Fisica 1 - prova scritta - 15 Ottobre 2024

Soluzioni

1. $\begin{cases} x(t) = x_0 + v_0 t + \frac{a t^2}{2} \\ v(t) = v_0 + a t \end{cases}$

$\Delta t = 6\,s$, $\Delta x = 60\,m$: $v_2 = 15\,\frac{m}{s}$

$v_2(\Delta t) = v_1 + a\Delta t \rightarrow v_1 = v_2 - a\Delta t$

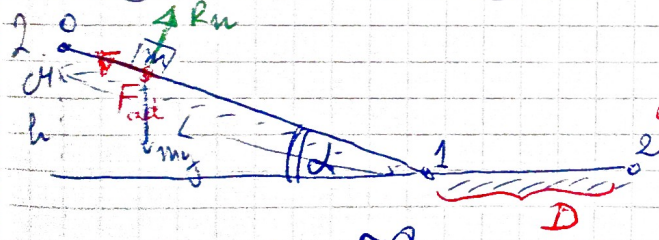
$\Delta x(\Delta t) = v_1 \Delta t + \frac{a\Delta t^2}{2}$

$\Rightarrow \Delta x = (v_2 - a\Delta t)\Delta t + \frac{a\Delta t^2}{2} = v_2 \Delta t - \frac{a\Delta t^2}{2} \Rightarrow a = \frac{2(v_2 \Delta t - \Delta x)}{\Delta t^2}$

$\Rightarrow \boxed{a = \frac{5}{3}\,\frac{m}{s^2}} \Rightarrow v_1 = v_2 - a\Delta t \Rightarrow \boxed{v_1 = 5\,\frac{m}{s}}$

Tra la partenza e il punto 1: $\Delta x_0 = 0 + \frac{a t_0^2}{2}$, $v_1 = 0 + a t_0 \Rightarrow t_0 = \frac{v_1}{a}$

$\Delta x_0 = \frac{a}{2}\cdot\frac{v_1^2}{a^2} = \frac{v_1^2}{2a} = \boxed{7.5\,m}$



$\Delta E = \mathcal{L}^{non\ cons.}$, $h = L\cdot\sin\alpha$

$v_2 = 0\,\frac{m}{s}$

a) $E_1 - E_0 = \mathcal{L}^{\text{forza attrito}} = -F_{ad}\cdot L = -\mu\cdot R_N \cdot L = -\mu\, mg\cos\alpha\cdot L$

$E_0 = mgh = mgL\sin\alpha$

$E_1 = \frac{mv^2}{2}$

$\Rightarrow \frac{mv^2}{2} - mgL\sin\alpha = -\mu mg\cos\alpha\cdot L$

$\Rightarrow \boxed{v = \sqrt{2gL(\sin\alpha - \mu\cos\alpha)}}$

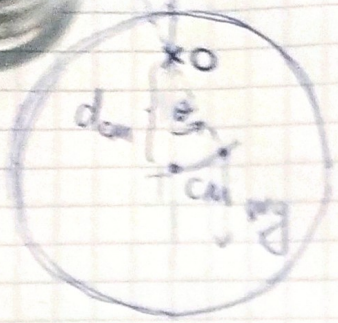
b) $E_2 - E_1 = -\mu_d mg\cdot D$ $\quad \boxed{\mu_d = \mu}$

$E_2 = 0$

$\Rightarrow -\frac{mv^2}{2} = -\mu_d mgD \Rightarrow D = \frac{v^2}{2\mu_d g} = \frac{2gL(\sin\alpha - \mu\cos\alpha)}{2\mu g}$

$\Rightarrow \boxed{D = \frac{L}{\mu}(\sin\alpha - \mu\cos\alpha)}$

5.



$$I\frac{d^2\theta}{dt^2} = -Mg\,d_{cm}\sin\theta$$

$$\Rightarrow \frac{d^2\theta}{dt^2} + \frac{Mg\,d_{cm}}{I}\,\theta = 0 \qquad \Rightarrow \omega^2 = \frac{Mg\,d_{cm}}{I}$$

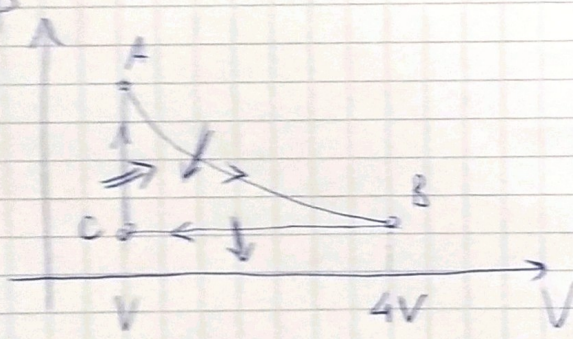
$$\Rightarrow T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{I}{Mg\,d_{cm}}}$$

$$d_{cm} = \frac{3}{4}R$$

$$I = I_{cm} + M\cdot d_{cm}^2 = \frac{MR^2}{2} + M\cdot\left(\frac{3R}{4}\right)^2 = \frac{MR^2}{2} + M\frac{9R^2}{16} = \frac{17MR^2}{16}$$

$$\Rightarrow T = 2\pi\sqrt{\frac{\frac{17}{16}MR^2}{Mg\cdot\frac{3}{4}R}} = \boxed{2\pi\sqrt{\frac{17R}{12g}}}$$

4.



$\eta = ?$

$\Delta S_{BC} = ?$

	p	V	T
A	p	V	T
B	p/4	4V	T
C	p/4	V	T/4

$$\eta = \frac{L\!\!\!/W}{Q_{ass}} \qquad L\!\!\!/W = W_{AB} + W_{BC}$$

$$Q_{ass} = Q_{AB} + Q_{CA}$$

$$W_{AB} = \int_A^B p\,dV = \int_A^B \frac{nRT\,dV}{V} = nRT\ln 4$$

$$W_{BC} = \frac{p}{4}(V_C - V_B) = \frac{p}{4}\cdot(-3V) = -\frac{3}{4}nRT$$

$$Q_{AB} = W_{AB} \text{ (isoterma)}$$

$$Q_{CA} = \Delta U_{CA} \text{ (isocora)} = nC_v(T_A - T_C) = n\frac{3}{2}R\cdot\frac{3T}{4}$$

$$\eta = \frac{nRT(\ln 4 - \frac{3}{4})}{nRT(\ln 4 + \frac{9}{8})} = \frac{\ln 4 - \frac{3}{4}}{\ln 4 + \frac{9}{8}}$$

$$\Delta S_{BC} = \int_B^C \frac{dQ}{T} = \int_b^c \frac{nc_p\,dT}{T} = n\frac{5}{2}R\ln\frac{T_C}{T_B} = -\frac{5}{2}nR\ln 4 = -\frac{5}{2}R\ln 4$$