ENGLISH FOR ELECTRICAL ENGINEERING AND

COMPUTING

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CONTENTS

PREFACE

These study materials are designed for undergraduate students of electrical engineering and computing to complement the coursebook that is studied in class. We try to supply students with additional texts and exercises believing that a larger language, especially lexical, input can be nothing but useful for their further education.

The contents are divided into four parts and each part includes a number of texts on relevant engineering phenomena, inventors, inventions, accompanied with vocabulary exercises, then grammar exercises and skills practice.

We intend to use these materials during class and as follow-up and homework exercises.

PART ONE
Engineering

I. INTRODUCTION

Engineering, term applied to the profession in which a knowledge of the mathematical and natural sciences, gained by study, experience, and practice, is applied to the efficient use of the materials and forces of nature. The term ***engineer*** properly denotes a person who has received professional training in pure and applied science, but is often loosely used to describe the operator of an engine, as in the terms ***locomotive engineer, marine engineer***, or ***stationary engineer***. In modern terminology these latter occupations are known as crafts or trades. Between the professional engineer and the craftsperson or tradesperson, however, are those individuals known as subprofessionals or paraprofessionals, who apply scientific and engineering skills to technical problems; typical of these are engineering aides, technicians, inspectors, draftsmen, and the like.

Before the middle of the 18th century, large-scale construction work was usually placed in the hands of military engineers. Military engineering involved such work as the preparation of topographical maps, the location, design, and construction of roads and bridges; and the building of forts and docks. In the 18th century, however, the term ***civil engineering*** came into use to describe engineering work that was performed by civilians for nonmilitary purposes. With the increasing use of machinery in the 19th century, mechanical engineering was recognized as a separate branch of engineering, and later mining engineering was similarly recognized.

The technical advances of the 19th century greatly broadened the field of engineering and introduced a large number of engineering specialties, and the rapidly changing demands of the socioeconomic environment in the 20th century have widened the scope even further.

Answer the following questions:

1) What is engineering?
2) What does the term ‘engineer’ denote?
3) Does a locomotive engineer have professional training in pure and applied science?
4) Who was construction work largely done by before the middle of the 18th century?
5) Why did the term ‘civil engineering’ come into use?

II. FIELDS OF ENGINEERING

The main branches of engineering are discussed below in alphabetical order. The engineer who works in any of these fields usually requires a basic knowledge of the other engineering fields, because most engineering problems are complex and interrelated. Besides the principal branches discussed below, engineering includes many more specialties than can be described here, such as acoustical engineering, architectural engineering, automotive engineering, ceramic engineering, transportation engineering, and textile engineering.

A. Aeronautical and Aerospace Engineering

Aeronautics deals with the whole field of design, manufacture, maintenance, testing, and use of aircraft for both civilian and military purposes. It involves the knowledge of aerodynamics, structural design, propulsion engines, navigation, communication, and other related areas. Aerospace engineering is closely allied to aeronautics, but is concerned with the flight of vehicles in space, beyond the earth's atmosphere, and includes the study and development of rocket engines, artificial satellites, and spacecraft for the exploration of outer space.

B. Chemical Engineering

This branch of engineering is concerned with the design, construction, and management of factories in which the essential processes consist of chemical reactions. It is the task of the chemical engineer to select and specify the design that will best meet the particular requirements of production and the most appropriate equipment for the new applications.

C. Civil Engineering

Civil engineering is perhaps the broadest of the engineering fields, for it deals with the creation, improvement, and protection of the communal environment, providing facilities for living, industry and transportation, including large buildings, roads, bridges, canals, railroad lines, airports, water-supply systems, dams, irrigation, harbors, docks, aqueducts, tunnels, and other engineered constructions.

D. Electrical and Electronics Engineering

The largest and most diverse field of engineering, it is concerned with the development and design, application, and manufacture of systems and devices that use electric power and signals. Among the most important subjects in the field in the late 1980s are electric power and machinery, electronic circuits, control systems, computer design, superconductors, solid-state electronics, medical imaging systems, robotics, lasers, radar, consumer electronics, and fiber optics.

Despite its diversity, electrical engineering can be divided into four main branches: electric power and machinery, electronics, communications and control, and computers.

D.1. Electric Power and Machinery

The field of electric power is concerned with the design and operation of systems for generating, transmitting, and distributing electric power. Engineers in this field have brought about several important developments since the late 1970s. One of these is the ability to transmit power at extremely high voltages in both the direct current (DC) and alternating current (AC) modes, reducing power losses proportionately. Another is the real-time control of power generation, transmission, and distribution, using computers to analyze the data fed back from the power system to a central station and thereby optimizing the efficiency of the system while it is in operation.

A significant advance in the engineering of electric machinery has been the introduction of electronic controls that enable AC motors to run at variable speeds by adjusting the frequency of the current fed into them. DC motors have also been made to run more efficiently this way.

D.2. Electronics

Electronic engineering deals with the research, design, integration, and application of circuits and devices used in the transmission and processing of information. Information is now generated, transmitted, received, and stored electronically on a scale unprecedented in history, and there is every indication that the explosive rate of growth in this field will continue unabated.

Electronic engineers design circuits to perform specific tasks, such as amplifying electronic signals, adding binary numbers, and demodulating radio signals to recover the information they carry. Circuits are also used to generate waveforms useful for synchronization and timing, as in television, and for correcting errors in digital information, as in telecommunications.

Prior to the 1960s, circuits consisted of separate electronic devices—resistors, capacitors, inductors, and vacuum tubes—assembled on a chassis and connected by wires to form a bulky package. Since then, there has been a revolutionary trend toward integrating electronic devices on a single tiny chip of silicon or some other semiconductive material. The complex task of manufacturing these chips uses the most advanced technology, including computers, electron-beam lithography, micro-manipulators, ion-beam implantation, and ultraclean environments. Much of the research in electronics is directed toward creating even smaller chips, faster switching of components, and three-dimensional integrated circuits.

D.3. Communications and Control

Engineers in this field are concerned with all aspects of electrical communications, from fundamental questions such as “What is information?” to the highly practical, such as design of telephone systems. In designing communication systems, engineers rely heavily on various branches of advanced mathematics, such as Fourier analysis, linear systems theory, linear algebra, complex variables, differential equations, and probability theory. Engineers work on control systems ranging from the everyday, passenger-actuated, as those that run an elevator, to the exotic, as systems for keeping spacecraft on course. Control systems are used extensively in aircraft and ships, in military fire-control systems, in power transmission and distribution, in automated manufacturing, and in robotics.

Engineers have been working to bring about two revolutionary changes in the field of communications and control: Digital systems are replacing analog ones at the same time that fiber optics are superseding copper cables. Digital systems offer far greater immunity to electrical noise. Fiber optics are likewise immune to interference; they also have tremendous carrying capacity, and are extremely light and inexpensive to manufacture.

D.4. Computers

Virtually unknown just a few decades ago, computer engineering is now among the most rapidly growing fields. The electronics of computers involve engineers in design and manufacture of memory systems, of central processing units, and of peripheral devices. Foremost among the avenues now being pursued are the design of Very Large Scale Integration (VLSI) and new computer architectures. The field of computer science is closely related to computer engineering; however, the task of making computers more “intelligent” (artificial intelligence), through creation of sophisticated programs or development of higher level machine languages or other means, is generally regarded as being in the realm of computer science.

One current trend in computer engineering is microminiaturization. Using VLSI, engineers continue to work to squeeze greater and greater numbers of circuit elements onto smaller and smaller chips. Another trend is toward increasing the speed of computer operations through use of parallel processors, superconducting materials, and the like.

E. Geological and Mining Engineering

This branch of engineering includes activities related to the discovery and exploration of mineral deposits and the financing, construction, development, operation, recovery, processing, purification, and marketing of crude minerals and mineral products.

F. Industrial or Management Engineering

This field pertains to the efficient use of machinery, labor, and raw materials in industrial production. It is particularly important from the viewpoint of costs and economics of production, safety of human operators, and the most advantageous deployment of automatic machinery.

G. Mechanical Engineering

Engineers in this field design, test, build, and operate machinery of all types; they also work on a variety of manufactured goods and certain kinds of structures. The field is divided into (1) machinery, mechanisms, materials, hydraulics, and pneumatics; and (2) heat as applied to engines, work and energy, heating, ventilating, and air conditioning.

H. Marine Engineering

Marine engineering is a specialized branch of mechanical engineering devoted to the design and operation of systems, both mechanical and electrical, needed to propel a ship. In helping the naval architect design ships, the marine engineer must choose a propulsion unit, such as a diesel engine or geared steam turbine that provides enough power to move the ship at the speed required.

I. Military Engineering

This branch is concerned with the application of the engineering sciences to military purposes. It is generally divided into permanent land defense and field engineering. In war, army engineer battalions have been used to construct ports, harbors, depots, and airfields.

J. Nuclear Engineering

This branch of engineering is concerned with the design and construction of nuclear reactors and devices, and the manner in which nuclear fission may find practical applications, such as the production of commercial power from the energy generated by nuclear reactions and the use of nuclear reactors for propulsion and of nuclear radiation to induce chemical and biological changes.

K. Safety Engineering

This field of engineering has as its object the prevention of accidents. Safety engineers develop methods and procedures to safeguard workers in hazardous occupations. They also assist in designing machinery, factories, ships, and roads, suggesting alterations and improvements to reduce the likelihood of accident.

