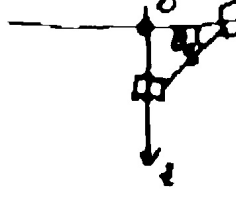


$m_1 = 0.1\,kg \quad m_2 = 0.3\,kg \quad d = 0.5\,m \quad \theta_0 = \frac{\pi}{6}$

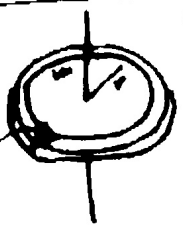
$mgd(1-\sin\theta) + m_2 g \frac{d}{2}(1-\sin\theta) = gd(1-\sin\theta_0)\left(m + \frac{m_2}{2}\right) = 0.61\,J = E_0$

$E_0 = \frac{1}{2}mv_1^2 + \frac{1}{2}I\omega^2 = \frac{1}{2}mv_1^2 + \frac{1}{2\cdot 3}m_2 d^2\omega^2 = v_1^2\left(\frac{m}{2} + \frac{m_2}{6}\right) \quad v_1 = \sqrt{\frac{2E_0}{3m+m_2}} = 1.47\,\frac{m}{s}$

$m_1 = 2\,kg \quad r = 0.15\,m \quad d = 0.12\,m \quad m_2 = 0.3\,kg \quad \mu \quad M = 0.23\,Nm \quad t_0 = 1.2\,s$

$I_1\alpha_1 = M - fd \quad I_2\alpha_2 = fd \quad I_1\alpha_1 + I_2\alpha_2 = M \quad \theta_1 = \frac{1}{2}\alpha_1 t_0^2 \quad \theta_2 = \frac{1}{2}\alpha_2 t_0^2$

$\Delta L = M t_0 = I_1\omega_1 + I_2\omega_2 \quad -\left(\frac{\theta_1 - \theta_2}{2\pi}\cdot 2\pi d\, m_1 g \mu\right) + M\theta_1 = \frac{1}{2}I_1\omega_1^2 + \frac{1}{2}I_2\omega_2^2$



$m = 2\,kg \quad r = 0.5\,m \quad M = 14.4\,Nm \quad K = 8\,Nm\frac{s}{rad} \quad m_2 = \frac{m}{4} \quad \mu = 0.2$

a) $\frac{dL}{dt} = M_{tot} \quad \int_0^L dL = \int_0^t (M - K\omega)\,dt \quad I\frac{d\omega}{dt} = M - K\omega \quad \int_0^\omega \frac{d\omega}{M-K\omega} = \int_0^t \frac{dt}{I}$

$\frac{t}{I} = \left[-\frac{1}{K}\ln(M-K\omega)\right]_0^\omega = -\frac{1}{K}\ln(M-K\omega) + \frac{1}{K}\ln M = \frac{1}{K}\ln\frac{M}{M-K\omega} \quad \frac{M}{M-K\omega} = e^{\frac{Kt}{I}}$

$Me^{-\frac{Kt}{I}} = M - K\omega \quad \omega = \frac{M}{K}\left(1 - e^{-\frac{K}{I}t}\right) \quad \lim_{t\to\infty}\omega = \frac{M}{K} = 1.8\,\frac{rad}{s}$

b) m_2 □ $I\omega = I'\omega' \quad \frac{mr^2}{2}\omega = \left(\frac{mr^2}{2} + \frac{m}{4}r^2\right)\omega' \quad \omega = \frac{3}{2}\omega' \quad \omega' = \frac{2}{3}\omega = 1.2\,\frac{rad}{s}$

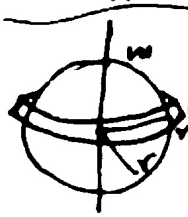
$m = 10\,kg \quad r = 0.2 \quad \mu = 0.2 \quad M_A = 3.88\,Nm \quad n_A = 20\,s^{-1}$

$M_{attr} = \mu mg\frac{r}{2} = 1.96\,Nm \quad I = \frac{mr^2}{2} = I_A = I_B = 0.2\,kg\,m^2$

$I\alpha_A = M_A - M_{attr} \quad \alpha_A = 19.6\,\frac{rad}{s^2} \quad I\alpha_B = M_{attr} \quad \alpha_B = 9.8\,\frac{rad}{s^2}$

$20\cdot 2\pi = \frac{1}{2}\alpha_A t^2 \quad t = \sqrt{\frac{80\pi}{\alpha_A}} = 3.6\,s \quad L = M_A t = I\omega_A + I\omega_B$

