

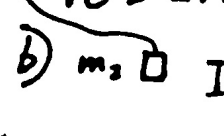
$m_1 = 0.1 \text{ kg}$ $m_2 = 0.3 \text{ kg}$ $d = 0.5 \text{ m}$ $\theta_0 = \frac{\pi}{6}$
 $m_1 g d (1 - \sin \theta) + m_2 g d (1 - \sin \theta) = g d (1 - \sin \theta) (m_1 + m_2) = 0.61 \text{ J} = E_0$
 $E_0 = \frac{1}{2} m v^2 + \frac{1}{2} I \omega^2 = \frac{1}{2} m v^2 + \frac{1}{2} \cdot \frac{1}{2} m_2 d^2 \omega^2 = v^2 \left(\frac{m}{2} + \frac{m_2}{6} \right)$ $v_1 = \sqrt{\frac{6 E_0}{3 m + m_2}} = 2.47 \text{ m/s}$



$m_1 = 2 \text{ kg}$ $r = 0.15 \text{ m}$ $d = 0.12 \text{ m}$ $m_2 = 0.3 \text{ kg}$ $\mu = 0.23 \text{ N m}$ $f = 1.2$
 $I_1 \alpha_1 = M - f d$ $I_2 \alpha_2 = f d$ $I_1 \alpha_1 + I_2 \alpha_2 = M$ $\theta_1 = \frac{1}{2} \alpha_1 t^2$ $\theta_2 = \frac{1}{2} \alpha_2 t^2$
 $\Delta L = M t_0 = I_1 \omega_1 + I_2 \omega_2 - \left(\frac{\theta_1 - \theta_2}{2\pi} \cdot 2\pi d m_2 g \mu \right) + M \theta_1 = \frac{1}{2} I_1 \omega_1^2 + \frac{1}{2} I_2 \omega_2^2$



$m = 2 \text{ kg}$ $r = 0.5 \text{ m}$ $M = 14.4 \text{ N m}$ $K = 8 \text{ N m s}^{-1} \text{ rad}$ $m_2 = \frac{M}{K}$ $\mu = 0.2$
 $\frac{dL}{dt} = M_{\text{ext}}$ $\int_0^t \frac{dL}{dt} dt = \int_0^t M_{\text{ext}} dt$ $I \frac{d\omega}{dt} = M - K \omega$ $\int_0^{\omega} \frac{d\omega}{M - K \omega} = \int_0^t \frac{dt}{I}$
 $\frac{t}{I} \left[-\frac{1}{K} \ln(M - K \omega) \right]_0^{\omega} = -\frac{1}{K} \ln(M - K \omega) + \frac{1}{K} \ln M = \frac{1}{K} \ln \frac{M}{M - K \omega}$ $\frac{M}{M - K \omega} = e^{\frac{K t}{I}}$
 $M e^{-\frac{K t}{I}} = M - K \omega$ $\omega = \frac{M}{K} (1 - e^{-\frac{K t}{I}})$ $\lim_{t \rightarrow \infty} \omega = \frac{M}{K} = 1.8 \text{ rad/s}$

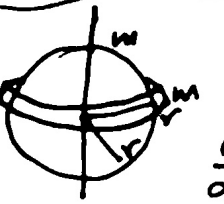


$b) m_2 \square$ $I \omega = I' \omega'$ $\frac{m r^2}{2} \omega = \left(\frac{m r^2}{2} + \frac{m}{4} r^2 \right) \omega'$ $\frac{m r^2}{2} \omega = \frac{3}{4} m r^2 \omega'$ $\omega' = \frac{2}{3} \omega = 1.2 \text{ rad/s}$



$m = 10 \text{ kg}$ $r = 0.2$ $\mu = 0.2$ $M_A = 5.88 \text{ N m}$ $n_A = 20 \text{ rev}$
 $M_A = \mu m g \frac{r}{2} = 1.96 \text{ N m}$ $I = \frac{m r^2}{2} = I_A = I_B = 0.2 \text{ kg m}^2$
 $I \alpha_A = M_A - M_{\text{ext}}$ $\alpha_A = 19.6 \text{ rad/s}^2$ $I \alpha_B = M_{\text{ext}}$ $\alpha_B = 9.8 \text{ rad/s}^2$
 $20 \cdot 2\pi = \frac{1}{2} \alpha_A t^2$ $t = \sqrt{\frac{80\pi}{\alpha_A}} = 0.6 \text{ s}$ $L = M_A t = I \omega_A + I \omega_B$

