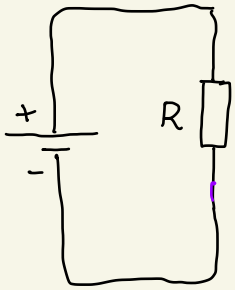
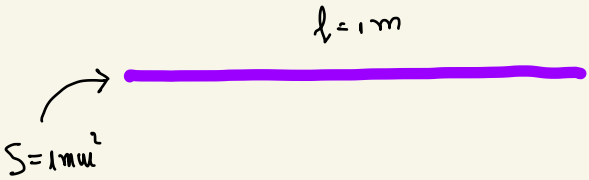
28 APRILIE

Măsurarea rezistențelor mici.
Determinarea rezistivității electrice a metalelor.
Verificarea legii lui OHM





$$R = \frac{\rho l}{S}$$

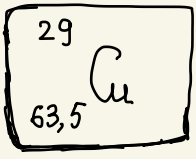
ρ - rezistivitatea electrică

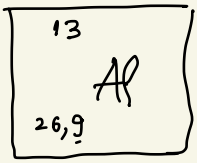
$$\rho_{Cu} = 1,68 \cdot 10^{-8}\ \Omega \cdot m$$

$$\rho_{Al} = 2,82 \cdot 10^{-8}\ \Omega \cdot m.$$

$$R_{Cu} = \frac{1,68 \cdot 10^{-8} \cdot 1}{10^{-6}}\ \Omega = 0,0168\ \Omega \simeq 0,02\ \Omega$$

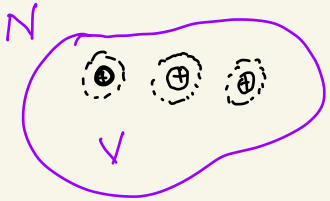
$$R_{Al} = \frac{2,82 \cdot 10^{-8} \cdot 1}{10^{-6}}\ \Omega = 0,0282\ \Omega \simeq 0,03\ \Omega$$





$$n = \frac{N}{V} \left(m^{-3}\right)$$

$$\boxed{n = \frac{d \cdot N_A}{\mu}}$$



$d_{Cu} = 8960 \frac{kg}{m^3}$ $\quad \mu_{Cu} = 63,5 \frac{g}{mol} =$

$d_{Al} = 2700 \frac{kg}{m^3}$ $\quad = 63,5 \cdot 10^{-3} \frac{kg}{mol}$

$\mu_{Al} = 27 \cdot 10^{-3} \frac{kg}{mol}$.

$n_{Cu} = 8,5 \cdot 10^{28} m^{-3}$

$n_{Al} \simeq 6 \cdot 10^{28} m^{-3}$

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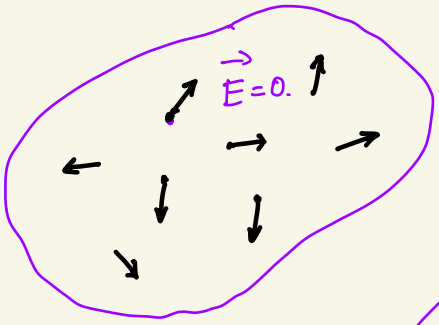
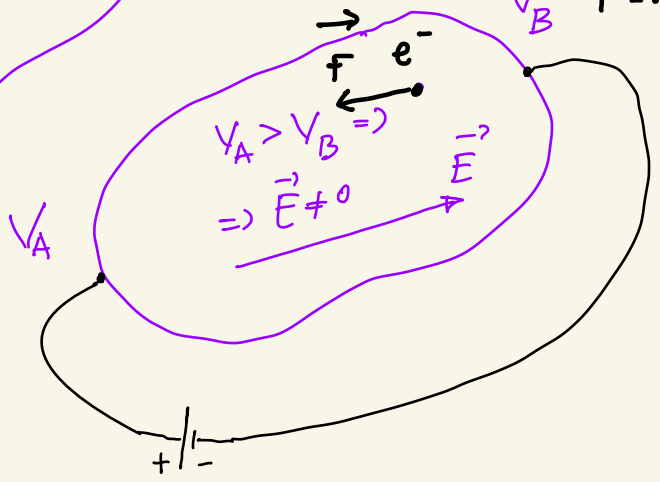


