Corrente e Resistenza

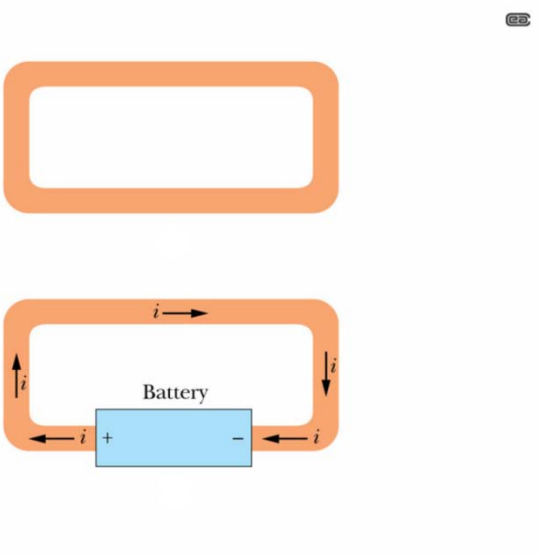
- Il flusso della carica
- Resistenza (serie e parallelo) e legge di Ohm
- Modello di Drude
- Semiconduttori

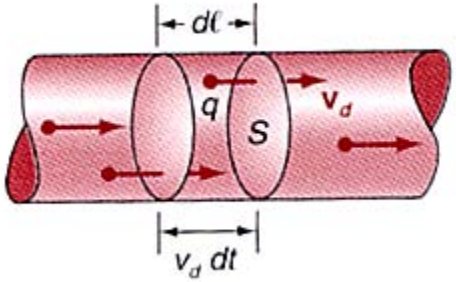
Flusso della carica

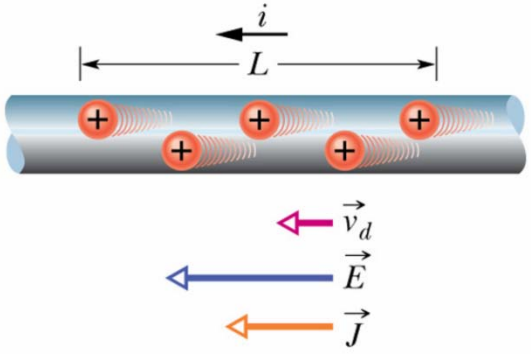
$$I = \frac{dQ}{dt} \qquad [\mathrm{A}] = [C/s]$$

