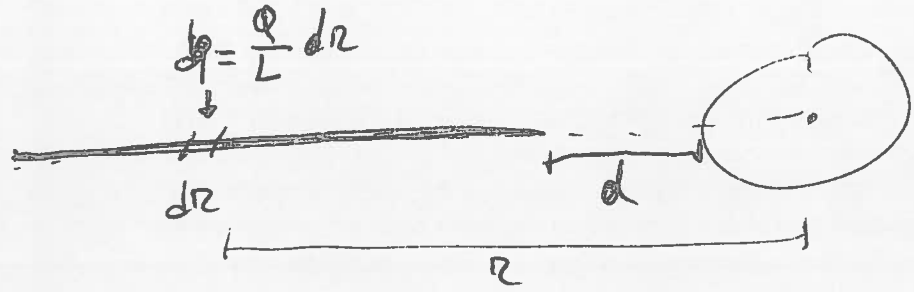
COMPITO DEL 24/01/2017

(1)

$$q_{SFERA} = \int_0^R \rho(r)\, 4\pi r^2\, dr = \int_0^R (Ar + Br^2)\, 4\pi r^2\, dr =$$

$$= \int_0^R 4\pi A r^3\, dr + \int_0^R 4\pi B r^4\, dr = \frac{4\pi A}{4} R^4 + \frac{4\pi B}{5} R^5$$

per $r > R$ $\quad E_{SFERA}(r) = \dfrac{q_{SFERA}}{4\pi\varepsilon_0 r^2}$



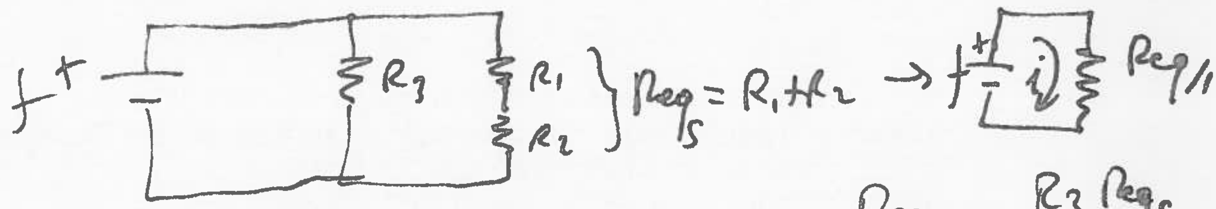
$$dF(r) = E_{SFERA}(r) \cdot dq(r) = \frac{q_{SFERA}}{4\pi\varepsilon\, r^2} \frac{Q}{L}\, dr$$

$$F_{TOT} = \int_{d+R}^{d+L+R} dF(r) = \int_{d+R}^{d+L+R} \frac{q_{SFERA}\, Q}{4\pi\varepsilon L} \frac{dr}{r^2} =$$

$$= \frac{q_{SFERA}\, Q}{4\pi\varepsilon_0 L} \int_{d+R}^{d+L+R} \frac{dr}{r^2} = -\frac{q_{SFERA}\, Q}{4\pi\varepsilon L} \left(\frac{1}{d+L+R} - \frac{1}{d+R} \right) =$$

$$= \frac{q_{SFERA}\, Q}{4\pi\varepsilon L} \left(\frac{1}{d+R} - \frac{1}{d+L+R} \right)$$

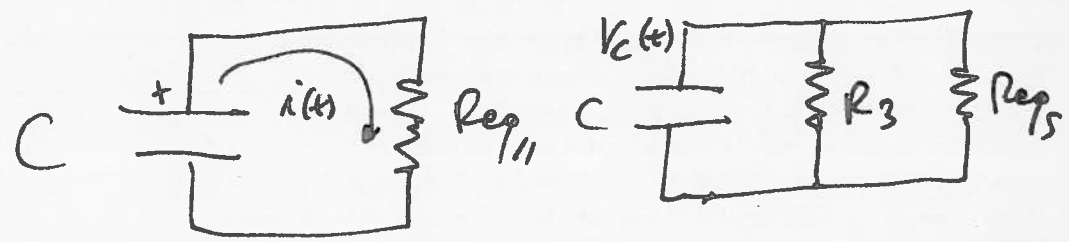
② Caso iniziale, qui C non scorre corrente



$$R_{eq_{//}} = \frac{R_3 R_{eq_s}}{R_3 + R_{eq_s}}$$

$i = \frac{f}{R_{eq_{//}}}$ inoltre $V_0 = f \rightarrow q_0 = Cf$

Caso finale



$V_c(t) = V_{su\,R_3} \rightarrow V_c(t) = V_0 e^{-\frac{t}{\tau}}$ $\boxed{\tau = R_{eq_{//}} C}$

