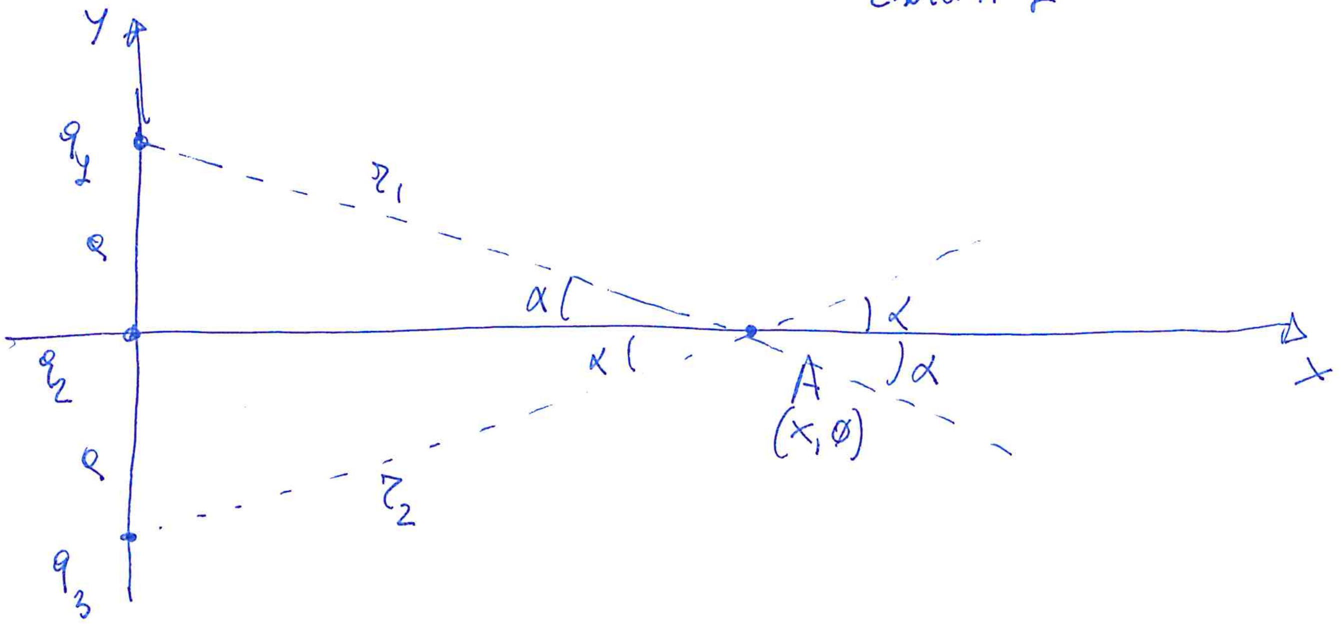


$q_1 = q_2 = q$

$$E_1\Big|_A = \frac{1}{4\pi\varepsilon_0} \frac{q}{r_1^2} \qquad \left(r_1^2 = \ell^2 + x^2 \right)$$

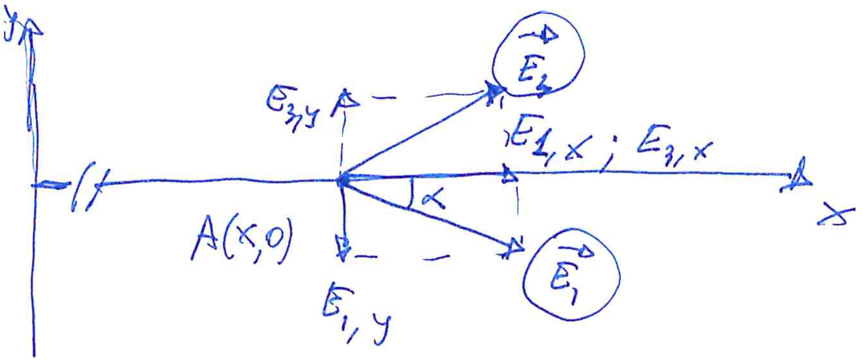
$$E_2\Big|_A = \frac{1}{4\pi\varepsilon_0} \frac{q}{\cancel{x}^2} \qquad \left(r_2 = x \right)$$

