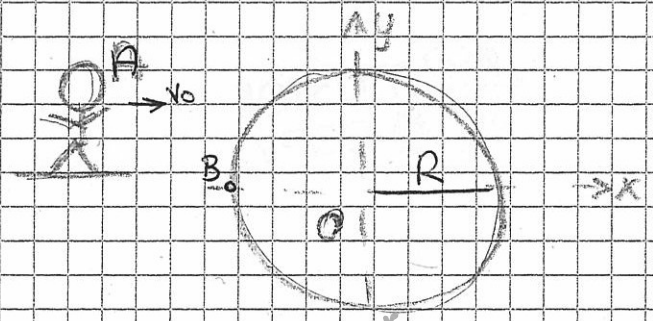
19/04

ESERCITAZIONE 1

1)



$A(-d, d)$

$B(-R, 0)$

1.1 = CALCOLA =

$t = ?$, $v_0 = ?$



$h = d$

Gittata $= -d$

$v_0 = g \cdot R$

$$\begin{cases} x: -d + v_0 \cdot t \\ y: +d + 0 - \frac{1}{2} g t^2 \end{cases}$$

$$\begin{cases} -R = -d + v_0 \cdot t \\ 0 = d - \frac{1}{2} g t^2 \end{cases} \quad \begin{cases} t = \frac{d-R}{v_0} \\ \boxed{t = \sqrt{\frac{2d}{g}}} \end{cases} \Rightarrow t = t \Rightarrow \boxed{v_0 = (d-R) \cdot \sqrt{\frac{g}{2d}}}$$

1.2 =

$v_x = v_0 = ?$ $\quad v_y = ?$

$v_y: -gt = -g\left(\sqrt{\frac{2d}{g}}\right)$

$v_y = -\sqrt{2gd}$

$\boxed{(v_{oy} = -gt)}$

massima altezza

1.3 =

$\omega = ?$ RUOTA + ACROBATA IN $t_0 + \varepsilon$

legge di conservazione del lavoro

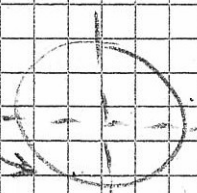
$\Delta L = 0$

$L_{EF} = \frac{1}{2}(I + MR^2) \cdot \omega$

$L_i = \underbrace{M v_A \cdot R}_{\text{ACROBATA}} + \underbrace{0}_{\text{RUOTA}} = M\sqrt{2gd} \cdot R$

$\frac{I + MR^2}{2} \omega^2 = M\sqrt{2gd} \cdot R$

$$\boxed{\omega = \frac{M\sqrt{2gd} \cdot R}{I + MR^2}}$$

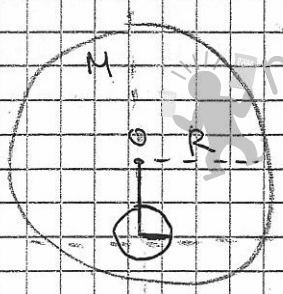


secondo cardinale

1.4 =

NO,

2)



2.1 = DISCO omogeneo

R/4 = Raggio foro

$d_{R_1} - d_{R_2} = \frac{R}{2}$

C = A + B

$R_{cm} = \frac{1}{m}\int R\,dm$ (A, B) $R_{cm} = \frac{\sum m_i R_i}{\sum m_i}$

R = 30 cm

? a) → centro di massa del buco. $M R_{cm}^{C} = M_A R_{cm}^{A} + M_B R_{cm}^{B}$

$M_C = \pi R^2 \sigma$ $M_B = \pi (R/4)^2 \sigma = \frac{M_C}{16}$

$M_A = 15/16\, M_C$ $\left[M_A \cdot R_{cm}^{A} = M_C R_{cm}^{C} + (-M_B) R_{cm}^{B}\right]$

$y: M_C \cdot 0 = M_A \cdot y_{cm}^{A} + M_B (-R/2) = 0$

$y_{cm}^{A} = \frac{M_B}{M_C} \cdot R/2 = \frac{1}{16} \cdot \frac{16}{15} \frac{R}{2} = \frac{30}{30} = 1\,cm$

2.2) M = cilindro ω = ? α = 0

attrito nullo

forza peso = conservative

A = O

B

C

$\Delta E = 0$ si conserva:

$E_F = \frac{1}{2} I \omega^2 - M_A g y_{cm}^{A}$

$E_I = 0 + M_A g \cdot y_{cm}^{A}$

$\omega^2 = \frac{2 \cdot 2 M_A g y_{cm}^{A}}{I} = \left[\frac{2}{15}\frac{M_A g R}{I}\right]$ II

