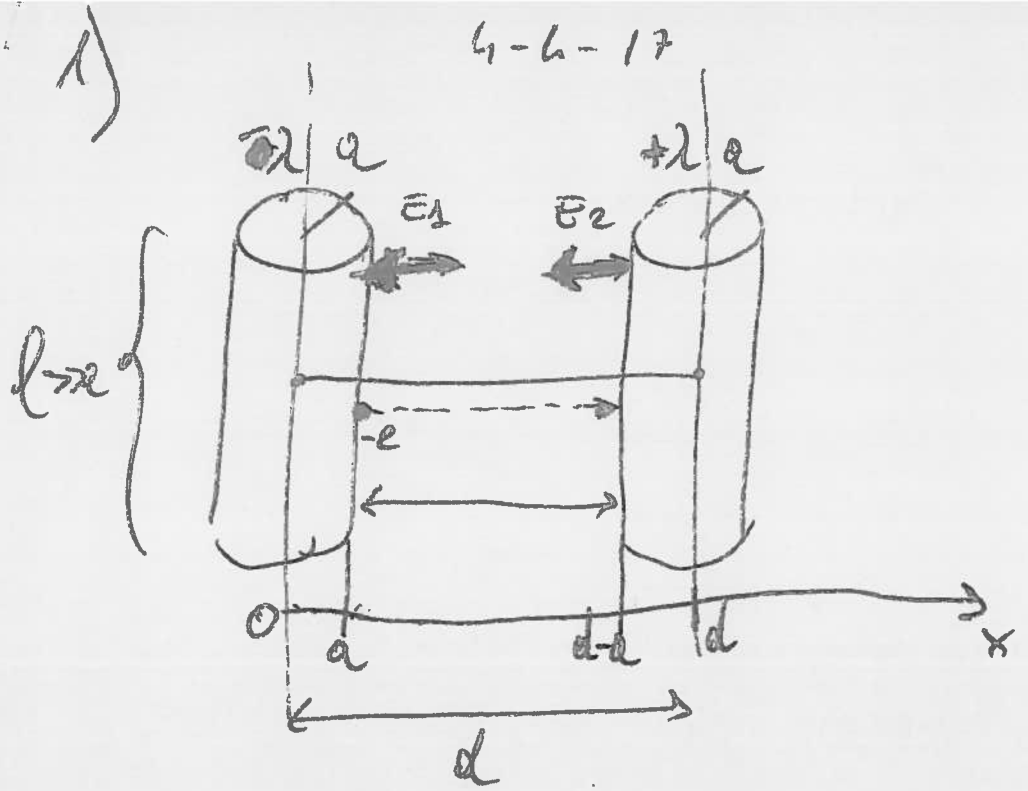
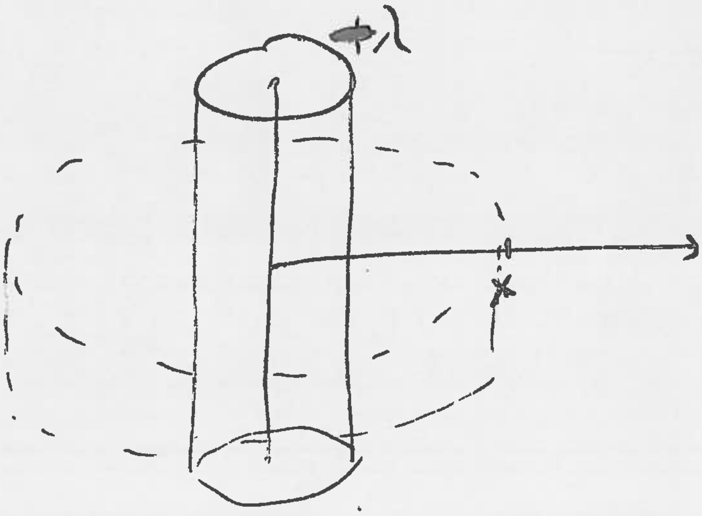
1) 4-4-17

