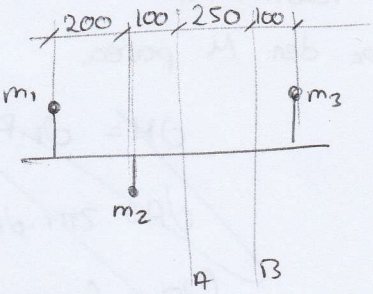
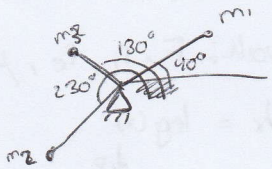
Azterketa eredua elementos

1) Kalkulatu A eta B planoetan kokatu behar diren m_A eta m_B irudiko sistema orekatzeko.





→ $m_1 = 60$ gr $\quad r_1 = 30$ mm $\quad \theta_1 = 40°$

→ $m_2 = 50$ gr $\quad r_2 = 25$ mm $\quad \theta_2 = 230°$

→ $m_3 = 80$ gr $\quad r_3 = 20$ mm $\quad \theta_3 = 130°$

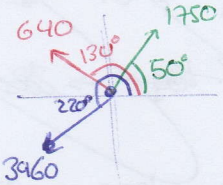
Distantziak: $r_A = 25$ mm $\quad r_B = 30$ mm

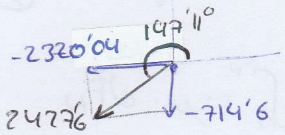
$m_1 r_1 = 1800$

$m_2 r_2 = 1250$

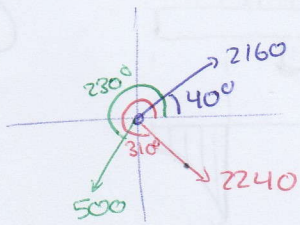
$m_3 r_3 = 1600$

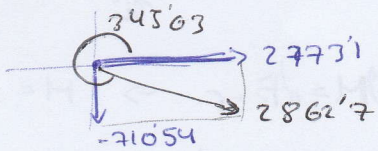
A planoa





B planoa





$m_A \cdot r_A = 2427'6 \rightarrow m_A = 97'104$ gr

$m_B \cdot r_B = 2862'7 \rightarrow m_B = 95'4$ gr

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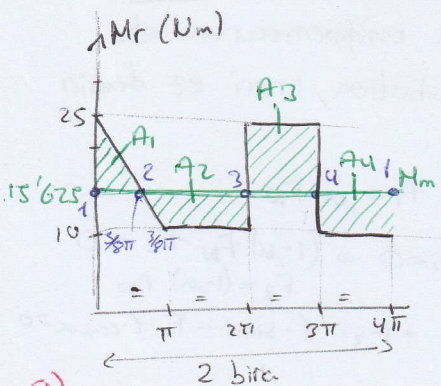
2) Makina bat erabiltzen da inertzia bolantearekin eta ondoko datuekin

- Erresistantzi-momentua aldakorra da
- Ziklo baten iraupena 2s
- Momentu eragilea (M_m) konstante
- Irregulartasun-koef. $\delta = 1/50$



Kalkulatu:

a) Eragileko behar den potentzia

b) Bolantearen inertzi-momentua eta neurriak, altzairuzkoa ($r = 10t$)

a)

$\Delta M = 10\pi + \frac{15\pi}{2} + 10\pi + 25\pi + 10\pi = 62'5\pi \qquad M_m = \frac{62'5\pi}{4\pi} = 15'625$ Nm

$\omega_m = \frac{\text{rad}}{s} = \frac{4\pi}{2s} = 2\pi$ rad/s $\qquad P = M_m \cdot \omega = 15'625 \cdot 2\pi \rightarrow \boxed{P = 31'25\pi\omega}$

b)

$\omega_1 > \omega_2 \qquad \omega_3 > \omega_4$

$\omega_2 < \omega_3 \qquad \omega_4 < \omega_1$

$-A_1 = \frac{9'375}{2} \cdot \frac{5}{8}\pi = 9'204 = 2'93\pi$

$+A_2 = 5'625\pi + \frac{5'625}{2} \cdot \frac{3}{8}\pi = 6'08\pi$

$-A_3 = 9'375\pi$

$+A_4 = 5'625\pi$

$\omega_{max} = \omega_3$

$\omega_{min} = \omega_4$

$\Delta E = 9'375\pi$

$I_b = \frac{\Delta E}{\delta (\omega_m)^2} = \frac{9'375\pi}{\frac{1}{50} \cdot (2\pi)^2} \rightarrow I_b = 37'302$ kgm^2

