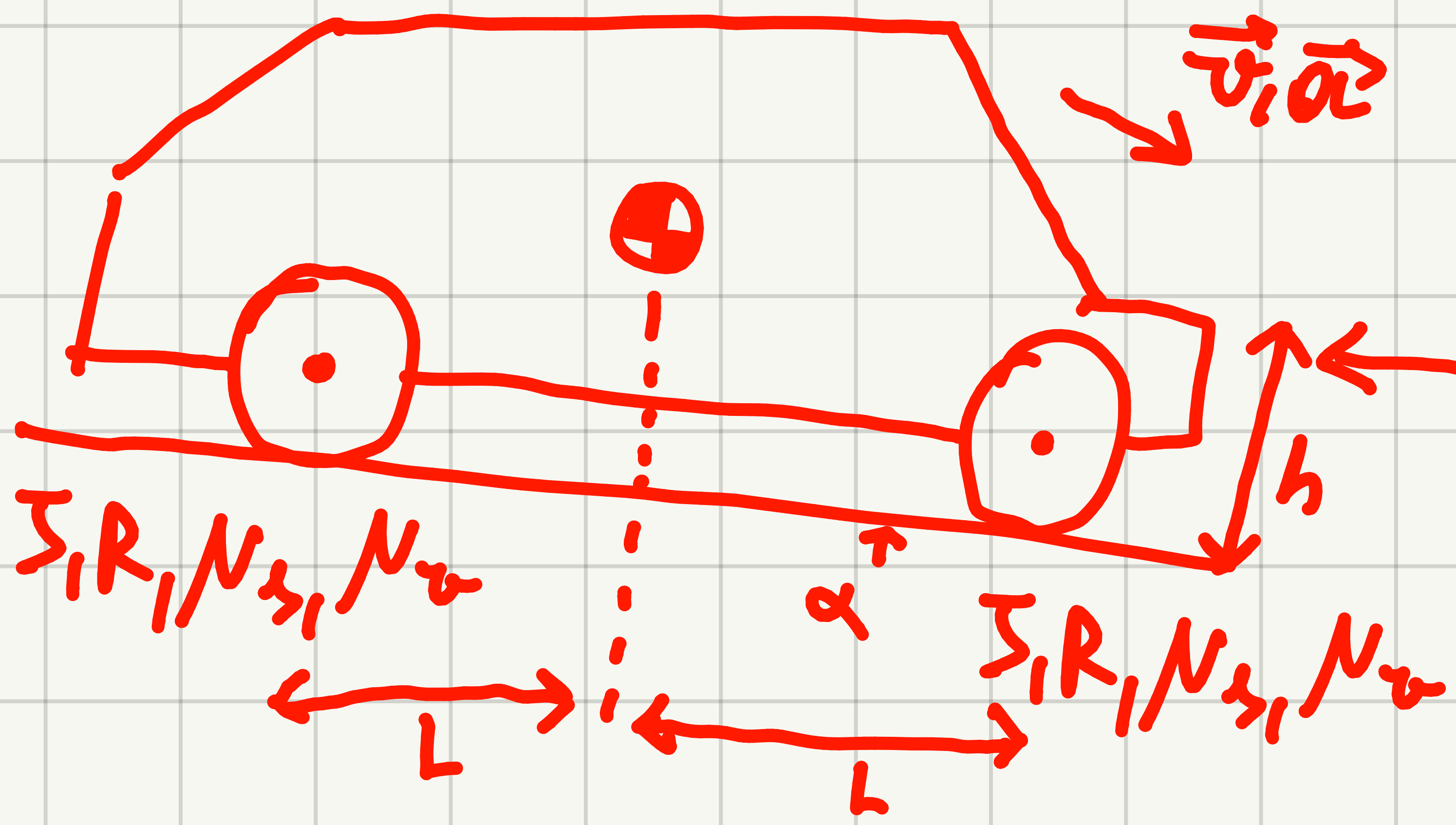


$M = 1000\,kg$ $\quad J = 2\,kgm^2$

$J_m = 0{,}01\,kgm^2$ $\quad F = 500\,N$

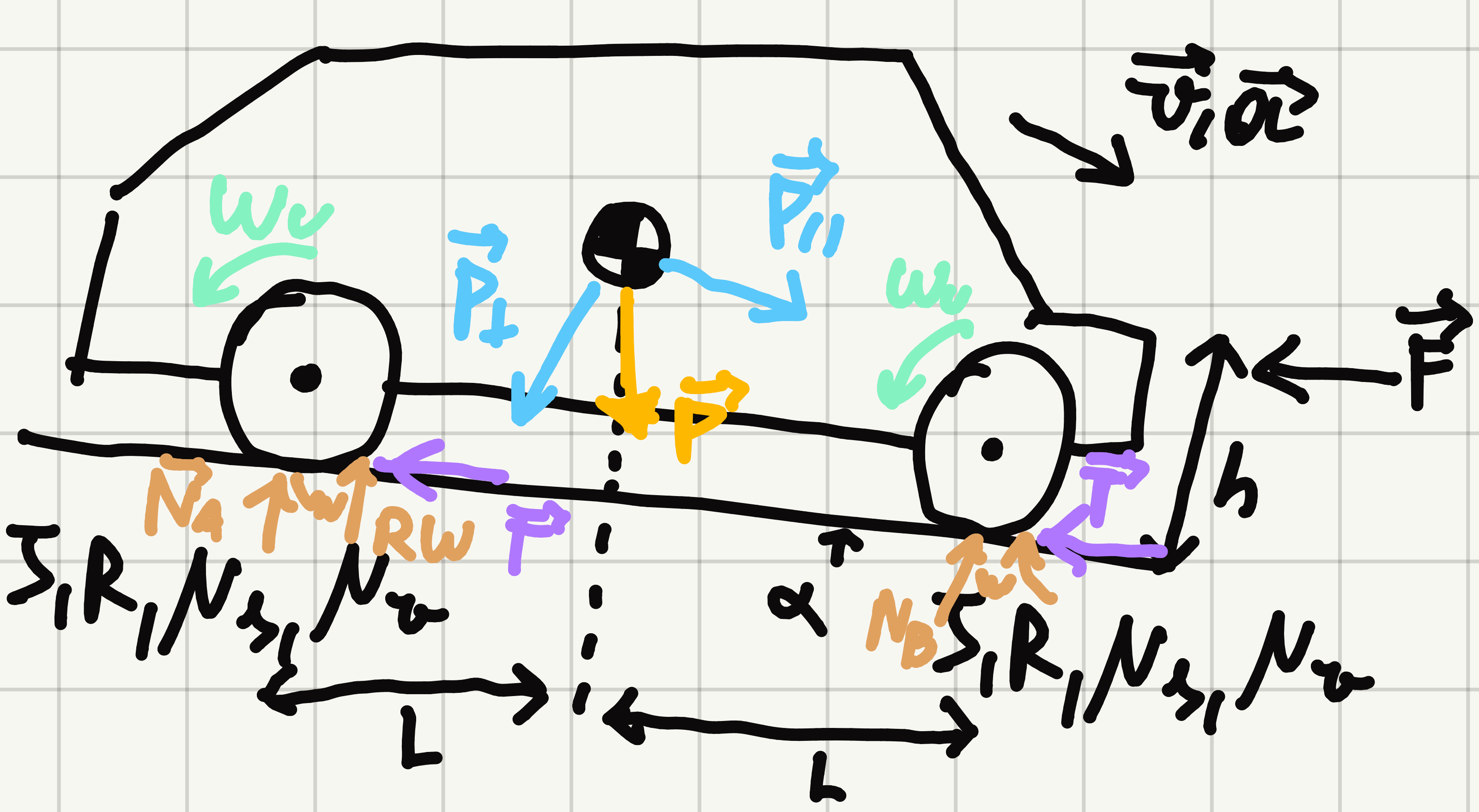
$R = 0{,}5\,m$ $\quad h = 1\,m$ $\quad L = 1\,m$

