Electronics

Introduction to Electronics

The Electronic system

- Electric system : any technical system is an assembly of components that are connected together to form a functioning machine or an operational procedure . An electronic system includes some common used electrical devices such as resistors , capacitors, transformers , inductors , and few classes of semiconductors (diodes , transistors)

The current in conductor and insulator

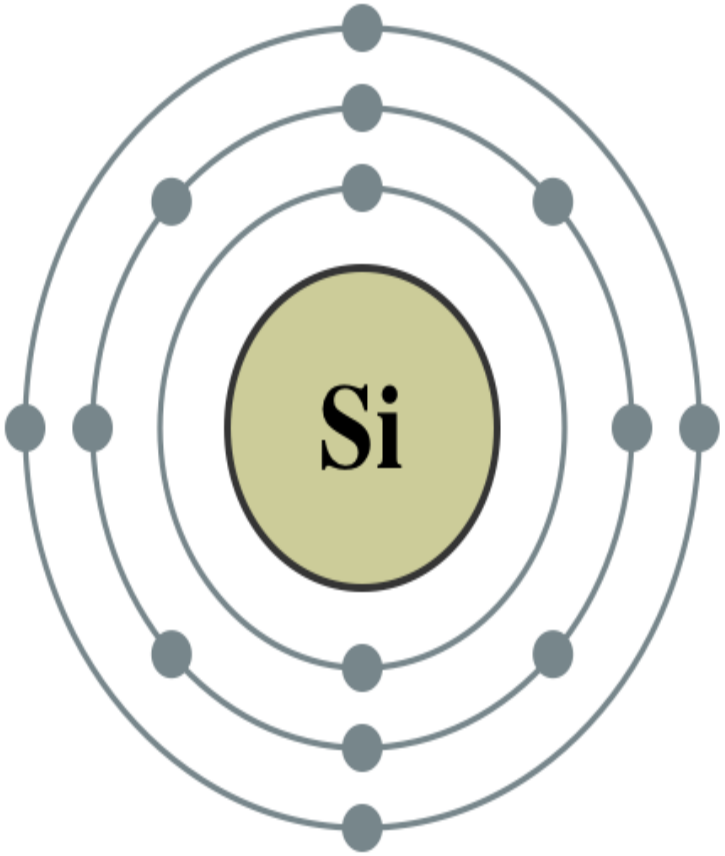
Structure of matter. The matter consists of *atoms*, which contain *electrons* and *a nucleus* with *protons* and *neutrons* in a particularly intimate association. The electron has a negative *charge*. The proton has a positive charge equal to the negative charge carried by the electron. The neutron, as its name implies, has no charge; it is electrically neutral. Each element possesses a certain number of protons and an equal number of electrons to keep the atom electrically neutral. Each element is characterized by its number of electrons, or as it is called, its *atomic number*. The electrons are spread out in space around the nucleus in shells, which have been compared to the orbits of the planets round the sun. The electrons can be often stripped off the atom rather easily, leaving it positively charged, naturally, but it is much more difficult to break up the nucleus.

