Mecatronica automobilului

electricitate si electronica

principii

Proceduri de siguranta

Orice activitate practica in relatie cu sisteme electrice sau electronice necesita masuri de siguranta pentru siguranta proprie si a altora

- Utilizati bunul simt
- Inainte de a actiona, informati-va!

Evaluarea si reducerea riscurilor

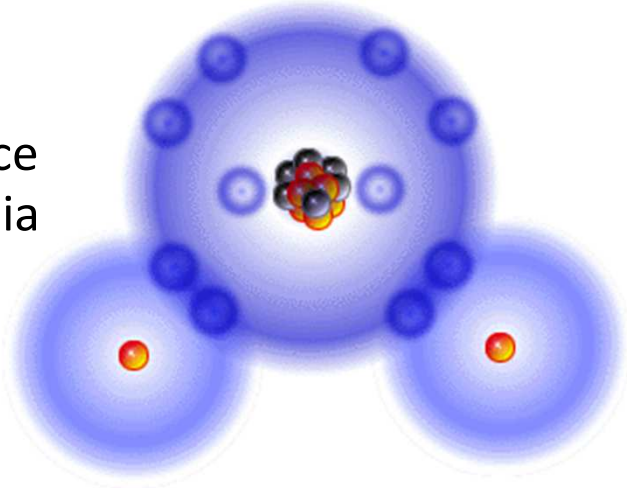
Risc identificat	Reducerea riscului
Electrocutare	Sistemul de aprindere (<=25000V) – circuite cu infasurari (sute de volti); utilizati scule izolate electric; utilizati aparatura si scule electrice avand conductorii in stare buna de functionare si daca e posibil cu impamantare.
Bateria auto	H_2SO_4 este coroziv – utilizati echipament de protectie personala
Inaltare sau ridicare vehicule	Blocati rotile; utilizati cricul pe elemente structurale, utilizati suporti de sustinere
Motoare in functiune	Nu purtati haine desfacute sau largi. Utilizati salopete. Atentie la organe de masina in miscare.
Gaze de evacuare	Utilizati extractoare de gaze cand se lucreaza in cladire. Atentie nu numai la CO ci si la ceilalti compusi ce pot provoca astm sau cancer.
Deplasarea sarcinilor	Ridicati doar cat puteti. Solicitati ajutor sau utilizati mijloace de ridicare si transport
Scurtcircuite	Utilizati cabluri de testare prevazute cu sigurante. Deconectati bateria (mai intai masa apoi +, la conectare invers)
Foc	Nu fumati cand lucrati. Identificati si remediati orice scurgere de combustibil. (triunghiul focului - caldura/combustibil/oxigen)
Probleme ale pielii	Utilizati creme si/sau manusi de latex. Spalati-va si stergeti-va cat mai des.

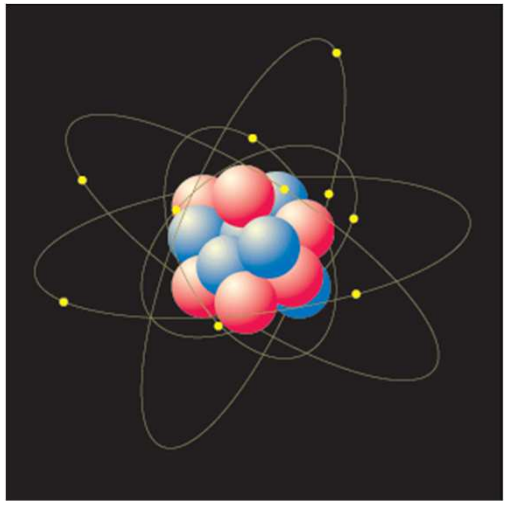
Principii de baza ale electricitatii

"Cu ce nu vad, io nu lucru" ➔ "complexitatea" electricitatii

Introducere

Molecula - cea mai mica parte dintr-o substanta ce pastreaza compozitia chimica si structura acesteia





Atomul – cea mai mica parte a unui element chimic ce pastreaza proprietatile fizico-chimice ale acestuia

PERIODIC TABLE

Atomic Properties of the Elements

NIST
National Institute of Standards and Technology
Technology Administration, U.S. Department of Commerce

Physics Laboratory
physics.nist.gov

Standard Reference Data Group
www.nist.gov/srd

Frequently used fundamental physical constants

For the most accurate values of these and other constants, visit physics.nist.gov/constants

1 second = 9 192 631 770 periods of radiation corresponding to the transition between the two hyperfine levels of the ground state of ^{133}Cs

speed of light in vacuum	c	299 792 458 m s^{-1}	(exact)
Planck constant	h	6.6261×10^{-34} J s	($\hbar = h/2\pi$)
elementary charge	e	1.6022×10^{-19} C	
electron mass	m_e	9.1094×10^{-31} kg	
	$m_e c^2$	0.5110 MeV	
proton mass	m_p	1.6726×10^{-27} kg	
fine-structure constant	α	1/137.036	
Rydberg constant	R_∞	10 973 732 m^{-1}	
	$R_\infty c$	$3.289\,842 \times 10^{15}$ Hz	
	$R_\infty hc$	13.6057 eV	
Boltzmann constant	k	1.3807×10^{-23} J K^{-1}	

Solids
Liquids
Gases
Artificially Prepared

Group 1 IA | 2 IIA | 3 IIIB | 4 IVB | 5 VB | 6 VIB | 7 VIIB | 8 | 9 VIII | 10 | 11 IB | 12 IIB | 13 IIIA | 14 IVA | 15 VA | 16 VIA | 17 VIIA | 18 VIIIA

