Centro Stampa

N° 1010

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ES 1 (1,15)

$a_0 = 6\ m/s^2$

$g = 9\ m/s^2$

$\alpha = 15°$

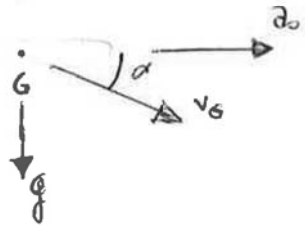
$V_G = 15000\ km/h = 4166{,}7\ m/s$

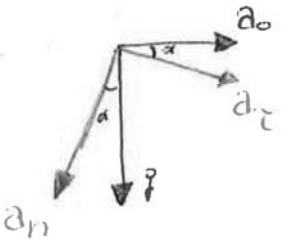
$\rho = ?$

$a_\tau = ?$

$\dot{\omega}?$

$\vec{a}?$





$\dot{c}$

$$\begin{cases} g = a_n \cos\alpha + a_\tau \operatorname{sen}\alpha \\ a_0 = -a_n \operatorname{sen}\alpha + a_\tau \cos\alpha \end{cases} \Rightarrow g = a_n \cos\alpha + \operatorname{tg}\alpha\, a_0 - a_n \frac{\operatorname{sen}\alpha \operatorname{sen}\alpha}{\cos\alpha}$$

$$a_\tau = \frac{a_0}{\cos\alpha} + a_n \operatorname{tg}\alpha$$

$$\Rightarrow a_n = g - \operatorname{tg}\alpha\, a_0 = 8{,}25\ m/s^2$$

$$a_\tau = \frac{a_0}{\cos\alpha} - a_n \operatorname{tg}\alpha = 4\ m/s^2$$

$$\begin{cases} g = a_n \cos\alpha + a_\tau \operatorname{sen}\alpha \\ a_0 = -a_n \operatorname{sen}\alpha + a_\tau \cos\alpha \end{cases} \Rightarrow \begin{cases} g = a_n \cos\alpha + (a_0 + a_n \operatorname{sen}\alpha)\operatorname{tg}\alpha \\ a_\tau = \frac{a_0 + a_n \operatorname{sen}\alpha}{\cos\alpha} \end{cases} \Rightarrow a_n(\cos\alpha + \operatorname{sen}\alpha \operatorname{tg}\alpha) = g - a_0 \operatorname{tg}\alpha$$

$$\Rightarrow a_n = 7{,}14$$

$$a_\tau = 8{,}12$$

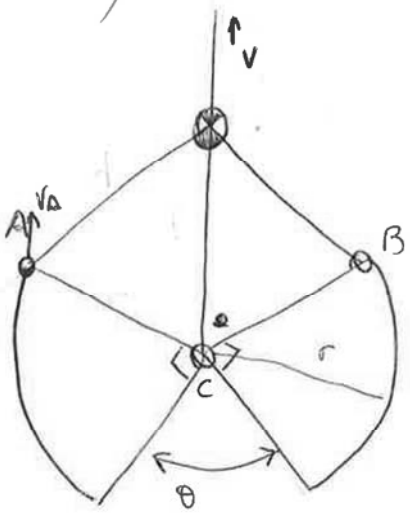
$$\vec{a} = \vec{a_n} + \vec{a_\tau}$$

$$a_n = -v^2/\rho \Rightarrow \rho = 2031{,}53\ km$$

$$a_\tau = \dot{\omega}\rho \Rightarrow \dot{\omega} = 3{,}339 \cdot 10^{-6}\ rad/s^2$$

$$\omega = v/\rho = 0{,}0017\ rad/s$$

ES 2 (1,27)



$V_0 = 0{,}3\ m/s = V$

$\theta = 45°$

$\omega = ?$

$r = 0{,}5\ m$

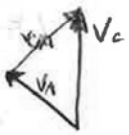
$AO = BO = d = 0{,}6\ m$

$\beta = 67.5$

$$V_C = V_A + V_{C/A}$$

$$/\!/ \ell \quad \perp AO \quad \perp AC$$

$$\text{ok} \quad V_A? \quad r\omega?$$



$$\frac{AO}{\operatorname{sen}\beta} = \frac{AC}{\operatorname{sen}\alpha} \Rightarrow \operatorname{sen}\alpha = 0{,}77 \Rightarrow \alpha = 50{,}35°$$

$$V_C = V_A \operatorname{sen}\alpha + V_{C/A} \operatorname{sen}\beta$$

$$V_C = V_A + \omega r$$

$$\frac{V_C}{\operatorname{sen}(\alpha+\beta)} = \frac{\omega \cdot r}{\operatorname{sen}\left(\frac{\pi}{2} - \alpha\right)} \Rightarrow \omega = 0{,}43\ rad/s$$

ES 03

1.26)

$r_1 = r_2 = r_3 = 0{,}1\ m$

$R_3 = 0{,}2\ m$

$V = ?$ $a = ?$

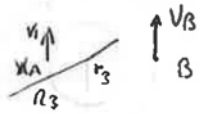
$\omega_3 = ?$ $\dot{\omega}_3 = ?$

caso a) $\omega_1 = 0$ $\dot{\omega}_1 = 0$

$\omega_2 = 3\ rad/s$ $\dot{\omega}_2 = -2\ rad/s^2$

caso b) $\omega_1 = 1\ rad/s$ $\dot{\omega}_1 = 4\ rad/s$

$\omega_2 = 2\ rad/s$ $\dot{\omega}_2 = -4\ rad/s$



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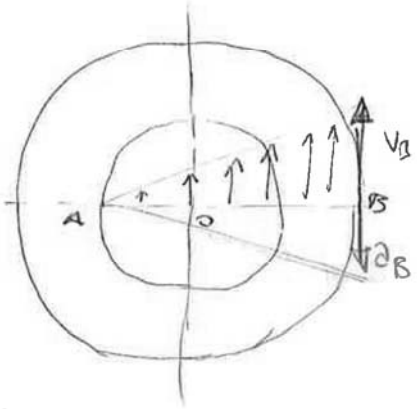
a) $V_B = R_2 V_2 = \omega_2 r_2 = 0{,}3\ m/s \Rightarrow \omega_3 = 1.5\ rad/s$

$V_B = R_3 \omega_3$

$\frac{V_B}{r_3 + R_3} = \frac{V_0}{r_3} \Rightarrow V_0 = 0{,}1\ m/s \rightarrow$

$V = 0{,}1\ m/s$



$\omega_1 = 0 \Rightarrow v_1 = 0 \Rightarrow v_A = 0$

$\dot{\omega}_1 = 0 \Rightarrow a_1 = 0 = a_A = 0$

$\dot{\omega}_2 = -2\ rad/s^2 \Rightarrow a_2 = -0{,}2\ m/s^2 = a_B = R_3 \dot{\omega}_3 \Rightarrow \dot{\omega}_3 = -1\ rad/s^2$

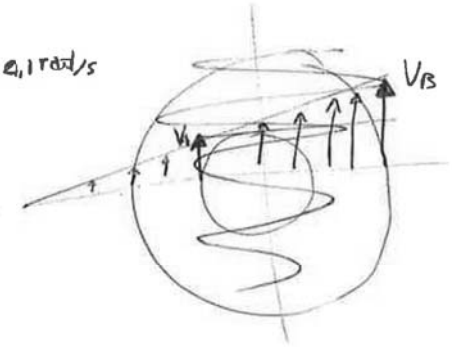
$\frac{a_B}{r_3 + R_3} = \frac{a_0}{r_3} \Rightarrow a = 0{,}066\ m/s^2$

b) $V_1 = \omega_1 r_1 = 0{,}1\ m/s = V_A = r_3 \omega_3 \Rightarrow \omega_3 = 0{,}1\ rad/s$

$V_2 = \omega_2 r_2 = 0{,}2\ m/s = V_B = R_3 \omega_3$

$\frac{V_B - V_A}{R_3 + r_3} = \frac{V_0'}{r_3} \Rightarrow V_0 = 0{,}033\ m/s$

$\Rightarrow V_0 = V_A + V_0' = 0{,}033\ m/s$



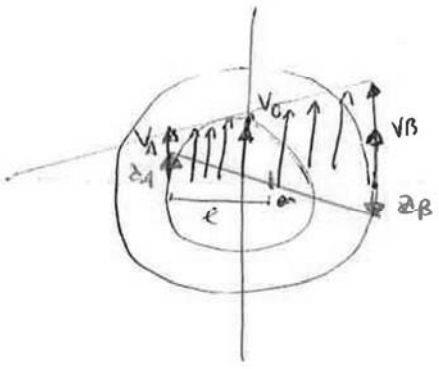
$\dot{\omega}_1 = 0$

$a_1 = \dot{\omega}_1 r_1 = 0{,}4\ m/s^2 \Rightarrow a_A = 0{,}4\ m/s^2 = r_3 \cdot$

$a_2 = \dot{\omega}_2 r_2 = -0{,}4\ m/s^2 \Rightarrow a_B = -0{,}4\ m/s^2$

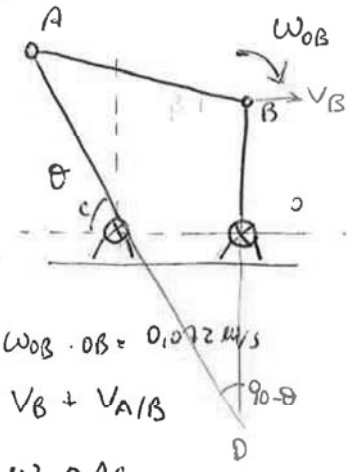
$\frac{a_1}{(r_3 + R_3)/2} = \frac{a_0}{(r_3 + R_3)/2 - r_3} \Rightarrow a = 0{,}13\ m/s^2$

