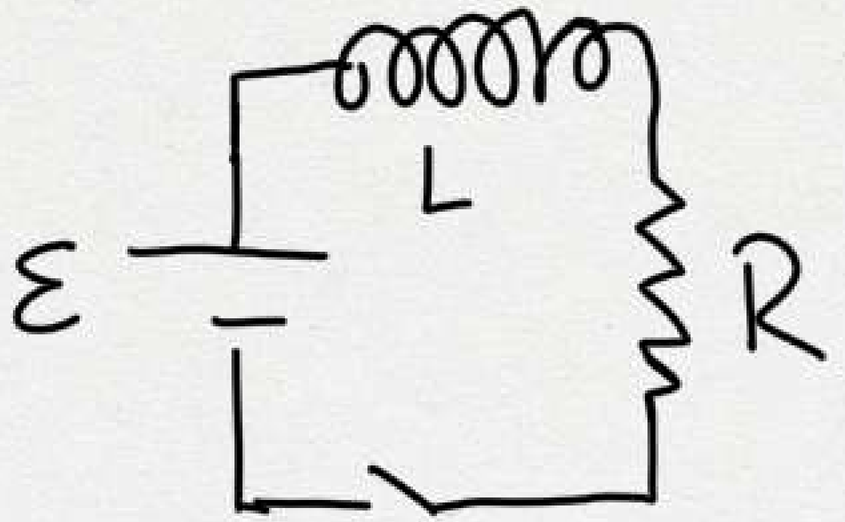


$$i_\infty = \frac{\mathcal{E}}{R} \;, \quad Ri(t) = \mathcal{E} + \mathcal{E}_i = \mathcal{E} - L\frac{di}{dt} \Rightarrow$$

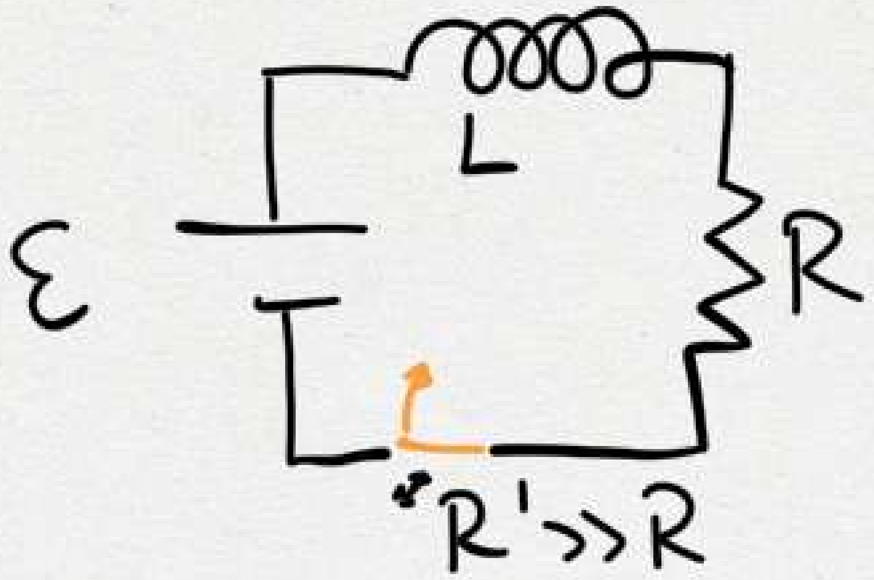
$$\mathcal{E} = Ri + L\frac{di}{dt} \Rightarrow$$

$$P = \mathcal{E}i = \underbrace{Ri^2}_{} + \underbrace{Li\frac{di}{dt}}_{} = \frac{dW}{dt} \Rightarrow$$

$$dW = P\,dt = Ri^2\,dt + \boxed{Li\,di} \Rightarrow$$

$$\frac{1}{2}mv^2 \;, \quad \frac{1}{2}I\omega^2 \;, \quad \frac{1}{2}C\Delta V^2$$

$$W_A(t) = \int_{i_1}^{i_2} Li\,di = \frac{1}{2}Li^2\Big|_{i_1}^{i_2} = \frac{1}{2}Li_2^2 - \frac{1}{2}Li_1^2 = U_m(2) - U_m(1)$$