Per trovare I uso il teorema degli assi paralleli

$I_O = I_{cm} + Md^2$

$I_O^{B} = I_{cm}^{B} + M_B (\frac{R}{2})^2$

$-\frac{9}{32} \cdot MR^2$ $(1/2 m_b (R/4)^2)$

$I_O^{C} = I_O^{A} + I_O^{B} \Rightarrow \frac{1}{2} M_C R^2 = I_O^{A} + \frac{9}{32} M_B R^2$

$I_O^{A} = 1/2\, M_C R^2 - \frac{9}{32} M_B R^2$

$I_O^{A} = \frac{247}{30 \cdot 16} M_C R^2$ ←

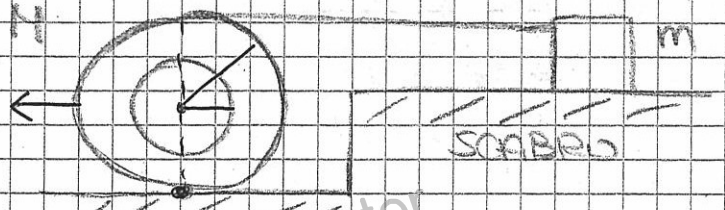
ESERCITAZIONE 2 — x 21/04

1)

3 DISCHI omogenei = R + 2·r

$r = \frac{R}{2}$

$\mu_s = 0{,}4$



2 DISCHI piccoli = $I_1 + I_2$

1 DISCO grande = I_3

$I_1 = I_2 = I_r$

$I_3 = I_R$

$P_{tot} = P$

$I_r = \frac{1}{2} M_r r^2$

1.1 $I = ?$

$\frac{M_r}{M_R} = \frac{r^2}{R^2} = \frac{R^2/4}{R^2} = \frac{1}{4}$

$I_R = \frac{1}{2} M_R R^2$ $\quad M = R/2$

$M = 2M_r + M_R = 2\left(\frac{1}{4}M_R\right) + M_R = 3/2\, M_R \;/\; M_R = \frac{2}{3}M$ $\quad \boxed{M_r = \frac{1}{4}\cdot\frac{2}{3}M = \frac{1}{6}M}$

$I_r = \frac{1}{2}\cdot\frac{1}{6}M\frac{R^2}{4}$ $\quad I_z = \frac{1}{2}\cdot\frac{2}{3}MR^2 + \frac{1}{24}MR^2 = \frac{9}{24}MR^2$

1.2 $F_{max} = ?$ SISTEMA in equilibrio

$\sum P_0 \times F + P_x \times T_2 = 0$

$-F\cdot P_x - T(2R) = 0$ $\quad (T = \frac{F}{2})$

CORPO 1)

$x = -F + \mu_s \cdot N + T_2 = 0$

$m\ T \rightarrow f_a \Rightarrow T = f_a \le \mu_s mg$

$x = -F + 2\mu_s \cdot N = 0$

max $\boxed{F = 2\mu_s mg}$

CORPO 2)

$y: -m_2 g + N = 0$

$x: -T_1 + \mu_s N = 0$

$T_1 = -T_2$

1.3 $a_{cm} = ? = a = T = ?$

$r: FR - T(2R) = I\alpha \Rightarrow T = \frac{FR - I_p\alpha}{2R}$

$m: T - f_A = m\cdot a$

$M: -T + f - f_a' = m\cdot a_{cm}$

$\frac{F}{2} - \frac{11}{32}Ma - \mu_d mg = ma$

$\boxed{a = \frac{(2\mu_s - \mu_d)mg}{m + \frac{11}{32}M}} \Rightarrow \boxed{A_u = \frac{1}{2}a} \Rightarrow \boxed{T = 2{,}4\mu_s mg - \frac{11}{32}M\cdot a}$

$I_p = I_{cm} + MR^2$

$\left(\frac{3}{8} + 1\right)\cdot MR^2 = \frac{11}{8}MR^2$

$\begin{cases} a = 2R\alpha \\ a_u = R\cdot\alpha \\ F_A = \mu_d \cdot mg \end{cases}$

$T = \frac{F}{2} - \frac{11}{8}m\cancel{a}\cdot\frac{1}{2}\frac{a}{\cancel{2R}} =$

$\downarrow$

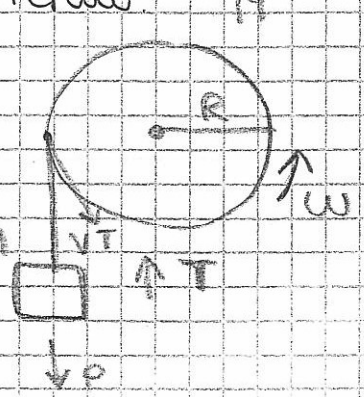
$\frac{F}{2} - \frac{11}{32}Ma$

2) $M = 7{,}5$ kg — RUOTA MA NON C'È ATTRITO.