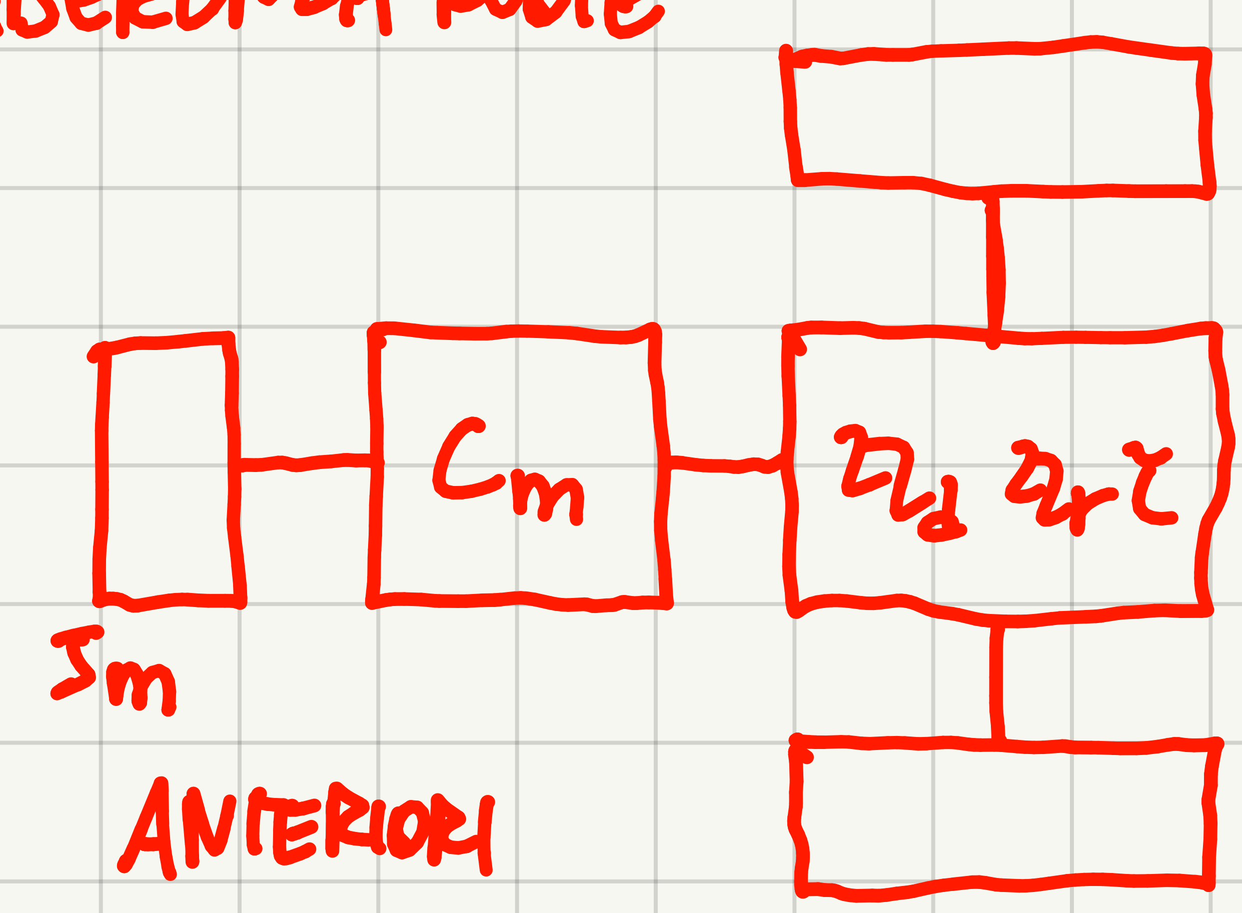
$\alpha = 5^\circ$ $\quad \eta_d = 0{,}9$ $\quad \eta_r = 0{,}45$ $\quad \tau = 1/10$ $\quad g = 9{,}81\,m/s^2$ $\quad C_m = A - B\omega_m$

$A = 1000\,Nm$ $\quad B = 300\,Nm/rad/s$ $\quad \mu_s = 0{,}8$ $\quad \mu_v = 0{,}2$ $\quad m_{ruote} \simeq 0$

1) C_m, ω_m A REGIME MOTO $\quad C_m = A - B\omega_m$

2) $a = 3\,m/s^2$ $\quad C_m$? $\quad$ VERIFICA ADERENZA RUOTE





LEGAMI CINEMATICI

$\vec\omega_v = \tau\vec\omega_m$ $\qquad |\vec v_A| = |\vec v_B| = |\vec v_G| = R\omega_v = \tau R\omega_m$

$\dot{\vec\omega}_v = \tau\dot{\vec\omega}_m$ $\qquad |\vec a_A^{(c)}| = |\vec a_B^{(c)}| = |\vec a_G^{(c)}| = \tau R\dot\omega_m$

BILANCIO DI POTENZE) $\quad P_1 + P_2 + P_T = 0$

- $P_1 = \sum P^{(M)} - \frac{d}{dt}K^{(M)} = C_m\omega_m - J_m\omega_m\dot\omega_m$

- $P_2 = \sum P^{(v)} - \frac{d}{dt}K^{(v)}$

$$-\frac{d}{dt}K^{(v)} = 2(J\omega_v\dot\omega_v) + M v_A a_A = 2J\omega_v\dot\omega_v + R^2 M\omega_v\dot\omega_v$$

$$-\sum P^{(u)} = (P_{//} - F)v - (T_A + T_B) =$$

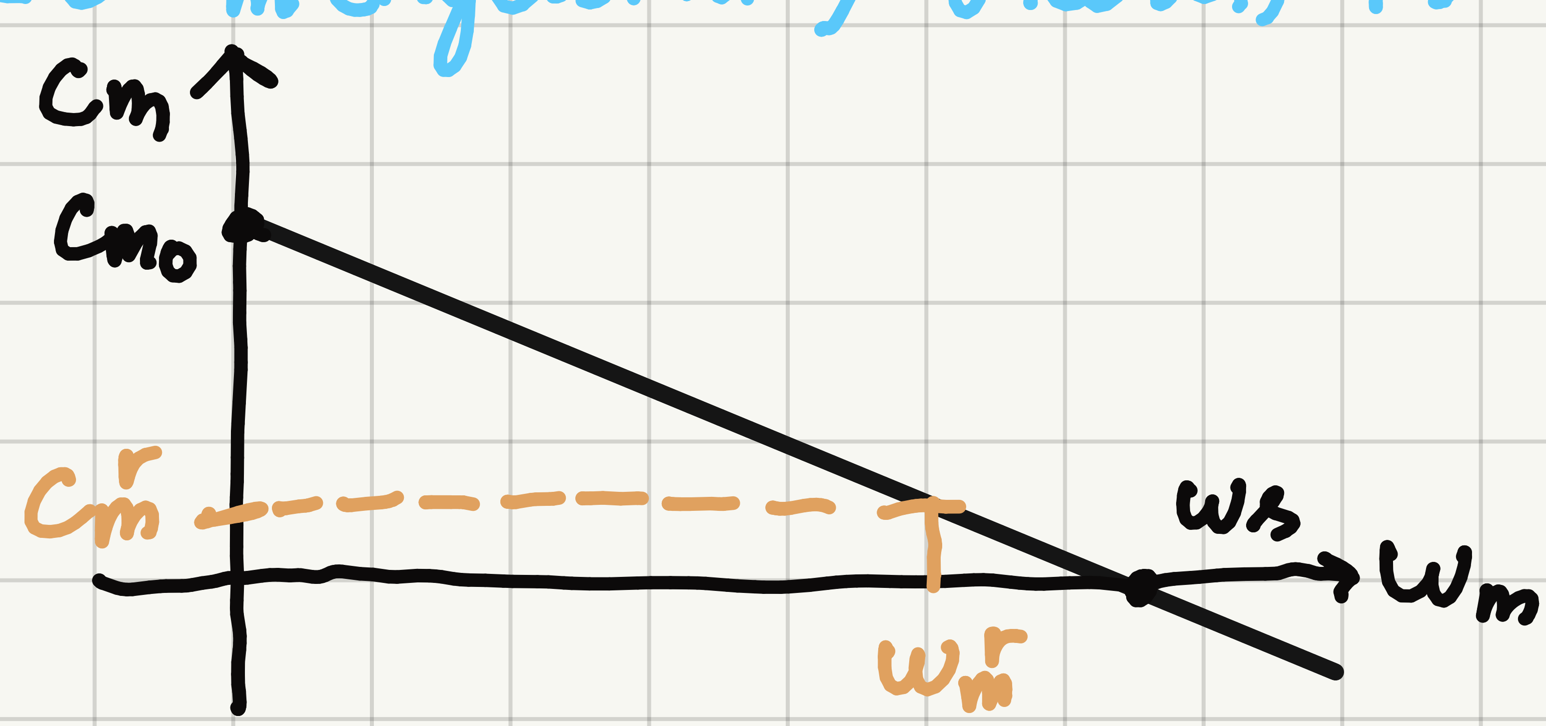
$$= Mgv\sin\alpha - Fv - \mu_v R\omega_v (N_A + N_B)$$

- $\sum F_y = 0 \quad N_A + N_B - P_\perp = 0 \quad N_A + N_B = Mg\cos\alpha$

$$\Rightarrow \sum P^{(u)} = MgR\tau\omega_m\sin\alpha - FR\tau\omega_m - \mu_v R\tau\omega_m Mg\cos\alpha$$

$$C_m\omega_m - J_m\omega_m\dot{\omega}_m + R\tau\omega_m(Mg(\sin\alpha - \mu_v\cos\alpha) - F) -$$

$$-2J\tau^2\omega_m\dot{\omega}_m + P_r = 0$$



$C_{m0} = A = 1000\,Nm$

$\omega_s = A/B = 3{,}33\ rad/s$

CASO 1) REGIME $\Rightarrow a, \dot{\omega}, \frac{d}{dt}K = 0 \quad C_m^r, \omega_m^r$

$P_2 = -79{,}98\omega_m < 0 \Rightarrow$ MOTO DIRETTO $\quad P_r = -(1-\eta_d)P_1$

$$\cancel{C}_m\cancel{\omega}_m + R\tau\cancel{\omega}_m(Mg(\sin\alpha - \mu_v\cos\alpha) - F) - (\cancel{1} - \eta_d)C_m\cancel{\omega}_m = 0$$

$$\Rightarrow C_m = \frac{R\tau(Mg(\sin\alpha - \mu_v\cos\alpha) - F)}{\eta_d} = 88{,}9\,Nm$$

$C_m^r = A - B\omega_m \Rightarrow \omega_m^r = 3{,}04\ rad/s \qquad P_1 > 0$ ✓

CASO 2) $a = 3\,m/s^2 \quad C_m$?

$$a = \tau R\dot{\omega}_m \Rightarrow \dot{\omega}_m = \frac{a}{\tau R} = 60\ rad/s$$

$$P_1 = \overbrace{C_m\omega_m}^{>0} - \overbrace{J_m\omega_m\dot{\omega}_m}^{>0} \quad ?$$

