

$R = 6.4 \cdot 10^4 \text{ m}$   $T = 24 \text{ h}$   $\theta = 43^\circ$   
 $V_e = \frac{2\pi R}{T} = 1.6 \cdot 10^3 \frac{\text{km}}{\text{h}}$   $V_f = \frac{2\pi R \cos \theta}{T} = 1.2 \cdot 10^3 \frac{\text{km}}{\text{h}}$   
 $m_1 = 4 \text{ kg}$   $m_2 = 6 \text{ kg}$   $\mu = 0.9$   
 $a_r = a - a_r = 0$   $m_2 a = F - f$   $a = \frac{F - f}{m_2}$   $\frac{m_1}{m_2} (F - f) \leq f$   $\frac{m_1}{m_2} F \leq f + \frac{m_1}{m_2} f$   
 $\frac{m_1}{m_2} F \leq (1 + \frac{m_1}{m_2}) \mu m_1 g$   $F \leq (m_1 + m_2) g \mu = 78.4 \text{ N} = F_{\text{max}}$   
 $F = \frac{F_{\text{max}}}{2}$   $a = \frac{F - f}{m_2} = \frac{F - \mu m_1 g}{m_2} = 1.3 \text{ m/s}^2$

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

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

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

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

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