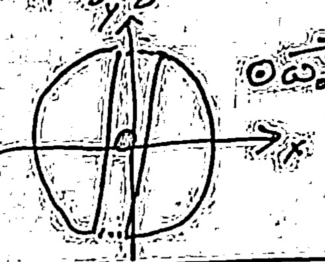
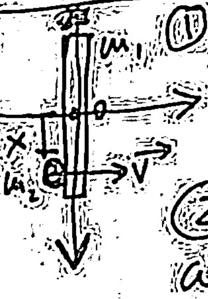
$m_1 = 9\,kg \quad m_2 = 1.5\,kg \quad \omega_0 = \dots \frac{}{s}$

Conservazione momento angolare



$\odot \vec{\omega_0}$ $\quad L_0 = I\omega_0 = \frac{m_1 r^2}{2}\omega_0 = L_1 = \frac{m_1 r^2}{2}\omega + m_2 r^2 \omega$

$\frac{m_1 \cancel{r^2}\omega_0}{2} = \cancel{r^2}\omega\left(\frac{m_1}{2} + m_2\right) \quad \omega = \frac{m_1 \omega_0}{m_1 + 2m_2} = \frac{54}{12}\frac{rad}{s} = 4.5\,\frac{rad}{s}$

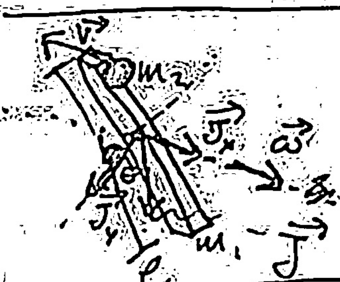


(1) $m_2 v = (m_1 + m_2)v_{cm} \quad v_{cm} = \frac{m_2}{m_1 + m_2}v \qquad r_{cm} = \frac{x m_2}{m_1 + m_2}$

$(x - r_{cm})m_2 v = I\omega = \left(\frac{m_1 \ell^2}{12} + r_{cm}^2 m_1 + m_2(x - r_{cm})^2\right)\omega \quad \omega = \frac{(x - r_{cm})m_2 v}{I}$

(2) $m_1 = m_2 = m \quad x = r \qquad r\cancel{m}v = I\omega = \left(\frac{\cancel{m}\ell^2}{12} + \cancel{m}r^2\right)\omega$

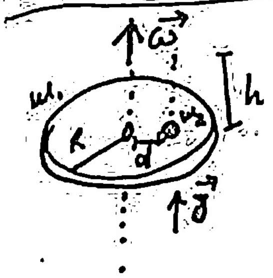
$\omega = \frac{rv}{\frac{\ell^2}{12} + r^2} \qquad J = \Delta p = m\omega r - mv$



$J_x = \Delta p_x = -m_2 v$

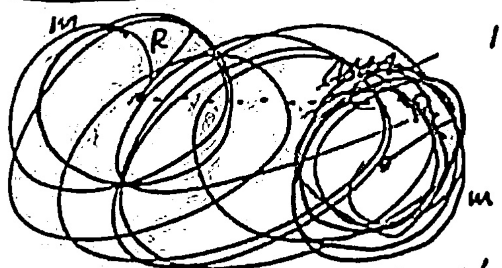
$I\omega = I'\omega' \quad \frac{m_1 \ell^2}{12}\omega = \left(\frac{m_1 \ell^2}{12} + \frac{m_2 \ell^2}{4}\right)\omega' \quad \omega' = \frac{m_1 \omega}{m_1 + 3m_2}$

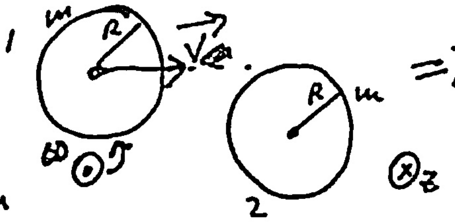
$J_y = \Delta p_y = m_2 \omega' \frac{\ell}{2} \qquad J = \sqrt{J_x^2 + J_y^2} \quad \theta = \arcsin \frac{J_x}{J}$



$I_0\omega = I_1\omega' \quad \frac{1}{2}m_1 R^2 \omega = \left(\frac{1}{2}m_1 R^2 + m_2 d^2\right)\omega' \quad \omega' = \frac{m_1 R^2 \omega}{m_1 R^2 + 2m_2 d^2}$

$J_y = m_2\sqrt{2gh} \qquad$ Impulso angolare $= J_y d$





1: $m, R, v = v, \omega = \dots$

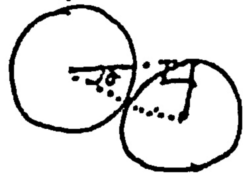
2: $m, R, v = 0\ \omega = \dots$

1,2: c.m. $\equiv 0$, $v = v_{cm}, \omega = \dots$

$\cancel{m}v = 2\cancel{m}v_{cm} \quad v_{cm} = \frac{v}{2} \qquad$ Polo: 0 $\quad L_i = Rmv\sin\theta - I\omega = \sin\theta\, Rmv - \frac{1}{2}mR^2\omega$

$L_f = 0 \qquad \Rightarrow \sin\theta\, R\cancel{m}v = \frac{\cancel{m}R^{\cancel{2}}\omega}{2} \qquad \omega = \frac{2v\sin\theta}{R}$

$\omega = \frac{v}{R}$

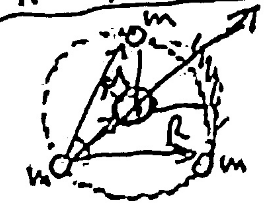


$2\cancel{R}\sin\theta = \cancel{R}$

$\sin\theta = \frac{1}{2}$

$\theta = \frac{\pi}{6}$

$\frac{GM}{R^{\cancel{2}}} = \frac{v^2}{\cancel{R}} \quad T = \frac{2\pi R}{v} \quad T^2 = \frac{4\pi^2 R^2}{v^2} = \frac{4\pi^2}{GM}R^3$



$P = m v_{cm} = 0 \qquad L = 3Rmv_m$

$\frac{\cancel{m}v^2}{\cancel{R}} = \frac{GMm}{R^2} + \frac{2Gm^2}{(2R\sin 60°)^2} = \frac{GM\cancel{m}}{\cancel{3}R^2} + \frac{2Gm^2}{3R^2} \quad v_m = \sqrt{\frac{G}{R}\left(M + \frac{2}{3}m\right)}$

$T = \frac{2\pi r}{v_m}$

E_p $\quad \frac{1}{\mu} = \frac{1}{M} + \frac{3}{m} = \frac{m + 3M}{Mm} \quad \mu = \frac{Mm}{m + 3M} \qquad E_p = -3\frac{GMm}{R} - 3\frac{Gm^2}{R\sqrt{3}}$