

UNIT 5

ELECTRICITY AND ITS MEASUREMENT

1. ELECTRIC CURRENT AND ITS MAGNITUDES
2. OHM'S LAW
3. DIRECT CURRENT AND ALTERNATING CURRENT

1. ELECTRIC CURRENT AND THEIR MAGNITUDES

- FUNDAMENTALS OF ELECTRICITY

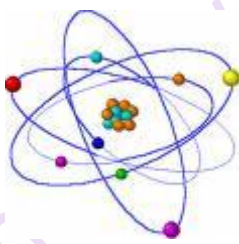
Electricity is the most widely used form of energy. Electricity runs our fridges, washing machines and in general, all electrical appliances in the kitchen. Electricity will probably power the most of all future cars.

The atom

To understand static electricity, we have to know the atom, how big it is and its structure. In other words, what is all the stuff around us made of?.

There are 115 kinds of atoms and all of them are different from each other.

All of them are made up of a "nucleus" situated in the middle of each atom. The nucleus contains two important kinds of tiny particles, called protons and neutrons. Orbiting around the nucleus are smaller particles called electrons.

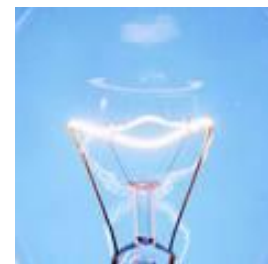
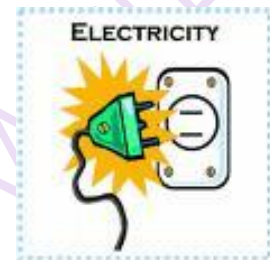


The electrons are said to be negatively charged and the protons positively charged. In **conductive materials**, such as metals, the outermost electron in the atom is basically free, so it is very easy for it to leave the atom and move around in the space between the atoms.

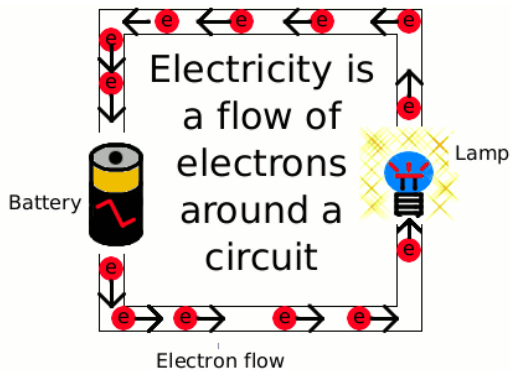
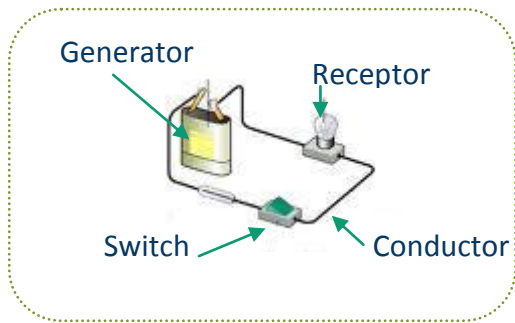
Conductors are made up of atoms whose electrons (conduction band) are able to escape from the atom's influence.

On the other hand, in **insulator** materials, such as glass, the outermost electron in the atom is tightly bonded to the nucleus by a electrostatic force. In this case, most electrons are attached to particular atoms. Almost none are free to wander through the material, and this prevents the flow of electricity.

An electric current in a conductive material is a flow of electrons



Electric circuit



- **Voltage**

The tension (V), also called voltage or potential difference between two points in a circuit, indicates the energy difference between two points. Its unit in the International System is the volt (V).

- **Resistance**

The resistance (R) of material, indicated the opposition to electric current that passes through it. It is measured in ohms (Ω).

- **Intensity**

The current intensity (I) expresses the amount of electric charge flowing through the circuit per second. It is measured in amperes (A).

2. OHM'S LAW

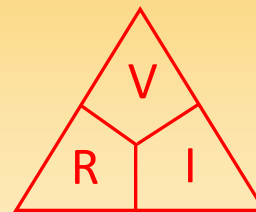
These three quantities are described by **Ohm's Law**.

Ohm's Law describes the relations between the electrical current and voltage and resistance:

$$I = V/R \quad ; \quad 1A = 1V/1\Omega$$

$$R = V/I \quad ; \quad 1\Omega = 1V/1A$$

$$V = R \cdot I \quad ; \quad 1V = 1\Omega \cdot 1A$$



- **The electrical energy**

The energy consumed by a receiver is calculated by multiplying the voltage, the intensity of the electric current that runs through it, and the time it is working.

$$E = V \cdot I \cdot t$$

Its unit in the International System is the Joule (J).

$$1J = 1V \cdot 1A \cdot 1sec. \quad \rightarrow \quad 1 \text{ Joule} = 1\text{Volt} \cdot 1 \text{ Ampere} \cdot 1 \text{ second}$$

- **Electric power**

Expresses the energy consumed by a receiver per second and is calculated:

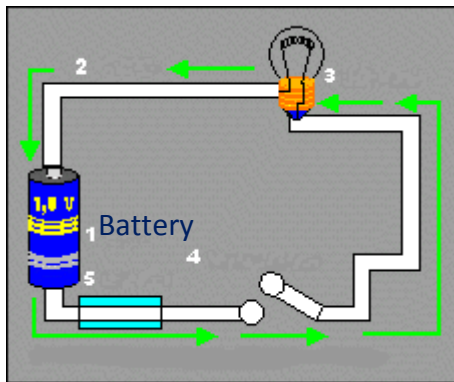
$$P = E/t = V \cdot I \cdot t / t = V \cdot I = R \cdot I^2$$

Power is measured in **watts (W)**

$$1W = 1V \cdot 1A = 1\Omega \cdot 1A^2$$

3. DIRECT CURRENT (DC) AND ALTERNATING CURRENT (AC)

There are two types of current, defined by the direction of the movement of the electrons. An electric current is called a **direct current (d.c.)** if electrons always flows in one direction. An electric current caused by a chemical cell or a battery is a direct current.



Electrons are always moving from the negative to the positive pole of the battery.

If an electric current in a circuit reverses direction every so often, it is called an **alternating current (a.c.)**.

For example, the current that flows through domestic light bulb when connected to the main electricity supply reverses direction 100 times every second and is therefore an alternating current.

Cycle or period (T) is the time it takes to repeat the signal from the current or voltage.

The frequency (f) of the alternating current, is the number of cycles per second. Frequency is measured in **hertz (Hz)**. In Europe, the frequency of electricity is 50 Hz, in the USA however, it's 60 Hz.

