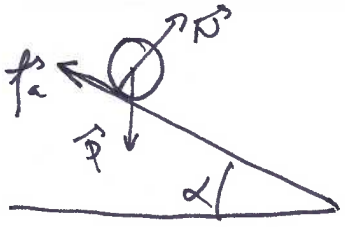
Soluzioni secondo esonero
22/06/2015

1. Meccanica



$$J = \frac{1}{2} m R^2$$

1. $$\begin{cases} mg\cos\alpha = N & (I) \\ mg\sin\alpha - f_a = ma & (II) \\ \tau = I\alpha & (III) \end{cases}$$

$$\tau = f_a R \quad ; \quad \alpha = \frac{a}{R} \quad ; \quad f_a = \frac{Ia}{R} = \frac{ma}{2}$$

$$mg\sin\alpha = ma + \frac{ma}{2} = \frac{3}{2}ma$$

$$\boxed{a = \frac{2}{3} g \sin\alpha}$$

2. angolo massimo per non scivolare:

$$f_a \leq f N = f mg\cos\alpha$$

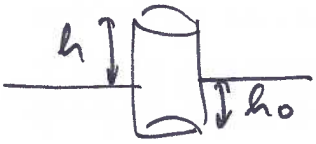
$(II) \rightarrow \quad mg\sin\alpha = ma + f mg\cos\alpha$

$$= 2 f mg\cos\alpha + f mg\cos\alpha$$

$$f = \frac{1}{3}\tan\alpha \qquad \alpha_{lim} \leq \arctan(3f)$$

2. Fluidi

1. profondità di immersione a vuoto:



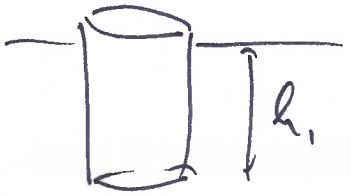
$$P = mg$$

$$F_a = \rho g V' = \rho_{acq} g \pi \frac{d^2}{4} h_0 \quad \text{(spinta di Archimede)}$$

$$\rho_a \pi g \frac{d^2}{4} h_0 = mg$$

$$h_0 = \frac{4m}{\rho_a \pi d^2} = 2.212\,m$$

con l'uomo



$$\rho_a \pi g \frac{d^2}{4} h_1 = (m + m_u) g$$

$$h_1 = 2.316\ m$$

$$\Delta h = h_1 - h_0 = 0.104\ m$$

2. periodo delle oscillazioni

$$T = 2\pi \sqrt{\frac{m}{k}}$$

costante elastica k determinata da

$$F = -m_u g = -k \Delta h \qquad k = \frac{m_u g}{\Delta h}$$

$$T = 2\pi \sqrt{\frac{m \Delta h}{m_u g}} = 2.99\ s$$

3 Termodinamica

1. $$\delta \mathcal{L}_1 = -\delta Q_1 = -p dV = -RT \frac{dV}{V}$$

$$Q_1 = -RT_1 \ln \frac{V_2}{V_1} = 90016\ J = -\mathcal{L}_1$$

$$\delta \mathcal{L}_2 = 0 \quad ; \quad Q_2 = \Delta U = n C_v (T_2 - T_1)$$

$$Q_2 = -12465\ J$$

$$\delta \mathcal{L}_3 = -\delta Q_3 = -pdV$$

$$\mathcal{L}_3 = -RT_2 \ln \frac{V_1}{V_2}$$

$$\mathcal{L}_3 = 67511\ J = -Q_3$$

$$\delta \mathcal{L}_4 = 0 \quad ; \quad Q_4 = n C_v (T_1 - T_2)$$

$$Q_4 = 12465\ J$$

2. rendimento del ciclo

$$\eta = 1 + \frac{Q_{ceduto}}{Q_{assorbito}}$$

$$= 1 + \frac{Q_2 + Q_3}{Q_1 + Q_4}$$

Con $n = 10$, $C_V = \frac{3}{2}R$ $\qquad \eta = 0.22$

3. entropia

$$\Delta S_1 = \frac{Q_1}{T} = \frac{RT_1}{T_1} \ln \frac{V_2}{V_1} = 22\,J$$

$$dS_2 = n C_V \frac{dT}{T} = n C_V \ln \frac{T_2}{T_1}$$

$$\Delta S_2 = -35.86\,J$$

$$\Delta S_3 = n R \ln \frac{V_1}{V_2} = -22\,J$$

$$\Delta S_4 = n C_V \frac{T_1}{T_2} = 35.16\,J$$

$$\Delta S_{TOT} = 0. \quad (\text{ciclo})$$