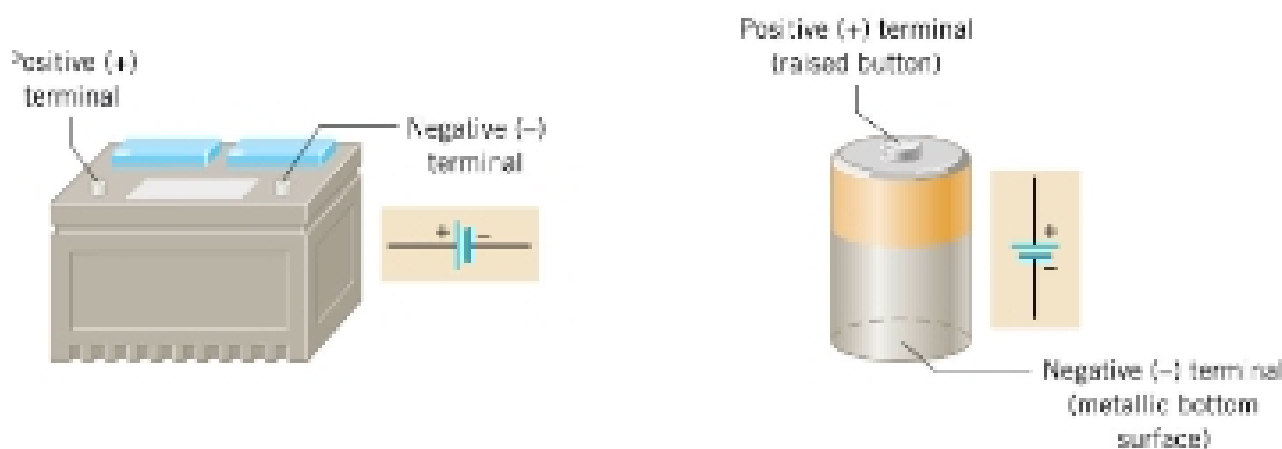


CHAPTER 20 - ELECTRIC CIRCUITS

Electromotive force(emf) of a battery is the maximum voltage that can be produced by the battery. It is measured with no current flowing in the circuit.



A car battery has an emf of 12.0 v and a flashlight battery has an emf of 1.5 v. Flashlight battery is really a misnomer since it consists internally of only one pair of electrodes. The car battery has 6 sets of electrodes(plates) arranged in series.

Electric current is defined as the rate at which charge flows past a point in a conductor. The equation for average or constant current is:

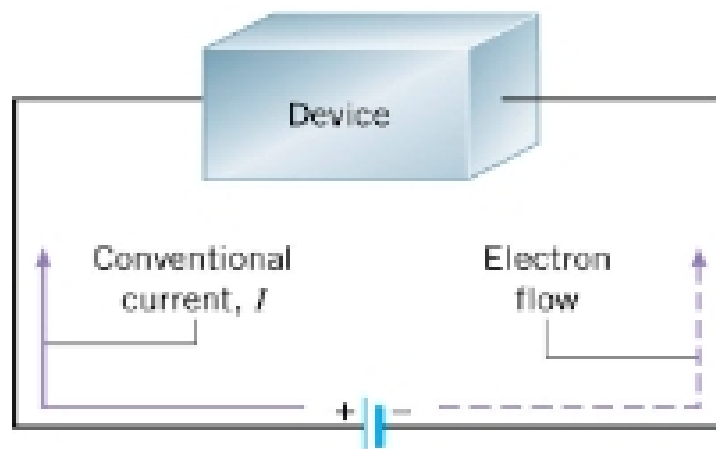
$$I = \Delta q / \Delta t$$

where I is current, Δq is the amount of charge, and Δt is the time for that charge to pass by. The unit of electric current is the ampere(A) which is one coulomb per second.

A defibrillator is used during a heart attack and passes 18.0 amps of current through a patient in 2.0 ms. How much charge passes through the patient?

If the defibrillator voltage is 2500v, how much energy is delivered to the patient?

Two types of electric current are direct current(dc) and alternating current(ac). Dc is produced by batteries and the current always flows in the same direction. In the case of ac, the current changes direction(+ to -) periodically. In the U.S. we use 60 Hz ac.



Today we know that electric current is carried by the electrons that move in conductors. Early pioneers in the study of electricity, however, thought that electric current was carried by positive charge. Conventional current describes the flow of electricity from the positive terminal to the negative terminal of a source of current.

Using this idea does not affect the amount or rate of energy transfer. We still use the same equations. Note in this text, I stands for conventional current.

Ohm's Law

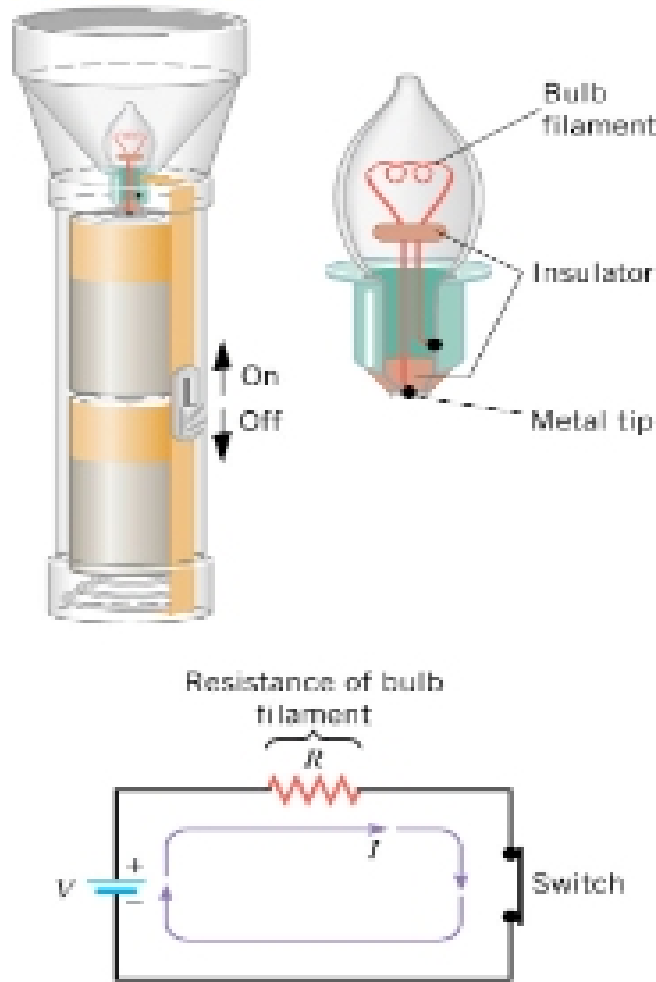
Ohm's Law relates current, voltage and resistance of a circuit. It states that the current in a circuit is directly proportional to the voltage across the circuit and inversely proportional to the resistance in the circuit. The equation is:

$$I = V/R$$

$$V = IR$$

The equation may be seen in either form. Resistance is defined as the tendency of a circuit component to oppose the flow of electric current. The SI unit of resistance is the Ohm(Ω) which is one volt per ampere.

A device that provides resistance in an electric circuit is called a resistor.



Above, we see a drawing of a flashlight and its bulb along with the circuit diagram.

Example

The filament of a light bulb has a resistance of 580 ohms. A voltage of 120 v is connected across the filament. How much current flows in the filament?

The resistance of a circuit component depends on several factors. For most materials the resistance is directly proportional to the length, inversely proportional to the cross-sectional area, and directly proportional to the resistivity.