$R = 0{,}055$ cm

$I = \frac{2}{3} MR^2$ — INIZIO: FERMO

$m = \frac{7{,}5}{3}$ kg



2.1 = a. CORPO m

$-P + T = ma$ e $TR = I\alpha$

2.2 = v di m dopo 2 giri.

v = costante

$K = \frac{1}{2} m v_1^2$

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

ENERGIA NON SI CONSERVA

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

$v_f^2 - v_i^2 = 2ad$ moto unif. accelerato

$v_F^2 = 2 \cdot \frac{g}{3} \cdot 2(2\pi R) = \sqrt{\frac{8}{3}\pi R g}$

$E_{in} = 0 + 0$ = perché fermo

$E_f = -mg(\text{DIST. PERC} = \frac{4\pi R}{2giri}) + \frac{1}{2} mv^2 + \frac{1}{2} I\omega^2$

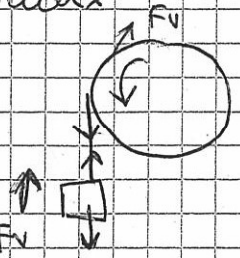
$\frac{1}{2} mv^2 + \frac{M}{2} \cdot \frac{1}{3} \frac{v^2}{R^2} = mg(4\pi R)$ $\omega = M/3$

$v^2\left(\frac{1}{2} m + \frac{1}{3} M\right) = mg(4\pi R)$

$v = \sqrt{\frac{m 4g\pi R}{\frac{1}{2} m + \frac{1}{3} M}} = \frac{\frac{M}{3} g\, 4\pi R}{\frac{\pi}{2} + \frac{\pi}{3} \cdot 3} = \frac{Mg\,4\pi R}{\frac{3}{2} M} = \frac{g\,4\pi \cdot 2R}{3}$

$2.3 = v_{max}$

F_V = FORZA d'ATTRITO VISCOSO



$F_V = \beta v$ con $\beta = 5\ kg/s$

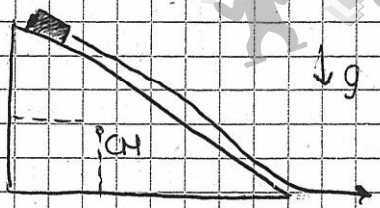
$mg - T - \beta v = 0$

$TR - \underbrace{\beta v}_{F} \cdot R = 0 \rightarrow T = \beta v$

$T = \beta \cdot v_{max}$

$mg = \beta v_{max} + T = 2\beta v_{max} \Rightarrow v_{max} = \frac{mg}{2\beta}$

ESERCIZIO 3

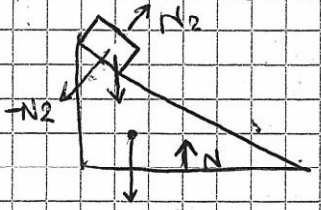


$m = 2.5\ kg \quad M = 8\ kg$

$h = 40\ cm \quad L = 69.3\ cm$

3.1 - quali tra le seguenti si conservano? (q.d.m, E, m.a.a.)

non c'è attrito, siamo assenza di forze:



- $\frac{dP}{dt} = \sum F_{ext} = Mg + mg + N$

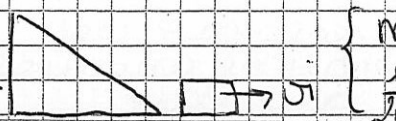
$x: F = 0 \rightarrow$ q.d.m = si conserva.

$y: \sum F_{ext} \neq 0 \rightarrow$ q.d.m = non si conserva

- l'energia si conserva ($= 0$) perché l'unica forza in atto è la forza peso (che è conservativa)

- $\frac{dL}{dt} = \sum \tau_{ext} \neq 0 \rightarrow$ il momento non si conserva angolare

3.2 = conservazione energia $\Delta E = 0 \rightarrow$ urto elastico $= v_{1,2} = ?$



$\begin{cases} m v_1 = M V_2 \\ \frac{1}{2} m V_1^2 + \frac{1}{2} M V_2^2 = mgh \end{cases}$ = con q.d.m = con Energia

FORZA ATTRITO DINAMICO: È NOTA

FORZA ATTRITO STATICO: È una reazione, come nella reazione vincolare

ES) APPLICO UNA F sul libro

$\rightarrow$ poi $F_{att} = -F$ $\quad$ se $F_{att} = 0$