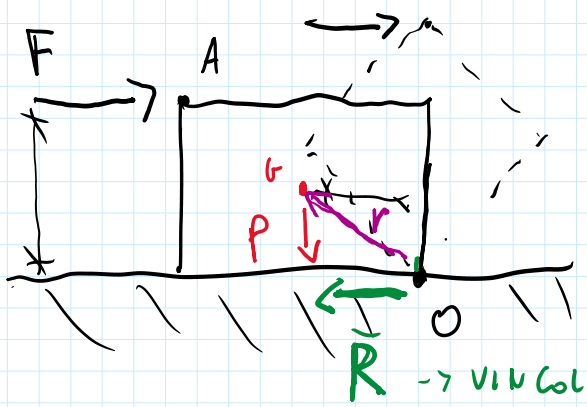
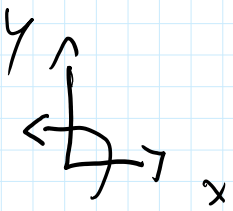
Tutorato10

giovedì 4 maggio 2023 12:43



$d = 1{,}2\ m$

$m = 4000\ kg$



$\bar{v}$ / urto / cambio velocità

$\Rightarrow$ quantità moto

momento angolare $\begin{cases} \bar{P} = m\bar{v} \\ \bar{L} = I\bar{\omega} \end{cases}$

energia $\rightsquigarrow \Delta E_M$ E_M $\Delta P = 0$?

$\rightarrow \Delta L = 0$?

$\bar{F}$ / $\bar{M}$ / accelerazione

$\Rightarrow \begin{cases} \Sigma \bar{F} = m\bar{a} \\ \Sigma \bar{M} = I\bar{\alpha} \end{cases}$ $\rightarrow$ $\begin{cases} \Sigma F = 0 \ ? \\ \Sigma M = 0 \ ? \end{cases}$

$E_M = \dots$

a) BLOCCO NON RUOTA $\rightsquigarrow$ FERMO

$\Sigma F = 0$

$\Sigma M = 0$

$\leftarrow$ EQUILIBRIO

$\begin{cases} \Sigma F_y = 0 & -P + R_2 = 0 \\ \Sigma F_x = 0 & F - R = 0 \end{cases}$ $F = R$ ok

$$\begin{cases} \Sigma F_x = 0 \quad F - R = 0 \quad F = R \quad \text{oh} \\ \Sigma M = 0 \quad \text{polo} \quad O \quad \text{incastro} \end{cases}$$

$$\hookrightarrow \quad -F_{MAX} \cdot d + m \cdot g \cdot \frac{d}{2} = 0$$

$$F_{MAX} = \frac{m \cdot g}{2} = 19620\ N$$

b) $F = 10000\ N < F_{MAX}$ → CORPO FERMO → $\Sigma F = 0$, $\Sigma M = 0$

$$\Sigma F_x = 0$$

$$F_x = R \rightsquigarrow R = 10000\ N$$

(FORZA VERSO $-x$ ←)

$$\Sigma F_y = 0$$

$$m \cdot g = R_2 \rightsquigarrow R_2 = 4000 \cdot 9{,}81 = 39240\ N$$

(verso $+y$ ↑)

$$\Sigma M_O = 0 \quad -F \cdot d + mg \cdot \frac{d}{2} - R_2 \cdot l = 0$$

$$l = \frac{-F \cdot d + mg\, d/2}{R_2} = 0{,}29\ m$$

(da O verso sinistra)

d) $F = 20000\ N > F_{MAX}$ → MOTO

↓

$\Sigma F = m \cdot a$

$\alpha = ?$

$\Sigma F = m \cdot a$

$\rightarrow \Sigma M_0 = I_z \cdot \alpha$

$\Sigma M_0 = I_z \cdot \alpha$

$-F \cdot d + m \cdot g \cdot \frac{d}{2} = I_z \alpha$

I_z CUBO BARICENTRICA $= \frac{1}{6} m d^2$

$I_{z\,\text{TOTALE}} = \frac{1}{6} m d^2 + m r^2 = \frac{1}{6} m d^2 + m\left(\frac{\sqrt{2}}{2} d\right)^2$

H.S. $= \frac{1}{6} m d^2 + \frac{m d^2}{2} = \frac{2}{3} m d^2$

$\alpha = \frac{-F \cdot d + \frac{m \cdot g \cdot d}{2}}{I} = 0{,}12 \text{ rad/s}^2$