Period

Period	Group 1 IA	Group 2 IIA	Group 3 IIIB	Group 4 IVB	Group 5 VB	Group 6 VIB	Group 7 VIIB	Group 8	Group 9 VIII	Group 10	Group 11 IB	Group 12 IIB	Group 13 IIIA	Group 14 IVA	Group 15 VA	Group 16 VIA	Group 17 VIIA	Group 18 VIIIA
1	1 $^2S_{1/2}$ **H** Hydrogen 1.00794 1s 13.5984																	2 $^1S_0$ **He** Helium 4.002602 $1s^2$ 24.5874
2	3 $^2S_{1/2}$ **Li** Lithium 6.941 $1s^22s$ 5.3917	4 $^1S_0$ **Be** Beryllium 9.012182 $1s^22s^2$ 9.3227											5 $^2P^o_{1/2}$ **B** Boron 10.811 $1s^22s^22p$ 8.2980	6 $^3P_0$ **C** Carbon 12.0107 $1s^22s^22p^2$ 11.2603	7 $^4S^o_{3/2}$ **N** Nitrogen 14.0067 $1s^22s^22p^3$ 14.5341	8 $^3P_2$ **O** Oxygen 15.9994 $1s^22s^22p^4$ 13.6181	9 $^2P^o_{3/2}$ **F** Fluorine 18.9984032 $1s^22s^22p^5$ 17.4228	10 $^1S_0$ **Ne** Neon 20.1797 $1s^22s^22p^6$ 21.5645
3	11 $^2S_{1/2}$ **Na** Sodium 22.989770 [Ne]3s 5.1391	12 $^1S_0$ **Mg** Magnesium 24.3050 $[Ne]3s^2$ 7.6462											13 $^2P^o_{1/2}$ **Al** Aluminum 26.981538 $[Ne]3s^23p$ 5.9858	14 $^3P_0$ **Si** Silicon 28.0855 $[Ne]3s^23p^2$ 8.1517	15 $^4S^o_{3/2}$ **P** Phosphorus 30.973761 $[Ne]3s^23p^3$ 10.4867	16 $^3P_2$ **S** Sulfur 32.065 $[Ne]3s^23p^4$ 10.3600	17 $^2P^o_{3/2}$ **Cl** Chlorine 35.453 $[Ne]3s^23p^5$ 12.9676	18 $^1S_0$ **Ar** Argon 39.948 $[Ne]3s^23p^6$ 15.7596
4	19 $^2S_{1/2}$ **K** Potassium 39.0983 [Ar]4s 4.3407	20 $^1S_0$ **Ca** Calcium 40.078 $[Ar]4s^2$ 6.1132	21 $^2D_{3/2}$ **Sc** Scandium 44.955910 $[Ar]3d4s^2$ 6.5615	22 $^3F_2$ **Ti** Titanium 47.867 $[Ar]3d^24s^2$ 6.8281	23 $^4F_{3/2}$ **V** Vanadium 50.9415 $[Ar]3d^34s^2$ 6.7462	24 $^7S_3$ **Cr** Chromium 51.9961 $[Ar]3d^54s$ 6.7665	25 $^6S_{5/2}$ **Mn** Manganese 54.938049 $[Ar]3d^54s^2$ 7.4340	26 $^5D_4$ **Fe** Iron 55.845 $[Ar]3d^64s^2$ 7.9024	27 $^4F_{9/2}$ **Co** Cobalt 58.933200 $[Ar]3d^74s^2$ 7.8810	28 $^3F_4$ **Ni** Nickel 58.6934 $[Ar]3d^84s^2$ 7.6398	29 $^2S_{1/2}$ **Cu** Copper 63.546 $[Ar]3d^{10}4s$ 7.7264	30 $^1S_0$ **Zn** Zinc 65.409 $[Ar]3d^{10}4s^2$ 9.3942	31 $^2P^o_{1/2}$ **Ga** Gallium 69.723 $[Ar]3d^{10}4s^24p$ 5.9993	32 $^3P_0$ **Ge** Germanium 72.64 $[Ar]3d^{10}4s^24p^2$ 7.8994	33 $^4S^o_{3/2}$ **As** Arsenic 74.92160 $[Ar]3d^{10}4s^24p^3$ 9.7886	34 $^3P_2$ **Se** Selenium 78.96 $[Ar]3d^{10}4s^24p^4$ 9.7524	35 $^2P^o_{3/2}$ **Br** Bromine 79.904 $[Ar]3d^{10}4s^24p^5$ 11.8138	36 $^1S_0$ **Kr** Krypton 83.798 $[Ar]3d^{10}4s^24p^6$ 13.9996
5	37 $^2S_{1/2}$ **Rb** Rubidium 85.4678 [Kr]5s 4.1771	38 $^1S_0$ **Sr** Strontium 87.62 $[Kr]5s^2$ 5.6949	39 $^2D_{3/2}$ **Y** Yttrium 88.90585 $[Kr]4d5s^2$ 6.2173	40 $^3F_2$ **Zr** Zirconium 91.224 $[Kr]4d^25s^2$ 6.6339	41 $^6D_{1/2}$ **Nb** Niobium 92.90638 $[Kr]4d^45s$ 6.7589	42 $^7S_3$ **Mo** Molybdenum 95.94 $[Kr]4d^55s$ 7.0924	43 $^6S_{5/2}$ **Tc** Technetium (98) $[Kr]4d^55s^2$ 7.28	44 $^5F_5$ **Ru** Ruthenium 101.07 $[Kr]4d^75s$ 7.3605	45 $^4F_{9/2}$ **Rh** Rhodium 102.90550 $[Kr]4d^85s$ 7.4589	46 $^1S_0$ **Pd** Palladium 106.42 $[Kr]4d^{10}$ 8.3369	47 $^2S_{1/2}$ **Ag** Silver 107.8682 $[Kr]4d^{10}5s$ 7.5762	48 $^1S_0$ **Cd** Cadmium 112.411 $[Kr]4d^{10}5s^2$ 8.9938	49 $^2P^o_{1/2}$ **In** Indium 114.818 $[Kr]4d^{10}5s^25p$ 5.7864	50 $^3P_0$ **Sn** Tin 118.710 $[Kr]4d^{10}5s^25p^2$ 7.3439	51 $^4S^o_{3/2}$ **Sb** Antimony 121.760 $[Kr]4d^{10}5s^25p^3$ 8.6084	52 $^3P_2$ **Te** Tellurium 127.60 $[Kr]4d^{10}5s^25p^4$ 9.0096	53 $^2P^o_{3/2}$ **I** Iodine 126.90447 $[Kr]4d^{10}5s^25p^5$ 10.4513	54 $^1S_0$ **Xe** Xenon 131.293 $[Kr]4d^{10}5s^25p^6$ 12.1298
6	55 $^2S_{1/2}$ **Cs** Cesium 132.90545 [Xe]6s 3.8939	56 $^1S_0$ **Ba** Barium 137.327 $[Xe]6s^2$ 5.2117		72 $^3F_2$ **Hf** Hafnium 178.49 $[Xe]4f^{14}5d^26s^2$ 6.8251	73 $^4F_{3/2}$ **Ta** Tantalum 180.9479 $[Xe]4f^{14}5d^36s^2$ 7.5496	74 $^5D_0$ **W** Tungsten 183.84 $[Xe]4f^{14}5d^46s^2$ 7.8640	75 $^6S_{5/2}$ **Re** Rhenium 186.207 $[Xe]4f^{14}5d^56s^2$ 7.8335	76 $^5D_4$ **Os** Osmium 190.23 $[Xe]4f^{14}5d^66s^2$ 8.4382	77 $^4F_{9/2}$ **Ir** Iridium 192.217 $[Xe]4f^{14}5d^76s^2$ 8.9670	78 $^3D_3$ **Pt** Platinum 195.078 $[Xe]4f^{14}5d^96s$ 8.9588	79 $^2S_{1/2}$ **Au** Gold 196.96655 $[Xe]4f^{14}5d^{10}6s$ 9.2255	80 $^1S_0$ **Hg** Mercury 200.59 $[Xe]4f^{14}5d^{10}6s^2$ 10.4375	81 $^2P^o_{1/2}$ **Tl** Thallium 204.3833 [Hg]6p 6.1082	82 $^3P_0$ **Pb** Lead 207.2 $[Hg]6p^2$ 7.4167	83 $^4S^o_{3/2}$ **Bi** Bismuth 208.98038 $[Hg]6p^3$ 7.2855	84 $^3P_2$ **Po** Polonium (209) $[Hg]6p^4$ 8.414	85 $^2P^o_{3/2}$ **At** Astatine (210) $[Hg]6p^5$	86 $^1S_0$ **Rn** Radon (222) $[Hg]6p^6$ 10.7485
7	87 $^2S_{1/2}$ **Fr** Francium (223) [Rn]7s 4.0727	88 $^1S_0$ **Ra** Radium (226) $[Rn]7s^2$ 5.2784		104 $^3F_2$? **Rf** Rutherfordium (261) $[Rn]5f^{14}6d^27s^2$? 6.0 ?	105 **Db** Dubnium (262)	106 **Sg** Seaborgium (266)	107 **Bh** Bohrium (264)	108 **Hs** Hassium (277)	109 **Mt** Meitnerium (268)	110 **Uun** Ununnilium (281)	111 **Uuu** Unununium (272)	112 **Uub** Ununbium (285)		114 **Uuq** Ununquadium (289)		116 **Uuh** Ununhexium (292)		

Lanthanides	57 $^2D_{3/2}$ **La** Lanthanum 138.9055 [Xe]5d6s² 5.5769	58 $^1G^o_4$ **Ce** Cerium 140.116 [Xe]4f5d6s² 5.5387	59 $^4I^o_{9/2}$ **Pr** Praseodymium 140.90765 $[Xe]4f^36s^2$ 5.473	60 $^5I_4$ **Nd** Neodymium 144.24 $[Xe]4f^46s^2$ 5.5250	61 $^6H^o_{5/2}$ **Pm** Promethium (145) $[Xe]4f^56s^2$ 5.582	62 $^7F_0$ **Sm** Samarium 150.36 $[Xe]4f^66s^2$ 5.6437	63 $^8S^o_{7/2}$ **Eu** Europium 151.964 $[Xe]4f^76s^2$ 5.6704	64 $^9D^o_2$ **Gd** Gadolinium 157.25 $[Xe]4f^75d6s^2$ 6.1498	65 $^8H^o_{15/2}$ **Tb** Terbium 158.92534 $[Xe]4f^96s^2$ 5.8638	66 $^5I_8$ **Dy** Dysprosium 162.500 $[Xe]4f^{10}6s^2$ 5.9389	67 $^4I^o_{15/2}$ **Ho** Holmium 164.93032 $[Xe]4f^{11}6s^2$ 6.0215	68 $^3H_6$ **Er** Erbium 167.259 $[Xe]4f^{12}6s^2$ 6.1077	69 $^2F^o_{7/2}$ **Tm** Thulium 168.93421 $[Xe]4f^{13}6s^2$ 6.1843	70 $^1S_0$ **Yb** Ytterbium 173.04 $[Xe]4f^{14}6s^2$ 6.2542	71 $^2D_{3/2}$ **Lu** Lutetium 174.967 $[Xe]4f^{14}5d6s^2$ 5.4259
Actinides	89 $^2D_{3/2}$ **Ac** Actinium (227) [Rn]6d7s² 5.17	90 $^3F_2$ **Th** Thorium 232.0381 $[Rn]6d^27s^2$ 6.3067	91 $^4K_{11/2}$ **Pa** Protactinium 231.03588 $[Rn]5f^26d^27s^2$ 5.89	92 $^5L_6$ **U** Uranium 238.02891 $[Rn]5f^36d^27s^2$ 6.1941	93 $^6L_{11/2}$ **Np** Neptunium (237) $[Rn]5f^46d^27s^2$ 6.2657	94 $^7F_0$ **Pu** Plutonium (244) $[Rn]5f^67s^2$ 6.0260	95 $^8S^o_{7/2}$ **Am** Americium (243) $[Rn]5f^77s^2$ 5.9738	96 $^9D^o_2$ **Cm** Curium (247) $[Rn]5f^76d^27s^2$ 5.9914	97 $^6H^o_{15/2}$ **Bk** Berkelium (247) $[Rn]5f^97s^2$ 6.1979	98 $^5I_8$ **Cf** Californium (251) $[Rn]5f^{10}7s^2$ 6.2817	99 $^4I^o_{15/2}$ **Es** Einsteinium (252) $[Rn]5f^{11}7s^2$ 6.42	100 $^3H_6$ **Fm** Fermium (257) $[Rn]5f^{12}7s^2$ 6.50	101 $^2F^o_{7/2}$ **Md** Mendelevium (258) $[Rn]5f^{13}7s^2$ 6.58	102 $^1S_0$ **No** Nobelium (259) $[Rn]5f^{14}7s^2$ 6.65	103 $^2P^o_{1/2}$? **Lr** Lawrencium (262) $[Rn]5f^{14}7s^27p$? 4.9 ?

