Electricidad

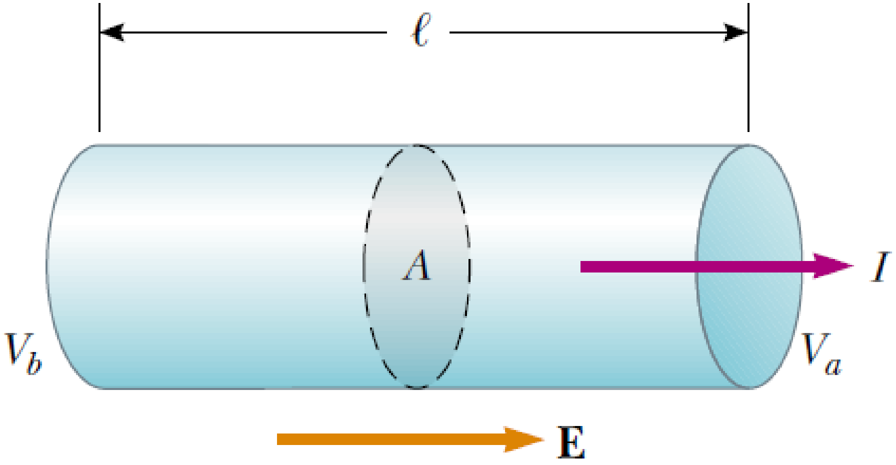
Alessandro Volta 1799

Ley de Ohm

$$\boxed{\mathbf{J} = \sigma \mathbf{E}}$$

$$\rho = \frac{1}{\sigma}$$

resistividad

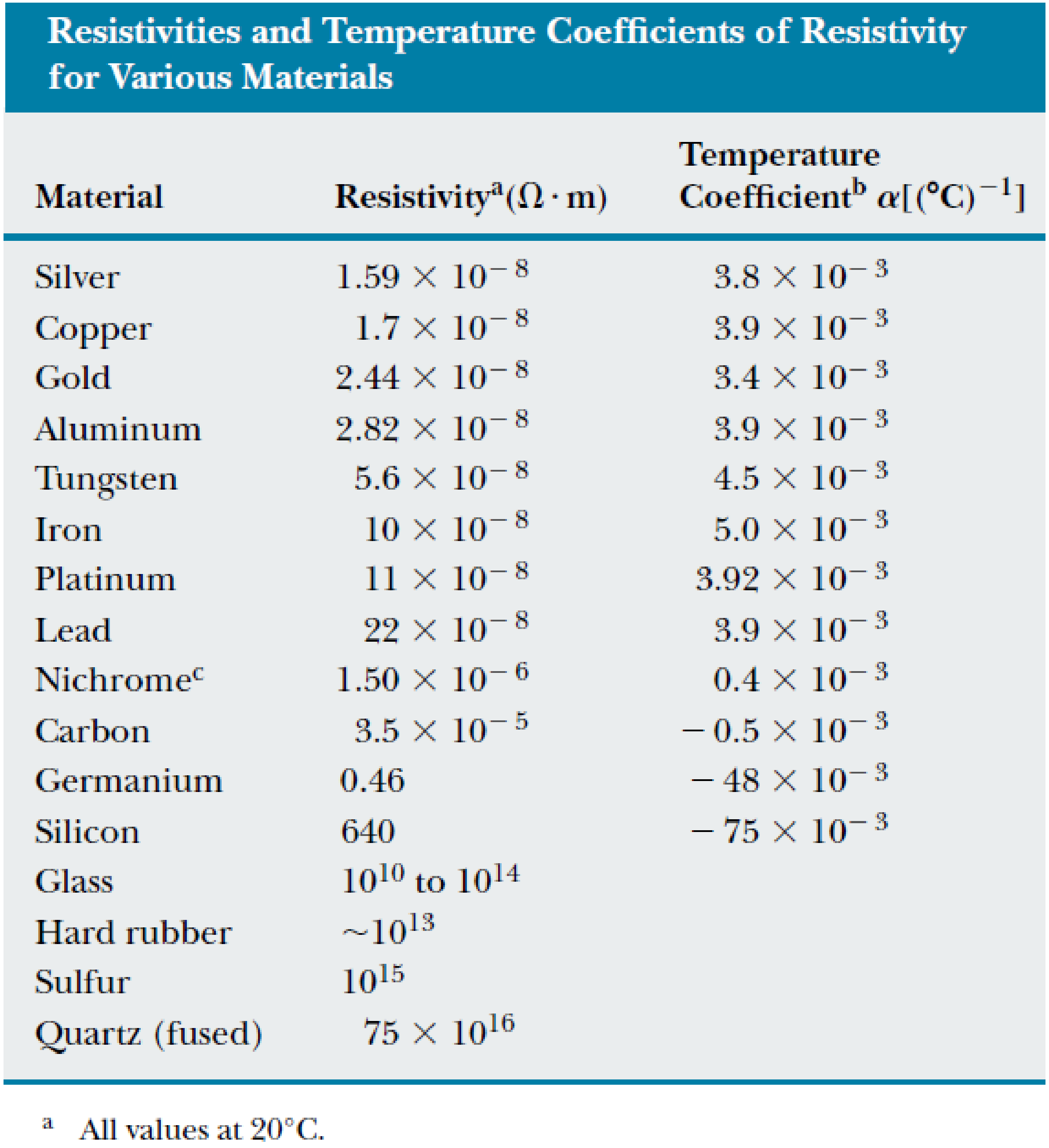


$$\Delta V = E\ell$$

$$\boxed{\Delta V = \frac{\ell}{\sigma} J = \left(\frac{\ell}{\sigma A}\right) I = RI}$$

Resistencia

$$1\ \Omega \equiv \frac{1\ \mathrm{V}}{1\ \mathrm{A}}$$



Resistivities and Temperature Coefficients of Resistivity for Various Materials

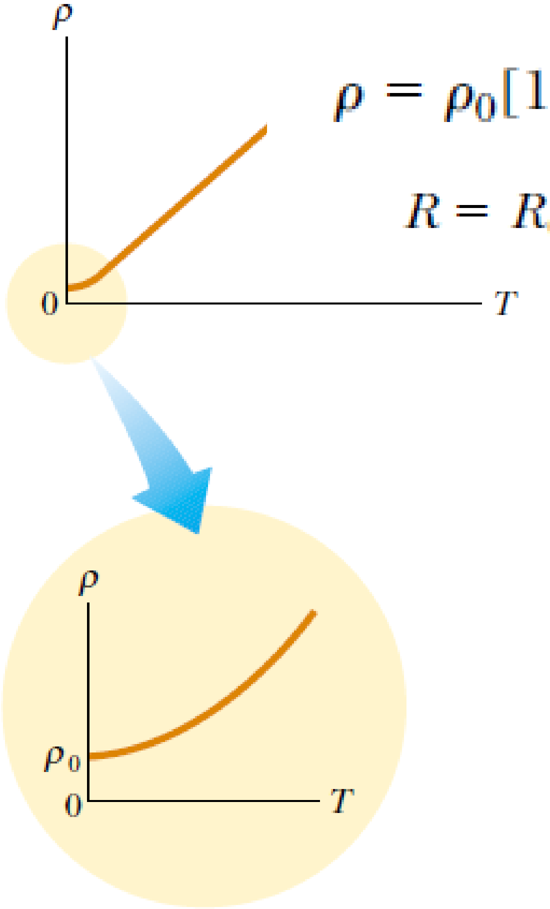
Material	Resistivity[a] ($\Omega \cdot m$)	Temperature Coefficient[b] $\alpha[(°C)^{-1}]$
Silver	1.59×10^{-8}	3.8×10^{-3}
Copper	1.7×10^{-8}	3.9×10^{-3}
Gold	2.44×10^{-8}	3.4×10^{-3}
Aluminum	2.82×10^{-8}	3.9×10^{-3}
Tungsten	5.6×10^{-8}	4.5×10^{-3}
Iron	10×10^{-8}	5.0×10^{-3}
Platinum	11×10^{-8}	3.92×10^{-3}
Lead	22×10^{-8}	3.9×10^{-3}
Nichrome[c]	1.50×10^{-6}	0.4×10^{-3}
Carbon	3.5×10^{-5}	-0.5×10^{-3}
Germanium	0.46	-48×10^{-3}
Silicon	640	-75×10^{-3}
Glass	10^{10} to 10^{14}	
Hard rubber	$\sim 10^{13}$	
Sulfur	10^{15}	
Quartz (fused)	75×10^{16}	

