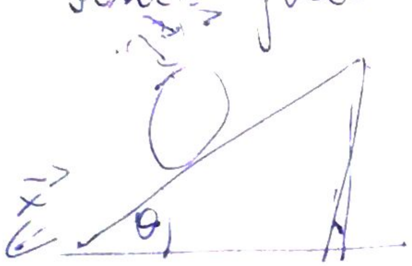
Fisica Generale I

02/12/2020

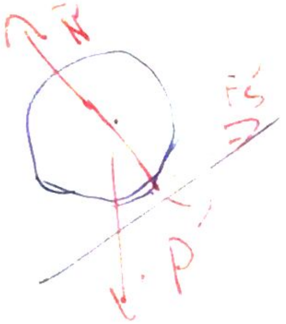


Moto di puro rotolamento lungo un piano inclinato

$\vec{F}^{E} = m \cdot \vec{a}_{cm}$

$x: mg\,sen(\theta) - F_s = m \cdot a_{cm}$ (1)

$y: N - mg\,cos(\theta) = 0$



Polo C.M.

$\tau_z = I_z \alpha$ (Simmetria)

$\tau_P = 0 \quad b = 0$

$\tau_N = 0 \quad \perp$

2) $F_S R = I_{cm} \alpha$

(3) $a_{cm} = \alpha R$

$F_S = \dfrac{I_{cm} a_{cm}}{R^2}$

$mg\,sen(\theta) - \dfrac{I_{cm} a_{cm}}{R^2} = m a_{cm}$

$mg\,sen(\theta) = \left(m + \dfrac{I_{cm}}{R^2}\right) a_{cm}$

$a_{cm} = \dfrac{mg\,sen(\theta)}{m + \dfrac{I_{cm}}{R^2}}$

Polo P

$\tau_{P\gamma} = 0$

$\tau_{FS} = 0$

$mg\,sen(\theta) = I_P \alpha$

$I_P = I_{cm} + mR^2 \quad \perp$

Sfera $I_{cm} = \frac{2}{5} m R^2$

$a_{cm} = \dfrac{mg\,sen(\theta)}{m + \frac{2}{5} m}$

$a_{cm} = \dfrac{g\,sen(\theta)}{1 + \frac{2}{5}}$

Cilindro

$a_{cm} = \frac{2}{3} g \operatorname{sen}(\theta)$ $\alpha = \frac{\frac{2}{3} g \operatorname{sen}(\theta)}{R}$

$$F_S = \frac{I_{cm} a_{cm}}{R^2}$$

$$= \frac{\frac{1}{2} m R^2 \frac{2}{3} g \operatorname{sen}(\theta)}{R^2}$$

$$= \frac{mg \operatorname{sen}(\theta)}{R^2}$$

$$F_S \leq \mu_S N$$

$$mg \frac{\operatorname{sen}(\theta)}{\cancel{R}3} \leq \mu_S mg \cos(\theta)$$

$\tan(\theta) \leq 3\mu_S \Longleftrightarrow$ Moto di pura rotolamento

$$K_0 + U_0 = K_f + U_f$$

$K_0 = 0$ $\quad$ h riferita a cm

$K_f = \frac{1}{2} I_P \omega^2$

$$\frac{1}{2} I_P \omega^2 = U_0 - U_f$$

$$= mgh$$

$$\frac{1}{2}\left(\frac{1}{2} mR^2 + mR^2\right)\omega^2 = mgh$$

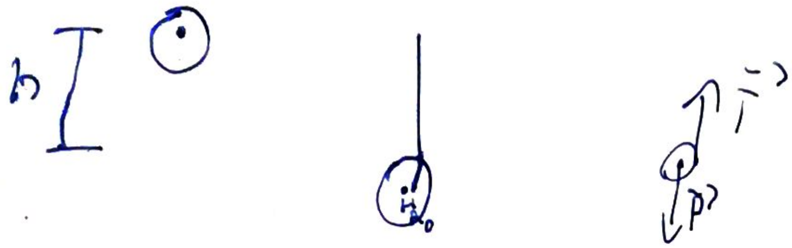
$$\frac{1}{2}\left(\frac{3}{2} R^2\right)\omega^2 = gh$$

