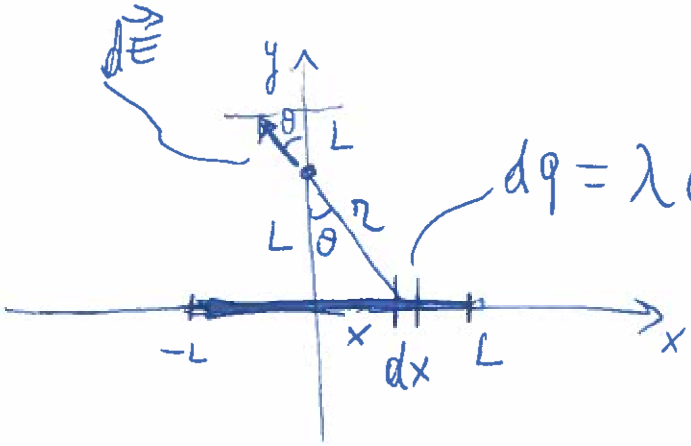
18-3-2021

1)



$$dE = \frac{dq}{4\pi\varepsilon}\frac{1}{r^2} \qquad dE_y = dE\cos\theta \qquad dE_x = dE(-\sin\theta)$$

$$dE = \frac{\lambda\,dx}{4\pi\varepsilon\, r^2} \qquad \lambda = \alpha\sqrt{x^2+L^2} = \alpha r$$

$$\frac{x}{L} = tg\,\theta \qquad x = L\,tg\,\theta \qquad dx = \frac{L}{\cos^2\theta}\,d\theta$$

$$\frac{L}{r} = \cos\theta \rightarrow r = \frac{L}{\cos\theta}$$

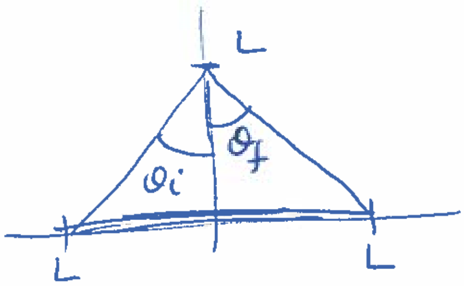
$$dE = \frac{\alpha r}{4\pi\varepsilon r^2}\frac{L}{\cos^2\theta}\,d\theta = \frac{\alpha \cancel{L} \cancel{\cos^2\theta}\ \cancel{L}}{\cos\theta\, 4\pi\varepsilon\, \cancel{L^2}\ \cancel{\cos^2\theta}}\,d\theta$$

$$dE = \frac{\alpha}{4\pi\varepsilon}\frac{d\theta}{\cos\theta} \qquad dE_y = \cos\theta\, dE = \frac{\alpha}{4\pi\varepsilon}\,d\theta$$

$$dE_y = -\sin\theta\, dE = -\frac{\alpha}{4\pi\varepsilon}\,tg\,\theta\, d\theta$$

dE_x non serve perché per simmetria per ogni dE_x dovuto ad una carica dq in (θ) c'è un $-dE_x$ dovuto alla carica dq in $(-\theta)$ per cui $\boxed{E_x = 0}$

$$E_y = \int dE_y = \int_{\theta_i}^{\theta_f} \frac{\alpha}{4\pi\varepsilon_0} d\theta = \frac{\alpha}{4\pi\varepsilon_0}[\theta_f - \theta_i]$$



$$\theta_i = -\frac{\pi}{4} \qquad \theta_f = \frac{\pi}{4}$$

$$E_y = \frac{\alpha}{4\pi\varepsilon}\left[\frac{\pi}{4} + \frac{\pi}{4}\right] = \frac{\alpha}{4\pi\varepsilon} 2 \frac{\pi}{4} = \frac{\alpha}{8\varepsilon_0}$$

$$\vec{E}_{TOTALE} = \hat{y} E_y + \hat{x}(\emptyset)$$ quindi è diretto lungo $+\hat{y}$

$$E_{TOT} = \frac{\alpha}{8\varepsilon}$$

2) alla fine, a regime, non scorre corrente su R

e la tensione sui condensatori è uguale

$$V_1 = V_2 \rightarrow \frac{Q_1}{C_1} = \frac{Q_2}{C_2} \quad \text{ma } Q_1 + Q_2 = Q_0$$