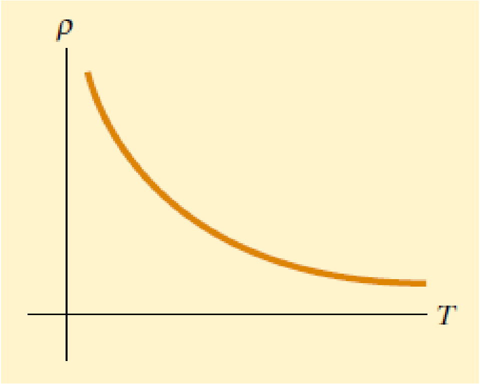
[a] All values at 20°C.

Variación de la resistencia con T

$$\rho = \rho_0[1 + \alpha(T - T_0)]$$

$$R = R_0[1 + \alpha(T - T_0)]$$





Variación de la resistividad con la T para un metal como Cu. Se pierde linealidad para T~0 K

Variación de la resistividad con la temperatura para un semiconductor como Si o Ge

α negativo!

Variación de la resistencia con T: Superconductores

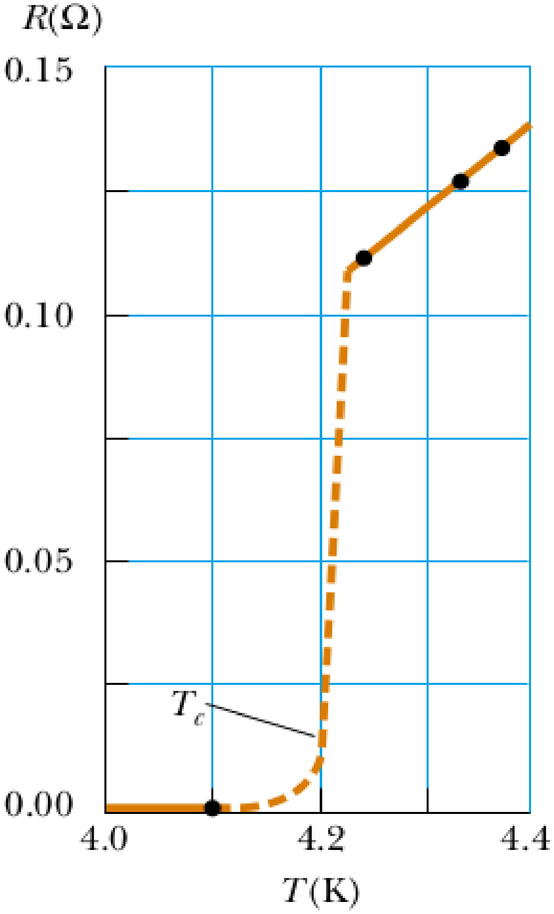


Figure 27.12 Resistance versus temperature for a sample of mercury (Hg). The graph follows that of a normal metal above the critical temperature T_c. The resistance drops to zero at T_c, which is 4.2 K for mercury.

