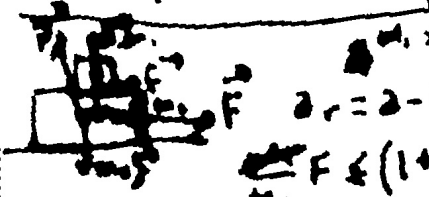
$R = 6.4\cdot10^6\,m$ $T = 24\,h$ $\theta = 45°$

$v_e = \frac{2\pi R}{T} = 1.8\cdot10^3\,km/h$ $V_f = \frac{2\pi R\cos\theta}{T} = 1.2\cdot10^3\,km/h$



$m_1 = 2kg$ $m_2 = 6kg$ $\mu = 0.1$ $\frac{m_2}{m_1}a = F - f$ $a = \frac{F-f}{m_2}$ $\frac{m_1}{m_2}(F-f) \le f$ $\frac{m_1}{m_2}F \le f + \frac{m_1}{m_2}f$

$m_1 a = f$ $a_r = a - a_t = 0$

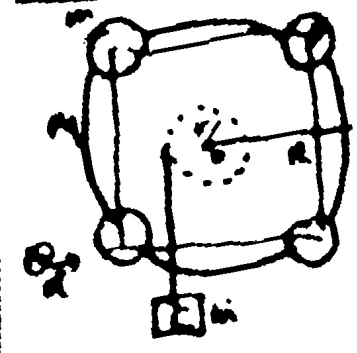
$\frac{m_1}{m_2}F \le \left(1+\frac{m_1}{m_2}\right)\mu m_1 g$ $F \le (m_1+m_2)g\mu = 78.4\,N = F_{max}$

$F = F_{max}$ $a = \frac{F-f}{m_2} = \frac{F-m_1 g\mu}{m_2} = 1.3\,m/s^2$

$m_1 a = T_1 - m_1 g\sin\theta$ $m_2 a = m_2 g - T_2$ $I\alpha = T_2 R - T_1 R$

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

$a = \frac{g(m_2 - m_1\sin\theta)}{m_1 + m_2 + \frac{M}{2}}$



$R = 3r$ $M = 4m$ $\omega = 2\,rad/s$ $r = 1\,m$

① $I = \frac{1}{2}MR^2 + 4\left(\frac{1}{2}mr^2 + mR^2\right) = 2MR^2 + 2mr^2 + 4mR^2 = 2m(9r^2 + r^2 + 18r^2)$

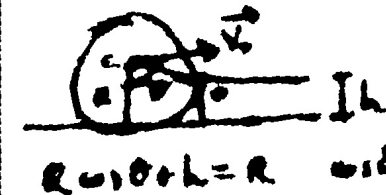
$I = 56mr^2$ $ma = mg - T$ $T = mg - ma$ $I\alpha = 56mr^2\frac{a}{r} = rT$

$56\mu a = \mu(g-a)$ $a = \frac{g}{57} = 0.17\,m/s^2$ $v(t) = at = 0.17\,m/s$

$\omega(t) = \alpha t = \frac{a}{r}t$ $E_k = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 = \frac{1}{2}mv^2 + \frac{1}{2}\cdot56mr^2\frac{a^2}{r^2}t^2$

$E_k = \frac{57}{2}mv^2 = 1.6\,J$

② $I = \frac{1}{2}mR^2 + 4mR^2 = 2mR^2 + 4mR^2 = 54mr^2$ $54a = g - a$ $a = \frac{g}{55} = 0.18\,m/s^2$ $E_k = 1.8\,J$

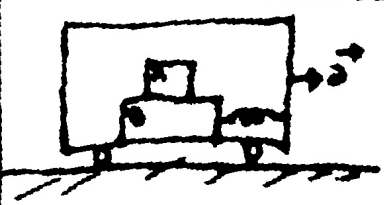


$mRv\cos\theta + I\frac{v_0}{R} = I\omega$ $I = \frac{2}{5}mR^2 + mR^2 = \frac{7}{5}mR^2$

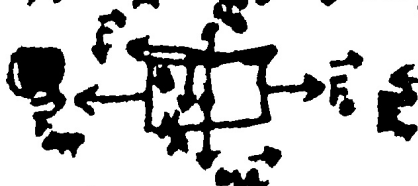
$\mu mgv\cos\theta + \frac{7}{5}\mu mR^2\frac{v_0}{R^2} = \frac{7}{5}\mu mR^2\omega$ $\omega = \frac{2v_0}{7R}(\cos\theta + \frac{1}{2}) = \frac{v_0}{R}(\frac{3}{7}\cos\theta + \frac{1}{2})$

$R\cos\theta + h = R$ $\cos\theta = \frac{R-h}{R}$ $\omega = \frac{v_0}{R}\left(\frac{5R-5h+7R}{7R}\right) = \frac{v_0}{7R}(12R-5h)$

$\frac{1}{2}I\omega^2 = mgh$ $\frac{7}{10}\mu mR^2\frac{v_0^2}{R^2}(12R-5h)^2 = \mu mgh$ $v_0 = \sqrt{\frac{10gh}{7(12R-5h)^2}}$



$a = 2\,m/s^2$ $m_A = 5kg$ $m_B = 2kg$ $\mu_s = 0.3$ $K = 400\,N/m$



$f = m_A a$ $\Delta x = \frac{a(m_A+m_B)}{K} = 0.035\,m$

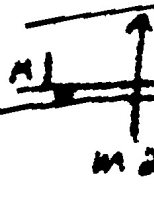
$F_e = f + m_B a \Rightarrow f = 100\,N$

μ_{min}: $Kx_0 = m_A g\mu_{min} + m_B a$ $\mu_{min} = \frac{Kx_0 - m_B a}{m_A g} = 0.2$

$m_B x'' = -Kx - m_B a - f = -K(x_0 + x) - m_B a - f = -Kx$ $x = R\cos(\sqrt{\frac{K}{m}}t + \phi)$

$Kx_{max} = m_B g\mu + m_B a$ $x_{max} = \frac{m_B g\mu + m_B a}{K} = 0.52\,m$

$x_{cm} = \frac{mR}{m+M}$ $V_c = \sqrt{2gR}$ $mV_c = MV$ $\Delta x = x_{cm}$



$M = 100\,kg$ $m = 75\,kg$

$(M+m)a_{cm} = R_{est} = 0$ $V_{cm} = cost \Rightarrow V_{cm} = 0$

$mv_r = Mv_M$ $a_M = \frac{m}{M}a_r = 0.24\,m/s^2$