$\dot{\omega}_3 = \frac{a_A}{\ell} = 2{,}67\ m/s^2$



ES 04

1.42



$\omega_{OB} = 0,6$ rad/s

$\tg\theta = 4/3 \Rightarrow \theta = 53,1°$

$OB = 0,12$ m

$CA = 0,2$ m

$OC = 0,12$ m

$\omega_{AC} = ?$

$\dot\omega_{AC} = ?$

$AB = \sqrt{(AC\sen\theta - OB)^2 + (AC\cos\theta + OC)^2} =$

$= 0,2483$ m

$\beta = \arctg\left(\frac{AC\sen\theta - OB}{AC\cos\theta + OC}\right) =$

$= 9,47°$

$V_B = \omega_{OB} \cdot OB = 0,0072$ m/s

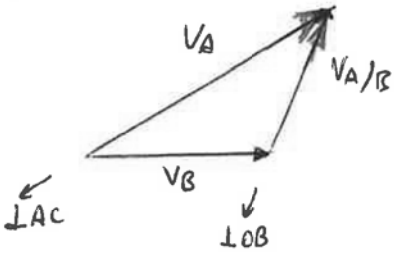
$V_A = V_B + V_{A/B}$

$V_A = \omega_{AC} \wedge AC$

$V_A = V_B + V_{A/B}$

$\perp AC \quad \perp OB \quad \perp AB$

$? \quad \omega_{OB}OB \quad ?$



$BD = OB + \frac{OC}{\tg(90-\theta)} = 0,28$ m

$V_B = DB\,\omega_{AB} \Rightarrow \omega_{AB} = 0,257$ rad/s

~~$V_A = V_B + \omega_{AB}$~~

$AD = AC + \frac{OC}{\sen(90-\theta)} = 0,4$

$V_A = AD\,\omega_{AB} = 0,1028$ m/s

$\omega_{AC} = V_{AD/OB} = 0,856$ rad/s

$V_A = V_B + \underbrace{\omega_{AB}\,AB}$

$V_{A/B} = 0,0308$ m/s

$a_{Bn} = V_B^2/OB = 0,0432$

$a_{B\tau} = \dot\omega_{OB}\,OB = 0$ perché $\dot\omega_{OB} = 0$

$a_A = a_{Bn} + a_{B/A}$

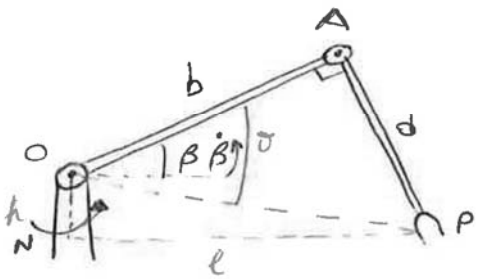
$a_{n} + a_{\tau} \quad\quad a_{nB/A} + a_{\tau\,B/A}$

$//BA \quad \perp BA \quad\quad //BA \quad \perp BA$

$? \quad ? \quad\quad ? \quad ?$

$V_A^2/AC \quad \omega_{AC}CA \quad\quad V_{A/B}^2/AB \quad \dot\omega_{BA}\,BA$

05) 1.34)



$N = 40°/s$
$b = 0,3\ m$
$\beta = 30°$
$\dot\beta = 10°/s$
$\ddot\beta = 20°/s^2$
$d = 0,2\ m$
$a_p = ?$

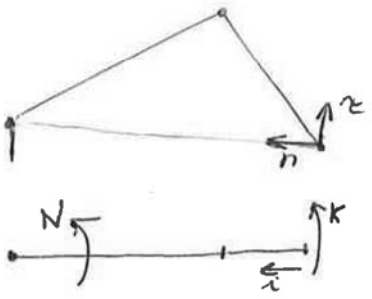
$OP = \sqrt{0,2^2 + 0,3^2} = 0,36\ m$

~~$\ell = OP + b$~~
~~$\ell = OP$~~
$\ell = b\cos\beta + d\ \mathrm{sen}\beta = 0,3598\ m$
$h = d\cos\beta - b\ \mathrm{sen}\beta = 0,023$

~~$a_A = a_O + a_{A/O}$~~

~~$a_{ASS} = a_{TR} + a_{rel} = a_i + a_k + a_n + a_z$~~

~~$N^2 \ell$~~

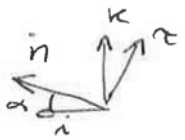


$a_{ass} = a_{rel} + a_{TR} + a_{cor.}$

$\ddot\beta OP\,\vec{n} + \dot\beta OP\,\vec{\tau} + N^2 \ell\,\vec{k} + 2N \wedge OP\,\dot\beta\,\vec{k}$

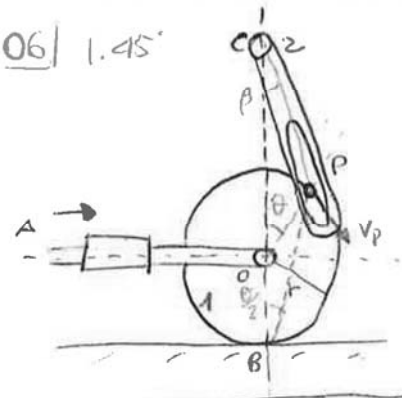
$(0,01 + 0,072 + 0,175 + 0,0877)\ m/s^2$

$a_p = \sqrt{\text{somma}^2} = 0,21\ m/s^2$



$i = n\cos\alpha - \tau\ \mathrm{sen}\alpha$
$k = \tau\cos\alpha + n\ \mathrm{sen}\alpha$

06 | 1.45



$V = 2$ m/s
$r = 0{,}1$ m
$OC = 0{,}2$ m
ω_2? ← $\theta = 30$
$\dot{\omega}_1$ = ?

$v = v_0 = \omega_1 r \Rightarrow \omega_1 = 20$ rad/s

~~$v_P = v_0 + v_{P/O}$~~
~~$\perp CP \quad \perp \omega \quad \perp OP$~~
~~$? \quad v \quad \omega_1 \cdot OP$~~

$v_P =$

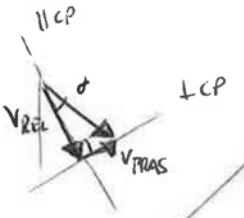
$CP = \sqrt{r^2 + OC^2 - 2 r\, OC \cos\theta} = 0{,}123$ m

β: $\frac{r}{\sin\beta} = \frac{CP}{\sin\theta} \Rightarrow \sin\beta = 0{,}406 \Rightarrow \beta = 23{,}98°$

$BP = 2r\cos\frac{\theta}{2} = 0{,}193$ m

$v_P = \omega_1 BP = 3{,}86$ m/s

V_P = V_{REL} + V_{TRASC}
$\perp BP$ $\quad \parallel CP$ $\quad \perp CP$
ok $\quad$? $\quad \omega_2 CP$

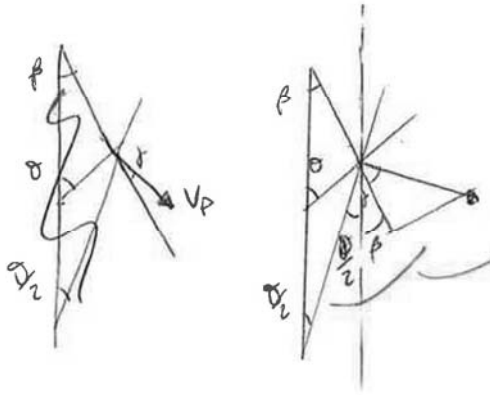


$\gamma = 90 - \frac{\theta}{2} - \beta = 54{,}02°$

$\Rightarrow V_{TR} = V_P \sin\gamma = 3$ m/s

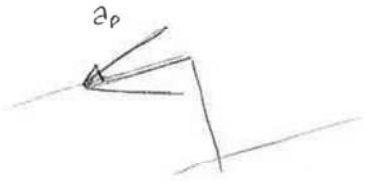
$\Rightarrow V_{TR} = \omega_2 CP \Rightarrow \omega_2 = 24{,}9$ rad/s

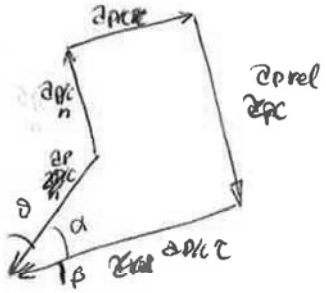
$V_{rel} = V_P \cos\gamma = 2{,}03$ m/s



$a_P = a_{REL} + a_{TR} + a_{PC}$

~~a_O~~ + $a_{P/On}$ + ~~$a_{P/OT}$~~ $\quad$? $\quad$ $a_{P/Cn}$ + $a_{P/CT}$ $\quad$ $2\omega_2 v_{rel}$
~~0~~
$\omega_1^2 OP$ $\quad \dot{\omega}_1 = 0$ $\quad \parallel CP$ $\quad \parallel CP$ $\quad \omega_2^2 CP$ $\quad \perp CP$ $\quad \perp CP$
? $\quad \dot{\omega}_2$? CP $\quad \dot{\omega}_2 CP$