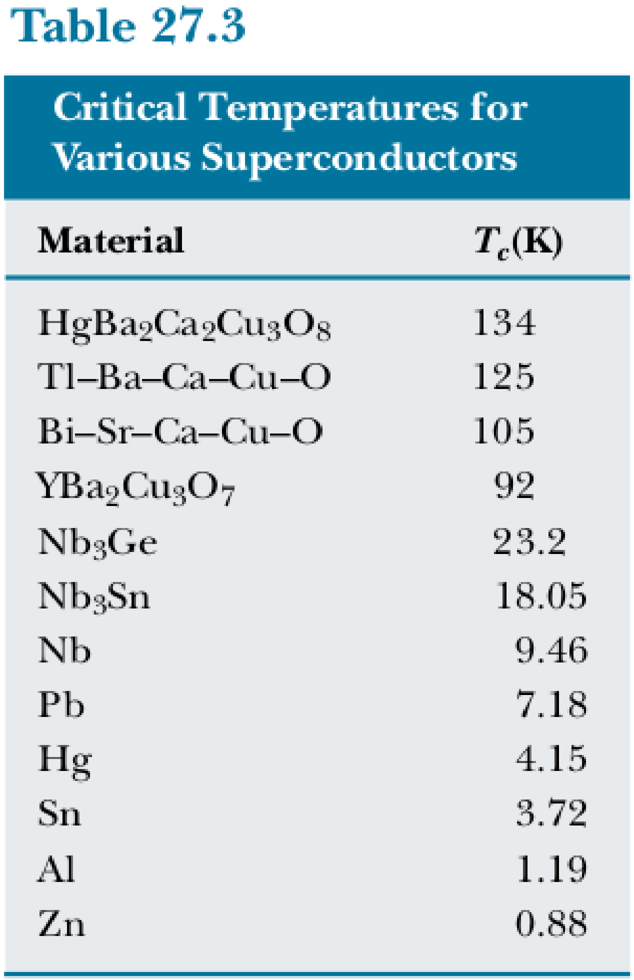
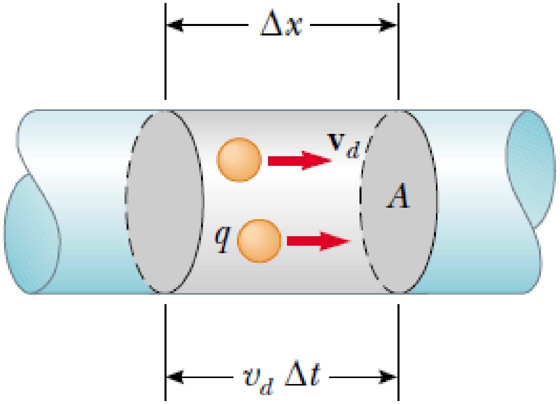


Table 27.3

Critical Temperatures for Various Superconductors

Material	T_c(K)
$HgBa_2Ca_2Cu_3O_8$	134
Tl–Ba–Ca–Cu–O	125
Bi–Sr–Ca–Cu–O	105
$YBa_2Cu_3O_7$	92
Nb_3Ge	23.2
Nb_3Sn	18.05
Nb	9.46
Pb	7.18
Hg	4.15
Sn	3.72
Al	1.19
Zn	0.88

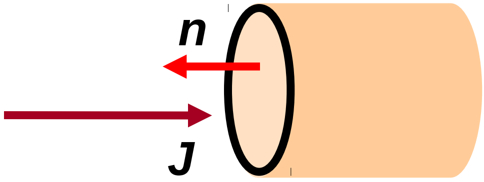
Repaso



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

Corriente eléctrica

$$I = -\oint_S \mathbf{J}\cdot\mathbf{n}\,da = -\int_V \nabla\cdot\mathbf{J}\,dv$$



