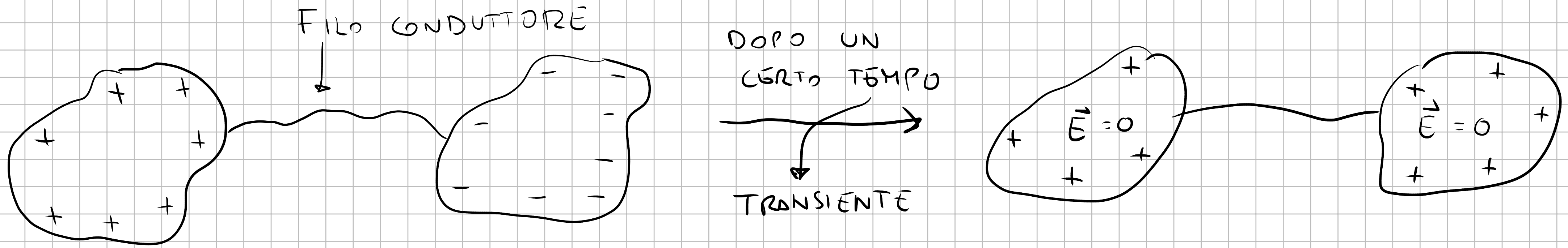
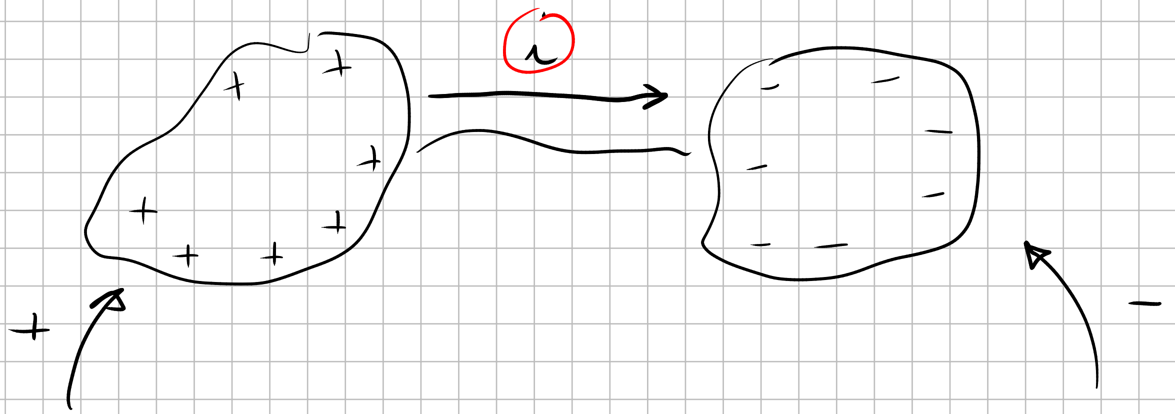
CORRENTE ELETTRICA

