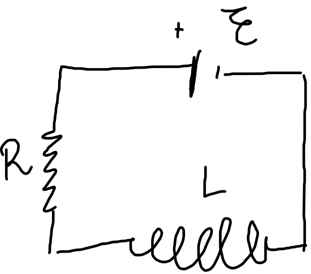
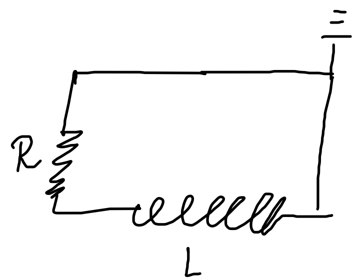


$$I(t) = \frac{\mathcal{E}}{R}\left(1 - e^{-t/\tau}\right) \qquad \tau = L/R$$

$\mathcal{E} = RI$ Mi aspetto che se $\mathcal{E} = 0$ $\Rightarrow I = 0$



$$\underset{\overset{\|}{0}}{\cancel{\mathcal{E}}} = \underbrace{Ri}_{\Delta V_R} + \underbrace{L\frac{di}{dt}}_{\Delta V_L}$$

Risolvere: $Ri + L\frac{di}{dt} = 0$ Risolvo per sep. di variabili

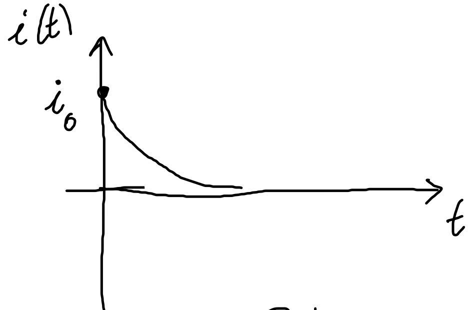
$$\frac{Ri}{Ri} = -L\frac{di}{dt}\frac{1}{Ri} \,; \quad dt = -\frac{L}{R}\frac{di}{i} = -\tau\frac{di}{i}$$

$$-\int_0^t \frac{dt}{\tau} = \int_{i_0}^{i(t)} \frac{di}{i}$$

$$-t/\tau = \ln i \Big|_{i_0}^{i(t)} \longleftarrow$$

$\ln i \Big|_{i_0}^{i(t)} = -t/\tau$; $\ln\left[\frac{i(t)}{i_0}\right] = -t/\tau$; $\frac{i(t)}{i_0} = e^{-t/\tau}$;

$$\boxed{i(t) = i_0 e^{-t/\tau}}$$



$\tau = L/R$ se $L = 0 \Rightarrow \tau = 0$

Se $t = 5\tau \Rightarrow i < 1\% i_0$

Ri - considero $\underbrace{i \times \mathcal{E}}_{P_{batteria}} = \left(Ri + L\,di/dt\right) \times i$ $\quad P = \mathcal{E} \cdot i$

$= \underbrace{Ri^2}_{P_{joule}} + \underbrace{L\left(\frac{di}{dt}\right) i}_{P_L}$

$P_L = L\, i \frac{di}{dt} = \frac{d}{dt}\left(L \frac{i^2}{2}\right)$

$\parallel$

$\frac{d(u_L)}{dt} \Rightarrow u_L = \frac{1}{2} L i^2$

Supponiamo che l'elemento induttore sia un solenoide

$$L = \mu_0 \frac{N^2}{l} S \qquad B = \mu_0 \frac{N}{l} I$$

$$\underbrace{U_L}_{\text{Energia}} = \frac{1}{2} L I^2 = \frac{1}{2} \mu_0 \frac{\cancel{N^2}}{\cancel{l}} S \frac{l^{\cancel{2}} B^2}{\mu_0^{\cancel{2}} \cancel{N^2}} = \underbrace{(S \cdot l)}_{\text{Volume}} \cdot \underbrace{\left(\frac{B^2}{2\mu_0}\right)}_{\text{Densità volumetrica di energia } (J/m^3)}$$

$$I = \frac{l B}{\mu_0 N}$$

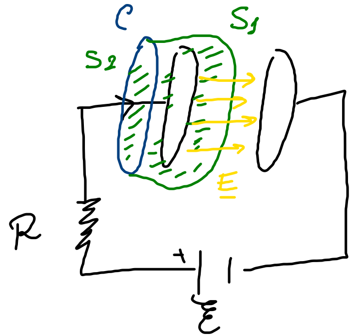
Dove c'è un $\underline{B} \neq 0$, in quella regione c'è una $\frac{\text{energia}}{\text{volume}} = \frac{B^2}{2\mu_0} = u_B$ $\quad \underline{\underline{u_B dV}} = dU$

