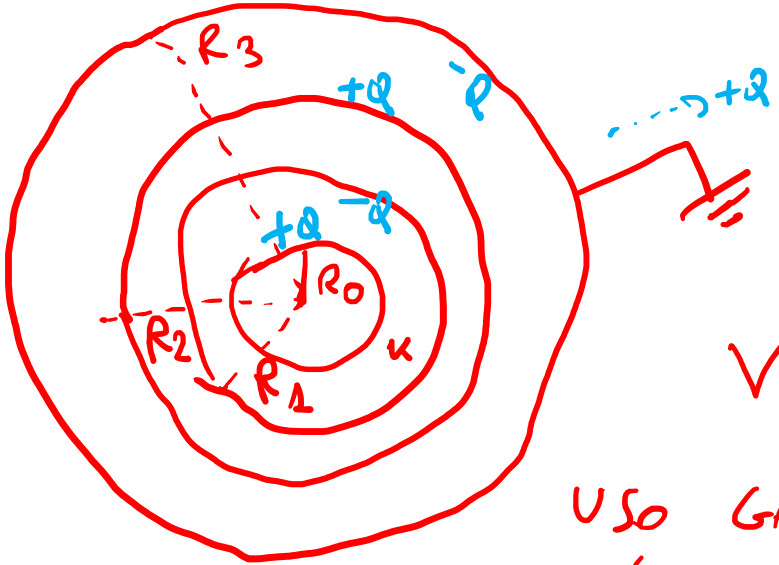
12/07/2022

1)



$$V(R_0) - V(+\infty) = V_0$$

$$V_0 = V(R_0) - V(+\infty) = -\int_{+\infty}^{R_0} \vec{E}(r)\cdot d\vec{r} = -\int_{+\infty}^{R_0} E(r)\,dr$$

USO GAUSS

$0 < r < R_0 \qquad q_{INT} = \emptyset \rightarrow E(r) = 0$

$R_0 < r < R_1 \qquad Q_{INT} = Q \rightarrow 4\pi r^2 E(r) = \frac{Q}{\varepsilon_0 k} \rightarrow E(r) = \frac{Q}{4\pi\varepsilon_0 k r^2}$

$R_1 < r < R_2 \qquad q_{INT} = +Q - Q = 0 \qquad E(r) = 0$

$R_2 < r < R_3 \qquad q_{INT} = +Q - Q + Q = Q \rightarrow 4\pi r^2 E(r) = \frac{Q}{\varepsilon_0} \rightarrow E(r) = \frac{Q}{4\pi\varepsilon_0 r^2}$

$R_3 < r < +\infty \qquad q_{INT} = +Q - Q + Q - Q = \emptyset \rightarrow E(r) = 0$

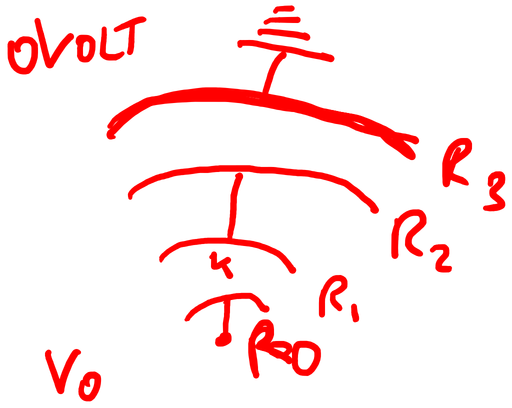
$$V_0 = -\int_{+\infty}^{R_0} E(r)\,dr = -\int_{+\infty}^{R_3} \cancel{0}\cdot dr - \int_{R_3}^{R_2} \frac{Q}{4\pi\varepsilon_0}\frac{dr}{r^2} - \int_{R_2}^{R_1} \cancel{0}\,dr - \int_{R_1}^{R_0} \frac{Q}{4\pi\varepsilon k}\frac{dr}{r^2} =$$

P. 2

$$= +\frac{Q}{4\pi\varepsilon_0}\left[\frac{1}{r}\right]_{R_3}^{R_2} + \frac{Q}{4\pi\varepsilon_0 k}\left[\frac{1}{r}\right]_{R_1}^{R_0} = \frac{Q}{4\pi\varepsilon_0}\left[\left(\frac{1}{R_2}-\frac{1}{R_3}\right)+\frac{1}{k}\left(\frac{1}{R_0}-\frac{1}{R_1}\right)\right]$$

$$\rightarrow \quad Q = \frac{4\pi\varepsilon V_0}{\frac{1}{R_2}-\frac{1}{R_3}+\frac{1}{kR_0}-\frac{1}{kR_1}}$$

