SVOLGIMENTO DELLA PROVA 18/9/2017 (A)

(1) $n=2$ $\quad P(T) = bT^2$ $\quad T_i = 400°K$ $\quad T_f = 300°K$

$b = 2\,J\,m^{-3}\,°K^{-2}$

$$L = \int_{V_i}^{V_f} P\,dV = \int_{V_i}^{V_f} bT^2\,dV \qquad V = \frac{nRT}{P} = \frac{nRT}{bT^2}$$

$$V = \frac{nR}{b}\frac{1}{T} \qquad dV = -\frac{nR}{b}\frac{1}{T^2}\,dT$$

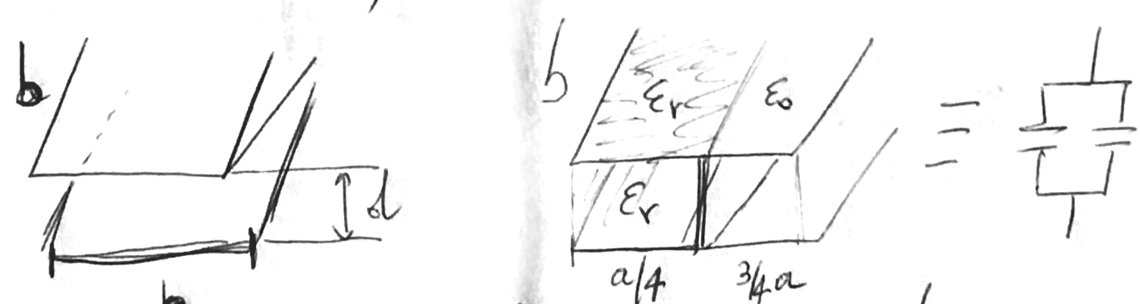
$$L = \int_{T_i}^{T_f} \cancel{b}\cancel{T^2}\frac{(-nR)}{\cancel{b}\cancel{T^2}}\,dT = nR\int_{T_f}^{T_i} dT = nR(T_i - T_f) = 1662\,J;$$

$$Q = L + \Delta U = nR(T_i - T_f) + n c_v (T_f - T_i) = n(c_v - R)(T_f - T_i) = -n c_p (T_f - T_i) = 5817\,J;$$

$$\Delta S = \int_i^f \frac{dQ}{T} = -n c_p \int_{T_i}^{T_f} \frac{dT}{T} = -n c_p \ln\frac{T_f}{T_i} = n c_p \ln\left(\frac{T_i}{T_f}\right) =$$

$$= 16{,}73\,J/°K;$$

(2)



$$U_0 = \frac{1}{2}\frac{Q^2}{C_0} \qquad U_f = \frac{1}{2}\frac{Q^2}{C_f} \qquad C_0 = \frac{\varepsilon_0 ab}{d}$$

$$C_f = C_r + C_0' = \frac{\varepsilon_0\varepsilon_r\, a/4\, b}{d} + \frac{\varepsilon_0\, 3/4\, a b}{d} = \frac{\varepsilon_0 ab}{d}\left(\frac{\varepsilon_r}{4} + \frac{3}{4}\right) =$$

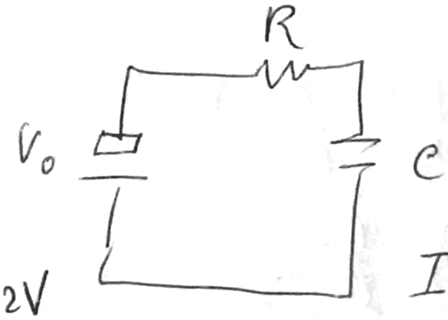
$$\text{Variaz \%} = \left|\frac{U_f - U_0}{U_0}\right| \times 100 = \left|\frac{\frac{1}{C_f} - \frac{1}{C_0}}{\frac{1}{C_0}}\right| = \left|\frac{\frac{C_0 - C_f}{C_0 C_f}}{\frac{1}{C_0}}\right| = \left|\frac{C_0 - C_f}{\cancel{C_0} C_f}\cancel{C_0}\right| = \left|\frac{C_0 - C_f}{C_f}\right|$$

B

$$= \left| \frac{\frac{\varepsilon_0 ab}{d} - \frac{\varepsilon_0 ab}{d}\left(\frac{\varepsilon_r+3}{4}\right)}{\frac{\varepsilon_0 ab}{d}\left(\frac{\varepsilon_r+3}{4}\right)} \right| = \left| \frac{1 - \frac{\varepsilon_r+3}{4}}{\frac{\varepsilon_r+3}{4}} \right| = \left| \frac{4-\varepsilon_r-3}{\varepsilon_r+3} \right| =$$

$$= \left| \frac{1-\varepsilon_r}{\varepsilon_r+3} \right| \longrightarrow \left| \frac{1-3}{3+3} \right| \times 100 = \frac{2}{9} \times 100 = 22,22\,\%$$

