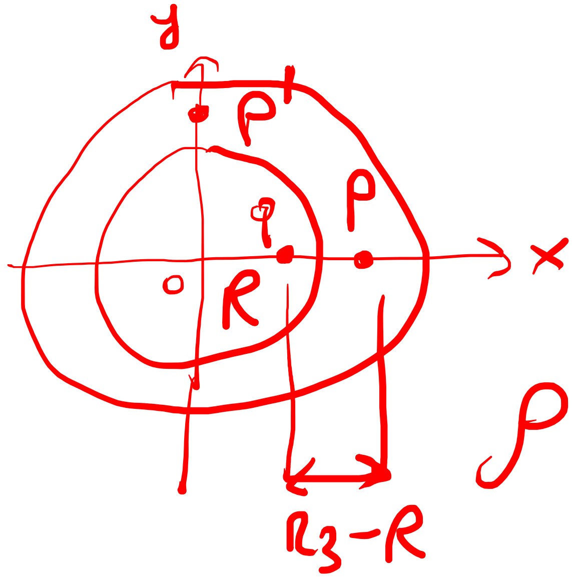
01-07-2021

1)



$$R_3 = \frac{R_1 + R_2}{2}$$

$$\rho = \frac{Q}{\frac{4}{3}\pi\left(R_2^3 - R_1^3\right)}$$

$$\vec{E}(P) = \vec{E}_q(P) + \vec{E}_Q(P) = 0$$

proiettato lungo x

$$E_q(P) = \frac{q}{4\pi\varepsilon_0 (R_3 - R)^2}$$

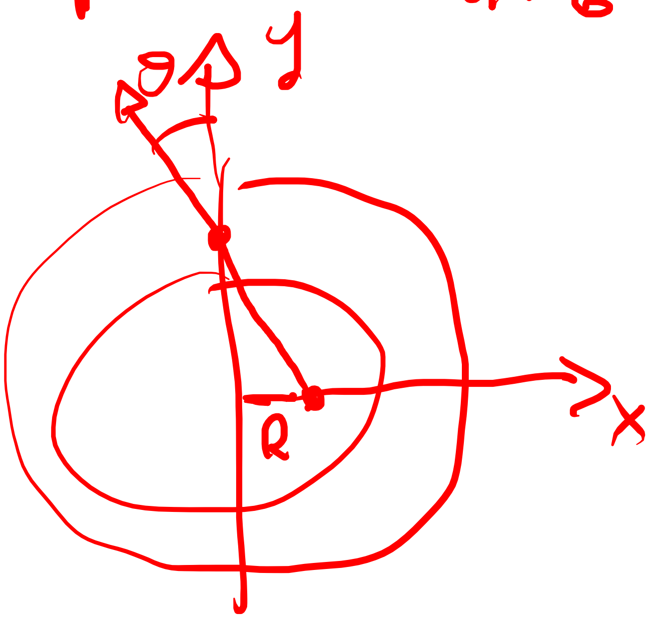
$$E_Q(P) = \frac{\rho \cdot \frac{4}{3}\pi\left(R_3^3 - R_1^3\right)}{4\pi\varepsilon_0 R_3^2}$$

$$q = -\left(\frac{R_3 - R}{R_3}\right)^2 Q \, \frac{\left(R_3^3 - R_1^3\right)}{\left(R_2^3 - R_1^3\right)}$$

