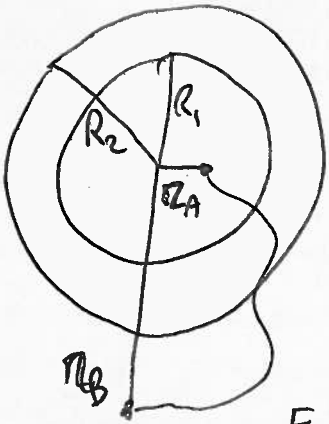
1)

USO GAUSS



• per $0 < r < R_1$

$$E_0(r)\, 4\pi r^2 = 0 \rightarrow E_0(r) = 0$$

• per $R_1 < r < R_2$

$$E_1(r)\, 4\pi r^2 = \frac{q_{INT}(r)}{\varepsilon_0} = \frac{\int_{R_1}^{r} \rho(r') \cdot 4\pi r'^2 dr'}{\varepsilon_0}$$

$$E_1(r) = \frac{1}{\cancel{4\pi}\varepsilon_0 r^2} \int_{R_1}^{r} k \cdot r' \cdot \cancel{4\pi} r'^2 dr' =$$

$$= \frac{k}{\varepsilon_0 r^2} \int_{R_1}^{r} r'^3 dr' = \frac{k}{4\varepsilon_0 r^2}\left(r^4 - R_1^4\right)$$

• per $R_2 < r < +\infty$

$$E_2(r)\, 4\pi r^2 = \frac{q_{INT}}{\varepsilon_0} = \frac{\int_{R_1}^{R_2} \rho(r') 4\pi r'^2 dr'}{\varepsilon_0}$$

$$E_2(r) = \frac{1}{\cancel{4\pi}\varepsilon_0 r^2} \int_{R_1}^{R_2} k r' \cancel{4\pi} r'^2 dr' = \frac{k}{4\varepsilon_0 r^2}\left(R_2^4 - R_1^4\right)$$

$$E_A = E_0(r = r_A) = 0 \qquad E_B = E_2(r = r_B) = \frac{k}{4\varepsilon_0 r_B^2}\left(R_2^4 - R_1^4\right)$$

$$\Delta E = E_B - E_A = E_B$$

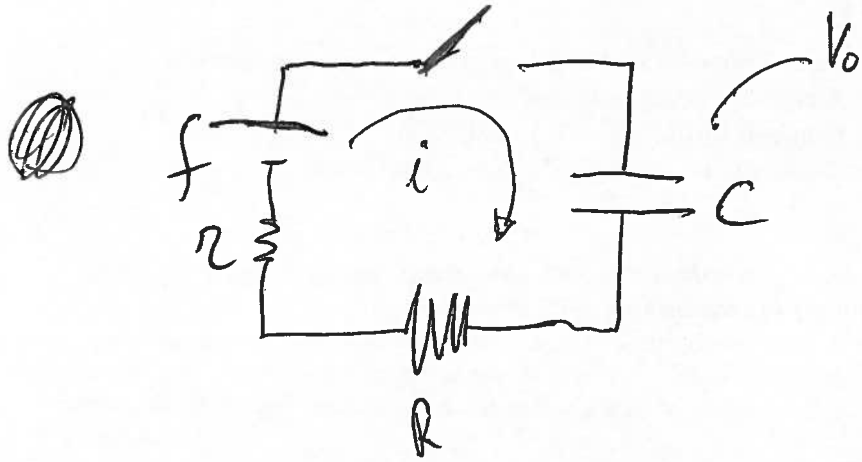
$$\Delta V = V_B - V_A = -\int_{r_A}^{r_B} \vec{E}(r) \cdot d\vec{r} = -\left[\int_{R_1}^{R_2} E_1(r)\, dr + \int_{R_2}^{r_B} E_2(r)\, dr\right] =$$

$\longrightarrow$

p. 2

$$= -\frac{k}{4\varepsilon_0}\left[\int_{R_1}^{R_2} r^2 dr - R_1^4 \int_{R_1}^{R_2} \frac{dr}{r^2} + (R_2^4 - R_1^4)\int_{R_2}^{R_B} \frac{dr}{r^2}\right] =$$

$$= \frac{-k}{4\varepsilon}\left[\frac{1}{3}(R_2^3 - R_1^3) + \frac{R_1^4}{1}\left(\frac{1}{R_2} - \frac{1}{R_1}\right) - \frac{(R_2^4 - R_1^4)}{1}\left(\frac{1}{R_B} - \frac{1}{R_2}\right)\right]$$



