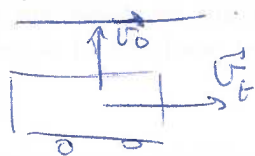


1. Cinematica



a) Velocità iniziale $v = \sqrt{v_x^2 + v_y^2} = 19.4 \text{ m/s}$

direzione $\tan \theta = \frac{v_y}{v_x}$ $\theta = 34^\circ$

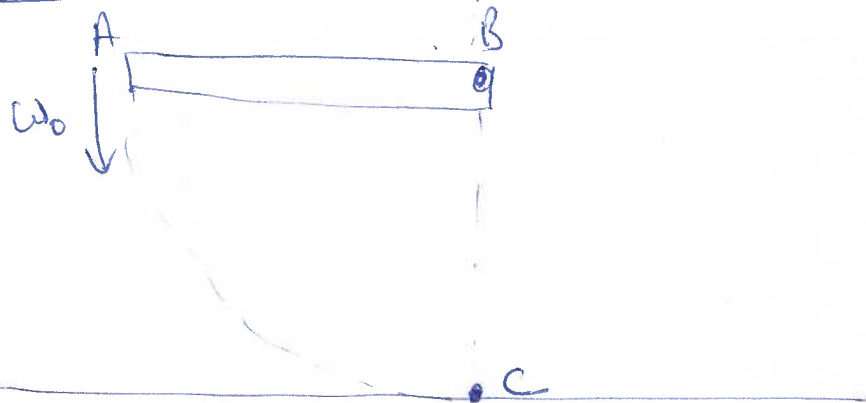
b) per il ragazzo : $G = 0$

per la ragazza : $G = 2 \frac{v_x v_y}{g} = 35.9 \text{ m}$

c) tempo di volo identico per tutti e due:

$$t = \frac{2 v_y}{g} = 2.24 \text{ s}$$

2. Meccanica



a) $I_{\text{totale}} = I_{\text{asta}} + I_{\text{pallina}} = \frac{1}{3} n L^2 + \frac{M}{5} L^2 = \frac{8}{15} n L^2$

b) centro di massa G:

$$\overline{BG} = \frac{1}{(n + \frac{M}{5})} \left(\frac{n L}{2} + \frac{M L}{5} \right) = \frac{7}{12} L$$

c) per fare un giro completo, l'angolo deve essere $3/4$ giro.

• Conservazione dell'energia prima del urto (primo quarto di giro):

$$\frac{1}{2} I_{\text{asta}} \omega_c^2 - \frac{1}{2} I_{\text{asta}} \omega_0^2 = \frac{L}{2} n g$$

$$\omega_c^2 = \omega_0^2 + \frac{3g}{L}$$

• conservazione del momento angolare durante l'urto:

$$I_{\text{asta}} \omega_c = I_{\text{tot}} \omega_1$$

$$\omega_1 = \frac{1}{3} n L^2 \times \frac{15}{8 n L^2} \sqrt{\omega_0^2 + \frac{3g}{L}} = \frac{5}{8} \sqrt{\omega_0^2 + \frac{3g}{L}}$$

• Conservazione dell'energia fra C e D:

$$\frac{1}{2} I_{\text{tot}} \omega_1^2 - 0 = 2 \times \frac{7}{12} L \times \left(\frac{M + \frac{M}{5}}{5} \right) g$$

$$\rightarrow \omega_0^2 = \frac{261}{25} \frac{g}{L}$$

$$\omega_0 = 29.2 \text{ rad/s}$$

3. Termodinamica

$$T_A = 27^\circ\text{C}$$

$$V_A = 1 \text{ L}$$

$$P_A$$

isoterma
reversibile

$$T_B = T_A$$

$$V_B = 2 V_A$$

$$P_B$$

Comprimete
adiabatica
reversibile

$$T_C$$

$$V_C$$

$$P_C = P_A$$

$$a) P_A = \frac{RT}{V_A} = 25 \text{ bars}$$

$$P_B = \frac{RT_0}{2V_A} = 12.5 \text{ bars}$$

$$P_C V_C^\gamma = P_B V_B^\gamma$$

$$V_C = \left(\frac{P_B}{P_C} \right)^{1/\gamma} V_B = 1.3 \text{ L}$$

$$T_C = \frac{P_C V_C}{R} = 397 \text{ K}$$

$$b) A \rightarrow B : \text{isoterma} \rightarrow \Delta U = 0 \quad W = -Q$$

$$\delta W = -P dV = -RT_A \frac{dV}{V}$$

$$W_{AB} = RT_A \ln \frac{V_A}{V_B} = -1728 \text{ J}$$

$$B \rightarrow C : Q = 0$$

$$W = n C_V \Delta T = 1209 \text{ J}$$

$$Q_{\text{tot}} = 1728 \text{ J}, \quad W_{\text{tot}} = -518 \text{ J}$$