quindi q ha segno opposto a Q | P. 2

in P' $\vec{E}(P') = \vec{E}_q(P') + \vec{E}_Q(P')$

$$E_q(P') = \frac{q}{4\pi\varepsilon(R^2 + r_3^2)}$$



$$E_q(P')_x = -E_q(P')\,\mathrm{sen}\,\theta$$

$$= -E_q(P')\frac{R}{\sqrt{R^2 + r_3^2}}$$

$$E_q(P')_y = E_q(P')\cos\theta = \qquad \underline{|P3}$$

$$= E_q(P')\frac{r_3}{\sqrt{R^2+r_3^2}}$$

$$\vec{E}_Q(P') = \hat{y}\, E_Q(P')$$

$$E_Q(P') = \frac{\rho\frac{4}{3}\pi(r_3^3-r_1^3)}{4\pi\varepsilon\; r_3^2}$$

$$\vec{E}(P') = \frac{1}{4\pi\varepsilon}\left\{\hat{x}\;\frac{qR}{(R^2+r_3^2)^{\frac{3}{2}}} + \hat{y}\left[\frac{q r_3}{(R^2+r_3^2)^{\frac{3}{2}}} + \frac{Q(r_3^3-r_1^3)}{(r_2^3-r_1^3)\,r_3^2}\right]\right\}$$

P.4

2) $C_{eq} = \frac{1}{1/C_1 + 1/C_2} = \frac{C_1 C_2}{C_1 + C_2}$

$\tau = C_{eq} R$

$Q(t^*) = f C_{eq}\left[1 - e^{-t^*/\tau}\right]$

$Q_1(t^*) = Q_2(t^*) = Q(t^*)$

$V_1(t^*) = \frac{Q_1(t^*)}{C_1} = \frac{f C_{eq}}{C_1}\left[1 - e^{-t^*/\tau}\right]$

$V_1(t^*) = \frac{f C_2}{C_1 + C_2}\left[1 - e^{-t^*/\tau}\right]$

$E_R = \int_0^{t^*} R i^2(t)\, dt$

$$i(t) = \frac{f}{R} e^{-\frac{t}{\tau}}$$ P.S

$$E_R = \int_0^{t^*} \cancel{R} \frac{f^2}{R^{\cancel{2}}} e^{-\frac{2t}{\tau}} dt$$

$$= \frac{f^2}{\cancel{R}} \left(-\frac{\cancel{R} C_{eq}}{2}\right)\left[e^{-\frac{2t^*}{\tau}} - 1\right] =$$

$$= \frac{1}{2} C_{eq} f^2 \left[1 - e^{-\frac{2t^*}{\tau}}\right]$$

3) il cilindro che gira è come se avesse una corrente $i = \frac{Q}{T}$ su tutta la superficie

con $T = \frac{2\pi}{\omega}$ e $Q = \sigma 2\pi R L$

con L = lunghezza cilindro

Supponendo di dividere il cilindro in N fette con N grande

è come se ogni fetta di spessore $s = \frac{L}{N}$ avesse una corrente di (corrente di una spira)

$$i_s = \frac{i}{N} = \frac{\sigma \cdot \cancel{2\pi} R L \omega}{\cancel{2\pi} N} = \frac{\sigma \omega R L}{N}$$

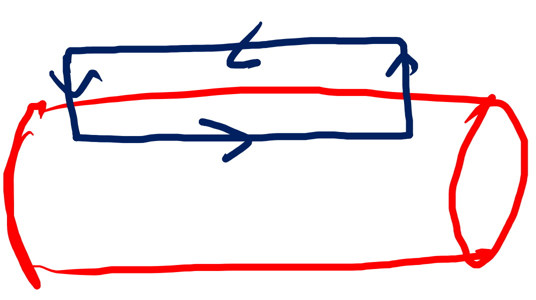
P.7

il numero di spire per unità di lunghezza $n = \frac{N}{L}$

per cui $B = \mu_0 n i_s =$

$$= \mu_0 \frac{\cancel{N}}{\cancel{L}} \sigma \omega R \frac{\cancel{L}}{\cancel{N}} = \mu_0 \sigma \omega R$$