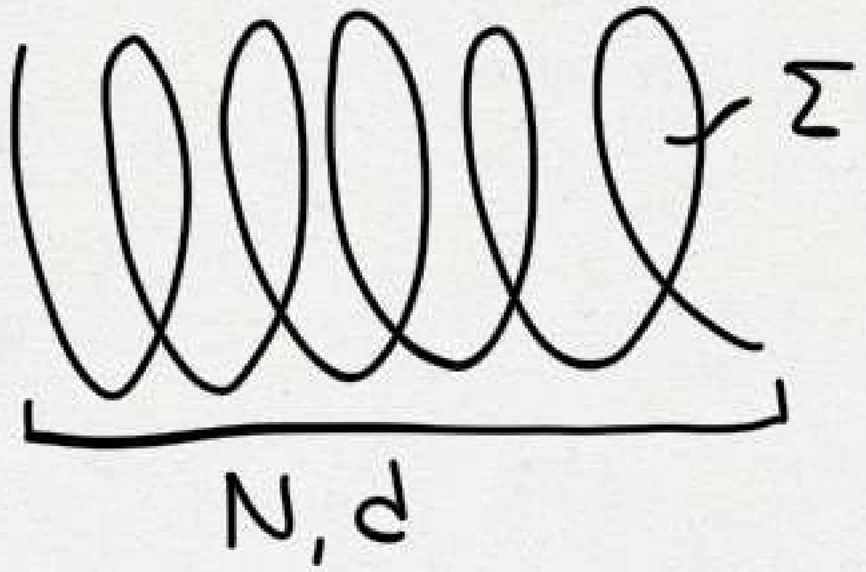


$$i_\infty = \frac{\mathcal{E}}{R}, \quad i(t) = \frac{\mathcal{E}}{R} e^{-\frac{R'}{L}t}$$

$$W = \int_0^\infty R' i^2 dt = \int_0^\infty R' \frac{\mathcal{E}^2}{R^2} e^{-\frac{2R'}{L}t} dt = \frac{R'\mathcal{E}^2}{R^2}\left(-\frac{L}{2R'}\right) e^{-\frac{2R'}{L}t}\Big|_0^\infty =$$

$$= \frac{\cancel{R'}\mathcal{E}^2}{R^2}\frac{L}{2\cancel{R'}} = \frac{1}{2} L \frac{\mathcal{E}^2}{R^2} = \frac{1}{2} L i_\infty^2$$

$$\boxed{U_L = \frac{1}{2} L i^2}$$



$$B = \mu_0 n i = \mu_0 \frac{N}{d} i \qquad U_L = \frac{1}{2} L i^2$$

$$\Phi(\vec{B}) = \boxed{L} i = B \Sigma N = \boxed{\Sigma N \mu_0 \frac{N}{d}} i \Rightarrow$$