$$dQ = nSdl\,|q| = nSv_d dt\,|q|$$

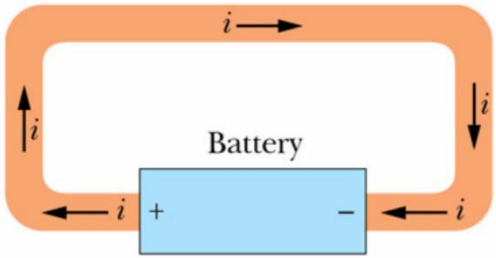
$$I = nSv_d\,|q|$$







Flusso della carica

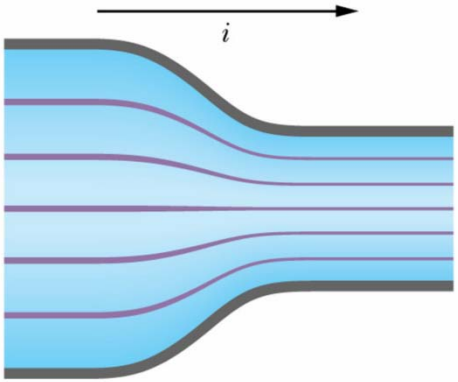


$$j = \frac{I}{S} = \frac{nSv_d|q|}{S} = nv_d|q|$$

Densità di corrente

$$\mathbf{j} = nq\mathbf{v_d}$$

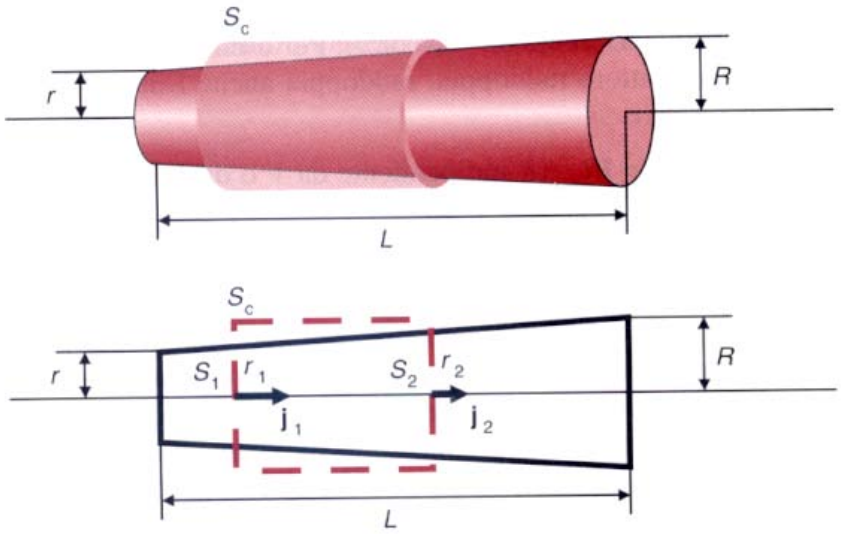
$$I = \iint \mathbf{j} \cdot d\mathbf{S}$$



Eq. di continuità

$$\Phi_j = \oiint_{S_{chiusa}} \mathbf{j} \cdot d\mathbf{S}$$

$$\Phi_j = \frac{dQ_{\text{int}}}{dt}$$



$$\oiint_{S_{chiusa}} \mathbf{j} \cdot d\mathbf{S} = -\frac{d}{dt} \iiint_{V_{\text{int}}} \rho dv$$

L. di conservazione della carica elettrica

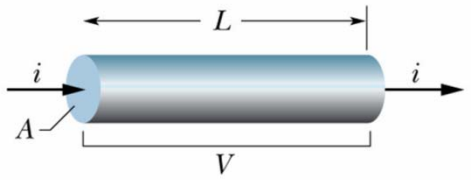
$$\oiint_{S_{chiusa}} \mathbf{j} \cdot d\mathbf{S} = 0$$

In condizioni stazionarie (correnti e densità di carica cost.)

