Electric currents and circuits

An electric current is defined as the flow or movement of free electrons through a conductor. Because current can be both measured and controlled it is a tremendously important source of energy in the modern world.

In the early days of experimentation with electricity before the nature of the phenomenon was well understood it was thought that the electric current flowed in the same way as water. Thus, many terms referring to electricity are the same as those used to describe the movement of water, current flow is one such term. We know now that electrons which are negatively charged flow externally through the circuit of a battery to the positive electrode. Formerly ,however, it was believed that an electric current flowed in the opposite direction from the positive to the negative side just as water flows from full to empty. Because the term “current flow “was used to refer to this erroneous conception of electricity dominant in the nineteenth century, now the term electron flow indicating the movement of electrons from the negative to the positive pole is generally used instead.

The force that generates a flow of electricity is sometimes called pressure, like the pressure that causes water to flow. A more accurate term is electromotive force usually abbreviated emf. The electromotive force is measured in volts, abbreviated with the letter V. Volts are named after the Italian scientist Alessandro Volta.

The strength of a current ,or the rate at which electrons move through a conductor ,varies. The number of electrons flowing per second is measured in amperes ,abbreviated amp. The ampere is named for a French scientist Andre Ampere.

Different conductors allow the current to flow at different rates. The degree to which they impede, or act against , the flow of current is called resistance. Three excellent conductors of electricity are silver, copper and aluminum. Silver has a lower resistance than copper , but copper is used for electric wires because it is cheaper than silver. As copper has become rarer and more expensive, however, aluminum has come into use for wiring purposes, even though it has a slightly higher resistance than copper.

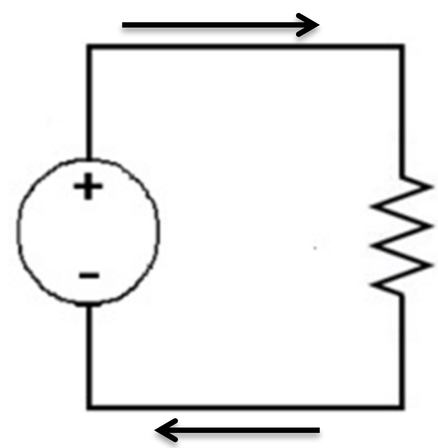
Resistance causes the electric energy to be changed into heat. An iron wire, for example, which has a higher resistance than copper or aluminum, will become read-hot when a strong enough current flows through it. Resistance is responsible for the heating and lighting effects of many common household appliances. In the electric light bulb a very thin wire (filament)of tungsten glows white-hot as current passes through it, thereby giving off light. Heating devices such as electric irons have resistors built in which heat up to the desired degree when a current moves through them.

Resistance is measured in ohms sometimes abbreviated with the Greek letter omega. Ohms are named after the German scientist George Simon Ohm.

Volts, amperes and ohms can all be defined in numerical terms that is they can be quantified for use in arithmetical and mathematical calculations.

The volt is defined as the electromotive force that send one ampere of current through a resistance of one ohm. An ampere is defined as the number of electrons that pass through a point ion one second. The ohm is the resistance of a conductor that will permit one ampere of current to flow when a force of one volt has been applied.

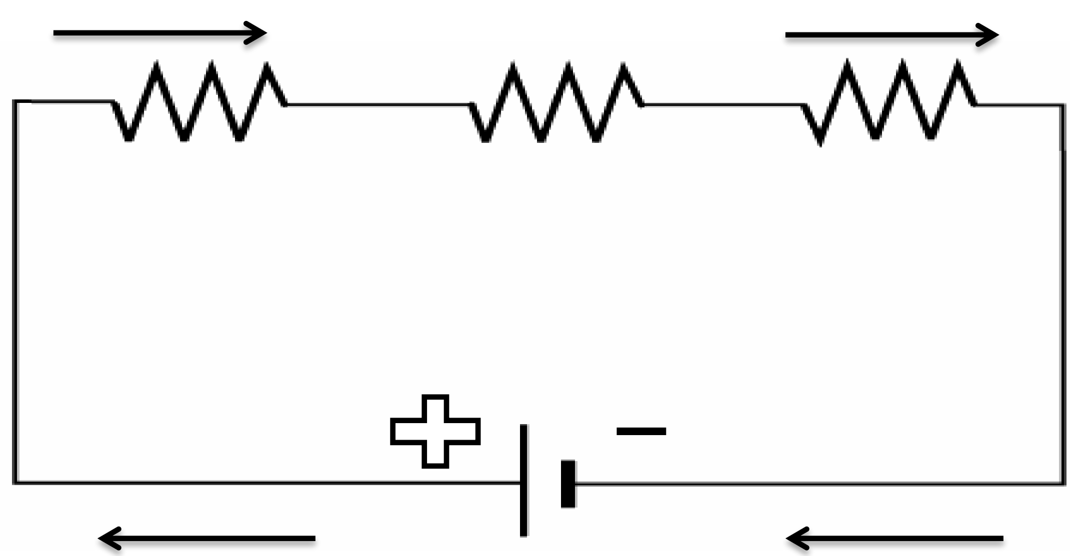
When a current has been generated it flows in a path called a circuit.



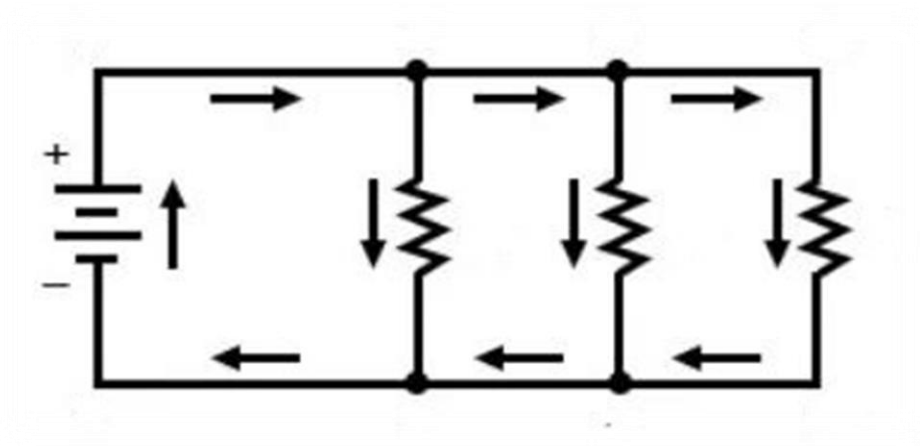
There are two basic kinds of circuit, depending on the way the electrical equipment is connected. The first is a series circuit , where the pieces of equipment are connected by wires that give the current only one path to follow.

In the circuit diagram at the right the symbol  indicates the source of electric current, and indicates the source of resistance-in this case a light bulb. The arrows indicate the electron flow from negative (-) to positive (+).

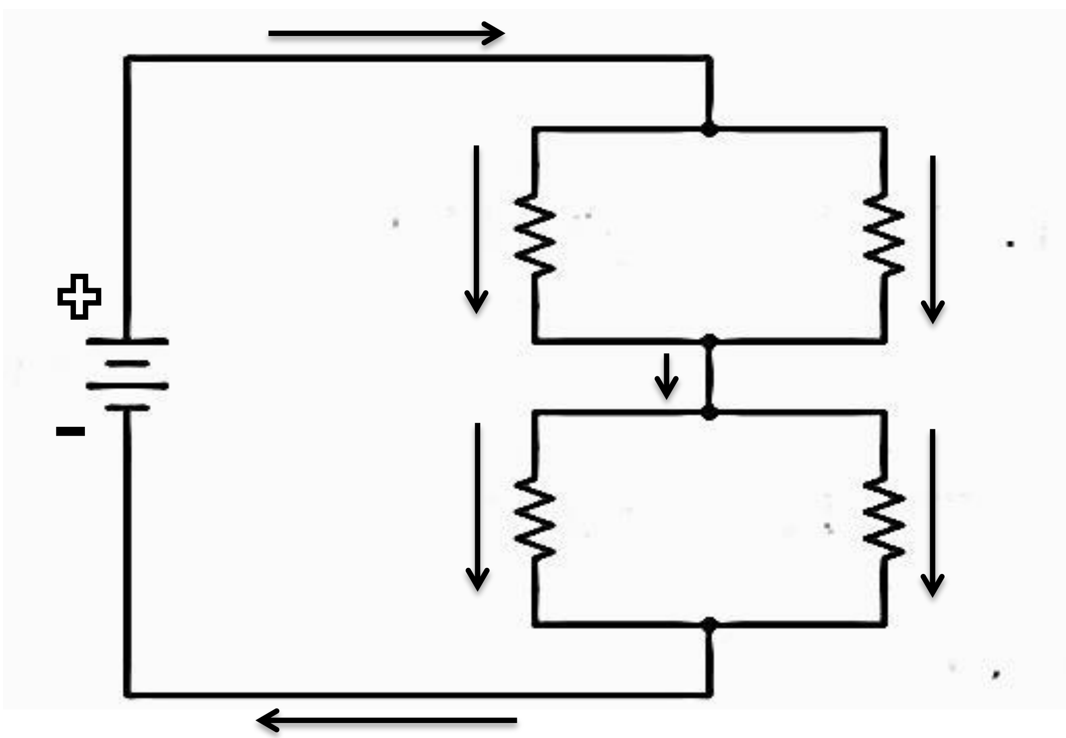
This is the simplest type of series circuit, with only one resistor. The diagram below shows how two or more bulbs can be connected in series circuit. A string of Christmas tree lights used to be a familiar sample of a series circuit. Since the current had only one path to follow, all the lights in the circuit went out when even one bulb burned out.

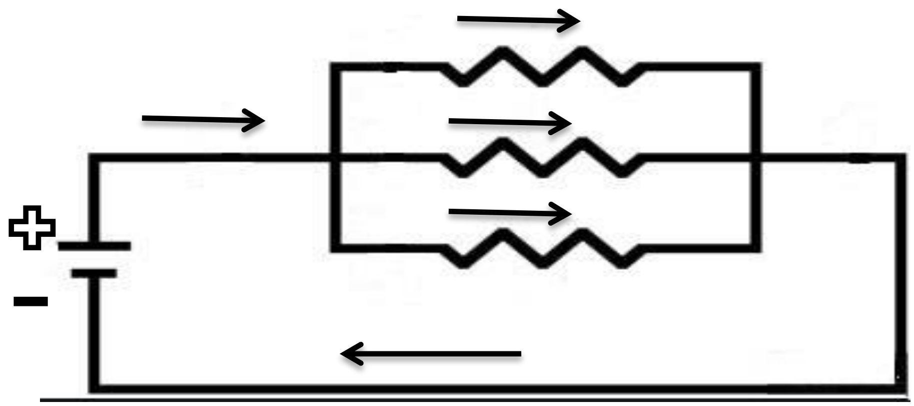


The other basic type of circuit is called parallel circuit . In this type of arrangement two ,or more wires are placed parallel to each other so that the current has more one path through which it can flow, In the diagram below, the current is divided up among the three resistors. When the resistors in the circuit are light bulbs, if one burned out, current will continue to flow through the other two. Household electricity is connected by parallel circuits so that the whole circuit will not fail because of the failure of one piece of electrical equipment.



The two kinds of circuits can also be used together in a series parallel circuit. Two possible arrangements for series parallel circuits are shown in the diagrams below.





The diagrams indicate that the circuit is completed by returning the wire to the positive terminal. In actual practice, many circuits and electrical appliances are grounded for safety reasons- one terminal, called the ground, is connected to the earth. This is done by connecting any metallic part of a machine or appliances to a water or sewer pipe. In cse of electrical trouble the current will go directly to the ground rather than through someone who accidently touches the equipment. Dissolves salts in the air provide positively charged ions that attract the free electrons.

When setting up a circuit one must be sure that there is sufficient voltage to supply the current necessary to overcome the resistance.

Thus , Ohm's law not only has theoretical value but is also a useful and necessary tool for electrical engineers in their daily work.

When too many electrical appliances are placed in a circuit the conducting wire may overheat. Therefore most circuits are protected fuses or other devices which break the circuit when it is overloaded. One familiar type of fuse has a wire with a low melting point protected by a window of a transparent mineral named mica. All the current in the circuit passes through the fuse. When the fuse heats up to a certain point at a specified rate of current, the wire in the fuse melts and the circuit is broken. Most household circuits are wired for a current of 20 amperes.

