ESAME SETTEMBRE

$m = 100\,g = 0{,}1\,Kg$

$K = 100\,N/m$

$f = 2\,Hz$

$l_0 = 10\,cm = 0{,}1\,m$

$r = ?$

$E_M = cost = \frac{1}{2} m v^2 + \frac{1}{2} K \Delta x^2$

$v = \omega \cdot r = \omega (l_0 + \Delta x)$

EQ ENERGETICHE? PER ORA NO

$\sum \vec{F} = m\vec{a}$

$|\vec{v}| = cost$

$\vec{\omega} = cost$

$|a_T| = 0$

$\alpha = 0$

$a_N \neq 0$

$K \cdot \Delta x = m \frac{v^2}{R}$

$R = l_0 + \Delta x$

$v = \omega \cdot R = \omega (l_0 + \Delta x)$

$K \cdot \Delta x = m\, \omega^2 (l_0 + \Delta x)$

$\omega = 2\pi f = 2 \cdot \pi \cdot 2 = 4\pi\ rad/s$

$= \left(\frac{2\pi}{T}\right)$

$K \cdot \Delta x = m \cdot \omega^2 l_0 + m \cdot \omega^2 \Delta x$

$\Delta x = \frac{m \cdot \omega^2 \cdot l_0}{K - m\omega^2} = 0{,}01875\,m = 0{,}019\,m$

$r = l_0 + \Delta x \cong 0{,}12\,m$

EQUILIBRIO con f_{MAX}

$$\Delta x = \frac{m w^2 l_0}{K - m w^2}$$

$\Delta x > 0$ per considerazione fisica

$\Delta x > 0 \rightsquigarrow K - m w^2 > 0$

$$w_{LIM} < \sqrt{\frac{K}{m}}$$

$$2\pi f_{LIM} < \sqrt{\frac{K}{m}}$$

$$f_{LIM} < 5\ Hz$$

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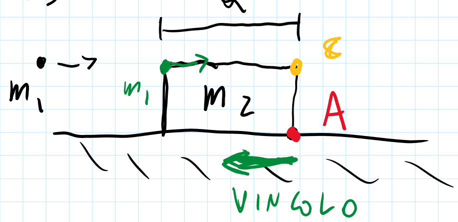
es 2



$a = 20\ cm$

$\rho = 1000\ kg/m^3$

$m_1 = 100\,g = 0{,}1\ kg$

$\bar{v} = 40\ m/s$

ELASTICO? NON TANTO

ANELASTICO? NO $\Delta p \neq 0$

$\bar{L} = 6\ st$ $\qquad$ $\bar{p} \neq 6\ st$ (VINCOLO ESPLICA UNA FORZA)

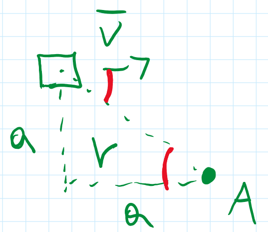
FULCRO A

$m_1 V \cdot a = I\, w$ (L proiettile)