$r = 10t$

$I = \frac{1}{2} m r^2 = \frac{1}{2} \cdot \delta \cdot \pi \cdot (10t)^2 \cdot t \cdot (10t)^2$

$37'302 = \frac{1}{2} \cdot 7850 \cdot \pi \cdot 10000 \cdot t^5 \rightarrow t = 0'0497$m

$t = 4'97$ cm

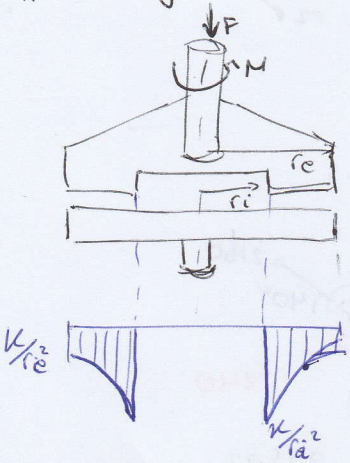
$r = 49'7$ cm

Errepaso ariketak

1) Irudiko sistema kontaktu-presioa honela adierazi daiteke: $p(r) = k/r^2$, k konstante ezezaguna izanik. Marruskadura koef., μ, konstantea da. Kalkulatu diskoa biratzeko beharrezkoa den M parea.

Datuak: F, r_i, r_e, μ

$\int \frac{1}{x}\,dx = \log(x)$



$dM = dr \cdot F_r \rightarrow M = \int_{ri}^{re} r \cdot dF_r$

$dA = 2\pi r \cdot dr$

$F = \int dF_N = \int p \cdot dA = \int_{ri}^{re} \frac{k}{r^2} \cdot 2\pi r \cdot dr = \int_{ri}^{re} \frac{2\pi k}{r}\,dr$

$dF_N = 2\pi k \int_{ri}^{re} \frac{1}{r} \cdot dr \rightarrow dF_N = 2\pi k \cdot \ln\left(\frac{re}{ri}\right)$

$dF_r = \mu \cdot 2\pi k \cdot \log r \rightarrow k = \frac{F}{2\pi \ln\left(\frac{re}{ri}\right)}$

$M = \int_{ri}^{re} \mu \cdot 2\pi k \cdot r \cdot \log r = 2\pi\mu k \int_{ri}^{re} r \cdot \log r$

$dM = dF_r \cdot r \rightarrow M = \int_{ri}^{re} r \cdot dF_r = \int_{ri}^{re} r \cdot \mu \cdot dF_N$

$dA = 2\pi r \cdot dr$

$dF_N = p \cdot dA = \frac{k}{r^2} \cdot 2\pi r \cdot dr = \frac{2\pi k}{r}\,dr$

$F = \int \frac{2\pi k}{r}\,dr = 2\pi k \cdot \ln\left(\frac{re}{ri}\right) \rightarrow k = \frac{F}{2\pi \ln\left(\frac{re}{ri}\right)}$

$M = \int_{ri}^{re} r \cdot \mu \cdot \frac{2\pi k}{r}\,dr = \int 2\pi k \mu \cdot dr = 2\pi\mu \frac{F}{2\pi \ln\left(\frac{re}{ri}\right)} \int_{ri}^{re} dr = \frac{\mu F \cdot (re - ri)}{\ln\left(\frac{re}{ri}\right)}$

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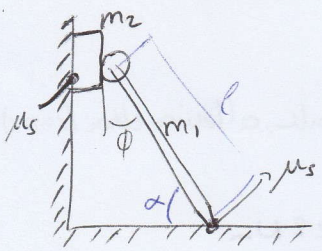
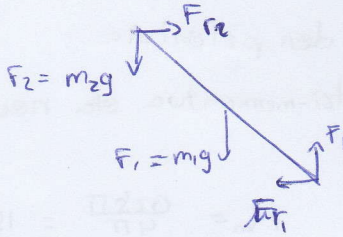
2) Masa m_2-ko bloke bat jartzen da m_1 masako barra uniformearen ate hormaren artean. Kalkulatu ϕ angelearen gutxieneko balioa, erori ez dadin.