POSSIAMO VEDERLO COME 2 CONDENSATORI IN SERIE



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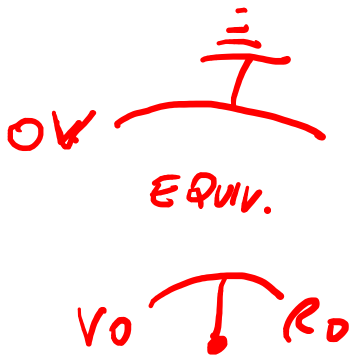
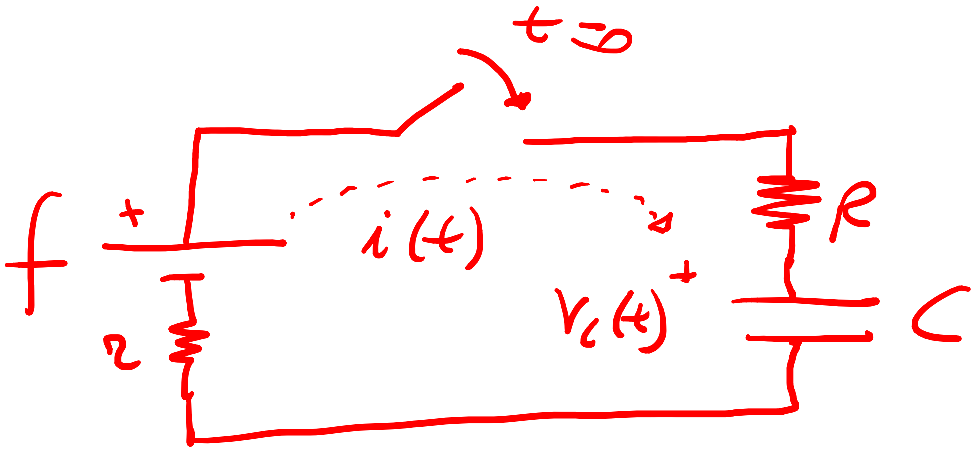


$$C = \frac{Q}{V_0} = \frac{4\pi\varepsilon_0}{\frac{1}{R_2} - \frac{1}{R_3} + \frac{1}{kR_0} - \frac{1}{kR_1}}$$

$$\text{ENERGIA E.S.} = \frac{1}{2} C V_0^2 = \frac{1}{2} Q V_0 = \frac{1}{2} \frac{4\pi\varepsilon_0 V_0^2}{\frac{1}{R_2} - \frac{1}{R_3} - \frac{1}{kR_0} - \frac{1}{kR_1}}$$

2)



$V_c(t=0) = V_0 \to f \quad Q_0 = CV_0$ | P.4

$V_c(t=t_1) = V_1 \to f \quad Q_1 = CV_1$

$t_1 = t^*$

$V_1 < V_0$

$R_s = R + r$

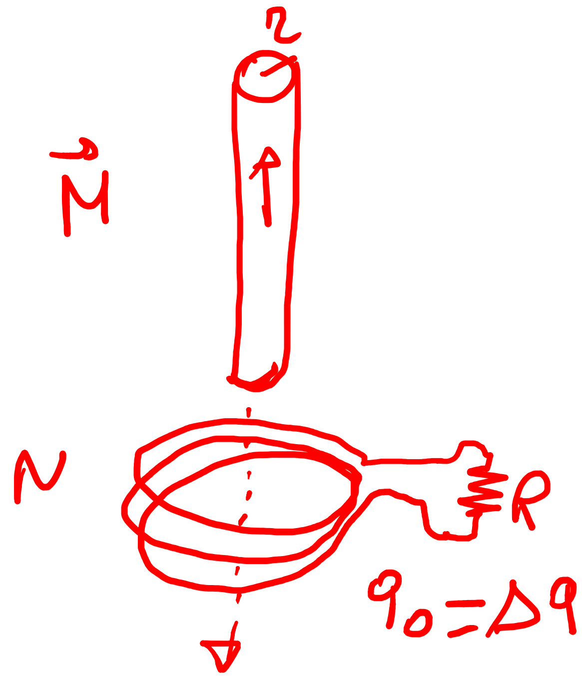
$i(t)$ SARÀ NEGATIVA PERCHÉ C SI SCARICA DA V_0 A V_1