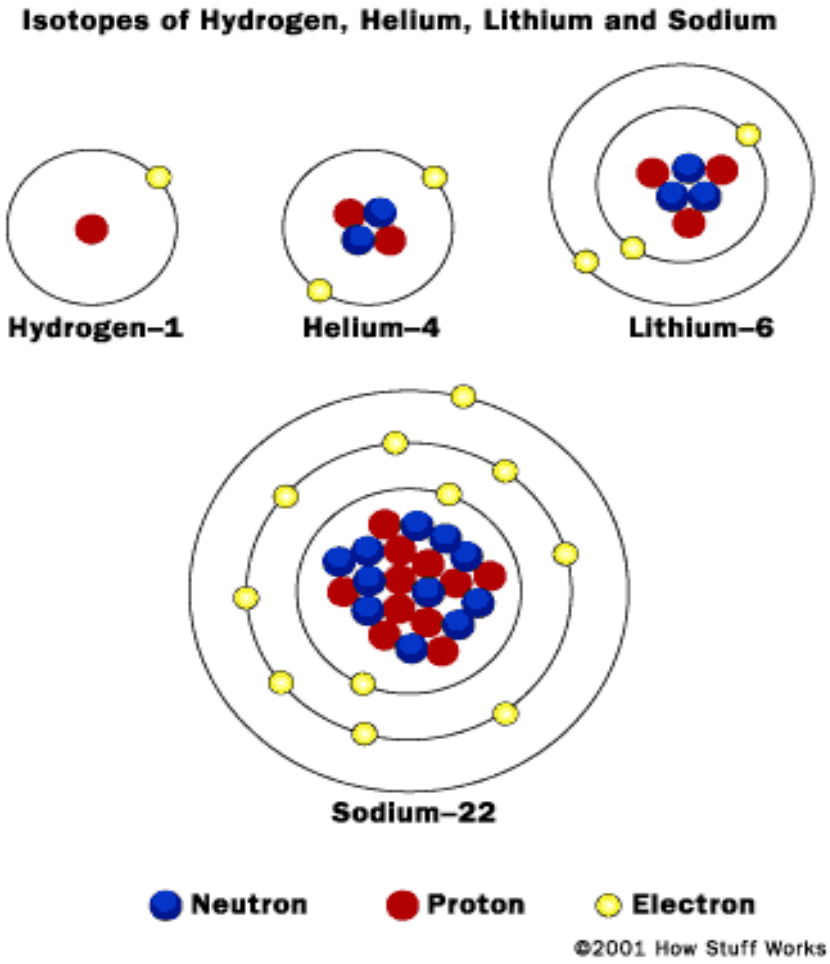
⊖ ELECTRONS HAVE A NEGATIVE ELECTRICAL CHARGE.

⊕ PROTONS HAVE A POSITIVE ELECTRICAL CHARGE.

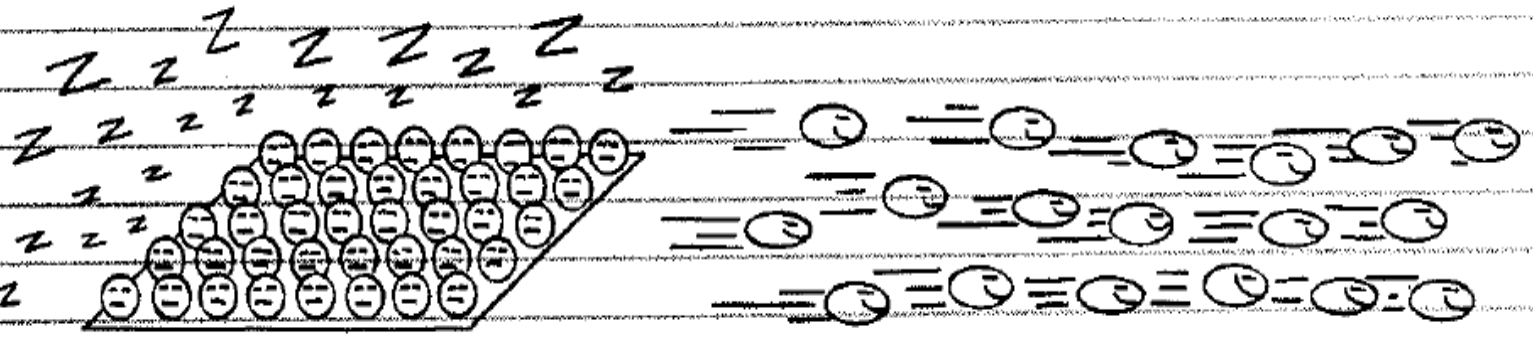
O NEUTRONS HAVE NO ELECTRICAL CHARGE.


