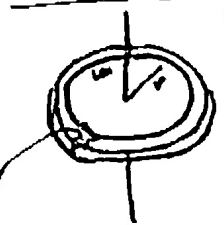


$m_1 = 0.1 \text{ kg}$ $m_2 = 0.3 \text{ kg}$ $d = 0.5 \text{ m}$ $\theta_0 = \frac{\pi}{6}$
 $mg d (1 - \sin \theta) + m_2 g d (1 - \sin \theta) = g d (1 - \sin \theta) (m + \frac{m_2}{2}) = 0.613 \text{ J} \approx E_0$
 $E_0 = \frac{1}{2} m v_1^2 + \frac{1}{2} I \omega^2 = \frac{1}{2} m v_1^2 + \frac{1}{2} \cdot \frac{1}{2} m_2 d^2 \omega^2 = v_1^2 (\frac{m}{2} + \frac{m_2}{6})$ $v_1 = \sqrt{\frac{6 E_0}{3m + m_2}} = 2.47 \text{ m/s}$



$m_1 = 2 \text{ kg}$ $r = 0.15 \text{ m}$ $d = 0.12 \text{ m}$ $m_2 = 0.3 \text{ kg}$ $\mu = 0.23 \text{ N m}$ $\tau = 1.2 \text{ s}$
 $I_1 \alpha_1 = M - f d$ $I_2 \alpha_2 = f d$ $I_1 \alpha_1 + I_2 \alpha_2 = M$ $\theta_1 = \frac{1}{2} \alpha_1 t^2$ $\theta_2 = \frac{1}{2} \alpha_2 t^2$
 $\Delta L = M t = I_1 \omega_1 + I_2 \omega_2 - \frac{(\theta_1 - \theta_2) 2\pi d m_2 g \mu}{2\pi} + M \theta_1 = \frac{1}{2} I_1 \omega_1^2 + \frac{1}{2} I_2 \omega_2^2$

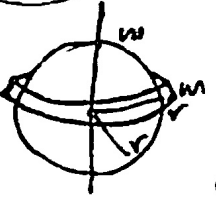


$m = 2 \text{ kg}$ $r = 0.5 \text{ m}$ $M = 14.4 \text{ N m}$ $K = 8 \text{ N m/rad}$ $m_2 = \frac{M}{4}$ $\mu = 0.2$
 $\frac{dL}{dt} = M_{\text{ext}}$ $\int_0^t M_{\text{ext}} dt = \int_0^t (M - K\omega) dt$ $I \frac{d\omega}{dt} = M - K\omega$ $\int_0^{\omega} \frac{d\omega}{M - K\omega} = \int_0^t \frac{dt}{I}$
 $\frac{t}{I} = \left[-\frac{1}{K} \ln(M - K\omega) \right]_0^{\omega} = -\frac{1}{K} \ln(M - K\omega) + \frac{1}{K} \ln M = \frac{1}{K} \ln \frac{M}{M - K\omega}$ $\frac{M}{M - K\omega} = e^{\frac{K}{I} t}$
 $M e^{-\frac{K}{I} t} = M - K\omega$ $\omega = \frac{M}{K} (1 - e^{-\frac{K}{I} t})$ $\lim_{t \rightarrow \infty} \omega = \frac{M}{K} = 1.8 \text{ rad/s}$
 $b) m_2 \square I \omega = I' \omega'$ $\frac{m r^2}{2} \omega = (\frac{m r^2}{2} + \frac{m}{4} r^2) \omega'$ $\frac{m r^2}{2} \omega = \frac{3}{4} m r^2 \omega'$ $\omega' = \frac{2}{3} \omega = 1.2 \text{ rad/s}$



$m = 10 \text{ kg}$ $r = 0.2 \text{ m}$ $\mu = 0.2$ $M_A = 5.88 \text{ N m}$ $\tau_A = 20 \text{ s}$
 $M_{\text{fr}} = \mu m g \frac{r}{2} = 1.96 \text{ N m}$ $I = \frac{m r^2}{2} = I_A = I_B = 0.2 \text{ kg m}^2$
 $I \alpha_A = M_A - M_{\text{fr}}$ $\alpha_A = 19.6 \text{ rad/s}^2$ $I \alpha_B = M_{\text{fr}}$ $\alpha_B = 9.8 \text{ rad/s}^2$
 $20 \cdot 2\pi = \frac{1}{2} \alpha_A t^2$ $t = \sqrt{\frac{80\pi}{\alpha_A}} = 0.8 \text{ s}$ $L = M_A t = I \omega_A + I \omega_B$