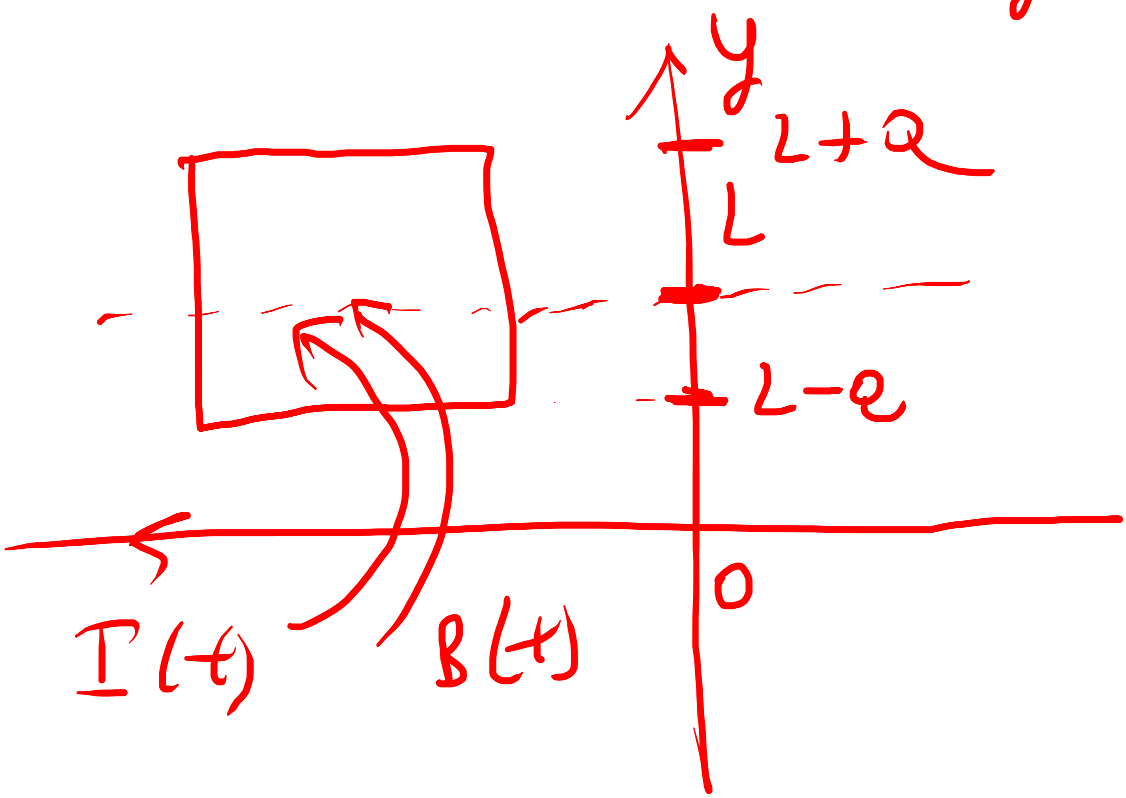
oppure considero la legge di AMPERE $\oint \vec{B} \cdot d\vec{l} = \mu_0 i$



$B \cdot L = \mu_0 \sigma \omega R L$

4)

la fem = 2 × fem dovuta ad un solo filo



$$B(t) = \frac{\mu_0 I(t)}{2\pi y}$$

$$\Phi(B) = \frac{\mu_0 I(t)}{2\pi} \int_{L-a}^{L+a} \frac{dy}{y} =$$

$$\phi(B) = \frac{\mu_0 I_0 \cos \omega t}{2\pi} \ln \frac{L+e}{L-e}$$ P.S

$$\mathcal{E}_{en\,1\,filo}(t) = -\frac{d}{dt}\phi(t) = \omega \frac{\mu_0 I_0}{2\pi} \sin(\omega t) \cdot \ln \frac{L+e}{L-e}$$

$$\mathcal{E}_{en} = 2 \times \mathcal{E}_{en\,1\,filo} =$$

$$= \frac{\cancel{2}\omega \mu_0 I_0}{\cancel{2}\pi} \sin(\omega t) \ln \frac{L+e}{L-e}$$

$$i = \frac{\mathcal{E}_{en}}{R} = \frac{\omega \mu_0 I_0}{R\pi} \sin(\omega t) \ln \frac{L+e}{L-e}$$