Electricity

Electricity, one of the basic forms of energy. Electricity is associated with electric charge, a property of certain elementary particles such as electrons and protons. Electric charges can be stationary, as in static electricity, or moving, as in an electric current.

Electricity is an extremely versatile form of energy. It can be generated in many ways and from many different sources. It can be sent almost instantaneously over long distances. Electricity can also be converted efficiently into other forms of energy, and it can be stored. Because of this versatility, electricity plays a part in nearly every aspect of modern technology. Electricity provides light, heat, and mechanical power. It makes telephones, computers, televisions, and countless other necessities and luxuries possible.

Electric Charge

Electricity consists of charges carried by electrons, protons, and other particles. Electric charge comes in two forms: positive and negative. Electrons and protons both carry exactly the same amount of electric charge, but the positive charge of the proton is exactly opposite the negative charge of the electron. If an object has more protons than electrons, it is said to be positively charged; if it has more electrons than protons, it is said to be negatively charged. If an object contains as many protons as electrons, the charges will cancel each other and the object is said to be uncharged, or electrically neutral.

Coulomb's Law

Objects with opposite charges attract each other, and objects with similar charges repel each other. Coulomb's law, formulated by French physicist Charles Augustin de Coulomb during the late 18th century, quantifies the strength of the attraction or repulsion. This law states that the force between two charged objects is directly proportional to the product of their charges and inversely proportional to the square of the distance between them. The greater the charges on the objects, the larger the force between them; the greater the distance between the objects, the lesser the force between them. The unit of electric charge, also named after Coulomb, is equal to the combined charges of 6.24 x 1018 protons (or electrons).

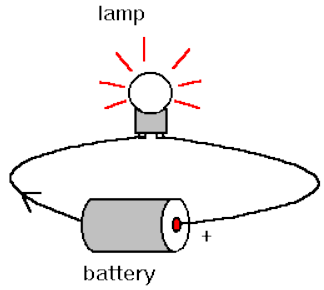
Charging by Induction

A charged object may induce a charge in a nearby neutral object without touching it. For example, if a positively charged object is brought near a neutral object, the electrons in the neutral object are attracted to

the positive object. Some of these electrons flow to the side of the neutral object that is nearest to the positive object. This side of the neutral object accumulates electrons and becomes negatively charged. Because electrons leave the far side of the neutral object while its protons remain stationary, that side becomes positively charged. Since the negatively charged side of the neutral object is closest to the positive object, the attraction between this side and the positive object is greater than the repulsion between the positively charged side and the positive object. The net effect is an attraction between the objects. Similarly, when a negatively charged object is brought near a neutral object, the negative object induces a positive charge on the nearside of the neutral object and a negative charge on the far side. As before, the,ne't effect is an attraction between the objects. The induced charges described above are not permanent. As soon as the charged object is taken away, the electrons on the other object redistribute themselves evenly over it, so that it again becomes neutral.

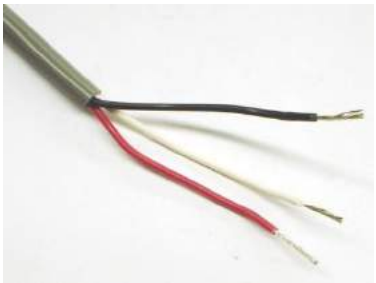
Electric Current

An electric current is a movement of charge. When two objects with different charges touch and redistribute their charges, an electric current flows from one object to the other until the charge is distributed according to the capacitances of the objects. If two objects are connected by a material that lets charge flow easily, such as a copper wire, then an electric current flows from one object to the other through the wire. Electric current can be demonstrated by connecting a small light bulb to an electric battery by two copperwires. When the connections are properly made, current flows through the wires and the bulb, causing the bulb to glow.



Conductors and Insulators

Conductors are materials that allow an electric current to flow through them easily. Most metals are good conductors.



Substances that do not allow electric current to flow through them are called insulators, nonconductors, or dielectrics. Rubber, glass, and air are common insulators. Electricians wear rubber gloves so that electric current will not pass from electrical equipment to their bodies. However, if an object contains a sufficient amount of charge, the charge can arc, or jump, through an insulator to another object. For example, if you

shuffle across a wool rug and then hold your finger very close to, but not in contact with, a metal doorknob or radiator, current will arc through the air from your finger to the doorknob or radiator, even though air is an insulator. In the dark/ the passage of the current through the air is visible as a tiny spark.