$\Rightarrow$ MOTO DIRETTO

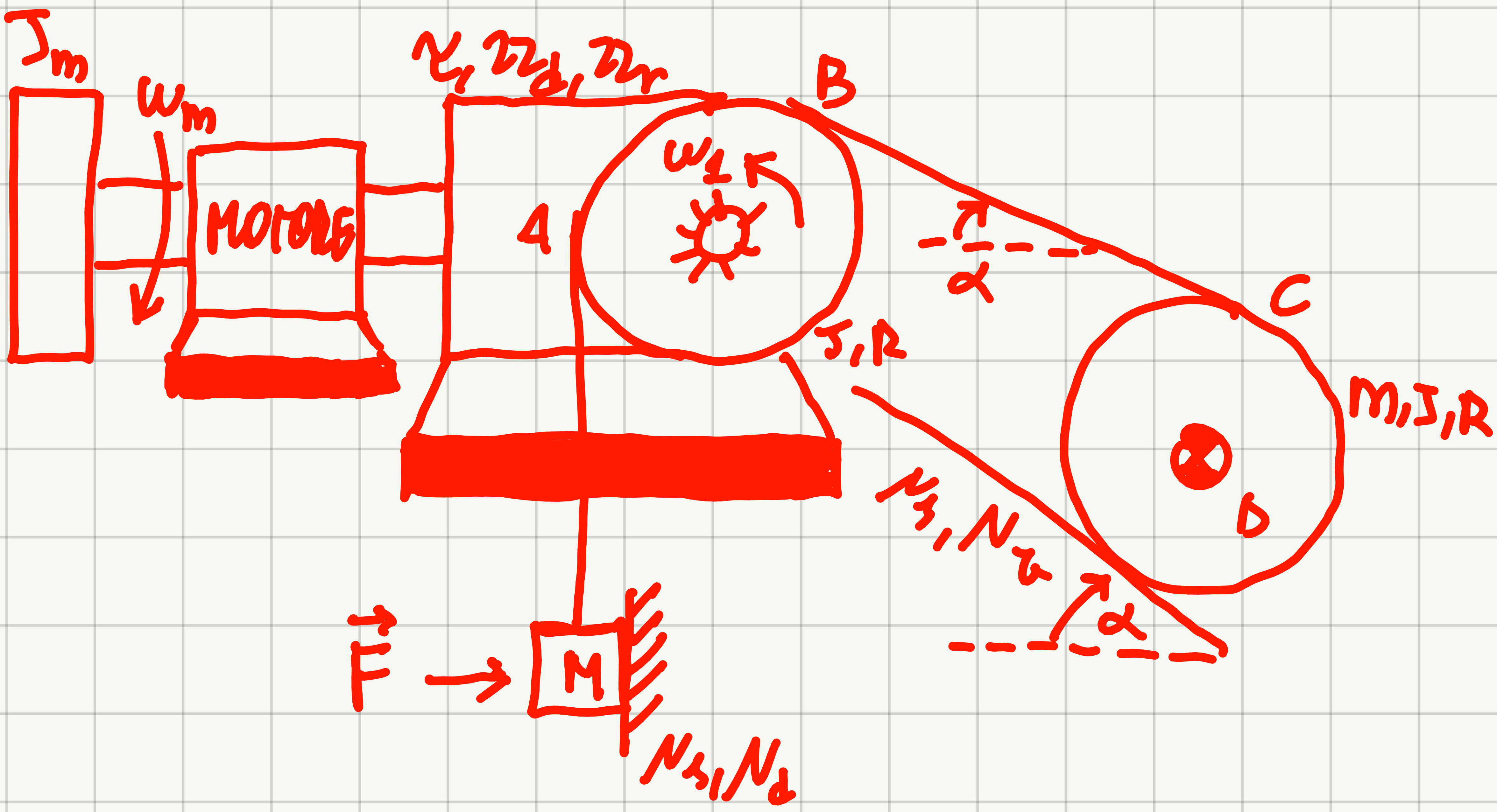
$$P_2 = \underbrace{R\tau\omega_m(Mg(\sin\alpha - \mu_v\cos\alpha) - F)}_{<0} \underbrace{-2J\tau^2\omega_m\dot{\omega}_m}_{<0} \underbrace{-R^2M\tau^2\omega_m\dot{\omega}_m}_{<0}$$

$$\cancel{C}_m \cancel{\omega}_m - \cancel{J}_m \cancel{\omega}_m \cancel{\dot{\omega}}_m + R\tau \cancel{\omega}_m \left(Mg(\sin\alpha - N_v \cos\alpha) - F\right) -$$

$$- \tau^2 \cancel{\omega}_m \dot{\omega}_m (2J + MR^2) - (\cancel{1} - \eta_d)(C_m \cancel{\omega}_m - J_m \cancel{\omega}_m \dot{\omega}_m) = 0$$

$$C_m = \frac{\eta_d J_m \dot{\omega}_m - R\tau(Mg(\sin\alpha - N_v\cos\alpha) - F) + \tau^2 \dot{\omega}_m (2J + MR^2)}{\eta_d} = 258{,}8\,\mathrm{NM}$$

$P_1 > 0$ ✓



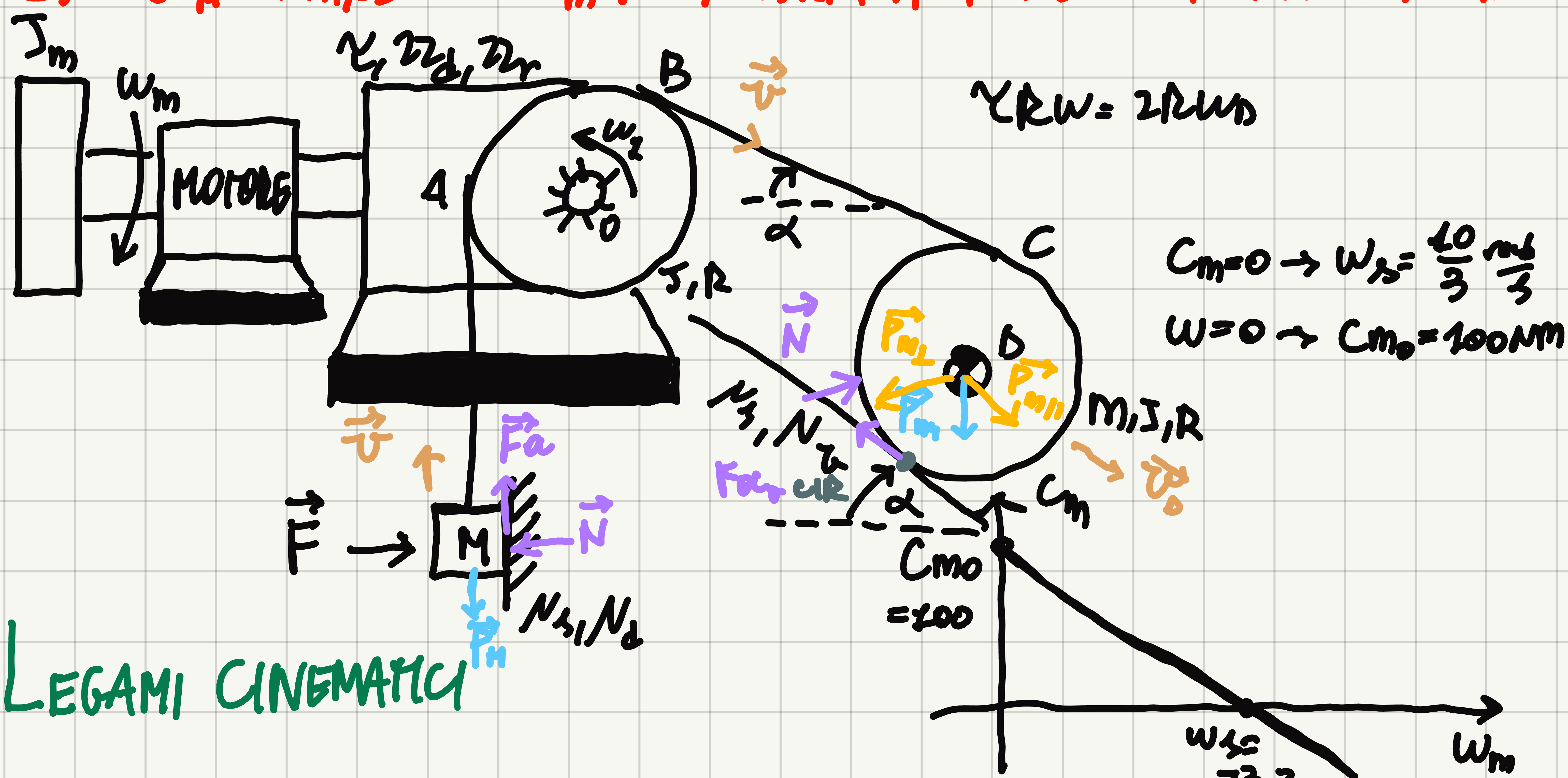
$M = 100\,kg$ $m = 20\,Kg$ $J_m = 0{,}1\,Kg\,m^2$ $J = 2\,Kg\,m^2$ $R = 0{,}5\,m$ $r = 0{,}75\,m$

$\alpha = 30°$ $F = 200\,N$ $\eta_d = 0{,}9$ $\eta_r = 0{,}45$ $\tau = 1/10$ $\mu_s = 0{,}8$ $\mu_d = 0{,}2$

$\mu_v = 0{,}05$ $C_m = A - B\omega_m$, $A = 100\,Nm$ $B = 30\,Nm/rad/s$

a) REGIME $\Rightarrow C_m, \omega_m$ M IN SALITA

b) $a_M = 1\,m/s^2 \Rightarrow C_m$? E VERIFICA DI ADERENZA DISCO SUL PIANO



$\tau R\omega = 2R\omega_D$

$C_m = 0 \rightarrow \omega_s = \frac{10}{3}\,\frac{rad}{s}$

$\omega = 0 \rightarrow C_{m0} = 100\,Nm$

LEGAMI CINEMATICI

$\omega_1 = \tau\omega_m$ $\dot{\omega}_1 = \tau\dot{\omega}_m$ $v = \cancel{v_O} + R\omega_1 = \tau R\omega_m$ $a = \tau R\dot{\omega}_m$

$v = v_B = v_C = \cancel{v_{CIR}} + 2R\omega_D \Rightarrow \omega_D = \frac{\tau}{2}\omega_m$ $\dot{\omega}_D = \frac{\tau}{2}\dot{\omega}_m$