$40\pi M_A = \frac{1}{2} I (\omega_A^2 + \omega_B^2) + 2\pi \mu M_{\text{fr}} (\tau_A - \tau_B) M_{\text{fr}}$
 $80\pi M_A = I t^2 (\alpha_A^2 + \alpha_B^2) + 4\pi \mu M_{\text{fr}} \tau_A \tau_B$ $\tau_A \tau_B = \frac{80\pi M_A - I t^2 (\alpha_A^2 + \alpha_B^2)}{4\pi \mu M_{\text{fr}}} = 10$ $\tau_B = 10$



m, r $M = 8.6 \text{ N m}$ $t_0 = 6.35$ $t' = 10.55$ $\omega_A(t') = \omega_B(t')$ $M(r_2 t_0) = 0$
 $I_s \alpha_s = M - M_2$ $I_A \alpha_A = M_2$ $\omega_A(t_0) = \alpha_A t_0$ $\omega_B(t_0) = \alpha_B t_0$
 $\frac{\alpha_A}{\alpha_B} = \frac{\omega_A}{\omega_B}$ $\omega_{A0} + \frac{M_A t'}{I_A} = \omega_{B0} - \frac{M_2 t'}{I_2}$ $2M_A t' = \omega_{B0} I_2 - \omega_{A0} I_2$
 $M_A t' (\frac{I_A + I_s}{I_A I_s}) = \omega_{B0} - \omega_{A0}$ $\frac{I_A + I_s}{I_A I_s} = \frac{m r^2 + \frac{2}{5} m r^2}{\frac{2}{5} m r^2} = \frac{7}{5} = \frac{7}{2 m r^2}$ $M_A = \frac{\omega_{B0} - \omega_{A0}}{7 t'} (2 m r^2)$
 $M_A = \frac{2 m r^2 t_0}{7 t'} (\alpha_B - \alpha_A) = \frac{2 m r^2 t_0}{7 t'} (\frac{M - M_2}{I_s} - \frac{M_2}{I_A}) = \frac{2 t_0}{7 t'} (\frac{5M - 5M_2 - 2M_2}{2}) = \frac{t_0}{7 t'} (5M - 7M_2)$
 $M_A + \frac{t_0}{t'} M_A = \frac{5 t_0}{7 t'} M$ $M_A = \frac{5 t_0 M}{7 t' (1 + \frac{t_0}{t'})} = \frac{5 t_0 M}{7 (t' + t_0)} = 2.3 \text{ N m}$ $\omega_s(t) = \alpha_s t - \frac{M_2}{I_s} (t' - t_0)$
 $\omega_s = 0$ $\alpha_s t_0 = \frac{M_2 t}{I_s}$ $\frac{M - M_2}{I_s} t_0 = \frac{M_2}{I_s} t$ $t = 8.34 = t' + 4.14 \text{ s}$
 $\text{rpm} = \frac{1200 \cdot 2\pi \text{ rad}}{60 \cdot 3} = 125.7 \text{ rad/s}$



$\rho = 7.10^3 \text{ kg/m}^3$ $r_1 = 0.3$ $r_2 = 0.5$ $f_{\text{se1}}: M_2 \omega_1 + M_2 \omega_2 = 1200$ $f_{\text{se2}}: M_1, M_2 = 0$
 $d_1 = 1 \text{ m}$ $d_2 = 2 \text{ m}$ $M_2 \text{ se } \omega_1 \text{ relative } t_0, t_0 = 100 \text{ s}$ $t_0 = 100 \text{ s}$ $\omega_1 = \omega_2$
 $m_1 = \rho \pi r_1^2 d_1 = 1979 \text{ kg}$ $m_2 = \rho (\pi r_2^2 d_2 - \pi r_1^2 d_2) = 70 \text{ kg}$ $I_1 = \frac{1}{2} m_1 r_1^2 = 89.1 \text{ kg m}^2$ $I_2 = \frac{1}{2} \rho \pi d_2 (r_2^4 - r_1^4) = 119.6 \text{ kg m}^2$
 $1) I_1 \alpha_1 = 0 = M_2 - M_1$ $I_2 \alpha_2 = M_2 - M_1$ $\omega_{20} = \alpha_2 t_0$ $\alpha_2 = 1.26 \text{ rad/s}^2$
 $2) I_2 \omega_{20} = (I_1 + I_2) \omega$ $\omega_1 = 72 \text{ rad/s}$ $\omega_{20} - \frac{M_2}{I_2} (t' - t_0) = \omega$ $M_2 = \frac{I_2 (\omega_{20} - \omega)}{t' - t_0} = 128.4 \text{ N m} = M$
 $M = M_1 + I_1 \alpha_1 = 279.1 \text{ N m}$