Atomic Number
Ground-state Level
Symbol
Name
Atomic Weight†
Ground-state Configuration
Ionization Energy (eV)

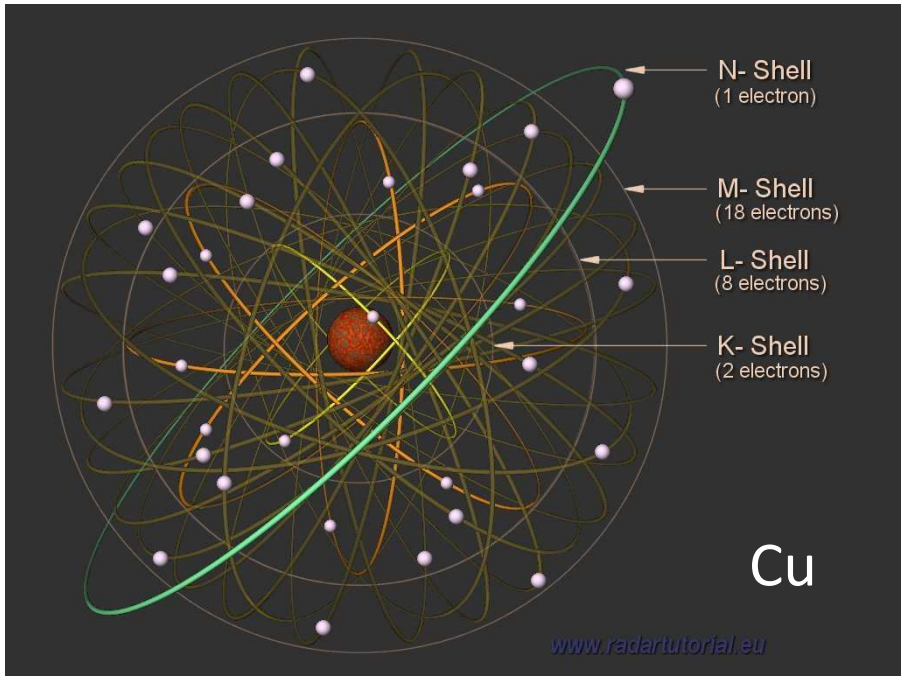
58 $^1G^o_4$
Ce
Cerium
140.116
$[Xe]4f5d6s^2$
5.5387

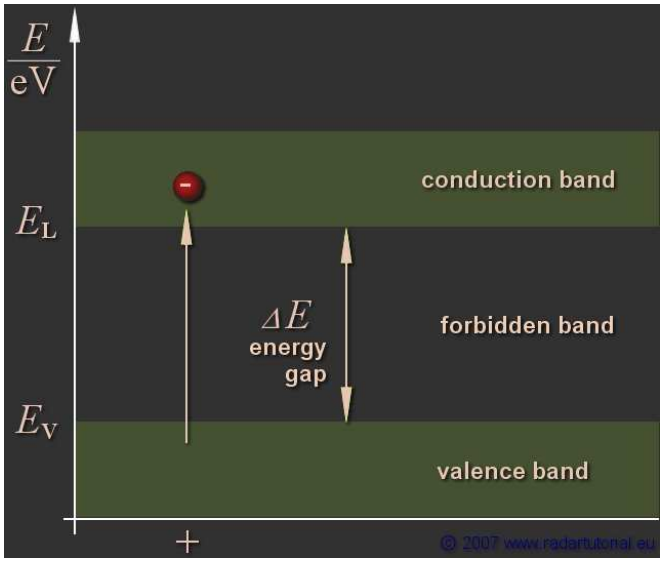
†Based upon ^{12}C. () indicates the mass number of the most stable isotope.

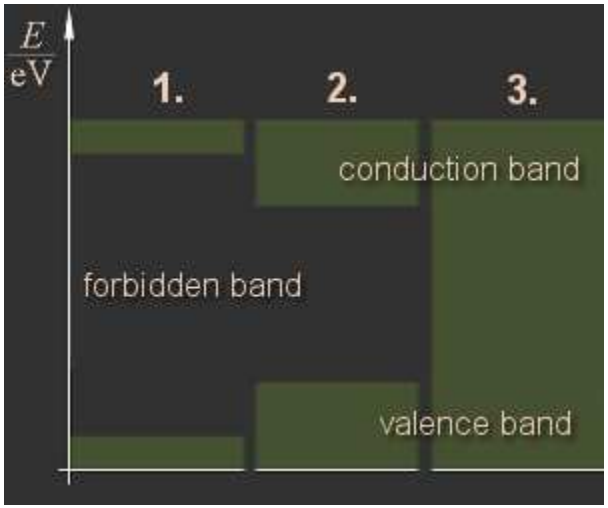
For a description of the data, visit physics.nist.gov/data

NIST SP 966 (September 2003)

Conductori si izolatori







Stratul K	2 e^-
Stratul L	8 e^-
Stratul M	18 e^-
Stratul N	32 e^-

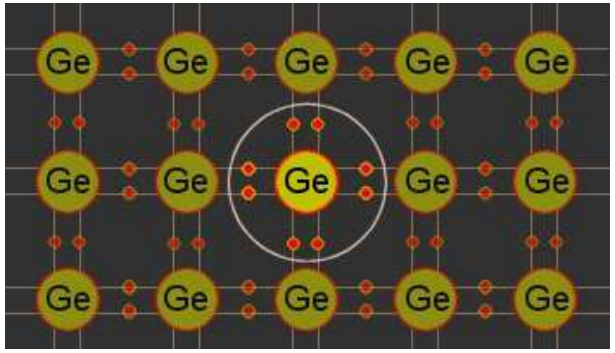
Nr. electroni pe ultimul strat

<= 3 e^- conductori electrici

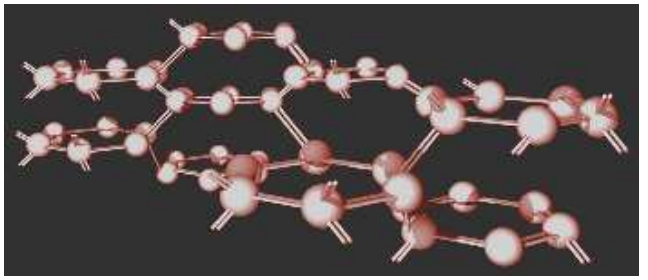
= 4 e^- semiconductori

>= 5 e^- izolatori

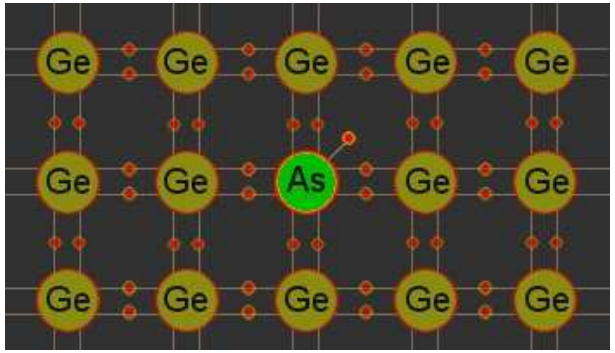
Semiconductori



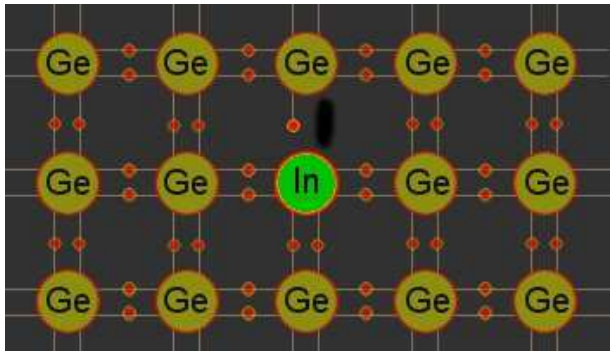
Germaniu - reprezentare 2D a retelei cubice



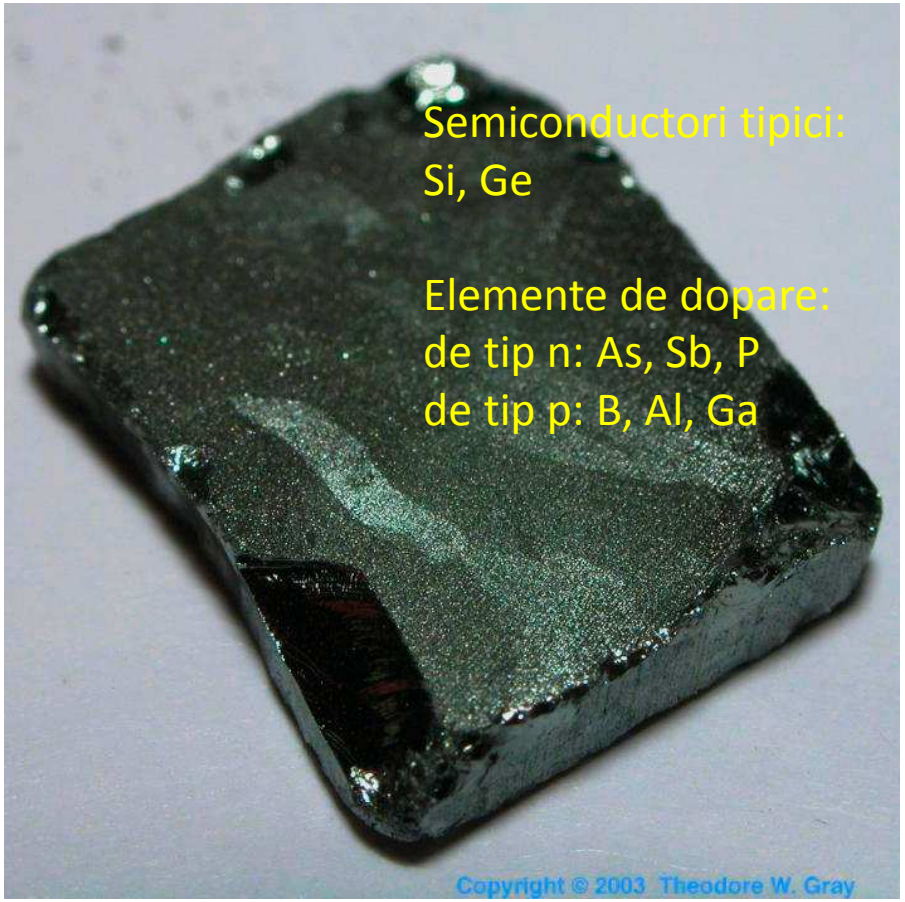
Structura cristalina tipica



Cristal de germaniu dopat cu arsen (semiconductor de tip n)