$\rightarrow Q_0 = CV_0$

$$i = \frac{dq_c}{dt}$$

$$f - \frac{q_c}{C} = (R+r)\,i = (R+r)\frac{dq_c}{dt}$$

$$Cf - q_c = C(R+r)\frac{dq_c}{dt}$$

$$\frac{dt}{C(R+r)} = \frac{dq_c}{Cf - q_c} \qquad -\frac{1}{C(R+r)}\int_0^{t^*} dt = \int_{Q_0}^{q_c^*} \frac{dq_c}{q_c - Cf}$$

con $q_c^* = q_c(t = t^*) = V_1 \cdot C$

$$-\frac{t^*}{C(R+r)} = \ln\frac{q_c^* - Cf}{Q_0 - Cf} \qquad \text{da cui}$$

$$t^* = -C(R+r)\ln\frac{q_c^* - Cf}{Q_0 - Cf}$$

volendo si trova

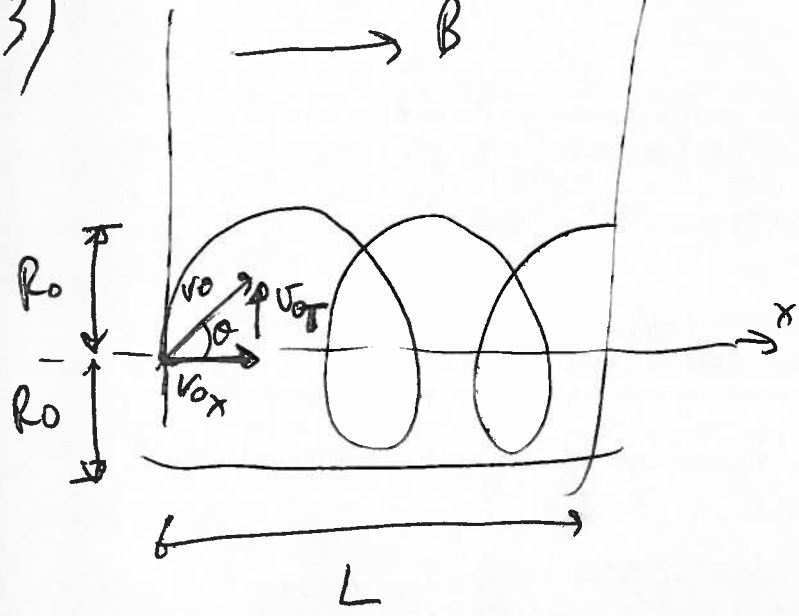
$$e^{-\frac{t^*}{\tau}} = \frac{q_c^* - Cf}{Q_0 - Cf} \qquad \text{con } \tau = (R+r)C$$

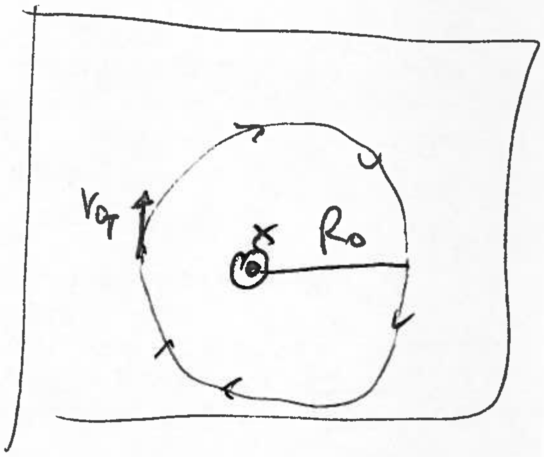
$$q_c^* - Cf = (Q_0 - Cf)\, e^{-\frac{t^*}{\tau}}$$

$$q_c^* = Cf + (Q_0 - Cf)\, e^{-\frac{t^*}{\tau}}$$

$$q_c^* = Cf + (CV_0 - Cf)\, e^{-\frac{t^*}{\tau}}$$

3)





$$v_{0x} = v_0 \cos\theta$$

$$v_{0T} = v_0 \,\text{sen}\,\theta$$

(TRASVERSALE)

