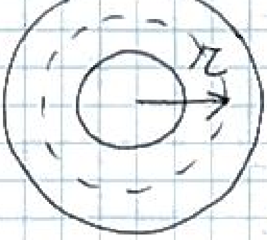
Soluzioni

(1)



$$\Phi_S(\vec{D}) = Q \Rightarrow 2\pi r \ell D = Q$$

$$D = \frac{Q}{2\pi \ell r}$$

$$\Delta V = \int_a^{2a} E\,dr = \int_a^{2a} \frac{D}{\varepsilon}\,dr = \frac{Q}{2\pi\varepsilon\ell}\int_a^{2a}\frac{dr}{r} \doteq$$

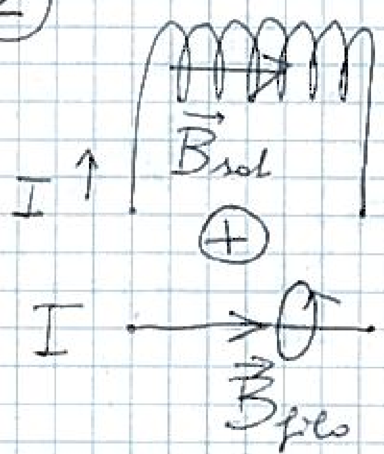
$$\doteq \frac{Q}{2\pi\varepsilon\ell}\ln 2 = 1,6\,kV$$

$$Q_{est} = 2\pi(2a)\ell\,\sigma_p$$

$$\sigma_p = P = D\,\frac{\varepsilon_r - 1}{\varepsilon_r} = \frac{Q}{2\pi\ell(2a)}\left(1 - \frac{1}{\varepsilon_r}\right)$$

$$Q_{est} = Q\left(1 - \frac{1}{\varepsilon_r}\right) = 0,5\,\mu C$$

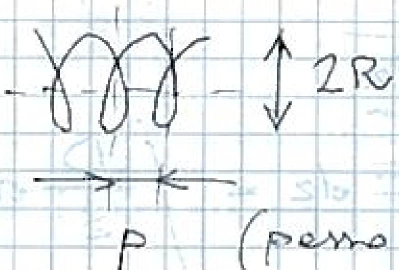
(2)



$$B_{sol} = \mu_0 n I$$

$$B_{filo} = \frac{\mu_0 I}{2\pi R}$$

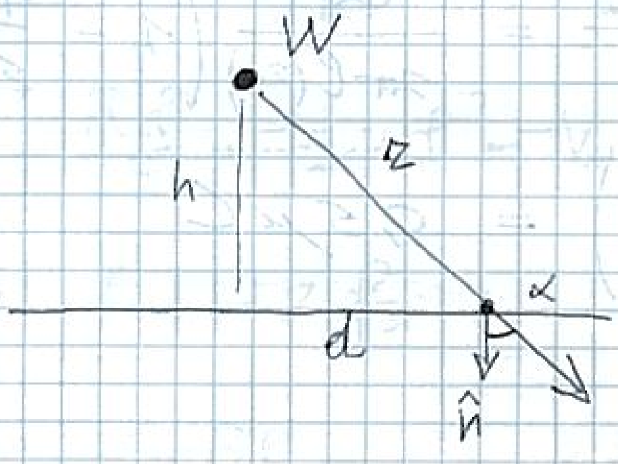
$\vec{B}_{sol} + \vec{B}_{filo}$:



(passo dell'elica)

$$\frac{B_{sol}}{B_{filo}} = \frac{p}{2\pi R} \Rightarrow p = 2\pi R \frac{B_{sol}}{B_{filo}} = 4\pi^2 n R^2$$

(5)



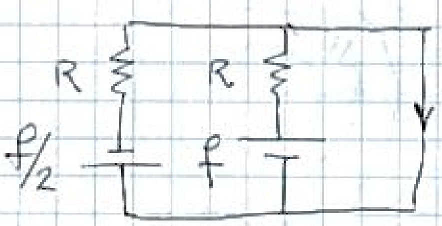
$\vec{I}$ (Vettore di Poynting)

$$\vec{I} \cdot d\vec{S} = dW \Rightarrow \frac{dW}{dS} = I \cos\alpha = \frac{W}{2\pi r \ell} \cdot \frac{h}{r}$$

$$\Rightarrow \frac{dW}{dS} = \frac{W h}{2\pi \ell (h^2 + d^2)}$$

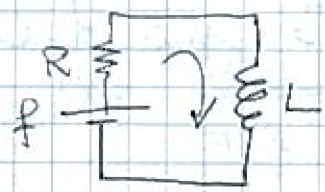
(3)

$t < 0$



$$I_0 = \frac{-\frac{1}{2}f}{R} + \frac{f}{R} = \frac{f}{2R}$$

$t \geqslant 0$



$$f - L\frac{dI}{dt} = RI$$

$$\Downarrow$$

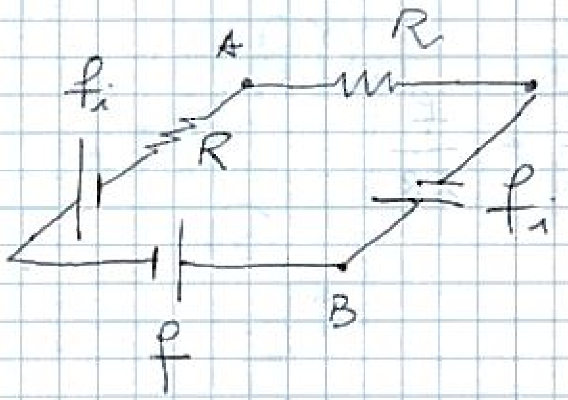
$$\frac{-dI}{\frac{f}{R} - I} = -\frac{dt}{L/R}$$

$$\Downarrow$$

$$\frac{f}{R} - I = K e^{-t/\tau} \qquad \begin{cases} \tau = \dfrac{L}{R} \\ K = \dfrac{f}{R} - I_0 \end{cases}$$

$$I(t) = \frac{f}{R} - \left(\frac{f}{R} - \frac{f}{2R}\right)e^{-t/\tau} = \frac{f}{R}\left(1 - \frac{1}{2}e^{-t/\tau}\right)$$

(4)



Forze di Lorentz $\longrightarrow$ f_i soltanto sui due lati ortogonali a $\vec{v}$.

$$f_i = \frac{qvB}{q}\ell = vB\ell$$

equazione alla maglia:

$$V_A - RI + f_1 + f = V_B$$

$$I = \frac{f_i + f - f_1}{2R} = \frac{f}{2R}$$

$$V_A - \frac{Rf}{2R} + f_1 + f = V_A + \frac{f}{2} + f_1 = V_B$$

$$\Rightarrow f = -2f_1$$

$$f = -2vB\ell = -2 \cdot 0{,}1 \cdot 1 \cdot 0{,}01 = -2\,mV$$