L. Sanitary Engineering

This is a branch of civil engineering which chiefly deals with problems involving water supply, treatment, and distribution; disposal of wastes and reclamation of useful components of such wastes; control of pollution of surface waterways, groundwaters, and soils; food sanitation; housing and institutional sanitation; insect control; control of atmospheric pollution; industrial hygiene, including control of light, noise, vibration, and toxic materials in work areas; and other fields.

Abridged and adapted from:

"Engineering," Microsoft® Encarta® Online Encyclopedia 2009

C.VOCABULARY PRACTICE

What is electricity?

Electricity is the phenomenon associated with positively and negatively charged particles of matter at rest and in motion, individually or in great numbers. Since every atom contains both positively and negatively charged particles, electricity is connected with the physical properties and structure of matter and is an important factor in physics, chemistry and biology.

Use the words underlined in the previous passage, either in their singular or plural form, to fill the gaps in the following sentences:

1. Lightning is a naturally occurring electrical __________.
2. Electrical conductivity is an important ____________ of metals.
3. Atoms, which were once thought to be the smallest ___________, are known to consist of even smaller ones.
4. ___________, atoms have only a weak charge, but a very large number together can make a powerful charge.
5. Albert Einstein discovered the relationship between __________ and energy.

Did you know….?

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

William Gilbert (1544-1603), English physicist and physician, known primarily for his original experiments in the nature of electricity and magnetism. He was born in Colchester and educated at Saint John's College, University of Cambridge. He began to practice medicine in London in 1573 and in 1601 was appointed physician to Elizabeth I, queen of England.

Gilbert found that many substances had the power to attract light objects when rubbed, and he applied the term ***electric*** to the force these substances exert after being rubbed[1]. He was the first to use the terms ***electric force, electric attraction***, and ***magnetic pole***. Perhaps Gilbert's most important contribution was the experimental demonstration of the magnetic nature of the earth[2]. The unit of magnetomotive force, the ***gilbert***, was named after him. He was also the first exponent in England of the Copernican system of celestial mechanics, and he postulated that fixed stars were not all at the same distance from the earth[3]. His most important work was *Of Magnets, Magnetic Bodies, and the Great Magnet of the Earth* (1600; trans. 1890), probably the first great scientific work written in England.

"William Gilbert," Microsoft® Encarta® Online Encyclopedia 2009

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

Charles Augustin de Coulomb (1736-1806), French physicist, pioneer in electrical theory, born in Angoulême. He served as a military engineer for France in the West Indies, but retired to Blois, France, at the time of the French Revolution to continue research in magnetism, friction, and electricity[1]. In 1777 he invented the torsion balance for measuring the force of magnetic and electrical attraction[2]. With this invention, Coulomb was able to formulate the principle, now known as Coulomb's law, governing the interaction between electric charges. In 1779 Coulomb published the treatise *Théorie des machines simples* (Theory of Simple Machines), an analysis of friction in machinery. After the war Coulomb came out of retirement and assisted the new government in devising a metric system of weights and measures[3]. The unit of quantity used to measure electrical charges, the ***coulomb***, was named for him.

"Charles Augustin de Coulomb," Microsoft® Encarta® Online Encyclopedia 2009

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

Joseph Henry (1797-1878), American physicist, who did his most important work in electromagnetism. He was born in Albany, New York, and educated at Albany Academy. He was appointed professor of mathematics and natural philosophy at Albany Academy[1] in 1826 and professor of natural philosophy at Princeton University in 1832[2]. The foremost American physicist of his day, he discovered the principle of electromagnetic induction before the British physicist Michael Faraday announced his discovery of electromagnetically induced currents, but Faraday published his findings first and is credited with the discovery. The discovery of the phenomenon of self-inductance, which Henry announced in 1832, is, however, attributed to him[3], and the unit of inductance is named the henry in his honor.

Henry experimented with and improved the electromagnet, which had been invented in 1823 by the Briton William Sturgeon. By 1829 he had developed electromagnets of great lifting power and efficiency and essentially of the same form used later in dynamos and motors. He also developed electromagnets that were capable of magnetizing iron at a distance from the source of current, and in 1831 he constructed the first practical electromagnetic telegraph[4]. Henry also devised and constructed one of the first electric motors. In 1842 he recognized the oscillatory nature of an electric discharge.

In 1846 Henry was elected secretary and director of the newly formed Smithsonian Institution, and he served in those positions until his death. Under his direction, the institution stimulated activity in many fields of science. He organized meteorological studies at the Smithsonian and was the first to use the telegraph to transmit weather reports, to indicate daily atmospheric conditions on a map, and to make weather forecasts from meteorological data. The meteorological work of the Smithsonian led to the creation of the U.S. Weather Bureau[5]. Henry was a founder of the American Association for the Advancement of Science and president (1868-78) of the National Academy of Sciences.

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

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

Michael Faraday (1791-1867), British physicist and chemist, best known for his discoveries of electromagnetic induction and of the laws of electrolysis.

Faraday was born on September 22, 1791, in Newington, Surrey, England. He was the son of a blacksmith and received little formal education. While apprenticed to a bookbinder in London, he read books on scientific subjects and experimented with electricity. In 1812 he attended a series of lectures[1] given by the British chemist Sir Humphry Davy and forwarded the notes he took at these lectures to Davy, together with a request for employment. Davy[2] employed Faraday as an assistant in his chemical laboratory at the Royal Institution and in 1813 took Faraday with him on an extended tour of Europe. Faraday was elected to the Royal Society[3] in 1824 and the following year was appointed director of the laboratory of the Royal Institution. In 1833 he succeeded Davy as professor of chemistry at the institution. Two years later he was given a pension of 300 pounds per year for life. Faraday was the recipient of many scientific honors, including the Royal and Rumford medals of the Royal Society; he was also offered the presidency of the society but declined the honor. He died on August 25, 1867, near Hampton Court, Surrey.

Faraday's earliest researches were in the field of chemistry[4], following the lead of Davy. A study of chlorine, which Faraday included in his researches, led to the discovery of two new chlorides of carbon. He also discovered benzene. Faraday investigated a number of new varieties of optical glass. In a series of experiments he was successful in liquefying a number of common gases[5].

The research that established Faraday as the foremost experimental scientist of his day was, however, in the fields of electricity and magnetism. In 1821 he plotted the magnetic field around a conductor carrying an electric current; the existence of the magnetic field had first been observed by the Danish physicist Hans Christian Oersted[6] in 1819. In 1831 Faraday followed this accomplishment with the discovery of electromagnetic induction and in the same year demonstrated the induction of one electric current by another. During this same period of research he investigated the phenomena of electrolysis and discovered two fundamental laws: that the amount of chemical action produced by an electrical current in an electrolyte is proportional to the amount of electricity passing through the electrolyte; and that the amount of a substance deposited from an electrolyte by the action of a current is proportional to the chemical equivalent weight of the substance. Faraday also established the principle that different dielectric substances have different specific inductive capacities[7].

In experimenting with magnetism, Faraday made two discoveries of great importance; one was the existence of diamagnetism, and the other was the fact that a magnetic field has the power to rotate the plane of polarized light passing through certain types of glass.

In addition to a number of papers for learned journals, Faraday wrote *Chemical Manipulation* (1827), *Experimental Researches in Electricity* (1844-1855), and *Experimental Researches in Chemistry and Physics* (1859).

GRAMMAR REVIEW

TENSES

I Past simple and Present perfect

An artist is being interviewed. Make questions to match his answers. Use the correct form of the Past simple or Present perfect, whichever is correct.

For example:

Q: *What did you do yesterday?*

A: Worked on the computer.

1) Q: What ...

A: Worked on a CD of my paintings.

2) Q: How many ...

A: About a third.

3) Q: What ...

A: I destroyed them.

4) Q: How ...

A: I scanned them in.

5) Q: How ...

A: I've organized them into themes.

6) Q: Have ...

A: Yes, I've added a sound track.

7) Q: How long ...

A: It's taken me about a week.

8) Q: When ...

A: I started about ten years ago.

9) Q: What ...

A: Before I had a computer, I had to use slides.

10) Q: Have ...
A: Yes, I've sold a few.

II Put the tenses in this dialogue in the correct form: Past simple or Present perfect.

