$R = 6.4 \cdot 10^6 m$ $T = 24h$ $\theta = 45°$

$v_e = \frac{2\pi R}{T} = 1.8 \cdot 10^3 \frac{Km}{h}$ $v_f = \frac{2\pi R \cos\theta}{T} = 1.2 \cdot 10^3 \frac{Km}{h}$

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

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

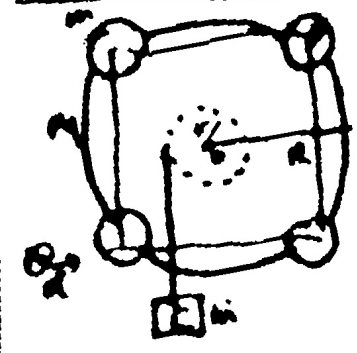
$\frac{m_1}{m_2} F \le \left(1 + \frac{m_1}{m_2}\right) \mu m_1 g$ $F \le (m_1 + m_2) g \mu = 78.4N = F_{max}$

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

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

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

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



$R = 3r$ $M = 4m$ $m = 2kg$ $r = 1m$

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

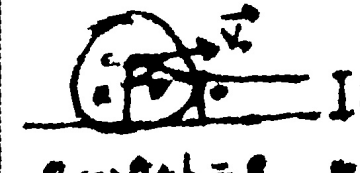
$I = 56 m r^2$ $ma = mg - T$ $T = mg - ma$ $I\alpha = 56 m r^2 \frac{a}{r} = rT$

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

$\omega(t) = \alpha t = \frac{a}{r} t$ $E_k = \frac{1}{2} m v^2 + \frac{1}{2} I \omega^2 = \frac{1}{2} m v^2 + \frac{1}{2} \cdot 56 m r^2 \frac{a^2}{r^2} t^2$

$E_k = \frac{57}{2} m v^2 = 1.68 J$

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

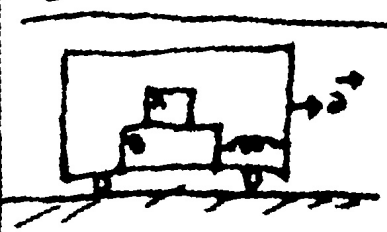


$mR v_0 \cos\theta + I \frac{v_0}{R} = I\omega$ $I = \frac{2}{5} m R^2 + m R^2 = \frac{7}{5} m R^2$

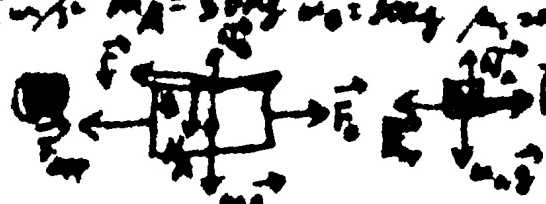
$\frac{1}{2} m R v_0 \cos\theta + \frac{7}{5} m R^2 \frac{v_0}{R} = \frac{7}{5} m R^2 \omega$ $\omega = \frac{2 v_0}{7R}(\cos\theta + \frac{7}{2}) = \frac{v_0}{R}(\frac{2}{7}\cos\theta + 1)$

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

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



$a = 2 \frac{m}{s^2}$ $m_A = 5kg$ $m_B = 2kg$ $\mu_s = 0.3$ $K = 400 \frac{N}{m}$



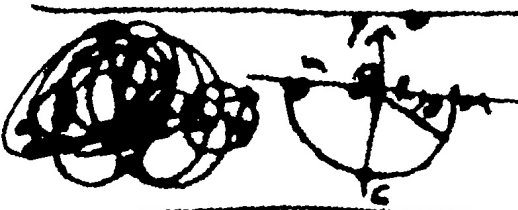
$f = m_A a$ $\Delta x = \frac{a(m_A + m_B)}{K} = 0.0$

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

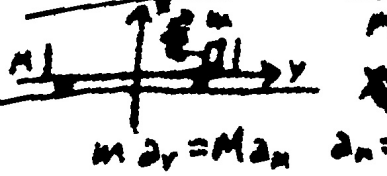
μ_{min}: $K x_0 = m_A g \mu_{min} + m_B a$ $\mu_{min} = \frac{K x_0 - m_B a}{m_A g} = 0.2$

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

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



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



$M = 100kg$ $m = 25kg$ $a_r = 0.8 \frac{m}{s^2}$

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

$m a_r = M a_M$ $a_M = \frac{m}{M} a_r = 0.24 \frac{m}{s^2}$