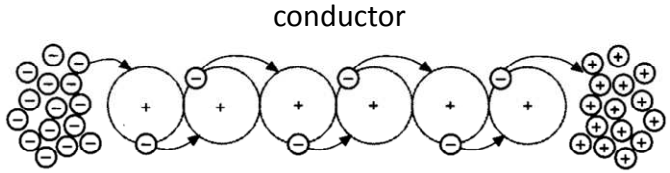


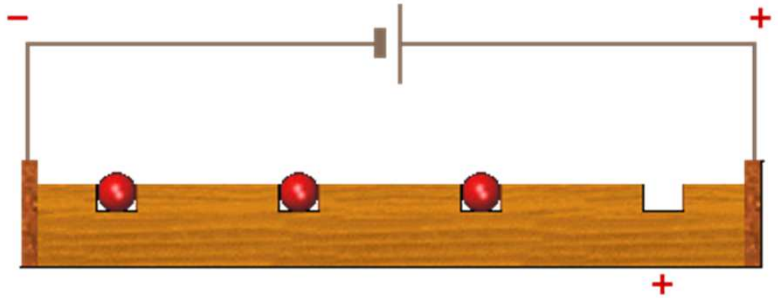
Cristal de germaniu dopat cu indiu (semiconductor de tip p)



Fenomenul electric

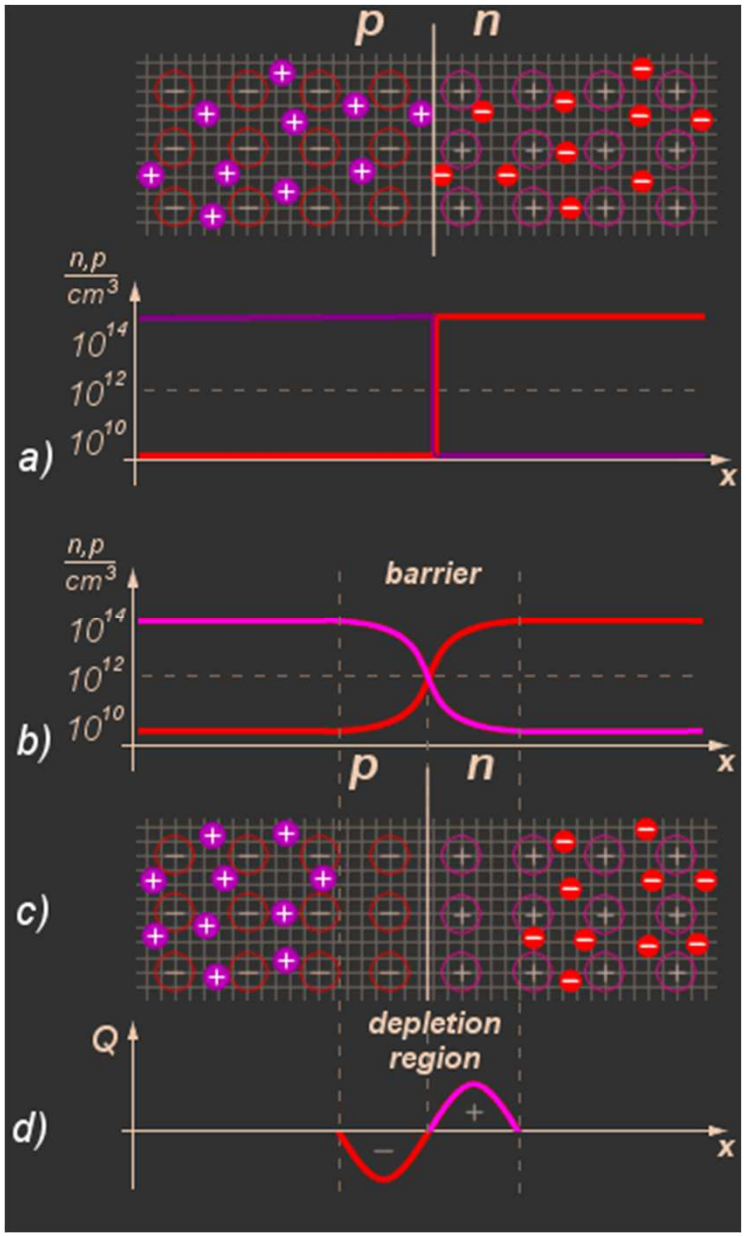
Electricitatea – proprietate fizica fundamentala a materiei ce se manifesta prin ansamblul fenomenelor legate de aparitia, miscarea si interactiunea corpurilor purtatoare de sarcina electrica.

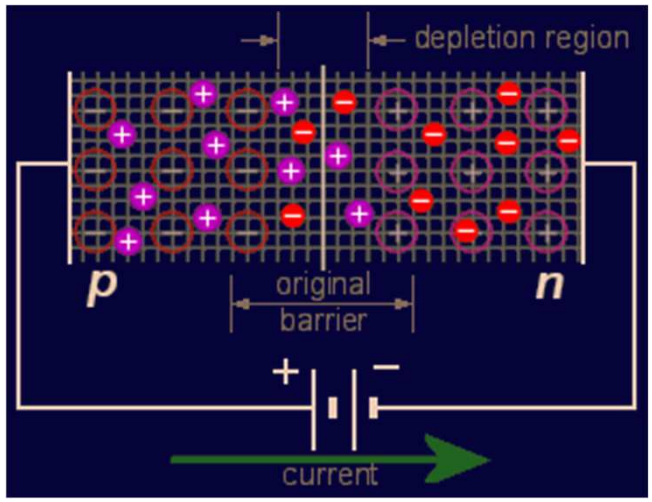


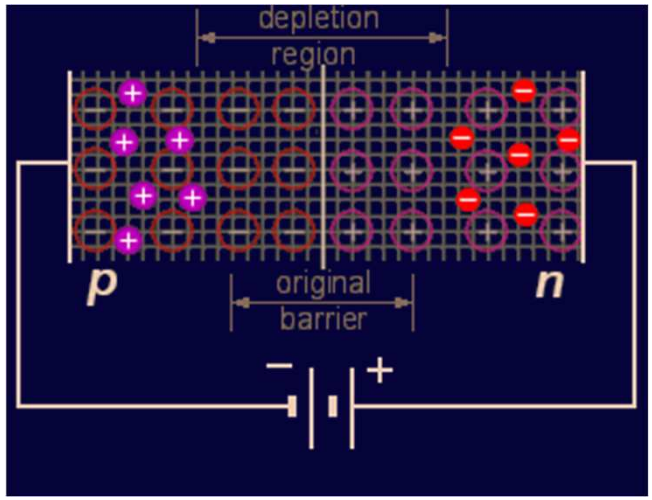


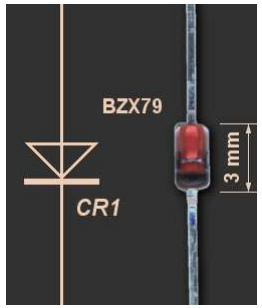
Teoria electronului
Teoria conventionala
Teoria deplasarii golului (hole-flow)

Semiconductori – jonctiunea pn





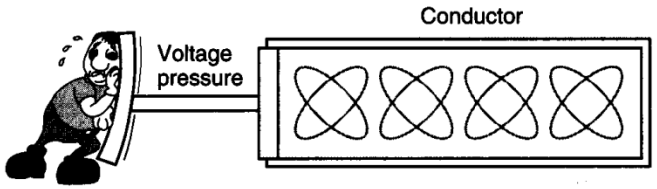




Marimi electrice de baza

Tensiunea electrica, U [V, $J \cdot C^{-1}$, $kg \cdot m^2 \cdot A^{-1} \cdot s^{-3}$]

Tensiunea electrică între două puncte ale unui circuit electric este diferența de potențial între cele două puncte și este proporțională cu energia necesară deplasării de la un punct la celălalt a unei sarcini electrice.



Tensiunea electromotoare reprezintă mărimea fizică scalară egală cu raportul dintre lucrul total efectuat de câmpul electric pentru a transporta sarcina electrică pe întregul circuit și mărimea sarcinii electrice.

$$U = \frac{L}{q}$$

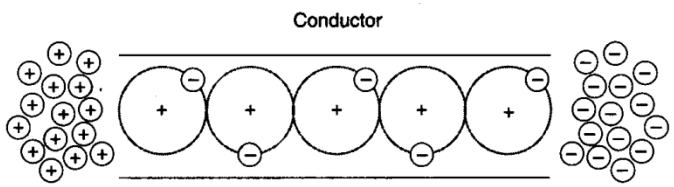
unde:
U - tensiune electromotoare;
L - lucrul forței electrice;
q - sarcina electrică

Tensiunea de 1 V este tensiunea de la capetele unui conductor care, străbătut de un curent de un amper, disipă o putere de un watt. În mod echivalent, pentru a transporta o sarcină electrică de un coulomb între două puncte cu diferența de potențial de un volt, se consumă (sau se obține, în funcție de sens) o energie de un joule.

Marimi electrice de baza

Intensitatea electrica, I [A]

Intensitatea curentului electric, numită mai simplu curent electric este o mărime fizică scalară ce caracterizează curentul electric și măsoară sarcina electrică ce traversează secțiunea unui conductor în unitatea de timp.