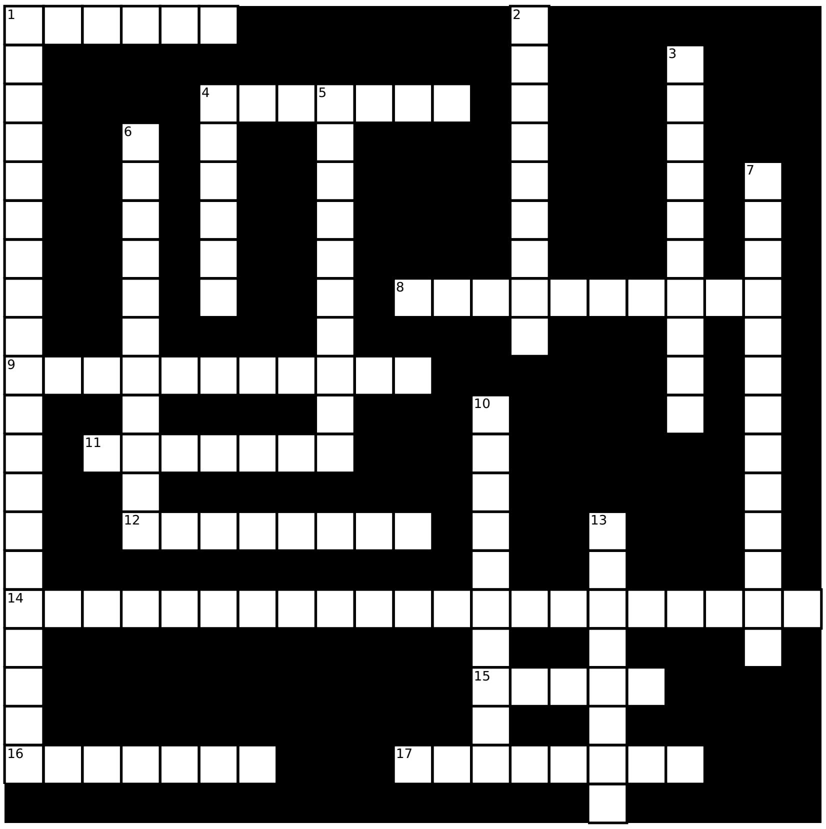
1 A: What _______ (do) today?
2 B: I ________ (work) on my project. I ________ (search) the Web for sites on digital cameras.
3 A: ________ (find) any good ones?
4 B: I ________(find) several company sites – Sony, Canon... but I ________ (want) one which ________ (compare) all the models.
5 A: Which search engine ________ (use)?
6 B: Dogpile mostly. ________ (ever use) it?
7 A: Yes, I ________ (try) it but I ________ (have) more luck with Ask Jeeves. Why don't you try it?
8 B: I ________ (have) enough for one night. I _______ (spend) hours on that project.
9 A: I _______ (not start) on mine yet.
10 B: Yeh? I bet you ________ (do) it all.

III Past simple questions

Study this description of a student's first term. What questions might the interviewer have asked to obtain the information in italics?

In her first term Pauline studied *six subjects*. She had classes on *four days* each week. On Monday morning she had *IT and Information Systems*. *Tuesday* was a free day for home study. On Wednesday she had Systems Analysis in *Room 324*. She studied *Computer* took place *once a week* on Friday afternoons. She liked *Mr Architecture* on Thursdays. *Programming* happened on Friday mornings. Communication *Blunt's classes* most. She had a 15-minute coffee break each day and a lunch break *from 12.00 to 1.00.*

Engineering
English



Across

1 A specialized branch of mechanical engineering devoted to the design and operation of systems needed to propel a ship
4 A semiconductor
8 An area studied in mechanical engineering
9 The branch of engineering dealing with the whole field of design, manufacture, maintenance, testing, and use of aircraft for both civilian and military purposes
11 Systems that have been replacing analog ones
12 The branch of engineering dealing with problems involving water supply, treatment, and distribution; disposal of wastes, etc.
14 The branch including the study and development of rocket engines, artificial satellites, and spacecraft for the exploration of outer space.
15 The branch of engineering dealing with providing facilities for living, industry and transportation
16 The branch concerned with the design and construction of nuclear reactors and devices
17 The branch concerned with the application of the engineering sciences to military purposes

Down

1 Squeezing greater numbers of circuit elements onto smaller chips
2 One of the branches of electrical engineering
3 The branch of engineering dealing with designing, testing, building, and operating machinery of all types
4 The field of engineering concerned with the prevention of accidents
5 The branch pertaining to the efficient use of machinery, labor, and raw materials in industrial production
6 The branch of engineering dealing with the research, design, integration, and application of circuits and devices used in the transmission and processing of information
7 A propulsion unit
10 The branch of engineering including activities related to the discovery and exploration of mineral deposits
13 The branch of engineering concerned with the design, construction, and management of factories in which the essential processes consist of chemical reactions

PART TWO

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.

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

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 _______________[1].
2. Phenomenon displayed by certain substances that conduct electricity but demonstrate no resistance to the flow of an electric current is called _____________[2].
3. _______________________[3] is the lowest temperature theoretically possible, characterized by complete absence of heat (thermal energy).
4. __________[4], in chemistry, are homogeneous (uniform) mixtures of two or more substances.

Answer the questions below the text:

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.

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

Answer the following questions:

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?

Semiconductors

Fill the gaps in the following two paragraphs on semiconductors with the following words: conduct, conductivity, impurities, semiconductors, electrons, intrinsic, bond, valence, increase.

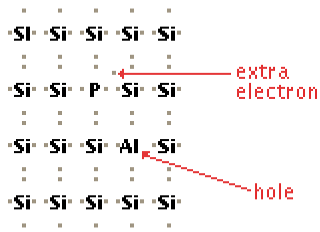
Semiconductor is a solid or liquid material, able to _______[1] (conduct) electricity at room temperature more readily than an insulator, but less easily than a metal. Electrical __________[2] (conductivity), which is the ability to conduct electrical current under the application of a voltage, has one of the widest ranges of values of any physical property of matter. Such metals as copper, silver, and aluminum are excellent conductors, but such insulators as diamond and glass are very poor conductors. At low temperatures, pure semiconductors behave like insulators. Under higher temperatures or light or with the addition of _________[3] (impurities), however, the conductivity of semiconductors can be increased dramatically, reaching levels that may approach those of metals. The physical properties of semiconductors are studied in solid-state physics.

The common _________[4] (semiconductors) include chemical elements and compounds such as silicon, germanium, selenium, gallium arsenide, zinc selenide, and lead telluride. The increase in conductivity with temperature, light, or impurities arises from an increase in the number of conduction _______[5] (electrons), which are the carriers of the electrical current. In a pure, or ________[6] (intrinsic), semiconductor such as silicon, the valence electrons, or outer electrons, of an atom are paired and shared between atoms to make a covalent ______[7] (bond) that holds the crystal together. These _______[8] (valence) electrons are not free to carry electrical current. To produce conduction electrons, temperature or light is used to excite the valence electrons out of their bonds, leaving them free to conduct current. Deficiencies, or "holes," are left behind that contribute to the flow of electricity. (These holes are said to be carriers of positive electricity.) This is the physical origin of the _______[9] (increase) in the electrical conductivity of semiconductors with temperature. The energy required to excite the electron and hole is called the energy gap.

Gases are used in many ways to produce semiconductors and integrated circuits. In this picture, a technician adjusts the tube through which gases flow into a chamber below. In the chamber, atoms from the gas attach to the surface of a semiconductor material and form a new solid layer. Different types of gases are used to make several layers of different chemical materials.

Some words bolded in the following two paragraphs have been jumbled. What are they?

Another method to produce free **rcairsre** _________[10] of electricity is to add **mripsuitei** **_______[11]** to, or to "dope," the semiconductor. The difference in the number of valence electrons between the **pogndi** ________[12] material, or dopant (either donors or acceptors of electrons), and host gives rise to negative (n-type) or positive (p-type) carriers of electricity. This concept is illustrated in the accompanying **madigra** _______[13] of a doped silicon (Si) crystal. Each silicon atom has **rofu** ______[14] valence electrons (represented by dots); two are required to form a covalent bond. In n- type silicon, atoms such as phosphorus (P) with five **nevealc**_______[15] electrons replace some silicon and provide extra negative electrons. In p-type silicon, atoms with three valence electrons such as aluminum (Al) lead to a deficiency of electrons, or to holes, which act as positive electrons. The extra electrons or holes can **dunctoc** _________ [16] electricity.



When p-type and n-type semiconductor regions are adjacent to each other, they form a **dicmosutero** __________ [17] diode, and the region of contact is called a p-n junction. (A diode is a two-terminal device that has a high resistance to electric current in one direction but a low resistance in the other direction.) The conductance properties of the p-n junction **pended** ________ [18] on the direction of the voltage, which can, in turn, be used to control the electrical nature of the device. Series of such junctions are used to make **nirsorsast** _________ [19] and other semiconductor devices such as solar cells, p-n junction lasers, rectifiers, and many others.

Adapted from:
"Semiconductor," Microsoft® Encarta® Online Encyclopedia 2009 http://encarta.msn.com

Did you know…?

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

Sir Joseph Wilson Swan (1828-1917), British chemist and inventor, who pioneered <u>important developments in photography and electric lighting</u>[1]. Born in Sunderland, Tyne and Wear, he was apprenticed to a chemist before joining the firm of John Mawson, in Newcastle upon Tyne, which supplied chemicals to photographers. He soon became a partner, and in 1862 invented <u>a process for making permanent prints, using carbon tissue, a paper coated with light-sensitive gelatin</u>[2]. Later, he noticed that heat increased the light sensitivity of silver bromide emulsion; the resulting development of dry-plate photography (patented in 1871) was also a significant advance in convenience for users. In 1879 he patented <u>bromide paper, the light-sensitive paper still used today for printing photographs</u>[3].

Swan's active interest in using electricity for lighting had begun in about 1848, when he started experimenting with passing a current through a carbon filament in a vacuum. Later, he tried different filaments, including cotton thread treated with sulphuric acid. Only in the 1870s, however, did the development of a dynamo to produce a steady supply of current and a pump capable of producing a sufficiently high vacuum begin to make a really practical light bulb possible. In 1878 he demonstrated <u>an electric light using a carbon wire in a vacuum</u>

bulb[4]. Thomas Edison arrived independently at the same solution the following year. Edison had been more systematic in patenting his developments, however, and attempted to prosecute Swan for patent infringement[5]. The action was defeated, and as part of the settlement the two men merged their production in the Edison and Swan United Electric Light Company in 1883. In that year, Swan improved the filament when he found a way of extruding nitrocellulose, which, treated with acetic acid, greatly lengthened the bulb's lifetime. In the early 20th century, this nitrocellulose fibre began to be exploited in textiles as an artificial silk. Swan was knighted in 1904.