$\sum F_x = 0 \rightarrow F_1 - F_r = 0 \rightarrow F_1 = \mu \cdot F_N$

$\sum F_y = 0 \rightarrow F_N - F_2 - F_1 = 0 \rightarrow (1-\mu) \cdot F_N - F_2 = 0$

$F_2 = (1-\mu)\,F_N$

$\sum M = 0 \rightarrow F_1 \cdot \frac{\ell}{2} \cdot \sin\alpha + F_2 \cdot \ell \cdot \sin\alpha - F_1 \cdot \ell \cdot \cos\alpha = 0$

$0 = \mu F_N \cdot \frac{\ell}{2} \cdot \sin\alpha + (1-\mu) F_N \cdot \ell \cdot \sin\alpha - \mu F_N \cdot \frac{\ell}{2} \cdot \cos\alpha$

$0 = \mu \cdot \frac{\sin\alpha}{2} + 1 - \mu \cdot \sin\alpha - \mu \cdot \frac{\cos\alpha}{2}$

$\phi = 90 - \alpha$

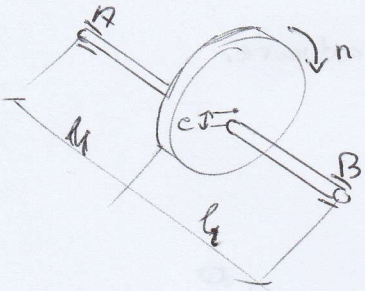
$\sum F_x = 0 \rightarrow F_{r2} = F_{r1} = \mu_s \cdot m_2 \cdot g$

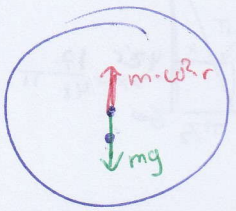
3] Kalkulatu A eta B planoetan kokatu behar diren m_A eta m_B masak irudiko sistema orekatzeko.

$m_1 = 60$ gr
$m_2 = 50$ gr
$m_3 =$

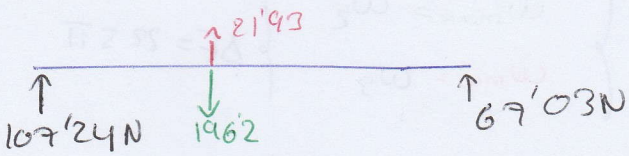
4] Irudiko m masako disko a ardatz batean muntatzen da, G grabitate-zentrotik $e = 10$ mm-ra. Ardatzaren abiadura: 100 rpm. Kalkulatu gehieneko eta gutxieneko indarrak A eta B errodamenduetan.

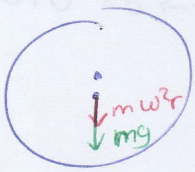
$e = 10$ mm $\quad m = 20$ kg
$\ell_1 = 500$ mm
$\ell_2 = 800$ mm



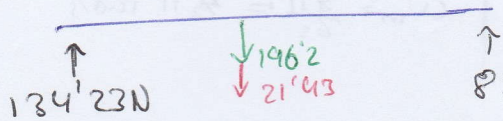


min

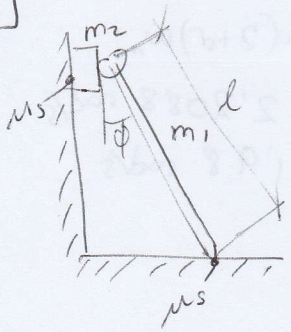


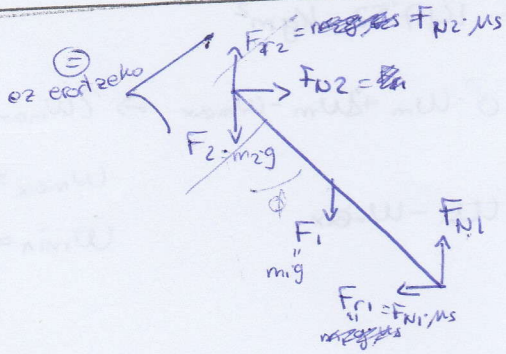


max



2]