$\Sigma M = I \alpha$

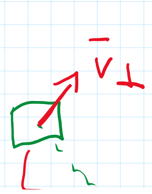
$\Sigma L = I\, w$

$V_\perp = v \cos \alpha$



$\alpha = 45°$

$L = m\, \bar{v} \times \bar{r}$

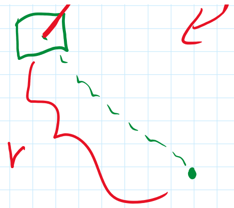


$L = m\,(v_\perp \cdot r)$

$v = \sqrt{2}\, a$

$\alpha = 45°$

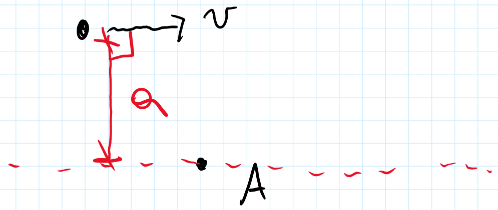
$\cos\alpha = \frac{\sqrt{2}}{2}$

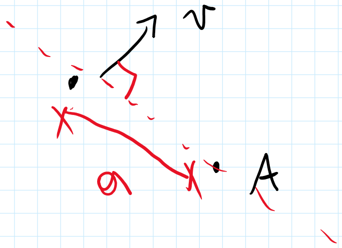


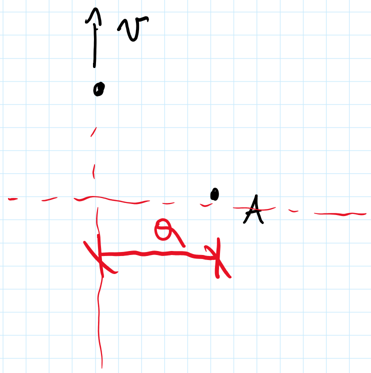
$L = m(v_\perp \cdot r)$

$= m\left(\frac{\sqrt{2}}{2} v \cdot \sqrt{2} a\right)$

$= m \cdot v \cdot a$







$m, v, a = I\,w$

→ TOTALE DEL SISTEMA

$I_A = I_{proiettile} + I_{cubo}$

→ rispetto retta passante per A uscente

$I_{proiettile} = m \cdot (\sqrt{2}\,a)^2$ $\quad (I = \sum m r^2)$

r_1^2

$I_{cubo} = \frac{1}{6} m_2 a^2 + m_2\left(\frac{\sqrt{2}}{2} a\right)^2$ → H.S.

r_2^2 → DISTANZA BARICENTRO - A

$= \frac{1}{6} m_2 a^2 + \frac{1}{2} m_2 a^2 = \frac{2}{3} m_2 a^2$

$I_{\text{SISTEMA RISPETTO A}} = 2a^2 m_1 + \frac{2}{3} m_2 a^2$

$= 2a^2\left(m_1 + \frac{1}{3} m_2\right)$

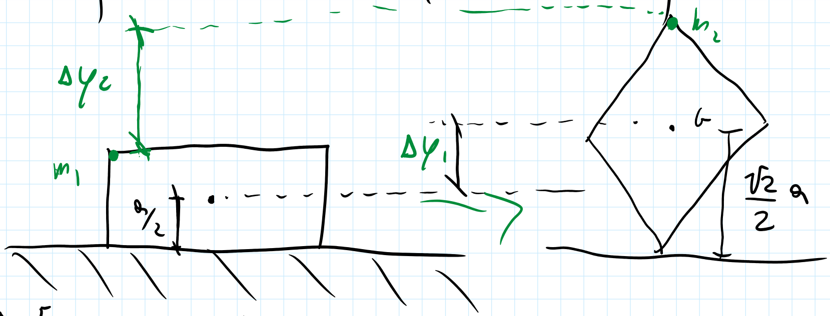
$$m_1 \cdot v_1 \cdot \cancel{a} = 2a^{\cancel{2}} \left(m_1 + \frac{1}{3} m_2\right) \cdot \omega$$

$$\omega = \frac{m_1 \cdot v_1}{2a\left(m_1 + \frac{1}{3} m_2\right)} = 3{,}65 \ rad/s$$

$$(m_1 = 0 m_2) \cong \frac{m_1 v_1}{2a\left(\frac{1}{3} m_2\right)} = 3{,}78 \ rad/s$$

$$m_2 = V \cdot \rho = a^3 \cdot \rho = 0{,}2^3 \cdot 1000 = 8 \ kg$$

2) RIBALTO (DOPO URTO)



$$\Delta E_p = m g \Delta y = m_1 g \Delta y_2 + m_2 g \Delta y_1$$

E_K proiettile deve essere sufficiente a portare baricentro in alto

$$\Delta E_p = m_2 g\left(\frac{\sqrt{2}}{2} a - \frac{a}{2}\right) + m_1 g\left(\sqrt{2} a - a\right)$$

Perché è ERRORE?