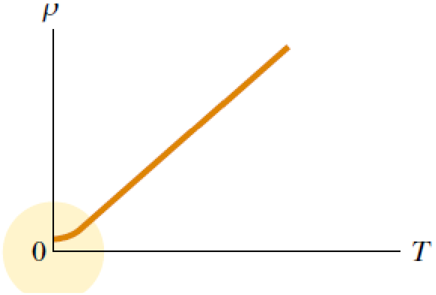
$$\mathbf{J} = \sigma\mathbf{E}$$

$$R \equiv \frac{\Delta V}{I}$$

Ley de Ohm

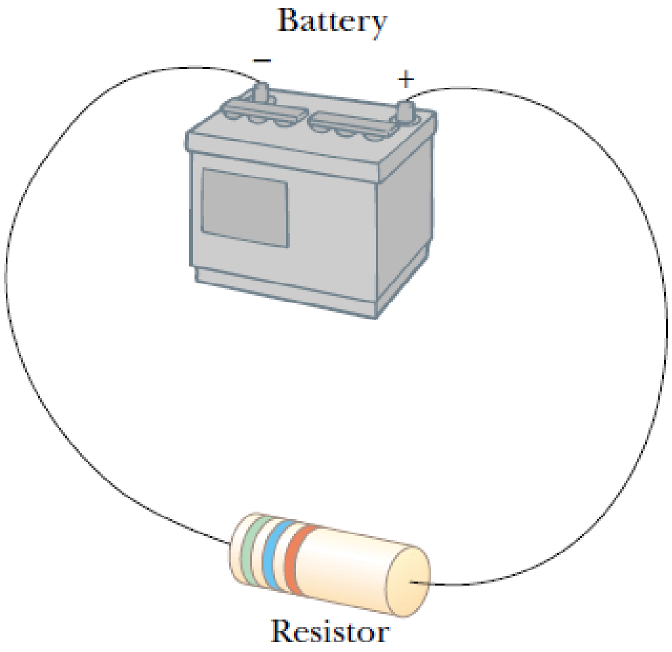
$$R = \ell/\sigma A$$

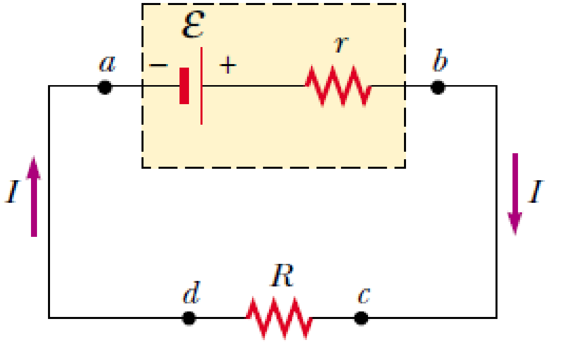
$$\rho = \rho_0[1 + \alpha(T - T_0)]$$

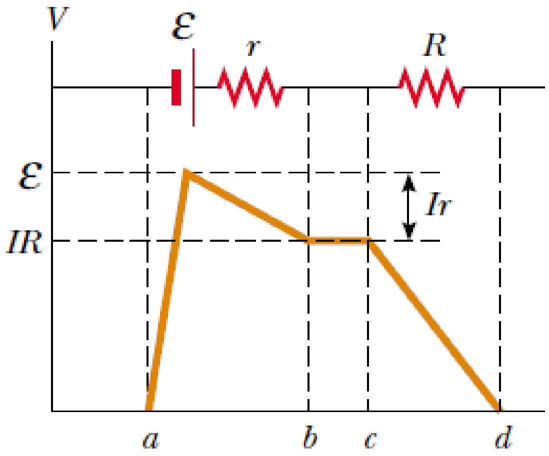


Universidad Nacional del Sur, Mayo de 2018

Circuitos de Corriente continua







$$\mathcal{E} = IR + Ir$$

$$I = \frac{\mathcal{E}}{R + r}$$

Cuidado! La diferencia de potencial V_{ab} depende de la resistencia R

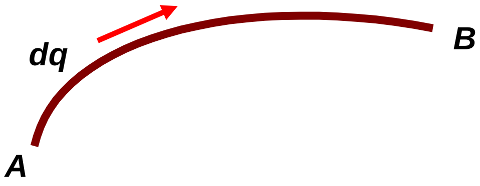
Preguntas…

¿Cómo puede ser que la corriente sea la misma en todo el circuito?