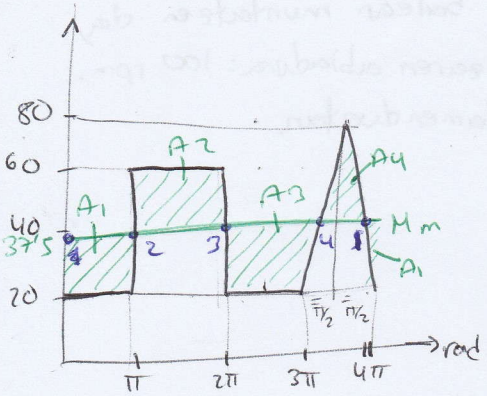
$F_{r2} = F_2 = m_2 \cdot g$

$F_{N2} \cdot \mu s = m_2 \cdot g \rightarrow F_{N2} = \frac{m_2 \cdot g}{\mu s}$

$\Sigma M = 0 \rightarrow F_1 \cdot \frac{\ell}{2} \cdot \cos\phi = F_{N2} \cdot \ell \cdot \sin\phi \rightarrow \tan\phi = \frac{F_{N2} \cdot \ell}{F_1 \cdot \frac{\ell}{2}} = \frac{2 F_{N2}}{F_1}$

$\tan\phi = \frac{2 F_{N2}}{F_1} = \frac{2 \cdot \frac{m_2 \cdot g}{\mu s}}{m_1 \cdot g} = \frac{2 \cdot m_2}{m_1 \cdot \mu s} \rightarrow \phi = \arctan\left(\frac{2 \cdot m_2}{\mu s \cdot m_1}\right)$

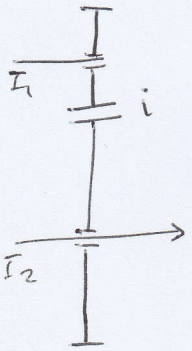
5] Makina bat erabiltzen da inertzia bolantearekin. Ondoko datuak haren bigarren ardatzari buruzkoak dira:



- $-M_r$, erresistentzi-momentu aldakorra
- Zikloa = 6s = 2bira
- M_m momentu ergilea konstantea.

$I_1 = 8\ kgm^2$, $I_2 = 32\ kgm^2$ $\quad i = 3'8$

Estimatu gehienezko eta gutxienezko abiaduraren balioak bigarren ardatzean.



$\Delta M = 20\pi + 60\pi + 20\pi + 20\pi + \frac{60\pi}{2} = 150\pi$

$M_m = \frac{150\pi}{4\pi} = 37'5\ Nm$

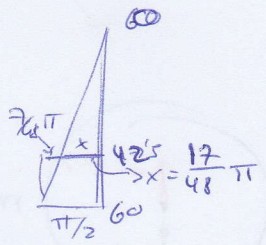
$\omega_1 < \omega_2$

$\omega_2 > \omega_3$ $\quad \omega_{max} = \omega_2$

$\omega_3 < \omega_4$ $\quad \omega_{min} = \omega_3$

$\omega_4 > \omega_1$

$\Delta E = 22'5\pi$



$\frac{42'5}{60} = \frac{x}{\frac{7}{6}\pi} \rightarrow x = \frac{17}{48}\pi$

$A_1 = 17'5\pi + \frac{7}{2\cdot 48}\pi \cdot 17'5 = 18'77\pi$

$A_2 = 22'5\pi$

$A_4 = 2 \cdot \frac{17}{48}\pi \cdot \frac{1}{2} \cdot 42'5 = 15'05\pi$

$A_3 = A_1 = 18'77\pi$

$I_b = \frac{\Delta E}{\delta \cdot (\omega_m)^2} = \frac{22'5\pi}{\delta(\frac{2}{3}\pi)^2} = 147'52 \rightarrow \delta = 0'109$

$\omega_m = \frac{4\pi}{6s} = \frac{2}{3}\pi\ rad/s$

$I_b = I_1 \cdot i^2 + I_2 = 8 \cdot 3'8^2 + 32 \rightarrow I_b = 147'52\ kgm^2$

$\delta = \frac{\omega_{max} - \omega_{min}}{\omega_m}$ $\quad \omega_m = \frac{\omega_{max} + \omega_{min}}{2}$

$\rightarrow \omega_{max} = \delta \cdot \omega_m + 2\omega_m - \omega_{max} \rightarrow 2\omega_{max} = (2+\delta)\omega_m$