Measuring Electric Current

Electric current is measured in units called amperes (amp). If 1 coulomb of charge flows past each point of a wire every second, the wire is carrying a current of 1 amp. If 2 coulombs flow past each point in a second, the current is 2 amp.

Voltage

When the two terminals of a battery are connected by a conductor, an electric current flows through the conductor. One terminal continuously sends electrons into the conductor, while the other continuously receives electrons from it. The current flow is caused by the voltage, or potential difference, between the terminals.

Resistance

A conductor allows an electric current to flow through it, but it does not permit the current to flow with perfect freedom. Collisions between the electrons and the atoms of the conductor interfere with the flow of electrons. This phenomenon is known as resistance. Resistance is measured in units called ohms. The symbol for ohms is the Greek letter omega, W.

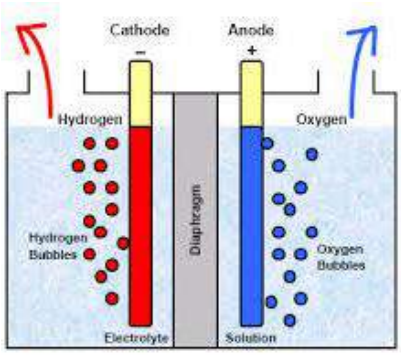
A good conductor is one that has low resistance. A good insulator has a very high resistance.

The resistance of a piece of wire depends on its length, and its cross-sectional area, or thickness. The longer the wire is, the greater its resistance. If one wire is twice as long as a wire of identical diameter and material, the longer wire offers twice as much resistance as the shorter one. A thicker wire, however, has less resistance, because a thick wire offers more room for an electric current to pass through than a thin wire does.

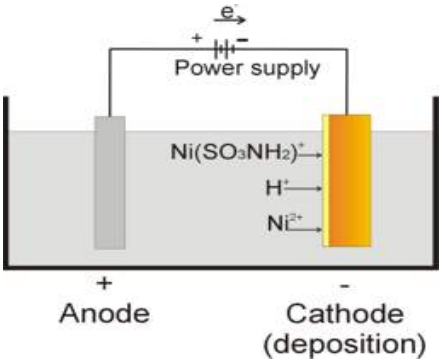
Chemical Effects of Electricity

In order to generate electricity there are many methods used, one of them is chemical. Remember batteries, where electricity is generated because of chemical reactions inside cell. Also in conductors like liquids and gases electricity is carried not by electrons as it is in solid constructions(copper, aluminium, etc.), but by ions - molecules with electric charges. Even non distilled water contain enough ions to be conductive. Lets go through several chemical effects of electricity.

Electrolysis: Electrolysis is a decomposition of liquid compound by passing electric current through liquid called electrolyte(salt water, copper sulphate, sulphuric acid). Electrolysis is used very widely in industry like electroplating of metals, refining of copper and extraction of aluminum from ore. To make electrolysis happen there are two conductors used cathode (-) and anode(+).



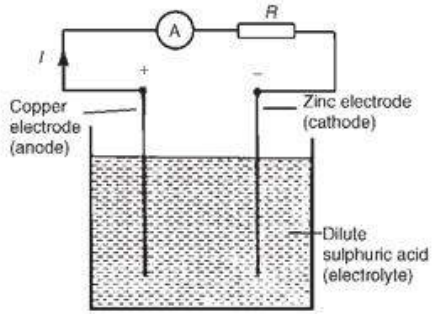
Electroplating: The process of covering a more reactive metal with a less reactive metal with the help of electricity is known as electroplating. Material to be plated should be connected as cathode while anode usually loses material.



Chemical Cell

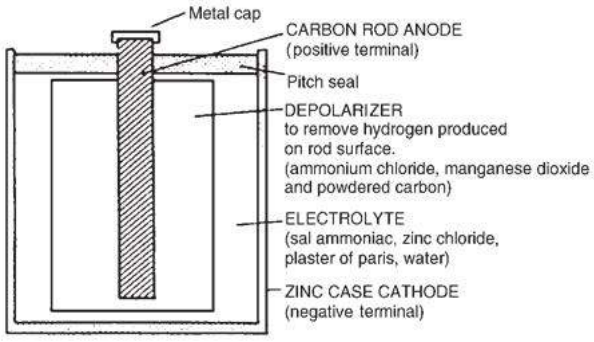
According to this principal all batteries are generating electric power. Chemical cells converts chemical energy in to electrical. If there are two different conductors(eg. Copper and zinc) placed in electrolyte, electric current starts flowing between electrodes.