Taaifnet
2.0
الجدول الدوري للعناصر
صلب C
سائل Br
غاز H
فلز
شبه فلز
لا فلز
العدد الذري ← 1
رمز العنصر ← H
اسم العنصر ← هيدروجين
الكتلة الذرية ← 1.008


Si


Isotopes of Hydrogen, Helium, Lithium and Sodium
Hydrogen–1
Helium–4
Lithium–6
Sodium–22
Neutron
Proton
Electron
©2001 How Stuff Works

☐ MORE ABOUT FREE ELECTRONS — MANY TRILLIONS OF ELECTRONS CAN REST ON A SURFACE OR TRAVEL THROUGH SPACE OR MATTER AT NEAR THE SPEED OF LIGHT (186,000 MILES PER SECOND)!



RESTING ELECTRONS MOVING ELECTRONS

☐ RESTING ELECTRONS — A GROUP OF NEGATIVE ELECTRONS ON A SURFACE CAUSES THE SUREFACE TO BE NEGATIVELY CHARGED. SINCE THE ELECTRONS ARE NOT MOVING, THE SURFACE CAN BE SAID TO HAVE A NEGATIVE STATIC ELECTRICAL CHARGE.

Voltage, current, and resistance

- Voltage : v and sometimes E

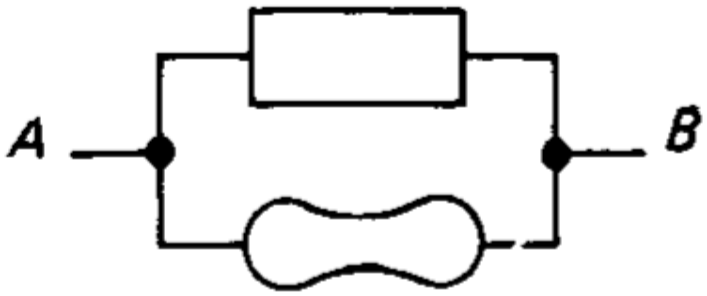
It's equal to the work done to move the electric charge from the negative point to the positive point and it's measured in volt.

- The electron charge is equal to $6*10^{18}$

- Current : I , the rate of flow of electric charge past from the negative to the positive point and measured in ampere or amp

- The same current into point in a circuit equals to the sum of the currents out from the circuit (kirchhoff current law)

- A node is



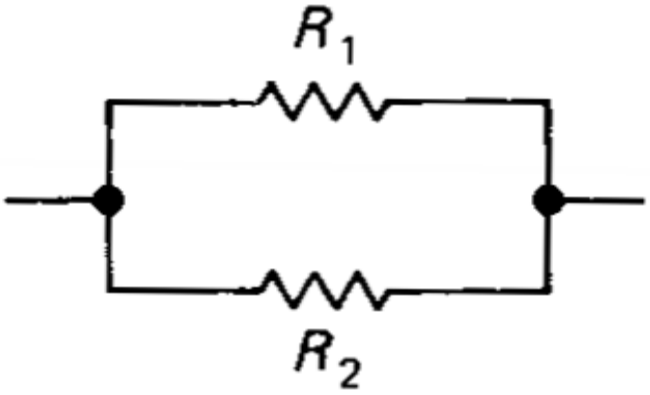
- The sum of voltage drops around any closed circuit is zero (kirchhoff voltage law)

Risistors

I-versus-*V* characteristics. Resistors (*I* simply proportional to *V*), capacitors (*I* proportional to rate of change of *V*), diodes (*I* flows in only one direction), thermistors (temperature-dependent resistor), photoresistors (light-dependent resistor),