A short circuit occurs when a zero resistance between two points on a wire shortens the path of electron flow. This usually results when the insulating material ,the rubber or plastic covering the wire, has worn a way so that the two bare pieces of wire come into contact with each other. The current is simply following the path of least resistance . When a circuit overloads or shorts out , there is a hazard of fire. To prevent it, safety devices like fuses or circuit breakers must be built into the system.

There are two kinds of current flow, direct current , usually abbreviated dc and ,alternating current, usually abbreviated ac.

In direct current the flow of electrons moves steadily in one direction. This is the kind of current is generated by a flashlight cell or an automobile battery. In alternating current , The flow of electrons is reversed rapidly over and over again. This is called electromagnetism.

Electrical conductor

Electrical conductor is any material that offers little resistance to the flow of an electric current. The difference between a conductor and an insulator, which is a poor conductor of electricity or heat, is one of degree rather than kind, because all substances conduct electricity to some extent. A good conductor of electricity, such as silver or copper, may have conductivity a billion or more times as great as the conductivity of a good insulator, such as glass or mica. A phenomenon known as superconductivity is observed when certain substances are cooled to a point near absolute zero, at which point their conductivity becomes almost infinite. In solid conductors the electric current is carried by the movement of electrons; in solutions and gases, the electric current is carried by ions.

Electric insulation

The perfect insulator for electrical applications would be a material that is absolutely nonconducting; such a material does not exist. The materials used as insulators, although they do conduct some electricity, have a resistance to the flow of electric current as much as 2.5×10^{24} greater than that of good electrical conductors such as silver and copper. Materials that are good conductors have a large number of free electrons (electrons not tightly bound to atoms) available to carry the current; good insulators have few such electrons. Some materials such as silicon and germanium, which have a limited number of free electrons, are semiconductors and form the basic material of transistors.

In ordinary electric wiring, plastics are commonly used as insulating sheathing for the wire itself. Very fine wire, such as that used for the winding of coils and transformers, may be insulated with a thin coat of enamel. The internal insulation of electric equipment may be made of mica or glass fibers with a plastic binder. Electronic equipment and transformers may also use a special electrical grade of paper. High-voltage power lines are insulated with units made of porcelain or other ceramic, or of glass.

The specific choice of an insulation material is usually determined by its application.

Polyethylene and polystyrene are used in high-frequency applications, and mylar is used for electrical capacitors. Insulators must also be selected according to the maximum temperature they will encounter. Teflon is used in the high-temperature range of 175° to 230° C (350° to 450° F). Adverse mechanical or chemical conditions may call for other materials. Nylon has excellent abrasion resistance, and neoprene, silicone rubber, epoxy polyesters, and polyurethanes can provide protection against chemicals and moisture.

Equivalence:

Material=substance
Offer=provide
Carried by=conduct
Observe=watch
Degree=rank
Phenomenon=occurrence

Sheathing=insulating
Winding=coiled
Coat=cover

Electrical conductor	موصل كهربائي
Material	مادة
Offer	يوفر
Resistance	مقاومة
Flow	انسياب
Electric current	التيار الكهربائي
Conductor	موصل
Insulator	عازل
Poor conductor	قليل التوصيل, موصل ردئ
Electricity	كهربائية
Heat	حرارة
Degree	درجة او مستوى
Kind	نوع
Silver	فضة
Copper	نحاس
Conductivity	قابلية التوصيل
Glass	زجاج
Mica	مادة زجاجية عازلة
Phenomenon	ظاهرة
Superconductivity	فائق التوصيل
Cooled	تبريد
Absolute zero	الصفر المطلق
Solids	مواد صلبة
Carried by	ينتقل او تحمله
Solutions and gases	السوائل والغازات
Property	خاصية
Electric insulation	عزل كهربائي
Nonconducting	غير موصل
Tightly bound	مرتبط بشدة بالذرة
Germanium	عنصر الجرمانيوم
Semiconductors	شبه موصل
Wiring	ربط الاسلاك
Insulating sheathing	عزل الاسلاك الكهربائية
Fine wire	سلك رفيع جدا
Winding	لف الاسلاك الكهربائية
Coil	ملف
Transformers	محولات
Thin coat	غلاف رقيق
Enamel	مادة المينا
Internal	داخل

Electric equipment	أجهزة كهربائية
Fiber	الياف
Plastic binder	غلاف من اللدائن
Grade of paper	نوع من الورق العازل
High voltage power lines	خطوط الضغط العالي
Porcelain	بورسلين
Ceramic	سيراميك
Application	تطبيقات
Polyethylene	بولي اثيلين
Polystyrene	بلاستك
Mylar	علامة تجارية لمادة مصنوعة من البلاستك
Capacitors	مكثفات
Temperature	درجة حرارة
Encounter	تتحملها المادة
Adverse mechanical	ميكانيكية مكثفة
Chemical conditions	شروط كيميائية
Abrasion	تآكل
Neoprene	مادة مضادة لحرارة الطقس والرطوبة
Rubber	مطاط
Protection	حماية
Moisture	رطوبة

Fiber Optics

Fiber Optics: a branch of optics dealing with the transmission of light through hair-thin transparent fibers. Light signals that enter at one end of a fiber travel through the fiber with very low loss of light, even if the fiber is curved. A basic fiber-optic system consists of a transmitting device (which generates the light signal), an optical-fiber cable (which carries the light), and a receiver (which accepts the transmitted light signal and converts it to an electrical signal).

Operation

Fiber-optic transmission of light depends on preventing light from escaping from the fiber. When a beam of light encounters a boundary between two transparent substances, some of the light is normally reflected, while the rest passes into the new substance. How much of the beam is reflected, and how much enters the second substance, depends on the angle at which the light strikes the boundary. When the Sun shines down on the ocean from directly overhead, for example, much of its light penetrates the water. When the Sun is setting, however, its light strikes the surface of the water at a shallow angle, and most of it is reflected. Fiber optics makes use of certain special conditions, under which all of the light encountering the surface between two materials is reflected, to reduce loss.

A principle called total internal reflection allows optical fibers to retain the light they carry. When light passes from a dense substance into a less dense substance, there is an angle, called the critical angle, beyond which 100 percent of the light is reflected from the surface between substances. Total internal reflection occurs when light strikes the boundary between substances at an angle greater than the critical angle. An optical-fiber core is clad (coated) by a lower density glass layer. Light traveling inside the core of an optical fiber strikes the outside surface at an angle of incidence greater than the critical angle so that all the light is reflected toward the inside of the fiber without loss.

As long as the fiber is not curved too sharply, light traveling inside cannot strike the outer surface at less than the critical angle. Thus, light can be transmitted over long distances by being reflected inward thousands of times with no loss (see Optics; Reflection).

Applications

The most widespread use of fiber optics is in communications. But optical fibers can carry light for illumination, to convey images, and even to transmit laser beams.

Answer the following questions?

1. Explain fiber optics?

2. Explain briefly the operation of fiber optics?

3. What are the basic elements of fiber optics?

4. Define the following the receiver, optical fiber cable, the transmitting device?

5. Explain the shallow angle?

6.” A principle called total internal reflection allows optical fibers to retain the light they carry.” Explain?

7. Explain the principle of total internal reflection?

8. What are the applications of fiber optics?

9. When the total internal reflection occurs?

10. ” Fiber optics makes use of certain special conditions, under which all of the light encountering the surface between two materials is reflected”. Explain?

Incandescent Lamp

Incandescent lamp is a device that produces light by heating a material to a high temperature. The most familiar example of an incandescent lamp is the common household bulb. It consists of a stretched or coiled filament of tungsten metal sealed inside a bulb filled with a gas that will not react with the tungsten or the bulb. This inert gas is a combination of nitrogen and argon in a proportion designed to suit the wattage, or brightness, of the bulb. When electric current flows through the filament, it heats the filament to a temperature of about 3000°C (about 5000°F), causing the filament to glow and provide light.

The incandescent lamp is based on the principle of incandescence, in which solids and gases emit visible light when burning or when an electric current heat them to a sufficiently high temperature. Each material gives off light in a color characteristic of that material.

The invention of vacuum pumps made it possible to use incandescent lamps for regular lighting. In 1878 British scientist Sir Joseph Wilson Swan invented the modern light bulb, which used carbon filaments in evacuated glass bulbs. But the invention of the light bulb is more often associated with American inventor Thomas Alva Edison. He independently discovered the same device a year later in his work on the development of the electrical infrastructure that enabled incandescent lamps to be widely used as a lighting system.

The light bulb has undergone various improvements since Edison's work. One of the most significant changes was the introduction in 1911 of lamps made with filaments of tungsten, which has the highest melting point of any metal. This advance was attributed largely to William David Coolidge, an American engineer working for General Electric Research Laboratory. In 1908 Coolidge had developed a process to make tungsten ductile, or capable of being drawn into a wire without breaking. Today, most light bulbs are made with ductile drawn tungsten filaments.

Match the following words with their definitions:

1. incandescent	a) very slow to move or act
2. bulb	b) to shine with or as if with an intense heat
3. filament	c) a substance that does not flow perceptibly under moderate stress
4. inert	d) white, glowing, or luminous with intense heat
5. glow	e) a glass envelope enclosing the light source of an electric lamp
6. solids	f) a tenuous conductor (as of carbon or metal) made incandescent by the passage of an electric current

Equivalence: مرادفات

Incandescent=glow

Material=substance

Familiar=common

Coiled=twisted

Brightness=radiance

Give off=release

Characteristic=features, properties

Ordinary=regular

Undergone=subject

Ductile=flexible

الكلمة	معناها
Incandescent lamp	المصباح المتوهج
Heating	حرارة
Common	شائع
Household bulb	المصباح المنزلي
Consist of	يتكون من
Stretched	يتمدد
Coiled	ملفوف
Sealed	مختوم
Filled with	مملوء
React	يتفاعل
Inert gas	غاز خامل (الغازات النبيلة)
Combination	مزيج
Proportion	نسب
Designed	صمم
Suite	يلائم
Brightness	سطوع
Filament	سلك رفيع
Glow	يتوهج
Based	يعتمد
Emit	يطلق
Visible	مرئي
Burning	اشعال الضوء
Sufficiently	كافي
Characteristics	مواصفات
Invention	اختراع
Vacuum pump	مضخات التفريغ
Regular lightning	الإضاءة اليومية
Associated	مرتبط بـ
Independently	بشكل مستقل
Discover	اكتشف
Device	جهاز
Infrastructure	البنية الأساسية التركيبية
Undergone for various improvements	خضع للعديد من التحسينات
Significant changes	تغييرات مهمة
Highest melting point	اعلى نقطة انصهار
Metal	معدن

Advance	تطور
Attributed	شارك
Engineer	مهندس
Ductile	مرن
Drawn into	قابل للتمدد
Breaking	يكسر

c) This gives access to family only.

PREPOSITIONS

I Complete the following sentences using *from, with* or *of.*

1) Bronze contains significant amounts ______ copper.
2) Galvanised steel is steel coated ______ zinc.
3) Steel is an alloy derived _____ iron.
4) Pure metals can usually be recovered _____ alloys.
5) To produce stainless steel, iron is mixed _____ other metals.
6) Stainless steel contains quantities _____ chromium and nickel.
7) Glass tableware contains traces _____ metals, such as lead.
8) When new metal is extracted _____ ore, the costs can be high.

II Complete each sentence using the correct preposition:

1) The CPU is a large chip ______ the computer.
2) Data always flow ______ the CPU ______ the address bus.
3) The CPU can be divided ______ three parts.
4) Data flows ______ the CPU and the memory.
5) Peripherals are devices ______ the computer but linked ______ it.
6) The signal moves ______ the VDU screen ______ one side ______ the other.
7) The CPU puts the address ______ the address bus.
8) The CPU can fetch data ______ memory ______the data bus.

LANGUAGE SKILLS

PRESENTATIONS
Presentation tips

The key is preparation. So the first step is to find out who you are going to be presenting to, and how much the audience knows about the subject. If possible, visit the room where you will be giving the presentation beforehand and organize it precisely to your own requirements.

Presentation:

- Stage one is the opening- the all-important first few moments that can make or break the presentation.
- Stage two is a brief introduction about the subject of your talk.
- Stage three is the main body of your presentation.
- Stage four is the conclusion which should include a summary of your talk and your final opinion.
- Stage five is the question and answer session.

The most important stage is the **opening minute** or so and when preparing for it you should memorize the text word by word. Write down the opening with all the pauses and the stress clearly marked, and practice it again and again.