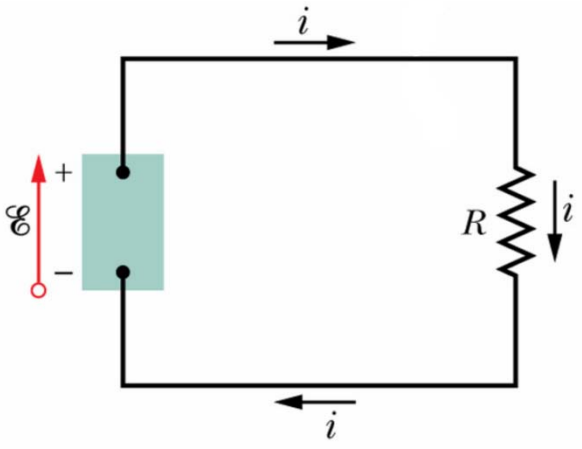
L. di Ohm e resistenza

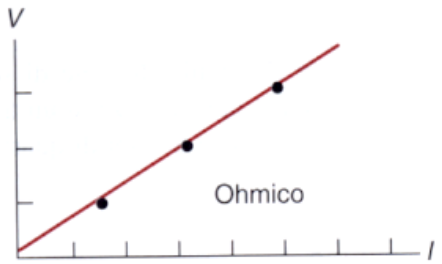
$$R = \frac{V}{I}$$

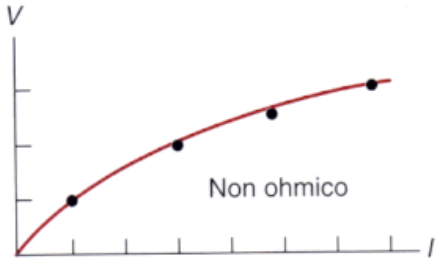
I Legge di Ohm



$$[\Omega] = \left[\frac{V}{A}\right]$$





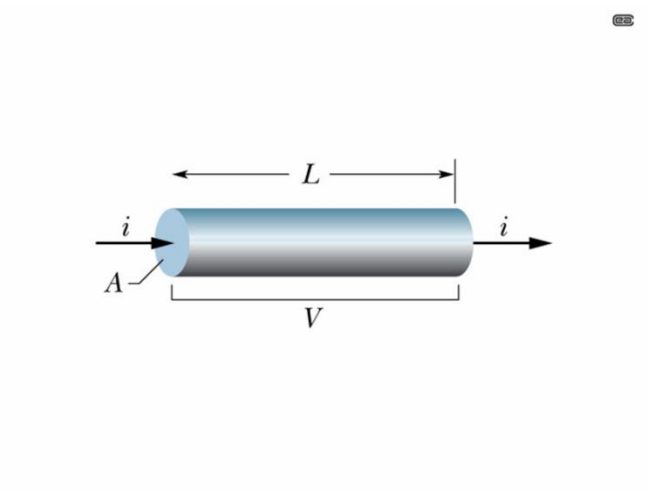


L. di Ohm e resistenza

$$R = \frac{\rho \mathrm{L}}{\mathrm{A}}$$

II Legge di Ohm

$$[\rho] = [\Omega \cdot \mathrm{m}]$$



$$\mathbf{j} = \sigma \mathbf{E} \quad \text{opp.} \quad \mathbf{E} = \rho \mathbf{j}$$

Legge di Ohm

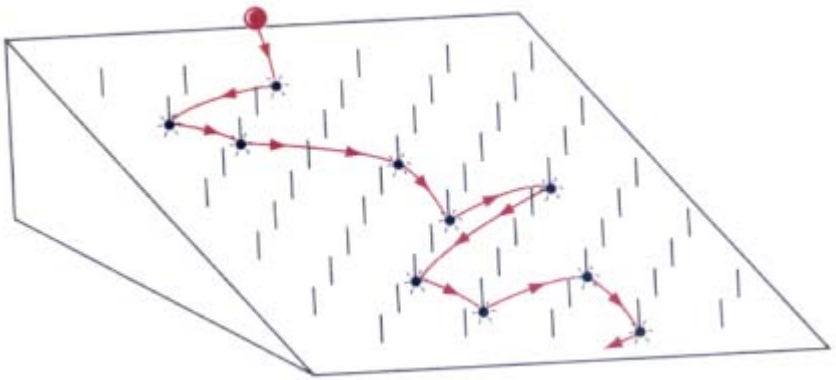
Tabella 5.1
Resistività a 20 °C

Sostanza	ρ, Ω · m
Metalli	
Argento	1.59×10^{-8}
Rame	1.673×10^{-8}
Oro	2.35×10^{-8}
Alluminio	2.655×10^{-8}
Tungsteno	5.65×10^{-8}
Nichel	6.84×10^{-8}
Ferro	9.71×10^{-8}
Platino	10.6×10^{-8}
Piombo	20.65×10^{-8}
Semiconduttori	
Silicio	4.3×10^{3}
Germanio	0.46
Isolanti	
Vetro	10^{10}-10^{14}
Quarzo	7.5×10^{17}
Zolfo	10^{15}
Teflon	10^{13}
Gomma	10^{13}-10^{16}
Legno	10^{8}-10^{11}
Carbonio (diamante)	10^{11}

Modello di Drude

$$j = n v_d |q|$$

$$\mathbf{j} = \sigma \mathbf{E}$$



$$v_x = v_{x0} + a_x t = v_{xo} - \left(\frac{eE}{m}\right) t$$

$$\langle v_x \rangle = \langle v_{x0} \rangle - \left(\frac{eE}{m}\right) \tau$$