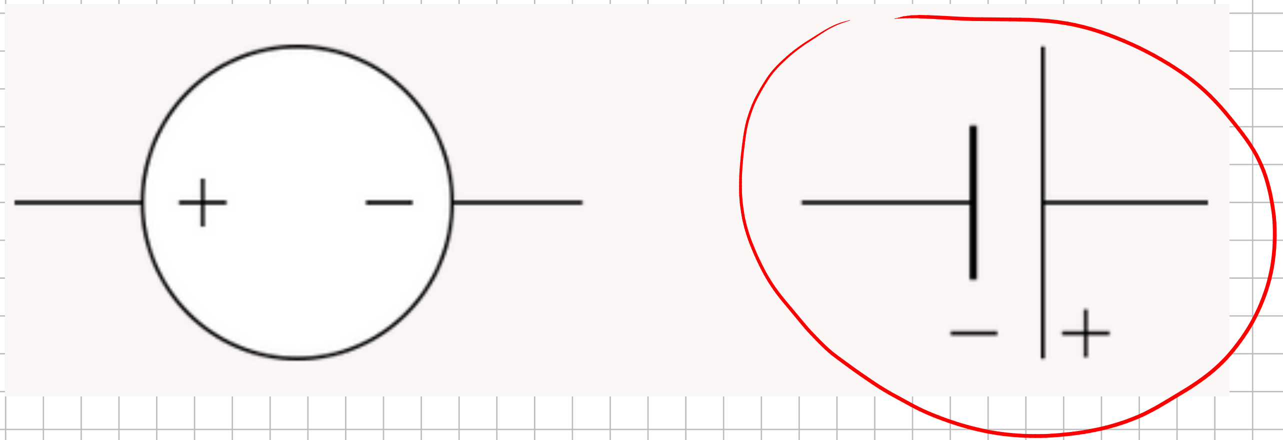


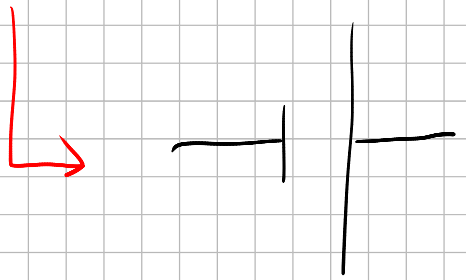
se abbiamo un meccanismo <u>non</u> elettrostatico ⇒ il "transiente" continua

PASSAGGIO DI CARICA → CORRENTE



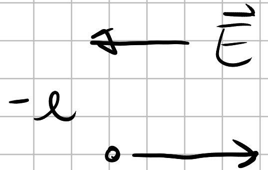
GENERATORE DI TENSIONE





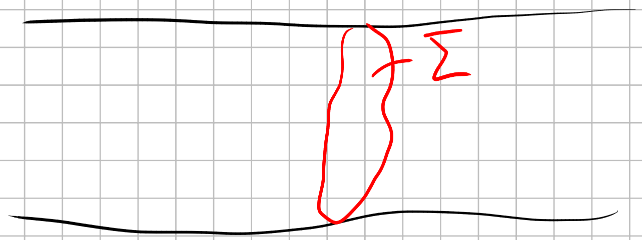
dispositivi che mantengono ΔV costante tra i poli

MODELLO DI DRUDE



$$v(t) = v_0 + at = v_0 + \frac{eE}{m_e}\,t$$

CONDUTTORE

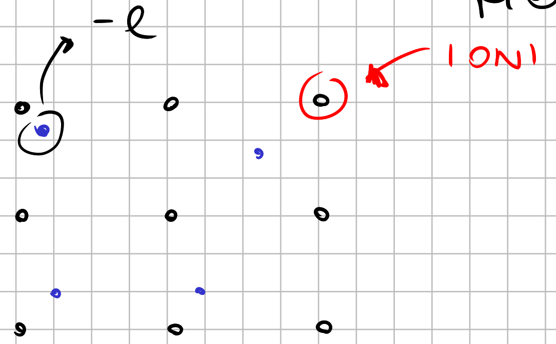


$$i_m = \frac{\Delta q}{\Delta t}$$ → carica che attraversa Σ

$$i = \lim_{\Delta t \to 0} \frac{\Delta q}{\Delta t} = \frac{dq}{dt}$$ → sempre attraverso Σ