$v_D = \cancel{v_{CIR}} + R\omega_D = \frac{\tau}{2}R\omega_m$ $a_D = \tau/2\,R\dot{\omega}_m$

BILANCIO DI POTENZE) $P_1+P_2+P_T=0$

$P_1)$ $\sum P^{(m)}-\frac{d}{dt}K^{(m)}=(\vec{C}_m\cdot\vec{\omega}_m-J_m\dot{\vec{\omega}}_m\cdot\vec{\omega}_m)=C_m\omega_m-J_m\dot{\omega}_m\omega_m$

$P_2)$ $\sum P^{(u)}-\frac{d}{dt}K^{(u)}$

$N=mg\cos(\alpha)$

- $\sum P^{(u)}=-Mgv-F_av+mgv_D\sin(\alpha)-\mu_v N v_D=$

$=-\tau RMg\omega_m-\tau\mu_d RF\omega_m+\frac{\tau}{2}Rmg\sin(\alpha)\omega_m-\frac{\tau}{2}\mu_v mg\cos(\alpha))\omega_m$

$=\tau R(-Mg-\mu_d F+\frac{mg}{2}\sin(\alpha)-\frac{mg}{2}\mu_v\cos(\alpha))\omega_m=-48{,}8\omega_m$

- $\frac{d}{dt}K=Mva+J\dot{\omega}_1\omega_1+mv_Da_D+J\dot{\omega}_D\omega_D=$

$=\tau^2R^2M\dot{\omega}_m\omega_m+\tau^2J\dot{\omega}_m\omega_m+\frac{\tau^2}{4}R^2m\dot{\omega}_m\omega_m+$

$+\frac{\tau^2}{4}J\dot{\omega}_m\omega_m=\tau^2(R^2M+J+\frac{R^2}{4}m+\frac{J}{4})\dot{\omega}_m\omega_m=0{,}28\dot{\omega}_m\omega_m$

$C_m\omega_m-J_m\dot{\omega}_m\omega_m-48{,}8\omega_m-0{,}28\dot{\omega}_m\omega_m+P_T=0$

CASO 1) REGIME $\Rightarrow$ v COSTANTE $\Rightarrow$ $\dot{\omega}_m=0$ $\quad C_m,\omega_m$?

$C_m\omega_m-48{,}8\omega_m+P_T=0$

$P_1)$ $C_m\omega_m \gtrless 0$? $\quad P_2)$ $-48{,}8\omega_m<0 \Rightarrow$ Hp MOTO DIRETTO

$P_T=-(1-\eta_d)P_1=-(1-\eta_d)C_m\omega_m$

$\cancel{C_m}\cancel{\omega_m}-48{,}8\cancel{\omega_m}-(\cancel{1}-\eta_d)C_m\cancel{\omega_m}=0 \Rightarrow C_m=54{,}2\,Nm$

$C_m=100-30\omega_m \rightarrow \omega_m=1{,}53\,rad/s$

- $P_1=82{,}9>0$ ✓

CASO 2) $a = 1\,m/s^2$ C_m?

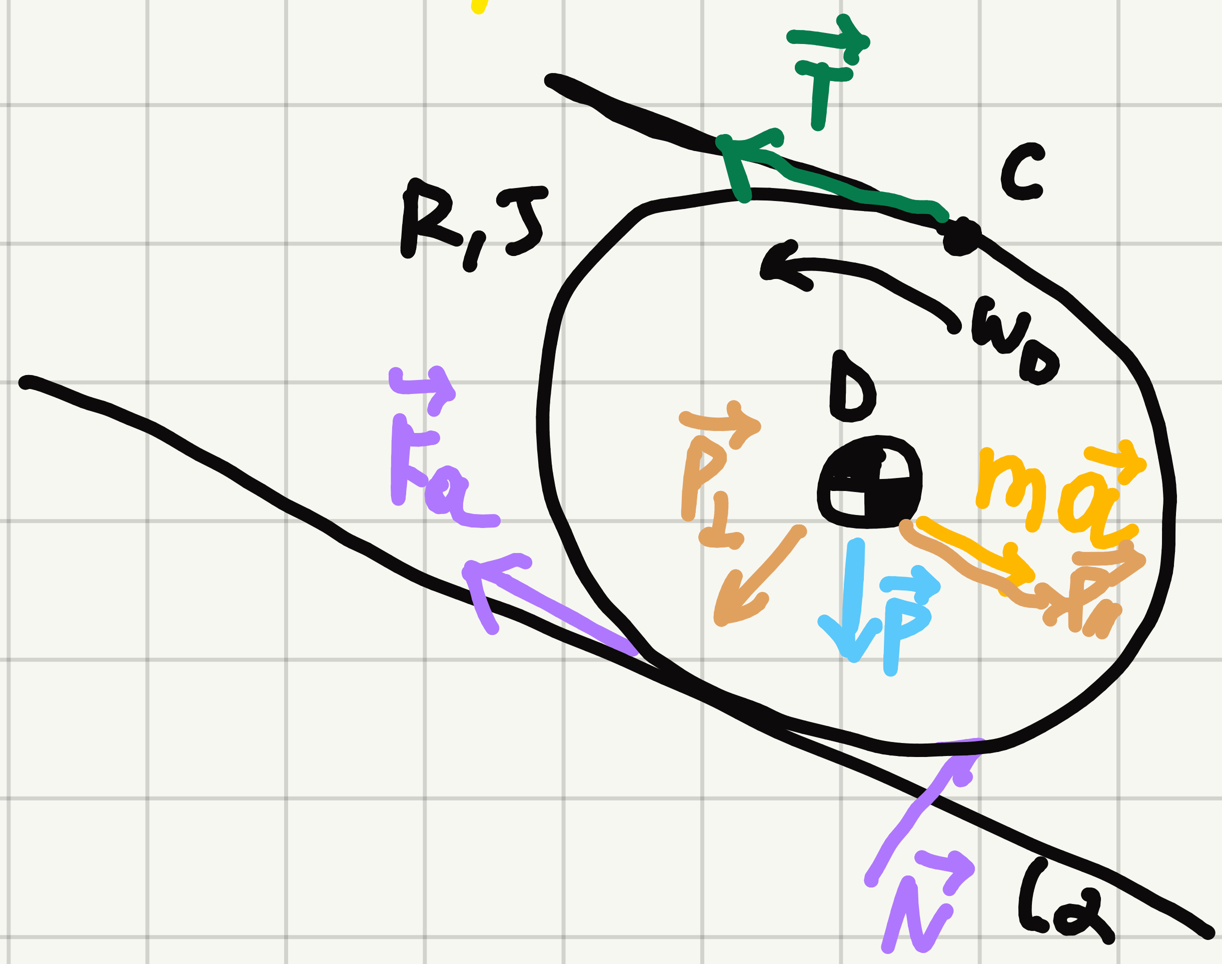
$a = 1\,m/s^2 \rightarrow \dot{\omega}_m = 20\,rad/s^2$

$C_m W_m - J_m \dot{W}_m W_m - 48{,}8 W_m - 0{,}28 \dot{\omega}_m W_m + P_T = 0$

- $P_1 = (C_m - 2) W_m \gtrless 0$?
- $P_2 = (-48{,}8 - 0{,}28 \cdot 20) W_m = -54{,}4\, W_m < 0 \Rightarrow$ MOTO DIRETTO

$P_T = -(1 - 2\eta_d)(C_m - 2) W_m$

$(C_m - 2)\cancel{W_m} - 54{,}4 \cancel{W_m} - (\cancel{1} - 2\eta_d)(C_m - 2)\cancel{W_m} = 0 \Rightarrow C_m = 62{,}4\,Nm$



$\Sigma F_y = 0 \quad N = mg\cos\alpha = 169{,}9\,N$

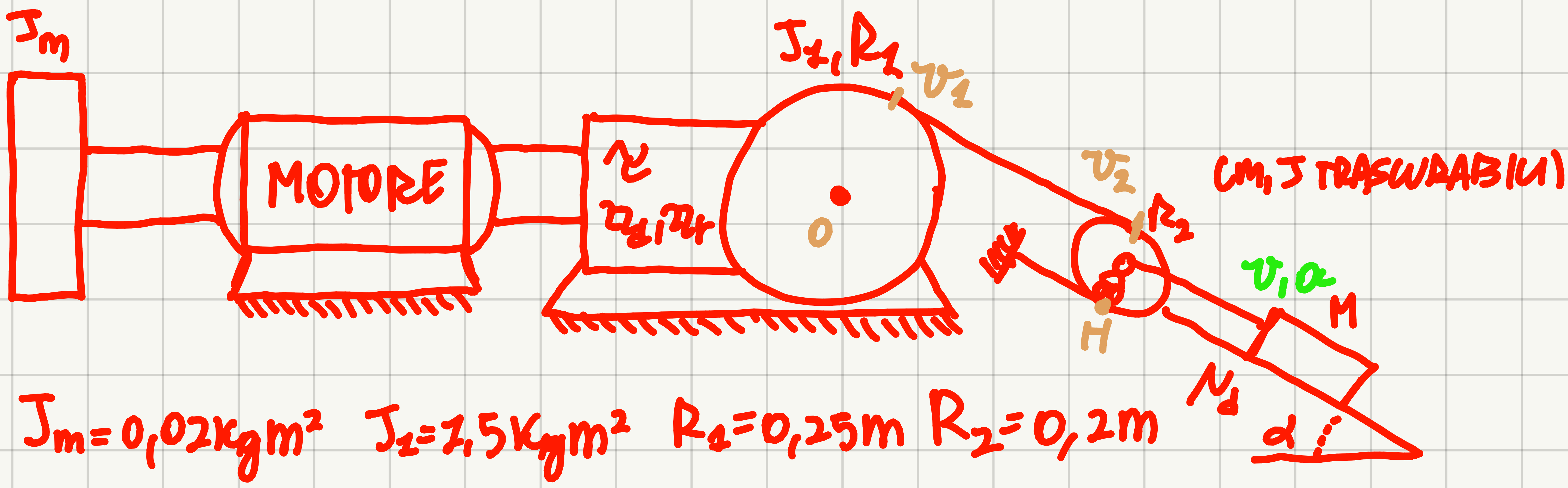
$\Sigma F_x = 0 \quad T + F_a - ma - mg\sin\alpha = 0$