Write the whole presentation out just like an essay, then select the **key points**, but read the full version over and over again until it is imprinted on your mind. The next step is to make small cards and write no more than one or two of the key points or key phrases onto each one.

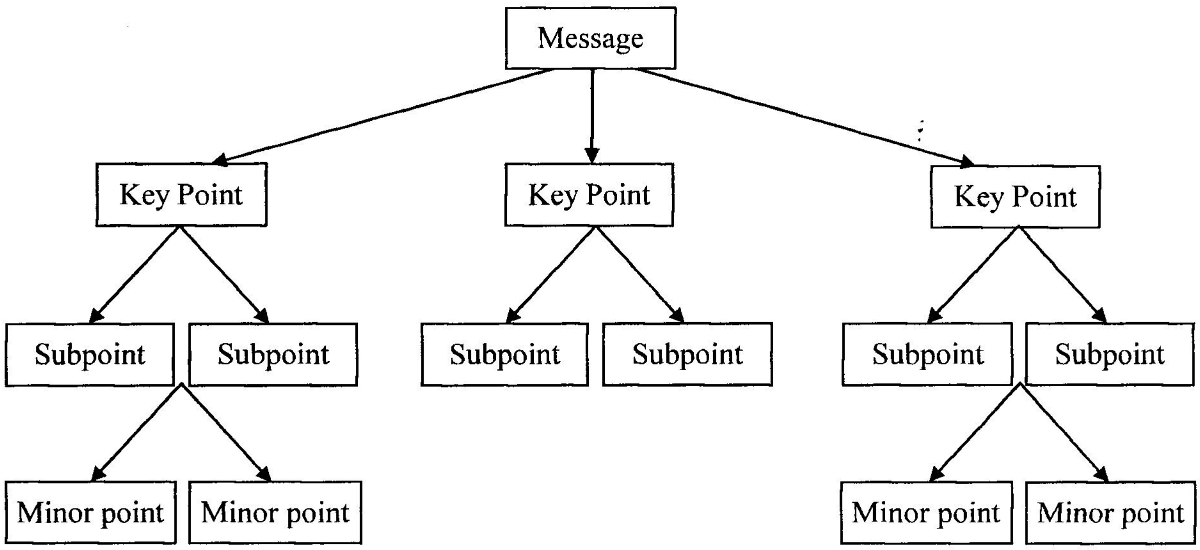
Visual aids are very important, but most people put far too much information on them. Face the audience at all times. Finally, remember that it is not just what you say, it is how you say it.

Follow these principles when making a presentation:

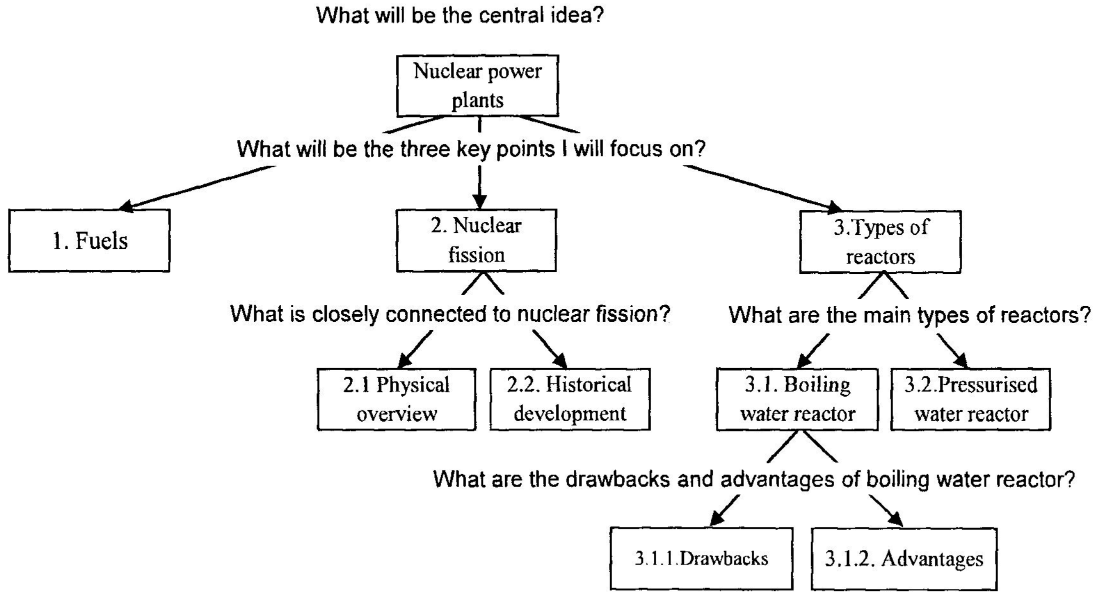
a) A pyramid structure is used to outline the key points.
b) The key points will form the sections of the presentation.
c) The slides should look consistent in font and overall design.
d) Colours should be used rather than black and white.
e) A corporate logo should be added.
f) Scales and numbering systems should be simple and consistent.
g) Numbers should be rounded off: 45.7 per cent is made into 46 etc.
h) Only data that support the argument are selected.
i) The quality of the presentation depends on the use of the voice, eyes, gestures, posture and movement, as well. Consistent body language, lively speaking and fluent English largely contribute to satisfactory performance. Rehearsing out loud results in fluency. Under-rehearsed presenters spend too much time working out what to say, struggling with finding words and expressions. Well-rehearsed presenters know what to say and can improvise according to the demands of the moment.

Building a pyramid

The pyramid brings order into chaos by giving thoughts a clear structure. Each idea is a result of a provoked question. The decimal numbering system is used for maximum clarity (1; 1.1.; 1.1.1.). Each key point, sub-point and minor point in the pyramid are answers to the questions. This question-answer process results in a pyramid structure. Every idea is a sentence, each idea must summarise the ideas grouped beneath it and each idea within a group is an answer to the question provoked by the summarizing idea. Ideas must be ordered in each group in terms of relevance, chronology or logical reasoning. The ideas need to be relevant and complete, summary points must clearly reflect the structure. By using the model of a pyramid, the ideas are transferred to the written form (a review paper) and to slides in an oral presentation, being an overview of the whole paper and presentation in miniature.



Example of a pyramid:



The following phrases are standard phrases for introducing the speaker, the topic, describing the key points, phrases for effective summaries and inviting questions covering the structure of the presentation:

1. **Opening**

1.1. **Introduction**

- On behalf of may I welcome you to .
- For those of you who don't know me already, my name is ..
- Before I begin, I'd like to thank you for inviting me to speak to you.

1.2. **Purpose and structure**

- I'm here today to talk about
- I've divided my talk into three parts.
- First, I'll look at , then I'll show you And finally I'll say a little about .
- Please feel free to interrupt me during the talk if you have any questions
- I'll be happy to answer your questions at the end.

2. Main body

2.1. **First point**

- Let's start with the first point .

2.2 New points

- Moving on now to my next point ..
- Let's turn now to ..

2.2. **Digressing**

- Before going on, I'd like to say a little about

2.3. **Visual aids**

- As you can see from the next slide
- Have a look at the diagram on the left

3. Closing

3.1. **Summarizing**

- So, just before I finish, let me summarize the main points again
- So, to sum up, I have talked about three main areas. First second and third

3.2. **Concluding**

- Right, let's stop here. Thank you very much for your attention

3.3. **Inviting questions**

1. And now, if you have any questions, I'll pleased to answer them

Example of a presentation: HEAT AND TEMPERATURE, Luka Vidačak

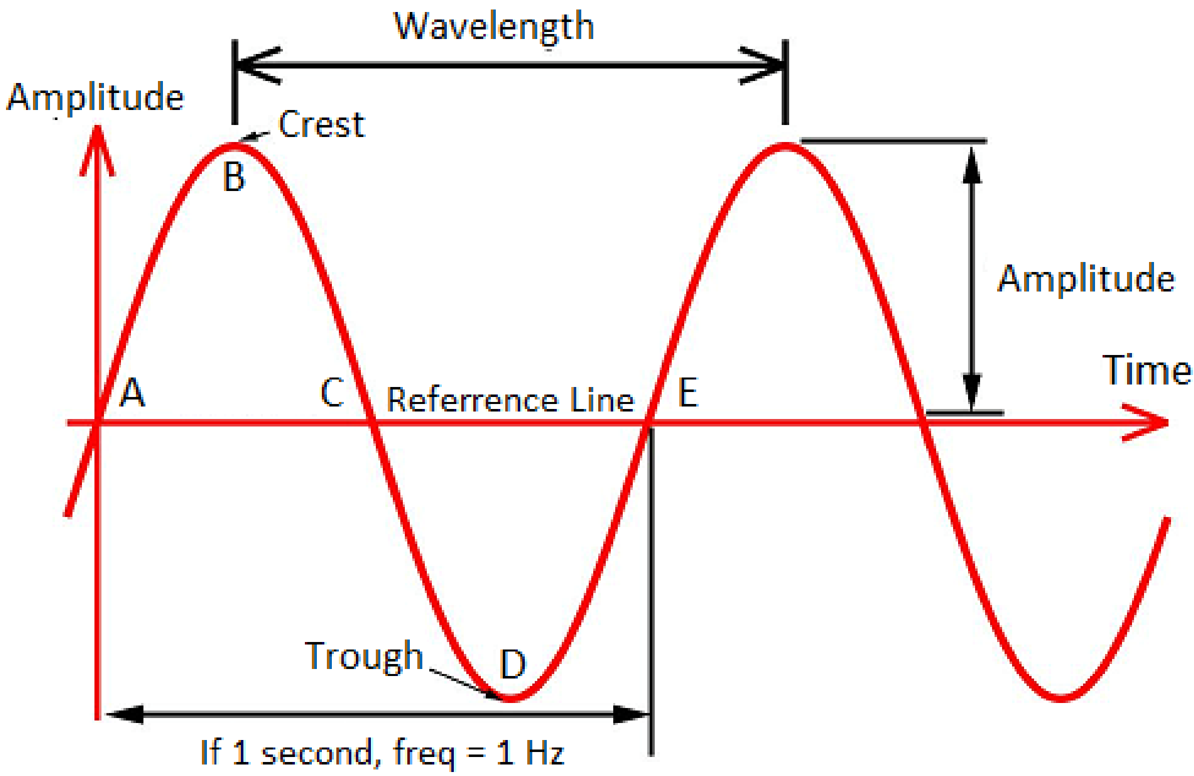
Radio waves and vacuum tubes

In 1865 the English scientist James Maxwell predicted that the electromagnetic waves would be produced if an electric charge were made or oscillate or vibrate back and forth. These waves would travel at the speed of light ,186,000 miles per second. In 1887 a German scientist Heinrich Hertz actually produced and measured such waves , the kind we now call radio waves. By 1901 the Italian inventor Guglielmo Marconi had succeeded in sending a signal across the Atlantic by means of electromagnetic waves. The way was now open for the radio which could transmit sound over long distances without the use of wires. In fact , the radio was often called the" wireless" in its early days a term still used in England.

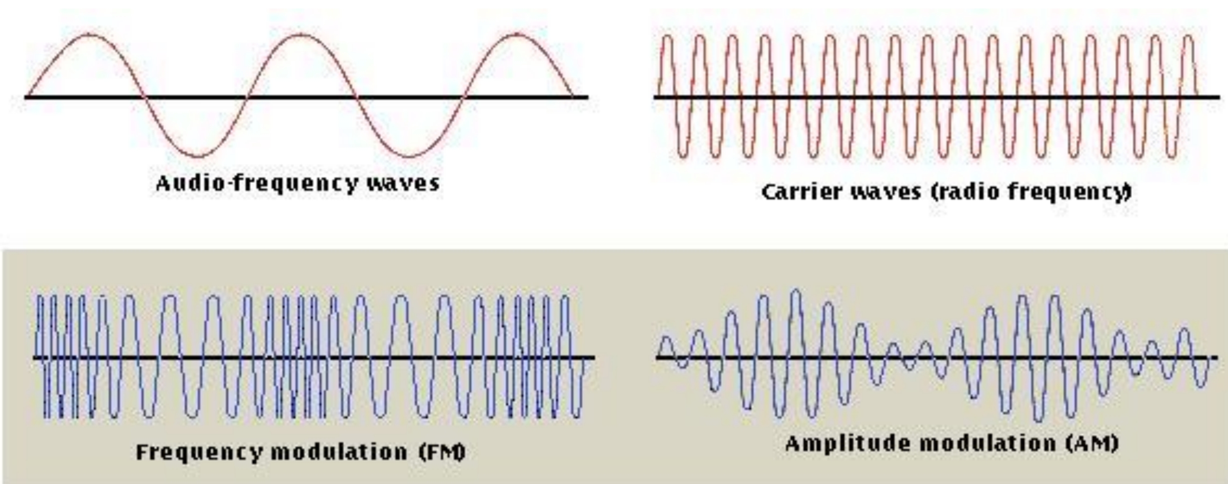
Communication by electrical signals had already been achieved with the telegraph and the telephone, but both devices required the use of conducting wire. The telephone sends a coded message over the wire in the form of electrical signals ,which are produced by making and breaking the electric circuit at specified intervals. A receiver converts the signals into sound which are then decoded. A telephone actually transmit sound. Sound is produced by vibrations which cause disturbances in the air known as sound waves. The telephone converts these sound waves into vibrating electrical signals that are carried over the wire and then converted back into sound by a receiver.