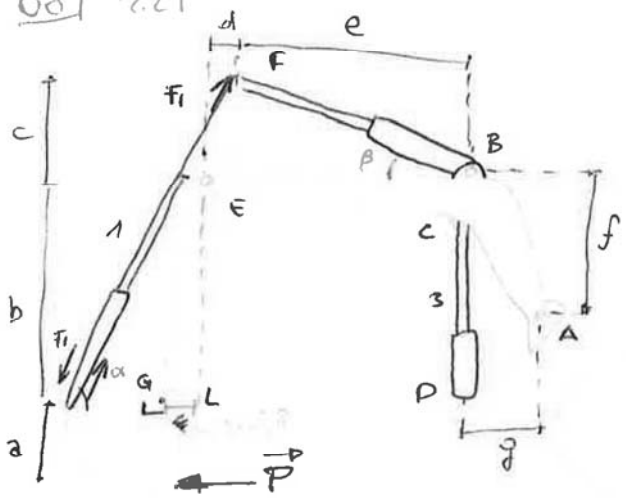


$\alpha = 90 - \beta - \gamma = 36{,}02°$

$a_{P/CT} = a_P \cos\alpha + a_{PC} = 150{,}9$

$\dot{\omega}_2 = \frac{a_{P/CT}}{PC} = 1227{,}1$ rad/s

08/ 7.21

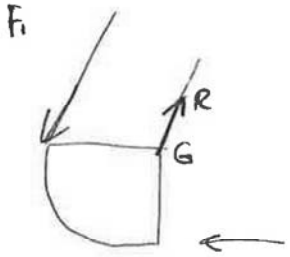


P = ~~10kN~~ 10kN

a = 0,9 m
b = 2,4 m
C = 1,2 m
d = 0,8m
e = 2,1 m
f = 1,5 m
g = 0,9 m
F_1 = ?
F_2 = ?
F_3 = ?
N_A = ?
N_E = ?

$\arctg\left(\frac{a+b}{e+(b+d)}\right) = \alpha = 61,38°$

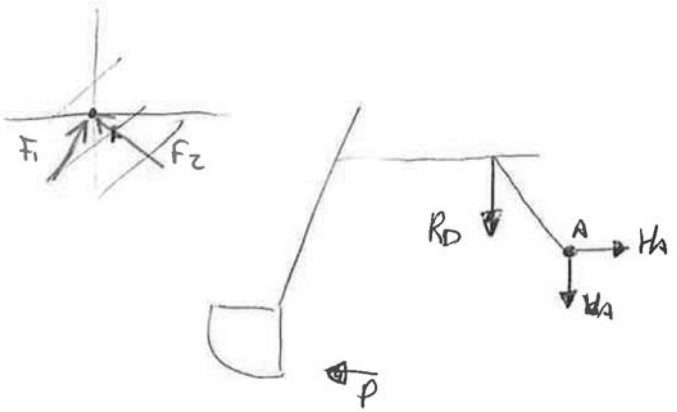
$\beta = \arctg\left(\frac{c}{e+d}\right) = 29,74°$



G ↻ : $F_1 \sin\alpha \cdot a - P a = 0$

$\Rightarrow F_1 = \frac{P}{\sin\alpha} = 11390\ N$

~~F_3~~ F_1

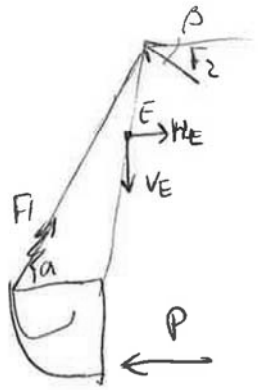


$H_A - P = 0$ → $H_A = 10000\ N$

$R_D + V_A = 0$ → $V_A = -20000\ N$ ⇒ $R_A = 22360\ N$

$P(a+b-f) - R_D \cdot g = 0 \Rightarrow R_D = 20000\ N$

$R_D = F_3$



→ $F_2 \cos\beta - H_E - F_1 \cos\alpha = 0$

↑ $F_1 \sin\alpha + F_2 \sin\beta - V_E = 0$

E ↻ $-F_1 \sin\alpha \cdot b + F_1 \cos\alpha \cdot (a+d) + F_2 \sin\beta \cdot c + F_2 \cos\beta \cdot d = 0$

$\Rightarrow F_2 = 22197,7\ N$

$\Rightarrow H_E = 13818\ N$ ⇒ $R_E = 25146\ N$

$\Rightarrow V_E = 21009\ N$

→ $F_2 \cos\beta - H_E + P = 0$

↑ $F_2 \sin\beta - V_E = 0$

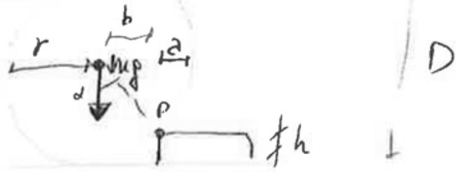
E ↻ $F_2 \cos\beta \cdot c + F_2 \sin\beta \cdot d - P(a+b) = 0$ ⇒ $F_2 = 37,7\ kN$

$\Rightarrow V_E = 13,74\ kN$ ⇒ $R_E = 36,27\ kN$

$H_E = 34,06 kN$

ES 0,9 (2.31)

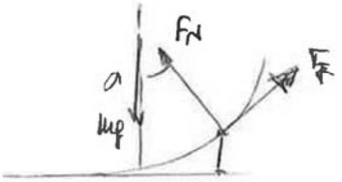
$D = 0{,}9\,m$
$m = 30\,kg$
$C = ?$
$h = 0{,}09\,m$
$f_a = ?$



$P\circlearrowleft : C - mg\,b = 0$
$\Rightarrow C = 79{,}38\,Nm$

$P = (0{,}27 ; 0{,}09)$

$(r-h)^2 + (r-a)^2 = r^2$
$= 0{,}1296 + r^2 + a^2 - 2ra = r^2$
$a^2 - 2ra + 0{,}1296 = 0$



$\frac{2r \pm \sqrt{4r^2 - 4\cdot 0{,}1296}}{2} =$

$\frac{0{,}9 \pm 0{,}54}{2} \Rightarrow a = 0{,}18 \Rightarrow b = 0{,}27$

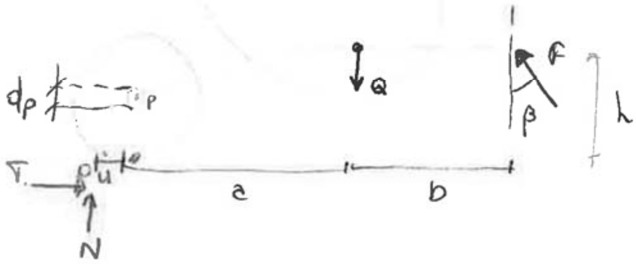
$\alpha = \arctan\left(\frac{b}{r-h}\right) = 36{,}87°$

Ok!

$F_N = mg\cos\alpha$
$F_T = mg\,\text{sen}\,\alpha$
$F_T = F_N f$

$\Rightarrow mg\,\text{sen}\,\alpha = mg\cos\alpha \cdot f \Rightarrow f = \tan\alpha = 0{,}75$

ES 10) (2.37)



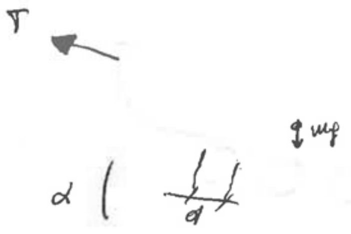
$Q = 900\,N$
$a = 0{,}6\,m$
$b = 0{,}5\,m$
$h = 0{,}8\,m$
$D = 0{,}4\,m$
$u = 0{,}01\,m$
$d_p = 25\,mm \Rightarrow r_p = 12{,}5$
$f_p = 0{,}18$
$F = ?\ \ v = cost$
$\beta = ?$

$\uparrow\ N - Q = F\cos\beta = 0$
$\rightarrow\ F\,\text{sen}\,\beta = T$
$a\circlearrowleft\ Q(\rho+u) + F\cos\beta(a+b) - F\,\text{sen}\,\beta\,h = 0$
$P\circlearrowleft\ Tr - N(\rho+u) = 0 \Rightarrow T = N(\rho+u)/r$
$Q(a+u) + (N-Q)(a+b) - \frac{N(\rho+u)}{r} = 0$
$\Rightarrow N = 424{,}1\,N$
$T = 25{,}9\,N$
$F = 476{,}6\,N$
$\beta = 3.12$

$\rho = r_p\,\text{sen}\,\varphi$
$\varphi = \arctan f =$
$\Rightarrow \rho = 2{,}21\,mm$

$P\circlearrowleft\ Tr - N(\rho+u) = 0$

ES 11 (2.39)



$m = 200\,kg$

$d = 0{,}25\,m$

$\alpha = 6°$

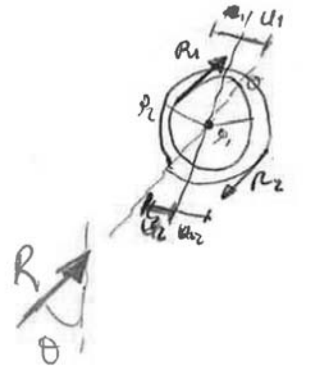
$\delta_{v_1} = 0{,}01 \Rightarrow u_1 = 0{,}00125\,m \Rightarrow \varphi_1 = 0{,}071°$