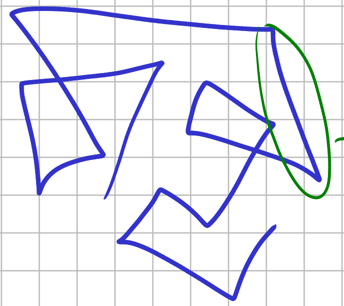
$$[i] = \frac{C}{s} = A$$ AMPERE

MODELLO DI DRUDE - 2



$\vec{v}_i$ velocità di un elettrone, $|\vec{v}_i| = 10^6\, m/s$

$\langle \vec{v}_i \rangle = 0$

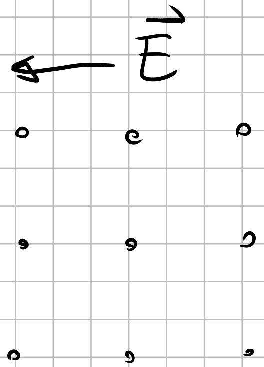


moto di $-e$ in assenza di campo

$\boxed{\ell}$ cammino libero medio

$\boxed{\tau_e} = \dfrac{\ell}{v_i}$ tempo medio fra due urti

MODELLO DI DRUDE - 3



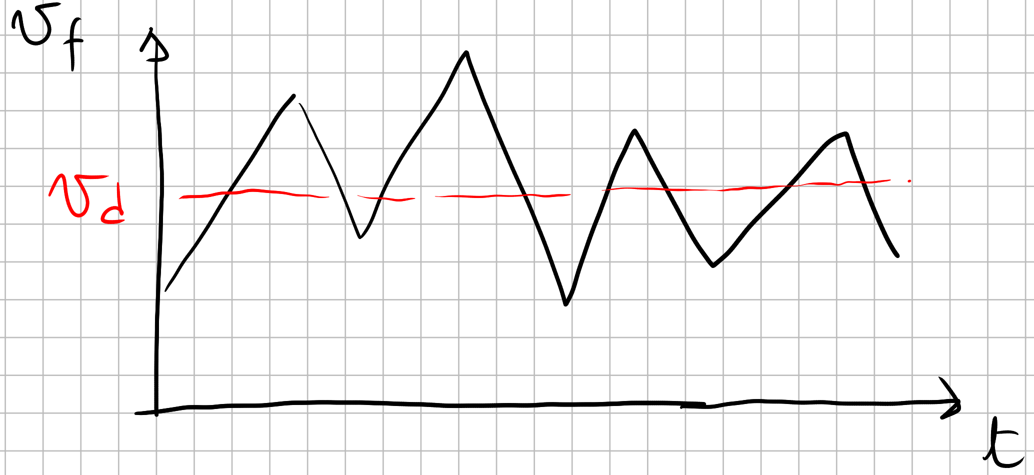
accendiamo un campo → stabilire una d.d.p.

$$\vec{a} = -\frac{e\vec{E}}{m_e} \quad \text{accelerazione di } -e$$

$$\vec{v}_i(t) = \vec{v}_i + \vec{a}t = \vec{v}_i - \frac{e\vec{E}}{m_e}t \Rightarrow \vec{v}_f = \vec{v}_i - \frac{e\vec{E}}{m_e}\tau_e \Rightarrow$$

$$\langle \vec{v}_f \rangle = \langle \overset{=0}{\cancel{\vec{v}_i}} \rangle - \left\langle \frac{e\vec{E}}{m_e}\tau_e \right\rangle = \boxed{-\frac{e\vec{E}\tau_e}{m_e} \equiv \vec{v}_d}$$

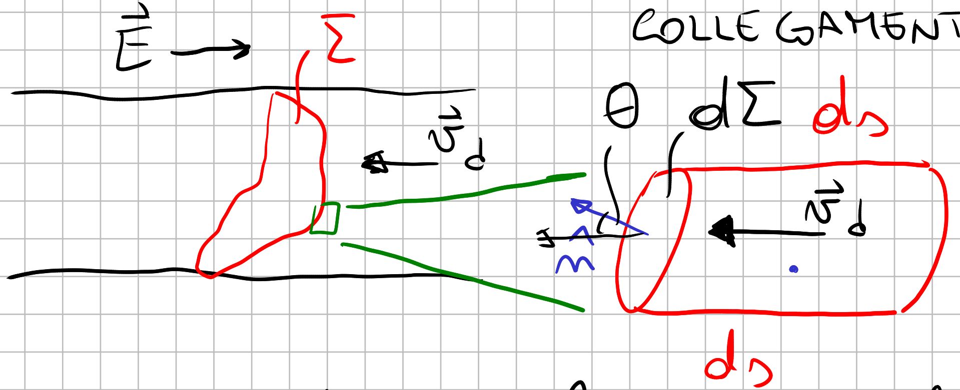
VELOCITÀ DI DERIVA



$$v_d \approx 10^{-3} \div 10^{-4} \ m/s$$

$$\Rightarrow \frac{v_d}{v_i} \approx 10^{-10}$$

COLLEGAMENTO CON LA CORRENTE



$$ds = v_d\, dt$$

$$d\tau = d\Sigma \cos\theta\, ds = d\Sigma \cos\theta\, v_d\, dt$$

volume del cilindro

se n densità di elettroni, il # di $-e$ nel cilindro è

$$dN = n\, d\tau = n\, d\Sigma \cos\theta\, v_d\, dt \,, \quad dq = -e\, dN = -e n\, d\Sigma \cos\theta\, v_d\, dt \Rightarrow$$