$\Sigma M_D = 0 \quad -RT + RF_a + J\dot{\omega} + N \mu_v R = 0$

$\Rightarrow F_a = 47{,}39\,N$

$F_{a\,lim} = \mu_s N = 78{,}45\,N$

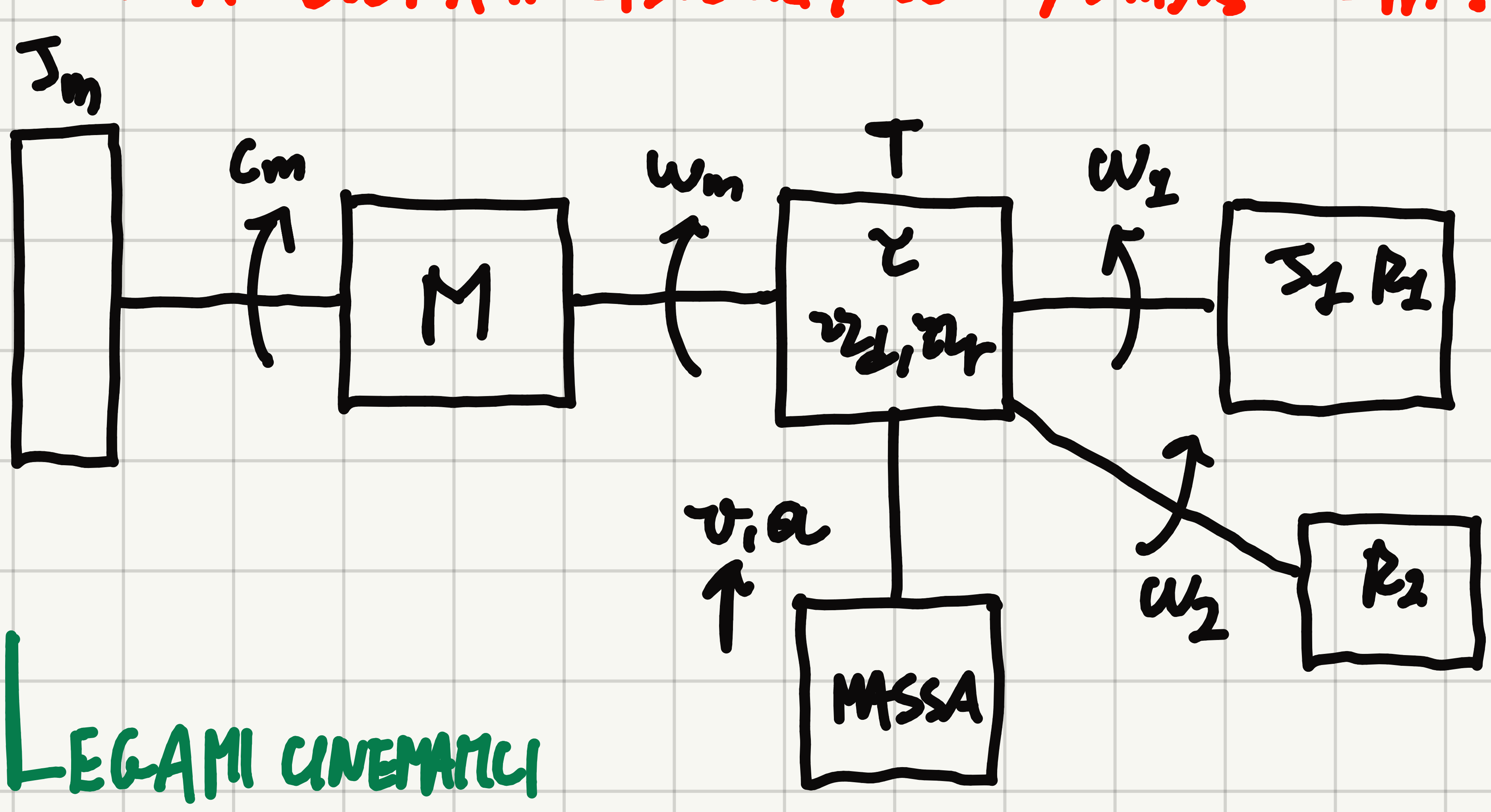
$F_a \leq F_{a\,lim} \Rightarrow$ ADERENZA VERIFICATA



$J_m = 0{,}02\,kgm^2 \quad J_1 = 1{,}5\,kgm^2 \quad R_1 = 0{,}25\,m \quad R_2 = 0{,}2\,m$

$\tau = 1/25 \quad \eta_d = 0{,}9 \quad \eta_r = 0{,}8 \quad M = 100\,kg \quad \alpha = 30° \quad \mu_d = 0{,}2$

- $C_m = 10\,Nm$ SPUNTO, M IN SALITA $a = ?$
- M IN SALITA, REGIME C_m ?
- M ACCELERA IN DISCESA, $a = 0{,}5\,m/s^2$ C_m ?



$v_1 = v_2$

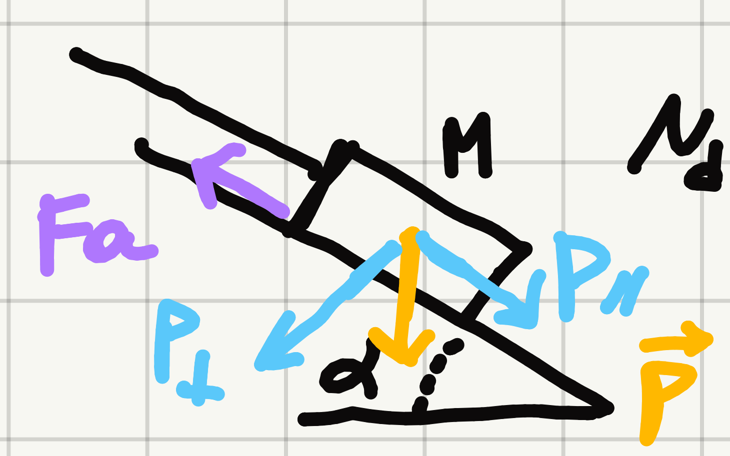
LEGAMI CINEMATICI

$$v_1 = v_2 \qquad (\cancel{v_0} + \omega_1 R_1) = (\cancel{v_H} + 2\omega_2 R_2) \rightarrow \omega_2 = \frac{R_1}{2R_2}\omega_1$$

$$\omega_1 = \tau\omega_m \qquad \omega_2 = \frac{\tau}{2}\frac{R_1}{R_2}\omega_m \qquad v = R_2\omega_2 = \frac{\tau}{2}R_1\omega_m$$

$$\dot{\omega}_1 = \tau\dot{\omega}_m \qquad \dot{\omega}_2 = \frac{\tau}{2}\frac{R_1}{R_2}\dot{\omega}_m \qquad a = R_2\dot{\omega}_2 = \frac{\tau}{2}R_1\dot{\omega}_m$$

BILANCIO DI POTENZE) $P_1 + P_2 + P_T = 0$



$$P_1 = \sum P^{(m)} - \frac{d}{dt}K^{(m)} = C_m\omega_m - J_m\dot{\omega}_m\omega_m$$

$$P_2 = \sum P^{(v)} - \frac{d}{dt}K^{(v)}$$

- $\sum P^{(v)} = \vec{P}_{\parallel} \cdot \vec{v} - F_a v = Mg\,v(\sin(\alpha) - \mu_d\cos(\alpha))$

$$\bullet\ \frac{d}{dt}K^{(w)} = (J_1 \dot{\omega}_1 \omega_1) + (0) + (M\, v\, a) = J_1 \tau^2 \dot{\omega}_m \omega_m + $$

$$+ \frac{\tau^2}{4} M R_1^2 \dot{\omega}_m \omega_m$$

$-$ SE M IN SALITA, $+$ IN DISCESA

$$C_m \omega_m - J_m \dot{\omega}_m \omega_m + \frac{\tau}{2} M g R_1 \omega_m (\mp \sin(\alpha) - \mu_d \cos(\alpha)) -$$

$$- J_1 \tau^2 \dot{\omega}_m \omega_m - \frac{\tau^2}{4} M R_1^2 \dot{\omega}_m \omega_m + P_T = 0$$

CASO 1) $C_m = 10\,Nm$ SPUNTO, M IN SALITA $a = ?$

$$C_m \omega_m - J_m \dot{\omega}_m \omega_m + \frac{\tau}{2} M g R_1 \omega_m (-\sin(\alpha) - \mu_d \cos(\alpha)) -$$

$$- J_1 \tau^2 \dot{\omega}_m \omega_m - \frac{\tau^2}{4} M R_1^2 \dot{\omega}_m \omega_m + P_T = 0$$

$$\bullet\ P_1 = \overbrace{C_m \omega_m}^{>0} - \overbrace{J_m \dot{\omega}_m \omega_m}^{>0} \gtrless 0 \,?$$

$$\bullet\ P_2 = \frac{\tau}{2} M g R_1 \omega_m (-\sin(\alpha) - \mu_d \cos(\alpha)) -$$

$$- J_1 \tau^2 \dot{\omega}_m \omega_m - \frac{\tau^2}{4} M R_1^2 \dot{\omega}_m \omega_m$$

