Esame 25/06/2014

Fisica I.

I. Meccanica.

Moto sul piano orizzontale.

$x=0$ (molla al riposo)

1. $\vec{F} = -kx\vec{e}_x$

   $E_p = \frac{1}{2}kx^2$

2. Conservazione dell'energia fra lo stato iniziale (molla compressa, cubo fermo) e un istante qualunque:

$$\frac{1}{2}ka^2 = \frac{1}{2}mv^2 + \frac{1}{2}kx^2$$

$$\rightarrow v^2 = \frac{k}{m}(a^2 - x^2), \quad v = \sqrt{\frac{k}{m}(a^2-x^2)}$$

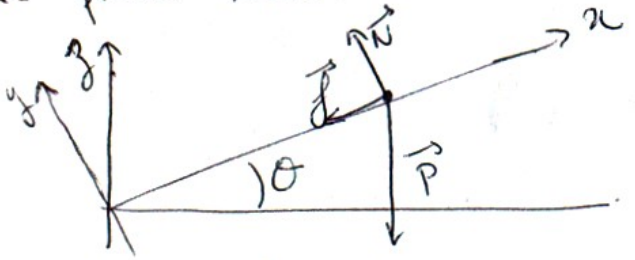
3. v massima per $x_0 = 0$

$$\rightarrow v_0 = \sqrt{\frac{k}{m}}\,a$$

4. $v_0 = \sqrt{\frac{10}{0.1}} \times 0.1 = 1\ m/s.$

Moto sul piano inclinato

1.



2. $\vec{P} + \vec{N} + \vec{f} = m\vec{a}$

$$su\,(y): \quad -P\cos\theta + N = 0 \quad \rightarrow N = mg\cos\theta$$

$$f = \mu_d N \Rightarrow f = \mu_d mg\cos\theta$$

3. $$W_{(f)} = \int_{x=0}^{x_f} \vec{f}\cdot d\vec{x} = \int_0^{x_f} -\mu_d mg\cos\theta\, dx = -\mu_d mg\cos\theta\,[x]_0^{x_f}$$

con $z = x\sin\theta$

$$W_{(f)} = -\mu_d mg\frac{\cos\theta}{\sin\theta}z = -\mu_d mg\cot\theta\, z.$$

4. $\Delta E_m = W_{(f)}$

e $\Delta E_m = \Delta E_c + \Delta E_p$

altezza massima $\rightarrow v_y = 0$, $y = h$

$$\left(0 - \frac{1}{2} m v_0^2\right) + \left(mgh - 0\right) = -\mu_d mg \cot an\theta \cdot h$$

$$h = \frac{v_0^2}{2g(1 + \mu_d \cot an\theta)}$$

2. Idrodinamica

1. eq. di continuità : $v_B D_B^2 = v_A D_A^2$

th. di Bernoulli : $\frac{1}{2}\rho_a v_A^2 + p_A + \rho g y_A = \frac{1}{2}\rho_B v_B^2 + p_B + \rho_{Hg} g y_B$

$$v_B^2 - v_A^2 = 2\frac{(p_A - p_B)}{\rho_a} + 2g(y_A - y_B)$$

$$v_B^2\left(1 - \frac{D_B^4}{D_A^4}\right) = 2\frac{(p_A - p_B)}{\rho_a} - 2gh'$$

portata $Q = v_B D_B^2 \frac{\pi}{4}$

$$Q = \frac{\pi D_B^2}{4}\sqrt{\frac{2(p_A - p_B)/\rho_a - 2gh'}{\left(1 - \frac{D_B^4}{D_A^4}\right)}}$$

