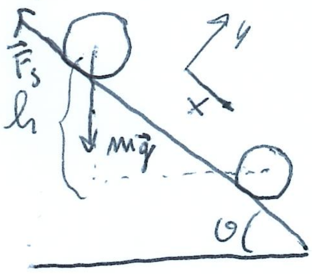
ING. INFORMATICA FISICA 23-10-18

1) 

$$\begin{cases} mg\sin\theta - F_s = m a_c \\ -F_s R = -I\dot{\omega} \end{cases}$$

PURO ROTOLAMENTO

$$\dot{\omega} = \frac{a_c}{R}$$

$$\begin{cases} a_c = g\sin\theta - \frac{F_s}{m} \\ F_s = \frac{I\dot{\omega}}{R} = \frac{I a_c}{R^2} \end{cases} \quad \begin{cases} F_s = \frac{I g\sin\theta}{R^2} - \frac{I}{mR^2} F_s \Rightarrow \\ \Rightarrow F_s\left(1 + \frac{I}{mR^2}\right) = \frac{I g \sin\theta}{R^2} \end{cases}$$

$$I = \frac{1}{2} m R^2$$

$$F_s = \frac{1}{3} mg\sin\theta$$

$$F_s \leq F_s^{MAX} = \mu_s mg\cos\theta \Rightarrow \frac{1}{3} mg\sin\theta \leq \mu_s mg\cos\theta$$

$$\Rightarrow \boxed{\mu_s \geq \frac{1}{3}\operatorname{Tg}\theta}$$

$$a_c = R\dot{\omega} = \frac{F_s R^2}{I} = \frac{2}{3} g\sin\theta$$

$$l = \frac{1}{2} a \tau^2 \Rightarrow \tau = \sqrt{\frac{2l}{a}} = \sqrt{\frac{2h}{\sin\theta\left(\frac{2}{3} g\sin\theta\right)}} = \boxed{\frac{1}{\sin\theta}\sqrt{\frac{3h}{g}} = \tau}$$

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2) $a = K + w\tau$

$$v - \underset{0}{v_0} = \int_0^\tau a\,d\tau = K\tau + \frac{1}{2} w \tau^2$$

$$x - \overset{0}{x_0} = \int_0^\tau v\,d\tau = \int_0^\tau K\tau\,d\tau + \int_0^\tau \frac{1}{2} w\tau^2\,d\tau = \frac{1}{2}K\tau^2 + \frac{1}{6} w \tau^3$$

condizione

$$x(\tau_1) = 0 = \tau_1^2\left(\frac{1}{2}K + \frac{1}{6} w \tau_1\right) = 0 \Rightarrow w = -\frac{3K}{\tau_1} = -6\, m/s^3$$

$$a_1(\tau_1) = K + w\tau_1 = 8\,\frac{m}{s^2} - \left(6\,\frac{m}{s^3}\right)(4s) = -16\, m/s^2$$

3) Per una adiabatica $\Delta U = -L \Rightarrow L = n C_v(T_A - T_B)$

dove T_B è la temperatura finale.

$$T_A V_A^{\gamma-1} = T_B V_B^{\gamma-1} \Rightarrow T_B = T_A \left(\frac{V_A}{V_B}\right)^{\gamma-1} \qquad \frac{V_A}{V_B} = \frac{1}{3} \qquad \gamma = \frac{5}{3}$$

$$\Rightarrow T_B = T_A \, 3^{-\frac{2}{3}} = 144{,}22\,°K \qquad \Rightarrow \boxed{L = 3885{,}46\ J}$$

Per una espansione libera nel vuoto

$$T_B = T_A \qquad L = 0$$

L'entropia si può calcolare lungo una isoterma reversibile

$$\Delta S = \int_A^B \frac{dQ}{T_A} = \int_A^B \frac{\delta L}{T_A} = \int_{V_A}^{V_B} \frac{p\,dV}{T_A} = \int_{V_A}^{V_B} \frac{nR\cancel{T_A}}{\cancel{T_A}}\frac{dV}{V} = nR \ln\frac{V_B}{V_A} = nR\ln 3 = 18{,}27\ J/K$$

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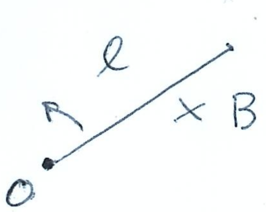
4)



campo elettromotore a distanza r

$$\vec{E} = \vec{v} \times \vec{B} \qquad E = vB = \omega r k r = \omega k r^2$$

$$V_0 - V_{r_1} = -\int_0^{r_1} \omega k r^2 dr = -\frac{\omega k r_1^3}{3}$$

$$V_{r_1} - V_l = -\int_{r_1}^{l} \omega k r^2 dr = \omega k \frac{r_1^3}{3} - \omega k \frac{l^3}{3}$$

Condizione $V_0 - V_{r_1} = V_{r_1} - V_l \Rightarrow -\frac{\omega k r_1^3}{3} = \frac{\omega k r_1^3}{3} - \frac{\omega k l^3}{3}$

$$\Rightarrow \frac{l^3}{3} = 2\frac{r_1^3}{3} \Rightarrow \boxed{r_1 = \sqrt[3]{\frac{1}{2}}\, l}$$