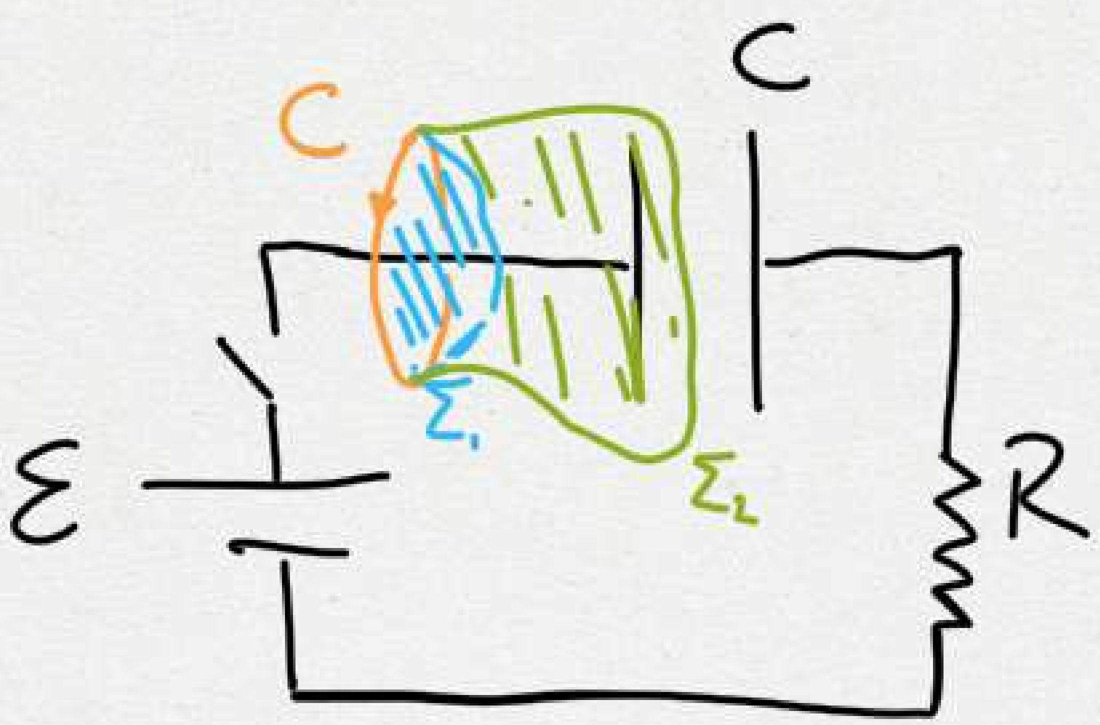
$$L = \Sigma \frac{N^2}{d} \mu_0$$

$$U_L = \frac{1}{2} \Sigma \frac{N^2}{d} \mu_0 i^2 = \frac{1}{2} \frac{N^2}{d^2} \mu_0^2 \frac{\cancel{d}}{\mu_0} \Sigma i^2 = \frac{1}{2} \overset{B^2}{\overset{\shortparallel}{\boxed{\frac{\mu_0^2 N^2 i^2}{d^2}}}} \frac{\Sigma d}{\mu_0} = \frac{1}{2} \frac{B^2}{\mu_0} \overset{\tau}{\overset{\shortparallel}{\boxed{\Sigma d}}} = \frac{1}{2} \frac{B^2}{\mu_0} \tau \Rightarrow$$

$$U_m = u_m \tau \quad , \quad u_m = \frac{1}{2} \frac{B^2}{\mu_0}$$ DENSITÀ DI ENERGIA MAGNETICA

$$u_m = \frac{1}{2} B H = \frac{1}{2} \mu_0 H^2 \qquad \left(u_e = \frac{1}{2} \varepsilon_0 E^2 \right)$$

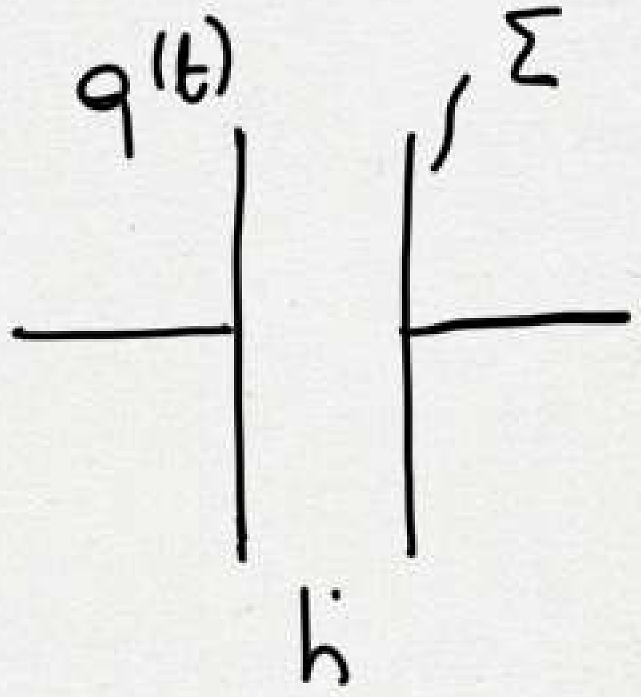
$$\boxed{U_m = \int_\tau u_m \, d\tau = \int_\tau \frac{1}{2} \frac{B^2}{\mu_0} \, d\tau}$$



$$\oint_C \vec{B} \cdot d\vec{s} = \mu_0 i_c = \mu_0 \int_{\Sigma(c)} \vec{J}_c \cdot \hat{n} \, d\Sigma$$

$$\int_{\Sigma_1} \vec{J}_c \cdot \hat{n} \, d\Sigma = i_c \quad , \quad \int_{\Sigma_2} \vec{J}_c \cdot \hat{n} \, d\Sigma = 0$$

