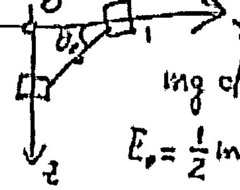
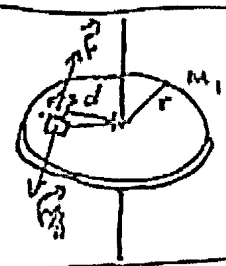


$m_1=0.1\,Kg$ $m_2=0.3\,Kg$ $d=0.5\,m$ $\theta_0=\frac{\pi}{6}$

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

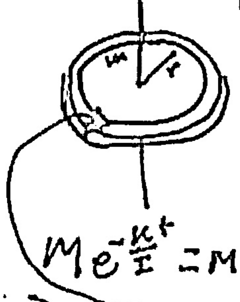
$E_0=\frac{1}{2}mv_1^2+\frac{1}{2}I\omega^2=\frac{1}{2}mv_1^2+\frac{1\cdot1}{2\cdot3}m_2d^2\omega^2=v_1^2\left(\frac{m}{2}+\frac{m_2}{6}\right)$ $v_1=\sqrt{\frac{6E_0}{3m+m_2}}=2.47\,m/s$



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

$I_1\alpha_1=M-fd$ $I_2\alpha_2=fd$ $I_1\alpha_1+I_2\alpha_2=M$ $\theta_1=\frac{1}{2}\alpha_1t_0^2$ $\theta_2=\frac{1}{2}\alpha_2t_0^2$

$\Delta L=Mt_0=I_1\omega_1+I_2\omega_2$ $-\left(\frac{\theta_1-\theta_2}{2\pi}\cdot2\pi d\,m_2g\mu\right)+M\theta_1=\frac{1}{2}I_1\omega_1^2+\frac{1}{2}I_2\omega_2^2$



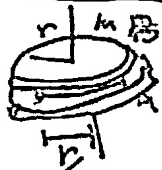
$m=2\,Kg$ $r=0.5\,m$ $M=14.4\,Nm$ $K=8\,Nm\frac{s}{rad}$ $m_2=\frac{m}{4}$ $\mu=0.2$

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

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

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

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



$m=10\,Kg$ $r=0.2$ $\mu=0.2$ $M_A=5.88\,Nm$ $n_A=20$ giri

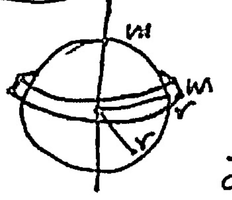
$M_{att}=\mu mg\frac{r}{2}=1.96\,Nm$ $I=\frac{mr^2}{2}=I_A=I_B=0.2\,Kg\,m^2$

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

$20\cdot2\pi=\frac{1}{2}\alpha_At^2$ $t=\sqrt{\frac{80\pi}{\alpha_A}}=3.6\,s$ $L=M_At=I\omega_A+I\omega_B$

$40\pi M_A=\frac{1}{2}I(\omega_A^2+\omega_B^2)+2\pi(n_A-n_B)M_{att}$

$80\pi M_A=It^2(\alpha_A^2+\alpha_B^2)+4\pi n_BM_{att}$ $n_A-n_B=\frac{80\pi M_A-It^2(\alpha_A^2+\alpha_B^2)}{4\pi M_{att}}=10$ $n_B=10$



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

$I_s\alpha_s=M-M_a$ $I_A\alpha_A=M_a$ $\omega_A(t>t')=0$

$\omega_A(t_0)=\alpha_At_0$ $\omega_S(t_0)=\alpha_St_0$

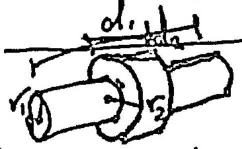
$\frac{\alpha_A}{\alpha_S}=\frac{\omega_A}{\omega_S}$ $\omega_{A0}+\frac{M_a}{I_A}t'=\omega_{S0}-\frac{M_a}{I_s}t'$

$M_At'\left(\frac{I_A+I_s}{I_AI_s}\right)=\omega_{S0}-\omega_{A0}$ $\frac{I_A+I_s}{I_AI_s}=\frac{mr^2+\frac{2}{5}mr^2}{\frac{2}{5}mr^2\,mr^2}=\frac{7}{2mr^2}$ $M_A=\frac{\omega_{S0}-\omega_{A0}}{7t'}(2mr^2)$

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

$M_A+\frac{t_0}{t'}M_A=\frac{5t_0}{7t'}M$ $M_A=\frac{5t_0M}{7t'(1+\frac{t_0}{t'})}=\frac{5t_0M}{7(t'+t_0)}=2.3\,Nm$ $(3.69\,Nm)$ $\omega_S=\alpha_st_0-\frac{M_a}{I_s}(t'-t_0)$

$\omega_s=0$ $\alpha_st_0=\frac{M_a}{I_s}t$ $\frac{M-M_a}{I_s}t_0=\frac{M_a}{I_s}t$ $t=8.34=t'+4.14\,s$



$\rho=7\cdot10^3\,\frac{Kg}{m^3}$ $r_1=0.3$ $r_2=0.5$ $d_1=1\,m$ $d_2=0.2\,m$ M_a secondo rot. relativa

fase 1: M_2 cost $\omega_{20}=1200$ rpm $=\frac{1200\cdot2\pi}{60}\frac{rad}{s}=125.7\,\frac{rad}{s}$; M_1 opposto, $\omega_1=0$ $t=0$, $t_0=100\,s$

fase 2: $M_1,M_2=0$ $t_0=100\,s$ $t_1=150\,s$ $\omega_1=\omega_{21}$

$m_1=\rho\cdot\pi r_1^2d_1=1979\,Kg$ $m_2=\rho(\pi r_2^2d_2-\pi r_1^2d_2)=704\,Kg$ $I_1=\frac{1}{2}m_1r_1^2=89.1\,Kg\,m^2$ $I_2=\frac{1}{2}\rho\pi d_2(r_2^4-r_1^4)=119.6\,Kg\,m^2$

1): $I_1\alpha_1=0=M_a-M_1$ $I_2\alpha_2=M_2-M_a$ $\omega_{20}=\alpha_2t_0$ $\alpha_2=1.26\,\frac{rad}{s}$

2): $I_2\omega_{20}=(I_1+I_2)\omega_1$ $\omega_1=72\,\frac{rad}{s}$ $\omega_{20}-\frac{M_a}{I_2}(t_1-t_0)=\omega_1$ $M_a=\frac{I_2(\omega_{20}-\omega_1)}{t_1-t_0}=128.4\,Nm=M_1$

$M_2=M_a+I_2\alpha_2=279.1\,Nm$