$$\omega^2 = \frac{4}{3} \frac{gh}{R^2}$$

$$\omega = \sqrt{\frac{4}{3} \frac{gh}{R^2}}$$

$$v_{cm} = \omega R$$

Yo-Yo



Rototraslatoria

$\vec{F}^{\,est} = m \cdot \vec{a}_{cm}$

$\vec{F}_x = 0$

I $\quad mg - T = m \cdot a_{cm}$

II $\quad$ Polo C.M. $\qquad$ Polo P

$\tau_P = 0 \qquad \tau_T = 0$

$T R_0 = I_{cm}\, \alpha \qquad mg\, R_0 = I_P\, \alpha$

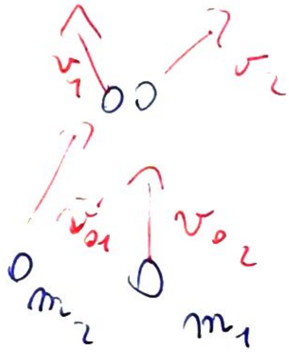
$T = \dfrac{I_{cm}\, \alpha}{R_0} \qquad \alpha = \dfrac{a_{cm}}{R_0}$

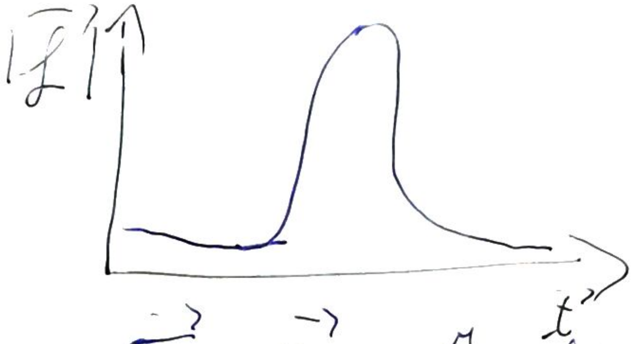
$mg - \dfrac{I_{cm}\, \alpha}{R_0} = m\, a_{cm}$

$mg - \dfrac{I_{cm}\, a_{cm}}{R_0^2} = m\, a_{cm}$

$a_{cm} = \dfrac{mg}{m + \dfrac{I_{cm}}{R_0^2}} \qquad I_{cm} = \frac{1}{2} m R^2$

Urti



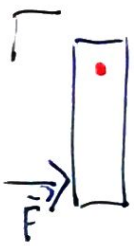


$\vec{F}_I + \vec{F}_E$ = Impulsive

$\vec{F}_E$ Trascurabile

$\vec{P}_0 = \vec{P}_f$ = const

Quando vincolato



$P_0 \neq P_f$

Conservazione momento angolare

$\tau_{vincolo} = 0$

$\vec{L}_0 = \vec{L}_f$

Conservazione Energia Meccanica

$\vec{F}_1$ Conservative

$m = 140g$

$v_0 = 30 m/s$

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

$v_f = 40 m/s$

$\Delta t = 2 ms$

$\vec{I}_p = \Delta \vec{P} =$

$= \vec{P}_f - \vec{P}_0$

$I_x = \vec{P}_{Fx} - \vec{P}_{0x} = -m v_F \sin(\frac{\pi}{6})$

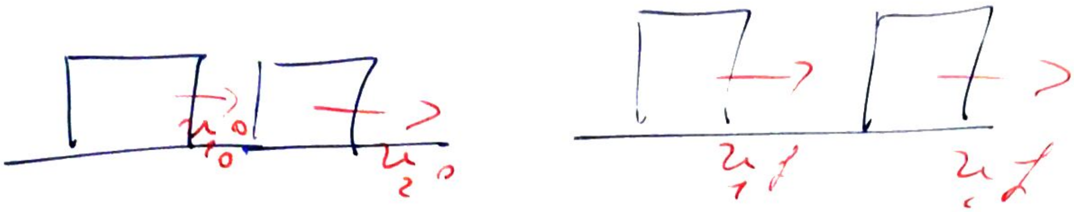
$I_y = \vec{P}_{Fy} - \vec{P}_{0y} = + m v_0 \sin(\frac{\pi}{6})$