"Sir Joseph Wilson Swan," Microsoft® Encarta® Online Encyclopedia 2009 http://encarta.msn.com

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

George Westinghouse

George Westinghouse (1846-1914), American inventor, engineer, and industrialist. Westinghouse was born in Central Bridge, New York, and educated at what is now Union College and the University at Schenectady, New York. His first important invention, developed while he was employed in his father's factory in Schenectady, was a so-called railway frog, a device permitting trains to cross from one track to another[1]. He devised his most famous invention, the air brake, about 1868. Although successfully demonstrated in 1868, the air brake did not become standard equipment until after the passage of the Railroad Safety Appliance Act in 1893[2].

Westinghouse invented many other safety devices, especially for automatic railway signaling; developed a system for transporting natural gas; and acquired more than 400 patents, including many for alternating-current machinery. With Charles Steinmetz, he pioneered in the use of alternating-current power in the U.S[3].

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

INVENTIONS

Incandescent Lamp

Thomas Edison's first light bulb

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 heats them to a sufficiently high temperature. Each material gives off light in a color characteristic of that material.

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

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.

Fill out this table with information from the text:

Inventor	**Invention**	**Year**

Read the following paragraphs and provide the correct form of the verbs in parentheses:

In addition to the common light bulb, a variety of other incandescent lamps _______ [1](exist). One is the carbon-arc lamp, ______[2](use) for spotlights and motion-picture projection. This lamp _______[3](provide) light by heating two carbon electrodes that have an arc of high-current electricity ______ [4](pass) between them and from the ionized gases in the arc. The gas-mantle lamp is a nonelectric incandescent lamp that provides light by heating a lattice of metal oxides to the point of glowing. Another example of a nonelectric incandescent lamp is the limelight, which was used in theatrical lighting until the turn of the century. It provides light by heating a block of lime (calcium oxide) in a flame _____ [5](fuel) by oxygen and hydrogen.

The incandescent light bulb is ______ [6](regard) as an inefficient use of energy in comparison with other lighting alternatives, such as the fluorescent light bulb. Scientists are seeking ________ [7](develop) more energy-efficient lighting sources, such as the organic light-emitting diode (OLED), which potentially could be 100 percent efficient by ______ [8](convert) electricity to light without _______ [9](give) off heat.

In 2007 the United States Congress _______ [10](pass) the Energy Independence and Security Act, which included provisions that phase out the use of incandescent light bulbs because of their energy inefficiency. Incandescent bulbs _____ no longer _____ [11] (sell) for home lighting or other uses beginning in 2012, with a final phase-out in 2014. By then American consumers will need to switch to more energy-efficient compact fluorescent bulbs or to LED lighting fixtures. Compact fluorescent bulbs screw into ordinary incandescent light fixtures but use 75 percent less electricity than incandescent bulbs and last 10 times longer. They are also more expensive. However, the use of compact fluorescent bulbs is seen as an interim solution because the bulbs ______ [12](contain) mercury and so present a potential pollution hazard. Researchers hope that improved LED lighting fixtures that are brighter and more energy efficient _________ [13](develop)by the time of the final phase-out of incandescent bulbs.

Abridged and adapted from:"Incandescent Lamp," Microsoft® Encarta® Online Encyclopedia 2009

Vacuum Tubes

Some words bolded in the following paragraph have been jumbled. What are they?

Vacuum tubes are electronic devices, consisting of a glass or steel vacuum envelope and two or more **steledocer**________[1] between which electrons can move freely. The vacuum-tube diode was first developed by the English physicist Sir John Ambrose Fleming. It **notiscan** ________[2] two electrodes: the cathode, a heated filament or a small, heated, metal tube that emits electrons through **mtenhcorii** __________[3] emission; and the anode, or **ltpea** _______[4], which is the electron-collecting element. In diodes, the electrons emitted by the **dhacoet** ________[5] are attracted to the plate only when the latter is positive with respect to the cathode. When the plate is negatively charged, no current **wfslo** _______ [6] through the tube. If an alternating potential is applied to the plate, the tube passes current only during the positive halves of the cycle and thus acts as a rectifier. Diodes are used extensively in the rectification of alternating current.

Fill the gaps in the following three paragraphs with the following words:

frequency, repels, tetrodes, transistors, voltage, grid, amplify, pentode

The introduction of a third electrode, called a ______[7], interposed between the cathode and the anode, forms the triode, which for many years was the basic tube used for amplifying current. (The triode was invented in 1906 by the American engineer Lee De Forest.) The function of the grid is to control the current flow. At a certain negative potential, the grid, because it ______ [8] electrons, can impede the flow of electrons between the cathode and the anode. At lower negative potentials, the electron flow depends on the grid potential. The grid usually consists of a network of fine wire surrounding the cathode. The capacity of the triode to ________ [9] depends on the small changes in the voltage between the grid and the cathode causing large changes in the number of electrons reaching the anode.

Through the years more complex tubes with additional grids have been developed to provide greater amplification and to perform specialized functions. _______[10] have an additional grid, closer to the anode, that forms an electrostatic shield between the anode and the grid to prevent feedback to the grid in high-frequency applications. The ________ [11] has three grids between the cathode and the anode; the third grid, close to the anode, reflects electrons that are emitted by the anode as it is heated by electron impact when the electron current in the tube is high. Tubes with even more grids, called hexodes, heptodes, and octodes, find applications as ________ [12] converters and mixers in radio receivers.

Vacuum tubes have now been almost entirely replaced by _______ [13] and semiconductor diodes, which are cheaper, smaller, and more reliable. Tubes still play an important role in certain applications, however, such as in power stages in radio and television transmitters, and in military equipment that must resist the ______[14] pulse (which destroys transistors) induced by an atmospheric nuclear explosion.

"Vacuum Tubes," Microsoft® Encarta® Online Encyclopedia 2009

Numbers

I Match the words with the examples on the right:

1. cardinal numbers	a) ¼, 2/3, 28/36
2. ordinal numbers	b) First, second, third, …
3. decimals	c) 1, 2, 3, …
4. fractions	d) 12%, 89%...
5. percentages	e) 2.3, 4.698

N.B. Each digit after the decimal point is read separately: two point three, four point six nine eight.

II Match these written numbers with the way they are read:

1. 60%	a) one third
2. 3 ½	b) two fifths
3. 3.4	c) two point eight seven
4. 8.5%	d) eight point five percent
5. 1/3	e) three point four
6. 2.87	f) sixty percent
7. 3/4	g) three and a half
8. 2/5	h) three quarters

III Put these words and phrases into the sentences below:

times/multiplied by, divided by, minus, plus

1. Four________ eighteen equals twenty-two.
2. Seventeen ____________ thirteen equals two hundred twenty-one.
3. Ninety-six _________ four equals twenty-four.
4. Ten ________ nine equals one.

Now match the following words with the four operations above:

Multiplication, addition, division, subtraction

IV ‘0’ is said in different ways depending on the context. Match the spoken phrases with the situations below:

1. It’s three oh five seven oh one
2. In eighteen oh four.
3. It’s five degrees below zero.
4. Manchester won two nil.
5. He’s winning two sets to love.

a) the result of a football match
b) the temperature
c) a phone number
d) the score in a tennis match
e) the year somebody was born

Table of non-technical numeric prefixes

Number	Derived from number words in		
	Greek	Latin	English
¼			quarter-
½	hemi-	semi-/demi-	half-
1	mono-/haplo-	uni-	one-
1¼		quasqui-	one and a quarter-
1½		sesqui-	one and a half-
2	di-	duo-/bi-	two-
3	tri-	tre-/ter-	three-
4	tetra-/tetr-	quadri-/quadr-	
5	penta-/pent-	quinque-/quinqu-	
6	hexa-/hex-	sexa-/sex-	
7	hepta-/hept-	septua-	
8	octa-/octo-/oct-		
9	ennea-	nona-/non-	
10	deka-/deca-	deci-	
11	hendeca-	undec-	
12	dodeca-	duodec-	

13	triskaideka-	tridec-	
14	tetradeca-	quattuordec-	
15	pentadeca-	quindec-	
16	hexadeca-	sedec-	
20	icosa-	vigen-	
100	hecto-/hect-	centi-	
1000	chilia-/kilo-	milli-	
10000	myria-		
Any no. > 1	poly-	multi-	

(Adapted from http://en.wikipedia.org/wiki/Greek_numerical_prefixes**)**

Study the above table and write how many functional parts the following devices mentioned in the text have:

a) diode ________
b) heptode ________
c) tetrode ________
d) octode ________
e) hexode ________
f) triode ________
g) pentode ________

Try to figure out what the following words could mean:

a) **octogenarian** (*plural* **octogenarians**)-
b) **demigod** (*plural* **demigods**) -
c) **quadrangle** (*plural* **quadrangles**) –
d) **triskaidekaphobia** (*uncountable*) -
e) **bicentennial –**
f) **sesquicentennial -**
g) vigesimal -
h) **nonagon** (*plural* **nonagons**) -
i) **icosagon** (*plural* **icosagons**) –
j) **myriametre** (*plural* myriametres) –

(Adapted from http://en.wiktionary.org/wiki/Wiktionary:Main_Page**)**

Did you know…?