With the radio expensive cables and wires were unnecessary. Radio waves travel at high rate of speed over long distances , and are able to carry sound because they can be modulated or varied by electrical signals derived from the slower sound waves.

All waves have the properties of amplitude and frequency. Beginning from a point of equilibrium or, zero value, a wave fluctuates back and forth reaching two extremes; on returning to the point of equilibrium ,it completes a full cycle. The high point reached by the wave called the crest and the low point , the trough. The amplitude is the height of the wave measured from its zero value to its crest. The frequency of the wave is the number of cycles produced per second.



In radio the oscillator produced vibrations which send out electromagnetic waves. Sound waves are converted into electrical vibrations which are used to adapt or modulate these waves. There are two types of modulation amplitude modulation (AM) in which the amplitude of the carrier wave is changed by the sound generated electrical wave and frequency modulation(FM) in which the frequency of the carrier wave is changed.



To produce a working radio it was necessary to develop many special devices _oscillator to produce waves, amplifier to strengthen them , and rectifiers to change alternating to direct current. It was in developing these devices that the science now called electronics made its first contribution : the vacuum tube. Placed at certain points in the circuit of the radio ,vacuum tubes performed several different functions by controlling the flow of electricity much in the same way as valves control the flow of liquids and gases.

A vacuum is a space from which matter has been removed. As we have seen there is a partial vacuum within the electric light bulb. Current flows through the resistance of a filament of tungsten placed in the vacuum causing the filament to become white- hot and thereby give off light. Even before the invention of the incandescent lamp ,an English scientist named William Crooks had experimented with a vacuum tube that glowed under special circumstances. Edison also had observed what is known as the “Edison effect”_ a flow of electricity across a vacuum from the cathode to the anode without the presence of a conductor. These observations were among those that led to Thomson’s discovery of the electron. By 1904 another English scientist John Ambrose Fleming had invented a vacuum tube, now called a diode, That could be used to detect radio signals more accurately than the crystals which had been in use up to that time. The diode contained a hot filament and a plate ;the filament gave off negatively charged electrons which were attracted to the positively charged plate. When the diode was placed in the circuit using alternating current , the current was rectified to direct current ,because the electrons flowed across the vacuum only in one direction.

In 1906 De Forest , an American inventor , made another significant advance in the use of vacuum tubes when he invented the triode. In addition to a cathode and an anode , the triode contained a third electrode called a grid , which was placed between the other two. The grid could control the flow of electrons through the vacuum by varying its voltage with respect to the cathode. Many further improvements in the vacuum tube followed. These included using different types of gases to achieve special effects ,coating the inside of the tube with substances that gave of light when struck by electrons (florescent tubes) creating high vacuum tubes through the removal of a greater amount of air and other matter , and developing vacuum tubes which used the properties of magnetism.

One of the most significant developments was the phototube ,in which electrons are released by the action of light on a photosensitive surface. Since Phototubes give off a very weak current , they are used with amplifiers which increase the strength of the electron flow. One of the most familiar uses of phototubes is for doors that open or close automatically when a beam of light is broken. Phototubes are OFTEN used in security systems and also have many industrial applications.

The vacuum tube created many new applications for electronics. It is not possible to discuss all of them here but it is worthwhile to mention two of the most important, radar and sonar. Radar is used for locating aircraft and sonar for locating underwater obstructions and measuring depth. They both take advantage of the echo property of waves_ waves are reflected back when they strike an obstruction or barrier of some kind. In radar radio waves are reflected back from aircraft in flight . Radio waves as, we have noted , travel at the speed of light 186,000 miles per second, and the echo is also returned at extremely high speed. To make radar a reality electronic devices were developed that could distinguish between different waves with an interval between them of only a microsecond _ millionth of a second.

IN spite of all the advances that were made vacuum tubes presented certain difficulties which made them unsatisfactory for use in many electronic devices such as the computer. First they needed time to worm up. Although the time in some cases was only a fraction of a second, it could cause operational problems. Second vacuum tubes occupied a lot of space even after technological improvements had reduced them in size. Though early computers were constructed with vacuum tubes in the more complex computers used today they would occupy so much space that an entire building would be necessary to house the equipment. Such a computer would also need hundreds of miles of electric wiring to connect all the tubes might burn out just as electric light bulbs burn out after they have been in use for a period of time. In fact it is hard to imagine that computers using only vacuum tubes were ever in perfect working order with every single tube functioning properly at the same time. Finally the tubes gave off a great deal of heat. This increased the amount of room necessary for them since space had to be left between them for air to circulate and cool them. In some cases the heat itself could cause problems in the operation of the device.

All of these problems led to the search for a device that would perform the same function as the vacuum tube without presenting so many difficulties. With the invention of the transistor electronics entered a new phase.

Equivalence:

Oscillate = vibrate

Transit = common

Form = shape

Intervals = regular time

Converts = changes

Modulated = varied

Equilibrium = zero value

The effects of an electric current

The effects of an electric current are thermal, luminous, chemical and magnetic. When a current flow through a conductor it may heat the conductor. This heat sometimes undesirable and has to be reduced. For this reason, many electric motors and generators contain a fan. However domestic appliances such as electric cookers and many industrial processes depend on the heating effect of an electric current. The passage of a current may produce light. This can happen in a number of ways. The heat generated by the current may be so great that the conductor becomes incandescent. For example, the filament of a light bulb emits intense light when heated by a current. Light is also produced when a current ionizes a gas. The color of the light will vary according to the gas used. Mercury vapor lamps give a greenish blue light.

An electric current can separate a chemical compound into its components. This is called electrolysis. Chlorine is generated by the electrolysis of salt water. Electrolysis can also be used to break down water into hydrogen and oxygen. Because pure water does not conduct well, sulphuric acid has to be added before the electrolysis take place.

A current flowing through a conductor creates a magnetic field round it. This field has three applications. It can magnetize materials and attract them to the conductor. The electric relay works on this principle. If the magnetic field is cut by another conductor an electromotive force will be induced in that conductor. For instance, the change in current flowing through the primary of a transformer will induce a current in the secondary. This principle is also used in generators. Thirdly if a current carrying conductor is placed in the magnetic field a force will be exerted on it. This effect is utilized in the electric motor.

Effects	تأثيرات
Electric current	التيار الكهربائي
Thermal	حرارية
Luminous	ضوئية
Chemical	كيميائية
Magnetic	مغناطيسية
Undesirable	غير مرغوب بها
Reduced	تقليل
Electric motors	محرك كهربائي
Generators	مولدات
Contain a fan	تحتوي على مروحة
Domestic appliances	أجهزة منزلية
Electric cookers	طباخ كهربائي
Industrial processes	عمليات صناعية
Passage	ممر مسلك
Generated	يولد
Incandescent	متوهج
Filament	سلك رفيع
Emits intense light	يولد ضوء شديد
Light will vary	اختلاف لون الضوء
Mercury	الزئبق
Vapor	بخار
Greenish blue	ازرق مخضر
Separate	يفصل
Chemical compound	مركب كيميائي
Components	مكونات
Electrolysis	عملية التحلل الكهربائي
Break down	يفصل
Chlorine	كلور
Generated	يتولد
Salt water	ماء مالح
Pure water	ماء صافي
Conduct well	ينقل بصورة جيدة
Before	قبل
Take place	يحدث

Creates	ينشأ
Magnetic field	حقل مغناطيسي
Round it	حولها
Applications	تطبيقات
Magnetize	ممغنط
Magnetic materials	مواد مغناطيسية
Relay	مرحل
Principle	مفهوم ، مبدأ
Induce	يحث
Primary	الاولي ، الأساسي
Transformer	محولة
Secondary	الثانوي
Generator	مولدة
Force will be exerted	تتولد الطاقة
Utilized	يستخدم
Electric motor	محرك كهربائي

Equivalence:

Separate= break own

Passage=path

Ionizes=convert into ions

Utilized=put to practical use

Q1 Answer the following questions:

1.What are the effects of an electric current?

2.Why many electric motors ana generators contain a fan?

3.Explain the luminous effect of an electric current?

4.Define electrolysis with an example?

5.Explain the chemical effect of the electric current?

6.Explain in brief the magnetic effect of electric current?

7. Magnetic field has three applications what are they with examples?

8. A current flowing through a conductor creates a magnetic field round it. This field has three applications. What are they?

Q2 complete the following sentences with the correct word or phrase:

1.The effects of an electric current are-------------,--------------,--------------,------------.

2.Heat can be undesirable like ,motor and -------------------------- like cooker.

3.------------------------------- break down of chemical compounds for example salt water into chlorine.

4.Current flowing in a conductor ------------------------------ round it.

5.Magnetic field has three applications are ------------------------------,-------------------------------------,-------------------------------.

Energy

Energy is capacity of matter to perform work as the result of its motion or its position in relation to forces acting on it. Energy associated with motion is known as kinetic energy, and energy related to position is called potential energy. Thus, a swinging pendulum has maximum potential energy at the terminal points; at all intermediate positions it has both kinetic and potential energy in varying proportions.

Energy exists in various forms, including mechanical, thermal, chemical, electrical, radiant, and atomic. All forms of energy are interconvertible by appropriate processes. In the process of transformation either kinetic or potential energy may be lost or gained, but the sum total of the two remains always the same.

A weight suspended from a cord has potential energy due to its position, in as much as it can perform work in the process of falling. An electric battery has potential energy in chemical form. A piece of magnesium has potential energy stored in chemical form that is expended in the form of heat and light if the magnesium is ignited. If a gun is fired, the potential energy of the gunpowder is transformed into the kinetic energy of the moving projectile. The kinetic mechanical energy of the moving rotor of a dynamo is changed into kinetic electrical energy by electromagnetic induction. All forms of energy tend to be transformed into heat, which is the most transient form of energy. In mechanical devices energy not expended in useful work is dissipated in frictional heat, and losses in electrical circuits are largely heat losses.

Empirical observation in the 19th century led to the conclusion that although energy can be transformed, it cannot be created or destroyed. This concept, known as the conservation of energy, constitutes one of the basic principles of classical mechanics. The principle, along with the parallel principle of conservation of matter, holds true only for phenomena involving velocities that are small compared with the velocity of light. At higher velocities close to that of light, as in nuclear reactions, energy and matter are interconvertible. In modern physics the two concepts, the conservation of energy and of mass, are thus unified.