SOMMA TERMINI NEGATIVI $\Rightarrow P_2 < 0 \Rightarrow$ MOTO DIRETTO

$$a = \frac{\tau}{2} R_1 \dot{\omega}_m \Rightarrow \dot{\omega}_m = \frac{2a}{\tau R_1} \qquad P_T = -(1-\eta_d)(C_m \omega_m - J_m \dot{\omega}_m \omega_m)$$

$$C_m \omega_m - J_m \dot{\omega}_m \omega_m - (1-\eta_d)(C_m \omega_m - J_m \omega_m \dot{\omega}_m) = \eta_d (C_m \omega_m - J_m \dot{\omega}_m \omega_m)$$

$$\eta_d (C_m \cancel{\omega_m} - J_m \dot{\omega}_m \cancel{\omega_m}) + \frac{\tau}{2} M g R_1 \cancel{\omega_m} (-\sin(\alpha) - \mu_d \cos(\alpha)) -$$

$$- J_1 \tau^2 \dot{\omega}_m \cancel{\omega_m} - \frac{\tau^2}{4} M R_1^2 \dot{\omega}_m \cancel{\omega_m} = 0$$

$$\Rightarrow \dot{\omega}_m = 248{,}82 \frac{rad}{s^2} \qquad \Rightarrow a = 1{,}24\, m/s^2$$

CASO 2) REGIME, M IN SALITA C_m?

$$a=0,\ \omega=0,\ \frac{d}{dt}K=0$$

$$C_m\omega_m+\frac{\tau}{2}Mg\,R_1\omega_m(-\sin(\alpha)-\mu_d\cos(\alpha))+P_T=0$$

$P_1=C_m\omega_m>0 \Rightarrow$ MOTO DIRETTO $\qquad P_T=-(1-\eta_d)(C_m\omega_m)$

$$\cancel{C_m\omega_m}-(\cancel{1}-\eta_d)(C_m\cancel{\omega_m})+\frac{\tau}{2}Mg\,R_1\cancel{\omega_m}(-\sin(\alpha)-\mu_d\cos(\alpha))=0$$

$$C_m=\frac{\tau/2\,MgR(-\sin(\alpha)-\mu_d\cos(\alpha))}{-\eta_d}=3{,}67\,Nm$$

CASO 3) M IN DISCESA, $a=0{,}5\,m/s^2$ C_m?

$$C_m\omega_m-J_m\dot\omega_m\omega_m+\frac{\tau}{2}Mg\,R_1\omega_m(\sin(\alpha)-\mu_d\cos(\alpha))-$$
$$-J_1\tau^2\dot\omega_m\omega_m-\frac{\tau^2}{4}M\,R_1^2\dot\omega_m\omega_m+P_T=0$$

$$a=\frac{\tau}{2}R_1\dot\omega_m \Rightarrow \dot\omega_m=\frac{2a}{\tau R_1}=100\,rad/s^2$$

- $P_1=\underbrace{C_m\omega_m}_{>0}-\underbrace{J_m\dot\omega_m\omega_m}_{>0}\quad \gtrless 0$?

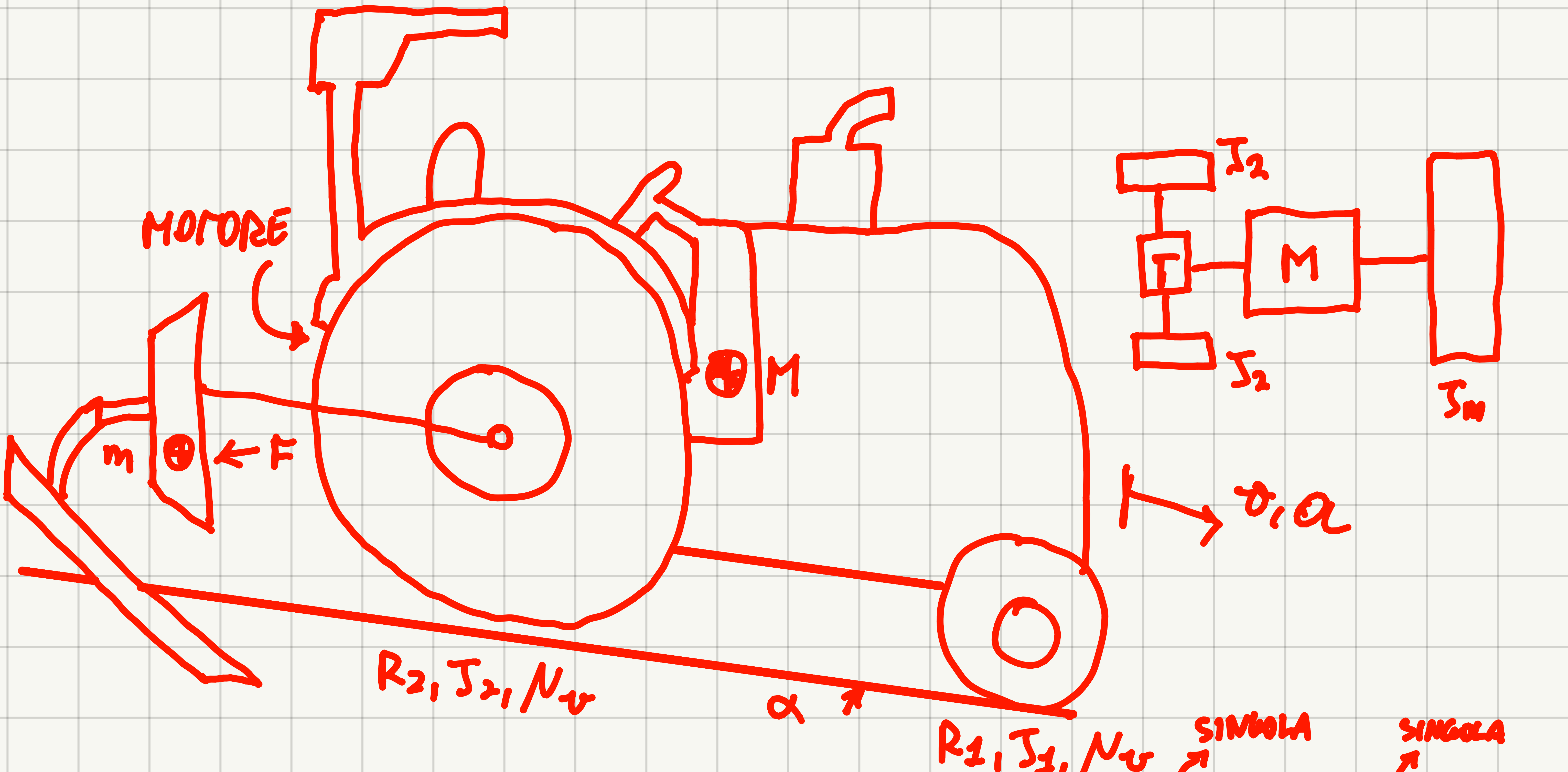
- $P_2=\frac{\tau}{2}Mg\,R_1\omega_m(\sin(\alpha)-\mu_d\cos(\alpha))-$
$$-J_1\tau^2\dot\omega_m\omega_m-\frac{\tau^2}{4}M\,R_1^2\dot\omega_m\omega_m=0{,}51\,\omega_m>0$$

$\Rightarrow$ MOTO RETROGRADO $\qquad P_T=-(1-\eta_r)P_2$

$$P_1-(1-\eta_r)P_2+P_2=P_1+\eta_rP_2=0$$

$$C_m\cancel{\omega_m}-J_m\dot\omega_m\cancel{\omega_m}+\eta_r\Big(\frac{\tau}{2}Mg\,R_1\cancel{\omega_m}(\sin(\alpha)-\mu_d\cos(\alpha))-$$
$$-J_1\tau^2\dot\omega_m\cancel{\omega_m}-\frac{\tau^2}{4}M\,R_1^2\dot\omega_m\cancel{\omega_m}\Big)=0 \qquad C_m=1{,}2\,Nm$$

$P_1=(C_m-\dot\omega_m)\omega_m=-0{,}8\,\omega_m \Rightarrow$ CONFERMA MOTO RETROGRADO