$I = \sqrt{I_x^2 + I_y^2}$

$I = F_m \Delta t$

$F_m = \frac{I}{\Delta t}$

Urti elastici



$v_1 > v_2$

$$m_1 v_1^{i} + m_2 v_2^{i} = m_1 v_1^{f} + m_2 v_2^{f}$$

Un urto è elastico se si conserva l'energia meccanica

$$K_0 + U_0 = K_f + U_f$$

$$K^0 + K^f = \text{costante}$$

$$\cancel{\tfrac{1}{2}} m v^2 + \cancel{\tfrac{1}{2}} m v_2^2 = \cancel{\tfrac{1}{2}} m_1 v^{f\,2} + \tfrac{1}{2} m_1 v_2^{f\,2}$$

$$m_2 v_{2f}^2 - m_2 v_{20}^2 = -\left(m_1 v_{1f}^2 - m_{10}^2\right)$$

$$m_2\left(v_{2f}^2 - v_{20}^2\right) = -m_1\left(v_{1f} - v_{10}\right)\left(v_{1f} + v_{10}\right)$$

$$m_2\left(v_{2f} - v_{20}\right) = -m_1\left(v_{1f} - v_{10}\right)$$

$$-m_1\left(v_{1f} - v_{10}\right)\left(v_{2f} + v_{20}\right) = -m_1\left(v_{1f} - v_{10}\right)\left(v_{1f} + v_{10}\right)$$

$$v_{2f} + v_{20} = v_{1f} + v_{10}$$

$$v_{2f} - v_{1f} = -\left(v_{20} - v_{10}\right)$$

allontanamento avvicinamento

$$v_{1f} = \frac{(m_1 - m_2)\, v_{10} + 2 m_2 v_{20}}{m_1 + m_2}$$

$$v_{2f} = \frac{(m_2 - m_1)\, v_{20} + 2 m_1 v_{10}}{m_1 + m_2}$$

$m_1 = 4\ Kg \quad v_1^{\circ} = 6\ m/s$

$m_2 = 2\ Kg \quad v_2^{\circ} = 3\ m/s$

$$m_1 v_1^{\circ} + m_2 v_2^{\circ} = m_1 v_1^{f} + m_2 v_2^{f}$$

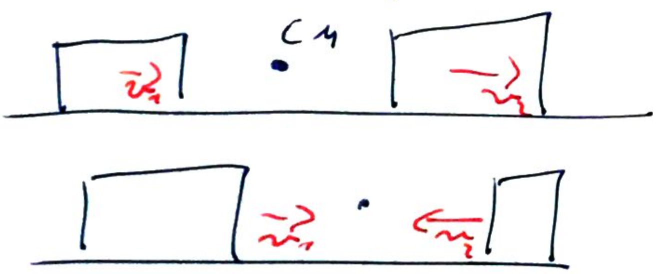
$$24 + 6 = 4 v_1^{f} + 2 v_2 f$$
$$= 30$$

$v_{2f} = v_1 f + 3 \qquad v_2 f - v_1 f = 3\ m/s$

$\qquad\qquad\qquad\qquad 6\ m/s - 3\ m/s = 3\ m/s$

$$4 v_1 f + 2(v_1 f - 3) = 30$$
$$6 v_1 f - 6 = 30$$
$$6 v_1 f = 24\ m/s$$
$$v_1 f = 4\ m/s$$
$$v_2 f = 7\ m/s$$

Sistema di riferimento C.M.



$$v_{CM} = \frac{m_1 v_1 + m_2 v_2}{m_1 + m_2}$$

$p_1^{\circ} = m_1 u_1^{\circ}$

$p_2^{\circ} = m_2 u_2^{\circ}$

u_1, u_2 velocità nel sistema C.M.

