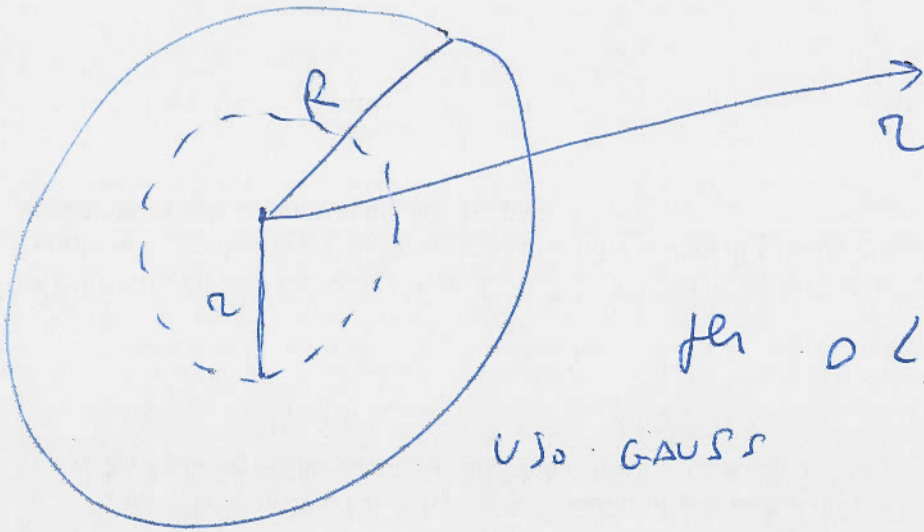


12/06/18

P. 1

(1)



$$\text{for } 0 < r < R$$

USO GAUSS

$$\oint (\vec{D}) \cdot \vec{n} d\tau = q_{\text{int}} \Rightarrow \oint \vec{D}(r) \cdot \vec{n} d\tau = q_{\text{int}}(r)$$

$$D(r) \cdot 4\pi r^2 = \int_0^r \rho(r') 4\pi r'^2 dr'$$

$$D(r) \cdot 4\pi r^2 = \int_0^r A r'^3 4\pi r'^2 dr' = \int_0^r A \pi 4 r'^5 dr'$$

$$D(r) \cdot 4\pi r^2 = 4\pi A \frac{r^6}{6} \rightarrow D(r) = \frac{A}{6} r^4$$

$$D(r) = \epsilon_0 E(r) \rightarrow E(r) = \frac{D(r)}{\epsilon_0} = \frac{A}{6\epsilon_0} r^4$$

Je $r > R$

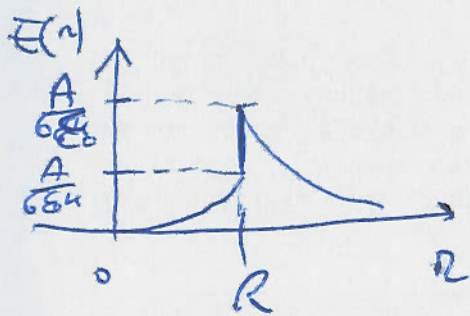
P. 2

$$\phi(\vec{0}) = q^{\text{int}} \rightarrow D(r) \cdot 4\pi r^2 = \int_0^R A(r') \cdot 4\pi r'^2 dr'$$

$$\begin{aligned} D(r) \cdot 4\pi r^2 &= \int_0^R A r'^3 4\pi r'^2 dr' = 4\pi A \int_0^R r'^5 dr' \\ &= 4\pi A \frac{R^6}{6} \end{aligned}$$

$$\rightarrow D(r) = \frac{4\pi A R^6}{6} \frac{1}{r^2}$$

$$E(r) = \frac{D(r)}{\epsilon} \rightarrow E(r) = \frac{4\pi A R^6}{6\epsilon} \frac{1}{r^2}$$



$$V(2R) - V(\infty) = - \int_{\infty}^{2R} E(r) \cdot dr =$$

P. 3

$$= - \int_{\infty}^{2R} \frac{AR^6}{6\epsilon} \frac{1}{r^2} dr = \frac{AR^6}{6\epsilon} \frac{1}{2R}$$