$\delta_{v_2} = 0{,}08 \Rightarrow u_2 = 0{,}01\,m \Rightarrow \varphi_2 = 0{,}57°$

$T = ?$

$\rho_1 = r \sin\varphi_1 = 0{,}31\,mm$

$\rho_2 = r \sin\varphi_2 = 2{,}48\,mm$



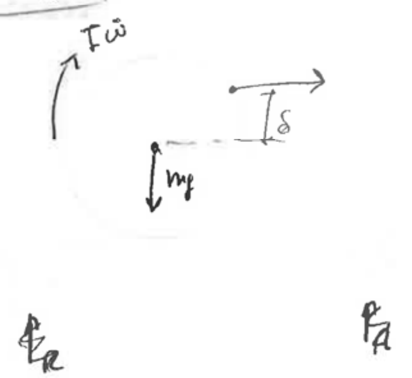
$\tan\theta = \frac{u_1 + u_2}{d} \Rightarrow \theta = 2{,}57°$

$T - mg \sin\alpha + R \sin\theta = 0$

$mg \cos\alpha - R\cos\theta = 0 \Rightarrow R = 1{,}951\,kN$

$\Rightarrow T = 117{,}4\,N$

12 (3.52)



$m = 8\,kg$

$J_G = 0{,}12\,kg\,m^2$

$d = 0{,}3\,m$

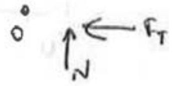
$T = 20\,N$

$u = 0{,}3\,mm$

$\delta = ?$

$a = \frac{T}{m} \quad \dot\omega = \frac{a}{r}$

$\Rightarrow \delta + \frac{d}{2} = 0{,}1 \Rightarrow \delta =$



$T(\delta + r) - Nu = (I + mr^2)\dot\omega$

$T = ma$

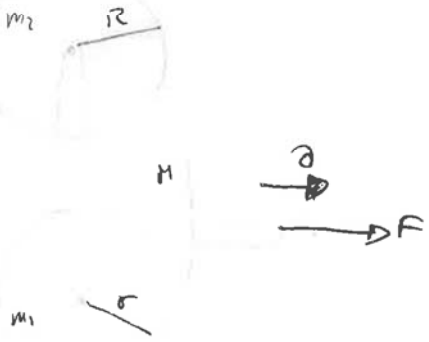
$N = mg$

$T(\delta + r) - Nu = (I + mr^2)\cdot\frac{T}{mr} \Rightarrow \delta + r = 0{,}251 \Rightarrow$

$\delta = 10{,}1\,cm$

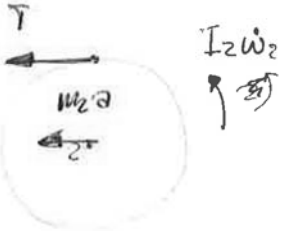
Es 13 (3.35)

$R = 0{,}5\,m$
$m_2 = 50\,kg$
$\rho_2 = 0{,}42\,m$
$M = 100\,kg$
$m_1 = 15\,kg$
$\rho_1 = 0{,}3\,m$
$F = 400$
$r = 0{,}4\,m$
$a = ?$



$\dot\omega_1 = a\,r$

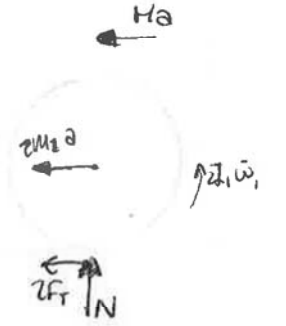
$\dot\omega_2 = a\,R$



$F - T - (m_2 + M + 2m_1)a = 0 \quad - 2f_T = 0$

2) $TR = \tfrac{1}{2} m_2 \rho_2^2 \dot\omega_2$

1) $2f_T r = 2\left(\tfrac{1}{2} m_1 \rho_1^2 \dot\omega_1\right)$

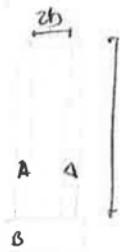


$$F - \frac{m_2 \rho_2^2 \dot\omega R}{R} - (m_2 + M + 2m_1)a - \frac{2 m_1 \rho_1^2 \dot\omega_1}{r} = 0$$

($\dot\omega R \to a$, $\dot\omega_1 \to \frac{a}{r}$)

$$\Rightarrow a = \frac{F}{kg\left[\frac{m_2\rho_2^2}{R^2} + (m_2 + 2m_1 + M) + \frac{2m_1\rho_1^2}{r^2}\right]} = \frac{400}{252{,}5} \approx 1{,}77\ m/s^2$$

Es 14 (3.39)



$l = 0{,}3\,m$
$m_A = 1{,}5\,kg$
$m_B = 4\,kg$
$\rho_B = 0{,}04\,m$
$n_0 = 300\ giri/min$
$b = 0{,}06\,m$

$$\tfrac{1}{2}\left(m_B \rho_B^2\right) n_0^2 + \tfrac{1}{2}\cdot 2\left(\tfrac{1}{12} m_A l^2\right) n_0^2 + 2 m_A \rho_2^2 =$$

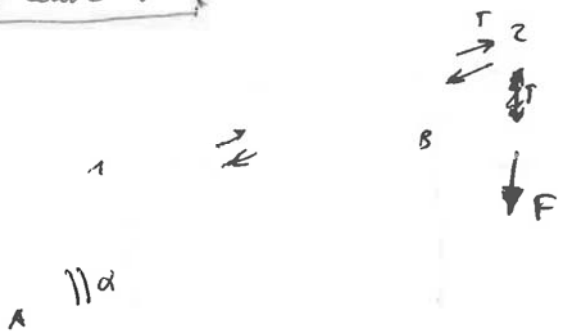
$$\tfrac{1}{2} m_B \rho_B^2 n^2 + \tfrac{1}{2}\cdot 2\cdot \tfrac{1}{12} m_A \left(\frac{l^2}{12} + (\rho_2 + b)^2\right) =$$

$\Rightarrow n = 164{,}8\ giri/min$

$$\tfrac{1}{2}\left(m_B \rho_B^2\right) n_0^2 + \tfrac{1}{2}\cdot 2\cdot (m_A b^2) n_0^2 + 4 m_A \rho_2^2 =$$

$$= \tfrac{1}{2} m_B \rho_B^2 n^2 + \tfrac{1}{2}\cdot 2 m_A \left(\frac{l^2}{12} + \left(\frac{l}{2} + b\right)^2\right) \Rightarrow$$

Problema 15

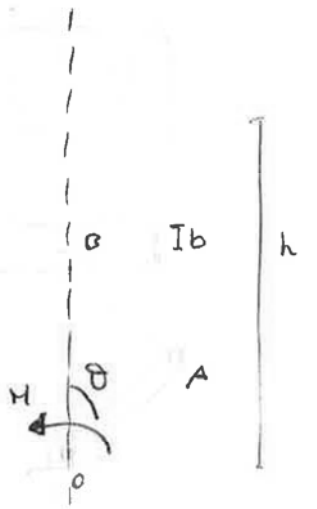


$m_1 = 50\,kg$
$\alpha = 30°$
$r_2 =$
$m_2 = 4\,kg$
$V_B = ?$
$V_A = 0$
$AB = 2\,m$
$F = 250\,N$

$$\tfrac{1}{2} m_1 V_A^2 + m_1 g h_1 + 2F \cdot AB = m_1 g AB \sin\alpha + \tfrac{1}{2} m_1 V_B^2 + \tfrac{1}{2} m_2 r_2^2 \cdot \frac{V_B^2}{r^2}$$

$$2F\,AB = m_1 g AB \sin\alpha + \tfrac{1}{2}(m_1 + m_2) V_2^2 \Rightarrow V_B = 4{,}35\,m/s^2$$

ES 16 (3.52)



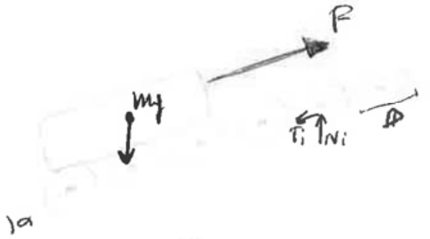
$m_A = m_B = 2\,kg$
$\rho_A = \rho_B = 0{,}06\,m$
$OA = AB = 0{,}2\,m$
$m_p = 3\,kg$
$k = 6\,kN/m$
$h = 0{,}4\,m$
$h = 0{,}05\,m$
$H = 20\,N\,m$
$\theta = 45° \rightarrow 0$

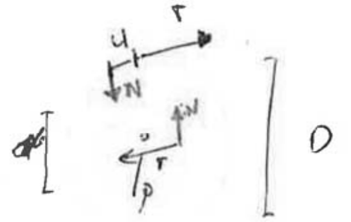
$$2 m_1 g \frac{AB}{2} \cos\theta \; H\theta + m_p \cdot 2 OA \cos\theta\, g = \tfrac{1}{2}\left(m_A \rho_A^2 + m_B \rho_B^2\right)\left[\frac{V}{OA}\right]^2 + m_p g h + \tfrac{1}{2} k \Delta x^2 + m_A g \cdot OA + m_B g \tfrac{3}{4} h + \tfrac{1}{2} m_A V_A^2 + \tfrac{1}{2} m_B V^2$$

$$\Rightarrow 3.44 = \tfrac{1}{2}\left\{ m_A \left[\left(\frac{\rho_A^2}{OA^2}\right) + 1\right] + m_B \left[\frac{\rho_B^2}{OB} + 1\right]\right\} V^2$$

$$3.44 = 2.18\,V^2 \Rightarrow V = 1.25\,m/s$$

Problema 18 (4.9)





