TALENT & OLYMPIAD



Electric Current and Its Effects

Electricity

It has been observed that when charged particles move, a special kind of effect is produced which can be used for various applications, as it posses energy.

This form of energy is called electrical energy, electric current or electricity. In other words, electricity is a form of energy, which is produced when charged particles move. Electricity can also be defined as flow of electrons through a conductor wire.

It is convenient to utilize electric energy .Therefore different sources of energy (fossil fuel, water, wind, etc.) is harvested to generate electrical energy, which is then converted into different other forms of energy ,i.e. heat energy, light energy, sound energy etc., as per our requirement.



Production of Electricity

Electricity is produced by harvesting various resources like fossil fuel, wind, water, solar energy etc. and is directly supplied to our houses. Various instruments for generating electricity has been developed, for example, cell, battery, generator etc., as per our requirements.







Charged Particles

Electron, Proton and Neutron are the three fundamental particles, which an atom is made up of. Out of the three, electron and proton are charged particles, whereas neutron is the neutral particle. Electron is negatively charged and proton is positively charged. Magnitude of charge on a proton is equal to that of an electron, but nature of the charge is opposite.



In an atom, number of protons is equal to the number of electrons. Therefore, atoms are neutral. But transfer of electrons from one atom to other atom causes the atoms to be charged. The atom, which looses the electrons gets positively charged because number of positively charged particle (protons) in the atom gets greater than that of negatively charged particles (electrons). Therefore, magnitude of total positive charge becomes greater than that of negative charge. And the atom, which receives the electrons gets negatively charged particles (protons) in the atom gets greater than that of negatively charged particle (electrons) in the atom gets greater than that of negatively charged particle (electrons) in the atom gets greater than that of negatively charged particle (electrons) in the atom gets greater than that of positively charged particles (protons). Hence, total magnitude of positive charge becomes greater than that of negative charge.

Charge Produced Due to Direction

Proton and neutron are present in the center of an atom, which is called nucleus. The electrons are revolving around the nucleus. The electrons close to the nucleus are tightly held by force of attraction produced by protons. And the electrons, which are far from the nucleus are loosely held; because force of attraction becomes weaker as the distance increases.

When we rub two substances with each other, some electrons, which are loosely held by nucleus, are transferred from one substance to other. As a result, the is substance that looses electrons, gets positively charged and the substance that gains electrons, gets negatively charged.



Force Around a Charged Particles

Charged particles have a force around them. This force can be experienced by bringing another charged particle close to them. Nature of the force is attraction or repulsion depending on the nature of the charged particles. If the charged particles are alike (both positively charged or both negatively charged), the force of repulsion works between them. And if charged particles are unlike (one positively charged and other

negatively charged), the force of attraction works between them. This is why between two protons or two electrons there is a force of repulsion and between an electron and a proton there is a force of attraction.

Movement of charged particles

Moving of charged particles has a number of applications for us, as this movement produces electricity. We already know that protons and electrons are the charged particles and when transfer of electrons occurs between two atoms, both the atoms get charged. Electricity is produced when any charged body move, like electrons, protons or charged atoms. Protons are tightly held in the nucleus and it cannot move from atom to atom like electron. Therefore, the electricity that we get is produced by moving electrons.

Commonly Asked

Which one of the following kind of energy is produced when a charged particle moves?

(a) Electrical energy(c) Light energy(e) None of theseAnswer: (a)

(b) Chemical energy(d) Sound energy



An atom gets charged because of _____

- (a) Transfer of proton(c) Transfer of electron(e) None of theseAnswer: (c)
- (b) Transfer of neutron
- (d) Transfer of nucleus

Electric Circuit

We know that when charged particles move, electricity is produced. For continue production of electricity, charge particles required to move continuously. Therefore, a path is prepared through which charge particles (electrons or charged atoms) keep on circulating. Thus electricity is produced continuously. The path through which charge particles move is called electric circuit.