per cui $Q_1 = Q_0 - Q_2 \rightarrow \frac{Q_0 - Q_2}{C_1} = \frac{Q_2}{C_2}$

$$\frac{Q_0}{C_1} - \frac{Q_2}{C_1} = \frac{Q_2}{C_2} \rightarrow \frac{Q_0}{C_1} = \frac{Q_2}{C_1} + \frac{Q_2}{C_2} = Q_2\left(\frac{C_1 + C_2}{C_1 C_2}\right)$$

$$Q_2 = \frac{Q_0}{C_1 + C_2} \cdot C_2 \rightarrow Q_1 = \frac{Q_0}{C_1 + C_2} C_1$$

Energia dissipata su R è $U_i - U_f = \frac{1}{2}\frac{Q_0^2}{C_1} - \left(\frac{1}{2}\frac{Q_1^2}{C_1} + \frac{1}{2}\frac{Q_2^2}{C_2}\right) =$

$$U_R = U_{IN} - U_{FIN} = \frac{1}{2}\frac{Q_0^2}{C_1} - \frac{1}{2}\frac{Q_0^2 C_1^{\cancel{2}}}{(C_1 + C_2)^2 \cancel{C_1}} - \frac{1}{2}\frac{Q_0^2 C_2^{\cancel{2}}}{(C_1 + C_2)^2 \cancel{C_2}} =$$

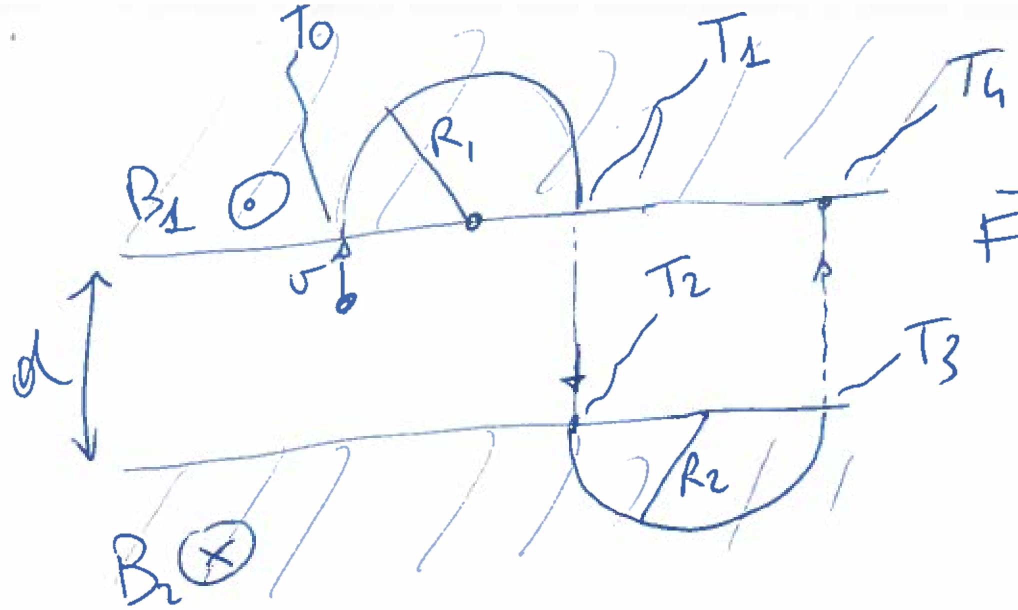
$$= \frac{1}{2} Q_0^2 \left[\frac{1}{C_1} - \frac{C_1}{(C_1 + C_2)^2} - \frac{C_2}{(C_1 + C_2)^2}\right] =$$

$$= \frac{1}{2} Q_0^2 \frac{(C_1 + C_2)^2 - C_1^2 - C_1 C_2}{C_1 (C_1 + C_2)^2} = \frac{1}{2} Q_0^2 \frac{\cancel{C_1^2} + C_2^2 + 2C_1C_2 - \cancel{C_1^2} - C_1C_2}{C_1 (C_1 + C_2)^2} =$$

$$= \frac{1}{2} Q_0^2 \frac{C_2^2 + C_1 C_2}{C_1 (C_1 + C_2)^2} = \frac{1}{2} Q_0^2 \frac{C_2 \cancel{(C_1 + C_2)}}{C_1 (C_1 + C_2)^{\cancel{2}}} =$$

$$= \frac{1}{2} Q_0^2 \frac{C_2}{C_1 (C_1 + C_2)}$$

3)