Se il volume dove $\underline{B} \neq 0$ è pari a V

$$U_E = \int_V \frac{1}{2} \varepsilon_0 E^2 dV \qquad U_B = \int_V u_B dV = \int_V \frac{B^2}{2\mu_0} dV$$

$$\oint_C \underline{E}\cdot d\underline{l} = -\frac{d}{dt}\int_S \underline{B}\cdot d\underline{S}$$

$$\oint_C \underline{B}\cdot d\underline{l} = \mu_0 I^{conc}$$



$$Q(t) = Q_0\left(1 - e^{-t/\tau}\right) \qquad \tau = RC$$

$$I(t) = \frac{dQ}{dt} = \frac{Q_0}{\tau} e^{-t/\tau}$$

La corrente concatenata attraverso S_2: $I(t)$

La corrente concatenata attraverso S_1: $I = 0$

Estendo il th Ampere

$$\oint_C \underline{B}\cdot d\underline{l} = \mu_0 \left(I^{conc} + I^S\right)$$

I^S: corrente di spostamento

$I^S = 0$ per fenomeni non dip. dal tempo

Individuiamo I_S:

$$I_S = \frac{dQ}{dt} = \frac{d}{dt}(\sigma \cdot S) = S\frac{d\sigma}{dt} = S\frac{d}{dt}(\varepsilon_0 E) = \varepsilon_0 \frac{d}{dt}\underbrace{(E\cdot S)}_{\text{flusso di } E \text{ attraverso } S} = \varepsilon_0 \frac{d}{dt}\int_S \underline{E}\cdot d\underline{S}$$

per condens.

$Q = \underbrace{\sigma}_{\text{dens. sup. carica}} \cdot S$

$E = \frac{\sigma}{\varepsilon_0}$

$$I_S = \varepsilon_0 \frac{d}{dt}\int_S \underline{E}\cdot d\underline{S}$$

Riesamino il problema originale per vedere se la contr. è risolta

Sup. S_2: $I = I^{conc} + I_S = I^{conc} = I(t)$

↳ S_2 è fuori dal condens.

$E = 0 \Rightarrow I_S = 0$

$E = \sigma/\varepsilon_0$

Sup. S_1: $I = \underset{0}{\cancel{I^{conc}}} + I^S = \varepsilon_0 \frac{d}{dt}\int_S \underline{E}\cdot d\underline{S} = \varepsilon_0 \frac{d}{dt}(\underline{E}\cdot\underline{S}) = \cancel{\varepsilon_0} S \frac{d}{dt}\left(\frac{\sigma}{\cancel{\varepsilon_0}}\right) = \cancel{S}\frac{d}{dt}\frac{Q}{\cancel{S}} = \frac{dQ}{dt} = I(t)$

campo nel condens.

Th Ampere - Maxwell

Campi — Sorgenti

$$\oint_C \underline{B} \cdot d\underline{l} = \mu_0 I^{conc} + \varepsilon_0 \mu_0 \frac{d}{dt} \int_S \underline{E} \cdot d\underline{S}$$

$$\oint_C \underline{E} \cdot d\underline{l} = -\frac{d}{dt} \int_S \underline{B} \cdot d\underline{S}$$

$$\underline{F} = q\left(\underline{E} + \underline{v} \times \underline{B}\right)$$

$$\int_S \underline{E} \cdot d\underline{S} = q^{int}/\varepsilon_0$$

$$\int_S \underline{B} \cdot d\underline{S} = 0$$