¿Cómo puede ser que la luz se prenda instantáneamente si los portadores de carga viajan con una velocidad del orden de 10^{-4} m/seg?

Discutamos mejor la batería…..

Ley de Joule



$$\underbrace{\frac{dW}{dt}}_{P}=\underbrace{\frac{dq}{dt}}_{I}\left(V_b-V_a\right)$$

$$\mathcal{P} = I\,\Delta V$$

Para una resistencia

Ley de Joule

$$\mathcal{P} = I^2 R$$

Corrientes variables en el tiempo

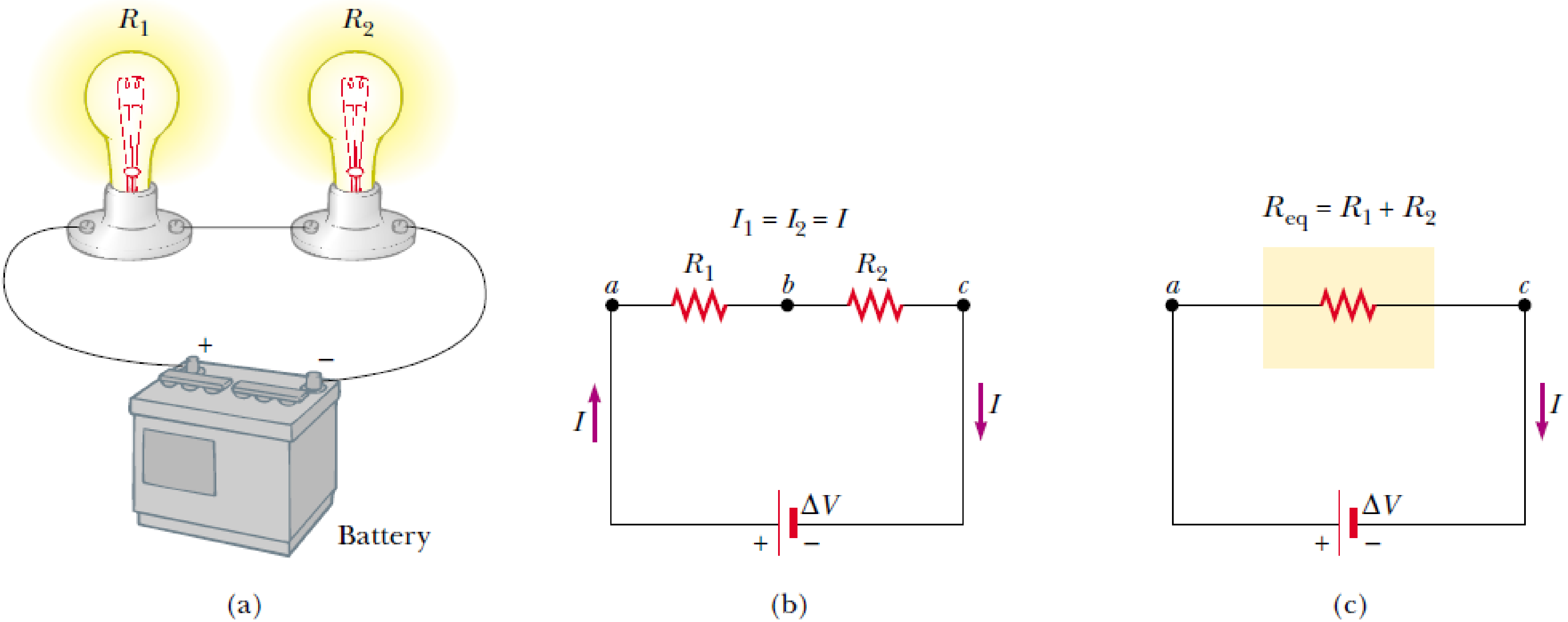
Valor medio

$$i_{med} t = \int i\left(t'\right) dt'$$

Valor eficaz

$$i_{ef}^{2} t = \int i\left(t'\right)^{2} dt'$$

Arreglos de Resistencias