P. 4

$$\vec{F} = q\vec{v}\times\vec{B}$$

$$F_1 = qvB_1 = m a_{c_1} = m\frac{v^2}{R_1} \rightarrow R_1 = \frac{mv}{qB_1}$$

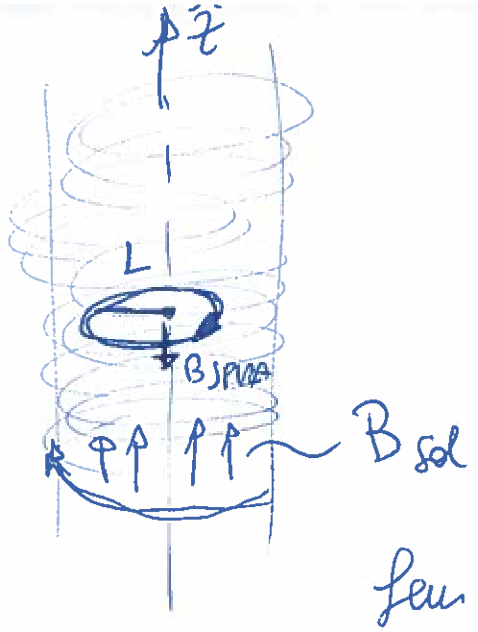
$$T_0 = 0 \qquad T_1 = \underset{0}{\underset{\shortparallel}{T_0}} + \frac{\cancel{2}\pi R_1}{\cancel{2}}\Big/v = \frac{\pi m \cancel{v}}{qB_1\cancel{v}} = \frac{\pi m}{qB_1}$$

$$T_2 = T_1 + \frac{d}{v} = \frac{\pi m}{qB_1} + \frac{d}{v}$$

$$T_3 = T_2 + \frac{\cancel{2}\pi R_2}{\cancel{2}}\Big/v = \frac{\pi m}{qB_1} + \frac{d}{v} + \frac{\pi m}{qB_2}$$

$$T_4 = T_3 + \frac{d}{v} = 2\frac{d}{v} + \frac{\pi m}{q}\left(\frac{1}{B_1} + \frac{1}{B_2}\right)$$

4)



$$\vec{B}_{sol} = B_{sol}\,\hat{z}$$

$$B_{sol} = \mu_0 n i(t) = \mu_0 n a t^3$$

$$\phi_{spira} = \pi L^2 B_{sol} = \pi L^2 \mu_0 n a t^3$$

$$fem_{spira} = -\frac{d\phi_{spira}}{dt} = -\pi L^2 \mu_0 n a 3 t^2$$

$$\underset{(t=t^*)}{i_{SPIRA}} = \frac{fem_{SPIRA}}{R} = -\frac{\pi L^2 \mu_0 n a 3 t^{*2}}{R}$$

in senso opposto alle correnti del solenoide

B_{SPIRA} è opposto a $B_{solenoide}$

$$\vec{B}_{SPIRA} = |B_{SPIRA}|(-\hat{z})$$

$$|B_{SPIRA}| = \left|\frac{\mu_0 i_{SPIRA}}{2L}\right| = \left|\frac{\mu_0^2 n \pi a L^{\cancel{2}} 3 t^{*2}}{2 \cancel{L} R}\right|$$

$$\vec{B}_{spira} = -\hat{z}\,\frac{\mu_0^2 \pi L n 3 a t^{*2}}{2R}$$

$$\vec{B}_{TOT} = \underset{(t=t^*)}{\vec{B}_{sol}} + \underset{(t=t^*)}{\vec{B}_{spira}} = \hat{z}\left(\mu_0 n a t^{*3} - \frac{\mu_0^2 \pi L n 3 a t^{*2}}{2R}\right) =$$

$$= \hat{z}\,\mu_0 n a t^{*2}\left(t^* - \frac{\mu_0 \pi L 3}{2R}\right)$$