v_1, v_2 sistema di laboratorio

$v_1 = u_1 + v_{CM}$

$v_2 = u_2 + v_{CM}$

CM

$v_{cm} = 0$

$$K_1 = \frac{1}{2} m_1 u_1^2 = \frac{p_1^2}{2m_1}$$

$$K_1^{\circ} + K_2^{\circ} = K_1^{f} + K_2^{f}$$

$$\frac{p_1^{2\circ}}{2m_1} + \frac{p_2^{2\circ}}{2m_2} = \frac{p_1^{2f}}{2m_1} + \frac{p_2^{2f}}{2m_2}$$

$$(m_1+m_2)\,v_{cm}=0$$

$$m_1u_1+m_2u_2=(m_1+m_2)\,v_{cm}=0$$

$$m_2u_2=-m_1u_1 \qquad p_1=-p_2$$

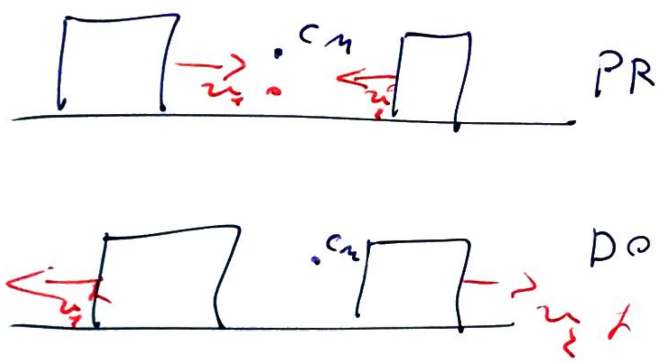
$$p_2^2=p_1^2$$

$$\frac{1}{2}p_0^2\left(\cancel{\frac{1}{m_1}+\frac{1}{m_2}}\right)=\frac{1}{2}p_f^2\left(\cancel{\frac{1}{m_1}+\frac{1}{m_2}}\right)$$

$$P_1^{2\,o}=P_2^{2\,o}$$

$$p_2^o=\pm p_1^o \longrightarrow \quad p_1^o=-p_2^f$$

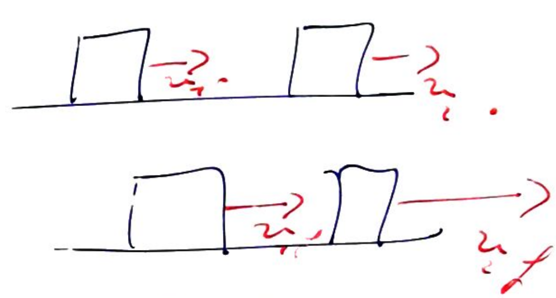
$$p_{\cancel{1}}^o=-p_2^f$$



PRIMA

DOPO

S. C.M.



S. LABORATORIO

$$v_{cm}=\frac{30}{6}=5\,m/s$$

$$=\frac{m_1v_1}{m_2v_2}$$

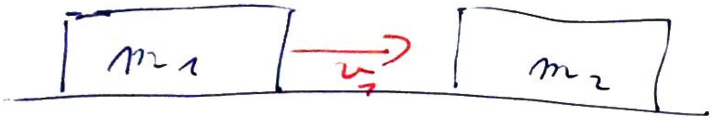
$$u_1=v_1-v_{cm}=1\,m/s$$

$$u_2=v_2-v_{cm}=-2\,m/s$$

$$u_1f=-1\,m/s \qquad u_2f=2\,m/s$$

$$v_1f=u_1+v_{cm}=4\,m/s$$

$$v_2f=u_2f+v_{cm}=7\,m/s$$



S.R. C.M.

$$v_{cm} = \frac{m_1 v_1}{m_1 + m_2}$$

$$u_1 = v_1 - v_{cm} \qquad u_1 = v_1 - \frac{m_1 v_1^0}{m_1 + m_2}$$

$$u_2 = v_2 - v_{cm} \qquad u_2 = -\frac{m_1 v_1^0}{m_1 + m_2}$$

$$\frac{m_1 v_1^0 + m_2 v_1^0 - m_1 v_1^0}{m_1 + m_2} = \frac{m_2 v_2^0}{m_1 + m_2}$$

$$u_2^f = -u_2^0 = + \frac{m_1 v_1^0}{m_1 + m_2}$$

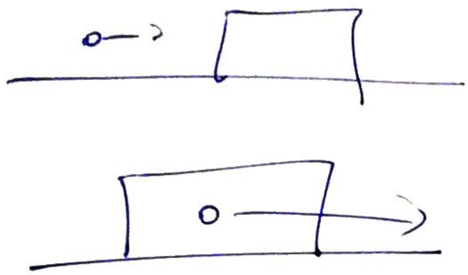
$$v_1^f = u_1^f - v_{cm} \qquad v_2^f = u_2^f + v_{cm}$$