Energy	الطاقة
Capacity of matter	قدرة المادة
Perform work	أداء شغل
As a result	كنتيجة
Motion	الحركة
Position	الموقع
In relation to forces acting on it	فيما يتعلق بالقوى المؤثرة عليها
Associated	متعلق ب
Kinetic energy	الطاقة الحركية
Related to position	المتعلقة بالموقع
Potential energy	الطاقة الكامنة
Swinging pendulum	البندول المتارجح
Maximum potential energy	اقصى طاقة حركية
Terminal points	الأطراف النهايات
Intermediate positions	مواقع متوسطة
Varying proportions	بنسب متفاوتة
Exists in various forms	يوجد باشكال مختلفة
Mechanical	ميكانيكية
Thermal	حرارية
Chemical	كيميائية
Electrical	كهربائية
Radiant	مشعة
Atomic	ذرية
All forms or energy	كل اشكال الطاقة
Are interconvertible	قابلة للتحويل
Appropriate processes	بعمليات مناسبة
Transformation	تحويل
Lost or gained	ربح وخسارة
Sum total	الإجمالي
Remains always the same	يبقى دائما على حاله
Weight suspended	ثقل معلق
Cord	حبل
Due to	بسبب
Position	موقع
Perform work	يؤدي شغل
Process of falling	عملية السقوط
Electric battery	بطارية كهربائية
Chemical form	بشكل كيميائي
Piece of magnesium	قطعة من المغنيسيوم
Stored	خزنت

Expended	استنفذت
Ignited	اشعلت
Gun is fired	يتم اطلاق نار من البندقية
Gunpowder	البارود
Transformed into	يتحول الى
Projectile	قذيفة
Kinetic mechanical energy	الطاقة الميكانيكية الحركية
Moving rotor of dynamo	الجزء الدوار المتحرك من الداينامو
Changed into	يتحول الى
Electromagnetic induction	حث كهرومغناطيسي
Mechanical devices	الأجهزة الميكانيكية
Useful work	عمل مفيد
Dissipated	تتبدد
Frictional	احتكاك
Electrical circuits	دائرة كهربائية
Largely	بشكل واسع
Heat loss	فقدان الحرارة
Empirical observation	ملاحظات تجريبية
Led	يقود الى
Conclusion	استنتاج
Although	على الرغم
Created	انشات
Destroyed	دمر
Concept	مفهوم
Conservation of energy	حفظ الطاقة
Constitutes	أسس
Classical mechanics	ميكانيك الكلاسيكية
Along with	يتماشى مع
Parallel principle	مفهوم موازي
Matter	المادة
Phenomena	ظاهرة
Involving	يتضمن
Velocity	السرعة
Compared with	مقارنة ب
Nuclear reaction	تفاعل نووي
Interconvertible	قابلة للتحويل
Modern physics	الفيزياء الحديثة
Mass	كتلة
Unified	موحد

Q1 Answer the following questions:

1. What is energy?

2. What is kinetic energy?

3. What is potential energy?

4. What are the forms of energy?

5. A weight suspended from a cord has potential energy due to it ______and ______.

٦.What happened if a piece of magnesium is ignited?

7.Can energy be ganged or transformed into another form of energy give an example?

8.Is there any loss of energy in kinetic mechanical energy?

9. Empirical observation in the 19th century led to the conclusion. Explain in brief?

10.Explain the concept conservation of energy?

11. What the form of potential energy of a piece of magnesium?

12. What happen if you fired a gun?

Conductors, insulators and semiconductors

If we connect a battery a cross a body, there is a movement of free electrons towards the positive end. This movement of electrons is an electric current. All materials can be classified into three groups according to how readily they permit an electric current to flow. These are: conductors, insulators and semiconductors.

In the first category are substances which provides an easy path for an electric current. All metals are conductors however some metals do not conduct well. Manganin, for example, is a poor conductor. Copper is a good conductor; therefore, it is widely used for cables. A non-metal which conducts well is carbon. Salt water is an example of a liquid conductor.

A material which does not easily release electrons is called an insulator. Rubber, nylon, porcelain and air are all insulators. There are no perfect insulators. All insulators will allow some flow of electrons; however, this can usually be ignored because the flow they permit is so small.

Semiconductors are midway between conductors and insulators; under certain conditions they allow a current to flow easily but under others they behave as insulators. Germanium and silicon are semiconductors. Mixtures of certain metallic oxides also act as semiconductors. These are known as thermistors. The resistance of the thermistors falls rapidly as their temperature rises. They are therefore used in temperature-sensing devices.

Conductor	موصل
Insulator	عازل
Semiconductor	شبه موصل
Connect	ربط
A cross	عبر
Movement	حركة
Free electrons	الكترونات حرة
Towards	باتجاه
Positive end	جزء موجب
Electric current	تيار كهربائي
Classified	يقسم او يصنف
Groups	مجاميع او فئات
According	طبقا ل
Readily	بسهولة
Permit	يسمح
Flow	انسياب
Category	الفئة
Substances	مواد
Provides	يوفر
Easy path	تسمح بمرور الالكترونات بسهولة
Metals	معدني
Well	جيد
Manganin	منغنيز
Poor conductor	موصل ضعيف
Copper	نحاس
Cables	اسلاك
Non- metal	غير معدني
Salt water	ماء مالح
Liquid conductor	سائل موصل
Easily release electrons	يطلق الالكترونات بسهولة
Rubber	مطاط
Porcelain	بورسلين
Air	هواء
Allow some flow	يسمح بمرور القليل من
Ignored	تجاهل
Midway	في المنتصف
Certain conditions	ظروف معينة
Behave	يتصرف
Mixtures	مزيج
Metallic	معدني
Act	يعمل كما لو كان

Known	يعرف على انه
Thermistors	الثرموسترات أجهزة قياس الحرارة
Resistance	مقاومة
Falls rapidly	تهبط بسرعة
Temperature	درجة الحرارة
Rises	ارتفاع
Temperature sensing devices	أجهزة قياس الحرارة

Equivalence:

Movement= flow

Classified=grouped=category

Permit= allow

Materials= substances

Act = behaves

Alloy= mixture

Release = emit

Exercise A:

Decide if these statements are true or false:

1.Electrons flow from positive to negative.

2.Copper provides an easy path for an electric current.

3.All metals are good conductors.

4.All good conductors all metals.

5.Air is not a perfect insulator.

6.Rubber readily releases electrons.

7.The resistance of thermistor is higher at low temperature than at high temperature.

Exercise B:

Rewrite the following sentences replacing the words in italics with expressions from the passage which have similar meanings:

1.The ***flow*** of free electrons is an electric current.

2.Materais in the first ***group*** are called conductors.

3.Materails which ***provide*** a path for an electric current are conductors.

4.All insulators ***permit*** some flow of electrons.

5.Germanuim sometimes ***acts*** as an insulator and sometimes as a conductor.

Exercise C:

Answer the following questions:

1. All materials can be classified into three groups according to how readily they permit an electric current to flow. What are they?
2. What is an insulator?
3. What do insulators restrict?
4. Why is copper widely used for cables?
5. Is there a perfect insulator, why?
6. What is a conductor?
7. What do conductors permit?
8. Define semiconductors with examples?
9. Why semiconductors used for (thermistors) used in temperature sensing devices?
10. Give an example for liquid conductor and non-metal conductor?

Deep Blue serves as a prototype for future computers that __________[16] (require) to solve complex problems. At issue, however, is whether a computer can be developed with the ability to learn to solve problems on its own, rather than one programmed to solve a specific set of tasks.

THE FUTURE OF COMPUTERS

In 1965 semiconductor pioneer Gordon Moore predicted that the number of transistors contained on a computer chip would double every year. This is now known as Moore's Law, and it has proven to be somewhat accurate. The number of transistors and the computational speed of microprocessors currently doubles approximately every 18 months. Components continue to shrink in size and are becoming faster, cheaper, and more versatile.

With their increasing power and versatility, computers simplify day-to-day life. Unfortunately, as computer use becomes more widespread, so do the opportunities for misuse. Computer hackers—people who illegally gain access to computer systems—often violate privacy and can tamper with or destroy records. Programs called viruses or worms can replicate and spread from computer to computer, erasing information or causing malfunctions. Other individuals have used computers to electronically embezzle funds and alter credit histories. New ethical issues also have arisen, such as how to regulate material on the Internet and the World Wide Web. Long-standing issues, such as privacy and freedom of expression, are being reexamined in light of the digital revolution. Individuals, companies, and governments are working to solve these problems through informed conversation, compromise, better computer security, and regulatory legislation.

Computers will become more advanced and they will also become easier to use. Improved speech recognition will make the operation of a computer easier. Virtual reality, the technology of interacting with a computer using all of the human senses, will also contribute to better human and computer interfaces. Standards for virtual-reality program languages—for example, Virtual Reality Modeling language (VRML)—are currently in use or are being developed for the World Wide Web.

Other, exotic models of computation are being developed, including biological computing that uses living organisms, molecular computing that uses molecules with particular properties, and computing that uses deoxyribonucleic acid (DNA), the basic unit of heredity, to store data and carry out operations. These are examples of possible future computational platforms that, so far, are limited in abilities or are strictly theoretical. Scientists investigate them because of the physical limitations of miniaturizing circuits embedded in silicon. There are also limitations related to heat generated by even the tiniest of transistors.

Intriguing breakthroughs occurred in the area of quantum computing in the late 1990s. Quantum computers under development use components of a chloroform molecule (a combination of chlorine and hydrogen atoms) and a variation of a medical procedure called magnetic resonance imaging (MRI) to compute at a molecular level. Scientists use a branch of physics called quantum mechanics, which describes the behavior of subatomic particles (particles that make up atoms), as the basis for quantum computing. Quantum computers may one day be thousands to millions of times faster than current computers, because they take advantage of the laws that govern the behavior of subatomic particles. These laws allow quantum computers to examine all possible answers to a query simultaneously. Future uses of quantum computers could include code breaking and large database queries. Theorists of chemistry, computer science, mathematics, and physics are now working to determine the possibilities and limitations of quantum computing.

Communications between computer users and networks will benefit from new technologies such as broadband communication systems that can carry significantly more data faster or more conveniently to and from the vast interconnected databases that continue to grow in number and type.

"Computer," Microsoft® Encarta® Online Encyclopedia 2009 http://encarta.msn.com

Answer the following questions:

1) What is Moore's Law?
2) What are the disadvantages of computer development?
3) What is virtual reality and why is it important?
4) What is quantum mechanics?
5) What could future uses of quantum computers include?

1. Guess the meaning of the following acronyms

AC ....
AFC ....
ASIC..
AV...
BCD...
BEV ....
BIFET ....
BW...
CAD...
CAN...
CAS...
CATV..
CC...
CMOS..
CP/M...
CRT ....
EMI..
IRED..
LED ....
LF...
SRAM...
SSI ....
UVA...
VDC ....

Read the text and then make questions so that the underlined structures provide answers:

Ada Lovelace (1815-1852), British mathematician who laid some of the early conceptual and technical groundwork for high technology by helping develop an early computer.

The daughter of English poet Lord Byron, Augusta Ada Byron, Countess of Lovelace, was born in London. With the help of friends and tutors, she taught herself geometry and later attended classes in astronomy and mathematics[1].

In 1833 Lovelace met British mathematician and inventor Charles Babbage. He had invented the Difference Engine, a mechanical device designed to handle complicated mathematical problems. She showed her understanding of the concept of a programmed computer in 1842, when she translated from French and annotated a paper by the Italian engineer Luigi F. Menabrea on Babbage's Difference Engine[2]. She also collaborated with Babbage to invent the Analytical Engine, an archetype of the modern digital computer[3]. The technology of their time was not capable of translating their ideas into practical use, but the Analytical Engine had many features of the modern computer. It could read data from a deck of punched cards, store data, and perform arithmetic operations.

Components of Lovelace's work remain in the modern digital electronic computer that receives a set of instructions, then carries out those instructions. Her set of instructions[4] was a forerunner of modern programming languages and historians have credited her as the first computer programmer[5].

"Ada Lovelace," Microsoft® Encarta® Online Encyclopedia 2009

Fiber optics

I. INTRODUCTION

Fiber optics, a branch of optics dealing with the transmission of light through hair-thin, transparent fibers. Light signals that enter at one end of a fiber travel through the fiber with very low loss of light, even if the fiber is curved. A basic fiber-optic system consists of a transmitting device (which generates the light signal), an optical-fiber cable (which carries the light), and a receiver (which accepts the transmitted light signal and converts it to an electrical signal).

II. OPERATION

Fiber-optic transmission of light depends on preventing light from escaping from the fiber. When a beam of light encounters a boundary between two transparent substances, some of the light is normally reflected, while the rest passes into the new substance. How much of the beam is reflected, and how much enters the second substance, depends on the angle at which the light strikes the boundary. When the Sun shines down on the ocean from directly overhead, for example, much of its light penetrates the water. When the Sun is setting, however, its light strikes the surface of the water at a shallow angle, and most of it is reflected. Fiber optics makes use of certain special conditions, under which all of the light encountering the surface between two materials is reflected, to reduce loss.

A principle called total internal reflection allows optical fibers to retain the light they carry. When light passes from a dense substance into a less dense substance, there is an angle, called the critical angle, beyond which 100 percent of the light is reflected from the surface between substances. Total internal reflection occurs when light strikes the boundary between substances at an angle greater than the critical angle. An optical-fiber core is clad (coated) by a lower density glass layer. Light traveling inside the core of an optical fiber strikes the outside surface at an angle of incidence greater than the critical angle so that all the light is reflected toward the inside of the fiber without loss. As long as the fiber is not curved too sharply, light traveling inside cannot strike the outer surface at less than the critical angle. Thus, light can be transmitted over long distances by being reflected inward thousands of times with no loss .