$\rightarrow \omega_{min} = 2\omega_m - \omega_{max}$

$\omega_{max} = 2'2088\ rad/s$

$\omega_{min} = 1'98\ rad/s$

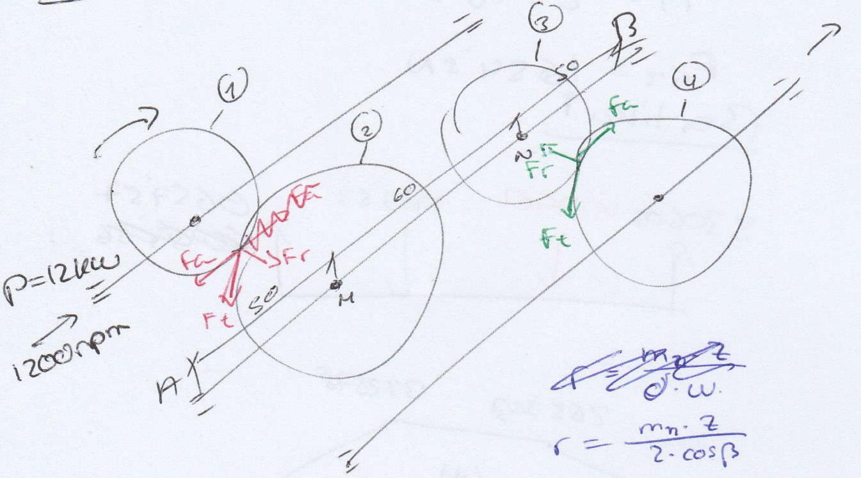
$n_{max} = 21'09\ rpm$

$n_{min} = 18'908\ rpm$ ✓

Azterketa eredua)

$\alpha = 20^\circ$

4)



	1	2	3	4
m_n	2'5	2'5	3	3
Z	18	45	20	54
β	10°	10°	12°	12°

$r = \frac{m_n \cdot z}{2 \cdot \cos\beta}$

$\omega_1 = n \cdot \frac{2\pi}{60} = 1200 \cdot \frac{2\pi}{60} = 40\pi$ / $P = M_t \cdot \omega \rightarrow M_t = \frac{P}{\omega} = \frac{12000}{40\pi} \rightarrow M_t = 95'49\ Nm$

$M_{t1} = 95\,492'96\ Nmm$

$r_{p1} = \frac{2'5 \cdot 18}{2\cos 10^\circ} = 22'845\ mm$

$r_{p2} = \frac{2'5 \cdot 45}{2\cos 10^\circ} = 57'115\ mm$

$r_{p3} = \frac{3 \cdot 20}{2\cos 12^\circ} = 30'67\ mm$

$r_{p4} = \frac{3 \cdot 54}{2\cos 12^\circ} = 82'81\ mm$

$M_{t2\text{-}3} = M_{t1} \cdot \frac{z_1}{z_2} \rightarrow M_{t23} = 238'730\ Nmm$

$M_{t4} = M_{t2\text{-}3} \cdot \frac{20}{54} \rightarrow M_{t4} = 644\,571\ Nmm$

$F_t = \frac{M_t}{r_p}$ $\quad F_r = \frac{F_t \cdot \tan\alpha}{\cos\beta}$ $\quad F_a = F_t \cdot \tan\beta$

$F_{t1} = 2090'02\ N$

$F_{r1} =$

$F_{t2} = 668'777\ N$

$F_{r2} = 247'17\ N$

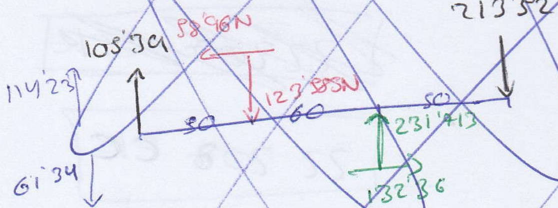
$F_{a2} = 117'92\ N$

$F_{t3} = 1245'426\ N$

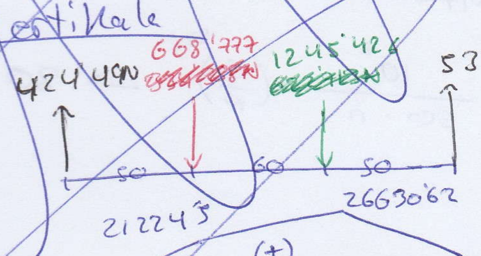
$F_{r3} = 463'426\ N$

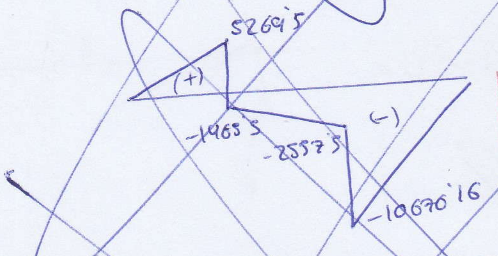
$F_{a3} = 264'72\ N$

Horizontala



Bertikala





τ_a?