$$di = \frac{dq}{dt} = -e n\, d\Sigma \underbrace{\cos\theta}_{\theta \text{ angolo tra } \vec{v}_d \text{ e } \hat{n}}\, v_d = -e n\, \vec{v}_d \cdot \hat{n}\, d\Sigma \equiv \vec{J} \cdot \hat{n}\, d\Sigma$$

di → attraverso $d\Sigma$

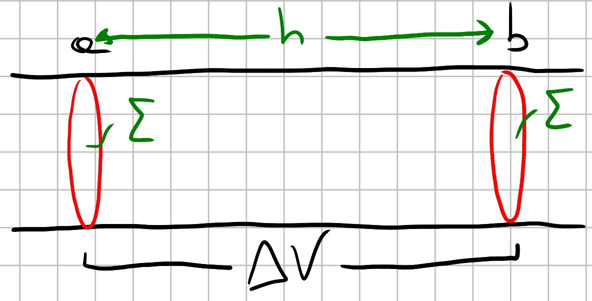
$$\vec{J} = -n e \vec{v}_d \quad \text{DENSITÁ DI CORRENTE}$$

$$i = \int_\Sigma di = \int_\Sigma \vec{J} \cdot \hat{n}\, d\Sigma \quad \text{CORRENTE ATTRAVERSO } \Sigma$$

LEGGE DI OHM

$$\vec{J} = -ne\vec{v}_d = \overbrace{\frac{ne^2\vec{E}\tau_e}{m_e}}^{\sigma} = \sigma\vec{E} \quad , \sigma \text{ CONDUTTIVITÀ ELETTRICA}$$

$$\vec{E} = \frac{1}{\sigma}\vec{J} = \rho\vec{J} \quad , \rho \text{ RESISTIVITÀ ELETTRICA} \quad , \rho = \frac{m_e}{ne^2\tau_e}$$



$$J = \frac{i}{\Sigma} \qquad i = J\Sigma$$

$$\Delta V = \int_a^b \vec{E}\cdot d\vec{s} = \int_a^b \rho\vec{J}\cdot d\vec{s} = \int_a^b \rho\boxed{J}\,ds = \int_a^b \rho\frac{i}{\Sigma}\,ds =$$

$$= i\underbrace{\int_a^b \frac{\rho}{\Sigma}\,ds}_{R} = Ri \quad , \quad R \text{ RESISTENZA} \Rightarrow$$

$$\Delta V = Ri$$

CONDUTTANZA S

$$[R] = \frac{V}{A} = \Omega \text{ OHM}, \quad [\rho] = \Omega m, \quad [\sigma] = \Omega^{-1}m^{-1}, \quad \left[\frac{1}{R}\right] = \Omega^{-1}$$

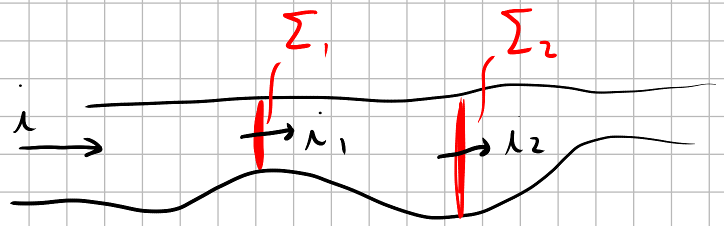
EFFETTO JOULE

$$dW = \Delta V \underbrace{dq}_{i = \frac{dq}{dt}} = \Delta V\, i\, dt \Rightarrow \frac{dW}{dt} = P = \Delta V i \overset{\text{LEGGE DI OHM}}{=} R i^2 = \frac{\Delta V^2}{R}$$

