$I = \frac{\Delta Q}{\Delta t}$ Ampere

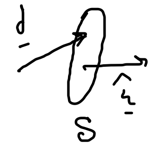
$\underbrace{j}_{A/m^2} = \underbrace{n}_{\text{dens. port.}} \overbrace{v_d}^{\text{vel. deriva}} \underbrace{q}_{\text{carica portatore}}$

$v_d \ll v_{th}$

$I = j \cdot S \qquad \vec{j} = n \vec{v}_d q$

Materiali ohmici: $j = \underbrace{\sigma}_{\text{conducibilità}} E$

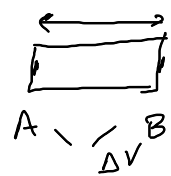
$I = \underline{j} \cdot \underline{S}$



″ non ohmici: j non è $\propto E$ (semiconduttori)

Legge di Ohm $\quad j = I/S \qquad \Delta V = E \cdot d_{AB} = E \cdot l \Rightarrow E = \frac{\Delta V}{l}$

E uniforme



$$\underbrace{I/S}_{j} = \sigma \underbrace{\frac{\Delta V}{l}}_{E} \quad ; \quad \Delta V = \frac{l}{S\sigma} \cdot I$$

$S\sigma \rightarrow R$: resistenza

$$\Delta V = RI \qquad R = \frac{l}{S \cdot \sigma} \qquad \frac{1}{\sigma} \overset{def}{=} \rho$$

$[\Delta V] = V \quad [I] = A$

R dipende → materiale
→ geometria

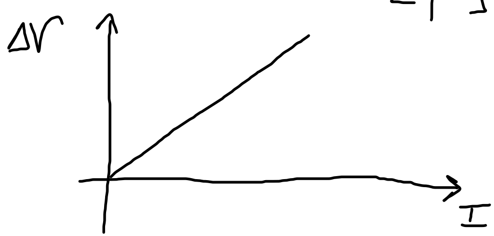
ρ : resistività

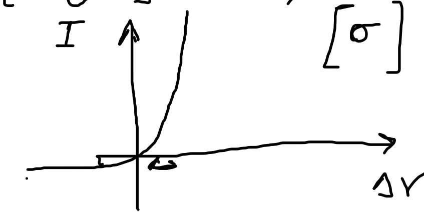
$$[R] = \frac{V}{A} = \Omega \quad \text{Ohm}$$

$$[\rho] = \left[\frac{R \cdot S}{l}\right] = \frac{\Omega \cdot m^{\cancel{2}}}{\cancel{m}} = \Omega \cdot m$$

$$[\sigma] = \Omega^{-1} m^{-1}$$

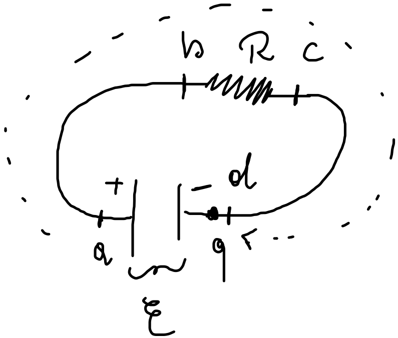
Materiale ohmico





Diodo

Potenza elettrica



$$\Delta U_{batt} = q\mathcal{E}$$

$$\Delta U_{ab} = 0 \qquad (a-b)$$

$$\Delta V_R = RI \qquad \Delta U_R < 0 \qquad (b-c)$$

$$\Delta U_{cd} = 0 \qquad (c-d)$$

$$\Delta U_{batt} = q\mathcal{E} = \Delta U_R = qRI$$

$$P = \frac{d(\Delta U)}{dt} = \frac{d}{dt}(qRI) \qquad \Delta V \cdot I$$

$$\|$$

$$= RI \underbrace{\frac{dq}{dt}}_{I} = RI^2 = \frac{\Delta V^2}{R}$$

$$\Delta V = RI$$

$$P_{centrale} = P_{linea} + P_{utilizzatore}$$

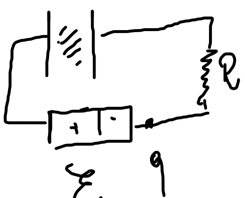
$$P_{centrale} = \Delta V \cdot I$$

$$P_{linea} = R \cdot I^2$$

Alte tensioni
Basse correnti

Trasformatore

Carica di un condensatore



Cons. energia

$$\Delta U_{batt} = q\,\mathcal{E} \qquad \Delta U_{batt} = \Delta U_C + \Delta U_R$$

