Soluzioni dell'appello del 22/06/15

1. Cinematica

1. $a = 1.2\ m/s^2$ $\quad d = 1100\ m$

$v = at$

$x = \frac{at^2}{2}$ $\quad t' = \sqrt{\frac{d}{2} \cdot \frac{2}{a}} = 30.27\ s$

$t = 2t' = \underline{60.6\ s}$

2. velocità massima

$v_{max} = at' = 36.33\ m/s = 131\ km/h$

2. Meccanica

1. $E_{c_B} = \frac{1}{2} m v_B^2 = mg(h - R)$

$E_{c_B} = 1.03\ J$

$E_{c_C} = mgh = 1.47\ J$

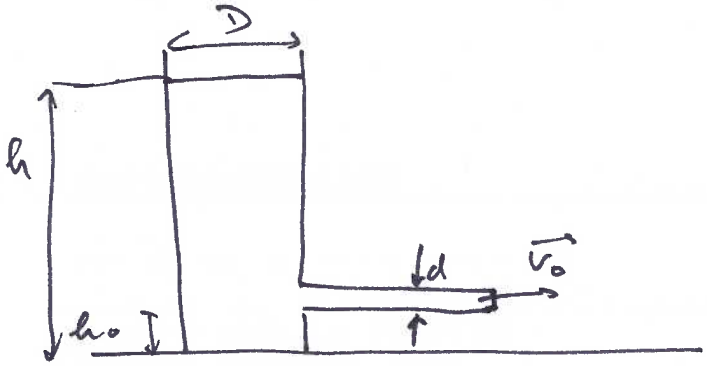
2. $a_{c_B} = \frac{v_B^2}{R} = \frac{\left(\sqrt{2g(h-R)}\right)^2}{R} = 45.78\ m/s^2$

$a_{c_C} = \frac{v_C^2}{R} = 65.4\ m/s^2$

3. $E_p = \frac{1}{2} k x^2 = E_{c_C}$

$k = \frac{2E_{c_C}}{x^2} = \frac{2 \cdot 1.47}{(0.01)^2} = 294.2\ N/m$

3. Fluidi



1. Bernoulli applicato fra la cima e il tubo:

$$\rho g h + \frac{1}{2}\rho v^2 = \rho g h_0 + \frac{1}{2}\rho v_0^2$$

$$h + \frac{v^2}{2g} = h_0 + \frac{v_0^2}{2g}$$

e conservazione della portata:

$$\pi \frac{D^2}{4} v = \pi \frac{d^2}{4} v_0 \qquad v = \frac{d^2}{D^2} v_0$$

$$\rightarrow \quad v_0^2 = \frac{2g(h - h_0)}{1 - \frac{d^4}{D^4}}$$

2. $$dm = \rho S v \, dt = \rho \pi \frac{d^2}{4} v_0 \, dt$$

$$dp = \rho \pi \frac{d^2}{4} v_0^2 \, dt$$

F necessaria per mantenere il recipiente fermo

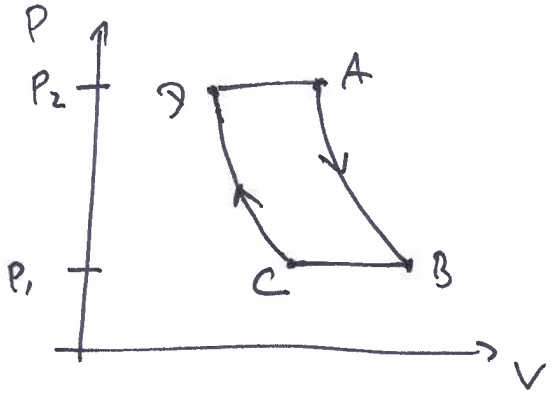
$= -$ forza esercitata dall'acqua che esce

$$= -\frac{dp}{dt} = -\rho \pi \frac{d^2}{4} v_0^2$$

$$F = -\rho \pi \frac{d^2}{4} \cdot \frac{2g(h - h_0)}{1 - \frac{d^4}{D^4}} = -6.3\,N$$

4. Termodinamica

Gas perfetto, 2 adiabatiche e 2 isobare



1. adiabatica $A \to B$ $\quad Q_{AB} = 0$

$$\delta \mathcal{L}_{AB} = p\,dV = -k\frac{dV}{V^\gamma}$$

$$\mathcal{L}_{AB} = \frac{k}{V^{\gamma+1}}(\gamma+1) = P_2 V_A^\gamma (\gamma+1)\left[\frac{1}{V_B^\gamma} - \frac{1}{V_A^\gamma}\right]$$

$$Q_{BC} = nC_p(T_C - T_B) = n\frac{C_p P_1}{nR}(V_C - V_B) < 0$$

$$\mathcal{L}_{BC} = -P_2(V_C - V_B)$$

$$Q_{CD} = 0 \quad , \quad \mathcal{L}_{CD} = P_1 V_C^\gamma (\gamma+1)\left[\frac{1}{V_D^\gamma} - \frac{1}{V_C^\gamma}\right]$$

$$Q_{DA} = n\frac{C_p P_2}{nR}(V_A - V_D) > 0$$

$$\mathcal{L}_{DA} = -P_1(V_A - V_D)$$

2. $$\eta = \frac{|\mathcal{L}|}{Q_{ass}} = \frac{-Q_{TOT}}{Q_{ass}} = 1 + \frac{Q_{ced}}{Q_{ass}}$$

$$\eta = 1 + \frac{Q_{DC}}{Q_{DA}} = 1 + \frac{P_1(V_C - V_B)}{P_2(V_A - V_D)}$$

adiab. rev. $P_2 V_A^{\gamma} = P_1 V_B^{\gamma}$

e $P_1 V_C^{\gamma} = P_2 V_D^{\gamma}$

$$\eta = 1 + \frac{P_1}{P_2} \cdot \frac{\left(\left(\frac{P_2}{P_1}\right)^{1/\gamma} V_D - \left(\frac{P_2}{P_1}\right)^{1/\gamma} V_A\right)}{V_A - V_D}$$

$$\boxed{\eta = 1 - \left(\frac{P_1}{P_2}\right)^{\frac{\gamma-1}{\gamma}}}$$