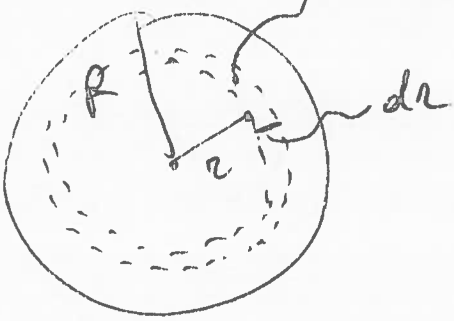
la potenza dissipata su $R_3 \Rightarrow P_{R_3} = \frac{V_{R_3}^2}{R_3} = \frac{V_c^2(t)}{R_3}$

l'energia $= E_{R_3} = \int_0^{+\infty} P_{R_3}\, dt = \int_0^{+\infty} \frac{V_c^2(t)}{R_3} dt = \frac{1}{R_3} V_0^2 \int_0^{+\infty} e^{-\frac{2t}{\tau}} dt =$

$$= -\frac{\tau}{2} \frac{V_0^2}{R_3} \left[e^{-\frac{2t}{\tau}} \right]_0^{+\infty} = \frac{\tau}{2} \frac{V_0^2}{R_3} = \frac{C R_{eq_{//}}}{2 R_3} f^2$$

③

$dq(r) = \sigma(r)\, 2\pi r\, dr \longrightarrow di(r) = \frac{dq(r)}{T} = \frac{dq(r)\omega}{2\pi}$



(~~SPIRA~~ SFERA PERCORSA DA CORRENTE

$$dB(r) = \frac{\mu_0\, di(r)}{2r}$$

$$dB(r) = \frac{\mu_0 \omega\, dq(r)}{4\pi r} = \frac{\mu_0 \omega\, \cancel{2}\cancel{\pi} r\, \sigma(r)\, dr}{\cancel{4}2 \cancel{\pi} r} =$$

$$= \frac{\mu_0 \omega\, \cancel{r}\, \sigma(r)\, dr}{2 \cancel{r}} = \frac{\mu_0 \omega\, \sigma(r)\, dr}{2} =$$

$$= \frac{\mu_0 \omega A r\, dr}{2}$$

$$\cancel{B_{TOT}}\ B_{TOT} = \int_0^R dB(r) = \frac{\mu_0 \omega A}{2} \int_0^R r\, dr = \frac{\mu_0 \omega A R^2}{2 \cdot 2} = \frac{\mu_0 \omega A R^3}{4}$$

$$\boxed{\omega = 2\pi \cdot 10\ \frac{rad}{s}}$$

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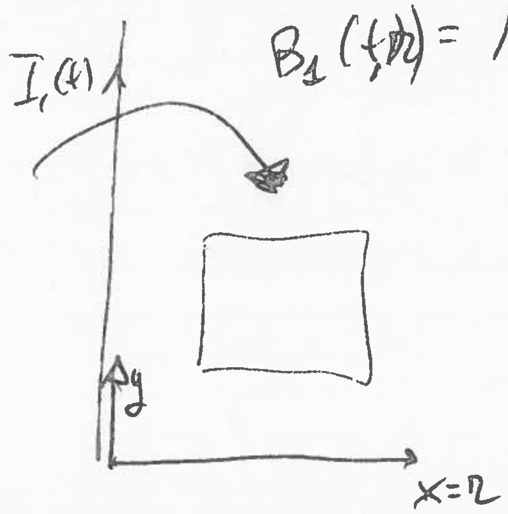

$$B_1(t,r) = \frac{\mu_0 I_1(t)}{2\pi r}$$

(siamo $x>0$) $\to$ dx = dr

$$\underset{\text{sulla spira}}{\phi(B_1)} = \int_0^a dy \int_b^{b+a} B_1(r,t)\,dr =$$

$$= \frac{a\,\mu_0 I_1(t)}{2\pi}\int_b^{b+a}\frac{dr}{r} =$$

$$= \frac{\mu_0 a I_1(t)}{2\pi}\ln\left(\frac{b+a}{b}\right) = \phi(t)$$

$$I_1(t) = I_{1MAX}\cos(\omega t)$$

$$\phi(t) = \frac{\mu_0 a}{2\pi}\ln\left(\frac{b+a}{b}\right)\cdot I_{1MAX}\cdot\cos(\omega t)$$

$$fem_{indotta}(t) = \frac{-d\phi(t)}{dt} = \underbrace{+\omega\frac{\mu_0 a}{2\pi}\ln\left(\frac{b+a}{b}\right)I_{1MAX}}_{fem_{MAX}}\,\sin(\omega t)$$

$$= fem_{MAX}\cdot\sin(\omega t)$$

$$I_2(t) = I_{2MAX}\sin(\omega t+\varphi) \qquad \tilde{Z} = R + j\omega L$$

$$I_{2MAX} = \frac{fem_{MAX}}{Z} \qquad \varphi = 0 - \varphi_z$$

$$Z = \sqrt{R^2+\omega^2L^2} \qquad \varphi_z = \operatorname{arctg}\frac{\omega L}{R}$$

$$I_2(t) = \frac{fem_{MAX}}{Z}\sin(\omega t - \varphi_z)$$