$$R = V/I$$

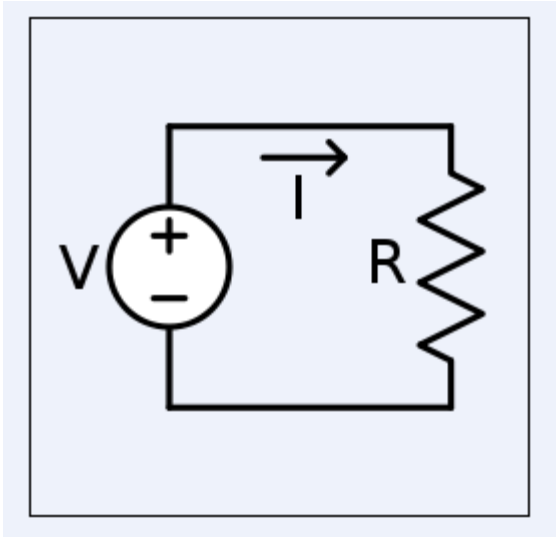
$$R = R_1 + R_2$$

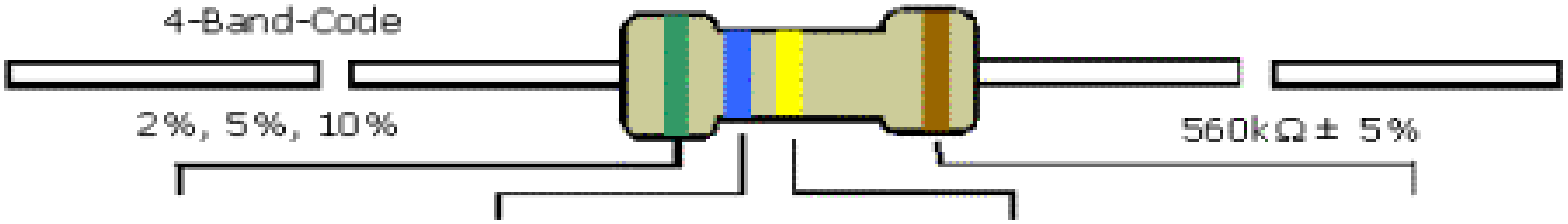


$$R = \frac{R_1 R_2}{R_1 + R_2}$$

Resistance

- 1-It has 2 kinds ,**constant resistance and** variable resistance that I control it by changing its value .
- 2-we can measure it using **avometers .**
- 3- It's job to decrease the current as a lot of application if don’t use resistance the system failure or corrupt .The law wish depend on it is ohm’s low V=I*R .V is constant but when R increase the **current** will decrease so as to the **volt must be** const


V
+
−
I
R



COLOR	1st BAND	2nd BAND	3rd BAND	MULTIPLIER	TOLERANCE
Black	0	0	0	1Ω	
Brown	1	1	1	10Ω	± 1% (F)
Red	2	2	2	100Ω	± 2% (G)
Orange	3	3	3	1KΩ	
Yellow	4	4	4	10KΩ	
Green	5	5	5	100KΩ	±0.5% (D)
Blue	6	6	6	1MΩ	±0.25% (C)
Violet	7	7	7	10MΩ	±0.10% (B)
Grey	8	8	8		±0.05%
White	9	9	9		
Gold				0.1	± 5% (J)
Silver				0.01	± 10% (K)

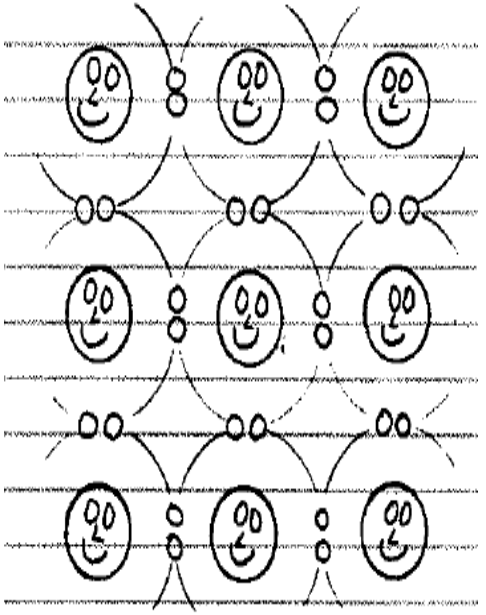
- Calculate the value of the next resistors

Semiconductors

Semiconductors are neither conductors nor insulators. The commonly used semiconductor elements are silicon, germanium, and gallium arsenide. *Silicon* is the most widely used semiconductor material. It has 14 protons and 14 electrons in orbits. An isolated silicon atom has four electrons in the valence bond. *Germanium* has 32 protons, 32 electrons, and 4 valence electrons like silicon.