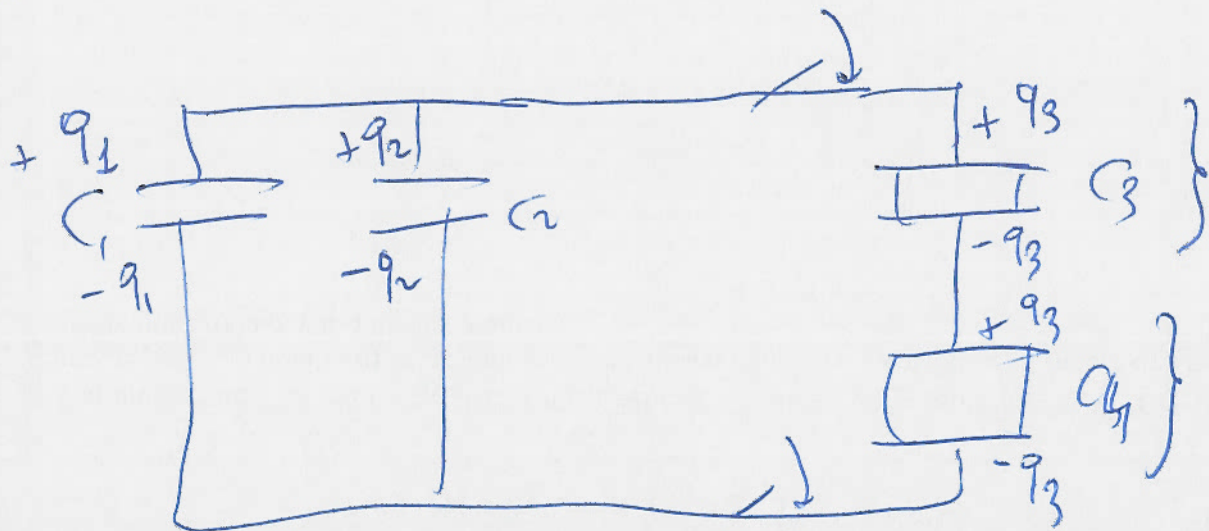
$$V\left(\frac{R}{2}\right) - V(\infty) = - \int_{\infty}^R E(r) \cdot dr - \int_R^{\frac{R}{2}} E(r) \cdot dr =$$

$$= - \int_{\infty}^R \frac{AR^6}{6\epsilon} \frac{1}{r^2} dr - \int_R^{\frac{R}{2}} \frac{A}{6\epsilon r^4} r^4 dr =$$

$$= \frac{AR^6}{6\epsilon} \frac{1}{R} - \frac{A}{6\epsilon r} \left[\frac{1}{5} \left(\frac{R}{2}\right)^5 - \frac{1}{5} (R)^5 \right]$$

2

P.4



$$C_3 = C_4 = \epsilon_2 C_1$$

$$q_1^{in} : q_1^{in} = 0 \quad q_2^{in} = 0 \quad q_3^{in} = C_3 \Delta V = \epsilon_2 C_1 \Delta V$$

$$q_4^{in} = C_4 \Delta V = \epsilon_3 C_1 \Delta V$$

$$q_3^{FIN} = q_4^{FIN} \text{ x de in serie}$$

$$C_S = \frac{C_3 C_4}{C_3 + C_4} = \frac{\epsilon_2 C_1 \epsilon_3 C_1}{\epsilon_2 C_1 + \epsilon_3 C_1} = \frac{\epsilon_2 \epsilon_3}{2}$$

$$+q_1^{FIN} + q_2^{FIN} + q_3^{FIN} = q_3^{in} \text{ per conserv- carica}$$

$$\Delta V_1^{FIN} = \Delta V_2^{FIN} = (\Delta V_3^{FIN} + \Delta V_4^{FIN}) = \Delta V_5^{FIN}$$

$$\frac{q_1^{FIN}}{C_1} = \frac{q_2^{FIN}}{C_2} = \frac{q_3^{FIN}}{C_S} = \frac{q_3^{FIN} \cdot 2}{\epsilon_2 C_1}$$

$$\rightarrow \frac{q_1^{FIN}}{\epsilon_1} = \frac{q_3^{FIN}}{\epsilon_2} \cdot 2 \rightarrow q_1^{FIN} = q_3^{FIN} \frac{2}{\epsilon_2}$$

$$q_2^{FIN} = \frac{2C_2}{\epsilon_2 C_1} q_3^{FIN}$$

P.S

e quindi:

$$\frac{q_3^{FIN}}{\epsilon_2} + \frac{2C_2}{\epsilon_2 C_1} q_3^{FIN} + q_3^{FIN} = q_3^{IN} = \epsilon_2 C_1 \Delta V$$

$$q_3^{FIN} \left(\frac{2}{\epsilon_2} + \frac{2C_2}{\epsilon_2 C_1} + 1 \right) = \epsilon_2 C_1 \Delta V$$

