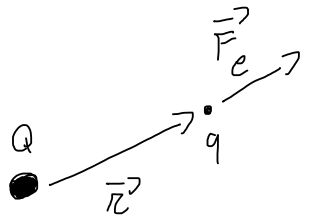
$$\vec{F}_e = q\vec{E}$$



$$\vec{E} = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}\vec{e}_r$$

$$\hookrightarrow d\vec{E} = \frac{1}{4\pi\varepsilon_0}\frac{dQ}{r^2}\vec{e}_r \quad \therefore \vec{E} = \int d\vec{E}$$

$$W = \int_a^b F_e\, dl = q V_{ab}$$

$$V = \int_p^{Ref} \vec{E}\, dl = \frac{Q}{4\pi\varepsilon_0}\left[\frac{1}{R_p} - \frac{1}{R_{ref}}\right]$$

$$E = -\nabla V$$

$$\oint \vec{E}\cdot\vec{n}\, dS = \frac{Q_{int}}{\varepsilon_0}$$

- plano: $E = \frac{Q}{A\varepsilon_0} = \frac{\sigma}{\varepsilon_0}$
- esfera: $E = \frac{Q}{4\pi\varepsilon_0 r^2} = \frac{\sigma a^2}{\varepsilon_0 r^2}$
- cilindro: $E = \frac{Q}{2\pi r L\varepsilon_0} = \frac{\lambda}{\varepsilon_0 2\pi r}$

Generalizando

$$\oint \vec{E}\cdot\vec{n}\, dS = \frac{Q_{int}}{\varepsilon}$$

$$\varepsilon = (1+\chi)\varepsilon_0$$

$$\vec{D} = \varepsilon\vec{E}$$

$$\oint \vec{D}\cdot\vec{n}\, dS = Q_{int}$$

$$u_E = \frac{1}{2}\varepsilon E^2$$

$$U_E = \int u_E\, dvol$$

$$J = N q \vec{v}$$

$$I = \left.\frac{dQ}{dt}\right|_S = \int J\cdot n\, dS$$

$$\vec{J} = \sigma_c\vec{E}$$

$$\vec{E} = \rho\vec{J}$$

$$p = JE \Rightarrow P = \int p\, dvol = VI$$

$$\oint \vec{E}\, dl = 0 \qquad \oint \vec{J}\cdot\vec{n}\, dS = 0$$

Capacidade [C]

$$Q \hookrightarrow \vec{E} \hookrightarrow V$$

$$C = \frac{Q}{V}$$

Resistência [Ω]

$$\vec{E} = \frac{\vec{J}}{\sigma}$$

$$I \hookrightarrow J \hookrightarrow E \hookrightarrow V$$

$$R = \frac{V}{I}$$

$$d\vec{B} = \frac{\mu_0}{4\pi} \frac{I\, d\vec{l} \times \vec{e}_r}{r^2}$$

$$I \hookrightarrow \vec{B} \hookrightarrow \phi_B$$

$$\frac{\phi_B}{I} = L$$

$$\vec{B} = \oint_{\text{circuito}} d\vec{B} \qquad \nabla B = 0$$

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 \int \vec{j}\, \vec{n}\, ds = \mu_0 I_{atv}$$

cilindro $B = \frac{\mu_0 I}{2\pi d}$

plano $B = \frac{\mu_0 \lambda}{2}$

solenoide $B = \frac{\mu_0 I N}{L} = \mu_0 I n$

Toroide $B = \frac{\mu_0 I N}{2\pi r}$

$$\vec{\nabla} \times \vec{B} = \mu_0 \vec{j}$$

Generalizando

$$\oint \vec{H}\, d\vec{l} = I_{atr}$$

$$\vec{\nabla} \times \vec{H} = \vec{j}$$

$$\vec{B} = \mu_0 (1+\chi) \vec{H} = \mu \vec{H}$$

$$\vec{B} = \mu_0 (\vec{H} + \vec{M})$$

$$\vec{M} = \chi \vec{H}$$

$$\mathcal{E} = -\frac{d\phi_B}{dt} \qquad R = \frac{\mathcal{E}}{I} \qquad \mathcal{E} = -L \frac{di}{dt}$$

$$\oint \vec{E}\, d\vec{l} = -\frac{d}{dt} \int \vec{B}\, \vec{n}\, ds$$

$$\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

$$d\vec{F} = I\, d\vec{l} \times \vec{B}$$

$$\vec{F}_m = q\vec{v} \times \vec{B}$$

$$\vec{F}_e = q\vec{E}$$

$$\vec{F}_T = q(\vec{E} + \vec{v}_\perp \times \vec{B})$$

$$\phi_i = L_i i_i + \sum_{j \neq i} M_{ji}\, i_j$$

$$R = \frac{m v_\perp}{qB}$$

$$U_M = \frac{1}{2} \phi I$$

$$\mu_m = \frac{1}{2} \frac{B^2}{\mu}$$

$$U_M = \int \mu_m\, dV$$

$$f = \frac{1}{T}$$

$$\omega = 2\pi f = \frac{2\pi}{T}$$

$$\lambda = vT = \frac{v}{f}$$

$$K = \frac{2\pi}{\lambda} = \frac{2\pi}{vT} = \frac{2\pi f}{v}$$

$$\vec{\nabla} \times \vec{H} = \vec{j} + \underbrace{\frac{\partial \vec{D}}{\partial t}}_{} \rightarrow \text{corrente de deslocamento}$$

$$\vec{S} = \vec{E} \times \vec{H}$$

linear : cos cos

circular cos sin

elíptica : a cos b sin

$$\frac{E}{B} = v \qquad \mu = \mu_E + \mu_B \qquad I = \langle \vec{S} \cdot n \rangle = v \langle \mu \rangle$$