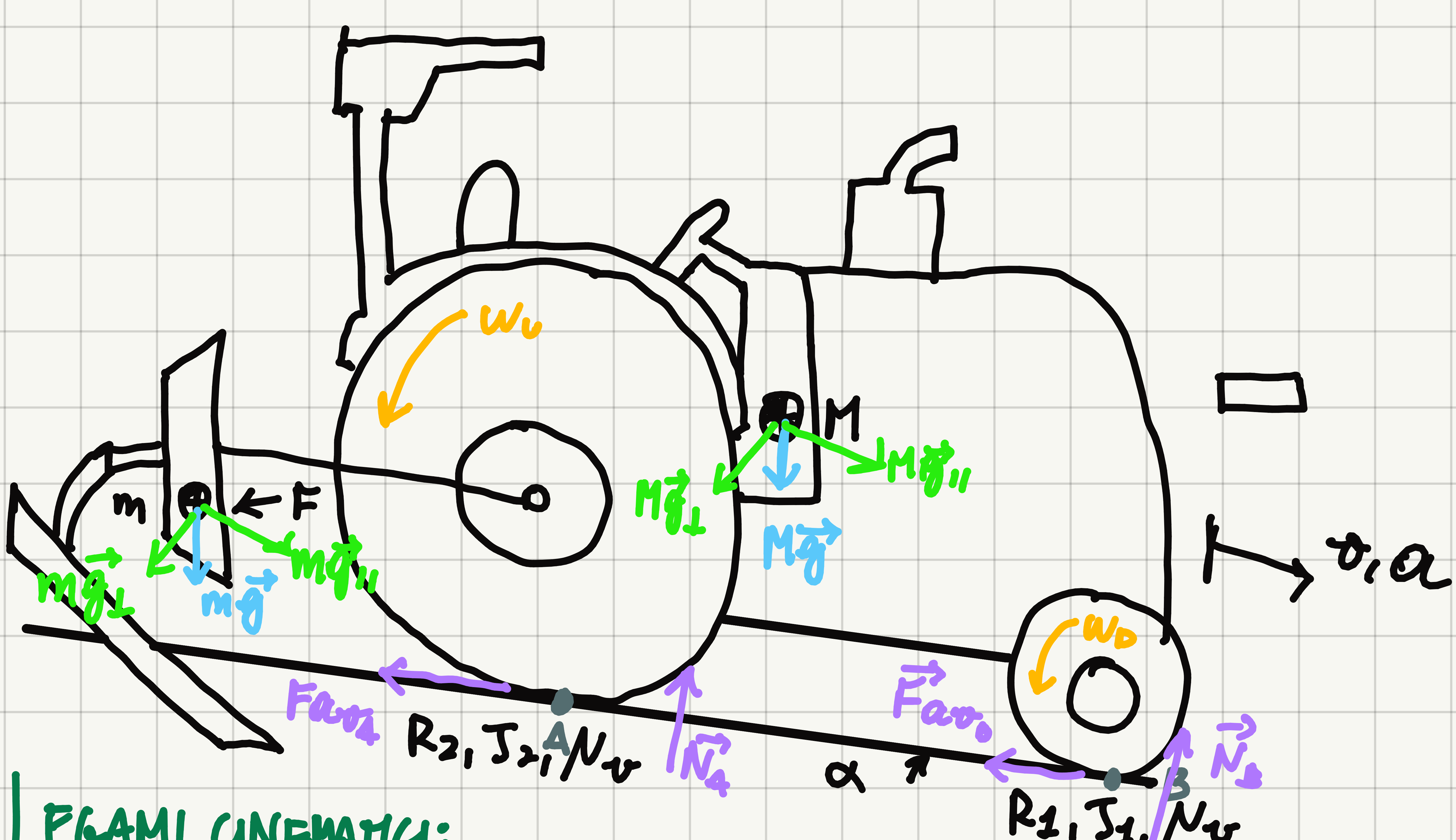


$M = 1500\,Kg \quad m = 100\,Kg \quad R_1 = 0{,}3\,m \quad R_2 = 0{,}6\,m \quad J_1 = 2\,Kgm^2 \quad J_2 = 3\,Kgm^2$

$J_m = 0{,}2\,Kgm^2 \quad F = 1000\,N \quad C_{ma} = 200\,Nm \quad \alpha = 5° \quad N_v = 0{,}05 \quad \eta_d = 0{,}8$

$\eta_r = 0{,}7$ · REGIME → C_m ? · $C_m = C_{ma}$ → a ?

· REGIME, ARATRO DISCONNESSO → C_m ?



LEGAMI CINEMATICI:

$\omega_v = \tau\omega_m \quad \dot{\omega}_v = \tau\dot{\omega}_m \quad v = v_A + R_2\omega_v = \tau R_2\omega_m \qquad a = \tau R_2\dot{\omega}_m$

$v = v_B + R_1\omega_D \rightarrow \omega_D = \tau \frac{R_2}{R_1}\omega_m \qquad \dot{\omega}_D = \tau \frac{R_2}{R_1}\dot{\omega}_m$

BILANCIO DI POTENZE) $P_1+P_2+P_T=0$

$$P_1=\sum P^{(m)}-\frac{d}{dt}K^{(m)}=C_m\omega_m-J_m\dot\omega_m\omega_m$$

$$P_2=\sum P^{(u)}-\frac{d}{dt}K^{(u)}$$

TRATTORE) $\sum F_y=0=N_A+N_B-Mg\cos(\alpha)$

$N_A+N_B=Mg\cos(\alpha)$

- $\sum P^{(u)}=(Mg_{\parallel}+mg_{\parallel}-F-F_{a_v})v$

$$=\tau R_2\,((M+m)g\sin(\alpha)-F-\mu_v(N_A+N_B))\,\omega_m=$$

$$=\tau R_2\,((M+m)g\sin(\alpha)-F-\mu_v Mg\cos(\alpha))\,\omega_m=-43{,}8\,\omega_m$$

- $\frac{d}{dt}K=mva+Mva+2J_2\dot\omega_v\omega_v+2J_1\dot\omega_D\omega_D=$

$$=\tau^2\left((M+m)R_2^2+2J_2+2J_1\left(\frac{R_2}{R_1}\right)^2\right)\dot\omega_m\omega_m=23{,}9\,\dot\omega_m\omega_m$$

$$C_m\omega_m-J_m\dot\omega_m\omega_m-43{,}8\,\omega_m-23{,}9\,\dot\omega_m\omega_m+P_T=0$$

CASO 1) REGIME C_m?

$$C_m\omega_m-43{,}8\,\omega_m+P_T=0$$

- $P_1=C_m\omega_m \gtrless 0$?
- $P_2=-43{,}8\,\omega_m<0 \Rightarrow$ MOTO DIRETTO

$P_T=-(1-\eta_d)C_m\omega_m$ $\quad \cancel{C}_m\cancel{\omega}_m-43{,}8\cancel{\omega}_m-(\cancel{1}-\eta_d)C_m\cancel{\omega}_m=0$ $\quad C_m=54{,}75\ \text{Nm}$

CASO 2) $C_m=C_{ma}=200\,\text{Nm}$ $\quad a$?

$$(200-0{,}2\dot\omega_m)\omega_m+(-43{,}8-23{,}9\dot\omega_m)\omega_m+P_T=0$$

- $P_1=(200-0{,}2\dot\omega_m)\omega_m \gtrless 0$?
- $P_2=(-43{,}8-23{,}9\dot\omega_m)\omega_m \gtrless 0$?

IPOTESI MOTO DIRETTO $\Rightarrow P_T = -(1-2\eta_d)(200-0{,}2\dot{\omega}_m)\omega_m$

$\cancel{(200-0{,}2\dot{\omega}_m)}\cancel{\omega_m} + (-43{,}8-23{,}9\dot{\omega}_m)\cancel{\omega_m} - (\cancel{1}-2\eta_d)(200-0{,}2\dot{\omega}_m)\cancel{\omega_m} = 0$

$\Rightarrow \dot{\omega}_m = 4{,}83 \ rad/s^2$

$P_1 = (200-0{,}2\cdot 4{,}83)\omega_m = 199{,}034\,\omega_m > 0$ ✓ $\quad a = 0{,}58 \ m/s^2$

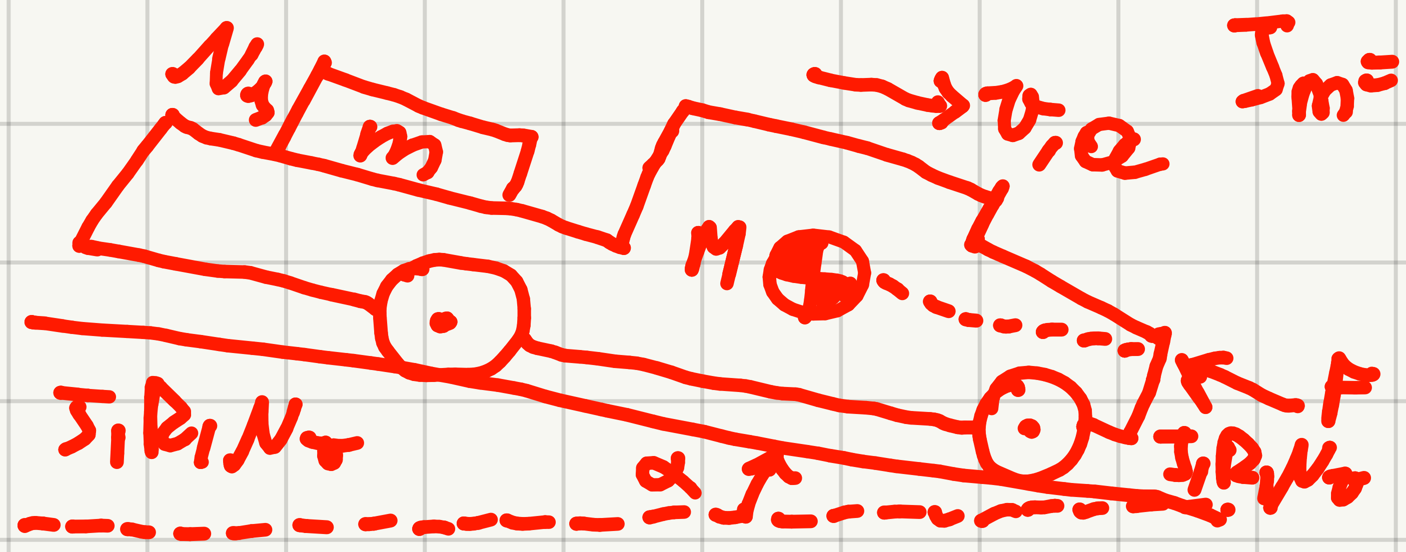
CASO 3) REGIME, ARATRO DISCONNESSO C_m?

