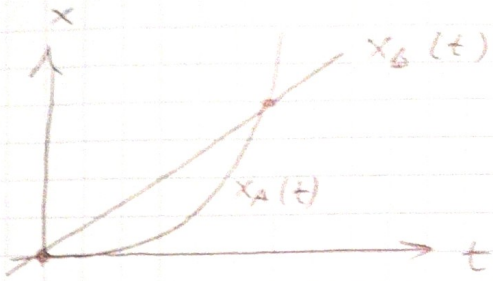
16.9.2024 Fisica 1

Soluzioni

1. $x_A(t) = a_A \cdot \frac{t^2}{2}$

$x_B(t) = v_B \cdot t$

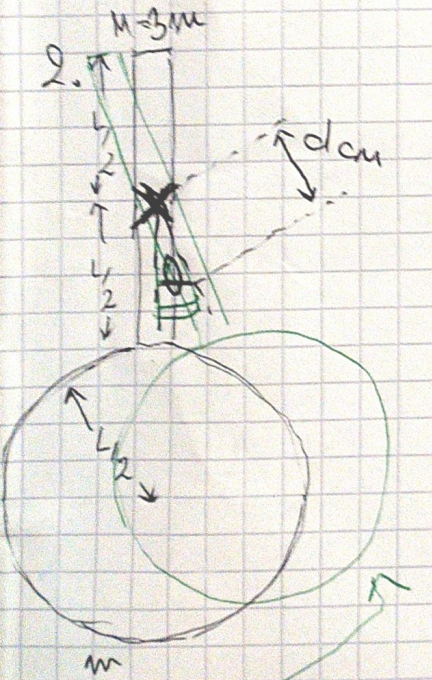


Sorpasso: $x_A(t^*) = x_B(t^*) \Rightarrow a_A \frac{t^{*2}}{2} = v_B \cdot t^* \Rightarrow t^* = \frac{2 v_B}{a_A}$

$\Rightarrow$ $t^* = \frac{2 v_B}{a_A} = 10\,s$

$x(t^*) = v_B \cdot t^* = 200\ m$

2. θ (piccole oscillazioni)



$I_{tot} \cdot \frac{d^2\theta}{dt^2} = -d_{cm} \cdot m_{tot} g \cdot \sin\theta$

$\Rightarrow \frac{d^2\theta}{dt^2} + \frac{m_{tot} g d_{cm}}{I_{tot}} \cdot \theta = 0$ $\quad = \omega^2 \Rightarrow T = \frac{2\pi}{\omega}$

$I_{tot} = I_{asta} + I_{disco}$

$I_{asta} = \frac{ML^2}{12} = \frac{3mL^2}{12} = \frac{mL^2}{4}$

$I_{disco} = m \cdot \frac{R^2}{2} + m \cdot \left(\frac{L}{2} + \frac{L}{2}\right)^2 = \frac{m}{2} \cdot \left(\frac{L}{2}\right)^2 + mL^2 =$

$= \frac{mL^2}{8} + \frac{8mL^2}{8} = \frac{9mL^2}{8}$

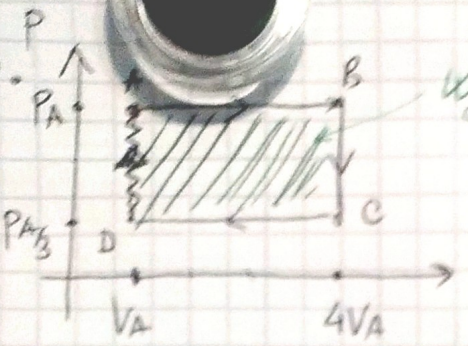
$\Rightarrow \boxed{I_{tot} = \frac{mL^2}{4 \cdot 2} + \frac{9mL^2}{8} = \frac{11\,mL^2}{8}}$

$m_{tot} = 4m$

$\boxed{d_{cm}} = \frac{3m \cdot 0 + m \cdot (L/2 + L/2)}{3m + m} = \boxed{L/4}$

$\Rightarrow \omega^2 = \frac{4m \cdot g \cdot L/4}{\frac{11\,mL^2}{8}} \Rightarrow \boxed{T = \frac{2\pi}{\omega} = 2\pi \sqrt{\frac{11L}{8g}}}$

3.



DA: isobara irrev.

$$W_{ciclo} = \Delta p\,\Delta V = (P_A - P_{A/3})(4V_A - V_A) = 2P_AV_A$$

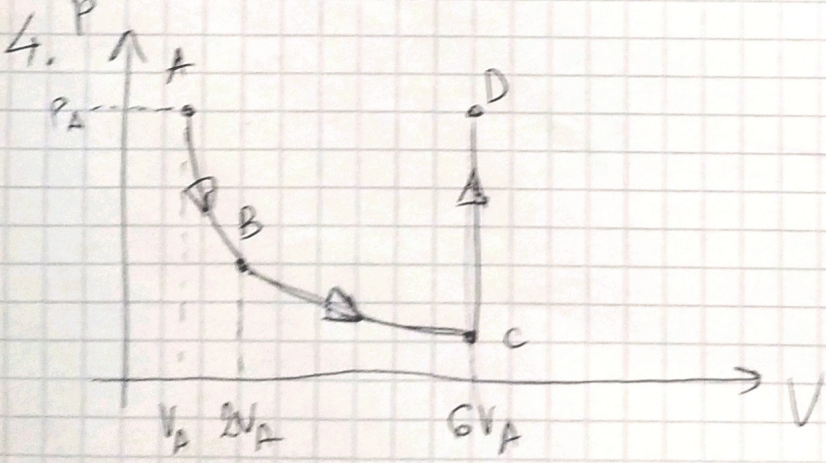
$$\Delta S_{CD} = \int_{C\ REV=isobara}^{D} \frac{dQ}{T} = \int_C^D \frac{nC_p\,dT}{T} = nC_p \ln\frac{T_D}{T_C} = nC_p \ln\frac{P_DV_D}{P_CV_C} = nC_p \ln\frac{V_A}{4V_A}$$

$$\Rightarrow \Delta S_{CD} = -n\cdot\frac{5}{2}R\cdot\ln 4 = -5R\ln 2$$

$$\Delta S_{DA} = \int_{D\ REV=isocora}^{A} \frac{dQ}{T} = S_A - S_D = \int_D^A \frac{PdV + nC_v\,dT}{T} = nC_v \ln\frac{T_A}{T_D} = nC_v \ln\frac{P_AV_A}{P_DV_D}$$

$$\Rightarrow \Delta S_{DA} = n\frac{3}{2}R\ln\frac{P_A}{P_{A/3}} = \frac{3}{2}R\ln 3$$

4.



$$\Delta S_{AD} = S_D - S_A = \Delta S_{AB} + \Delta S_{BC} + \Delta S_{CD} \overset{\text{più veloce}}{=} \Delta S_{A\to D\ rev} = \int_{A\ REV\ isobara}^{D} \frac{dQ}{T}$$

$$\Rightarrow \Delta S_{AD} = \int_A^D \frac{nC_p\,dT}{T} = nC_p \ln\frac{T_D}{T_A} = nC_p \ln\frac{P_DV_D}{P_AV_A} = nC_p \ln 6 = n\frac{5}{2}R\ln 6$$