$40\pi M_A = \frac{1}{2}I(\omega_A^2 + \omega_B^2) + 2\pi M_{attr}(n_A - n_B) \quad 80\pi M_A = It^2(\alpha_A^2 + \alpha_B^2) + 4\pi n_B M_{attr} \quad n_A - n_B = \frac{80\pi M_A - It^2(\alpha_A^2+\alpha_B^2)}{4\pi M_{attr}} = 10 \quad n_B = 10$



$m, r \quad M = 8.6\,Nm \quad t_0 = 6.3\,s \quad t' = 10.5\,s \quad \omega_A(t') = \omega_B(t') \quad M(r>r_0) = 0 \quad \omega_A(r>t') = 0$

$I_S\alpha_S = M - M_2 \quad I_A\alpha_A = M_2 \quad \omega_A(t_0) = \alpha_A t_0 \quad \omega_S(t_0) = \alpha_S t_0$

$\frac{\alpha_A}{\alpha_S} = \frac{\omega_A}{\omega_S} \quad \omega_{A0} + \frac{M_2}{I_A}t' = \omega_{S0} - \frac{M_2}{I_S}t'$

$M_2 t'\left(\frac{I_A + I_S}{I_A I_S}\right) = \omega_{S0} - \omega_{A0} \quad \frac{I_A + I_S}{I_A I_S} = \frac{mr^2 + \frac{2}{5}mr^2}{\frac{2}{5}mr^2 \cdot mr^2} = \frac{7}{2}\cdot\frac{1}{mr^2} = \frac{7}{2mr^2} \quad M_2 = \frac{\omega_{S0} - \omega_{A0}}{7t'}(2mr^2)$

$M_A = \frac{2mr^2 t_0}{7t'}(\alpha_S - \alpha_A) = \frac{2mr^2 t_0}{7t'}\left(\frac{M - M_2}{\frac{2}{5}mr^2} - \frac{M_2}{mr^2}\right) = \frac{2t_0}{7t'}\left(\frac{5M - 5M_2 - 2M_2}{2}\right) = \frac{t_0}{7t'}(5M - 7M_2)$

$M_A + \frac{t_0}{t'}M_A = \frac{5t_0}{7t'}M \quad M_A = \frac{5t_0 M}{7t'\left(1 + \frac{t_0}{t'}\right)} = \frac{5t_0 M}{7(t' + t_0)} = 2.3\,Nm \quad (3.69\,Nm) \quad \omega_S = \alpha_S t_0 - \frac{M_2}{I_S}(t' - t_0)$

$\omega_S = 0 \quad \alpha_S t_0 = \frac{M_2}{I_S}t \quad \frac{M - M_2}{I_S}t_0 = \frac{M_2}{I_S}t \quad t = 8.34 = t' + 4.14\,s$

$\rho = 7\cdot 10^3\,\frac{kg}{m^3} \quad r_1 = 0.3 \quad r_2 = 0.5 \quad d_1 = 1\,m \quad d_2 = 2\,m \quad M_2$ sec. rotat. relative

fase 1: $M_2\,\omega_1 + \omega_{20} = 1200\,rpm$, M_1 opposto, $\omega_1 = 0$ $\quad t = 0,\ t_0 = 100\,s$

fase 2 $\quad M_1, M_2 = 0 \quad t_0 = 100\,s;\ t_1 = 150\,s \quad \omega_{11} = \omega_{21}$

$m_1 = \rho\cdot\pi r_1^2 d_1 = 1979\,kg \quad m_2 = \rho(\pi r_2^2 d_2 - \pi r_1^2 d_2) = 7044\,kg \quad I_1 = \frac{1}{2}m_1 r_1^2 = 89.1\,kg\,m^2 \quad I_2 = \frac{1}{2}\rho\pi d_2\left(r_2^4 - r_1^4\right) = 119.6\,kg\,m^2$

1): $I_1\alpha_1 = 0 = M_2 - M_1 \quad I_2\alpha_2 = M_2 - M_2 \quad \omega_{20} = \alpha_2 t_0 \quad \alpha_2 = 1.26\,\frac{rad}{s}$

2): $I_2\omega_{20} = (I_1 + I_2)\omega_1 \quad \omega_1 = 72\,\frac{rad}{s} \quad \omega_{20} - \frac{M_2}{I_2}(t_1 - t_0) = \omega_1 \quad M_2 = \frac{I_2(\omega_{20} - \omega_1)}{t_1 - t_0} = 128.4\,Nm = M$

$M_1 = M_2 + I_1\alpha_1 = 279\,Nm$

$\omega_{pm} = \frac{1200\cdot 2\pi}{60}\,\frac{rad}{s} = 125.7\,\frac{rad}{s}$