$S_t \cdot 0'3 = 16'2\ Kg/mm^2$
$S_R \cdot 0'18 = 18\ Kg/mm^2$ } $16'2 \cdot 9'8 \cdot 0'75 \rightarrow \tau_a = 119'191\ N/mm^2$

$d^3 = \frac{16}{\pi \cdot \frac{\tau_a}{S_R} \cdot (1-\beta^4)} \cdot \sqrt{(K_M \cdot M_f)^2 + (K_t \cdot M_t)^2} \longrightarrow d =$

Hau gaizki

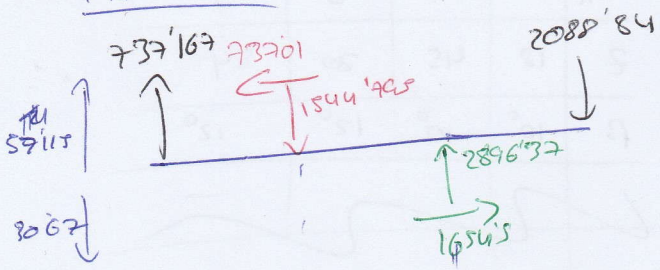
Hau ongi dago

$F_{t2} = 4179'81\ N$

$F_{r2} = 1544'745\ N$

$F_{a2} = 737'01\ N$

Horizontal

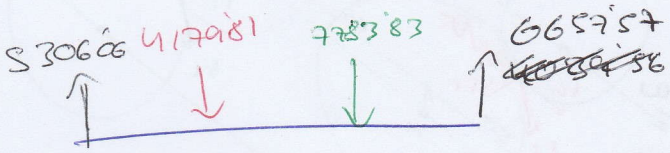


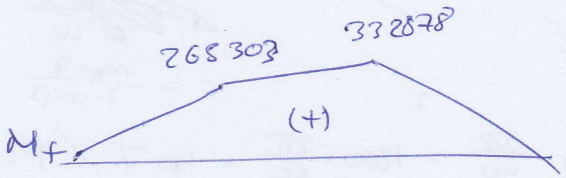
$F_{t3} = 7783'83N$

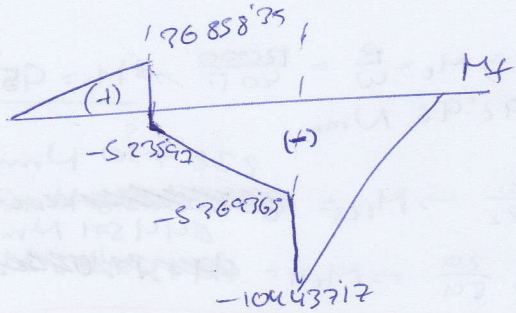
$F_{r3} = 2896'37N$

$F_{a3} = 1654'5N$

Vertical







$M_{fM} = \sqrt{523594^2 + 265303^2} = 265\,354'66$

$$d = \frac{1C}{\pi \frac{119'191}{15}} \cdot \sqrt{(2 \cdot 265\,354'66)^2 + (2 \cdot 238730)^2} \rightarrow d_M = 35\ mm$$

$n_2 = n_1 \cdot \frac{Z_1}{Z_2} = 4\,800 \cdot \frac{2}{10} = 960\ rpm$

Suposalvet (B punter) $Y_i = 2'3$ $\frac{F_a}{F_r} \geq e$ $F_r = \sqrt{2088'84^2 + 6657'57^2} = 6977'57\ N$

$F_a = 917'5N$

$P = 6977'57 + 2'3 \cdot 917'5 \rightarrow P = 9087'82$

$$L = \frac{10^6}{60 \cdot n} \cdot \left(\frac{C}{P}\right)^{10/3} \rightarrow 30\,000 = \frac{10^6}{60 \cdot 480} \left(\frac{C}{9087'82}\right)^{10/3} \rightarrow C = 69089'7$$

~~22207 EK~~

22 208 EK