III. APPLICATIONS

The most widespread use of fiber optics is in communications. But optical fibers can carry light for illumination, to convey images, and even to transmit laser beams.

A. Communications

Use of fiber optics in communications is growing. Fiber-optic communications systems have key advantages over older types of communication. They offer vastly increased bandwidths, allowing tremendous amounts of information to be carried quickly from place to place. They also allow signals to travel for long distances without repeaters, which are needed to compensate for reductions in signal strength. Fiber-optic repeaters are currently about 100 km (about 62 mi) apart, compared to about 1.5 km (about 1 mi) for electrical systems.

Many long-distance fiber-optic communications networks for both transcontinental connections and undersea fiber cables for international connections are in operation. Companies such as AT&T, MCI WorldCom, and Sprint have virtually replaced their long-distance copper lines with optical-fiber cables. Local telephone service providers use fiber-optic cables between central office switches and sometimes extend it into neighborhoods and even individual homes. Cable television companies transmit high-bandwidth TV signals to subscribers via fiber-optic cable.

Local area networks (LANs) are another growing application for fiber optics. Unlike long-distance communications, LANs connect many local computers to shared equipment such as printers and servers. LANs readily expand to accommodate additional equipment and users. Private companies also use fiber optics and its inherent security to send and receive data. Such firms and institutions as IBM, Wall Street brokerages, banks, and universities transfer computer and monetary information between buildings and around the world via optical fibers.

One of the fastest growing fiber-optic markets is transmitting information for so-called intelligent transportation systems: “smart” highways and streets with traffic lights that respond to changing traffic patterns, automated toll booths, and changeable message signs that give motorists information about delays and emergencies.

B. Other Applications

The simplest application of optical fibers is the transmission of light to locations that are otherwise difficult to illuminate. Dentists’ drills, for example, often incorporate a fiber-optic cable that lights up the insides of patients’ mouths.

Optical fibers are used in some medical instruments to transmit images of the inside of the human body. Physicians use an instrument called an endoscope to view these inaccessible regions. The endoscope sends a beam of light into a body cavity, such as the inside of the stomach, via a fiber. A bundle of fibers returns a reflection of the inside of the cavity. The bundle consists of several thousand very thin fibers assembled precisely side by side and optically polished at their ends. Each individual fiber carries a tiny bit of the final image, which is reconstituted and observed through a magnifier or a television camera. Image transmission by optical fibers is also widely used in photocopiers, in phototypesetting, in computer graphics, and in other imaging applications.

Optical fibers are used in a wide variety of sensing devices, ranging from thermometers to gyroscopes. The potential in this field is nearly unlimited because transmitted light is sensitive to many environmental parameters, including pressure, sound waves, structural strain, heat, and motion. The fibers are especially useful where electrical effects make ordinary sensors or wiring useless, less accurate, or even hazardous. Fibers have also been developed to carry high-power laser beams for cutting and drilling. Fiber-optic lasers are sometimes used for surgery.

IV. HISTORY AND CURRENT RESEARCH

In the early 1950s, Abraham van Heel of the Delft University of Technology in The Netherlands introduced cladding as a way to reduce light loss in glass fibers. He coated his fibers with plastic. Even with cladding, however, light signals in glass fibers would fade after traveling only a few meters. In 1967 electrical engineers Charles Kao and George Hockham of Britain’s Standard Telecommunications Labs speculated that these high losses were due to impurities in the glass. They were correct: Impurities within the fibers absorbed and scattered light. Within two decades, engineers solved the impurity problem. Today, silica glass fibers of sufficient purity to carry infrared light signals for 100 km (62 mi) or more without repeater amplification are available.

The development of new optical techniques will expand the capability of fiber-optic systems. Newly developed optical fiber amplifiers, for example, can directly amplify optical signals without first converting them to an electrical signal, speeding up transmission and lowering power requirements. Dense wave division multiplexing (DWDM), another new fiber-optic technique, puts many colors of light into a single strand of fiber-optic cable. Each color carries a separate data stream. Using DWDM, a single strand of fiber-optic cable can carry up

Electrical conductor

Electrical conductor is any material that offers little resistance to the flow of an electric current. The difference between a conductor and an insulator, which is a poor conductor of electricity or heat, is one of degree rather than kind, because all substances conduct electricity to some extent. A good conductor of electricity, such as silver or copper, may have conductivity a billion or more times as great as the conductivity of a good insulator, such as glass or mica. A phenomenon known as superconductivity is observed when certain substances are cooled to a point near absolute zero, at which point their conductivity becomes almost infinite. In solid conductors the electric current is carried by the movement of electrons; in solutions and gases, the electric current is carried by ions.

Fill the gaps with words from the text above:

1.Property of any object or substance to resist or oppose the flow of an electrical current is called ______________.
2.Phenomenon displayed by certain substances that conduct electricity but demonstrate
no resistance to the flow of an electric current is called ____________.
3.______________ is the lowest temperature theoretically possible, characterized by complete absence of heat (thermal energy).
4.__________, in chemistry, are homogeneous (uniform) mixtures of two or more substances.

Answer the following questions:

1.Define the electrical conductor?
2.What is the difference between conductor and insulator?
3.Explain the term "good conductor"?
4.What is super conductivity?
5.How the electric current carried in solids and gases?

Equivalence:

Material=substance
Offer=provide
Carried by=conduct
Observe=watch
Degree=rank
Phenomenon=occurrence

Electric insulation

The perfect insulator for electrical applications would be a material that is absolutely nonconducting; such a material does not exist. The materials used as insulators, although they do conduct some electricity, have a resistance to the flow of electric current as much as 2.5×10^{24} greater than that of good electrical conductors such as silver and copper. Materials that are good conductors have a large number of free electrons (electrons not tightly bound to atoms) available to carry the current; good insulators have few such electrons. Some materials such as silicon and germanium, which have a limited number of free electrons, are semiconductors and form the basic material of transistors.

In ordinary electric wiring, plastics are commonly used as insulating sheathing for the wire itself. Very fine wire, such as that used for the winding of coils and transformers, may be insulated with a thin coat of enamel. The internal insulation of electric equipment may be made of mica or glass fibers with a plastic binder. Electronic equipment and transformers may also use a special electrical grade of paper. High-voltage power lines are insulated with units made of porcelain or other ceramic, or of glass.

The specific choice of an insulation material is usually determined by its application. Polyethylene and polystyrene are used in high-frequency applications, and mylar is used for electrical capacitors. Insulators must also be selected according to the maximum temperature they will encounter. Teflon is used in the high-temperature range of 175° to 230° C (350° to 450° F). Adverse mechanical or chemical conditions may call for other materials. Nylon has excellent abrasion resistance, and neoprene, silicone rubber, epoxy polyesters, and polyurethanes can provide protection against chemicals and moisture.

<u>Answer the following questions:</u>

1.What would a perfect insulator be like?
2.What characterizes good insulators?
3.What materials are used as insulating sheathing for wire?
4.What materials are used for insulation of electronic equipment?
5.What determines the choice of an insulation material?

<u>Equivalence:</u>

Sheathing=insulating
Winding=coiled
Coat=cover

8. What is a *commutator*?

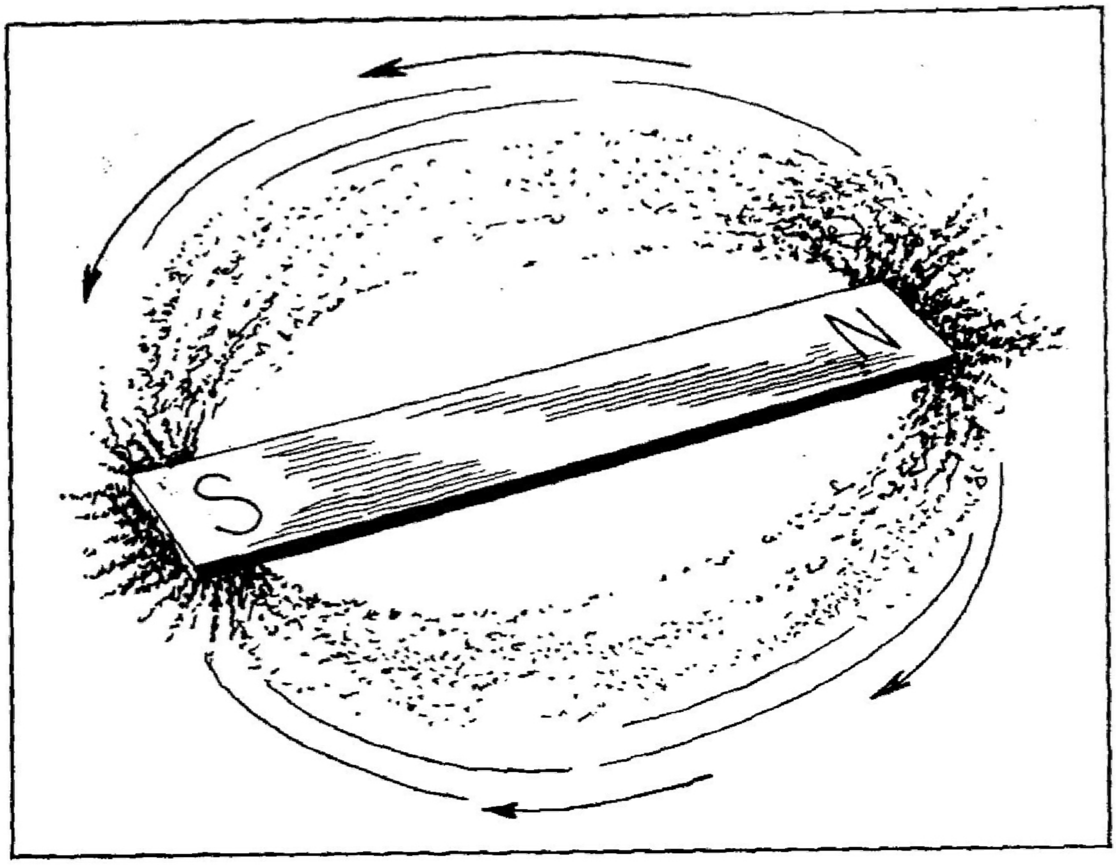
9. What is the difference between a *stator* and a *rotor*?

10. What is a *generator*?

11. What is the relation of a *turbine* to a generator?

12. What is the difference between a *step-up* and a *step-down transformer*?

13. Through which coil does current enter a transformer and what effect is produced?



The lines of force of a magnetic field.

Electromagnetism

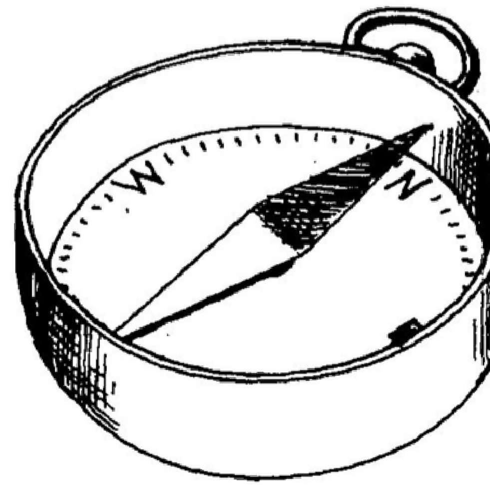
In addition to static electricity, the ancient Greeks observed another natural phenomenon. They discovered a kind of iron ore which possessed the ability to attract or repel certain other kinds of material, especially iron. This property is called *magnetism*, and an object that possesses it is called a *magnet*. Iron containing a small amount of carbon can be made into a magnet by placing it in contact with another magnet; it is then said to have been magnetized.

When two bar magnets are brought together, one end of the first magnet attracts one end of the second magnet, but repels the opposite end of that magnet. If the direction of one magnet is reversed, the attraction and repulsion are also reversed. The two ends of a magnet are called *north* and *south poles*, shortened forms for "north-seeking" and "south-seeking" poles, because when a magnet is allowed to pivot freely, one end always points toward the north and the other end toward the south. This is because the earth itself is a giant magnet with magnetic poles near the geographic North and South Poles.