6.241506×10^{18}
electroni pe secunda = 1 Amper

$$I = \frac{dQ}{dt} \quad ; \quad i(t) = \frac{dq(t)}{dt}$$

Amperul reprezinta intensitatea unui curent electric constant care, menţinut în două conductoare paralele, rectilinii, cu lungimea infinită şi cu secţiunea circulară neglijabilă, aşezate în vid, la o distanţă de 1 metru unul de altul, ar produce între aceste conductoare o forţă de 2×10^{-7} dintr-un newton pe o lungime de 1 metru

Marimi electrice de baza

Rezistenta electrica, R [Ω, $V \cdot A^{-1}$, $kg \cdot m^2 \cdot A^{-2} \cdot s^{-3}$]

Rezistența electrică este o mărime fizică prin care se exprimă proprietatea unui conductor electric de a se opune trecerii prin el a curentului electric. În electrotehnică, ea este o măsură care determină ce valoare de tensiune este necesară pentru ca un anumit curent electric să treacă printr-un circuit (conductor) electric dat.

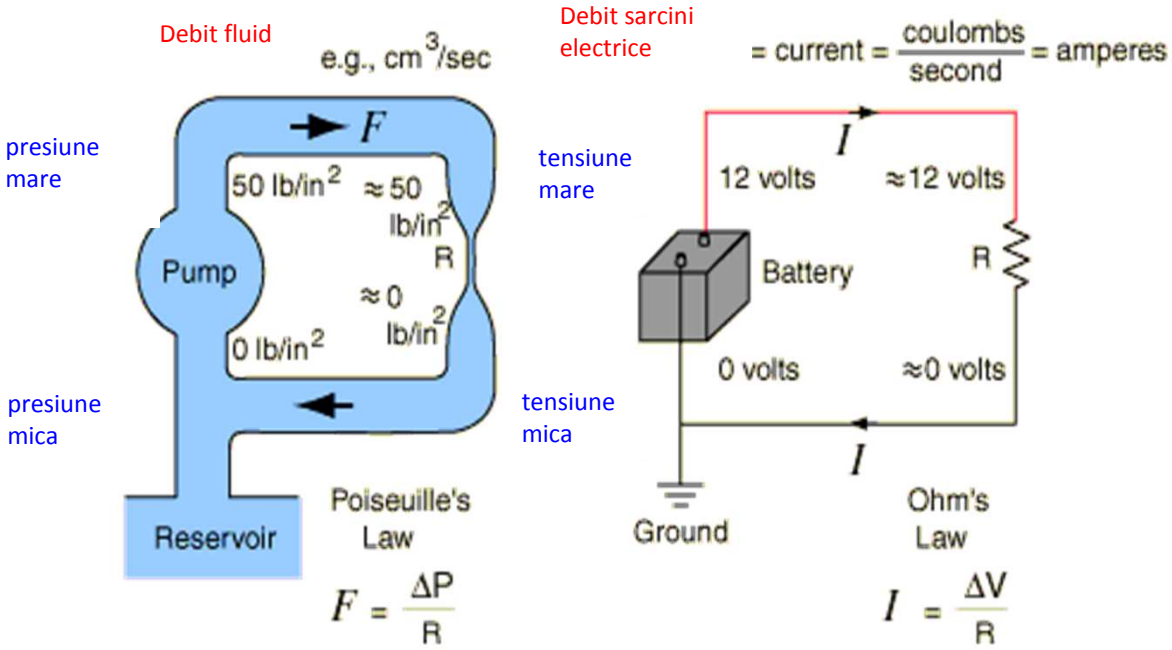
$$R = \rho \frac{l}{S}$$

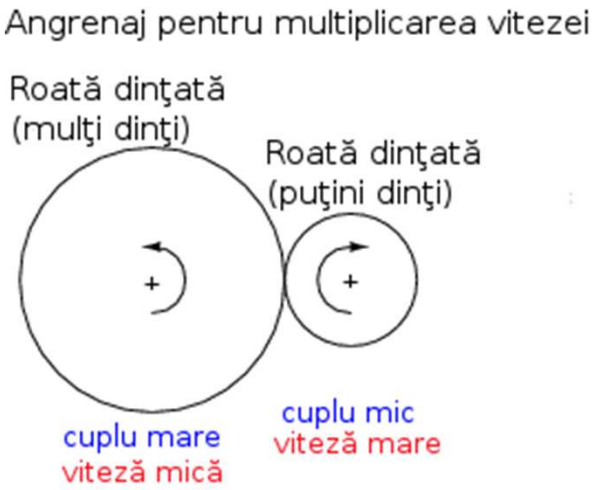
unde:

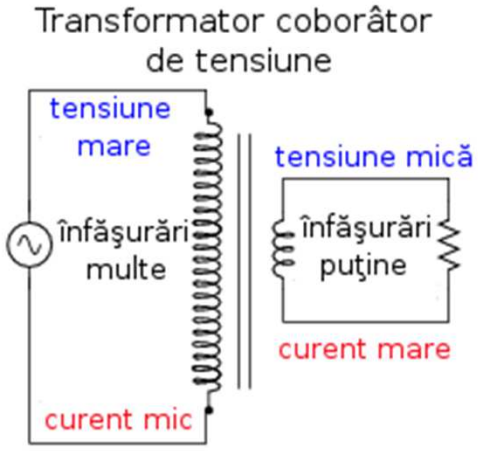
ρ este rezistivitatea materialului din care este făcut conductorul, măsurată în ohm · metru;
l este lungimea conductorului, măsurată în metri;
S este secțiunea transversală a conductorului, măsurată în metri pătrați;

Rezistența de 1 Ω corespunde unui conductor în care se dezvoltă un curent electric continuu cu intensitatea de 1 amper atunci cînd la capetele sale se aplică o tensiune electrică continuă de 1 volt, cu condiția ca pe parcursul conductorului să nu se genereze în nici un punct o tensiune suplimentară.

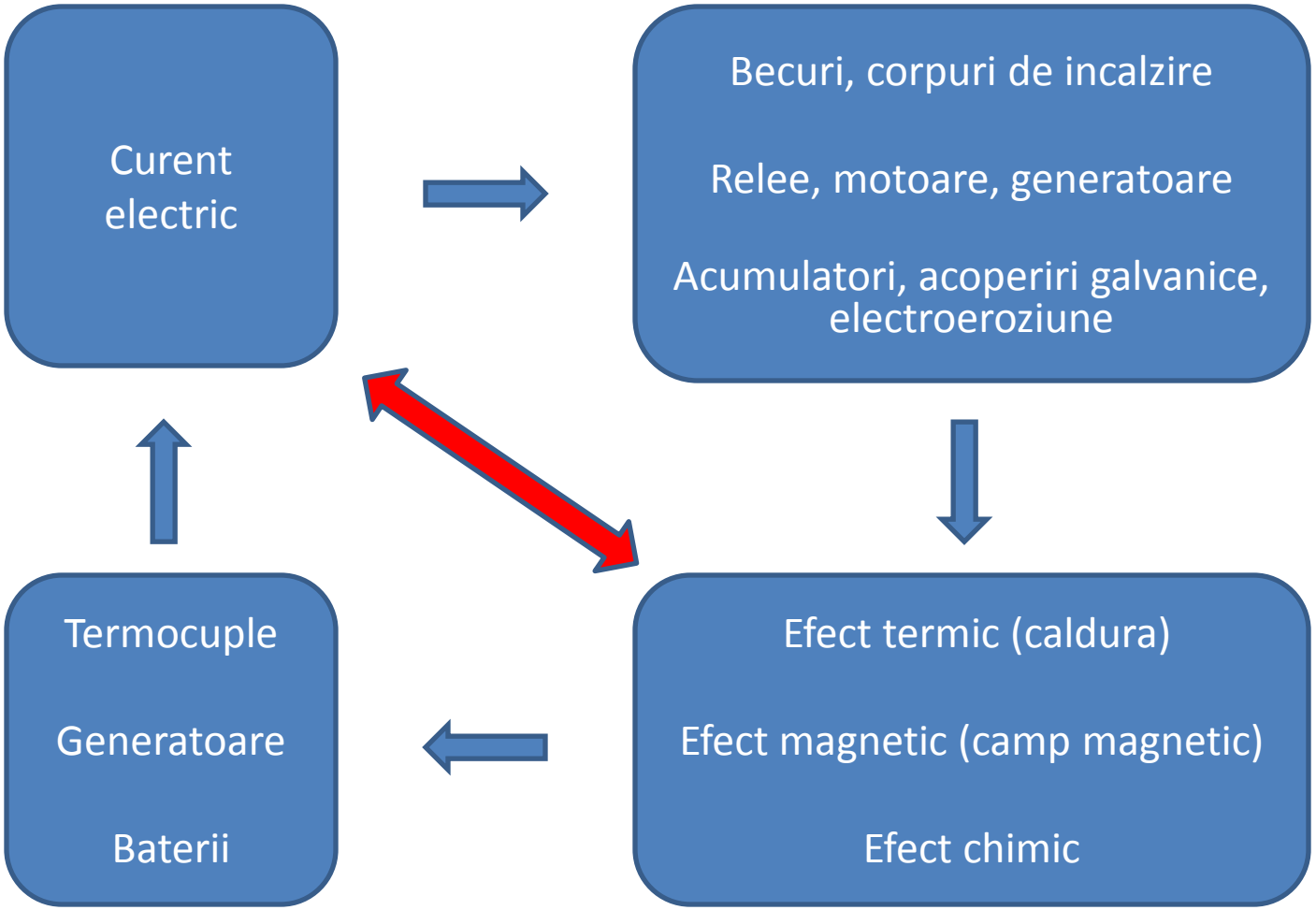
Analogii


Debit fluid
e.g., cm3/sec
presiune mare
presiune mica
F
50 lb/in2
≈ 50 lb/in2
R
Pump
≈ 0 lb/in2
0 lb/in2
Reservoir
Poiseuille's Law
F = ΔP / R
Debit sarcini electrice
= current = coulombs / second = amperes
tensiune mare
tensiune mica
I
12 volts
≈12 volts
Battery
R
0 volts
≈0 volts
Ground
Ohm's Law
I = ΔV / R