CORRENTE DI SPOSTAMENTO i_s



$$q(t) = C\mathcal{E}\left(1 - e^{-t/\tau}\right) \quad , \quad i(t) = \frac{dq}{dt}$$

$$q = C\Delta V \Rightarrow i_s = \frac{d}{dt}(C\Delta V) = \frac{d}{dt}\left(\frac{\varepsilon_0 \Sigma}{h}\Delta V\right) = \varepsilon_0 \frac{d}{dt}\left(\Sigma \frac{\Delta V}{h}\right) =$$

$$= \varepsilon_0 \frac{d}{dt}(\Sigma E) = \varepsilon_0 \frac{d\Phi_\Sigma(\vec{E})}{dt} \Rightarrow$$

$$i_s = \varepsilon_0 \frac{d\Phi(\vec{E})}{dt}$$ CORRENTE DI SPOSTAMENTO

$$i = i_c + i_s$$ CORRENTE TOTALE

$$\oint_c \vec{B} \cdot d\vec{s} = \mu_0 \left(i_c + \varepsilon_0 \frac{d\Phi(\vec{E})}{dt} \right)$$ AMPERE - MAXWELL

se non si sono i_c

$$\oint_c \vec{B} \cdot d\vec{s} = \mu_0 \varepsilon_0 \frac{d\Phi(\vec{E})}{dt} \quad \text{"="} \quad \oint_c \vec{E} \cdot d\vec{s} = -\frac{d\Phi(\vec{B})}{dt}$$

$$\mu_0 = 4\pi \cdot 10^{-7}$$
$$\varepsilon_0 = 8.854 \cdot 10^{-12} \longrightarrow \mu_0 \varepsilon_0 = \frac{1}{c^2}$$

EQUAZIONI DI MAXWELL

$$\oint_\Sigma \vec{E}\cdot\hat{n}\, d\Sigma = \frac{Q}{\varepsilon_0}$$

$$\oint_c \vec{E}\cdot d\vec{s} = -\frac{d\Phi(\vec{B})}{dt}$$

$$\oint_\Sigma \vec{B}\cdot\hat{n}\, d\Sigma = 0$$

$$\oint_c \vec{B}\cdot d\vec{s} = \mu_0\left(i_c + \varepsilon_0\frac{d\Phi(\vec{E})}{dt}\right)$$

$$\oint_c \vec{E}\cdot d\vec{s} \underset{\text{STOKES}}{=} \oint_{\Sigma(c)} \vec{\nabla}\times\vec{E}\,\hat{n}\,d\vec{s} = -\frac{d}{dt}\int_{\Sigma(c)} \vec{B}\cdot\hat{n}\,d\Sigma = -\int_{\Sigma(c)} \frac{\partial\vec{B}}{\partial t}\cdot\hat{n}\,d\Sigma \Rightarrow$$

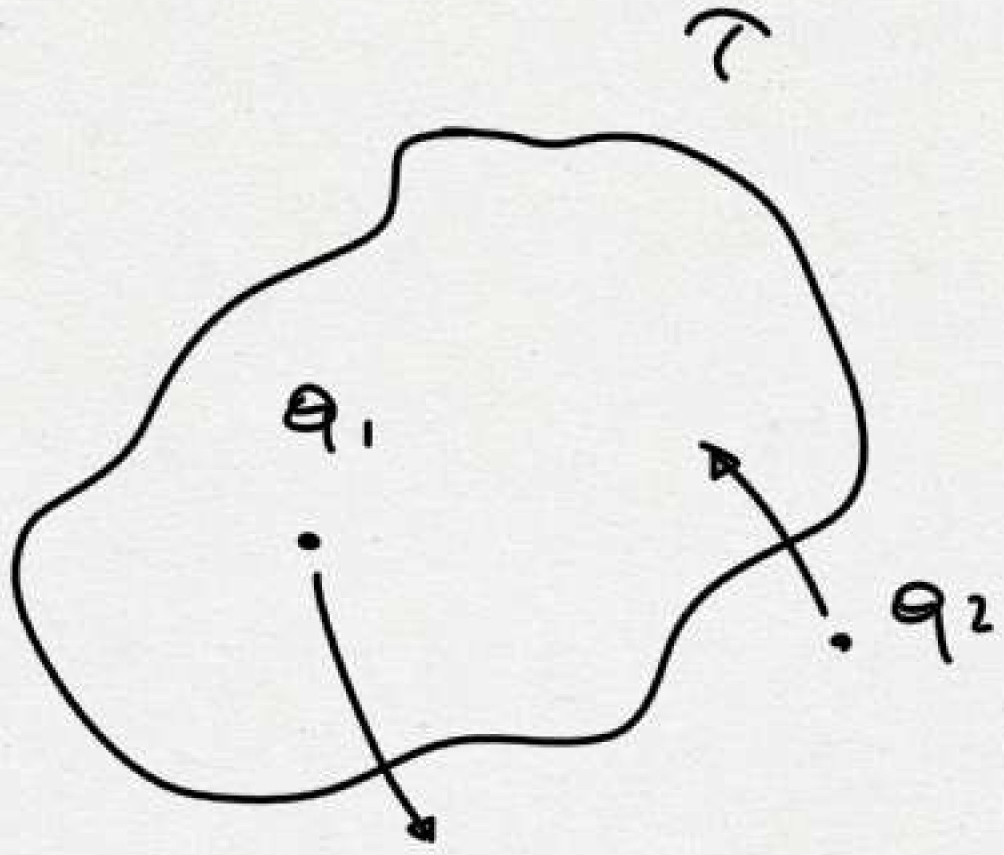
$$\vec{\nabla}\times\vec{E} = -\frac{\partial\vec{B}}{\partial t} \qquad (\vec{\nabla}\times\vec{E} = 0) \text{ IN E.S.}$$