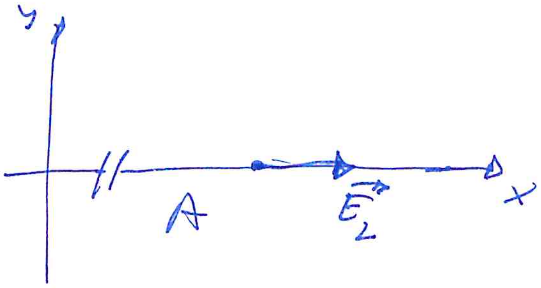
$$E_3\Big|_A = \frac{1}{4\pi\varepsilon_0} \frac{q}{r_3^2} \qquad \left(r_3^2 = \ell^2 + x^2 \right)$$

$$E_1\Big|_A = \frac{1}{4\pi\varepsilon_0} \frac{q}{\ell^2 + x^2}$$

$$E_2\Big|_A = \frac{1}{4\pi\varepsilon} \frac{q}{x^2}$$

$$E_3\Big|_A = \frac{1}{4\pi\varepsilon_0} \frac{q}{\ell^2 + x^2}$$





$$\begin{cases} E_{1,x}\big|_A = E_1 \cos\alpha \\ E_{1,y}\big|_A = -E_1 \sin\alpha \end{cases}$$

$$\begin{cases} E_{2,x}\big|_A = E_2 \\ E_{2,y}\big|_A = \varnothing \end{cases}$$

$$\begin{cases} E_{3,x}\big|_A = E_3 \cos\alpha \\ E_{3,y}\big|_A = E_3 \sin\alpha \end{cases}$$

$$\Rightarrow \quad \vec{E}_{TOT}\big|_A = \vec{E}_1\big|_A + \vec{E}_2\big|_A + \vec{E}_3\big|_A$$

$$\Rightarrow \quad E_x^{(TOT)}\big|_A = E_1\big|_A \cos\alpha\big|_A + E_3 \cos\alpha\big|_A + E_2\big|_A$$

$$\cos\alpha = \frac{x}{\sqrt{\ell^2 + x^2}} \qquad \operatorname{sen}\alpha = \frac{\ell}{\sqrt{\ell^2 + x^2}}$$

$$\begin{cases} E_{1,x} = \dfrac{1}{4\pi\varepsilon} \dfrac{q\,x}{(\ell^2 + x^2)^{3/2}} \\[2ex] E_{1,y} = -\dfrac{1}{4\pi\varepsilon} \dfrac{q\,\ell}{(\ell^2 + x^2)^{3/2}} \end{cases}$$

$$\begin{cases} E_{2,x} = \dfrac{1}{4\pi\varepsilon} \dfrac{q}{x^2} \\[2ex] E_{2,y} = \emptyset \end{cases}$$

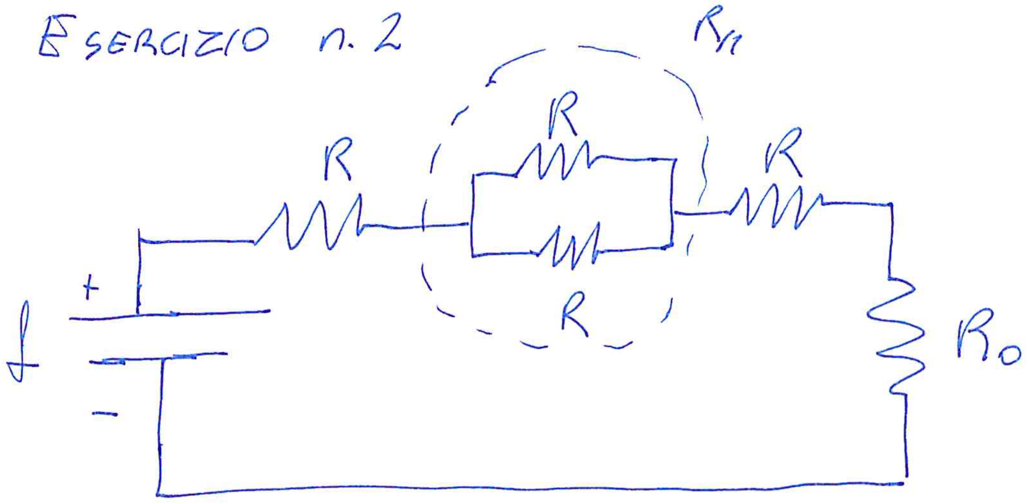
$$\begin{cases} E_{3,x} = \dfrac{1}{4\pi\varepsilon} \dfrac{q\,x}{(\ell^2 + x^2)^{3/2}} \\[2ex] E_{3,y} = \dfrac{1}{4\pi\varepsilon} \dfrac{q\,\ell}{(\ell^2 + x^2)^{3/2}} \end{cases}$$