A magnet does not simply exert a force of attraction in a straight line from one pole to the other. Rather, it establishes a *magnetic field*, in which the direction and strength of the force are indicated by *lines of force*. These extend out from each pole of the magnet and meet to form an oval-shaped arc. Lines of force go out of the north pole and back into the south pole. Where the magnetic field is strongest there are proportionately more lines of force.

There is an obvious similarity between the phenomena of electricity and magnetism. We have already noted that like electric charges repel and unlike charges attract. With magnets, like poles repel and unlike poles attract.

The relationship between electricity and magnetism was discovered accidentally by a Danish scientist, Hans Oersted, in 1819. He had left a compass on a table where he was experimenting with an electric current. A compass is a navigational device with a magnetized needle which points to the earth's north and south magnetic poles. Oersted observed that the needle moved whenever the current was turned on, and concluded that electric current possessed the property of magnetism. Oersted had discovered the phenomenon of *electromagnetism*, a discovery which has had momentous conse-

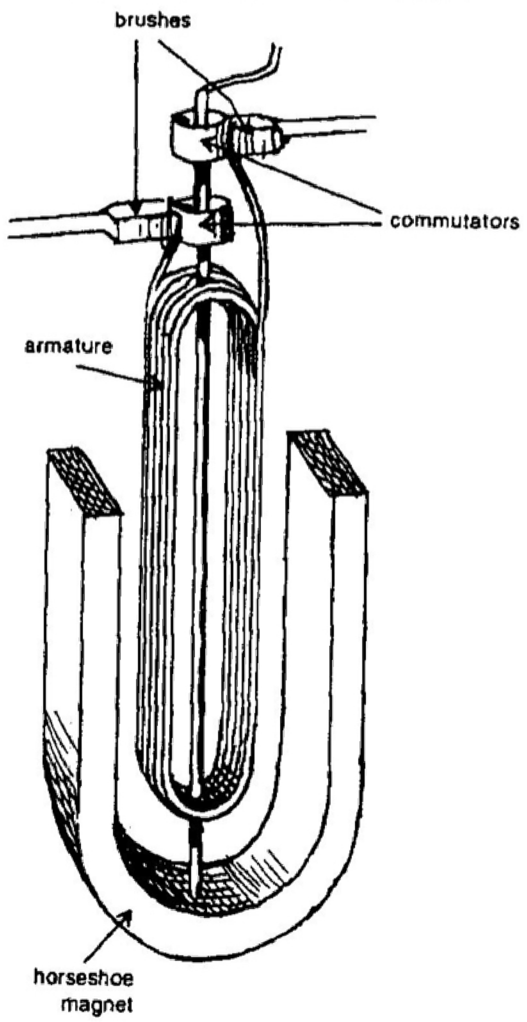


A compass.

quences. It has led to the development of many devices which make use of electromagnetism, including electric motors, generators, and transformers. Without these devices, electricity could never have become a major source of power.

Other scientists experimenting with electromagnetism found that the magnetic effect of an electric current could be strengthened by sending the current through a *coil*—a wire conductor twisted into a spiral shape. A greater number of turns of wire in the coil strengthens the magnetism, as does a stronger electric current. Wrapping the coil around a core of iron further increases the magnetism, because the iron itself becomes magnetized. All these discoveries led the way to converting electromagnetic energy into motion. The great advantage of this energy conversion is that devices based on electromagnetism can be controlled simply by switching the current on or off.

One such device is an electric motor, in which a bar known as an *armature* is placed between the two arms of a horseshoe magnet. Magnetic poles are induced in the armature by sending a current through a coil wrapped around it. Magnetic force then causes it to move in the direction in which the unlike poles attract each other. Of course, if the poles of the armature reached a position directly opposite the unlike poles of the horseshoe magnet, the armature would become locked and no further motion would be possible. It is necessary, therefore, to prevent the unlike poles from becoming aligned. In a direct current electric motor, this is done by a device called a *commutator*, which reverses the electron flow, changing the magnetic poles of the armature at each half-turn. This causes the armature to move on to the new poles of



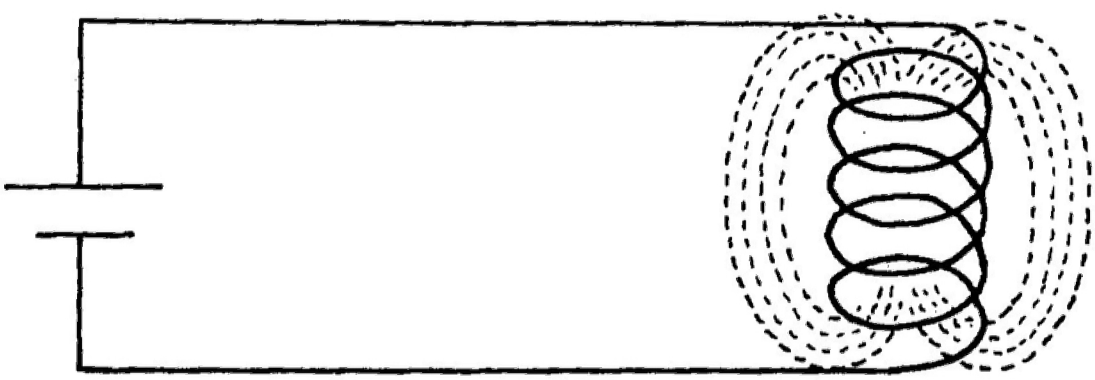
A dc electric motor.

attraction, completing a full rotation, or "cycle."

In an alternating current electric motor, the stationary portion is called a *stator* and the rotating portion, a *rotor.* With alternating current, the flow of electrons reverses at rapid intervals. The intervals are timed to change the stator and rotor poles simultaneously so that the rotor continues to move in a circle, or cycle. In the United States, alternating current electric motors are timed to complete 60 cycles per second (abbreviated cps), but in Europe they are timed for 50 cycles per second.

The property of electromagnetism is also vital to the production of electrical power. Electricity from chemical action—the cell or battery—is suitable only for special and limited uses. *Generators* based on electromagnetism, however, produce sufficient cheap electricity to supply most of the world's needs.

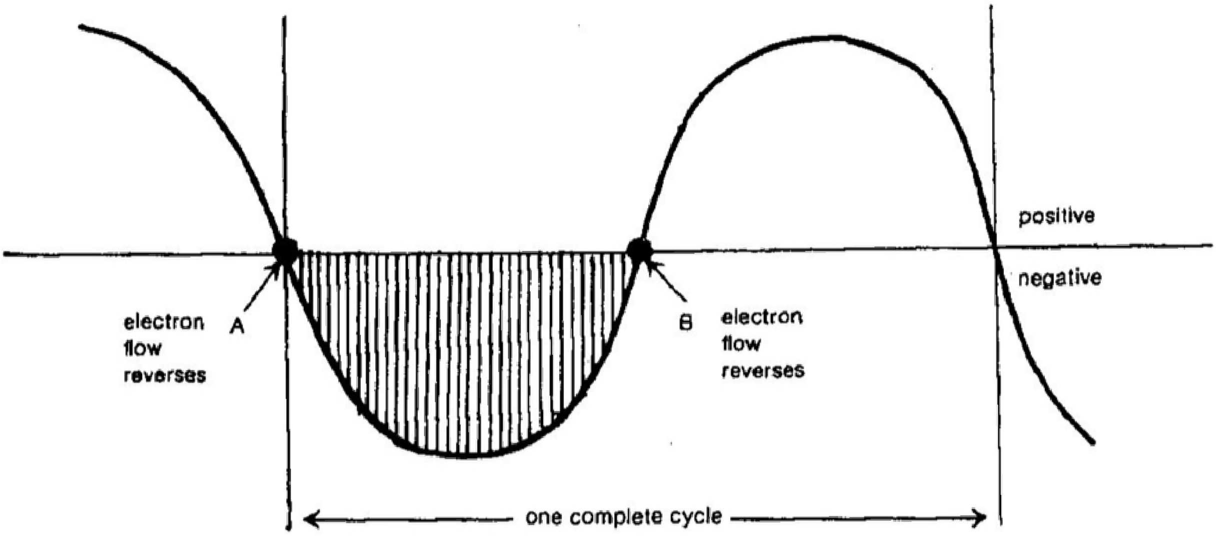
Not long after the discovery that a magnetic field could be created by an electric current, the English scientist Michael Faraday



A loop of wire passing through a magnetic field.

discovered that the reverse was also true—a current could be created by a magnetic field. When a closed loop of wire moves through a magnetic field, an electromotive force is created. This causes a current of electrons to flow through the wire and is the basis for generating electricity. Because it is electromotive force that is produced, the power of generators is described in terms of volts, the units of measurement for emf. To generate emf, the wire must cut the lines of force in the magnetic field; if the wire moves parallel to them, no emf is produced. Also, the faster the wires are made to move, the greater the production of emf. For this reason, a rotary (circular) motion is used in a generator rather than a reciprocating (up-and-down or back-and-forth) motion—it is much easier to maintain a rotary motion at high speeds.

A generator contains a stator, a stationary magnet, with a rotor placed between its north and south poles. As the rotor turns, the wires in it cut the lines of force in the magnetic field of the stator. With each



Alternating current cycle.

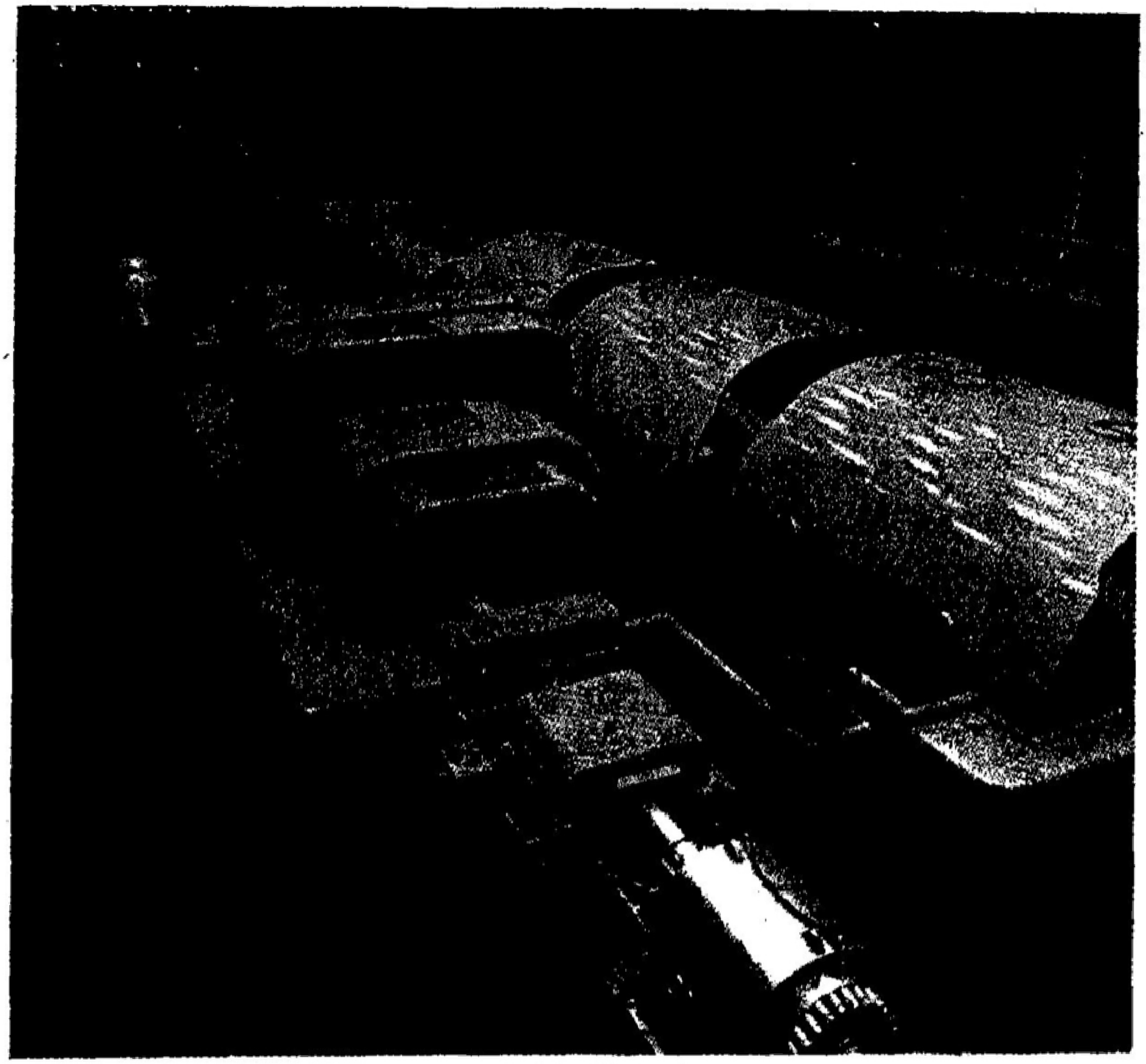
half-turn the current flow is reversed. This is what produces alternating current, in which the electron flow rapidly changes direction over and over again.