semiconductors

A **semiconductor** is a material which has electrical conductivity between that of a conductor such as copper and an insulator such as glass. The conductivity of a semiconductor increases with increasing temperature, behavior opposite to that of a metal. Semiconductors can display a range of useful properties such as passing current more easily in one direction than the other. Because the conductive properties of a semiconductor can be modified by controlled addition of impurities or by the application of electrical fields or light, semiconductors are very useful devices for amplification of signals, switching, and energy conversion. Understanding the properties of semiconductors relies on quantum physics to explain the motions of electrons through a lattice of atoms.



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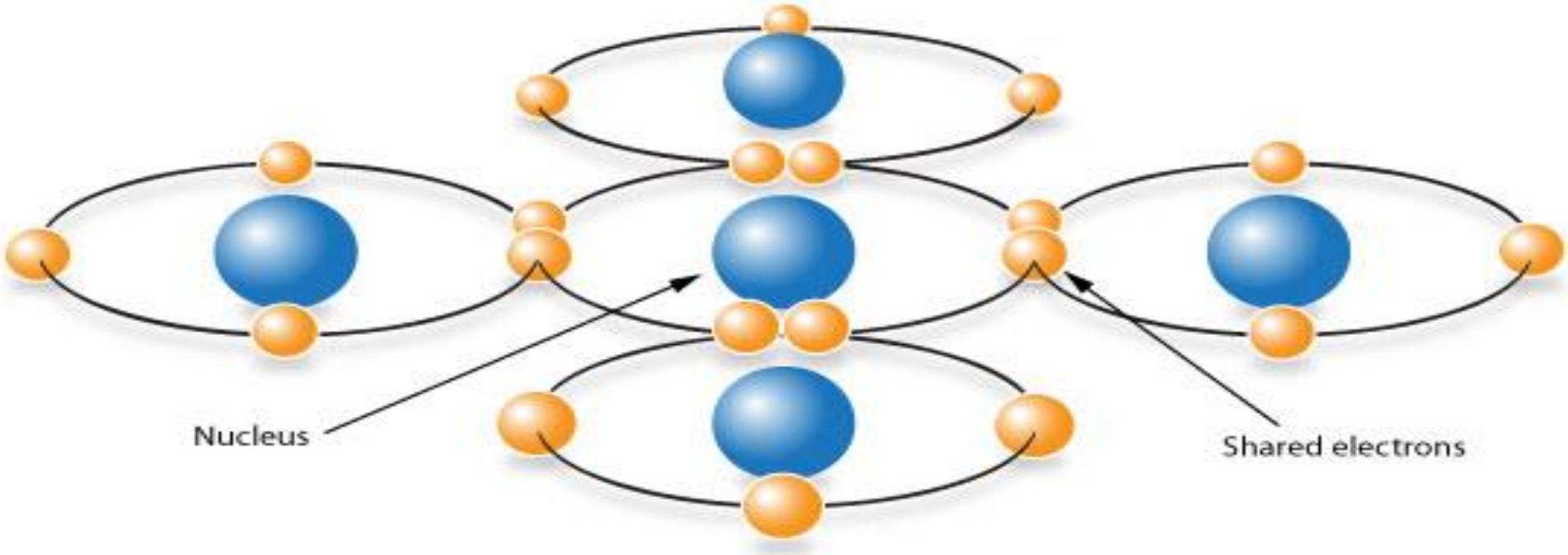
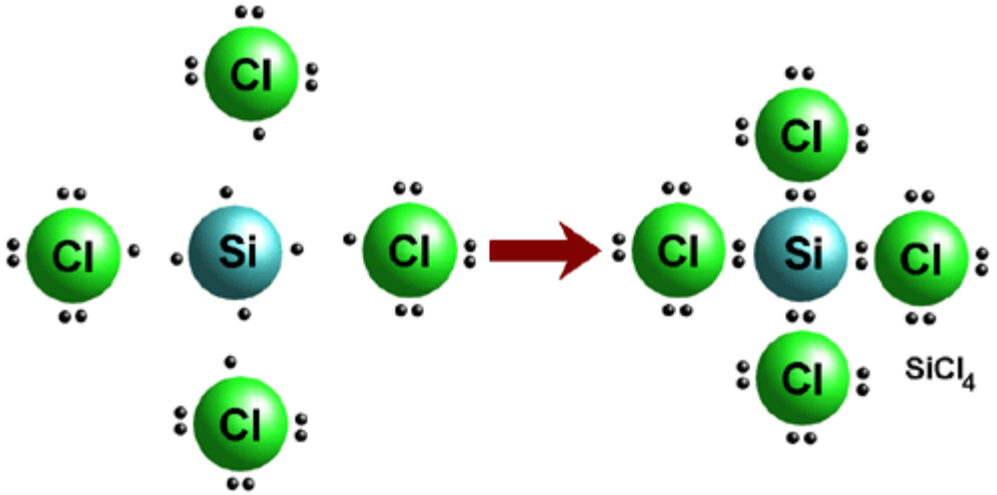
- Current conduction in a semiconductor occurs via free electrons and "holes", collectively known as charge carriers. Adding impurity atoms to a semiconducting material, known as "doping", greatly increases the number of charge carriers within it. When a doped semiconductor contains excess holes it is called "p-type", and when it contains excess free electrons it is known as "n-type". The semiconductor material used in devices is doped under highly controlled conditions to precisely control the location and concentration of p- and n-type dopants. A single semiconductor crystal can have multiple p- and n-type regions; the p-n junctions between these regions have many useful electronic properties.
- Semiconductors are the foundation of modern electronics, including radio, computers, and telephones. Semiconductor-based electronic components include transistors, solar cells, many kinds of diodes including the light-emitting diode (LED), the silicon controlled rectifier, photo-diodes, and digital and analog integrated circuits. Increasing understanding of semiconductor materials and fabrication processes has made possible continuing increases in the complexity and speed of semiconductor devices, an effect known as Moore's Law.


