

$$R = 6.4 \cdot 10^4 \text{ m} \quad T = 24 \text{ h} \quad \theta = 43^\circ$$

$$V_e = \frac{2\pi R}{T} = 1.6 \cdot 10^3 \frac{\text{km}}{\text{h}} \quad V_f = \frac{2\pi R \cos \theta}{T} = 1.2 \cdot 10^3 \frac{\text{km}}{\text{h}}$$

$m_1 = 4 \text{ kg} \quad m_2 = 6 \text{ kg} \quad \mu = 0.8$
 $m_2 g = F - f \quad a = \frac{F - f}{m_2}$
 $m_1 a = f$
 $a_r = a - a_r = 0$
 $\frac{m_1}{m_2} F \leq (1 + \frac{m_1}{m_2}) \mu_1 g$
 $F \leq (m_1 + m_2) g \mu = 78.4 \text{ N} = F_{\max}$
 $F = \frac{F_{\max}}{2}$
 $a = \frac{F - f}{m_2} = \frac{F - m_1 g \mu}{m_2} = 1.3 \text{ m/s}^2$

$m_1 a = T_1 - m_1 g \sin \theta \quad m_2 a = m_2 g - T_2 \quad I \alpha = T_2 R - T_1 R$
 $T_1 = m_1 a + m_1 g \sin \theta \quad T_2 = m_2 g - m_2 a \quad \frac{1}{2} M R^2 \frac{a}{R} = R(T_2 - T_1)$
 $\frac{M}{2} a = m_2 g - m_2 a - m_1 g \sin \theta$
 $a = \frac{g(m_2 - m_1 \sin \theta)}{m_1 + m_2 + \frac{M}{2}}$

$R = 3r \quad M = 4m \quad m = 2 \text{ kg} \quad t = 1 \text{ s}$
 $I = \frac{1}{2} M R^2 + 4(\frac{1}{2} m r^2 + m R^2) = 2m R^2 + 2m r^2 + 4m R^2 = 2m(9r^2 + r^2 + 18r^2)$
 $I = 56 m r^2 \quad M a = m g - T \quad T = m g - m a \quad I \alpha = 56 m r^2 \frac{a}{R} = r T$
 $56 \mu a = 4(g - a) \quad a = \frac{g}{57} = 0.17 \text{ m/s}^2 \quad v(t) = a t = 0.17 \text{ m/s}$
 $\omega(t) = \alpha t = \frac{a}{r} t \quad E_k = \frac{1}{2} m v^2 + \frac{1}{2} I \omega^2 = \frac{1}{2} m v^2 + \frac{1}{2} \cdot 56 m r^2 \cdot \frac{a^2}{r^2} t^2$
 $E_k = \frac{57}{2} m v^2 = 1.68 \text{ J}$
 $I = \frac{1}{2} M R^2 + 4 m R^2 = 2m R^2 + 4m R^2 = 54 m r^2 \quad 54 a = g - a \quad a = \frac{g}{55} = 0.18 \text{ m/s}^2 \quad E_k = 1.8 \text{ J}$

$m R V_0 \cos \theta + I \frac{V_0}{R} = I \omega \quad I = \frac{2}{5} m R^2 + m R^2 = \frac{7}{5} m R^2$
 $\frac{m R V_0 \cos \theta}{R} + \frac{I V_0}{R^2} = \frac{I \omega}{R} \quad \omega = \frac{5 V_0}{7 R} (\cos \theta + \frac{7}{5}) = \frac{V_0}{R} (\frac{5}{7} \cos \theta + 1)$
 $R \omega \cos \theta + h = R \quad \cos \theta = \frac{R - h}{R} \quad \omega = \frac{V_0}{R} (\frac{5R - 5h + 7R}{7R}) = \frac{V_0}{7R^2} (12R - 5h)$
 $\frac{1}{2} I \omega^2 = m g h \quad \frac{7}{10} \frac{m R^2}{R^2} \frac{V_0^2}{R^2} (12R - 5h)^2 = m g h \quad V_0 = \sqrt{\frac{10 g h}{7(12R - 5h)^2}}$

$a = 2 \text{ m/s}^2 \quad m_A = 50 \text{ kg} \quad m_B = 30 \text{ kg} \quad \mu_s = 0.3 \quad k = 400 \text{ N/m}$
 $f = m_A a \quad x_0 = \frac{a(m_A + m_B)}{k} = 0.4$
 $F_c = f + m_B a \quad f = 100 \text{ N}$
 $\mu_{\min} = \frac{K x_0 - m_B a}{m_A g} = 0.2$
 $m_B x'' = -K x - m_B a - f = -K(x_0 + x) - m_B a - f = -K x$
 $x = R \cos(\sqrt{\frac{K}{m}} t + \phi)$
 $K x_{\max} = m_A g \mu + m_B a \quad x_{\max} = \frac{m_A g \mu + m_B a}{K} \approx 0.52 \text{ m}$

$M = 250 \text{ kg} \quad m = 75 \text{ kg} \quad a_r = 0.8 \text{ m/s}^2$
 $(M + m) a_{cm} = R_{\text{rest}} = 0 \quad V_{cm} = \cos t \omega R \Rightarrow V_{cm} = 0$
 $m a_r = M a_m \quad a_m = \frac{m}{M} a_r = 0.24 \text{ m/s}^2$
 $X_{cm} = \frac{-m R}{m + M} \quad V_c = \sqrt{2 g R} \quad m V_c = M V \quad \Delta x = X_{cm}$