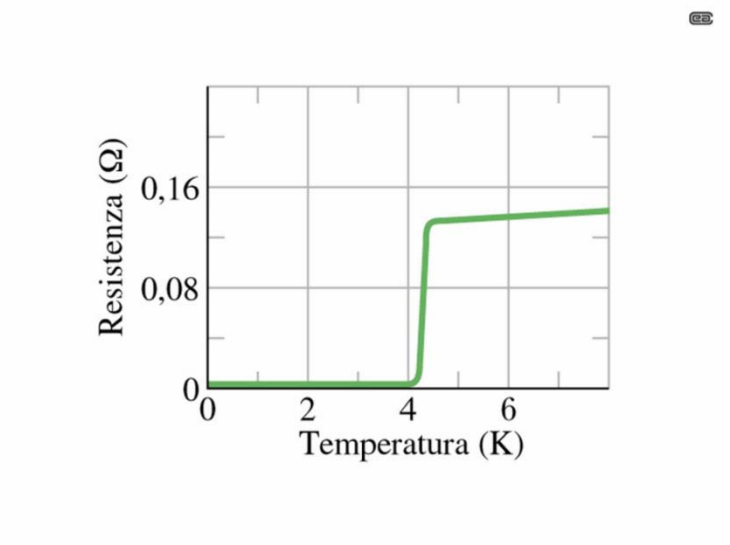
$$\langle v_x \rangle = \frac{-eE}{m} \tau = v_d$$

$$\mathbf{j} = n(-e)\left(\frac{-eE\tau}{m}\right)\mathbf{i} = \frac{ne^2\tau}{m}\mathbf{E}$$