Angrenaj pentru multiplicarea vitezei
Roată dinţată (mulţi dinţi)
Roată dinţată (puţini dinţi)
cuplu mare
viteză mică
cuplu mic
viteză mare


Transformator coborâtor de tensiune
tensiune mare
înfăşurări multe
curent mic
tensiune mică
înfăşurări puţine
curent mare

Efectele curentului electric



Elemente ale teoriei electricitatii

Sarcina electrica $Q = It$ [C]

Intensitatea c.e. $I = UR^{-1}$ [A]

Tensiunea el. $U = IR^{-1}$ [V]

Rezistenta el. $R = UI^{-1}$ [Ω]

Conductanta $G = IR^{-1}$ [S]

Densitatea de curent $J = IA^{-1}$ [Am^{-2}]

Rezistivitate ρ; $R = \rho l A^{-1}$ [Ωm]

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

Putere el. $P = UI$ [W]

Capacitate $C = QU^{-1} = \varepsilon A d^{-1}$ [F]

Inductanta L; $i = UR^{-1}(I-e^{-Rt/L})$ [H]

$\varepsilon_0 = 10^7/4\pi c^2$ [F/m]

$\mu_0 = 4\pi 10^{-7}$ [N/A^2]

$c = (\varepsilon_0\ \mu_0)^{-1/2}$= **299.792.458 m/s**

Quantity	Unit Name	Unit Symbol
Voltage (V)	Volt	V
Electromotive force (emf)	Volt	V
Electric current (I)	Ampere (amp)	A
Resistance (R)	Ohm	Ω
Impedance (Z)	Ohm	Ω
Electric power (P)	Watt	W
Electric power (P)	dBm	dBm
Reactive power (Q)	Volt-Ampere-Reactive	VAR
Apparent power (S)	Volt-Ampere	VA
Capacitance (C)	Farad	F
Inductance (L)	Henry	H
Conductance (G)	siemens / mho	S
Admittance (Y)	siemens / mho	S
Electric charge (Q)	Coulomb	C
Electric charge (Q)	Ampere-hour	Ah
Resistivity (ρ)	Ohm-meter	Ω·m
Conductivity (σ)	siemens per meter	S/m
Electric field (E)	Newtons per coulomb	N/C
Magnetic field (B)	Tesla	T
Magnetic field (B)	Gauss	G
Magnetic flux (Φ)	Weber	Wb
Energy (E)	Joule	J
Energy (E)	Kilowatt-hour	KWh
Frequency (f)	Hertz	Hz
Time (t)	Seconds	s
Length (l)	Meter	m
Area (A)	Square-meter	m^2

Volt (V)
Volt is the electrical unit of voltage.
One volt is the energy of 1 joule that is consumed when electric charge of 1 coulomb flows in the circuit.
1V = 1J / 1C

Ampere (A)
Ampere is the electrical unit of electrical current. It measures the amount of electrical charge that flows in an electrical circuit per 1 second.
1A = 1C / 1s

Ohm (Ω)
Ohm is the electrical unit of resistance.
1Ω = 1V / 1A

Watt (W)
Watt is the electrical unit of electric power. It measures the rate of consumed energy.
1W = 1J / 1s
1W = 1V · 1A

dBm
dBm is a unit of electric power, measured in dB-milliwatts.
$1dBm = 10 \cdot \log_{10}(1.2589mW / 1mW)$

Farad (F)
Farad is the unit of capacitance. It represents the amount of electric charge in coulombs that is stored per 1 volt.
1F = 1C / 1V

Henry (H)
Henry is the unit of inductance.
1H = 1Wb / 1A

siemens (S)
siemens is the unit of conductance, which is the opposite of resistance.
1S = 1 / 1Ω

Coulomb (C)
Coulomb is the unit of electric charge.
$1C = 6.238792 \times 10^{18}$ electron charges

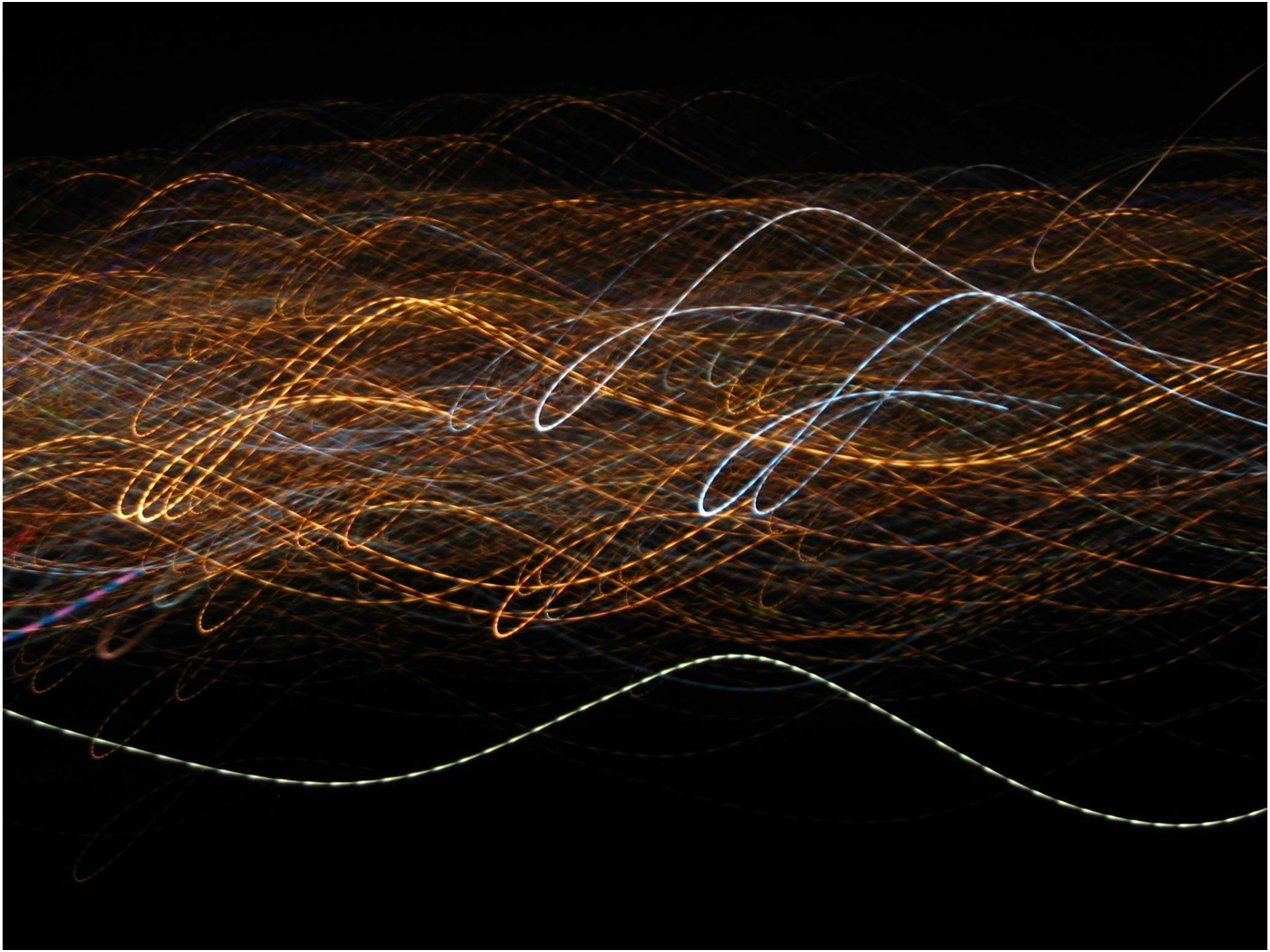
Ampere-hour (Ah)
Ampere-hour is a unit of electric charge.
One ampere-hour is the electric charge that flow in electrical circuit, when a current of 1 ampere is applied for 1 hour.
1Ah = 1A × 1hour
One ampere-hour is equal to 3600 coulombs.
1Ah = 3600C

Tesla (T)
Tesla is the unit of magnetic field.
$1T = 1Wb / 1m^2$

Weber (Wb)
Weber is the unit of magnetic flux.
1Wb = 1V × 1s

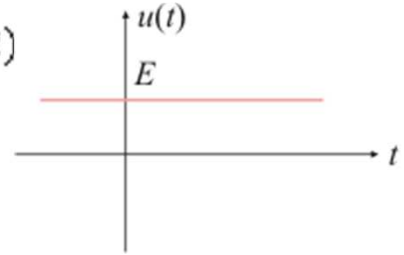
Joule (J)
Joule is the unit of energy.
$1J = 1\ kg \cdot 1(m / s)^2$

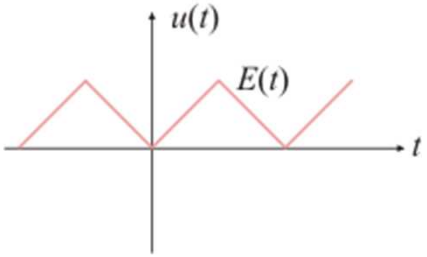
Hertz (Hz)
Hertz is the unit of frequency. It measures the number of cycles per second.
1 Hz = 1 cycles / s