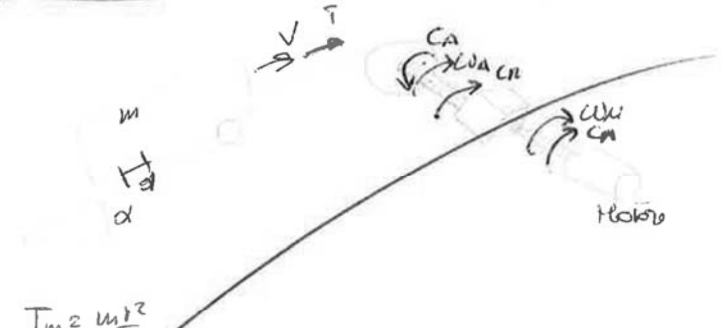
$\alpha = 5°$
$D = 0.3m$
$d = 0,05m$
$f = 0.08$
$u = 1.25\ mm$
$\eta = ?$

~~$F - mg\,sen\alpha - \Sigma T_i = 0$~~
~~$\Sigma N_i - mg = 0$~~

$F - mg\,sen\alpha - \Sigma T_i = 0$
$\Sigma N_i - mg\cos\alpha = 0$
$\varphi = arctg(f)$
$\rho = \frac{d}{2}\,sen\varphi$
$\circlearrowleft_1\ Nu + N\rho - T\frac{D}{2} = 0 \Rightarrow T = N\left(\frac{u+\rho}{D/2}\right)$
$T = N\cdot 0{,}0216$
$N = mg\cos\alpha \Rightarrow T = m\,0{,}211$
~~$F - m\,0{,}85 - m\,0{,}034$~~
$F - m\,0.85 - m\,0.21$

$\eta = \frac{L_{utile}}{L_{svolto}} = \frac{mg\,sen\alpha\,V}{F\,V} = \frac{0{,}85\,m}{1{,}06\,m} = 80.10\%$

Es 19 (4.13)



$m = 2000\,kg$ $d = 0{,}7m$
$\alpha = 10°$ $\rho = 0{,}005m$
$D = 1.28m$ $u = 15mm$
$I_A = 25\ kg\,m^2$
$I_M = 0.15\,kg\,m^2$
$\tau = \frac{\omega_A}{\omega_M} = 1/36$ $\eta = 0{,}75$

$I_m = \frac{m r^2}{2}$

1) $V = 18\,km/h$ P?
2) $\omega_M = ?$
$T_0 = ?$ \ $C_0 = 2C_r$

$T - mg\,sen\alpha = ma$
$N - mg\cos\alpha = 0$
$\circlearrowleft -Nu + T\frac{D}{2} + N\rho = 4 I_m \frac{a}{d/2}$

$-mg\cos\alpha(u+\rho) + m(a + g\,sen\alpha)\frac{D}{2} = 4 I_m \frac{a}{d/2} \Rightarrow$ 1,406 7458,6V

$\Rightarrow mg\cos\alpha(u+\rho) + mg\,sen\alpha\frac{d}{2} = \left(4\frac{I_m}{d/2} + m\right)a \Rightarrow a = 0{,}22\,m/s^2 \Rightarrow T = 5096{,}7N$

$P_A: T\,V = 25{,}483\,kW$
$\omega_A = V/\frac{D}{2} \Rightarrow C_R = \frac{P_A}{\omega_A} = 3261{,}88\,Nm$
$\omega_M = \frac{\omega_A}{\tau} = 180\,rad/s$
$\frac{P_R}{P_M} = \eta \Rightarrow P_M = P_A/\eta = 34\,kW \Rightarrow C_M = 188{,}76\,Nm$

INV: $P_A = \eta P_M \Rightarrow T_0 V = \eta\, 2 C_M \omega \Rightarrow T_0 = 10198{,}52N$

$C_A = C_R - I_M \alpha$ ~~ω_R~~

$\omega_A = V/R = 5.2$ rad/s $\Rightarrow \omega_H = \frac{\omega_A}{\tau} = 180$ rad/s

$\alpha_A = a/R = 0.659$ rad/s² $\Rightarrow \alpha_M = 23.724$ rad/s²

$\omega_A = V/R = 7.81$ rad/s $\Rightarrow \omega_M = 100$ rad/s

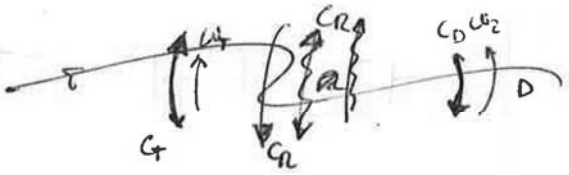
$P_R = C_R \omega_A = \eta P_M$ ~~$= \eta C_H \omega_H \Rightarrow C_H = 187.66$ Nm~~

$P_H = [C_H - (I_M \alpha)]\omega$

$\Rightarrow C_H = 2806$ Nm

KUTTO: $P_H = (2C_H - I_M \alpha)\omega = 100,396$ kW $\Rightarrow P_R = 75289.8$ W $= TV \Rightarrow T = 1505.8$ N

ES 20 (4.17)



$I_D = 10$ kgm²

$\omega_D = 100$ rad/s

$\tau = \frac{\omega_D}{\omega_F} = \frac{1}{3}$

$I_F = 0.5$ kgm²

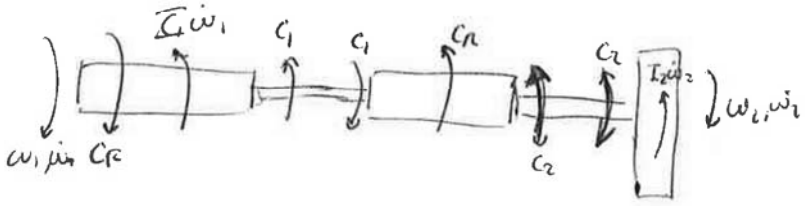
C_F?

$\Delta\theta = \pi$

C_R

$\eta = \frac{C_D \omega_D}{C_R \omega_F} = 1$

$\frac{1}{2} I_D \dot{\omega}^2 + \frac{1}{2} I_F \left(\frac{\omega_2}{\tau}\right)^2 = C_F \Delta\theta \Rightarrow C_F = 16003.3$ Nm



All'istante dt

$C_2 = 1$

$C_2 \omega_2 = \frac{1}{2} \frac{I\omega_2^2}{dt}$

$\dot{\omega}_2 = \frac{d\omega_2}{dt} = \omega_2 \frac{d\omega_2}{d\theta_2} \Rightarrow \dot{\omega} \int_0^{\theta} d\theta_2 = \int_{\omega_2}^{0} \omega_2 d\omega_2 \Rightarrow \dot{\omega}_2 \theta = \frac{1}{2}\omega_2^2 \Rightarrow \dot{\omega}_2 = -1591.4$ rad/s²

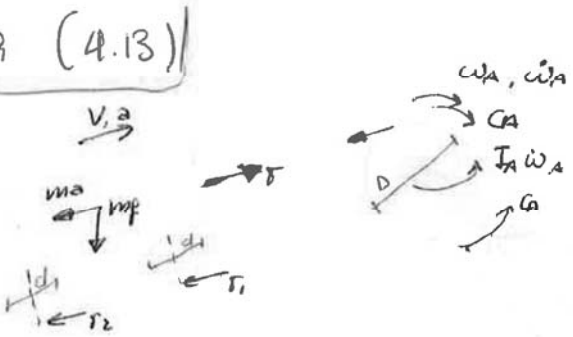
$C_2 = I_2 \dot{\omega}_2 \Rightarrow \frac{C_2/\omega_2}{C_1/\omega_1} = 1 \Rightarrow C_1 = C_2 \tau \Rightarrow C_1 = I_2 \dot{\omega}_2 \tau$

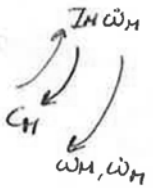
$C_F = C_1 + I_1 \dot{\omega}_1 \Rightarrow I_2 \dot{\omega}_2 \tau + I_1 \frac{\dot{\omega}_2}{\tau} = (5252.11 + 2389.7) = 7642$ Nm

$\frac{\dot{\omega}_2}{\dot{\omega}_1} = \tau$

$C_1 - C_R - C_2 = 0 \Rightarrow C_R = I_2\dot{\omega}_2 - I_2\dot{\omega}_2\tau = I_2\dot{\omega}_2(1-\tau) = 10609.3$ Nm

Es 19 (4.13)





$m = 2400\ kg$ $\alpha = 0$

$D = 1.28\ m$

$I_A = 25\ kg\,m^2$

$I_M = 0.15\ kg\,m^2$

$\tau = \frac{\omega_A}{\omega_M} = \frac{1}{36}$ $\eta = 0.75$

$d = 0,7\ m$

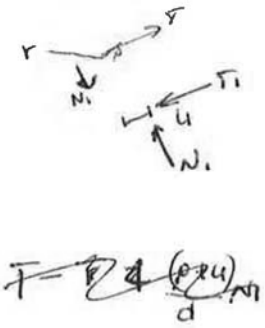
$\rho = 5\ mm$

$u = 15\ mm$

$P_M = ?$ $a = 0$ $V = 18\ km/h$

$\omega_M = ?$

$T_0 \setminus C_0 = 2C_M$, $V = 0$



$$\begin{cases} T_1 = \frac{2(\rho+u)}{d} N_1 \\ T_2 = \frac{2(\rho+u)}{d} N_2 \\ T - T_1 - T_2 - mp\sin\alpha = ma \rightarrow T = mp\left[\sin\alpha + \frac{2(\rho+u)\cos\alpha}{d}\right] + ma \\ N_1 + N_2 - mp\cos\alpha = 0 \end{cases}$$