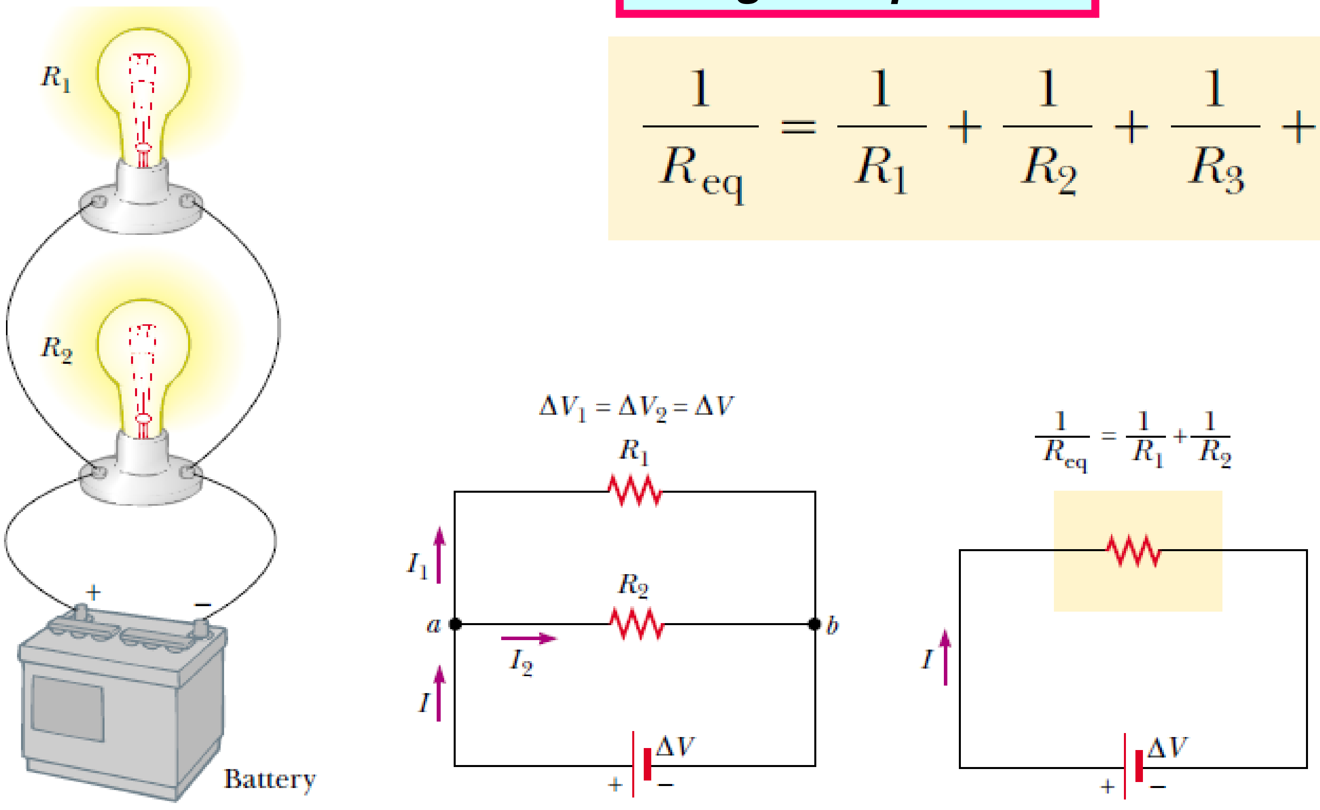
Arreglo en Serie

$$R_{eq} = R_1 + R_2 + R_3 + \cdots$$

Arreglos de Resistencias

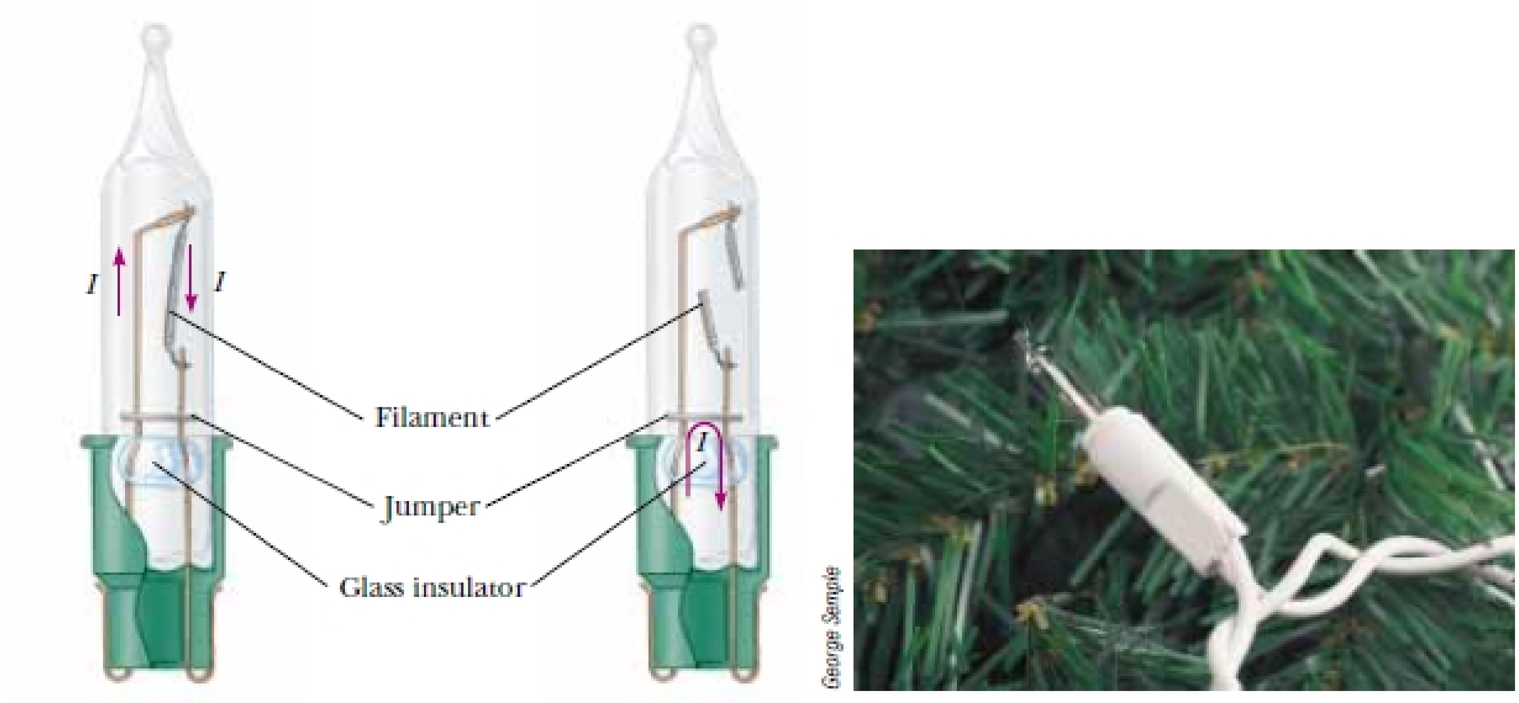
Arreglo en paralelo

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots$$



(a) (b) (c)

Caso particular: arreglos de luces



(a) (b) (c)