P. 1



CONSIDERO UN SOLO CONDUTTORE E APPLICO GAUSS



$$\Phi(E) = \frac{q_{int}}{\varepsilon_0} = \frac{-\lambda l}{\varepsilon_0}$$

$$\downarrow$$

$$E(x) 2\pi x \cancel{l} = \frac{-\lambda \cancel{l}}{\varepsilon_0}$$

$$E(x) = \frac{-\lambda}{2\pi\varepsilon_0 x}$$

$$\Delta V = V(d-a) - V(a) = -\int_a^{d-a} E(x)\,dx =$$

$$= -\int_a^{d-a} \frac{-\lambda}{2\pi\varepsilon_0 x}\,dx = +\frac{\lambda}{2\pi\varepsilon_0}\int_a^{d-a}\frac{dx}{x} = +\frac{\lambda}{2\pi\varepsilon_0}\ln\frac{d-a}{a}$$

SE CONSIDERO ANCHE L'ALTRO CILINDRO, CHE AVRÀ UN CAMPO DIRETTO NELLA STESSA DIREZIONE E CON STRUTTURA SIMILE, DEVO CONSIDERARE UN'ALTRA ΔV UGUALE DA AGGIUNGERE

PER CUI SI AVRÀ

$$\Delta V_{TOT} = 2\Delta V = +\frac{2\lambda}{2\pi\varepsilon}\ln\frac{d-a}{a} = \frac{+\lambda}{\pi\varepsilon}\ln\frac{d-a}{a}$$

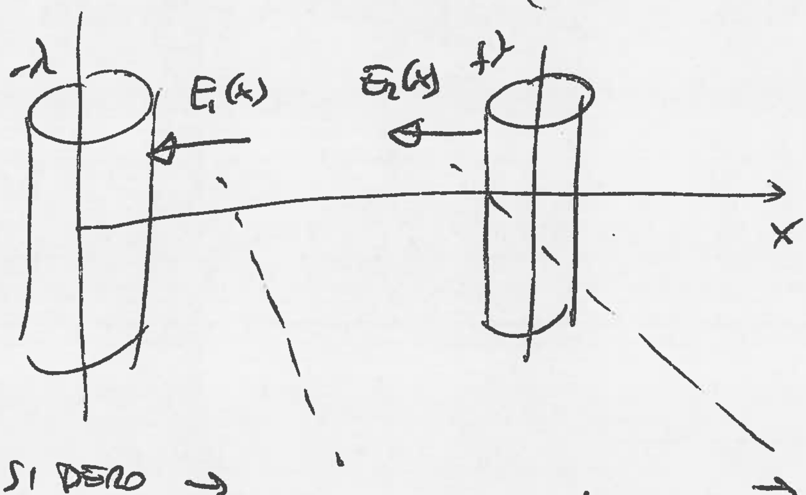
QUINDI

$$\frac{1}{2}m_e v_f^2 - \underbrace{\frac{1}{2}m_e v_i^2}_{0} = -\Delta U_{TOT} = -(-e)\Delta V_{TOT}$$

$$\frac{1}{2}m_e v_f^2 = +e\Delta V_{TOT} = +e\frac{\lambda}{\pi\varepsilon}\ln\frac{d-a}{a}$$

$$v_f = \sqrt{\frac{2e\lambda}{m_e\pi\varepsilon_0}\ln\frac{d-a}{a}}$$

OPPURE (CHE È LO STESSO)



CONSIDERO →

$$\vec{E}_1(x) = \frac{-\lambda}{2\pi\varepsilon_0 x}\hat{x} \qquad \vec{E}_2(x) = \frac{+\lambda}{2\pi\varepsilon(d-x)}(-\hat{x})$$

$$\vec{E}_{TOT} = \vec{E}_1(x) + \vec{E}_2(x) = \hat{x}\left[-\frac{\lambda}{2\pi\varepsilon x} - \frac{\lambda}{2\pi\varepsilon(d-x)}\right] =$$

$$= -\frac{\lambda}{2\pi\varepsilon}\hat{x}\left(\frac{1}{x} + \frac{1}{d-x}\right)$$

$$\Delta V_{TOT} = - \int_a^{d-a} E_{TOT}\, dx =$$

$$= + \frac{\lambda}{2\pi\varepsilon_0} \left[\int_a^{d-a} \frac{1}{x}\, dx + \int_a^{d-a} \frac{1}{d-x}\, dx \right] =$$

$$= \frac{\lambda}{2\pi\varepsilon_0} \left[\ln \frac{d-a}{a} - \ln \frac{d-(d-a)}{d-a} \right] =$$

$$= \frac{\lambda}{2\pi\varepsilon_0} \left[\ln \frac{d-a}{a} - \ln \frac{+a}{d-a} \right] =$$

$$= \frac{\lambda}{2\pi\varepsilon_0} \left[\ln \frac{d-a}{a} + \ln \frac{d-a}{a} \right] =$$