(senso orario attorno asse z)

e) R_1 e R_2 $\rightarrow \vec{R}$ reazioni vincolari

R_1 e R_2 sullo spigolo

$\rightarrow R_1 = 20000\ N \quad R_2 = m \cdot g = \ldots$

SONO NEL CASO DI MOTO NO

$\Sigma F = m \cdot a$

$$\Sigma M = I \cdot \alpha$$

asse x $\rightsquigarrow$ $F - R_1 = m a_x$

asse y $\rightsquigarrow$ $-m \cdot g + R_2 = m a_y$

$$\Sigma M = I \cdot \bar{\alpha}$$

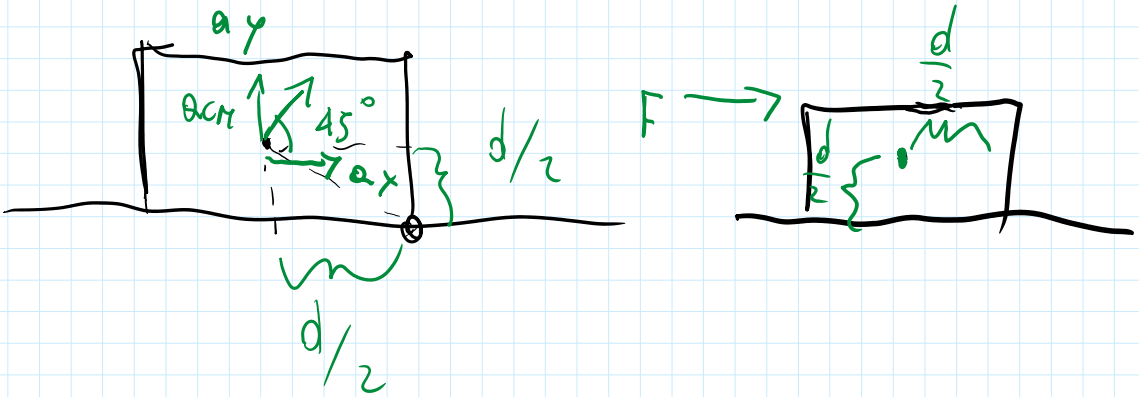
$$\bar{\alpha} = \frac{a_{CM}}{r}$$

~~$\Sigma M = I \cdot \left(\frac{\bar{a}_{CM}}{r}\right)$~~ $\rightsquigarrow$ $\bar{a}_{CM} = \bar{\alpha} \times \bar{r}$

I) $\bar{a}_{CM} = \bar{\alpha} \times \bar{r} = \alpha \cdot \frac{\sqrt{2}}{2} d = \frac{\sqrt{2}}{2} \alpha d$

$a_{CM\,x} = a_{CM} \cos 45 = \frac{\sqrt{2}}{2} \alpha \cdot d \cdot \frac{\sqrt{2}}{2} = \frac{\alpha \cdot d}{2}$

$a_{CM\,y} = a_{CM} \sin 45 = \frac{\sqrt{2}}{2} \alpha \cdot d \cdot \frac{\sqrt{2}}{2} = \frac{\alpha \cdot d}{2}$



II) $a_{CM} = \alpha \times r = \left(\frac{\alpha \cdot d}{2}\right) \bar{u}_x + \left(\frac{\alpha \cdot d}{2}\right) \bar{u}_y$

$a_{CM\,x}$ $a_{CM\,y}$

$a_{CM\,x} = \frac{\alpha \cdot d}{2}$

conosco $\alpha = -0,12$

$a_{cmx} = \frac{a \cdot a}{2}$

$a_{cmy} = \alpha \cdot \frac{d}{2}$

conosco $\alpha = -0,12$

$F - R_1 = m \cdot \frac{\alpha \cdot d}{2}$

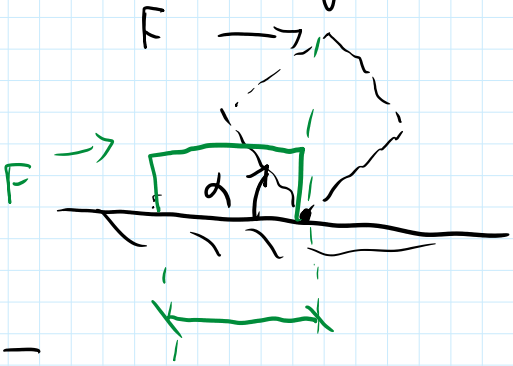
$R_1 = F - \frac{m \cdot \alpha \cdot d}{2} = 19715 \ N$