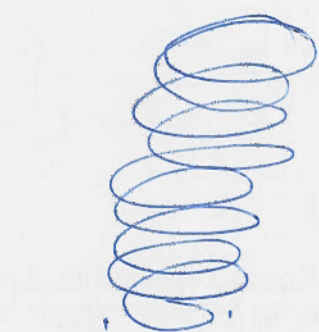
$$q_3^{FIN} = \frac{\epsilon_2 C_1 \Delta V}{\left(\frac{2}{\epsilon_2} + \frac{2C_2}{\epsilon_2 C_1} + 1 \right)}$$

$$q_2^{FIN} = \frac{2C_2}{\epsilon_2 C_1} q_3^{FIN} = \frac{2C_2}{\epsilon_2 C_1} \frac{\epsilon_2 C_1 \Delta V}{\left(\frac{2}{\epsilon_2} + \frac{2C_2}{\epsilon_2 C_1} + 1 \right)}$$

$$q_1^{FIN} = \frac{2}{\epsilon_2} q_3^{FIN} = \frac{2}{\epsilon_2} \frac{\epsilon_2 C_1 \Delta V}{\left(\frac{2}{\epsilon_2} + \frac{2C_2}{\epsilon_2 C_1} + 1 \right)}$$

3

R6



$$i(t) = e - b t$$

$$B(t) = \mu_0 n i(t) \quad \text{for } 0 < r < R$$

$$B(t) = 0 \quad \text{for } r > R$$

$$-\frac{d\Phi(B)}{dt} = \mathcal{E}_{\text{em}} = \oint \vec{E}_{\text{ind}} \cdot d\vec{\ell}$$



$$\int_{\text{Sup.aggio}(2R)} \vec{B} \cdot \hat{n} d\tau = \int_{\text{Sup.aggio} R} \vec{B} \cdot \hat{n} d\tau = B(t) \cdot \pi R^2$$

Sup.aggio R
che fuori R
B=0

$$-\frac{d}{dt} \pi R^2 (e - b t) = \int_{\text{lineaggio } 2R} \vec{E}_i d\ell = E(2R) \cdot 2\pi(2R)$$

$$\pi R^2 b = E(2R) 2\pi(2R) \rightarrow E(2R) = \frac{bR}{4}$$

$$F = m a_e \rightarrow -eE = m a_e \rightarrow a_e = \frac{-eE}{m} = -\frac{e b R}{4m}$$

donc $r < R$



$$\hookrightarrow \Phi(B) = \int B \cdot d\vec{\tau} = B(t) \cdot \pi r^2$$

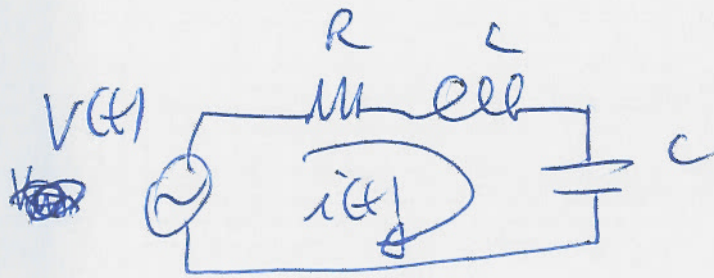
$$-\frac{d}{dt} B(t) \pi r^2 = b \pi r^2 = \oint_{(r)} \vec{E} \cdot d\vec{\ell} = E(r) 2\pi r$$

donc $E(r) = \frac{b r}{2}$

c'est un r^* tel que $E(r^*) = \frac{b r^*}{2} = E(R) = \frac{b R}{4}$?

Si $r^* = \frac{R}{2}$

$$a_e^* = -e \frac{b}{2m} (r^*) = -\frac{e b}{2m} \left(\frac{R}{2} \right) = \frac{-e b R}{4m}$$



$$V(t) = V_{\max} \cos(\omega t)$$

$$V(t) = V_0 \cos(\omega t)$$

$$\boxed{\omega = 2\pi f}$$

$$I_{\max} = \frac{V_{\max}}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}}$$

$$V_{\max} R = I_{\max} R$$

$$V_{\max} L = I_{\max} \omega L$$

$$V_{\max} C = I_{\max} \frac{1}{\omega C}$$

$$\cos \phi = \frac{R}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}}$$

$$P_{\text{av}} = \frac{V_{\max} I_{\max}}{2} \cos \phi$$