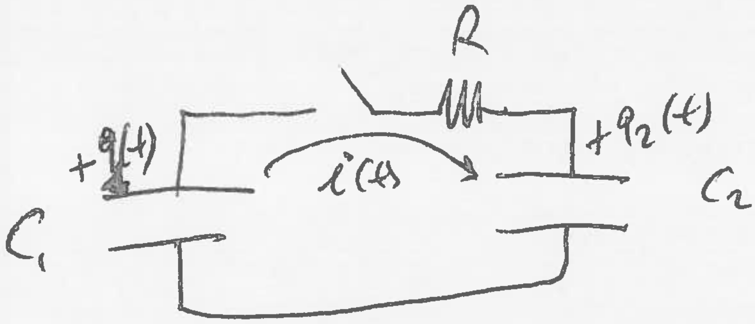
$$= \frac{\lambda}{2\pi\varepsilon_0} \left[2 \ln \frac{d-a}{a} \right] = \frac{\lambda}{\pi\varepsilon_0} \ln \frac{d-a}{a}$$

QUINDI $\frac{1}{2} m_e v_f^2 = -(-e)\Delta V_{TOT} = \frac{e\lambda}{\pi\varepsilon_0} \ln \frac{d-a}{a}$

$$\downarrow$$

$$v_f = \sqrt{\frac{2e\lambda}{m_e \pi \varepsilon_0} \ln \frac{d-a}{a}}$$

2)



SI HA SEMPRE $q_1(t) + q_2(t) = Q$

ALL'INIZIO $q_1(t=0) = Q \qquad q_2(t=0) = 0$

$$q_2(t) = Q - q_1(t)$$

MAGLIA :
$$V_{C_1}(t) - V_{C_2}(t) = R\, i(t)$$

$$\begin{cases} \dfrac{q_1(t)}{C_1} - \dfrac{(Q - q_1(t))}{C_2} = R\, i(t) \\ i(t) = -\dfrac{d q_1(t)}{dt} \end{cases} ; \quad C_1 = C_2 = C$$

$$\frac{q_1(t)}{C} - \frac{Q - q_1(t)}{C} = -R \frac{d q_1(t)}{dt}$$

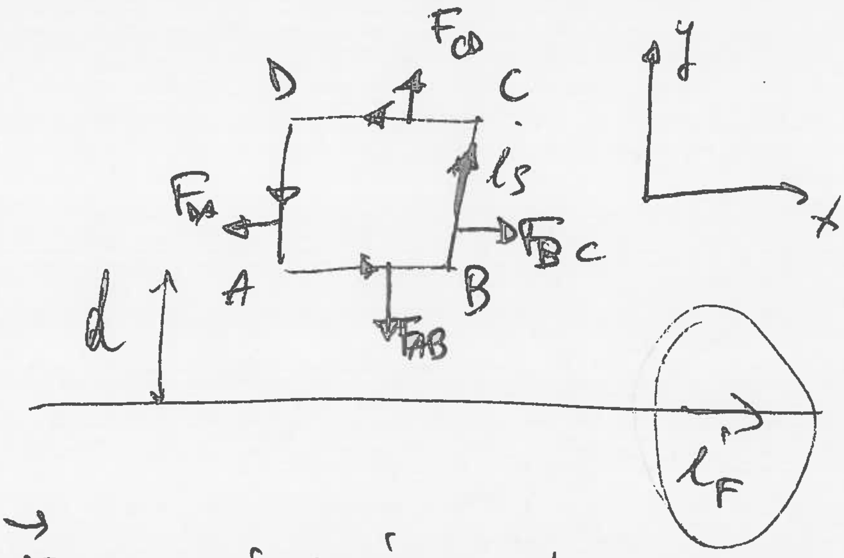
$$q_1(t) - Q + q_1(t) = -RC \frac{d q_1(t)}{dt} = 2 q_1(t) - Q$$

$$q_1(t) - Q/2 = -\frac{RC}{2} \frac{d q_1(t)}{dt} \rightarrow -\frac{2}{RC}\int_0^{t^*} dt = \int_Q^{q^*} \frac{d q_1(t)}{q_1(t) - Q/2}$$

$$-\frac{2}{RC} t^* = -\ln \frac{Q - Q/2}{q^* - Q/2} = -\ln \frac{Q - Q/2}{\frac{3}{4}Q - Q/2} = -\ln \frac{Q/2}{Q/4} = -\ln 2$$