$\vec{F} = q\vec{E}$

$\vec{F} = m\vec{a}$

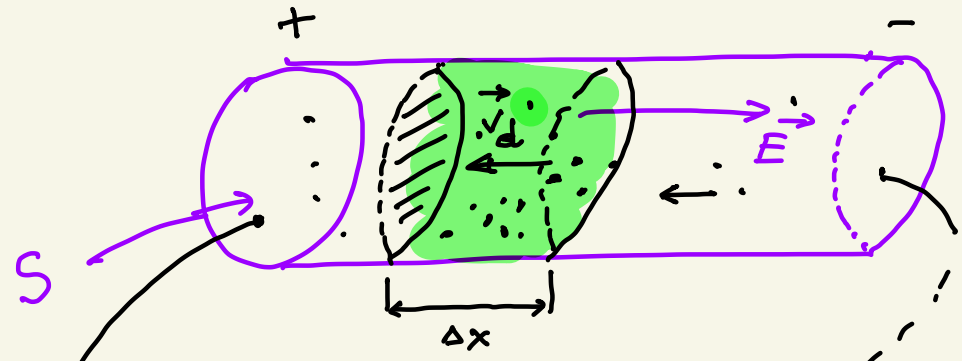


Forța de tensiune electromotoare are rolul de a produce o separare de sarcină electrică ce dă naștere unui câmp electric $\neq 0$ în interiorul metalului. Echilibrul electrostatic se strică și mișcarea de electroni liberi începe să se miște dirijat spre stânga cu viteze din ce în ce mai mari. Dacă nu ar întâmpina nici o piedică, viteza electronilor liberi ar crește mereu. Însă în metal există piedici: nodurile rețelei cristaline. Electronii se ciocnesc de acele noduri și își micșorează viteza după care iarăși își mărește viteză; iarăși se ciocnesc; iarăși își pierd viteza și din nou își mărește viteza ș.a.m.d.

Procesul acesta poate sugestiv exprimat prin succesiunea de cuvinte:

START - STOP - START - STOP - START - ...

Deși mișcarea reală nu este rectilinie și uniformă ea poate fi caracterizată printr-o mișcare cu o viteză medie a mării de electroni, numită <u>viteză de drift</u>. ($\vec{v}_d$)



t_1: N_1

t_2:

$$J = \frac{|Q_1|}{\Delta t} = \frac{|N_1(-e)|}{\Delta t} = \frac{N_1 e}{\Delta t} =$$

$$= \left(\frac{N_1}{\Delta V}\right) \frac{\Delta V e}{\Delta t} = n \frac{S \cdot \Delta x \cdot e}{\Delta t}$$

$$= S v_d e n$$

$$\boxed{J = S v_d e n}$$

$$v_d = \frac{J}{Sen} \quad ; \quad \text{Dacă } J = 1\ A \Rightarrow$$

$$\Rightarrow v_d = \frac{1}{10^{-6} \cdot 1{,}6 \cdot 10^{-19} \cdot 8{,}5 \cdot 10^{28}} \frac{m}{s}$$

$$= \frac{10^{-3}}{1,6 \cdot 8,5} \frac{m}{s}$$

$$v_{d\,Cu} = \frac{10^{-3}}{13,6} \frac{m}{s} \simeq 0,07 \cdot 10^{-3} \frac{m}{s}$$

$$= 0,07 \cdot 10^{-1} \cdot 10^{-2} \frac{m}{s}$$

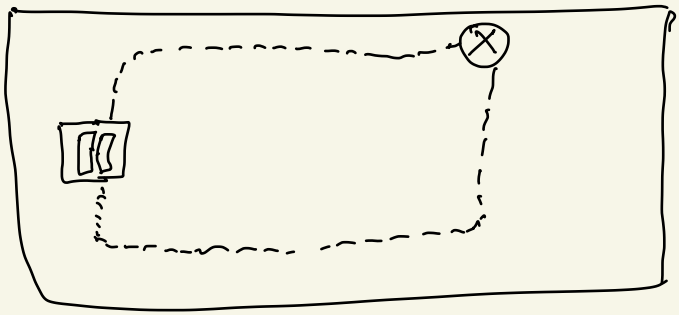
$$= 0,07 \cdot 10^{-1} \frac{cm}{s} = 0,07 \frac{mm}{s}$$

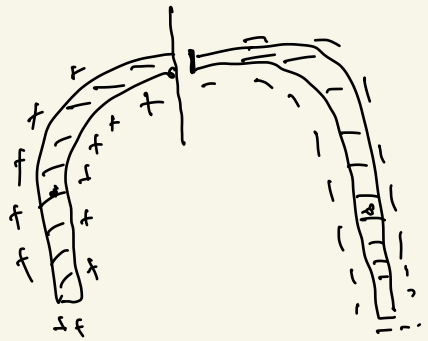
$$v_{snail} \simeq 0,013 \frac{m}{s} = 13 \frac{mm}{s}$$

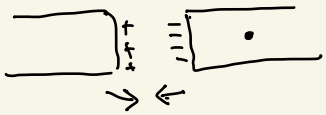
$$t = \frac{l}{v_d} = \frac{1}{0,07 \cdot 10^{-3}} s = \frac{1000}{0,07} s = \frac{100.000}{7} s$$