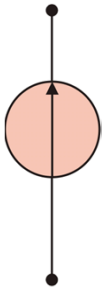
Circuite electrice

$u(t) = E(t)$

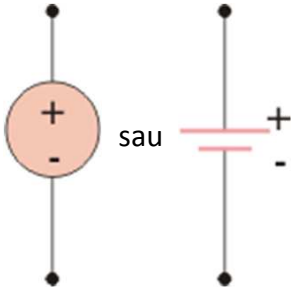




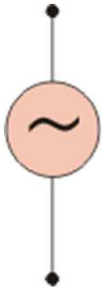
Simbol general pentru sursele de tensiune

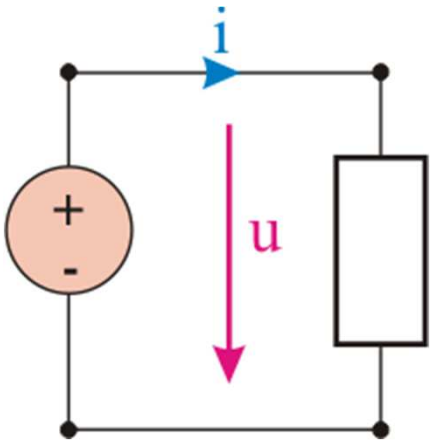


Sursă de tensiune Continuă (DC)



Sursă de tensiune alternativă (AC)

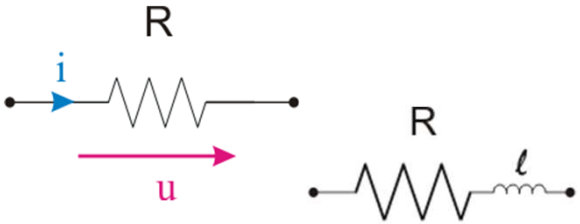




Rezistorul

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

Rezistivitate
Lungime
Aria sectiunii



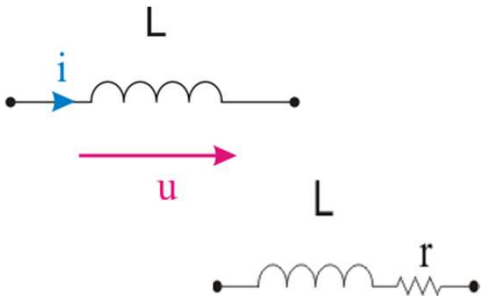
$$u(t) = R\, i(t)$$

$$p(t) = u(t)\, i(t) = R\, [i(t)]^2 = \frac{[u(t)]^2}{R}$$

Inductanta

$$L = \frac{N^2}{R_m}$$

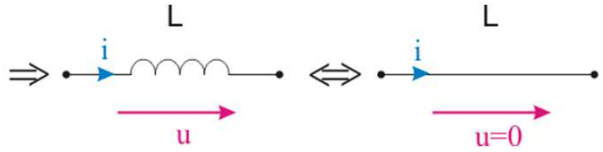
Numar spire
Reluctanta magnetica



$$u(t) = L \frac{di}{dt}$$

$$p(t) = u(t)\, i(t) = L\, i\, \frac{di}{dt}$$

Daca i(t) = ct. $\Rightarrow$ di/dt = 0

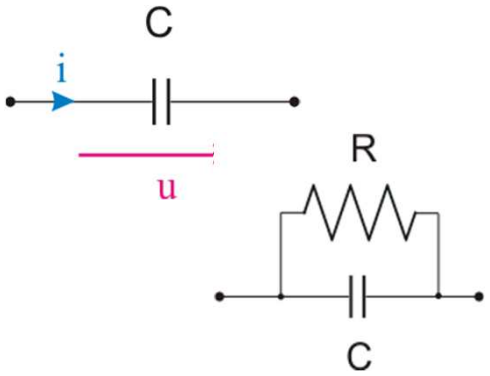


$$W_m = \int_0^t p(t)\, dt + W_m(0) = \frac{1}{2} L\, [i(t)]^2 + W_m(0)$$

Condensatorul

$$C = \varepsilon \frac{A}{d}$$

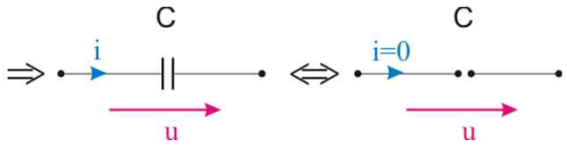
Permitivitate electrica
Aria placilor
Distanta dintre placi



$$i(t) = C \frac{du}{dt}$$

$$p(t) = u(t)\, i(t) = C\, u\, \frac{du}{dt}$$

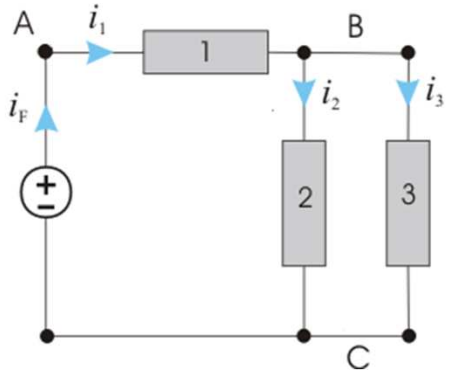
Daca u(t) = ct. $\Rightarrow$ du/dt = 0



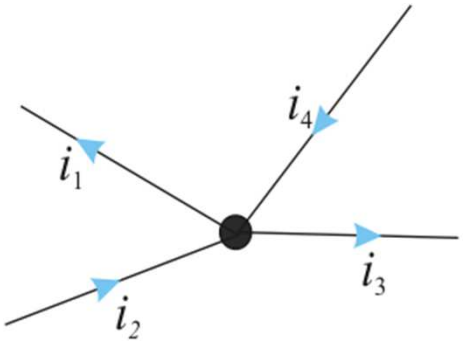
$$W_C = \int_0^t p(t)\, dt + W_C(0) = \frac{1}{2} C\, [u(t)]^2 + W_C(0)$$

Teoremele lui Kirchhoff

I. Legea nodurilor $\sum \mathbf{i_n} = 0$

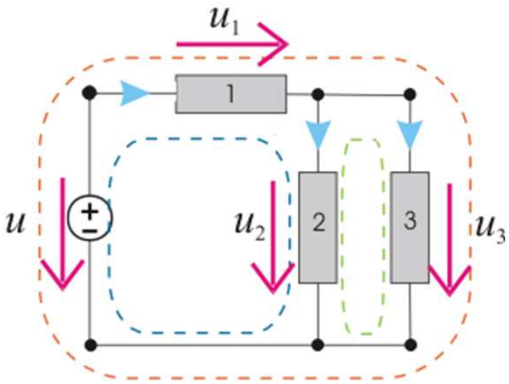


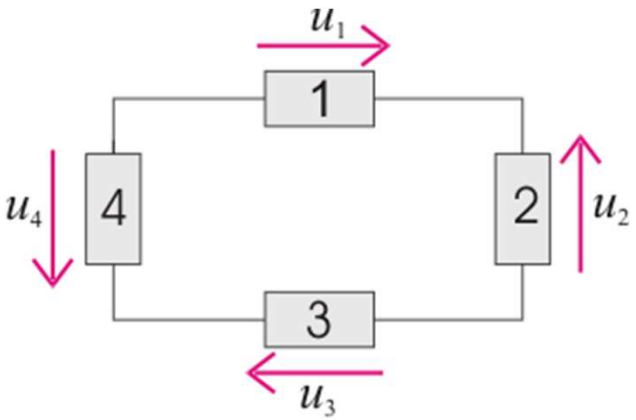
- în nodul A $i_F - i_1 = 0$ conectare serie
- în nodul B $i_1 - i_2 - i_3 = 0$
- în nodul C $-i_F + i_2 + i_3 = 0$



$-i_1 + i_2 - i_3 + i_4 = 0$

II. Legea ochiurilor $\sum \mathbf{u_n} = 0$

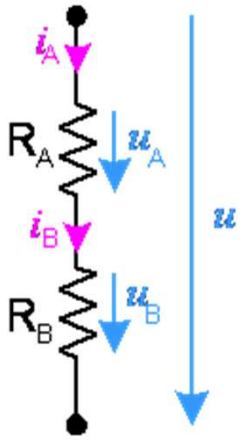




$u_1 - u_2 + u_3 - u_4 = 0$

pe ochiul indicat cu linie roşie, parcurs în sens orar $u_1 + u_3 - u = 0$
pe ochiul indicat cu linie albastră, parcurs în sens orar $u_1 + u_2 - u = 0$
pe ochiul indicat cu linie verde, parcurs în sens orar $u_3 - u_2 = 0$

conectare paralel



$$u = u_A + u_B$$

$$u = R_A\, i_A + R_B\, i_B$$

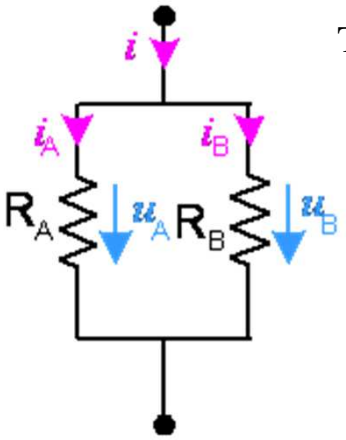
Teorema I Kirchhoff ➔ $i_A = i_B$

$$u = (R_A + R_B) i_A = (R_A + R_B) i_B \;\rightarrow\; \frac{u}{R_A + R_B} = i_A = i_B \;\rightarrow\; u_A = R_A i_A = \frac{R_A}{R_A + R_B} u$$

$$u_B = R_B i_B = \frac{R_B}{R_A + R_B} u$$

$$\mathbf{R_e = R_A + R_B}$$

$$u_k = \frac{R_k}{R_1 + R_2 + \ldots + R_n} u \;\leftarrow\; \textbf{Divizor de tensiune}$$



Teorema I Kirchhoff ➔ $i = i_A + i_B$ $\quad i = \frac{u_A}{R_A} + \frac{u_B}{R_B}$