$$\oint_c \vec{B}\cdot d\vec{s} \underset{\text{STOKES}}{=} \oint_{\Sigma(c)} \boxed{\vec{\nabla}\times\vec{B}}\cdot\hat{n}\,d\Sigma = \mu_0\int_{\Sigma(c)} \vec{J}\cdot\hat{n}\,d\Sigma + \mu_0\varepsilon_0\int_{\Sigma(c)} \frac{\partial\vec{E}}{\partial t}\cdot\hat{n}\,d\Sigma = \boxed{\mu_0}\int_{\Sigma(c)} \boxed{\left(\vec{J}+\varepsilon_0\frac{\partial\vec{E}}{\partial t}\right)}\cdot\hat{n}\,d\Sigma$$

$$\vec{\nabla}\times\vec{B} = \mu_0\vec{J} + \frac{1}{c^2}\frac{\partial\vec{E}}{\partial t}$$

$$\vec{\nabla}\cdot\vec{E} = \frac{\rho}{\varepsilon_0} \qquad \vec{\nabla}\times\vec{E} = -\frac{\partial\vec{B}}{\partial t}$$

$$\vec{\nabla}\cdot\vec{B} = 0 \qquad \vec{\nabla}\times\vec{B} = \mu_0\left(\vec{J}+\varepsilon_0\frac{\partial\vec{E}}{\partial t}\right)$$



$$\vec\nabla\times\vec B = \mu_0\left(\vec J + \varepsilon_0\frac{\partial\vec E}{\partial t}\right)$$

$$\vec\nabla\cdot\left(\vec\nabla\times\vec B\right) = 0$$

$$\mu_0\vec\nabla\cdot\vec J + \mu_0\varepsilon_0\vec\nabla\cdot\left(\frac{\partial\vec E}{\partial t}\right) = \mu_0\vec\nabla\cdot\vec J + \mu_0\varepsilon_0\frac{\partial}{\partial t}\big(\overbrace{\vec\nabla\cdot\vec E}^{\frac{\rho}{\varepsilon_0}}\big) = 0 \implies$$

$$\boxed{\vec\nabla\cdot\vec J = -\frac{\partial\rho}{\partial t}}$$ EQ. DI CONTINUITÀ

$$\int_\tau\vec\nabla\cdot\vec J\,d\tau = -\frac{\partial}{\partial t}\int_\tau\rho\,d\tau = -\frac{\partial Q_{TOT}}{\partial t}$$

$$\int_\tau\vec\nabla\cdot\vec J\,d\tau \underset{\substack{\text{T.}\\\text{DELLA}\\\text{DIVERGENZA}}}{=} \int_{\Sigma(\tau)}\vec J\cdot\hat n\,d\Sigma = \boxed{i = -\frac{\partial Q_{TOT}}{\partial t}}$$

CONSERVAZIONE DELLA CARICA