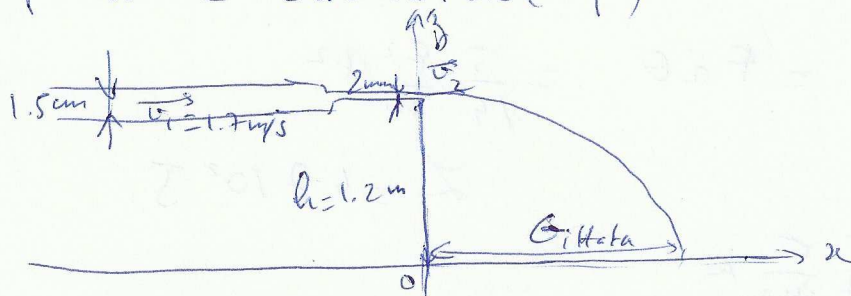


I. fluidi e cinematica (7 pt)



Conservazione della portata: $v_1 d_1^2 = v_2 d_2^2$

$$v_2 = v_1 \left(\frac{d_1}{d_2} \right)^2$$

$$v_2 = 95.6 \text{ m/s}$$

$$\begin{cases} a_z(t) = -g \\ a_x(t) = 0 \end{cases} \rightarrow \begin{cases} v_z(t) = -gt \\ v_x(t) = v_2 \end{cases}$$

$$\begin{cases} z(t) = -\frac{1}{2}gt^2 + h \\ x(t) = v_2 t \end{cases}$$

gittata: $x(t)$ per $z=0$?

$$z=0 \rightarrow h = \frac{1}{2}gt_g^2 \quad t_g = \sqrt{\frac{2h}{g}}$$

$$G = v_2 \sqrt{\frac{2h}{g}}$$

$$G = 47 \text{ m}$$

II. Rotolamento (6 pt.)

$$\sum \tau = I_P \alpha$$

$$F r = I_P \alpha$$

$$I_P = I_0 + m r^2 = \frac{7}{5} m r^2$$

$$\rightarrow \alpha(t) = \frac{5}{7} \frac{F}{m r}$$

$$\omega(t) = \frac{5}{7} \frac{F}{m r} t + \omega_0$$

$$\theta(t) = \frac{5}{14} \frac{F}{m r} t^2$$

$$v = \omega r = \frac{5}{7} \frac{F}{m} t$$

per $t = 4.2 \text{ s}$

$$v = 11 \text{ m/s}$$

altre soluzioni:

$$\begin{cases} F - f_s = m a \\ f_s r = \frac{2}{5} m r^2 \alpha \end{cases}$$

$$a = r \alpha$$

solo $\vec{F}$ lavora perché f_s è applicata su un punto fermo $\rightarrow$ spostamento è sempre uguale a 0.

$$L = \int_0^{\theta} \tau d\theta = F r \theta = \frac{5}{14} \frac{F^2}{m} t^2$$

$$L = 4.7 \cdot 10^2 \text{ J}$$

$$3/ \quad F - f_s = ma = m \frac{5}{7} \frac{F}{m} \quad \therefore$$

$$F - f_s = \frac{5}{7} F$$

$$\boxed{f_s = \frac{2}{7} F}$$

$$4/ \quad F_{\max} \text{ per non scivolare} : f_s \leq \mu_s N$$

$$f_s \leq \mu_s mg$$

$$F = \frac{7}{2} f_s$$

$$F_{\max} = \frac{7}{2} \mu_s mg$$

III Moto armonico (6 pt)

La bobina muove per via delle onde che passano ogni 5 s.

$$x(t) = A \cos(\omega t + \phi) \quad \text{per un moto armonico.}$$

$$v(t) = -\omega A \sin(\omega t + \phi)$$

$$\omega = \frac{2\pi}{T} = \frac{2\pi}{5}$$

$$\left| \begin{array}{l} \text{per } t=0 \quad x(0)=A \quad (\text{posizione in cui } v=0) \\ \rightarrow \phi=0 \end{array} \right.$$

$$v_{\max} = \omega A = 0.26 \text{ m/s} \rightarrow A = 0.2 \text{ m}$$

$$\underline{x(t) = 0.21 \cos(1.26t)}$$

IV Termodinamica (7 pt)

$$T_A = 300 \text{ K}$$

$$V_B = 3V_A$$

espansione adiabatica: $Q=0$

$$T_B$$

$$\Delta U = W + Q = W = n C_v \Delta T$$

$$T_A V_A^{\gamma-1} = T_B V_B^{\gamma-1}$$

$$T_B = T_A \left(\frac{V_A}{V_B} \right)^{\gamma-1} = 144.22 \text{ K}$$

$$C_v = \frac{3}{2} R, \quad \gamma = \frac{5}{3}$$

$$W = 2 \times \frac{3}{2} \cdot 8.31 (300 - 144.22) = 3883.6 \text{ J}$$