③



$V_0 = 12V$
$R = 10^7\,\Omega$

$$\tau = RC \qquad I(t) = I_0\, e^{-t/\tau}$$

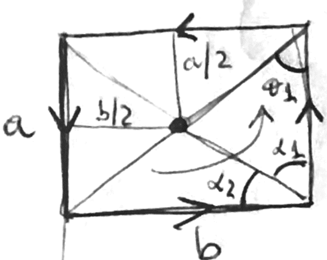
$$= \frac{V_0}{R}\, e^{-t/\tau}$$

$$I(\tau/4) = \frac{V_0}{R}\, e^{-1/4} = 9{,}35 \cdot 10^{-7}\,A$$

$$I(10\tau) = \frac{V_0}{R}\, e^{-10} \cong 5{,}44 \cdot 10^{-11}\,A \simeq 0$$

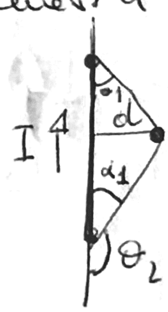
④

$\hat{z} \odot$



$a = 10\,cm$
$b = 15\,cm$
$I = 20\,A$
$\alpha_1 = \theta_1$

In generale



$$\vec{B} = \frac{\mu_0 I}{4\pi d}(\cos\theta_1 - \cos\theta_2)\hat{z}$$

$$= \frac{\mu_0 I}{4\pi d}(\cos\theta_1 + \cos\alpha_1)\hat{z}$$

$$tg\,\alpha_1 = \frac{b}{a} \qquad tg\,\alpha_2 = \frac{a}{b}$$

$$\vec{B}_{TOT} = \cancel{2}\,\frac{\mu_0 I}{\cancel{4}\pi\, b/2}\,\cancel{2}\cos\alpha_1\,\hat{z} + 2\,\frac{\mu_0 I}{\cancel{4}\pi\, a/2}\,\cancel{2}\cos\alpha_2\,\hat{z}$$

$$= \left(\frac{2\mu_0 I}{\pi b}\cos\alpha_1 + \frac{2\mu_0 I}{\pi a}\cos\alpha_2\right)\hat{z}$$

$$= \frac{2\mu_0 I}{\pi}\left(\frac{1}{b}\frac{a}{\sqrt{a^2+b^2}} + \frac{1}{a}\frac{b}{\sqrt{a^2+b^2}}\right)\hat{z} = \frac{2\mu_0 I}{\pi\sqrt{a^2+b^2}}\left(\frac{a}{b} + \frac{b}{a}\right)\hat{z}$$

$$\vec{F}_L = q\,\vec{v} \times \vec{B} \longrightarrow |\vec{F}_L| = q\,|\vec{v}|\,\frac{2\mu_0 I}{\pi\sqrt{a^2+b^2}}\left(\frac{a}{b} + \frac{b}{a}\right) =$$

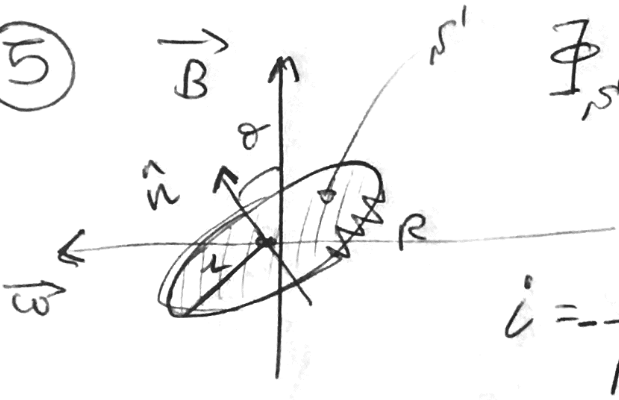
(C)

$$|\vec{B}_{TOT}| = 1{,}9\cdot10^{-4}\,T \;,$$

$$\omega = \frac{e|\vec{B}_{TOT}|}{m} = 18{,}42\cdot10^{3}\,s^{-1} \;;$$

$$R = \frac{m|\vec{v}|}{e|\vec{B}_{TOT}|} = 1{,}08\cdot10^{-3}\,m \;;$$

(5)



$$\Phi_{S'}(\vec{B}) = \int_{S'} \vec{B}\cdot d\vec{S} = |\vec{B}|\pi r^2\cos\theta$$

$$= |\vec{B}|\pi r^2\cos\omega t$$

$$i = -\frac{1}{R}\frac{d\Phi_S}{dt} = +\frac{\omega|\vec{B}|\pi r^2}{R}\sin\omega t$$

$$P = R i^2 = \cancel{R}\,\frac{\omega^2|\vec{B}|^2\pi^2 r^4}{R^{\cancel{2}}}\sin^2\omega t$$

$$= \left[\frac{\omega^2|\vec{B}|^2\pi^2 r^4}{R}\right]\sin^2\omega t$$

$$\langle P\rangle = \frac{\omega^2|\vec{B}|^2\pi^2 r^4}{R}\langle\sin^2\omega t\rangle = \frac{\omega^2|\vec{B}|^2\pi^2 r^4}{R}\,\frac{1}{2} =$$

potenza mediata su un periodo

$$= 7{,}89\cdot10^{-4}\,W$$