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

Carl Friedrich Gauss

Carl Friedrich Gauss (1777-1855), German mathematician, noted for his wide-ranging contributions to physics, particularly the study of electromagnetism.

Born in Braunschweig on April 30, 1777, Gauss studied ancient languages in college, but at the age of 17[1] he became interested in mathematics and attempted a solution of the classical problem of constructing a regular heptagon, or seven-sided figure, with ruler and compass[2]. He not only succeeded in proving this construction impossible, but went on to give methods of constructing figures with 17, 257, and 65,537 sides. In so doing he proved that the construction, with compass and ruler, of a regular polygon with an odd number of sides was possible only when the number of sides was a prime number of the series 3, 5, 17, 257, and 65,537 or was a multiple of two or more of these numbers. With this discovery he gave up his intention to study languages and turned to mathematics. He studied at the University of Göttingen from 1795 to 1798; for his doctoral thesis he submitted a proof that every algebraic equation has at least one root, or solution[3]. This theorem, which had challenged mathematicians for centuries, is still called "the fundamental theorem of algebra". His volume on the theory of numbers, *Disquisitiones Arithmeticae* (Inquiries into Arithmetic, 1801), is a classic work in the field of mathematics.

Gauss next turned his attention to astronomy[4]. A faint planetoid, Ceres, had been discovered in 1801; and because astronomers thought it was a planet, they observed it with great interest until losing sight of it. From the early observations Gauss calculated its exact position, so that it was easily rediscovered. He also worked out a new method for calculating the orbits of heavenly bodies. In 1807[5] Gauss was appointed professor of mathematics and director of the observatory at Göttingen, holding both positions until his death there on February 23, 1855.

Although Gauss made valuable contributions to both theoretical and practical astronomy, his principal work was in mathematics and mathematical physics[6]. In theory of numbers, he developed the important prime-number theorem. He was the first to develop a non-Euclidean geometry, but Gauss failed to publish these important findings because he wished to avoid publicity[7]. In probability theory, he developed the important method of least squares and the fundamental laws of probability distribution. The normal probability graph is still called the Gaussian curve. He made geodetic surveys, and applied mathematics to geodesy. With the German physicist Wilhelm Eduard Weber, Gauss did extensive research on magnetism. His applications of mathematics to both magnetism and electricity are among his most important works; the unit of intensity of magnetic fields is today called the gauss[8]. He also carried out research in optics, particularly in systems of lenses. Scarcely a branch of mathematics or mathematical physics was untouched by Gauss.

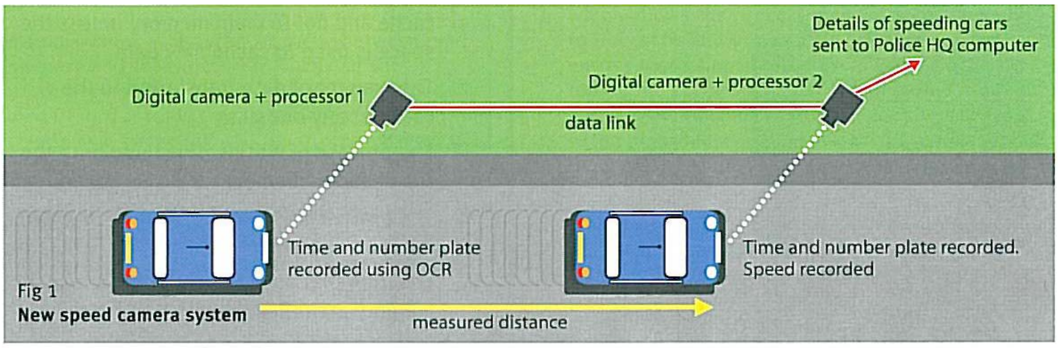
"Carl Friedrich Gauss," Microsoft® Encarta® Online Encyclopedia 2009 http://encarta.msn.com

GRAMMAR REVIEW

THE PASSIVE

I Present Passive

Describe the operation of the new speed trap by converting each of these statements to the Present Passive.



2) The first unit records the time each vehicle passes.
3) It identifies each vehicle by its number plates using Optical Character Recognition (OCR) software.
4) It relays the information to the second unit.
5) The second unit also records the time each vehicle passes.
6) The microprocessor calculates the time taken to travel between the units.
7) It relays the registration numbers on speeding vehicles to police headquarters.
8) A computer matches each vehicle with the Driver and Vehicle Licensing Centre (DVLC) database.
9) It prints off a letter to the vehicle owners using mailmerge.

RELATIVE CLAUSES

I Complete these definitions with the correct participle of the verb given in brackets.

1) A *gateway* is an interface (enable) dissimilar networks to communicate.

2) A *bridge* is a hardware and software combination (use) to connect the same type of

networks.

3) A *backbone* is a network transmission path (handle) major data traffic.

4) A *router* is a special computer (direct) messages when several networks are linked.

5) A *network* is a number of computers and peripherals (link) together.

6) A *LAN* is a network (connect) computers over a small such as within a company.

7) A *server* is a powerful computer (store) many programs (share) by all the clients in the network.

8) A *client* is a network computer (use) for accessing a service on a server.

9) A *thin client* is a simple computer (comprise) a processor and memory, display, keyboard, mouse and hard drives only.

10) A *hub* is an electronic device (connect) all the data cabling in a network.

II Link these statements using a relative clause with a participle.

1) a) The technology is here today.
   b) It is needed to set up a home network.
2) a) You only need one network printer.
   b) It is connected to the server.
3) a) Her house has a network.
   b) It allows basic file-sharing and multi-player gaming.
4) a) There is a line receiver in the living room.
   b) It delivers home entertainment audio to speakers.
5) a) Eve has designed a site.
   b) It is dedicated to dance.
6) a) She has built in links.
   b) They connect her site to other dance sites.
7) a) She designed the site using a website creation program.
   b) It is called Dreamweaver.
8) a) At the centre of the home of tomorrow is a network.
   b) It is accessed through a control pad.
9) a) The network can stimulate the owner's presence.
   b) This makes sure vital tasks are carried out in her absence.
10) a) The house has an electronic door-keeper.
    b) It is programmed to recognize you.

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.

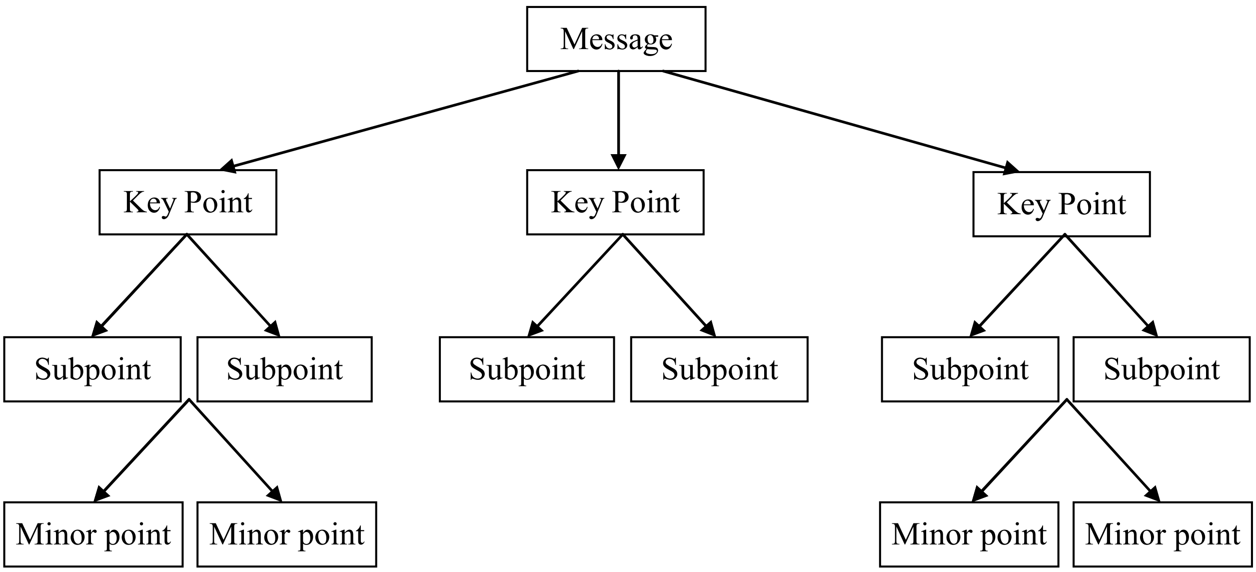
Visual aids are very important, but most people put far too much information on them. Face the audience at all times. Finally, remember that it is not just what you say, it is how you say it.