2. $p_A - p_B = p_1 - \rho_a g(y_A - y_2) - \left(p_2 - \rho_a g(y_B - y_2)\right)$

$$p_1 - p_2 = \rho_{Hg} g h$$

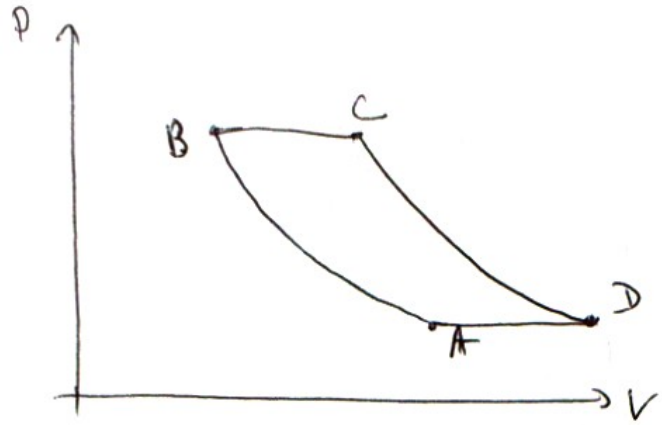
$$p_A - p_B = (\rho_{Hg} - \rho_a) g h + \rho_a g h'$$

$$Q = \frac{\pi D_B^2}{4}\sqrt{\frac{2(\rho_{Hg} - \rho_a) gh}{\left(1 - D_B^4/D_A^4\right)}}$$ → indipendente di h'!

$v_B = 4 v_A = 9.7\ m/s$, $Q = 172\ l/s$

3. Thermodynamique

1.



2 a)

A	B	C	D
$V_1 = 2\,L$	$P_2 = 7\,10^5\,Pa$	$P_3 = P_2$	$P_4 = P_1$
$P_1 = 10^5\,Pa$	$P_1 V_1^\gamma = P_2 V_2^\gamma$	$T_3 = 1180\,K$	$V_4 = \left(\frac{P_3}{P_4}\right)^{1/\gamma} \cdot V_3$
$T_1 = 300\,K$	$V_2 = \left(\frac{P_1}{P_2}\right)^{1/\gamma} V_1$	$V_3 = 1.12\,L$	$V_4 = 4.5\,L$
$n_1 = \frac{P_1 V_1}{R T_1}$	$V_2 = 0.5\,L$		$T_4 = 676\,K$
$n_1 = 0.08\,mol$	$T_2 = 526\,K$		

b) $C_p = \frac{7}{2} R$ $\quad C_v = \frac{5}{2} R$

c) gaz parfaits : $\frac{3}{2} k_b T = \frac{1}{2} m v^2$

$\frac{3}{2} RT = \frac{1}{2} M_{mol} v^2$

$v = \sqrt{\frac{3RT_4}{M_{mol}}} = 507\ m/s$

3. a)

	Q	W
A → B	$Q_{AB} = 0$ adiabatica	$\Delta U = W + Q = nC_v dT$ $W_{AB} = nC_v (T_2 - T_1)$ $W_{AB} = 375,8\ J$
B → C isobara	$\delta Q = nC_p dT$ $Q = nC_p (T_3 - T_2)$ $Q_{BC} = 1522,5\ J$	$\delta W = -P dV$ $W = -P_2 (V_3 - V_2)$ $= -nR(T_3 - T_2)$ $W = -435\ J$
C → D	$Q = 0$	$W_{CD} = nC_v (T_4 - T_3)$ $W_{CD} = -838\ J$
D → A	$Q_{DA} = nC_p (T_1 - T_4)$ $Q_{DA} = -875,3\ J$	$W_{DA} = -nR(T_1 - T_4)$ $W_{DA} = 250\ J$

b) $W_{tot} = -64\ J, 2\ J$ → il ciclo produce lavoro

c) rendimento $\varphi = -\frac{W_{tot}}{Q_{ricevuta}} = \frac{Q_{tot}}{Q_{ricevuta}}$

$Q_{ricevuta} = Q_{BC} = nC_p (T_3 - T_2)$

$Q_{rilasciata} = Q_{DA} = nC_p (T_1 - T_4)$

$$\varphi = 1 + \left(\frac{T_1 - T_4}{T_3 - T_2} \right) \qquad \varphi = 42,5\%$$