NEL PIANO

$$F_m = +e v_{0T} B_0 = m_e a = m_e \frac{v_{0T}^2}{R_0}$$

$$\boxed{\omega = \frac{v_{0T}}{R_0}} \quad v_{0T} = +\frac{e B_0 R_0}{m_e} = v_0 \,\text{sen}\,\theta_M$$

da cui $\theta_M = \arcsin\left(\frac{e B_0 R_0}{v_0 m_e}\right)$

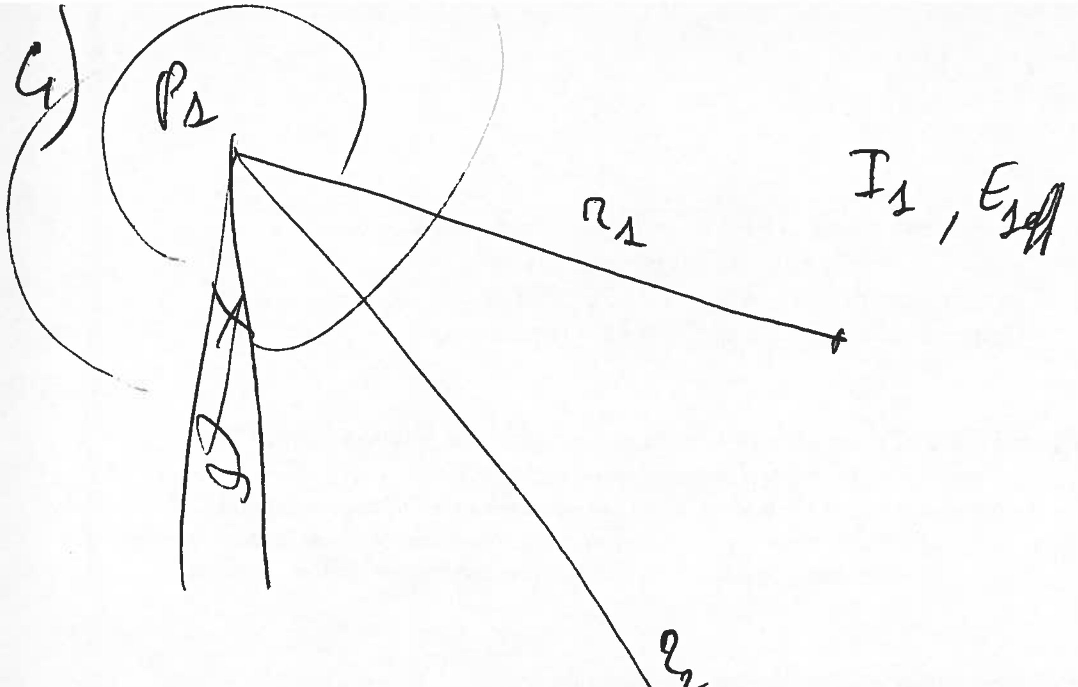
NELLA DIREZIONE X

v_{0x} = COSTANTE $\qquad v_{0x} \cdot t^* = L \rightarrow t^* = \frac{L}{v_{0x}} = \frac{L}{v_0 \cos\theta_M}$

$$t^* = T \text{ (un periodo)} \rightarrow T = \frac{2\pi}{\omega} = \frac{2\pi R_0}{v_{0T}} = \frac{2\pi R_0}{v_0 \,\text{sen}\,\theta_M}$$

da cui $L = v_0 \cos\theta_M \cdot \frac{2\pi R_0}{v_0 \,\text{sen}\,\theta_M}$

4)



$$I_1 = \frac{P_1}{4\pi r_1^2}$$

$$E_{1\,eff} = \sqrt{\frac{I_1}{c\varepsilon_0}}$$

$$I_2 = \frac{P_2}{4\pi r_2^2} \stackrel{!}{=} I_1 = \frac{P_1}{4\pi r_1^2}$$

$$P_2 = P_1 \frac{\cancel{4\pi} r_2^2}{\cancel{4\pi} r_1^2} = P_1 \left(\frac{r_2}{r_1}\right)^2$$