~~$T = T\frac{d}{(\rho+u)} N_1$~~

$C_A = T_A \frac{D}{2} + I_A \dot{\omega}_A$

~~$C_M = \frac{T_A}{\eta} + I_M \dot{\omega}_M$~~

$P_A = P_M \eta$

~~$C_A \omega_A = \eta C_M \left(\frac{\omega_A}{\tau}\right)$~~

$C_A \omega_A =$

$\dot{\omega}_M = \frac{\dot{\omega}_A}{\tau}$

$P_A = \eta P_M$

~~$C_A \omega_A = \eta \left[C_M \frac{\omega_A}{\tau}\right] \rightarrow C_M = C_A \frac{\omega_A}{\tau}$~~

$C_A \omega_A = \eta \left[C_M - I_M \dot{\omega}_M\right] \omega_A / \tau \Rightarrow \frac{C_A \tau}{\eta} + I_M \dot{\omega}_M = C_M \rightarrow \frac{C_A \tau}{\eta} + I_M \frac{\dot{\omega}_A}{\tau} = C_M$

$\Rightarrow \left(T_A \frac{D}{2} + I_A \dot{\omega}_A\right)\frac{\tau}{\eta} + I_M \frac{\dot{\omega}_A}{\tau} = C_M$ ma $\dot{\omega}_M = 0$ se ~~$V = 18\ km/h$~~ $V = 5\ m/s$

$\Rightarrow C_M = mp\left[\sin\alpha + \frac{2(\rho+u)\cos\alpha}{d}\right]\frac{D}{2}\cdot\frac{\tau}{\eta} = 125.1\ Nm$

$\omega_M = \frac{\omega_A}{\tau}$ $\omega_A = V/D/2 \Rightarrow \omega_M = 281.25\ rad/s$

$C_0 = \left(T_A \frac{D}{2} + I_A \dot{\omega}_A\right)\frac{\tau}{\eta} + I_M \frac{\dot{\omega}_A}{\tau} = mp\left[\sin\alpha + \frac{2(\rho+u)\cos\alpha}{d}\right]\frac{D}{2}\frac{\tau}{\eta} + I_M \frac{\dot{\omega}_M}{\tau} + (ma + I_A \dot{\omega}_A)\frac{\tau}{\eta}$

$\downarrow 2C_M$

$\Rightarrow$

$\omega_A = 0,88\ rad/s^2 \Rightarrow a = 0,563\ m/s^2 \Rightarrow T_0 = 6626,7\ N$

$2C_0 = \frac{\tau}{\eta}\left\{I_A \dot{\omega}_A + \frac{D}{2}\left(mp\left[\sin\alpha + \frac{2(\rho+u)\cos\alpha}{d}\right] + ma\right)\right\} + I_M \frac{\dot{\omega}_A}{\tau}$

$250,2 = 126,1 + 5,4\dot{\omega}_A + 0,29\dot{\omega}_A + 80\dot{\omega}_A \Rightarrow \omega_A = 1281,29 \Rightarrow a = 2,03\ m/s^2 \Rightarrow T = 10149\ N$

Problema 21 (4.22)

$L = 1000\,J$

$f = 36$ cicli/min $\Rightarrow 0{,}6$ Hz

$\Delta\theta = 144°$

$\tau = 1/6{,}5 = \frac{\omega_2}{\omega_1}$

$\varepsilon = 0{,}2$

I_{rot} (riferito al motore)

$\varepsilon = \frac{\Delta L}{I\omega^2}$

$\bar{\omega} = \frac{\omega_1 + \tau\omega_1}{2}$

$\varepsilon = \frac{\omega_1 - \omega_2}{\bar{\omega}} = \frac{\omega_1(1-\tau)}{\omega(1+\tau)/2} \Rightarrow \varepsilon = \frac{2(1-\tau)}{(1+\tau)}$

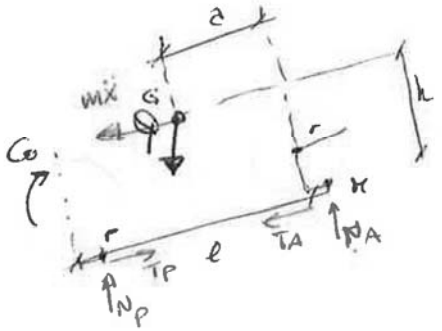
$f \Rightarrow \Delta t = 1.66\,S \Rightarrow \bar{\omega} = \frac{\Delta\theta}{\Delta t} = \frac{48}{100}\pi$ rad/s

$I = \frac{\Delta L}{\varepsilon\omega^2} = 21988{,}1$ kgm²

$\Delta L = L \cdot \frac{360 - 144}{360} = 600\,J$ $\Rightarrow I = \frac{\Delta L}{\varepsilon\omega_1^2} = 49{,}96$ kgm²

$\omega_2 = \frac{2\pi f}{60} = 3{,}77$ rad/s $\Rightarrow \omega_1 = \frac{\omega_2}{\tau_1} = 24{,}5$ rad/s

Problema 22 (4.41)



$\mu_{pa} = 0{,}03$

$t = 0 \quad V_0 = 10$ m/s

$m_{tot} = 1000$ kg

$a = 1$ m

$h = 0{,}8$ m

$l = 2{,}5$ m

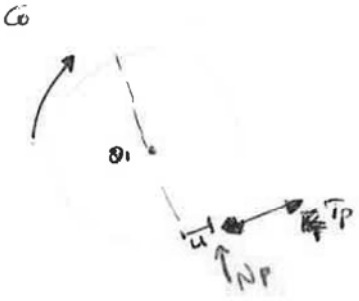
$r = 0{,}3$ m

$u = 20$ mm

$f_a = 0{,}5$

$C_0 = 500$ Nm

$a = ?$ ribaltamento? Pot. attrito?



$\rightarrow \quad T_P - T_A - m\mu_p \cos\alpha = ma$

$\uparrow \quad N_P + N_A = mg\cos\alpha$

$\circlearrowleft_P \quad N_P(l+u) - mg\cos\alpha(a+u) - mg\sin\alpha\, h - \ldots = 0$

$\circlearrowleft_P \quad C_0 = N_P u + T_P r \Rightarrow N_P = (C_0 - T_P r)/u$

$\circlearrowleft_A \quad N_A u = T_A r \Rightarrow N_A = T_A \frac{r}{u}$

$a = 0{,}719$ m/s²

$N_P = 4058{,}25$ N

$T_P = 1396{,}11$ N

$\frac{T_P}{N_P} \leq f$? $= 0{,}34 < 0{,}5$

$(C_0 - T_P r + T_A r)/u = mg\cos\alpha \Rightarrow$

$+ (T_P - T_A) = -u mg\cos\alpha + C_0 \Rightarrow$

$\frac{C_0 - u mg\cos\alpha}{r} = T_P - T_A \Rightarrow \frac{C_0 - u mg\cos\alpha}{r} - mg\sin\alpha = ma$

macchina rotola $\rightarrow$ moto relativo tra ruota e terreno nullo $\Rightarrow \Delta E_K = 0$ ma la componente normale N

$W_0 = (N_P + N_A)u \cdot \frac{V_0}{r} = 6530$ W

ES 1.1

$a = 5 - 0,2 v^2$

$t_f = ?$

$v = 7,5 \text{ m/s}$

$s_f =$

$v_0 = 0$

$a = (5 - 1,25) = 3,75 \text{ m/s}^2$

$v = v_0 + at \rightarrow t_f = 0,67 \text{ s}$

$s_f = v_0 + \frac{1}{2} a t_f^2 = 0,833 \text{ m}$

$a = \frac{dv}{dt} \rightarrow dt = \frac{dv}{a(v)}$

$t_f = \int_0^{v_f} \frac{dv}{5 - 0,2v^2} =$

$= \left[\ln(5 - 0,2v) \right] \cdot \frac{0,2 v^3}{3}$

$a_0 = 5 \text{ m/s}^2 \quad 0,2 \text{ m}^{-1} = c$

$t_f = \int_0^{v_f} \frac{dv}{a_0 - cv^2} = \int_0^{v_f} \frac{dv}{\frac{a_0}{c} - v}$

$\sqrt{\frac{a_0}{c}} = v$

1.2

$a = 4 - 0,5t$

$s = 100 \text{ m}$

$t = ?$

$v_0 = 0$

$t = \frac{-a + 4}{0,5}$ Considero l'istante in cui $a = 0 \rightarrow t^* = 8 \text{ s}$

$v^* = \int_0^8 a(t)\,dt = \int_0^{t^*} (4 - 0,5t)\,dt = \left(4t - 0,5 \frac{t^2}{2} \right)_0^8 = 32 - 16 = 16 \text{ m/s}$