DA CUI $t^* = \dfrac{RC}{2} \ln 2 \qquad \left(q^* = \dfrac{3}{4} Q\right)$

3)



← PRODUCE UN CAMPO $B(r)$ =

$$B(r) = \frac{\mu_0 i_F}{2\pi r}$$

$$\vec{F}_{AB} = \frac{i_S \mu_0 i_F L}{2\pi d}(-\hat{y})$$

$$\vec{F}_{CD} = \frac{i_S \mu_0 i_F L}{2\pi (d+L)}(+\hat{y})$$

$$\vec{F}_{BC} = -\vec{F}_{DA}$$

$$\vec{F}_{TOT} = \vec{F}_{AB} + \vec{F}_{CD} = \frac{i_S i_F \mu_0 L}{2\pi}\left(\frac{1}{d+L} - \frac{1}{d}\right)\hat{y}$$

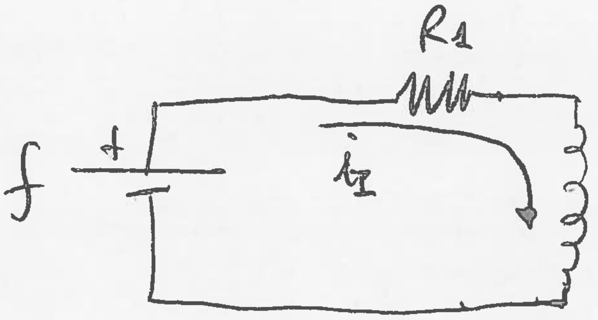
$$\vec{F}_{TOT} = -\hat{y}\,\frac{\mu_0 i_S i_F L}{2\pi}\left(\frac{1}{d} - \frac{1}{d+L}\right)$$

$$W = \int_d^{d/2} \vec{F}\cdot d\vec{s} = \int_d^{d/2} \frac{\mu_0 i_S i_F L}{2\pi}\left(\frac{1}{x} - \frac{1}{x+L}\right)dx =$$

$$= \frac{\mu_0 i_S i_F L}{2\pi}\left[\ln\frac{d/2}{d} - \ln\frac{\frac{d}{2}+L}{d+L}\right]$$

4)

ALL'INIZIO, A REGIME SI HA CHE L_1 SI COMPORTA COME UN CORTO CIRCUITO ($\Delta V_{L_1} = 0$)



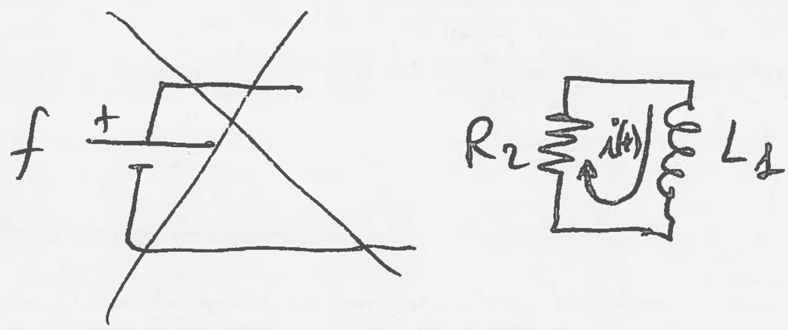
INFATTI $\Delta V_{L_1} = -L_1 \frac{di}{dt} = 0$

PERCHÈ A REGIME i NON VARIA

PER CUI LA CORRENTE NON PASSA PER R_2

$$i_I = \frac{f}{R_1}$$

POI DOPO L'APERTURA DELL'INTERRUTTORE SI HA:



LA CORRENTE $i(t)$ DIMINUISCE DAL VALORE INIZIALE i_I FINO A ZERO CON ANDAMENTO ESPONENZIALE

$$i(t) = i_I e^{-\frac{t}{\tau}} \quad \text{CON } \tau = \frac{L_1}{R_2}$$

$$i(t^*) = i_1 = i_I e^{-\frac{t_1}{\tau}} = \frac{f}{R_1} e^{-\frac{t_1 R_2}{L_1}} \rightarrow L_1 = +R_2 t_1 \ln\left(\frac{i_I}{i_1}\right)$$

$$L_1 = +R_2 t_1 \ln\left(\frac{f}{R_1 i_1}\right)$$