$m \cdot g - R_2 = m \cdot \frac{\alpha \cdot d}{2}$

$R_2 = m \cdot g - \frac{m \alpha d}{2}$

$= 39525 \ N$

f) Lavoro della forza per arrivare a 45°



$E_m = cost$

$W = \Delta E_p + \Delta E_k$

$W = \bar{F} \cdot \bar{s}$

$= 20000 \cdot d = 24000 \ J$

$d = 1,2$

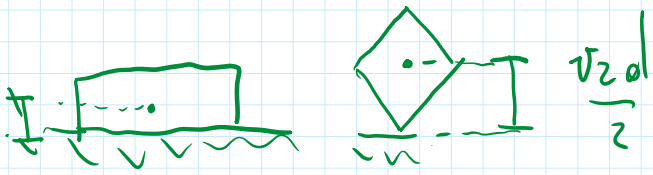
g) w nell'ISTANTE SOPRA

$W_{FORZA} = \Delta E_p + \Delta E_k$

$W + E_{p_1} + E_{k_1} = E_{p_2} + E_{k_2}$

$$\left(W + E_{p_1} + E_{k_1} = E_{p_2} + E_{k_2} \right)$$

E_{p_1}: $m \cdot g \cdot \frac{d}{2}$ — E_{p_2}: $m \cdot g \cdot \frac{v_2 \, dt}{2}$

