Soluzioni appello del 27/07/2015.

1. Cinematica.

1. da 0 a L:

$$\begin{cases} v = at \\ x = \frac{1}{2} a t^2 \end{cases}$$

da L a D:

$$\begin{cases} v = v_0 \\ x = v_0 t + L \end{cases}$$

2. da 0 a L (a l'istante t_1)

$$t_1 = \frac{v_0}{a} \qquad t_2 = \frac{D-L}{v_0} = \frac{D}{v_0} - \frac{v_0}{2a}$$

$$L = \frac{1}{2} a \cdot \frac{v_0^2}{a^2}$$

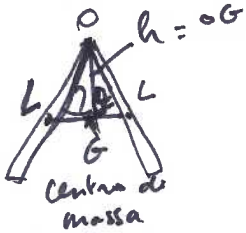
$$t_1 + t_2 = t_s \ (= 10 s)$$

$$t_1 + t_2 = \frac{v_0}{a} + \frac{D}{v_0} - \frac{v_0}{2a} = t_s$$

$$a = \frac{v_0}{2\left(t_s - \frac{D}{v_0}\right)} \qquad a = 4.077 m/s^2$$

3. $$t_1 = \frac{11.67}{4.077} = 2.8 s$$

2. Moto oscillante.



$\beta \equiv$ angolo di oscillazioni

1. periodo delle oscillazioni

$$\sum \tau = I \alpha \qquad \tau = g \sin\theta h = g \sin\beta \frac{L}{2} \cdot \cos\theta$$

$$I_0 = I_1 + I_2 = 2\left(\frac{mL^2}{12} + m\frac{L^2}{4}\right) = \frac{2}{3}mL^2$$

→ con l'approssimazione di oscillazioni piccole: $\sin\beta \approx \beta$

$$\Rightarrow -2mg\frac{L}{2}\cos\theta \cdot \beta = I\ddot{\beta} = \frac{2}{3}mL^2\ddot{\beta}$$

$$\ddot{\beta} + \frac{3}{2}\frac{g}{L}\cos\theta\,\beta = 0 \qquad (1).$$

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periodo di oscillazioni $T = \frac{2\pi}{\omega_0}$, con $\omega_0 = \sqrt{\frac{3}{2}\frac{g}{L}\cos\theta}$

ω_0 pulsazione.

$$T = 2\pi\cdot\sqrt{\frac{2}{3}\frac{L}{g\cos\theta}}$$

2. velocità angolare massima ω_m:

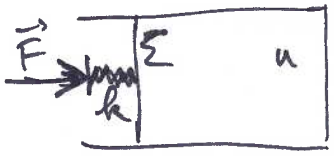
soluzione dell'eq. (1):

$$\beta = \beta_m \cos(\omega_0 t + \phi)$$

velocità angolare: $\omega = \omega_0 \beta_m \sin(\omega_0 t + \phi)$

$$\omega_m = \omega_0 \beta_m = \cdot\sqrt{\frac{3}{2}\frac{g}{L}\cos\theta}$$

3. Termodinamica.



gas perfetto monoatomico:

$$C_v = \frac{3}{2}R$$

$$\gamma = \frac{5}{3}$$

1. trasformazione fase 1: compressione adiabatica reversibile A → B

trasf. fase 2: termalizzazione isocora B → C

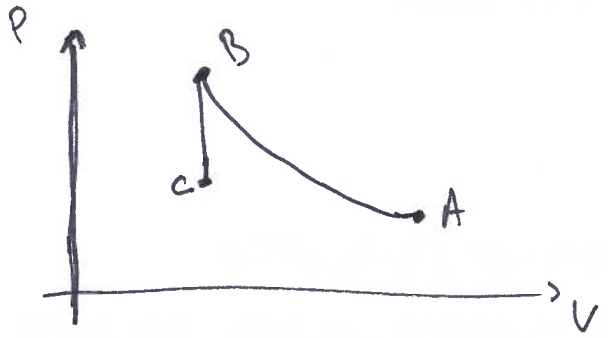
→ $T_C = T_A = 300\,K$

$PV^\gamma = c \qquad p^{1-\gamma} T^\gamma = c$

$P_A = P_0$

$P_B = P_0 + \frac{F}{\Sigma} = P_0 + \frac{h_0 k}{\Sigma}$ $\qquad P_B = 1.25$ bar

$T_B = \left(\frac{P_A}{P_B}\right)^{\frac{1-\gamma}{\gamma}} T_A \qquad T_B = 328$ K



$T_C = T_A$
$V_B = V_C$, $V_B < V_A$
$P_C > P_A$.

2. prima fase : trasf. adiabatica $\quad Q = 0$

$$W = \Delta U = n C_v \Delta T$$
$$= 10 \times \frac{3}{2} R (T_B - T_A) = 3490 \text{ J}$$

3. seconda fase (isocora)

Calore scambiato $\quad \delta Q = n C_v dT + P \cancel{dV}$

$$Q = n C_v (T_C - T_B) = -3490 \text{ J}$$

$$dS = n C_v \frac{dT}{T} \qquad \Delta S = n C_v \ln \frac{T_A}{T_B}$$
$$= -11.12 \text{ J/K}$$