Soluzioni

1) $$\rho_{el} = \begin{cases} -\dfrac{Ze}{\frac{4}{3}\pi R^3} & , r \leq R \\ 0 & , r > R \end{cases}$$

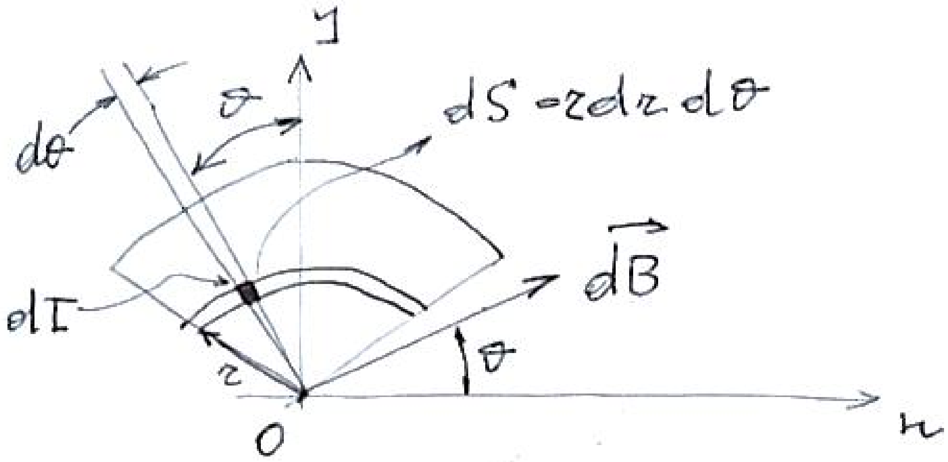
$$\int_{sfera} \vec{E} \cdot d\vec{S} = \frac{Q_{int}}{\varepsilon_0}$$

$$\int_{sfera} \vec{E} \cdot d\vec{S} = 4\pi r^2 E$$

$$Q_{int} = \begin{cases} Ze\left[1 - \left(\dfrac{r}{R}\right)^3\right] & , r \leq R \\ 0 & , r > R \end{cases}$$

$$\vec{E} = \begin{cases} \dfrac{Ze}{4\pi\varepsilon_0}\left(\dfrac{1}{r^2} - \dfrac{r}{R^3}\right)\hat{r} & , r \leq R \\ 0 & , r > R \end{cases}$$

2)



$$dI = J\,dS = J\,r\,d\theta\,dr \quad ; \quad J = \frac{I}{S} \quad ; \quad S = \frac{\alpha}{2}R^2 \,;$$

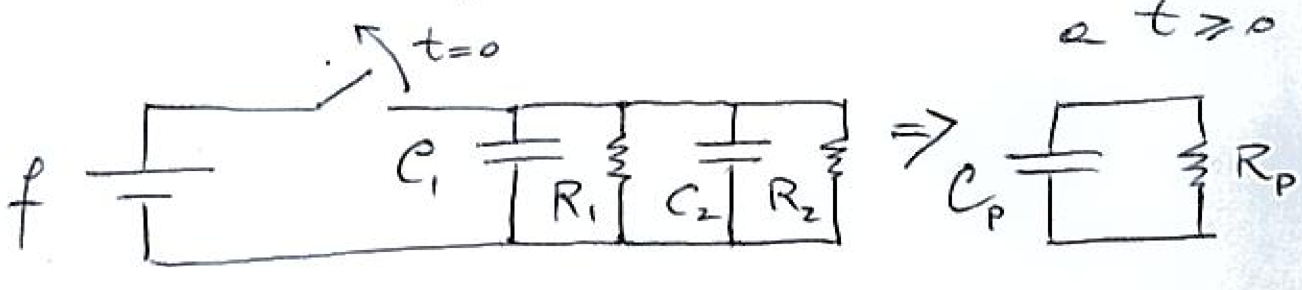
Per simmetria $B_y = 0$, $\vec{B} = B_x \hat{x}$;

$$dB_x = dB\cos\theta = \frac{\mu_0\,dI}{2\pi r}\cos\theta = \frac{\mu_0 I}{\pi\alpha R^2}\cos\theta\,d\theta\,dr$$

$$dB_x = \frac{\mu_0 I}{\pi\alpha R^2}\,dr\int_{-\alpha/2}^{\alpha/2}\cos\theta\,d\theta = \frac{2\mu_0 I}{\pi\alpha R^2}\,\mathrm{sen}\left(\frac{\alpha}{2}\right)dr$$

$$B_x = \int_0^R dB_x = \frac{2\mu_0 I}{\pi\alpha R^{\cancel{2}}}\,\mathrm{sen}\left(\frac{\alpha}{2}\right)\cancel{R}$$