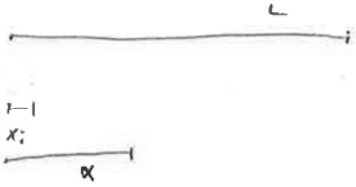
$s^* = \int_0^{16^8} v(t)\,dt = \int_0^8 \left(4t - \frac{t^2}{4} \right) dt = \left(2t^2 - \frac{t^3}{12} \right)_0^8 =$

$= 128 - \frac{128}{3} = \frac{256}{3} = 85,33 \text{ m}$

$s - s^* = 14,67 \text{ m} = \Delta s \rightarrow \Delta t = v^* t \rightarrow t = 0,916 \text{ s}$

$\rightarrow t_{tot} = t^* + t = 8,916 \text{ s}$

1.3



$a = \frac{k}{x}$ $\quad k = cost$

$x_i = 7,5\ mm \quad v = 0$

$V_L = 600\ m/s$

$L = 0,76\ m$

$a_M = ? \quad x_M = 0,38\ m$

$dx = \frac{V dV}{a(x)} \Rightarrow a(x)\,dx = V dV \rightarrow$

$\rightarrow \int_{x_i}^{L} \frac{k}{x} dx = \int_{0}^{V} \frac{V^2}{2} \Big] =$

$= k \ln(x)\Big|_{x_i}^{L} = \frac{V^2}{2} \rightarrow V^2 = 2k \ln\left(\frac{L}{x_i}\right)$

$\rightarrow k = \frac{V^2}{2 \ln \frac{L}{x_i}} = 38974,4\ m^2/s^{-2}$

$a_M = \frac{k}{x_M} = 102564,2\ m/s^2$

1.4

$a = -C_1 - C_2 V^2$ $\quad C_1$ e C_2 costanti cost

$D = ?$

$C_1 = 0,3\ m/s^2$

$C_2 = 0,0025\ m^{-1}$

$V_0 = 327,78\ m/s$

$a = \frac{dV}{dt} \rightarrow dt = \frac{dV}{a}$

$V = \frac{dx}{dt} \rightarrow \frac{dV}{a} V = dx$

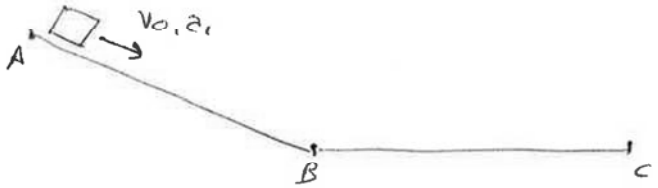
$D = \int_{V_0}^{0} \frac{V}{-C_1 - C_2 V^2} dV =$

$= \frac{-1}{2C_2} \int_{V_0}^{0} \frac{2 C_2 V}{-C_1 - C_2 V^2} = -\frac{1}{2C_2} \cdot \ln\left(-C_1 - C_2 V^2\right)_{V_0}^{0} = -\frac{1}{2C_2} \ln\left(\frac{-C_1}{-C_1 - C_2 V^2}\right) =$

$= +401,13\ m$

1.7

$v_0 = 1.2\ m/s$
$a_1 = 3\ m/s^2$
$a_2 = ?$
$t_2 = ?$
$s_1 = 3\ m$
$s_2 = 3.6\ m$



AB: $\begin{cases} s_1 = \frac{1}{2} a_1 t^2 + v_0 t \\ v_1 = v_0 + a_1 t \end{cases}$ $\Rightarrow$ $3 = 1.5t^2 + 1.2t \Rightarrow 1.2t + 1.5t^2 - 3 = 0$

$\frac{-1.2 \pm 4.4}{3} = 1.06\ s$ $\Leftarrow$ $4.407\ m/s = v_1$

BC: $\begin{cases} s_2 = \frac{1}{2} a_2 t_2^2 + v_0 t_2 \\ v_2 = v_1 + a_2 t_2 \rightarrow 0 \end{cases}$ $\Rightarrow$ $v_0 - \frac{v_1}{a_2} = a t_2^2$

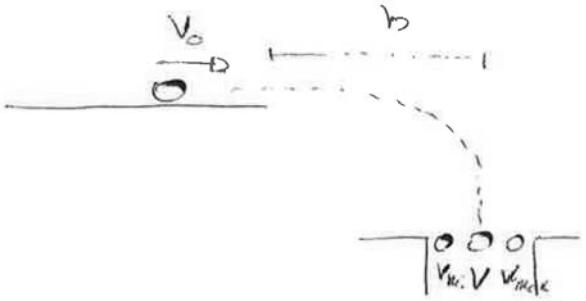
$s_2 = \frac{1}{2} a_2 \frac{v_1^2}{a_2^2} + v_1 \left(-\frac{v_1}{a_2}\right) \Rightarrow s_2 = \frac{1}{2}\frac{v_1^2}{a_2} - \frac{v_1^2}{a_2} \rightarrow$

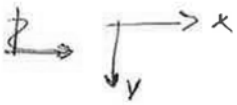
$\Rightarrow s_2 = -\frac{1}{2}\frac{v_1^2}{a_2^2} \rightarrow a_2 = -\frac{1}{2}\frac{v_1^2}{s_2} = -2.7\ m/s^2$

$t_2 = 1.632\ s$

1.12

$d = 0.02\ m$
$D = 0.08\ m$
$v_{min}?$
$v_{MAX}?$
$h = 0.09\ m$
$b = 0.12\ m$





$\rightarrow$: $x = v_{0x} t$
$\downarrow$: $y = v_{0y} t + \frac{1}{2} g t^2$

$\begin{cases} x = v_{0x} t \\ y = v_{0x} t \tan\alpha + \frac{1}{2} g t^2 \end{cases}$

$v_{0x} = \frac{v_{0y}}{v_{0x}} = \tan\alpha$

$\frac{h}{b} = \tan\alpha \rightarrow \tan\alpha$

$\tan\alpha = 0.75$

Se $x = \left(\frac{D}{2} - \frac{3}{2}d\right) \rightarrow \begin{cases} \frac{c_1}{\frac{D}{2} - \frac{3}{2}d} = v_{0x} t \\ h = t v_{0x} \tan\alpha + \frac{1}{2} g t^2 \end{cases}$

$v_{0x} = \frac{c_1}{t}$

$h = v_{0x} \tan\alpha + \frac{1}{2} g \left(\frac{c_1}{v_{0x}}\right)^2$

$h = \frac{c_1}{t} + \frac{1}{2} g t^2 \rightarrow$

$t = 0.277\ s \rightarrow v_{0x} = 0.07\ m/s$
0.129
$V = 0.096\ m/s$

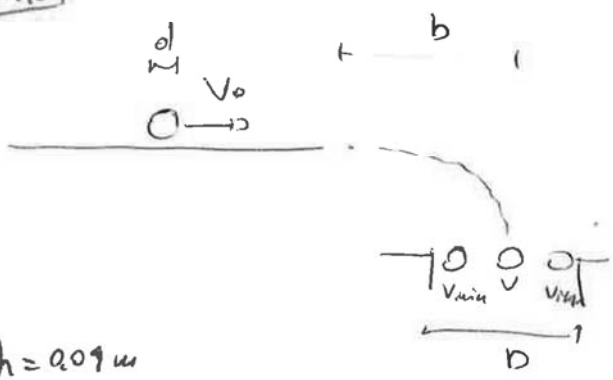
Se $x = \frac{D}{2} + \frac{3}{2}d \rightarrow c_2 = v_{0x} t$

$h = t v_{0x} \tan\alpha + \frac{1}{2} g t^2 \rightarrow$

$\rightarrow h = \frac{c_2}{t} \tan\alpha + \frac{1}{2} g t^2 \rightarrow t = 0.0875\ s$

$\rightarrow v_{0x} = 0.8\ m/s \rightarrow V = 1\ m/s$

1.12



$h = 0{,}09\ m$

$b = 0{,}02\ m$

~~V_0?~~

V_{min} = ?

V_{max} = ?

$D = 0{,}08\ m$

$d = 0{,}02\ m$

$$\begin{cases} x = V_0 t \\ y = \frac{1}{2} g t^2 \rightarrow t^2 = \sqrt{\frac{2y}{g}} \end{cases}$$

$t = 0{,}135\ s$

Se $x = b - \frac{D}{2} + \frac{3}{2}\frac{d}{2} \rightarrow 0{,}07\ m$

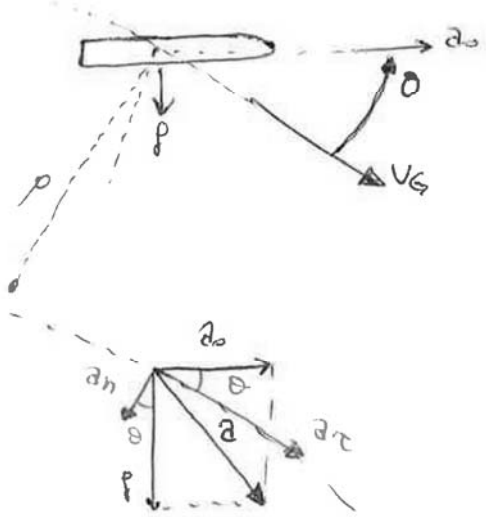
~~V_{min} = 0,94~~

$V_{min} = 0{,}67\ m/s$

Se $x = b + D/2 - \frac{d}{2} = 0{,}15\ m$

$V_{max} = 1{,}11\ m/s$

1.16



$a_0 = 6\ m/s^2$

$g = 9\ m/s^2$

$\theta = 15°$

$V_G = 4166\ m/s$

ρ = ?