The rotor is turned by a *turbine*, a machine with huge blades which are generally moved by water or steam. Steam for an electric power plant can be obtained from the heat supplied by burning coal or oil, or by nuclear fission.

The enormous size of modern generators and the speed with which the rotor can turn mean that electric power of very high voltage can be produced. As much as half a million volts can be transmitted over high-voltage lines to substations. There the voltage is reduced to strengths that can be used in factories or homes. In the United States the customary voltage for household use has become 110-120v, since it was discovered that higher voltages could cause fatal accidents. 220v is still supplied for some heavy-duty uses, however, such as for operating an electric stove.

Transformers are the devices that increase or decrease the amount of voltage. Like generators, they also depend on electromagnetic effects.

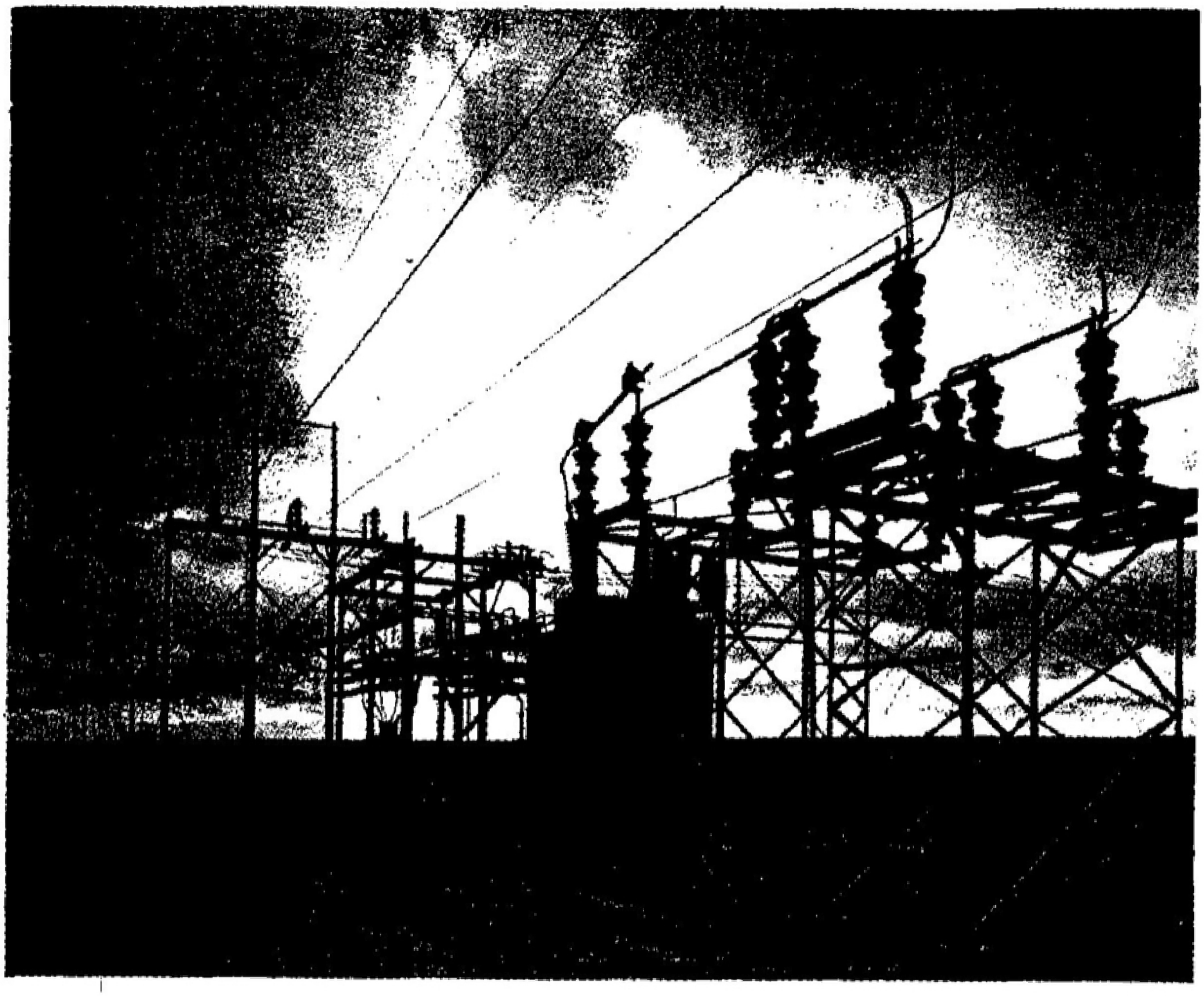
A transformer basically consists of two coils of wire wrapped around iron cores. Current is supplied to a transformer through the



A turbine and generator. (Courtesy of Con Edison, New York)

primary coil and is taken from the *secondary coil.* When an alternating current passes through the primary coil, the constant reversal of electron flow produces a changing magnetic field that creates a current in the secondary coil.

When the primary coil has more turns than the secondary coil, the secondary voltage is decreased; this is a *step-down transformer.* When the secondary coil has more turns than the primary, the secondary voltage is increased; this is a *step-up transformer.* Step-up transformers are used at a power plant to increase the voltage for transmission. As we have pointed out, the higher the voltage in transmission, the less energy loss takes place. At substations that distribute electricity for use, and in all buildings or houses supplied with electricity, there are step-down transformers to change the power to voltages suitable for industrial or domestic use.



A modern transformer at a 4000-kilovolt substation
in New Mexico. (Courtesy of
New Mexico Electric Service Company)

Discussion

1. What did the Greeks observe about a certain kind of iron ore? What is this phenomenon called?

2. What can be done to iron containing carbon?

3. What happens when two bar magnets are brought together?

4. What are the names for the ends of a magnet? Why were they given these names?

5. In what direction does magnetism exert a force of attraction?

6. What is an important similarity between magnetism and electricity?

7. Who discovered electromagnetism? How did he discover it?

8. What is a compass?

9. Why was Oersted's discovery of such great importance?

10. What other discoveries were made about electromagnetism?

11. What is the great advantage of converting electromagnetic energy into motion?

12. What is the name of the bar in an electric motor? Where is it placed?

13. What happens when an electric current flows through the coil around the armature?

14. Why is it necessary to prevent the unlike poles from becoming aligned? How is this prevented in a direct current motor?

15. What are the names of the two main parts of an alternating current electric motor?

16. Why is the rotor able to continue moving in a complete circle?

17. How are ac electric motors timed in the United States? In Europe?

18. What discovery made it possible to generate electricity by means of electromagnetism? What happens when a loop of wire is passed through a magnetic field?

19. Why is the power of generators described in terms of volts?

20. Why is a rotary motion better for producing electricity than a reciprocating motion?

21. How is alternating current produced by a generator?

22. What turns the rotor in a generator? Where does the power come from?

23. Is electricity transmitted at low or high voltages?

24. Why has 110-120v come into common use for households in the United States? Is any other voltage in use?

25. What do transformers do?

26. What are the basic parts of a transformer?

27. Through which coil is current supplied to a transformer? From which is the current taken?

28. What happens when the primary coil has more turns than the secondary? What kind of transformer is this?

29. What happens when the secondary coil has more turns than the primary? What kind of transformer is this?

30. Why are step-up transformers used at power plants?

31. Why are step-down transformers used at distribution substations?

Review

A. Fill in the spaces in the following sentences with the appropriate word or phrase.

1. The ancient Greeks discovered that certain kinds of ________________ ore could attract or repel other substances. They called this phenomenon ________________.

2. The two ends of a magnet are called the ________________ and the ________________.

3. A ________________ is used for navigation because its magnetized needle points in the directions of the geographic ________________ and ________________.

4. Like poles of a magnet ________________, and unlike poles ________________.

5. The ________________ extending out from a magnet are ________________ in shape. They indicate the ________________ established by the magnet.

6. A generator creates an electromotive force which is expressed in terms of ________________.

7. Electromagnetism can be increased by winding a ________________ of conducting wire around an iron core.

8. In an electric motor, a bar known as an ________________ is placed between the arms of a horseshoe magnet.

9. A ________________ in an electric motor changes the direction of the electron flow so that the armature continues to move.

10. A ________________ motion is circular and a ________________ motion is back-and-forth or up-and-down.

11. Current enters a transformer through the ________________ coil and is taken from the ________________ coil.

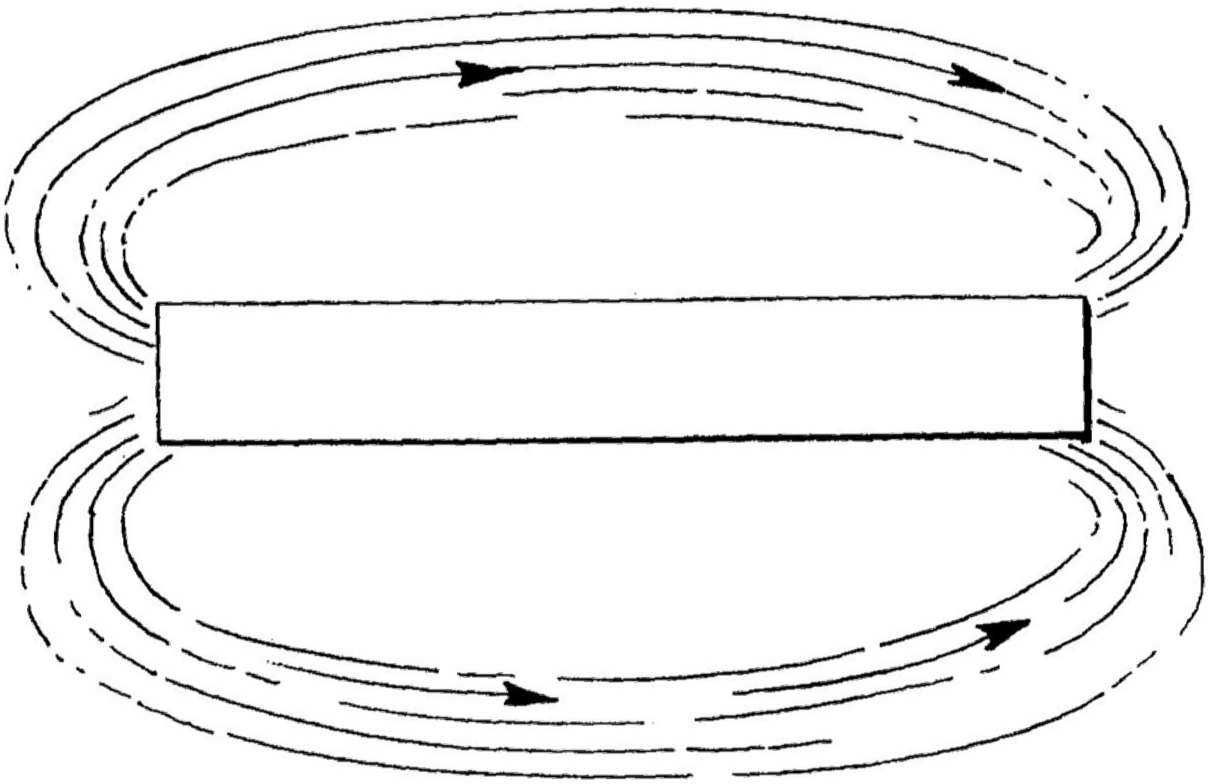
12. A transformer that increases voltage is a ________________ transformer; one that decreases voltage is a ________________ transformer.

13. A ________________ is the moving part of a generator and a ________________ is the stationary part.

14. The moving part of a generator is turned by a ________________ which is usually powered by ________________ or ________________.

15. There is less energy loss when electricity is transmitted at a high ________.

B. Indicate the north pole and the south pole of the magnet in the drawing below.



C. Indicate in which direction these magnetizable particles would point if the north pole of a magnet were placed in the position on the left.