Follow these principles when making a presentation:

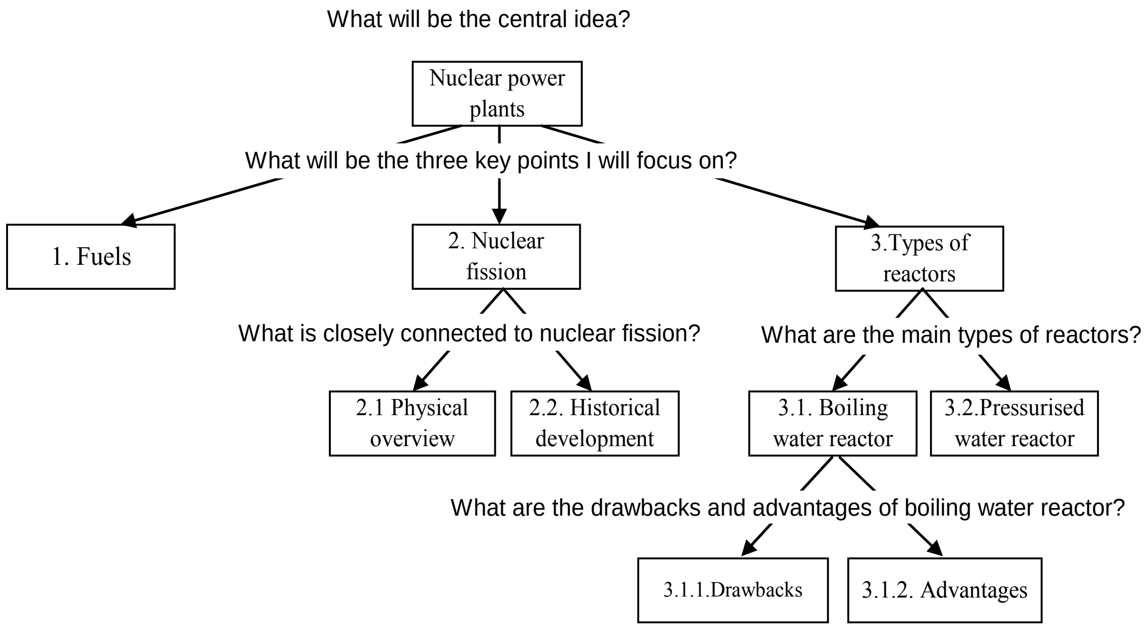
a) A pyramid structure is used to outline the key points.
b) The key points will form the sections of the presentation.
c) The slides should look consistent in font and overall design.
d) Colours should be used rather than black and white.
e) A corporate logo should be added.
f) Scales and numbering 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

HEAT AND TEMPERATURE

Luka Vidačak
Fakultet Elektrotehnike, Strojarstva i Brodogradnje

INTRODUCTION

1. Energy
2. Heat
3. Temperature

1. ENERGY

- There are several kinds of energy:
  -potential energy
  -kinetic energy...
- Energy is measured in the joule which is the energy required each second to push an ampere od current trough an ohm of resistance.
- The energy in this case is change into heat.

2.HEAT

2.1 DEFINITION

- Heat is the energy of molecular motion.
- All molecules move, so all matter contains heat energy(Figure 1).

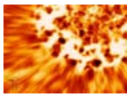


Figure 1: Heat

2. HEAT

2.2 TRANSFERING

- Heat can be transferred from place to place by:
  -conduction(solids)
  -convection(fluids)
  -radiation(sun (Figure 2))

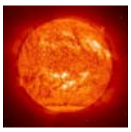


Figure 2:Sun

2. HEAT

2.2 TRANSFERING

- Silver(Figure 3) is the best conductor of the heat.
- Styrofoam(Figure 4) is one of the worst conductors, therefore it is used as a heat insulator.

Figure 3: Silver

Figure 4: Styrofoam

2. HEAT

2.3 MEASURING UNITS

- Heat is measured in units called calories.
- 1 calorie = 4.19 joules
- This measure is common practice in food labeling and nutritional references(Calorie note capital C).

3. TEMPERATURE

3.1 DEFINITION

- Temperature is a measure of the concentration of heat, or the average amount of motion per molecule.
- Adding heat to the substance makes the molecules move faster and therefore increases the temperature.

3.TEMPERATURE

- At the certain temperature, additional heat will change the elemetary state from one to another without any increase in temperature.
- In the case of water adding heat to ice at zero degrees Celsius produces water at zero degrees Celsius(Figures 5 and 6).
- It is called latent heat.

Figure 5: Water

Figure 6: Ice

3. TEMPERATURE

3.3 MEASURING

- Temperatures are commonly measured with thermometers.
- The mercury – filled glass thermometer is commonly used for taking human temperature.
- Tempreature is measured in degrees Fahrenhiet and Celsius(98.6 F=37 C).

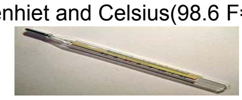


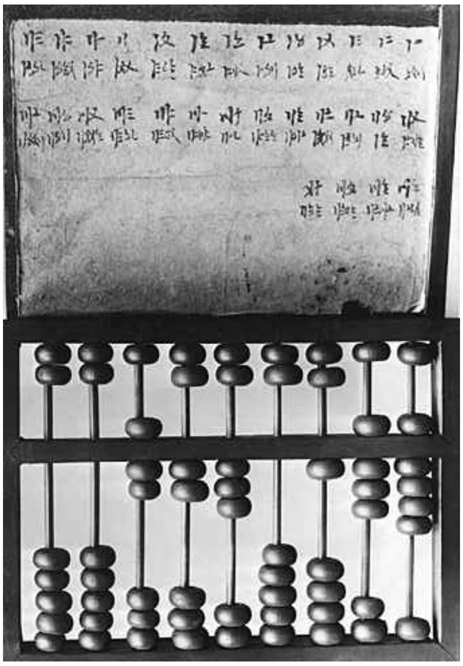
Figure 7: Mercury-filled glass thermometer

Questionnaire 1: Students' criteria for evaluation

1. Verbal and vocal delivery		
1. Did the presenter use too many fillers (mostly the non-lexicalized "hm") and repetitions?	*Yes*	*No*
2. Was the presenter well-prepared?	*Yes*	*No*
4. Was the presenter precise (clear objective and message)?	*Yes*	*No*
5. Did the presenter use rhetorical questions?	*Yes*	*No*
6. Did the presenter follow the KISS principle?(Keep it short and simple)	*Yes*	*No*
7. Was the pronunciation satisfactory?	*Yes*	*No*
8. Was the presenter:		
a) too fast	*Yes*	*No*
b) too slow	*Yes*	*No*
c) monotonous	*Yes*	*No*
9. Did the presenter change intonation?	*Yes*	*No*
10. Did the presenter have a pleasant performance?	*Yes*	*No*
2. Non-verbal communication		
1. Did the presenter follow the rules of effective non verbal communication (body posture, effective eye contact)?	*Yes*	*No*
3. Quality of slides		
1. Were the visual aids designed effectively (pie charts, graphs, histograms.)?	*Yes*	*No*
2. Were the figures and tables of appropriate size, sharpness and colour, were they properly annotated?	*Yes*	*No*
3. Was the used font readable to the audience?	*Yes*	*No*
4. Was too many information presented on the slides?	*Yes*	*No*
5. Did the presenter use the key-points?	*Yes*	*No*
6. Did the presentation follow the chronology of the abstract?	*Yes*	*No*
4. Questions		
1. Could the speaker answer simple clarification questions that would indicate that she/he had thoroughly read the article?	*Yes*	*No*
5. Organization		
1. Was the presenter well-prepared?	*Yes*	*No*
2. Was the presentation interesting?	*Yes*	*No*
3. Did the speaker digress during explanations?	*Yes*	*No*
4. Did the topic closely relate to the field of electrical engineering?	*Yes*	*No*
5. Did the presenter provide sufficient information on the topic?	*Yes*	*No*
6. Did the presentation contain all necessary elements, constructed in a logical sequence (key points, minor points, sub points, effective introduction, main body, closing and inviting questions)?	*Yes*	*No*

PART THREE
INVENTIONS

Abacus



Abacus is an instrument used in performing arithmetic calculations. It consists essentially of a tablet or frame bearing parallel wires or grooves on which counters or beads are moved. A modern abacus consists of a wooden frame with beads on parallel wires, and a crossbar oriented perpendicular to the wires that divides the beads into two groups. Each column—that is, each wire—represents one place in the decimal system. The column farthest to the right is the ones column; the next column to the left is the tens column; and so on. In each column, there are five beads below the crossbar, each of which represent one unit, and two beads above the crossbar, each of which represent five units. For example, in the tens column, each of the group of five beads represents ten, and each of the group of two beads represents fifty. Beads that are to be counted as part of a number are placed against the crossbar.

Many early civilizations used the abacus. In ancient Roman culture it was a sand-covered wax tablet, marked table, or grooved table or tablet. A simplified form of abacus was used in medieval England. It consisted of a tablet ruled into spaces representing the positions of the counters; coins, buttons, stones, or other small objects were moved to make the calculations. The checkered tablecloth, from which the name Exchequer is derived, was originally a calculating device like the ruled tablet. The abacus is still used in China and Japan.

“Abacus,” Microsoft® Encarta® Online Encyclopedia 2009 http://encarta.msn.com

Find the terms from the text that correspond to the following definitions:

1) A slab of stone, wood, or metal used for inscription or engraving. _________
2) A long narrow channel or depression. _______
3) A small piece of material pierced for threading on a string or wire. _______

4) A transverse bar, stripe, or band. _______
5) Being at right angles to a given line or plane. _________
6) A substance that is secreted by bees and is used by them for constructing the honeycomb. ________
7) With a pattern of small squares. _______
8) Formerly in the United Kingdom and some other countries, the government department responsible for collecting taxes and managing public spending. ________

COMPUTERS

The history of computing began with an analog machine. In 1623 German scientist Wilhelm Schikard invented a machine that used 11 complete and 6 incomplete sprocketed wheels that could add, and with the aid of logarithm tables, multiply and divide.

French philosopher, mathematician, and physicist Blaise Pascal invented a machine in 1642 that added and subtracted, automatically carrying and borrowing digits from column to column. Pascal built 50 copies of his machine, but most served as curiosities in parlors of the wealthy. Seventeenth-century German mathematician Gottfried Leibniz designed a special gearing system to enable multiplication on Pascal's machine.