Teorema II Kirchhoff ➔ $u_A = u_B$

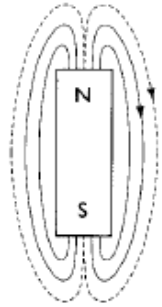
$$i = \left(\frac{1}{R_A} + \frac{1}{R_B}\right) u_A + \left(\frac{1}{R_A} + \frac{1}{R_B}\right) u_B \;\rightarrow\; i = \frac{R_A + R_B}{R_A \times R_B} u_A = \frac{R_A + R_B}{R_A \times R_B} u_B \;\rightarrow\; \frac{i}{\frac{1}{R_A} + \frac{1}{R_B}} = u_A = u_B$$

$$\mathbf{\frac{1}{R_e} = \frac{1}{R_A} + \frac{1}{R_B}}$$

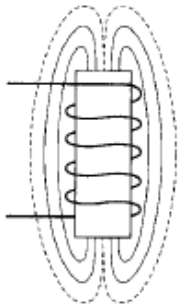
$$i_A = \frac{u_A}{R_A} = \frac{\frac{1}{R_A}}{\frac{1}{R_A} + \frac{1}{R_B}} i$$

$$i_B = \frac{u_B}{R_B} = \frac{\frac{1}{R_B}}{\frac{1}{R_A} + \frac{1}{R_B}} i \;\leftarrow\; \textbf{Divizor de curent}$$

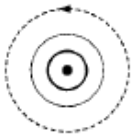
Magnetism si electromagnetism



Permanent bar magnet



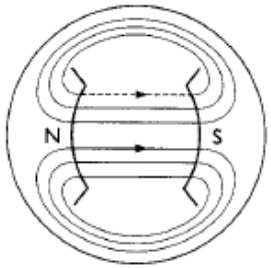
Solenoid (coil or winding)



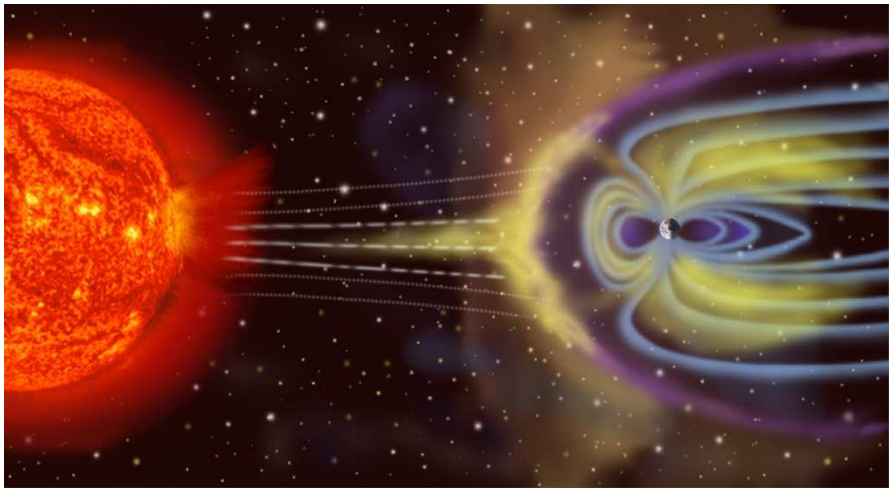
Current flowing towards us

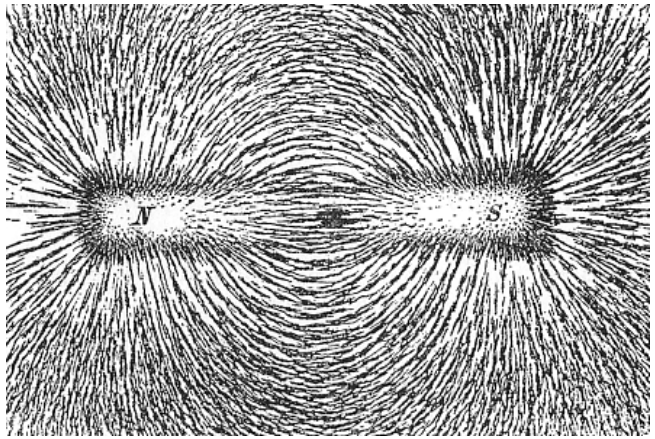


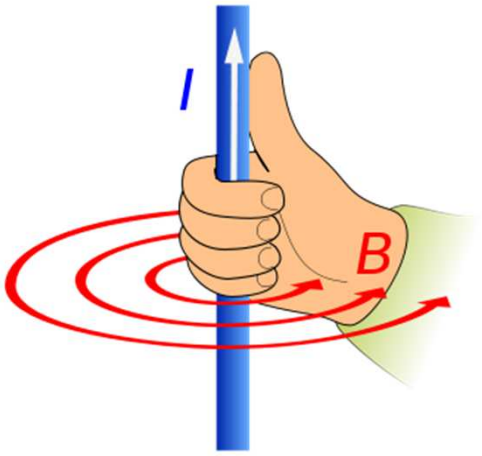
Current flowing away from us

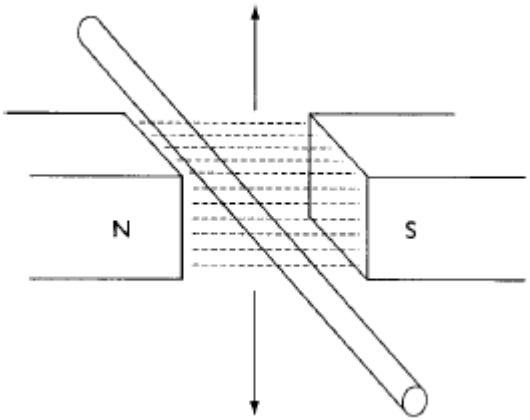


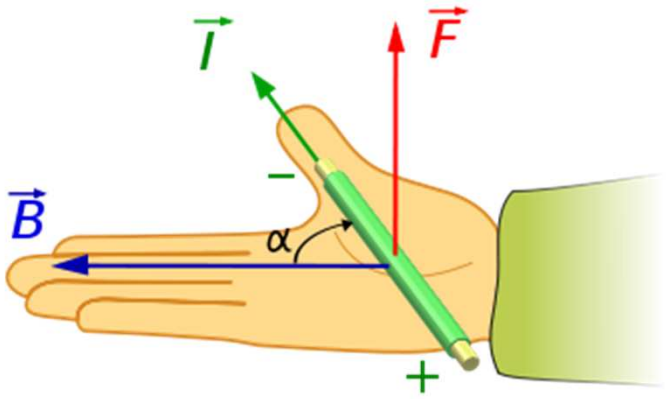
Section of a motor











Autoinductia (t.e.m. inversa – Lenz)

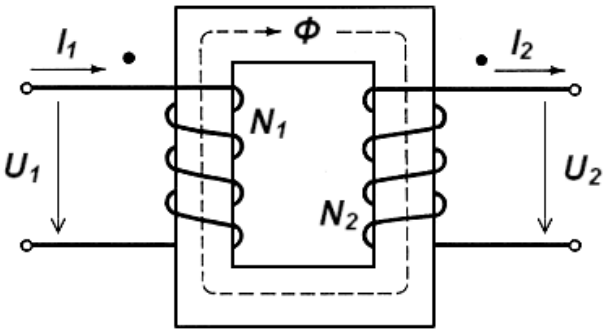
Reducere efecte: condensator, dioda

Inductia mutuala:

Curent primar

N sp. primar/ N sp. secundar

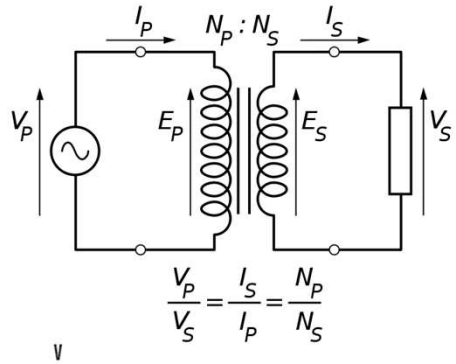
Frecv.

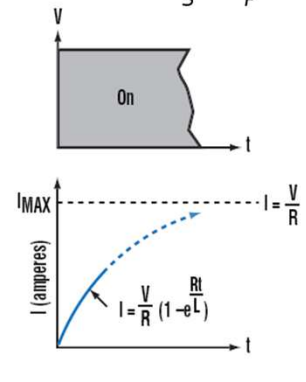


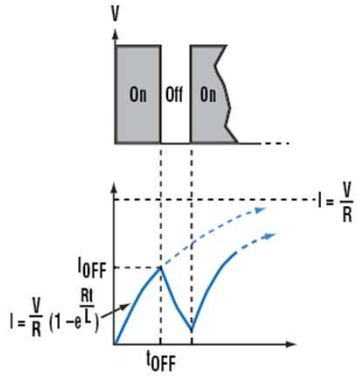
$$\frac{U_1}{U_2} \simeq \frac{E_1}{E_2} = \frac{N_1}{N_2} = k$$

P1≈P2 (efect Joule redus)

$$\left.\begin{array}{l} \\ \end{array}\right\} \quad \frac{U_1}{U_2} = \frac{I_2}{I_1} \simeq \frac{N_1}{N_2} = k$$







Definitii si legi

Legea lui Ohm

Legea lui Lenz

Legile lui Kirchhoff

Legea lui Faraday

Regula lui Fleming (a mainii drepte)

Legea lui Ampere

Legile lui Murphy: *Dacă ceva poate să meargă prost, va merge prost;*
Orice cauti vei gasi in ultimul loc in care te uiti;
Pe autostrada, intotdeauna se merge mai repede pe cealalta banda.