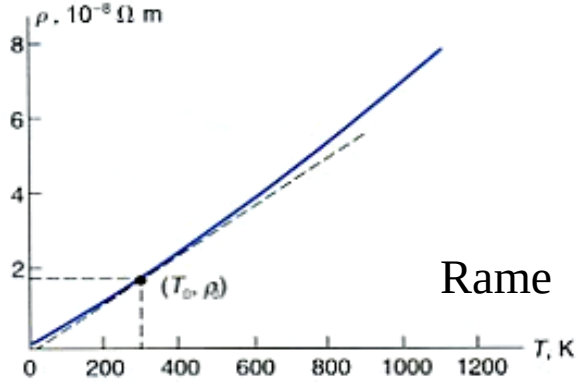
$$\sigma = \frac{ne^2\tau}{m}$$

Conducibilità nei metalli

$$\rho \approx \rho_0 \left[1 + \alpha \left(T - T_0\right)\right]$$

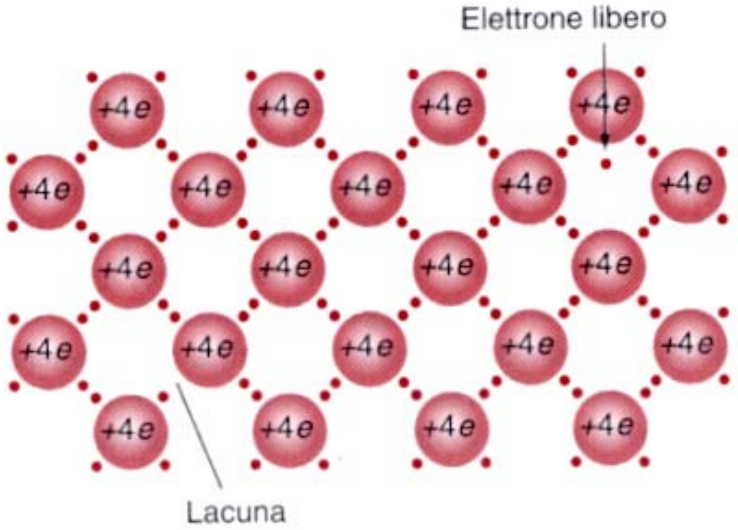


← Superconduttività

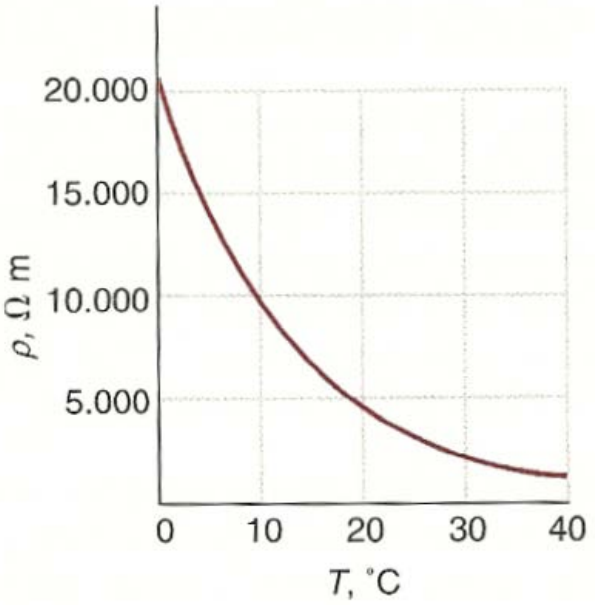


Rame

Semiconduttori



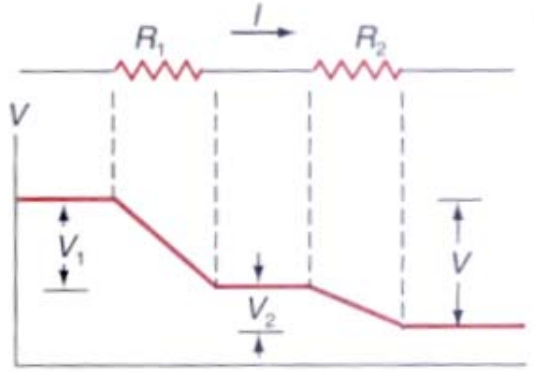
Silicio

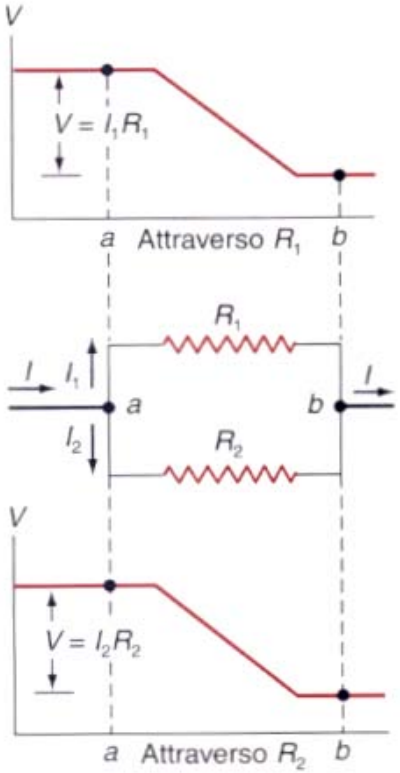


Resistenze in serie e parallelo

$$V = IR_1 + IR_2 = I\left(R_1 + R_2\right)$$

$$R_{12} = R_1 + R_2$$

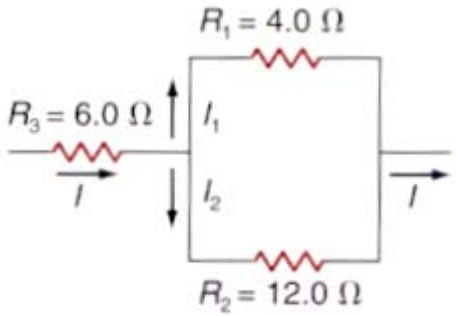


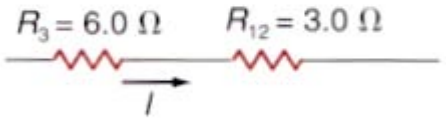


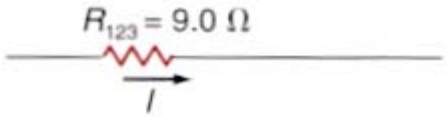
$$I = I_1 + I_2 = \frac{V}{R_1} + \frac{V}{R_2}$$

$$\frac{1}{R_{12}} = \frac{1}{R_1} + \frac{1}{R_2}$$

Esempio


$R_1 = 4.0\ \Omega$
$R_3 = 6.0\ \Omega$
I_1
I_2
I
I
$R_2 = 12.0\ \Omega$


$R_3 = 6.0\ \Omega$
$R_{12} = 3.0\ \Omega$
I


$R_{123} = 9.0\ \Omega$
I

Amperometri e voltmetri