3) Circuito equivalente:



$$Q(t) = Q(0)\,e^{-t/\tau}$$

$$Q(0) = C_P \cdot f = (C_1 + C_2) f =$$

$$= \left(\varepsilon_0 \frac{S/2}{d} \varepsilon_{r1} + \varepsilon_0 \frac{S/2}{d} \varepsilon_{r2} \right) f =$$

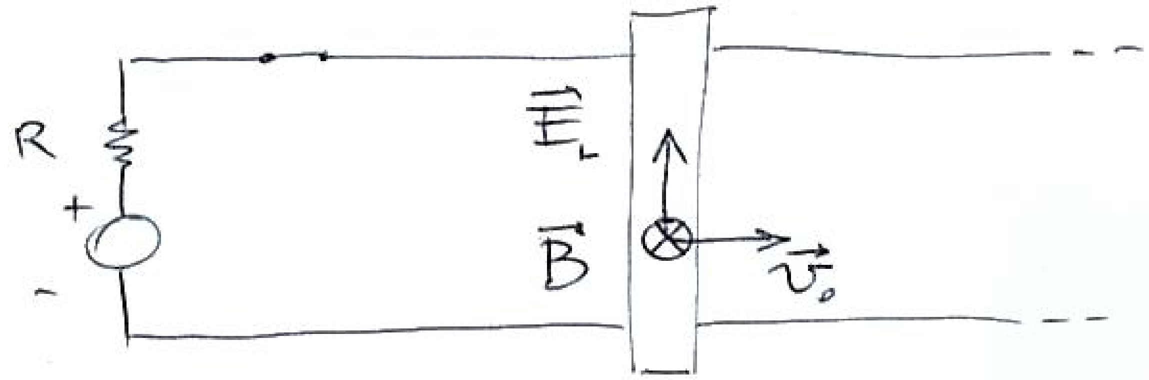
$$= \varepsilon_0 \frac{S}{2d} (\varepsilon_{r1} + \varepsilon_{r2}) f$$

$$\tau = (C_1 + C_2) \cdot \left(\frac{R_1 R_2}{R_1 + R_2} \right) = (\varepsilon_1 + \varepsilon_2) \frac{\rho_1 \rho_2}{\rho_1 + \rho_2} .$$

4) A regime $\vec{v}_{barretta} = \vec{v}_0 =$ "costante"

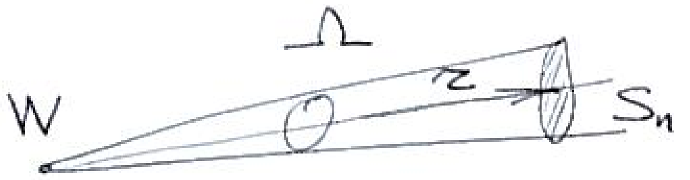
$\Rightarrow \sum \vec{F} = 0$ Le cariche della barretta non subiscono forze.

La corrente nel circuito (corrente indotta) è nulla.



$$f_L = v_0 B \ell = f. \Rightarrow v_0 = \frac{f}{B\ell}$$

5) $I = \frac{E_{eff}^2}{Z_0}$ $\quad \Omega = \frac{S_n}{r^2}$



$$I = \frac{W}{S_n} = \frac{W}{\Omega r^2}$$

$$E_{eff} = \sqrt{\frac{Z_0 W}{r^2 \Omega}} = \frac{1}{r}\sqrt{\frac{Z_0 W}{\Omega}} = 10^{-4} \cdot \sqrt{\frac{377 \cdot 10^4}{10^{-2}}} \ \frac{V}{m}$$

$$E_{eff} = 1.94 \ \frac{V}{m}$$

$$B_{eff} = E_{eff}/c = \frac{1.94}{3} 10^{-8} \, T = 0,65 \, T$$