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



m, r $M = 8.6 \text{ N m}$ $t_0 = 6.35$ $t' = 10.55$ $\omega_A(t') = \omega_B(t')$ $M(r_2 t_0) = 0$
 $I_5 \alpha_5 = M - M_2$ $I_A \alpha_A = M_2$ $\omega_A(t_0) = \alpha_A t_0$ $\omega_5(t_0) = \alpha_5 t_0$
 $\frac{\alpha_A}{\alpha_5} = \frac{\omega_A}{\omega_5}$ $\omega_{A0} + \frac{M_2 t'}{I_A} = \omega_5 - \frac{M_2 t'}{I_5}$ $2 M_2 t' = \omega_5 (I_5 - I_A)$ $M_2 = \frac{\omega_5 (I_5 - I_A)}{2 t'}$
 $M_A t' \left(\frac{I_A + I_5}{I_A I_5} \right) = \omega_5 t_0 - \omega_{A0}$ $\frac{I_A + I_5}{I_A I_5} = \frac{m r^2 + \frac{2}{3} m r^2}{\frac{2}{3} m r^2 \cdot \frac{2}{3} m r^2} = \frac{7}{8} = \frac{7}{2 m r^2}$ $M_A = \frac{\omega_5 t_0 - \omega_{A0}}{7 t'}$
 $M_A = \frac{2 m r^2 t_0}{7 t'} (\alpha_5 - \alpha_A) = \frac{2 m r^2 t_0}{7 t'} \left(\frac{M - M_2}{\frac{2}{3} m r^2} - \frac{M_2}{\frac{2}{3} m r^2} \right) = \frac{2 t_0}{7 t'} \left(\frac{5M - 5M_2 - 2M_2}{2} \right) = \frac{t_0}{7 t'} (5M - 7M_2)$
 $M_A + \frac{t_0}{t'} M_A = \frac{5 t_0}{7 t'} M$ $M_A = \frac{5 t_0 M}{7 t' (1 + \frac{t_0}{t'})} = \frac{5 t_0 M}{7 (t' + t_0)} = 2.3 \text{ N m}$ $\omega_5(t) = \alpha_5 t - \frac{M_2}{I_5} (t' - t_0)$
 $\omega_5 = 0$ $\alpha_5 t_0 = \frac{M_2 t}{I_5}$ $\frac{M - M_2}{I_5} t_0 = \frac{M_2}{I_5} t$ $t = 8.34 = t' + 4.14 \text{ s}$



$\rho = 7.10^3 \text{ kg/m}^3$ $r_1 = 0.3$ $r_2 = 0.5$ $f_{\text{axel 1}}: M_2 \text{ co-rot } \omega_2 = 1200$ $f_{\text{axel 2}}: M_1, M_2 = 0$
 $d_1 = 1 \text{ m}$ $d_2 = 2 \text{ m}$ $M_2 \text{ co-rot } \omega_2 = 1200$ $M_1, M_2 = 0$ $t_0 = 10 \text{ s}$ $\omega_1 = \omega_2$
 $m_1 = \rho \pi r_1^2 d_1 = 1979 \text{ kg}$ $m_2 = \rho (\pi r_2^2 d_2 - \pi r_1^2 d_2) = 70 \text{ kg}$ $I_1 = \frac{1}{2} m_1 r_1^2 = 89.1 \text{ kg m}^2$ $I_2 = \frac{1}{2} \rho \pi d_2 (r_2^4 - r_1^4) = 119.6 \text{ kg m}^2$
 $I_1 \alpha_1 = 0 = M_2 - M_1$ $I_2 \alpha_2 = M_2 - M_1$ $\omega_2 = \alpha_2 t_0$ $\alpha_2 = 1.26 \text{ rad/s}^2$
 $I_2 \omega_2 = (I_1 + I_2) \omega$ $\omega_1 = 72 \text{ rad/s}$ $\omega_2 - \frac{M_2}{I_2} (t' - t_0) = \omega$ $M_2 = \frac{I_2 (\omega_2 - \omega)}{t' - t_0} = 128.4 \text{ N m} = M$
 $M_1 = M_2 + I_1 \alpha_1 = 279.1 \text{ N m}$