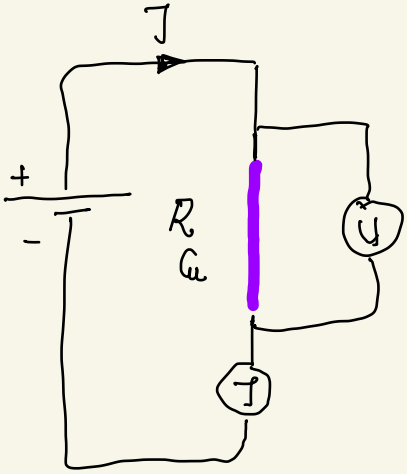
$$\simeq 1,4 \cdot 10.000 s = 14000 s = \frac{14000}{3600} h =$$

$$= \frac{140}{36} h \simeq 4 h.$$







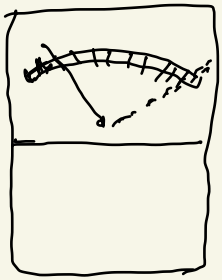


$J = 10\,mA$

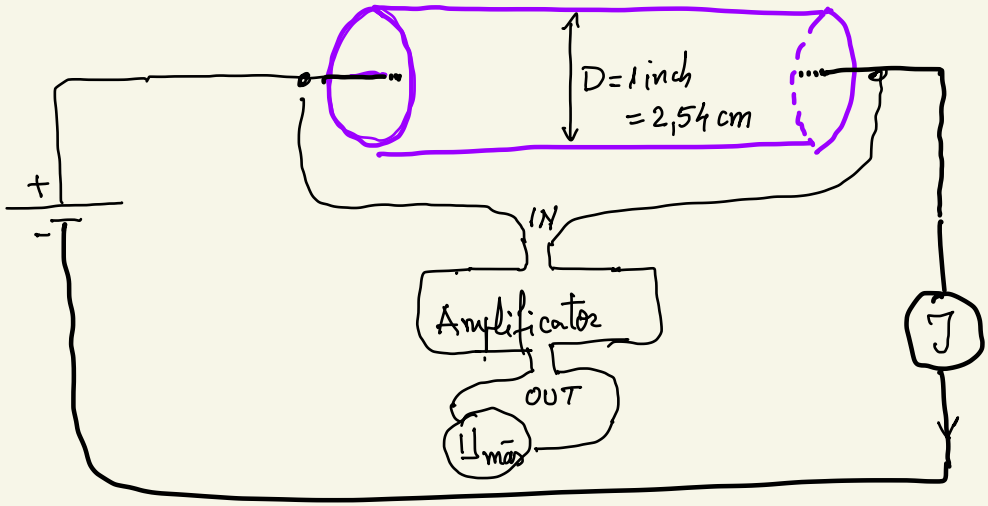
$U_{Cu} = R_{Cu} \cdot J = 0,02 \cdot 10 \cdot 10^{-3}\,V$

$= 0,02 \cdot 10^{-2}\,V$

$= 0,0002\,V$



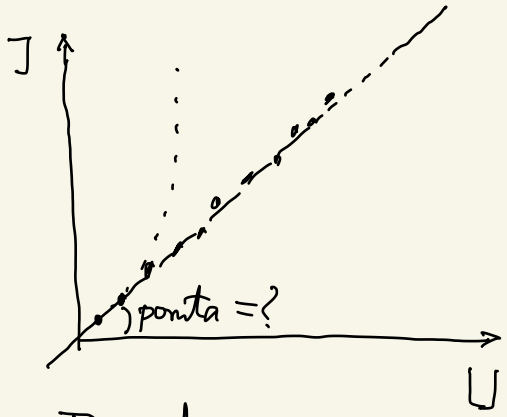
Montajul experimental.



$$U_{mās} = 10^5 \cdot U$$

$$U = \frac{U_{mās}}{100.000}$$

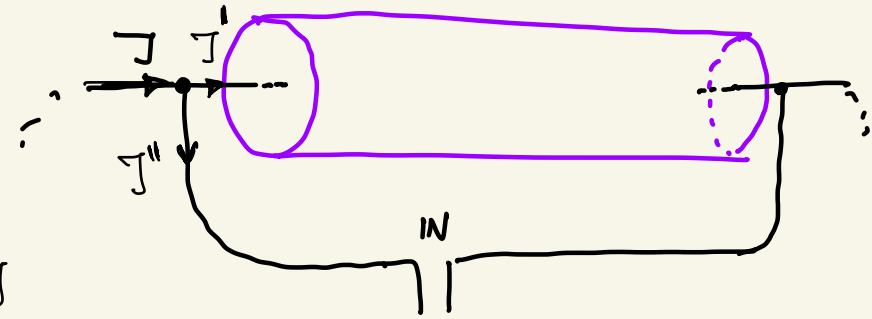
$I(A)$	$U_{mās}(V)$	$U = \frac{U_{mās}}{100.000}$



$$R = \frac{1}{\text{panta}}$$

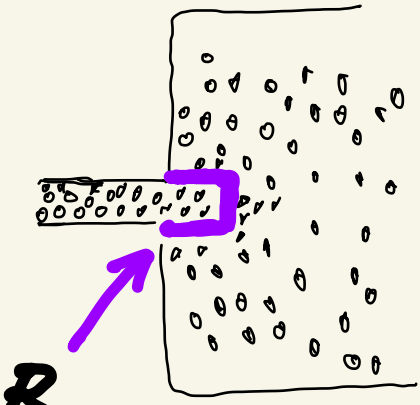
$$R = \frac{\rho l}{S} \Rightarrow \rho = \frac{RS}{l}$$

Deși am rezolvat problema măsurării rezistențelor mici, montajul de mai sus încă nu este „bun". De ce?



$I' \simeq I$

$I' \gg I''$



$R_{contact} \gg R_{bară}$