$E_M = cost$ NEGLI ISTANTI SUCCESSIVI ALL'URTO

⇓

IL FENOMENO DI URTO NON ELASTICO PORTA A DISSIPAZIONE DI ENERGIA

⇓

IL BILANCIO FATTO DA ME DICEVA

CHE $E_m = cost$ TRA ISTANTE PRIMA DELL'URTO E DOPO L'URTO E CIÒ È SBAGLIATO (HO IGNORATO DISSIPAZIONE ENERGETICA DELL'URTO)

$$E_m = cost$$

$$E_K + E_{p_0} = E_{p_{MAX}}$$

$$E_K = \Delta E_p$$

$$\frac{1}{2} m_1 v_{MIN}^2 \neq \frac{1}{2} I \omega_{MIN}^2$$

CAUSA DISSIPAZ. URTO NON ELASTICO

corpo fermo in cima

$$\frac{1}{2} m_1 v_{MIN}^2 = \frac{1}{2} m_1 (\omega_1 \sqrt{2} a)^2 + \frac{1}{2} m_2 \left(\omega_2 \frac{a}{2}\right)^2 + m_2 g \left(\frac{\sqrt{2}}{2} a - \frac{a}{2}\right) + m_1 g (\sqrt{2} a - a)$$

$\frac{1}{2} I \omega^2$

$$\frac{1}{2} m_1 v_{LIM}^2 = m_2 g \left(\frac{\sqrt{2}}{2} a - \frac{a}{2}\right) + m_1 g (\sqrt{2} a - a)$$

$\frac{1}{2} I \omega^2$

ERRORE

Δy centro massa

Δy proiettile

$\frac{1}{2} I \omega^2$

$$\frac{1}{2} v_{LIM}^2 = \frac{m_2}{m_1} g (\dots) + g (\dots)$$

$$\frac{1}{2} v_{LIM}^2 = \frac{\rho V}{m_1} g (\dots) + g (\dots)$$

$\frac{1}{2} I \omega^2$

$E_M = \text{cost}$ **DOPO URTO**

$$E_K + E_{p_0} = E_{p_{MAX}} + E_{K\,MIN}$$

($E_{K\,MIN} = 0$)

$$E_K = \Delta E_p$$

DOPO URTO INIZIALE

$$\frac{1}{2} I \omega_{MIN}^2 = m_2 g\left(\frac{\sqrt{2}}{2}a - \frac{a}{2}\right) + m_1 g\left(\sqrt{2}a - a\right)$$

$\omega_{MIN} \rightsquigarrow ?$

conservazione $\vec{L}$ tra prima urto - dopo urto

$$L = m v_{MIN} \cdot a = I \omega_{MIN}$$ → come INIZIO

$$\rightsquigarrow \omega_{MIN} = \frac{m \cdot v_{MIN} \cdot a}{I}$$

$$\frac{1}{2} I \left(\frac{m_1 \cdot v_{MIN} \cdot a}{I}\right)^2 = m_2 g\left(\frac{\sqrt{2}}{2}a - \frac{a}{2}\right) + m_1 g\left(\sqrt{2}a - a\right)$$

$$\frac{1}{2} I \frac{m_1^2 \cdot v_{MIN}^2 \cdot a^2}{I^2} = m_2 g\left(\frac{\sqrt{2}}{2}a - \frac{a}{2}\right) + m_1 g\left(\sqrt{2}a - a\right)$$

Ora per $m_1 = \theta m_2$ $\rightsquigarrow$ $\begin{cases} I = \frac{2}{3}a^2 m_2 + \theta(m_2) \\ \rightsquigarrow m_1 g\left(\sqrt{2}a - a\right) = \theta\left(m_2 g\left(\frac{\sqrt{2}}{2}a - \frac{a}{2}\right)\right) \end{cases}$

$$\rightsquigarrow \frac{1}{2} \frac{m_1^2 \cdot v_{MIN}^2 \cdot a^2}{I} = \frac{m_2 g}{2}\left(\sqrt{2}a - a\right)$$

$$v_{MIN}^2 = \frac{m_2 g\left(\sqrt{2}a - a\right) I}{m_1^2 \cdot a^2}$$

$$v_{MIN} = \sqrt{\frac{m_2 g\left(\sqrt{2}a - a\right) I}{m_1^2 \cdot a^2}} = 58{,}85 \text{ m/s}$$

$\simeq 58,85 \, m/s$

V e ρ PROSSIMO TUTORA-