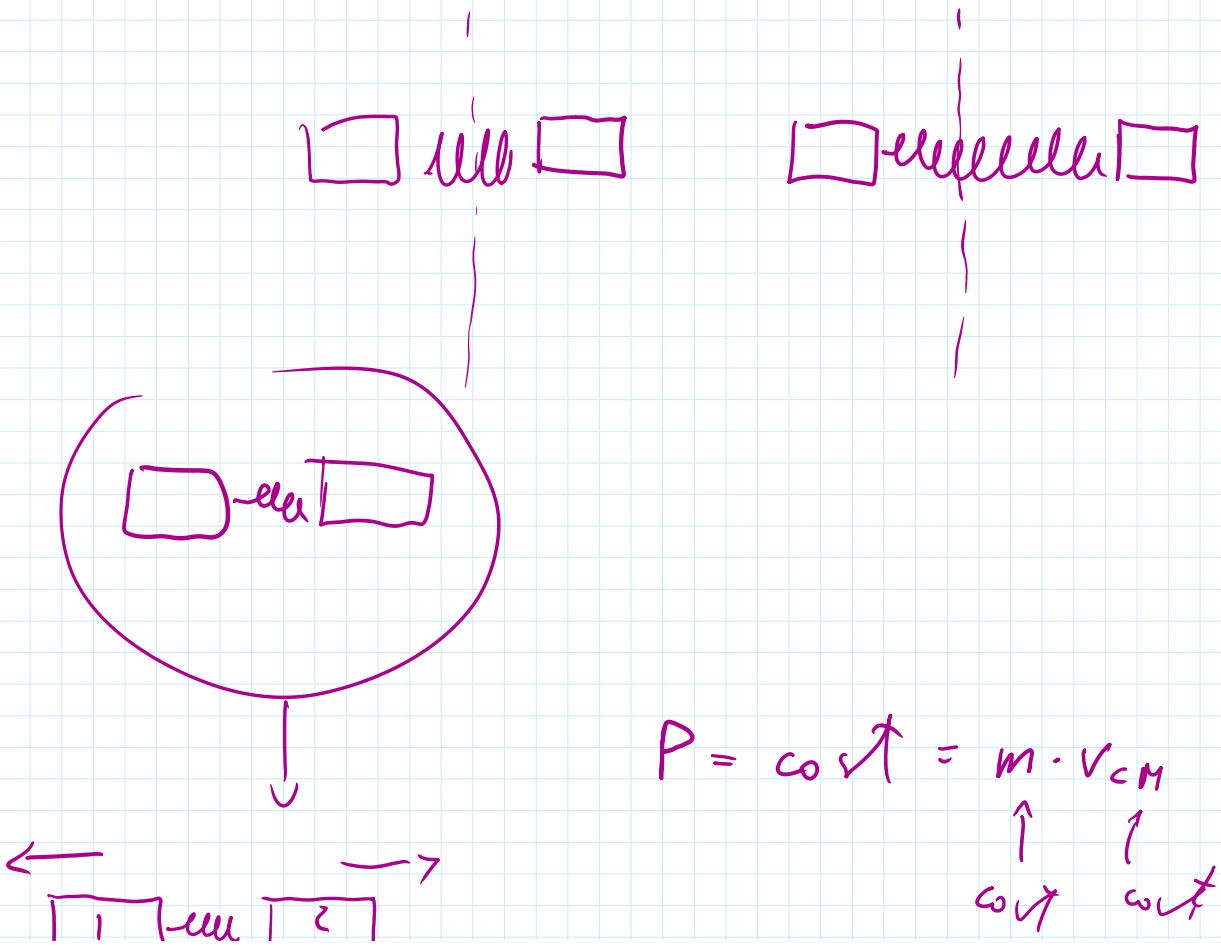


$$W = \left(E_{p_2} - E_{p_1} \right) + \left(E_{k_2} - E_{k_1} \right)$$

$$= \frac{m \cdot g \cdot d}{2} \left(v_2 - 1 \right) + \left(\frac{1}{2} I \omega^2 - 0 \right)$$

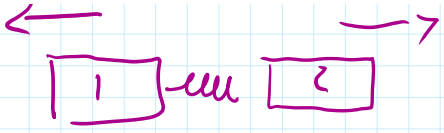
$$24000 = \frac{m \cdot g \cdot d}{2} \left(v_2 - 1 \right) + \left(\frac{1}{2} I \omega^2 \right)$$

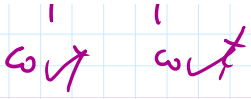
$$\omega^2 = \frac{d}{I} \left(2F - mg \left(v_2 - 1 \right) \right) \rightsquigarrow \omega = 2{,}72 \text{ rad/s}$$



$P = \text{cost} = m \cdot v_{CM}$

cost cost





$$P = m_1 \cdot (-v_1) + m_2 (v_2)$$

$P \simeq \omega \not{A}$

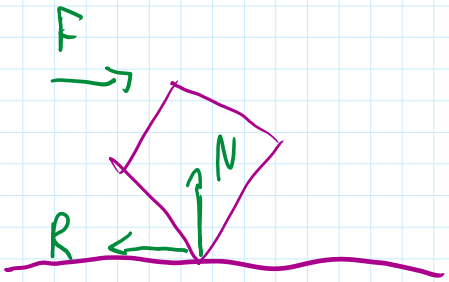
$$\Delta P = 0 \qquad m_1 (-v_1 - 0) + m_2 (+v_2 - 0) = 0$$

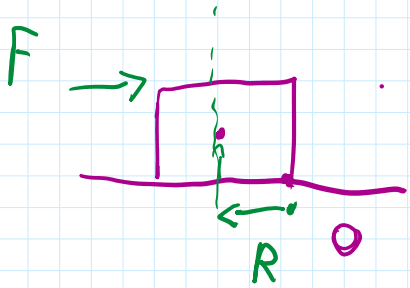
$$m_1 v_1 = m_2 v_2$$

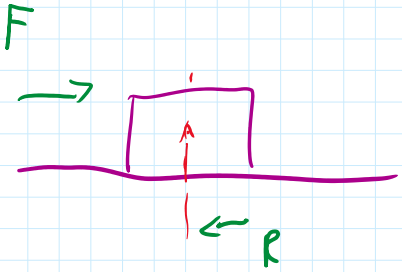
$$\frac{m \cdot v_1 + m \cdot v_2}{m_1 + m_2}$$

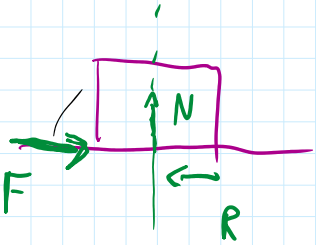
$Q_{moto\ A} = Q_{moto}$

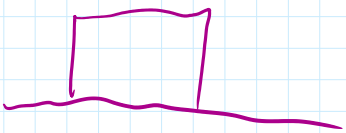
SINISTRA DESTRA











$$G \frac{M_1 M_2}{r^2}$$