$$[P] = \frac{J}{s} = W \quad \text{WATT}$$

$$W = \int_{t_1}^{t_2} P\, dt$$

CORRENTE ELETTRICA STAZIONARIA



$i_1 = i_2$ CONDIZIONE DI STAZIONARIETÀ

se $i = J\Sigma$, allora $J_1\Sigma_1 = J_2\Sigma_2 \Rightarrow$

$$\frac{J_1}{J_2} = \frac{\Sigma_2}{\Sigma_1}$$

RESISTORI

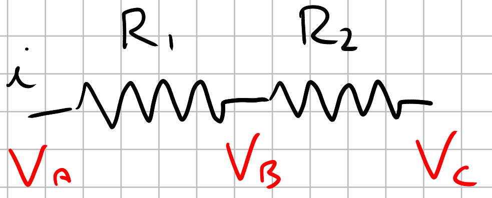
un filo di rame di l 1 cm e ϕ 1 mm ha $R \sim 2 \cdot 10^{-4}\ \Omega$

nel nostro caso: fili $\rightarrow$ conduttori ideali $\rightarrow R = 0$

RESISTORE, $R \neq 0$

CONNESSIONE DI RESISTENZE (O RESISTORE)

IN SERIE $\rightarrow$ STESSA CORRENTE



$$\Delta V_1 = R_1 i \,, \quad \Delta V_2 = R_2 i \,, \quad \Delta V = V_C - V_A = \Delta V_1 + \Delta V_2 =$$

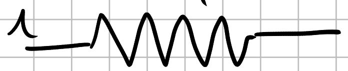
$$= R_1 i + R_2 i = (R_1 + R_2) i =$$

$$= R_{eq}\, i$$

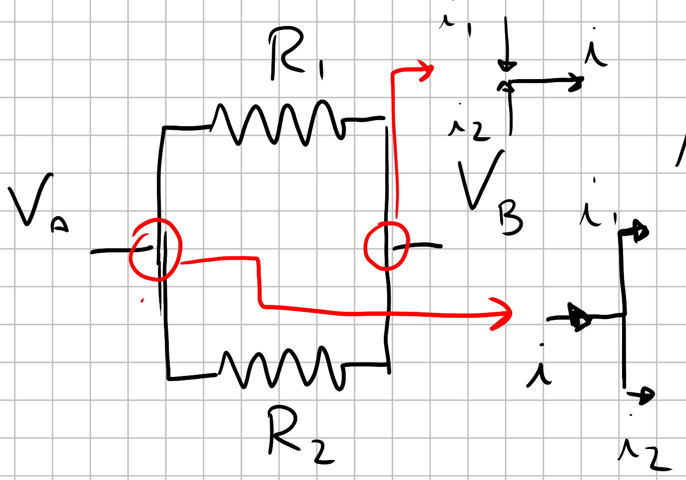
" "

=

$$R_{eq} = R_1 + R_2$$



IN PARALLELO



$$\Delta V = V_B - V_A \, , \qquad i = i_1 + i_2$$

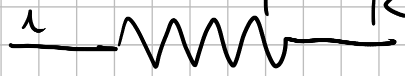
$$\Delta V = R_1 i_1 = R_2 i_2 \Rightarrow$$

$$\begin{cases} i_1 = \dfrac{\Delta V}{R_1} \\ i_2 = \dfrac{\Delta V}{R_2} \end{cases} \Rightarrow \quad i = i_1 + i_2 = \frac{\Delta V}{R_1} + \frac{\Delta V}{R_2} = \Delta V \left(\frac{1}{R_1} + \frac{1}{R_2} \right) =$$

$$= \frac{\Delta V}{R_{eq}} \, , \text{ con } \frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$$

"="

$$R_{eq} = \frac{R_1 R_2}{R_1 + R_2}$$



	C_{eq}	R_{eq}
PARALLELO	$C_1 + C_2$	$\left(\frac{1}{R_1} + \frac{1}{R_2} \right)^{-1}$
SERIE	$\left(\frac{1}{C_1} + \frac{1}{C_2} \right)^{-1}$	$R_1 + R_2$