First Punch Cards

In the early 19th century French inventor Joseph-Marie Jacquard devised a specialized type of computer: a silk loom. Jacquard's loom used punched cards to program patterns that helped the loom create woven fabrics. Although Jacquard was rewarded and admired by French emperor Napoleon I for his work, he fled for his life from the city of Lyon pursued by weavers who feared their jobs were in jeopardy due to Jacquard's invention. The loom prevailed, however: When Jacquard died, more than 30,000 of his looms existed in Lyon. The looms are still used today, especially in the manufacture of fine furniture fabrics.

Precursor to Modern Computers

Another early mechanical computer was the Difference Engine, designed in the early 1820s by British mathematician and scientist Charles Babbage. Although never completed by Babbage, the Difference Engine was intended to be a machine with a 20-decimal capacity that could solve mathematical problems. Babbage also made plans for another machine, the Analytical Engine, considered the mechanical precursor of the modern computer. The Analytical Engine was designed to perform all arithmetic operations efficiently; however, Babbage's lack of political skills kept him from obtaining the approval and funds to build it.

Augusta Ada Byron, countess of Lovelace, was a personal friend and student of Babbage. She was the daughter of the famous poet Lord Byron and one of only a few woman mathematicians of her time. She prepared extensive notes concerning Babbage's ideas and the Analytical Engine. Lovelace's conceptual programs for the machine led to the naming of a programming language (Ada) in her honor. Although the Analytical Engine was never built, its key concepts, such as the capacity to store instructions, the use of punched cards as a primitive memory, and the ability to print, can be found in many modern computers.

Answer the following questions:

1) Who were the first scientists in the 17^{th} century dealing with history of computing and what did they invent?
2) What did Joseph-Marie Jacquard design?
3) Who was Charles Babbage?
4) What is Ada and where does the term come from?

Early Electronic Calculations

Herman Hollerith, an American inventor, used an idea similar to Jacquard's loom when he combined the use of punched cards with devices that created and electronically read the cards. Hollerith's tabulator was used for the 1890 U.S. census, and it made the computational time three to four times shorter than the time previously needed for hand counts. Hollerith's Tabulating Machine Company eventually merged with two companies to form the Computing-Tabulating-Recording Company. In 1924 the company changed its name to International Business Machines (IBM).

In 1936 British mathematician Alan Turing proposed the idea of a machine that could process equations without human direction. The machine (now known as a Turing machine) resembled an automatic typewriter that used symbols for math and logic instead of letters. Turing intended the device to be a "universal machine" that could be used to duplicate or represent the function of any other existing machine. Turing's machine was the theoretical precursor to the modern digital computer. The Turing machine model is still used by modern computational theorists.

In the 1930s American mathematician Howard Aiken developed the Mark I calculating machine, which was built by IBM. This electronic calculating machine used relays and electromagnetic components to replace mechanical components. In later machines, Aiken used vacuum tubes and *solid state transistors* (tiny electrical switches) to manipulate the binary numbers. Aiken also introduced computers to universities by establishing the first computer science program at Harvard University in Cambridge, Massachusetts. Aiken obsessively mistrusted the concept of storing a program within the computer, insisting that the integrity of the machine could be maintained only through a strict separation of program instructions from data. His computer had to read instructions from punched cards, which could be stored away from the computer. He also urged the National Bureau of Standards not to support the development of computers, insisting that there would never be a need for more than five or six of them nationwide.

Match the beginnings and the endings of the following sentences:

1) Hollerith used an idea similar to Jacquard's loom when he combined the use of punched cards
2) Modern computational theorists
3) The Mark I calculating machine
4) Aiken used vacuum tubes and solid state transistors in later machines
5) Aiken's computer had to read instructions from punched cards,

a to manipulate the binary numbers.
b which could be stored away from the computer.
c used relays and electromagnetic components to replace mechanical components.
d with devices that created and electronically read the cards.
e still use the Turing machine model.

EDVAC, ENIAC, and UNIVAC

At the Institute for Advanced Study in Princeton, New Jersey, Hungarian-American mathematician John von Neumann developed one of the first computers used to solve problems in mathematics, meteorology, economics, and hydrodynamics[1]. Von Neumann's 1945 design for the Electronic Discrete Variable Automatic Computer (EDVAC)—in stark contrast to the designs of Aiken, his contemporary—was the first electronic computer design to incorporate a program stored entirely within its memory. This machine led to several others, some with clever names like ILLIAC, JOHNNIAC, and MANIAC.

American physicist John Mauchly proposed the electronic digital computer[2] called ENIAC, the Electronic Numerical Integrator And Computer. He helped build it along with American engineer John Presper Eckert, Jr., at the Moore School of Engineering at the University of Pennsylvania in Philadelphia. ENIAC was operational in 1945[3] and introduced to the public in 1946. It is regarded as the first successful, general digital computer[4]. It occupied 167 sq m (1,800 sq ft), weighed more than 27,000 kg (60,000 lb), and contained more than 18,000 vacuum tubes. Roughly 2,000 of the computer's vacuum tubes were replaced each month by a team of six technicians. Many of ENIAC's first tasks were for military purposes[5], such as calculating ballistic firing tables and designing atomic weapons. Since ENIAC was initially not a stored program machine, it had to be reprogrammed for each task.

Eckert and Mauchly eventually formed their own company, which was then bought by the Rand Corporation. They produced the Universal Automatic Computer (UNIVAC), which was used for a broader variety of commercial applications. The first UNIVAC was delivered to the United States Census Bureau in 1951. By 1957, there were 46 UNIVACs in use.

Between 1937 and 1939, while teaching at Iowa State College, American physicist John Vincent Atanasoff built a prototype computing device[6] called the Atanasoff-Berry Computer, or ABC, with the help of his assistant, Clifford Berry. Atanasoff developed the concepts that were later used in the design of the ENIAC. Atanasoff's device was the first computer to separate data processing from memory, but it is not clear whether a functional version was ever built. Atanasoff did not receive credit for his contributions until 1973, when a lawsuit regarding the patent on ENIAC was settled.

Make questions to which the underlined words are the answers.

THE TRANSISTOR AND INTEGRATED CIRCUITS TRANSFORM COMPUTING

Put the verbs in brackets into the right form:

In 1948, at Bell Telephone Laboratories, American physicists Walter Houser Brattain, John Bardeen, and William Bradford Shockley ____________[1](develop) the transistor, a device that _________[2](can) act as an electric switch. The transistor ______ [3](have) a tremendous impact on computer design, replacing costly, energy-inefficient, and unreliable vacuum tubes.

In the late 1960s integrated circuits (tiny transistors and other electrical components arranged on a single chip of silicon) ___________[4] (replace) individual transistors in computers. Integrated circuits resulted from the simultaneous, independent work of Jack Kilby at Texas Instruments and Robert Noyce of the Fairchild Semiconductor Corporation in the late 1950s. As integrated circuits ________[5] (become) miniaturized, more components __________[6] (can) be designed into a single computer circuit. In the 1970s refinements in integrated circuit technology _______[7] (lead) to the development of the modern microprocessor, integrated circuits that contained thousands of transistors. Modern microprocessors _______ [8](can) contain more than 40 million transistors.

Manufacturers used integrated circuit technology to build smaller and cheaper computers. The first of these so-called personal computers (PCs)—the Altair 8800—appeared in 1975, sold by Micro Instrumentation Telemetry Systems (MITS). The Altair _______ [9](use) an 8-bit Intel 8080 microprocessor, had 256 bytes of RAM, received input through switches on the front panel, and displayed output on rows of light-emitting diodes (LEDs). Refinements in the PC continued with the inclusion of video displays, better storage devices, and CPUs with more computational abilities. Graphical user interfaces were first designed by the Xerox Corporation, then later used successfully by Apple Inc. Today the development of sophisticated operating systems such as Windows, the Mac OS, and Linux _______ [10](enable) computer users to run programs and manipulate data in ways that were unimaginable in the mid-20th century.

Several researchers claim the "record" for the largest single calculation ever performed. One large single calculation _____[11] (be) accomplished by physicists at IBM in 1995. They solved one million trillion mathematical subproblems by continuously running 448 computers for two years. Their analysis demonstrated the existence of a previously hypothetical subatomic particle called a glueball. Japan, Italy, and the United States _________[12] (collaborate) to develop new supercomputers that will run these types of calculations 100 times faster.

In 1996 IBM __________[13] (challenge) Garry Kasparov, the reigning world chess champion, to a chess match with a supercomputer called Deep Blue. The computer had the ability to compute more than 100 million chess positions per second. In a 1997 rematch Deep Blue defeated Kasparov, _____________[14] (become) the first computer to win a match against a reigning world chess champion with regulation time controls. Many experts __________ [15] (predict) these types of parallel processing machines will soon surpass human chess playing ability, and some speculate that massive calculating power will one day replace intelligence.

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 ....

VDD ....
VFC ....
VHF ....
VLF ....
WV...
XTAL ....

2 Guess the meaning of the following abbreviations:

BSCE..
BSCSE...
BSEE..
MSEE..
MSME..

Did you know…?

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

Charles Babbage

Charles Babbage (1792-1871), British mathematician and inventor, who designed and built mechanical computing machines[1] on principles that anticipated the modern electronic computer. Babbage was born in Teignmouth, Devonshire, and was educated at the University of Cambridge. He became a fellow of the Royal Society in 1816 and was active in the founding of the Analytical, the Royal Astronomical, and the Statistical societies.