$\sum P^{(ws)} = \tau R_2 (Mg\sin(\alpha) - \mu_v Mg\cos(\alpha))\omega_m = 65{,}95\,\omega_m$

$C_m\omega_m - 43{,}8\,\omega_m + P_T = 0$

- $P_1 = C_m\omega_m \gtrless 0$?
- $P_2 = 65{,}95\,\omega_m < 0 \Rightarrow$ MOTO RETROGRADO

$P_T = -(1-2\eta_r)65{,}95\,\omega_m \quad C_m\cancel{\omega_m} + \cancel{65{,}95}\,\cancel{\omega_m} - (\cancel{1}-2\eta_r)65{,}95\,\cancel{\omega_m} = 0 \quad C_m = -46{,}17 \ Nm$

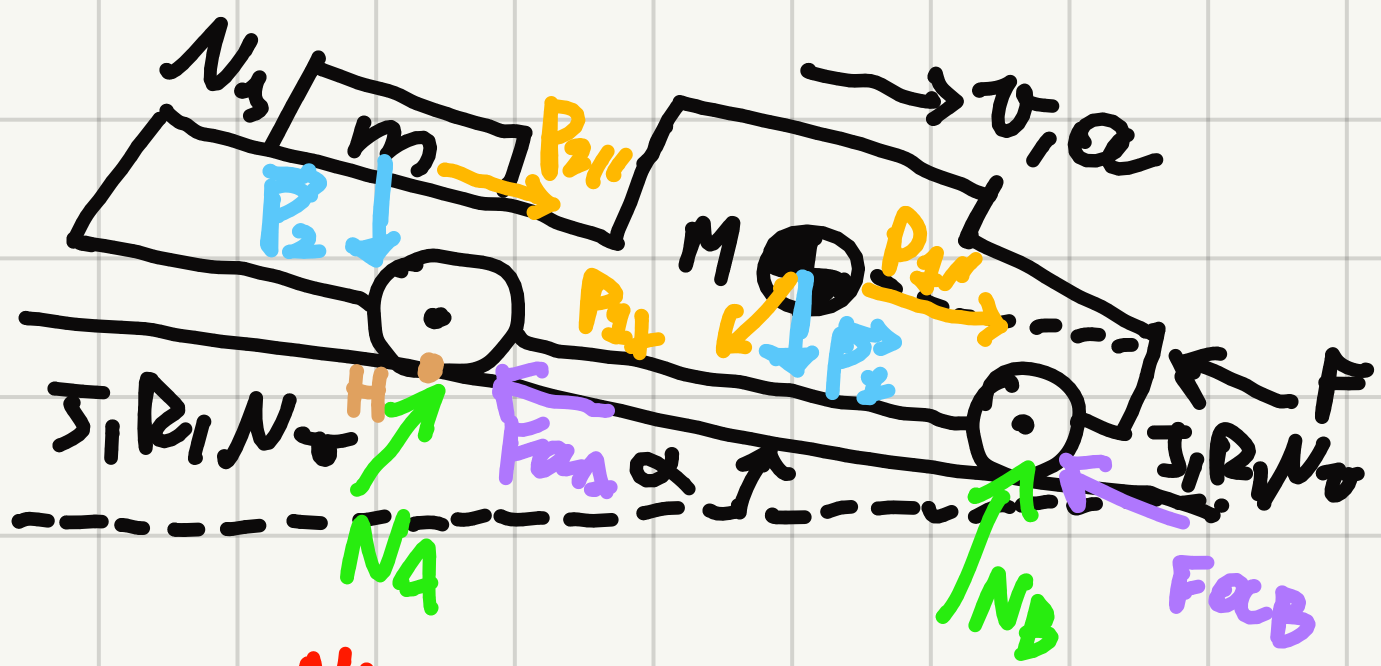


$J_m = 0{,}5\,kg\,m^2$ $J = 2\,kg\,m^2$ PER SINGOLA RUOTA

$R = 0{,}3\,m$ $M = 2500\,kg$ $m = 100\,kg$

$F = 10000\,N$ $\mu_s = 0{,}8$ $\mu_v = 0{,}05$

$\alpha = 30°$ $\tau = 1/20$ $\eta_d = 0{,}9$ $\eta_r = 0{,}8$



$C_m = A - B\omega_m$ $A = 100\,Nm$

$B = 10\,\frac{Nm}{rad/s}$ • REGIME → C_m, ω_m ? • $a = 0{,}5\,m/s^2$ C_m ADERENZA DIM

LEGAMI CINEMATICI

$\omega_v = \tau\omega_m$ $|\vec{v}_A| = |\vec{v}_B| = \cancel{v_H} + \omega_v R$ $|\vec{v}_G| = |\vec{v}_A|$ PER DEFINIZIONE DI CORPO RIGIDO

$\dot{\omega}_v = \tau\dot{\omega}_m$ $|\vec{a}_A^{(t)}| = |\vec{a}_B^{(t)}| = |\vec{a}_G^{(t)}| = \dot{\omega}_v R$

BILANCIO DI POTENZE) $P_1 + P_2 + P_T = 0$

$P_1 = \sum P^{(m)} - \frac{d}{dt}K^{(m)} = C_m\omega_m - J_m\dot{\omega}_m\omega_m$

$P_2 = \sum P^{(u)} - \frac{d}{dt}K^{(u)}$

• $\sum P^{(u)} = ((P_{1\parallel} + P_{2\parallel})v_G - F v_G) - Fa_A v_G - Fa_B v_G$

! NON SI HA DISSIPAZIONE DI POTENZA DA $\mu_s P_{2\perp}$ TRATTANDOSI DI UN CORPO STATICO RISPETTO ALL'AUTO

$Fa_A v_G + Fa_B v_G = \mu_v (N_A + N_B) R\omega_v$

$\sum F_y = 0$ $N_A + N_B - P_{1\perp} - P_{2\perp} = 0 \Rightarrow N_A + N_B = (M+m)\,g\cos\alpha$

$\frac{d}{dt}K = (M+m)v_G a_G - 4J\dot{\omega}_v\omega_v$

$$C_m \omega_m - J_m \dot{\omega}_m \omega_m + ((M+m) g \sin\alpha - F - \mu_v (M+m) g \cos\alpha) R \tau \omega_m -$$

$$- ((M+m)R^2 + 4J)\tau^2 \dot{\omega}_m \omega_m + P_T = 0$$

$$C_m \omega_m - J_m \dot{\omega}_m \omega_m + 24{,}73\,\omega_m - 0{,}605\,\dot{\omega}_m \omega_m + P_T = 0$$

CASO 1) REGIME C_m?

$$C_m \omega_m + 24{,}73\,\omega_m + P_T = 0$$

- $P_1 = C_m \omega_m \gtrless 0$?
- $P_2 = 24{,}73\,\omega_m > 0 \Rightarrow$ MOTO RETROGRADO

$$\Rightarrow P_T = -(1 - 2\eta_r) P_2$$

$$C_m \cancel{\omega_m} + \cancel{24{,}73}\,\cancel{\omega_m} - (\cancel{1} - 2\eta_r) \cdot 24{,}73\,\cancel{\omega_m} = 0 \Rightarrow C_m = -19{,}78\ \text{Nm}$$

$$C_m = A - B\omega_m = 100 - 10\omega_m \Rightarrow \omega_m = 11{,}98\ \text{rad/s}$$

$P_1 = C_m \omega_m < 0 \Rightarrow$ IPOTESI DI MOTO RETROGRADO VERIFICATA

CASO 2) $a = 0{,}5\ \text{m/s}^2$ C_m?

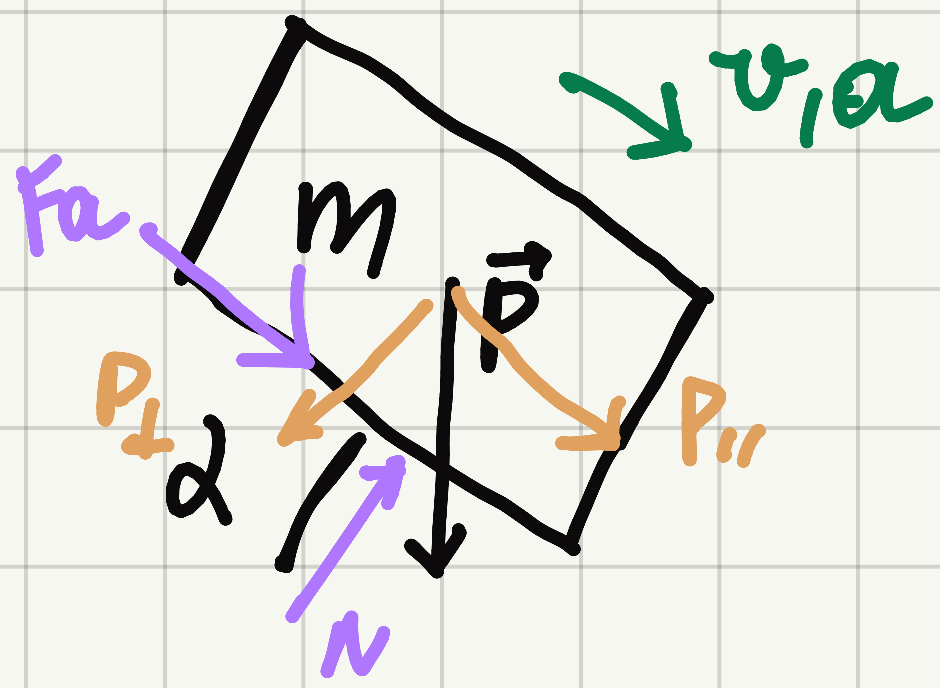
$$a = \tau \dot{\omega}_m R \Rightarrow \dot{\omega}_m = 33{,}3\ \text{rad/s}^2$$

$$C_m \omega_m - J_m \dot{\omega}_m \omega_m + 24{,}73\,\omega_m - 0{,}605\,\dot{\omega}_m \omega_m + P_T = 0$$

- $P_1 = (C_m - 16{,}65)\,\omega_m \gtrless 0$?
- $P_2 = (24{,}73 - 0{,}605 \cdot 33{,}3)\,\omega_m = 4{,}58\,\omega_m > 0 \Rightarrow$ MOTO RETROGRADO

$$\Rightarrow P_T = -(1 - 2\eta_r) P_2$$

$$(C_m - 16{,}65)\cancel{\omega_m} + \cancel{4{,}58}\,\cancel{\omega_m} - (\cancel{1} - 2\eta_r) \cdot 4{,}58\,\cancel{\omega_m} = 0 \Rightarrow C_m = 12{,}98\ \text{Nm}$$



$F_a \leq \mu_s N$

$\sum F_x = ma \qquad F_a - P_\parallel = ma$

$\Rightarrow F_a = (a + g\sin(30))m \qquad \sum F_y = 0 \quad -P_\perp + N = 0 \qquad N = mg\cos(30)$

$(a + g\sin(30))\cancel{m} \leq \mu_s \cancel{m}g\cos(30) \qquad 5{,}41 \leq 6{,}79$ ✓