$f - V_c(t) = R_s i \to f - \frac{q(t)}{C} = R_s \frac{dq(t)}{dt}$ CON $i = \frac{dq}{dt}$

$Cf - q(t) = R_s C \frac{dq(t)}{dt} \to -\int_0^{t_1} \frac{dt}{R_s C} = \int_{Q_0}^{Q_1} \frac{dq(t)}{q(t) - Cf} \qquad -\frac{1}{R_s C} t^* = \ln \frac{Q_1 - Cf}{Q_0 - Cf}$

$t^* = -R_s C \ln \frac{Q_1 - Cf}{Q_0 - Cf} = R_s C \ln \frac{Q_0 - Cf}{Q_1 - Cf} = R_s C \ln \frac{V_0 - f}{V_1 - f}$

3)



$q_0 = \Delta q$

$$i = \frac{f_{em}}{R} = \frac{-\frac{d}{dt}\Phi(\vec{B})}{R} \Rightarrow i\,dt = -\frac{1}{R}\,d\Phi(\vec{B}) \quad \boxed{P.S}$$

$$\frac{dq}{\cancel{dt}}\,\cancel{dt} = -\frac{1}{R}\,d\Phi(\vec{B})$$

LEGGE DI FELICI $\displaystyle\int_{q_{IN}}^{q_{FIN}} dq = -\frac{1}{R}\int_{\Phi_{IN}}^{\Phi_{FIN}} d\,\Phi(\vec{B})$

$$\vec{B} = \underbrace{\cancel{\mu_0\vec{H}}}_{0} + \mu_0\vec{M} = \mu_0\vec{M}$$

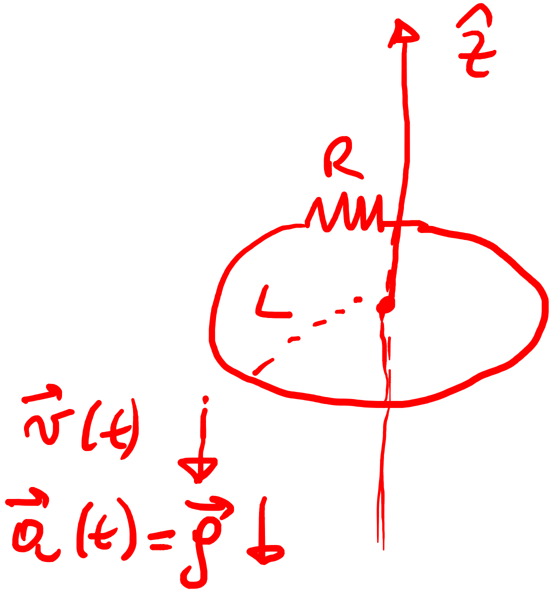
$$q_0 = q_{FIN} - q_{IN} = -\frac{1}{R}\left[\Phi_{FIN} - \Phi_{IN}\right]$$

$$\Phi_{FIN} = \pi r^2 B N = \pi r^2 \mu_0 M N \qquad \Phi_{IN} = 0$$

$$q_0 = -\frac{1}{R}\pi r^2 \mu_0 M N$$

$$R = \left|\frac{N\pi r^2 \mu_0 M}{q_0}\right|$$

4)



$\uparrow \vec{B} = \hat{z}\,\alpha\,z$

$v(t=0) = 0$

P.6

$|B|$ DIMINUISCE CON LA CADUTA

PER CUI L'INDUZIONE È TALE DA CERCARE DI OPPORSI E AD AUMENTARE IL FLUSSO DI $\vec{B}$

$\uparrow B$ $i(t)$

VERSO $i(t)$ È ANTIORARIO

$$|i(t)| = \frac{|f_{em}|}{R} = \left| \frac{-\frac{d}{dt}\phi(\vec{B})}{R} \right|$$

$$|i(t)| = \left| -\frac{1}{R} \frac{d\, \pi L^2 \alpha\, z(t)}{dt} \right| = \left| -\frac{\pi L^2 \alpha}{R} \frac{dz(t)}{dt} \right| = \frac{\pi L^2 \alpha}{R} g t$$

$$\frac{dz}{dt} = v_z(t) = -gt$$

$$i(t^*) = \frac{\pi L^2 \alpha}{R} g\, t^*$$