Each different pair of electrodes generate different potential. As long as there is an external circuit, electrons can flow through it from one electrode to another. Because zinc tends to lose electrons more readily than copper, zinc atoms in the zinc electrode lose electrons to produce zinc ions. The net result is that zinc metal reacts with copper ions to produce zinc ions and copper metal.



Non Rechargeable Lechlanche Cells

These are cells that generate about 1.5V of EMS, but if falls in continuous use due to polarization of electrode. These cells are better to us for intermittent purposes like torches, bells, indicators etc. These cells are cheap and has a shelf life about 2 years.



DRY LECLANCHÉ CELL

There are more dry cell technologies that enables to remain EMF constant for longer times. Ones are Mercury cells. These cells provide 1.3V for longer time than Lechlanche cells.

Rechargeable Cells

Rechargeable cells are most commonly used today as main factor - the price is becoming acceptable for everyone. And there is another practical approach - these cells can be recharged after use. In other words the conversion of chemical energy to electrical is reversible. There are many types of rechargeable cell technologies. Ones of common are lead-acid and the alkaline cells. These cells are usually used in cars.

Commonly Asked QUESTIONS

If an object contains more protons than electrons, the object is:

(a) Positively charged (b) Negatively charged
(c) Neutral (d) All of these (e) None of these

Answer: (a)

Which one of the following is a conductor?

(a) Wood (b) Rubber
(c) Iron (d) All of these (e) None of these

Answer: (c)

SUMMARY

- Electricity is an extremely versatile form of energy.
- Protons are positively charged particles whereas electrons are negatively charged particles.
- Coulomb's law quantifies the strength of the attraction or repulsion
- The materials which allow electricity to pass through them are called insulators.
- The materials which do not allow electricity to pass through them are called conductors.

Self Evaluation TEST

Duration 10 Minutes

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1. A liquid which can conduct electricity is called:

(a) Electrolyte (b) Solution
(c) Solvent (d) All of these
(e) None of these

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2. Which one of the following statements is correct?

Statement 1: The positively charged electrode is called anode.
Statement 2: The negatively charged electrode is called cathode.

(a) Statement 1 (b) Statement 2
(c) Both statements are correct (d) Both statements are incorrect

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3. Which one of the following is a conductor of electricity?

(a) Plastic (b) Paper
(c) Glass (d) Aluminium
(e) None of these

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4. Which one of the following is an insulator of electricity?

(a) Copper (b) Iron
(c) Mercury (d) Air
(e) None of these

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5. The chemical decomposition produced by passing an electric current through a conducting liquid is called :

(a) Combination (b) Electroplating
(c) Electrolysis (d) All of these
(e) None of these

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6. The process of depositing a thin layer of desired metal over a metal object with the help of electric current is called?

(a) Combination (b) Electroplating
(c) Electrolysis (d) All of these
(e) None of these

7. **The metal object on which electroplating is to be done is:**

(a) Connected to the negative terminal of battery
(b) Connected to the positive terminal of battery
(c) Not connected to the battery
(d) Both (a) and (b)
(e) None of these

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8. **Which one of the following statements is correct?**

Statement 1: If a little salt is dissolved to the distilled water, it becomes good conductor of electricity
Statement 2: Rainwater is a conductor of electricity

(a) Statement 1 (b) Statement 2
(c) Both statements are correct (d) Both statement a re incorrect

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9. **Which one of the following statements is correct?**

Statement 1: The liquid that conduct electricity is solution of acids, bases/ salts and water
Statement 2: When electric current passes through an electrolyte, chemical changes takes place

(a) Statement 1 (b) Statement 2
(c) Both statements are correct (d) Both statements are incorrect

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10. **Which one of the following statements is correct?**

Statement 1: Corrosion is a gradual destruction of metal in environment
Statement 2: Corrosion of iron cannot be prevented by electroplating

(a) Statement 1 (b) Statement 2
(c) Both statements are correct (d) Both statements are incorrect

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Answers – Self Evaluation Test																			
1.	A	**2.**	C	**3.**	D	**4.**	D	**5.**	C	**6.**	B	**7.**	A	**8.**	C	**9.**	C	**10.**	A