A simple electric circuit is composed of a battery, wire, and a switch. One end of the wire is connected to the negative terminal of the battery and the other end of the wire is connected to the positive terminal of the battery. Switch is fitted in the wire in such a way that when switch is on, the wires of the circuit are connected and current is passed. When the switch is off, the wires are disconnected and the current cannot passed through the circuit. Thus the switch gives us the facility of using electrical energy as per our requirement. Different electrical appliances are fitted in the circuit for different purposes.



Resistance

Resistance is the force that oppose the flow of electrons in a conductor. Resistance of a matter depends on its nature. Generally metals offer lower resistance, whereas non-metals offer higher resistance. Moreover, the resistance of a wire also depends on the thickness and length of the wire.

Resistance Due to Thickness

If the thickness of the wire is increased, it will offer less resistance and if the thickness of the wire is decreased, it will offer greater resistance.



Low resistance

High resistance

Resistance Due to Length

If the length of the wire is increased, it will offer higher resistance and if the length of the wire is decreased, it will offer less resistance.

High resistance Low resistance

Conductor and Insulator

For the production of electricity a path is needed through which charge particles keep on moving. The substances, which allow the charge particles to move through themselves, are called conductors. In other words, conductors are the substances, which give the way for movement of charge particles through themselves. For example, silver, copper, aluminum, gold etc are conductors. Insulators are the substances, which do not allow the charge particles to move through themselves .For example, plastic, paper, wood etc.

Effects Due to Movement of Electric Charges

Moving charged particles produce some special kinds of effect, i.e. heating effect, magnetic effect, chemical effect, etc. These effects are made useful by various electrical instruments, like, bulb, heater, fan, etc. Thus electric energy is utilized by using the effects produced by the charge particles when they move.

Heating Effect

Charged particles have to do work to move through a substance. Substances are made up of atoms. So when charged particles move through them, they collide with the atoms of the substance. This collision changes a part of mechanical energy of electron into heat energy. Therefore, when electric charges flow through a substance, the substance gets heated. This phenomenon is known as heating effect of electricity. In other words, heating effect is the phenomenon in which electric energy changes into heat energy.



The amount of heat produced in the wire depends on the two factors:

Amount of Current Passes through the Wire

As the amount of current passing through the wire increases, amount of heat produced in the wire also increases. And, as the amount of current passing through the wire decreases, amount of heat produced in the wire also decreases. We can therefore conclude that the amount of heat produced in the wire is directly proportional to the amount of current passing through the wire.

The Resistance that the Wire Offer to the moving Charged Particles

The resistance of a wire depends on its nature. If the wire offers greater resistance, the higher amount of heat is produced. And if the wire offers less resistance, less amount of heat is produced. Thus, amount of heat produced in the wire is directly proportional to the resistance of the wire.

Applications of Heating Effects of Current

There a number of electrical instruments like bulb, heater, iron etc have been prepared to utilize this heat energy produced in the wire. Bulb is used for producing light.

Magnetic Effect

In 1820, Hans Christian Oersted noticed a deflection of magnetic needle, placed near to the current carrying wire. He found that it was because of appearance of a force produced by current carrying conductor. Like a magnet, a current carrying conductor also applies a force on magnets when they are brought close. Thus when current passes through a wire, it acts as a magnet and produce a magnetic field. This phenomenon is called the magnetic effect of current.



Applications of Magnetic Effects of Current

Magnetic effect of current has a number of applications. A variety of instruments like electric bells, electromagnet, fans etc. are there which work using this magnetic effect of current.

Electromagnet

Electromagnet is a magnet prepared by using the effect of magnetism of electric current. It consists of long, coiled copper wire wrapped around a iron rod. When current is passed through the wire, it behaves like a magnet, called electromagnet.







Applications of Electromagnet

Electromagnet has a number of applications as the magnetism of electromagnet can be switched on or switched off as per our wishes. Its strength can be increased or decreased as per our requirements. It is used in a number of devices like electric bell, fans, toys etc.