Nucleus
Shared electrons


Cl
Cl
Si
Cl
Cl
Cl
Cl
Si
Cl
Cl
SiCl4

The Semiconductor Industry

- Semiconductor devices such as diodes, transistors and integrated circuits can be found everywhere in our daily lives, in Walkman, televisions, automobiles, washing machines and computers. We have come to rely on them and increasingly have come to expect higher performance at lower cost.
- Personal computers clearly illustrate this trend. Anyone who wants to replace a three to five year old computer finds that the trade-in value of his or her computer is surprising low. On the bright side, one finds that the complexity and performance of the today's personal computers vastly exceeds that of their old computer and that for about the same purchase price, adjusted for inflation.

intrinsic semiconductor

- As a result of the thermal energy present in the material, electrons can break loose from covalent bonds and become free electrons able to move through the solid and contribute to the electrical conductivity. The covalent bonds left behind have an electron vacancy called a **hole. Electrons from neighboring covalent bonds can easily move into an** adjacent bond with an electron vacancy, or hole, and thus the hold can move from one covalent bond to an adjacent bond. As this process continues, we can say that the hole is moving through the material

Doped semiconductor

- **A semiconductor that has had impurity atoms added to modify the electrical** conduction characteristics.

Extrinsic semiconductor

- **A semiconductor that has been doped with impurities to modify the electrical** conduction characteristics.

Hole

- **An electron vacancy in a covalent bond between two atoms in a semiconductor. Holes are mobile** charge carriers with an effective charge that is opposite to the charge on an electron.

P-N

- **N-type semiconductor: A semiconductor that has been doped with donor impurities to produce the** condition that the population of free electrons is greater than the population of holes.
- **P-type semiconductor: A semiconductor that has been doped with acceptor impurities to produce the** condition that the population of holes is greater than the population of free electrons.