$$\begin{cases} E_x^{TOT} = \dfrac{q}{4\pi\varepsilon} \left[\dfrac{2 \cdot x}{(\ell^2 + x^2)^{3/2}} + \dfrac{1}{x^2} \right] \\[2ex] E_y^{TOT} = \emptyset \end{cases}$$

$$E_x^{TOT} = \frac{q}{4\pi\varepsilon}\left[\frac{2x}{\left[x^2\left(\frac{\ell^2}{x^2}+1\right)\right]^{3/2}} + \frac{1}{x^2}\right] \longrightarrow \frac{q}{4\pi\varepsilon}\left[\frac{2x}{x^3} + \frac{1}{x^2}\right]$$

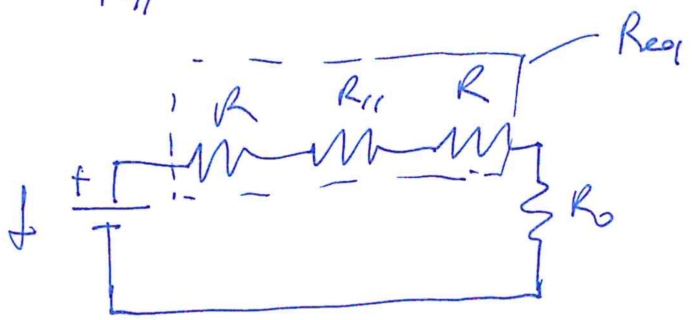
$$E_x^{(TOT)} \xrightarrow[\frac{\ell}{x} \ll 1]{} \frac{3q}{4\pi\varepsilon x^2}$$

ESERCIZIO n. 2

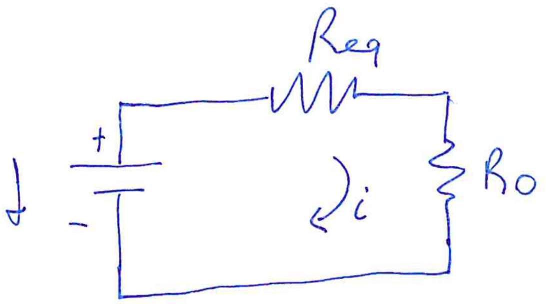


Il circuito può essere ridotto nel seguente circuito equivalente:

$$\frac{1}{R_{//}} = \frac{1}{R} + \frac{1}{R}$$



$$R_{eq} = R + R_{//} + R$$

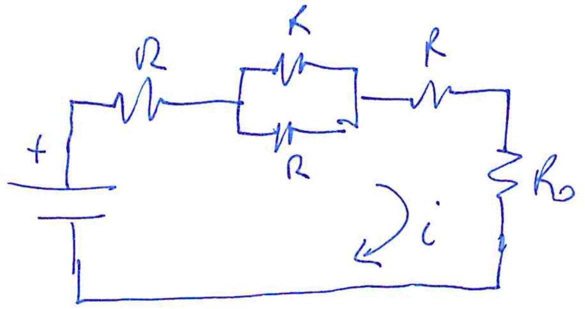


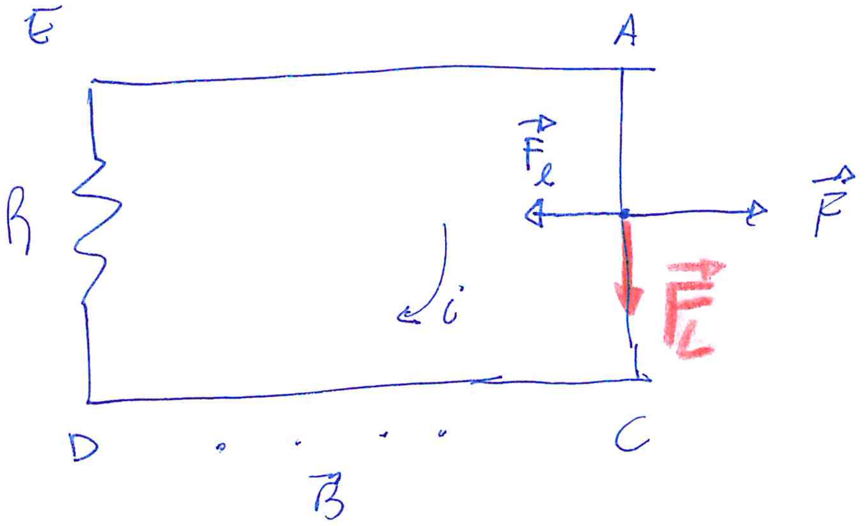
$$R_{eq} = R + \frac{R}{2} + R = \frac{5}{2} R$$

$$f - i R_{eq} - i R_0 = 0 \quad \Rightarrow \quad i = \frac{f}{R_{eq} + R_0}$$

$$i = \frac{f}{\frac{5}{2}R + R_0} \qquad i = 50\,mA$$

Il verso di percorrenza della corrente è orario





Il moto di AC in presenza di $\vec{B}$ genera una fem indotta e quindi una corrente (i) nel circuito.

$$fem = \oint \vec{E}\, d\vec{s} = \oint \frac{\vec{F}_L}{q}\, d\vec{s}$$

$$\vec{F}_L = q\,\vec{v} \wedge \vec{B} \Rightarrow F_L = qvB$$

$\vec{F}_L$ è diretta come in figura

(Percorriamo la circuitazione di $\oint \vec{E}\, d\vec{s}$ come il verso ~~direzione~~ di $\vec{F}_L$)

$$fem = \oint \frac{\vec{F}_L}{q} d\vec{s} = v h B$$

$$\Rightarrow \quad i = \frac{fem}{R} = \frac{v h B}{R}$$

i percorre il circuito in senso orario

La presenza di i genera una forza magnetica su AC:

$\vec{F}_e = i \vec{h} \wedge \vec{B}$ con $\vec{h}$ diretto come $\vec{F}_L$.

$F_e = i h B$ diretta come in figura

$$F_e = \frac{v h^2 B^2}{R}$$

quindi per il II p. di dinamica:

$$m \frac{dv}{dt} = F - F_e$$

nel caso limite $\frac{dv}{dt} = 0 \Rightarrow F - \frac{v_{eq} h^2 B^2}{R} = 0$

$$\Rightarrow \quad v_{eq} = \frac{F \cdot R}{h^2 B^2}$$

$$\Rightarrow \quad i_{eq} = \frac{v_{eq}\, hB}{R} = \frac{FR}{h^2B^2}\,\frac{hB}{R} = \frac{F}{hB}$$

$$fem_{eq} = \frac{FR}{hB}$$

$$v_{eq} = \frac{1N \cdot 10\Omega}{(0{,}1\ m)^2 \cdot \left(5\ \frac{Wb}{m^2}\right)^2} = 40\ m/s$$

$$i_{eq} = 2\ A$$

$$fem_{eq} = 20\ V$$

Alternativamente $\quad fem = -\frac{d}{dt}\phi(B) = v\,hB$