$$\cancel{q}\,\mathcal{E} = \cancel{q}\,\Delta V_C + \cancel{q}\,\Delta V_R$$

$$\mathcal{E} = \Delta V_R + \Delta V_C \qquad \Delta V_R = R \cdot I$$

$$C = \frac{Q}{\Delta V_C} \; ; \qquad \Delta V_C = Q/C$$

variabili

$$\mathcal{E} = R \cdot I + Q/C$$

costanti

$I(t)$

$Q(t)$

$$I = \frac{dQ}{dt}$$

$$\mathcal{E} = R\frac{dQ}{dt} + Q/C$$

eq. differenziale 1° ordine a coeff. costanti

$$\mathcal{E}C = RC\frac{dQ}{dt} + Q \; ; \qquad \mathcal{E}C - Q = RC\frac{dQ}{dt} \; ;$$

$$\frac{dQ}{\mathcal{E}C - Q} = \frac{dt}{RC} \; ; \qquad \frac{dQ}{Q - \mathcal{E}C} = -\frac{dt}{RC}$$

$$\frac{dQ}{Q-\mathcal{E}C} = -\frac{dt}{RC}$$

adimensionale

$[\tau]=[RC]=s$ Tempo caratteristico

$$\int_0^{Q(t)} \frac{dQ}{Q-\mathcal{E}C} = -\int_0^t \frac{dt}{\tau}$$

$$\ln\left[Q-\mathcal{E}C\right]\Big|_0^{Q(t)} = -t/\tau$$

$$\ln\left[\frac{Q(t)-\mathcal{E}C}{-\mathcal{E}C}\right] = -\frac{t}{\tau};$$

$$\frac{Q(t)-\mathcal{E}C}{-\mathcal{E}C} = e^{-t/\tau}$$

$$Q(t) = \mathcal{E}C\left[1-e^{-t/\tau}\right]$$

$$I(t) = \frac{dQ}{dt} = \frac{d}{dt}\left[\mathcal{E}C\left(1-e^{-t/\tau}\right)\right]$$

$$= \frac{\mathcal{E}C}{\underset{\hookrightarrow RC}{\tau}}\, e^{-t/\tau} = \frac{\mathcal{E}}{R}\, e^{-t/\tau}$$

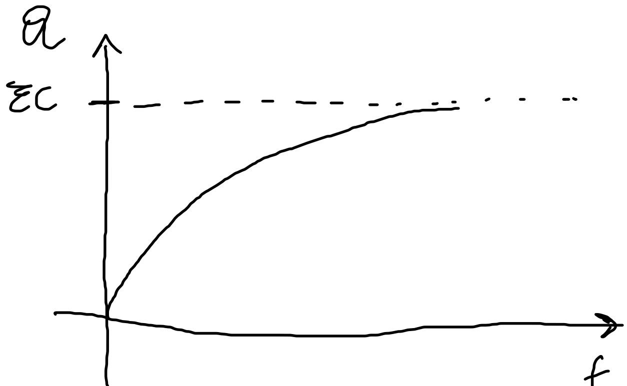
$$Q(t) = \mathcal{E}C\left(1-e^{-t/\tau}\right)$$

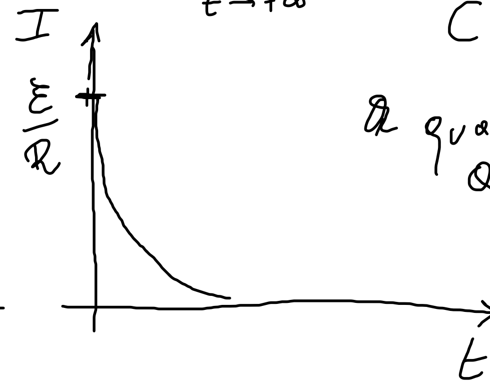
$$\lim_{t\to+\infty} Q(t) = \mathcal{E}C$$

$$C = \frac{Q_{max}}{\mathcal{E}} \rightarrow Q_{max} = C\cdot\mathcal{E}$$

A quale t^* si ha

$$Q(t^*) = \frac{Q_{max}}{2} = \frac{\mathcal{E}C}{2}$$





$$\underbrace{\frac{\cancel{\mathcal{E}C}}{2}}_{Q(t^*)} = \cancel{\mathcal{E}C}\left(1 - e^{-t^*/\tau}\right)$$

$$\tau = RC$$

$$\frac{1}{2} = e^{-t^*/\tau}$$

$$-\ln 2 = \ln\left(\frac{1}{2}\right) = \ln\left(e^{-t^*/\tau}\right) = -t^*/\tau$$

$$t^* = \ln 2 \cdot \tau \simeq 0.69 \cdot \tau$$

$\tilde{t} \longrightarrow 99\%\ Q_{max}$

$$\tilde{t} \simeq 4.6\,\tau$$

Se aspetto $t = 5\tau$

$\Longrightarrow Q > 99\%\ Q_{max}$