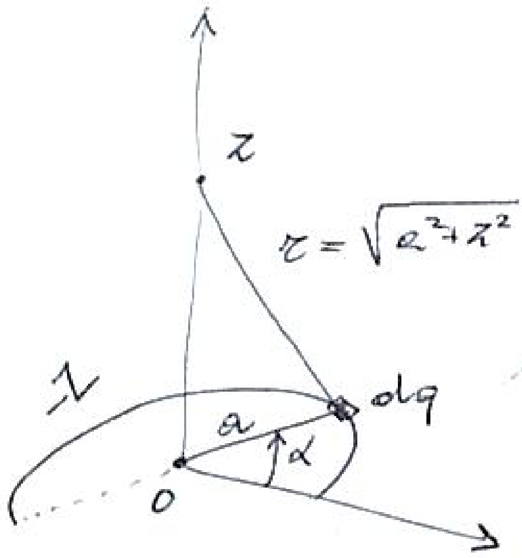
# Soluzioni

①




$$dV = \frac{1}{4\pi\varepsilon_0}\frac{dq}{r} = \frac{\lambda_0 a \sin(\alpha) d\alpha}{4\pi\varepsilon_0 r}$$

$$V = \frac{\lambda_0 a}{4\pi\varepsilon_0 r}\int_0^{3\pi/2} \sin\alpha \, d\alpha = \frac{\lambda_0 a}{4\pi\varepsilon_0 r}$$

$$E_z = -\frac{\partial V}{\partial z} = -\frac{\partial}{\partial z}\left(\frac{\lambda_0 a}{4\pi\varepsilon_0}\frac{1}{\sqrt{z^2+a^2}}\right) \Rightarrow$$

$$E_z = \frac{\lambda_0 a z}{4\pi\varepsilon_0 (a^2+z^2)^{3/2}}$$

②

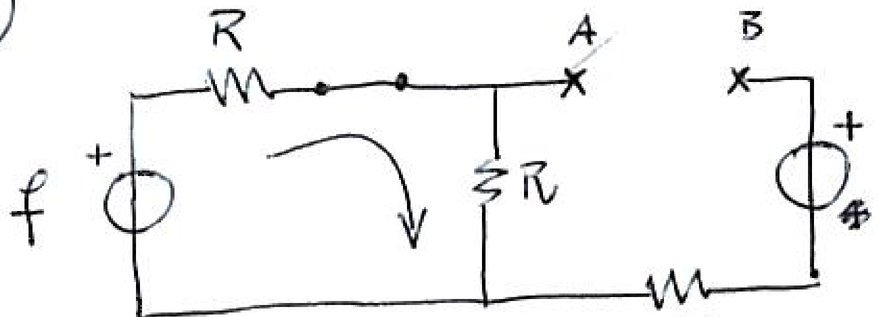
$$U_E = \frac{1}{2}C\Delta V^2 = \frac{1}{2}\varepsilon_0\frac{a\ell}{d}R^2 I^2$$

$$U_M = \frac{1}{2}I\Phi = \frac{1}{2}IBS = \frac{1}{2}I\mu_0 J_s \ell d$$

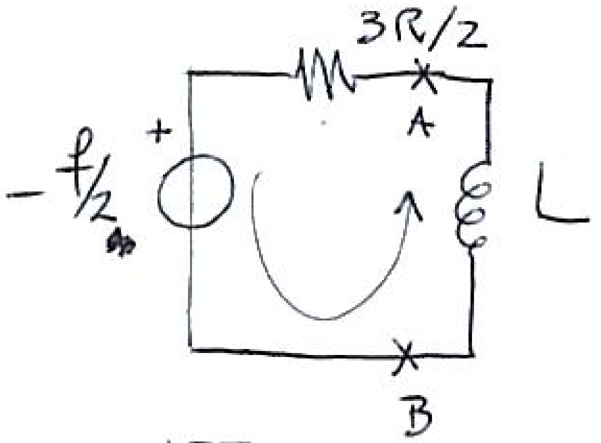
$$U_M = \frac{1}{2}\mu_0 \frac{\ell d}{a} I^2$$

$$\Rightarrow \frac{U_E}{U_M} = \frac{\varepsilon_0}{\mu_0} R^2 \left(\frac{a}{d}\right)^2 = \left(\frac{R}{Z_0}\right)^2 \left(\frac{a}{d}\right)^2 \simeq 10^4$$

③




$$\begin{cases} f_{eq} = \Delta V_{AB} = \cancel{R}\frac{f}{2\cancel{R}} - f = -\frac{f}{2} \\ R_{eq} = \frac{R}{2} + R = \frac{3}{2}R \end{cases}$$




$$\frac{f}{2} - L\frac{dI}{dt} = \frac{3}{2}RI$$

$$\frac{f}{3R} - \frac{2L/3R}{dt}dI = I$$

$$\left(\frac{f}{3R} - I\right) = \frac{2L/3R}{dt}\, dI$$

$$\left(I - \frac{f}{3R}\right) = -\frac{2L/3R}{dt}\, dI$$

$$\frac{d\left(I - \frac{f}{3R}\right)}{\left(I - \frac{f}{3R}\right)} = -\frac{dt}{2L/3R}$$

$$I(t) - \frac{f}{3R} = \left[I(0) - \frac{f}{3R}\right] e^{-t/\tau}$$

$$\begin{cases} \tau = \dfrac{2L}{3R} \\ I(0) = \dfrac{f}{2R} \end{cases}$$

$$I(t) = \frac{f}{3R} + \left(\frac{f}{2R} - \frac{f}{3R}\right) e^{-t/\tau} =$$

$$= \frac{f}{3R} + \frac{f}{6R} e^{-t/\tau} = \frac{f}{3R}\left(1 - \frac{1}{2} e^{-t/\tau}\right)$$

④ $\vec{F}_L = q\vec{v} \times \vec{B} = q\omega B\vec{r} = q\vec{E}_L$

$$\vec{E}_s = -\vec{E}_L = -\omega B\vec{r}$$

$$\Phi_{cil}(\vec{E}_s) = \frac{Q_{cil}}{\varepsilon_0} \quad (\text{Gauss})$$

$$\Phi_{cil}(\vec{E}_s) = -2\pi\omega B a^2 h$$

$$Q_{cil} = -2\pi\varepsilon_0\omega a^2 h B$$

⑤ $I = \dfrac{6}{1 \cdot 10^{-4} \cdot 60} = 1\,\dfrac{kW}{m^2}$

$$E_0 = \sqrt{2Z_0 I} \mathrel{\hat{=}} 868\ V/m$$

$$B_0 = \frac{E_0}{c} \mathrel{\hat{=}} 2.9 \cdot 10^{-6}\ \frac{Wb}{m^2}$$