$$= -\frac{m_2 v_1^0}{m_1 + m_2} + \frac{m_1 v_1^0}{m_1 + m_2} \qquad = \frac{m_1 v_1^0}{m_1 + m_2} + \frac{m_1 v_1^0}{m_1 + m_2}$$

$$= \frac{m_1 + m_2}{m_1 + m_2} v_1^0 \qquad = 2 \frac{m_1 v_1^0}{m_1 + m_2}$$

$m_1 = m_2$	$m_1 \gg m_2$	$m_1 \ll m_2$
$v_1^f = 0$	$v_1^f \approx \frac{\cancel{m_1}}{\cancel{m_1}} v_1^0$	$v_1^f \approx -v_1^0$
$v_2^f = 2 v_1^0$	$v_2^f = 2 v_1 \cdot \frac{\cancel{m_1}}{\cancel{m_1}}$	$v_2^f \approx 0$
		Pallina contro Parete

Urto completamente anelastico



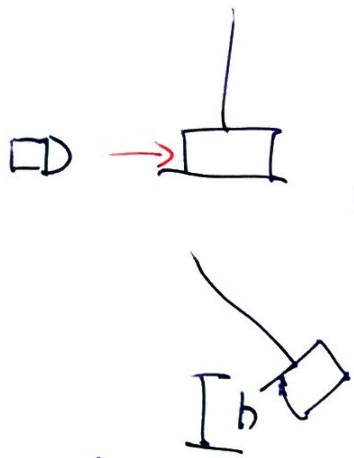
Conservazione quantità di moto

$$m_1 v_0 = (m_1 + m_2) v_{cm}$$

$$v_{cm} = \frac{m_1 v_0}{m_1 + m_2}$$

Corpi insieme

Pendolo Balistico

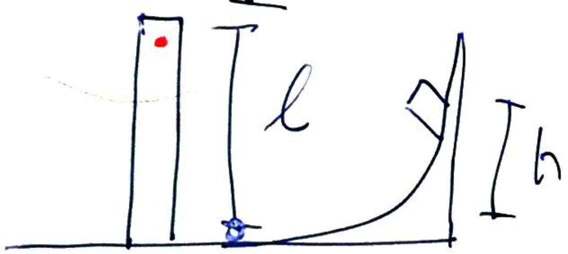


$$m v_0 = (m_1 + m_2) v_f$$

$$(m_1 + m_2) g h = \frac{1}{2} (m_1 + m_2) v_f^2$$

$$K_0 + U_0 = K^f + U_f$$

$$U_0 = K^f$$

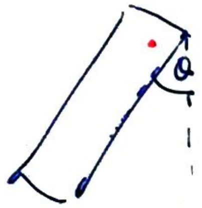


$P_0 \neq P_f$ (Vincolata)

$$\tau_z^0 \Rightarrow L_z^0 = L_z^F$$

$\tau_N = 0$

$\tau_P //$ $\quad \tau_z = 0$



$$mgh = \frac{1}{2} m v_0^2$$

$$v_0^2 = 2gh$$

$$v_0 = \sqrt{2gh}$$

$$L_z^0 = L_z^f$$

$$m v_0 l = \left(I_z^0{}_{asta} + m l^2\right) \omega^2$$

$$\omega = \frac{m v_0 l}{\frac{1}{3} M l^2 + m l^2} \qquad v_B = \omega l$$

$$\frac{1}{2}\left(\frac{1}{3} M l^2 + m l^2\right)\omega^2 = \overbrace{m g \frac{l}{2}\left(1-\cos(\theta)\right)}^{asta} + \underbrace{m g l \left(1-\cos(\theta)\right)}_{pallina}$$

$$\underline{I} = P_F - P_0$$

$$= \underbrace{M \omega \frac{l}{2}}_{P_f \text{ asta e pallina}} + \underbrace{m \omega l}_{P_0 \text{ pallina}}$$