$\dot{\beta}$ = ?

a_τ = ?

$\vec{a}$? (τ, n)

$a_\tau = a_0 \cos\theta + g \operatorname{sen}\theta = 2{,}12\ m/s^2$

$a_n = g \cos\theta - a_0 \operatorname{sen}\theta = 7{,}14\ m/s^2$

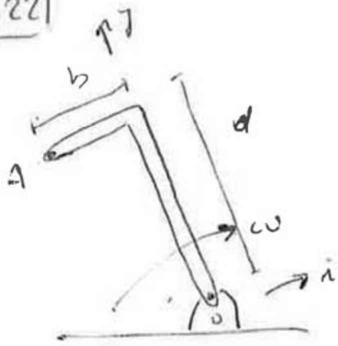
$a_n = V^2/\rho \rightarrow \rho = 2430{,}35\ km$

$a_\tau = \ddot{\beta} \cdot \rho \rightarrow \ddot{\beta} = 3{,}34 \cdot 10^{-6}\ rad/s^2$

$a_n = \dot{\beta}^2 \cdot \rho \rightarrow \dot{\beta} = 1{,}7138 \cdot 10^{-3}\ rad/s$

CINEMATICA CORPI RIGIDI

1.22



~~ω~~
$\dot{\omega} = 2\ rad/s$

$V_A = ?$ \ $\omega = 3\ rad/s$
$a_A = ?$

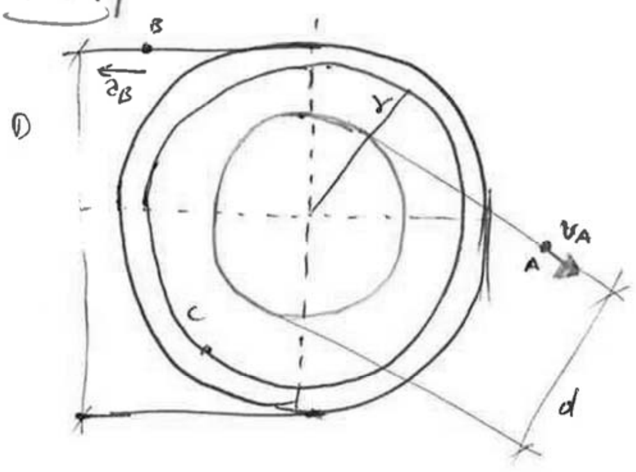
$b = 0{,}3m$
$d = 0{,}4m$

$OA: -b\,i + d\,j$

$V_A = \omega \wedge OA = -0{,}9\,i + 1{,}2\,j \quad rad/s$

$a_A = \dot{\omega} \wedge OA + \omega^2(OA) = -0{,}6\,i + 0{,}8\,j + 2{,}7\,i + 3{,}6\,j$
$= 1{,}9\,i - 4{,}2\,j \quad rad/s$

1.24



$V_A = 2\,m/s$
$a_B = 35\,m/s^2$
$a_c = ?$
$D = 0{,}8m$
$d = 0{,}15\,m$
$r = 0{,}36\,m$

c) ~~$a_t = a_B \cdot r = 12{,}6\,m/s^2$~~
~~$a_n = V_A^2/r =$~~

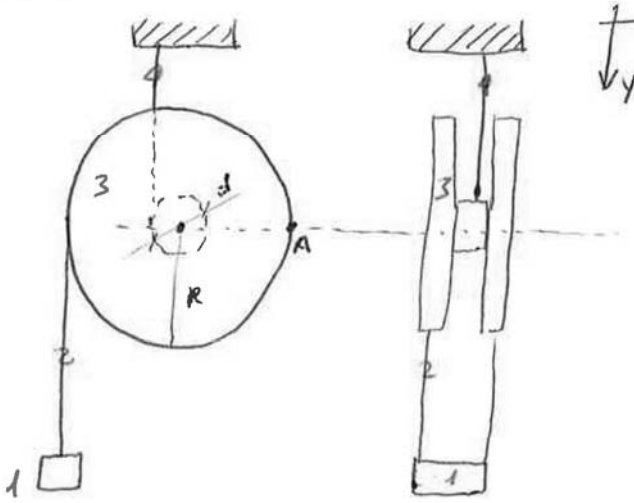
$\alpha_B = a_B / (D/2) = 87{,}5\ rad/s^2$

$\omega_A = V_A / (d/2) = 26{,}67\ rad/s$

→ c) $a_\tau = \alpha_B \cdot r = 31{,}5\,m/s^2$

$a_n = \omega_A^2 \cdot r = 256\,m/s^2$

1.28



1: $\Delta y = 1.5\,m$
$v_0 = 0$
$a = 0{,}1\,m/s^2$

$v_A = ?$
$a_0 = ?$
$d = 0{,}08\,m$
$R = 0{,}2\,m$

$\Delta y = \frac{1}{2} a t^2 \rightarrow t = 5{,}48\,s$

$V_1 = 0{,}547\,m/s \rightarrow \omega_3 = v_1/R = 2{,}739\,rad/s$

~~$V_A = V_1 + V_{0/1} = V_1 = 0{,}656\,m/s$~~ ~~$V_A = V_1$~~

$v_1 : R - \frac{d}{2} = v_A : R + \frac{d}{2}$

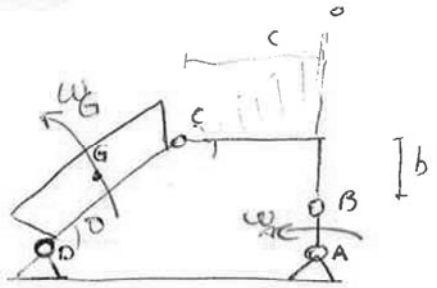
$v_1 \frac{R+d/2}{R-d/2} = v_A \rightarrow v_A = 0{,}8205\,m/s$

~~$V_1 = \omega_3 \frac{d}{2} = 0{,}109\,m/s \rightarrow v_0 = \omega_3 \cdot \frac{d}{2} = 0{,}109\,m/s$~~

~~$\alpha_1 = a/R = 0{,}5\,rad/s^2$~~ $a_0 = a_1 \cdot \frac{d/2}{R-d/2} = 0{,}025\,m/s^2$

~~Di cui $a_0 = \frac{d/2}{R-d/2} a_1$~~

1.36 CINEMATISMI ARTICOLATI

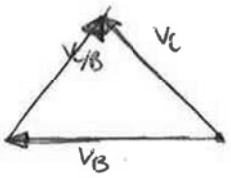


$DC = d = 0,36m$
$c = 0,24m$
$b = 0,1m$
$a = AB = 0,08m$
$\omega_A = 120$ giri/min
$\omega_G = ?$

$V_B = V_A + V_{B/A} = 1$ rad/s
$0 \quad \frac{2\pi n}{60} \cdot a$

$CB = \sqrt{c^2 + b^2} = 0,26m$

$V_C = V_B + V_{C/B}$
$\perp CD \quad \perp AB \quad \perp CB$
$\omega_G d \quad \omega_A a \quad ? \cdot CB$
$?$



$\omega_A : AB = \omega_{CB} : CB$
$\omega_{CB} = \omega_A \frac{CB}{AB} = 3,25$ rad/s
$V_C = \omega_G = \frac{\omega_A a + \omega_{CB} \cdot CB}{d} =$
$= 2,57$ rad/s

$\theta = 2 \arctan \frac{a+b}{d} = 30°$

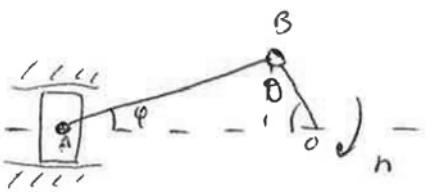
$OC = \frac{c}{\cos\theta} = 0,277m$

$OB = b + tg\theta \cdot c = 0,238m$

$V_C : OC = \omega_B : OB \rightarrow V_C = \frac{V_B \cdot OC}{OB} = 1,16$ m/s

$\rightarrow \omega_G = 3,22$ rad/s

1.37

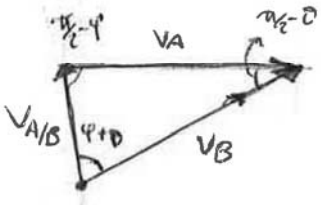


$AB = L = 0,35m$
$OB = r = 0,125m$
$n = 1500$ rpm $\omega_{OB} = 157,07$ rad/s
$\theta = ? \quad \theta = 60°$
$V_A = ?$
$a_A = ?$
$\omega_{AB} ?$
$\alpha_{AB} = ?$

$V_B = V_B + \omega_{OB} r = 19,6$ m/s
0

$L \sin\varphi = r \sin\theta \rightarrow \varphi = 15,02°$

$V_A = V_B + V_{A,B}$
$\parallel AO \quad \downarrow \quad \perp AB$
$\perp OB \quad \omega_{B/A} \cdot AB$
$\omega_{OB} r$



$29,44$ rad/s $= \omega_{BA} \leftarrow V_{B/A} = 10,3$ m/s $\frac{V_{B/A}}{\sin(\frac{\pi}{2} - \theta)} = \frac{V_B}{\sin(\frac{\pi}{2} - \varphi)} = \frac{V_A}{\sin(\varphi + \theta)} \rightarrow \omega_A = 20,17$ rad/s

$\rightarrow$

$\omega_{BA} = \frac{V_B - V_A}{AB} = -7,77$ rad/s