Fuses

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Fuse is a safety device used to protect electric circuit and other electrical devices like, bulbs, tube lights, fans, TV, refrigerators etc. from being damaged of excessive current flow.

Sometimes, due to touching of live wire with neutral wire, known as short circuit, excessive amount of current passes through the wire. This excessive amount of current causes production of large amount of heat. As a result the wire gets burnt and the house may catch fire. Overloading is another major danger which sometimes causes fire and other damages. Thus to protect our houses and other electrical appliances from these problems, fuses are used.

A fuse consists of a strip of low melting alloy. In case of over loading or short circuiting, the alloy wire of the fuse gets melted immediately. As a result, the circuit of electricity breaks and supplying is stopped. In this way other electrical appliances are saved from damage.



The wire of greater resistance produces greater amount of heat energy' is the above statement true ?
(a) Yes
(b) No
(c) Resistance has nothing to do with heat

- (d) All of these
- (e) None of these

Answers (a)



Which one of the following is an insulator?

- (a) Water
- (c) Dried wood
- (e) None of these

Answer: (c)





(b) Human body

(d) Iron nail

- Flow of electrons through a wire is called electricity.
- The path, in which electrons move to produce electricity, is called electric circuit.
- A simple electric circuit is composed of a battery, wire and a switch .
- Fuse is a safety device which protects the electric appliances in case of short circuiting and overloading.
- When current is passed from a wire the heat energy is produced, the phenomenon is known as heating effect of current.
- Bulb is an instrument, which works on the heating effect of current.
- When current moves from a conductor wire, it acts as a bar magnet. This phenomenon is known as magnetic effect of current.
- Electric bell works on magnetic effect of current.

Self Evaluation TEST



The wire used in a fuse has 1.

- (a) High melting point
- (c) Average melting point
- (e) None of these

- (b) Low melting point
- (d) All of these

(d) All of these

2. On which one of the following effects of electric current the electric bulb works?

- (a) Heating effect of current
- (c) Chemical effect of current
- (e) None of these

(b) Magnetic effect of current

- 3. Why only iron is used for making electromagnet; not steel, nickel, cobalt?
 - (a) Because iron is cheep and easily available
 - (b) Because iron is a good conductor of electricity
 - (c) Because when current is switched off in the coil of an electromagnet made of iron, iron loses all its magnetism
 - (d) Because iron is a temporary magnet
 - (e) None of these

Which one of the following phenomenon occurs when two naked wires of electricity supply line touch 4. each other?

(a) Overloading

(b) Short circuiting

(c) Lightening

(d) All of these

(e) None of these

5. The electric fuse work on which one of the following phenomenon?

- (a) Chemical effect of current
 - (c) Heating effect of current
- (b) Magnetic effect of current (d) All of these

(e) None of these

On which one of the following the resistance of wire depends? 6.

- (a) Length of the wire
- (c) Nature of the wire
- (b) Thickness of the wire
- (d) All of these

(e) None of these

7. In which one of the following conditions, amount of heat produced in a current carrying wire, will increase?

- (a) When amount of current passing in the wire is increased
- (b) When amount of current passing in the wire is decreased
- (c) When terminals of the are changed
- (d) All of these
- (e) None of these

8. Which one of the following is the best conductor of electricity?

(a) Silver

(b) Copper (d) Iron

(c) Aluminium

(e) None of these

9. Magnetic effect of current was discovered by

(a) Thomas Jefferson(c) Flemming

(b) Hans Christian Oersted(d) Louis Pasteur

(e) None of these

10. What is overloading?

- (a) Touching of live wire with the neutral wire
- (b) Touching of live wire with the Earth wire
- (c) Touching of neutral wire with the earth wire
- (d) Drawing extremely large amount of current from the single house, hold circuit
- (e) None of these

| | Answers – Self Evaluation Test | | | | | | | | | | | | | | | | | |
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