Interesting Facts About Electricity !

What does Electric shock means?

Every one would have experienced electric shock in our life time atleast once. Have you ever wondered, how it happens. To understand this we must look back in to few fundamentals related to electricity.

VOLTAGE

CURRENT

RESISTANCE

Now you may ask, among these parameters which is responsible for electric shock in our body.

To explain this let me consider few cases:

Indian standard Single phase 230 volt AC supply

CASE 1

Accidentaly, if you touches the bare hot conductor (230V AC) while standing on the ground, you will receive severe shock. Now let us calculate how much current, your body allowed to pass through.

To calculate that Mr. Georg Simon Ohm proposed a relation, about 193 years back and it is called Ohm's law

$$V=I*R$$

The average human body resistance is about 1000 Ω

$$I=230/1000$$

$$I=230mA$$

This 230mA causes ventricular fibrillation which leads to heart paralysis.

CASE 2

If you touch the bare hot conductor(230V AC) while standing on the plastic ladder, you wont receive any shock, which is fatal to your body.

Let us find out the reason using Ohms's law.

$$V=I*R$$

The average human body resistance is about 1000 Ω

The resistance of plastic will be in the range of 10^{10}Ω

Total resistane = Resistance of human body + Resistance of Plastic ladder

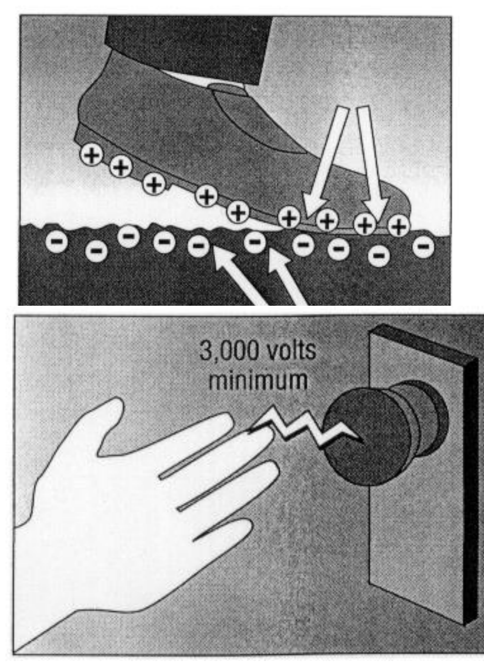
$$I=230/(1000+10^{10})$$

$$I=0.023\mu A$$

This 0.023μA will not cause much fatal to your body

CASE 3

Shock Due to Static Electricity



Static electricity is nothing but accumulation of positive or negative charges on the surface of insulating material due to friction between the material. This phenomenon is called charge imbalance or net charge separation.

Now let us see how static electricity creates shock in our body.

Have you ever experienced shock while touching door handle after walking on a carpet ?

If your answer is Yes, Here is the reason.

When you walk on a carpet, the electrons from the carpet get dislocated and attach on your foot wear, now these extra electrons waits to dicharge throuhg any conducting body, when you touch the door handle which is conducting body, the extra electrons jumps out of your body at the rate one millionth of the second, so you feel slight tingling in your skin.

The potential build in your body when you walk on the carpet is approximately 3000V.

Now you may rise a question, why this much heavy voltage didn't burn us?

The reason is time duration for flow of charge. Eventhough voltage is high enough to break the resistance of your body, it doesn't have that much charge for continuous flow.

Conclusion

- Eventhough if you touch HT line you won't receive any shock if you provide high resistance in the current flow path. So, resistance plays a major role for you to receive shock.

- Time duration for flow of charge also one of the important factor for creating shock in our body, this we have seen with static electricity

How electrons travels inside the conductor?

You may be surprised to learn that electrons flow through a typical copper wire much *slower* than a turtle walks.

Each wire that conducts a flow of electrons, producing usable electric current, is composed of billions of atoms. To move along it, the electrons have to traverse these atoms, randomly zig-zagging their way as they do, resulting in the net flow rate, called "drift velocity," in a given direction being quite slow.

How slow exactly? To calculate it, we use this formula:

$$I = n*A*v*Q \text{ or } v = I/(n*A*Q)$$

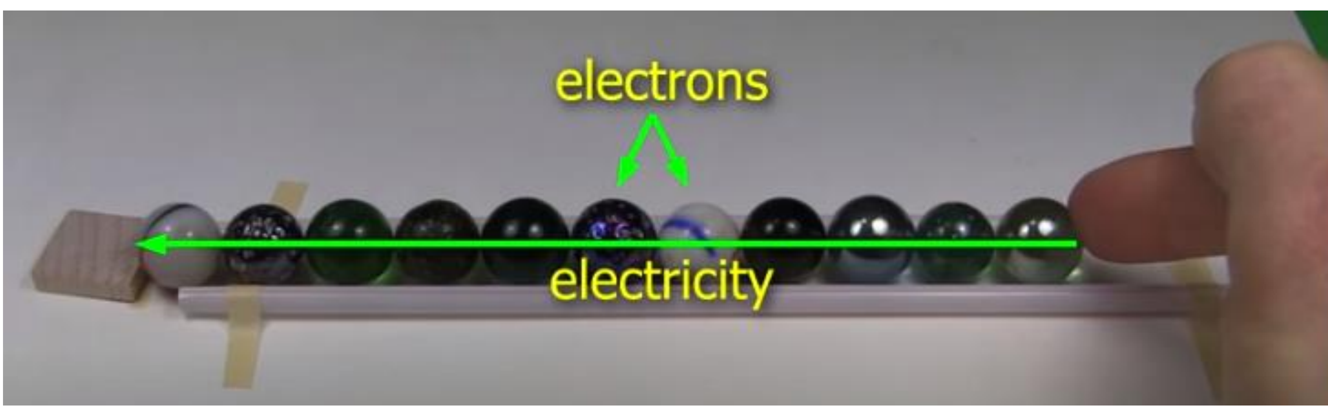
I is the current, n is the number of electrons per cubic meter, A is the cross-section of the wire, Q is the charge of an electron and v is the drift velocity of the electrons.

Since the number of electrons in a copper wire (n) is $8.5 * 10^{28}$ per m^3, and the charge of an electron (Q) is $1.6 * 10^{-19}$C, if we also know the cross sectional area and the current, we can calculate the electrons' drift velocity.
For example, suppose you have a current of 14 amps and a copper wire with a cross section of $3 * 10^{-6}$ m^2. Substitute all the numbers and you get that the electrons are moving at a speed of $3.4 * 10^{-4}$ m/s or about one-third of a millimeter per second.

To put it in values that are easier to conceptualize, this works out to about 1.2 meters (4.1 feet) per hour, a rate far slower than the average box turtle, which can cover about 800 feet in that same amount of time.

So how is it that something that is essentially slower than a turtle can more or less instantaneously turn on a light across a room?

Chain reaction.



The atoms in the wire are crammed together cheek to jowl, which, while it makes the going slow, also has the electrons more or less abutting one another. When the switch is turned on, a force is created to move the electrons, with each pushing its neighbor, which in turn pushes its neighbor and so on all the way through the wire.

So, while no electrons zoom through the wire to turn on the light as you might have previously thought, it ends up seeming like that is what's happening. This is not unlike how when you turn on your faucet, water instantly comes out despite the fact that your water source might be many miles away.