In the 1820s Babbage began developing his Difference Engine, a mechanical device that can perform simple mathematical calculations. Babbage started to build his Difference Engine, but was unable to complete it because of a lack of funding[2]. However, in 1991 British scientists, following Babbage's detailed drawings and specifications, constructed the Difference Engine. The machine works flawlessly, calculating up to a precision of 31 digits, proving that Babbage's design was sound. In the 1830s Babbage began developing his Analytical Engine, which was designed to carry out more complicated calculations[3], but this device was never built. Babbage's book *Economy of Machines and Manufactures* (1832) initiated the field of study known today as operational research.

"Charles Babbage," Microsoft® Encarta® Online Encyclopedia 2009

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 to 3 trillion bits of information per second. At that rate, downloading the entire contents of the Library of Congress, a feat requiring 82 years with a dial-up modem, would take just 48 seconds.

Reviewed By:
April Holladay, B.S. (CE), M.S. (Math)
"Fiber Optics," Microsoft® Encarta® Online Encyclopedia 2009

Answer the following questions:

1) What is fiber optics?
2) What does a basic fiber-optic system consist of?
3) What is total internal reflection? Explain its principle!
4) Where is fiber optics mostly used?
5) Who introduced cladding and with which purpose?
6) How was the impurity problem solved?
7) What will the development of new optical technologies expand?

Did you know...?

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

Samuel Morse

Samuel Finley Breese Morse (1791-1872), American artist and inventor, known for his part in the invention of the electric telegraph and the Morse code.

Samuel Finley Breese Morse was born in Charlestown, Massachusetts (now part of Boston), on April 27, 1791, and educated at Yale College (now Yale University). He studied painting in London and became a successful portrait painter and sculptor[1]. In 1825 he helped found the National Academy of Design in New York City, and the following year he became the first president of the institution. He continued his painting and became a professor of painting and sculpture at New York University in 1832. About that time he became interested in chemical and electrical experiments and developed apparatus for an electromagnetic telegraph[2] that he completed in 1836. The following year he filed a caveat, or legal notice, at the patent office in Washington, D.C., and tried without success to obtain European patents for his apparatus. He also invented a code, now known as the Morse code[3], for use with his telegraph instrument.

Several contemporary scientists gave Morse significant financial and technical help with his work on the telegraph and Morse code.

In 1843 the U.S. Congress appropriated $30,000 for Morse to construct an experimental telegraph line between Washington, D.C., and Baltimore, Maryland[4]. The line was successfully installed, and on May 24, 1844, Morse sent the first message: "What hath God wrought!" Morse was subsequently involved in much litigation over his claim to the invention of the telegraph, and the courts decided in his favor. He received many honors. Later he experimented with submarine cable telegraphy[5].

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

GRAMMAR REVIEW

I With the help of this diagram, sequence these steps in the operation of an Electronic Point of Sale (EPOS) till. Then write a description of its operation in the Present Passive.

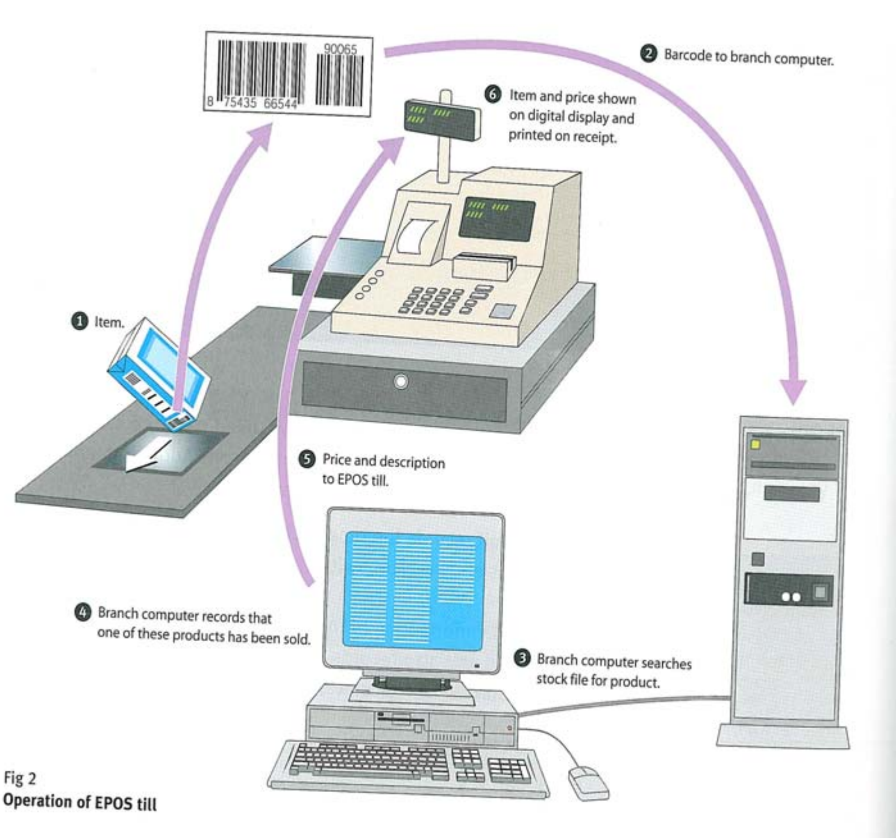


Fig 2
Operation of EPOS till

A The scanner converts the barcode into electrical pulses.

B The branch computer sends the price and description of the product to the EPOS till.

C The scanner reads the barcode.

D The branch computer records the sale of the product.

E The till shows the item and price.

F The checkout operator scans the item.

G The scanner sends the pulses to the branch computer.

H The till prints the item and price on the paper receipt.

I The branch computer searches the stock file for a product matching the barcode European Article Number (EAN).

MODAL AUXILIARIES

Requirements: *need to, have to, must*

I Fill in the blanks with the appropriate form of the verbs *need to, have to* or *must*. More than one answer is possible in some examples.

1) Technical qualifications __________ to be renewed at intervals to ensure they do not go out of date.
2) You __________ become an expert in too narrow a field.
3) You __________ to have good communications skills to become an IT manager.
4) You __________ be an expert in hardware to become a programmer.
5) You __________ have worked with IBM mainframes for at least two years.
6) You __________ be able to show leadership.
7) You __________ have a degree but it __________be in computing science.
8) You __________ to have experience in JavaScript.
9) You __________ be able to use C++.
10) These days you __________ study BASIC.

II Ability: *can, could, be able to*

Complete the blanks in this text using the correct form of *can* or *be able to*. In some cases there is more than one possible answer.

Imagine __________ open doors and switch on computers as you approach them. Professor Warwick __________ because he had an electronic chip fitted into his arm for a month. He __________ demonstrate to the press how computers would greet him with, 'Good morning, Professor Warwick' as he walked past. Next he wants to record the signals from his brain to his arm to see if he __________ program a computer to operate his arm. In the long term, this may help people who __________ use their limbs. His wife too will have a chip implanted. They hope __________ feed messages into each other's brains. According to the Professor, one day we __________ communicate directly with machines. If he is right, we __________ drive a car from the passenger seat and we __________ operate a computer without using a mouse or keyboard. However, there is also the alarming prospect that someone __________ hack into your brain.

III Fill in the blanks with the correct forms of these verbs: *need, have to, must, can, could, be able to*. Sometimes more than one answer is possible.

1) After the success of Windows 95, Microsoft __________ outsell any competitor.
2) Computer consultants __________ specialise in too narrow a field.
3) Programmers __________ to know a range of up-to-date languages.
4) To be a successful consultant, you __________ be better than the competition.
5) Before IBM set the standard for PCs, software houses __________ write different versions of their programs for every make of computer.
6) When he was a schoolboy, Bill Gates __________ write programs in BASIC.
7) Support engineers must __________ empathise with users.
8) The Altair 8800 was one of the first computers you __________ assemble at home.
9) Most website designers __________ use HTML and XML.
10) You __________ learn COBOL unless you want to work with business software.

ADJECTIVE COMPARISON

Fill in the blanks with the proper adjective in the proper form: *good(x3), little, much, great, thin, important, efficient, high, heavy, far(x2), early.*

1) Metals are __________ conductors of electricity.
2) Lead is __________ than aluminium.
3) Ohm's law is one of the ___________ laws in physics.
4) From the __________ times, people dreamed of air flights.
5) Materials having free electrons are __________ electric conductors.
6) The metals are the __________ conductors of heat.

7) The electrons ____________ from the nucleus are loosely bound to the atom.
8) The thicker wire you use, the ________ current will flow through it.
9) The _________ wire you use, the __________ current will flow through it.
10) The greater the energy of the revolving electron, the __________ from the nucleus it will revolve.
11) The __________ the voltage, the better should be the insulation.
12) The __________ the difference between the temperatures, the __________ the heat engine.

RELATIVE CLAUSES

I Change the following pair of sentences into single sentence using *which,* making the second sentence into a relative clause.

Model: ***The transformer is an electronic unit. It makes a major contribution to the usefulness of the a.c. power system.***

The transformer is an electronic unit* WHICH *makes a major contribution to the usefulness of the a.c. power system.

1. The first coil is called the primary. It is normally connected to the power source.
2. A.C. current flow causes a flux in the transformer core. It varies in magnitude sinusoidally with time.
3. The flux set up in an inductance produces a voltage. This voltage is equal to and opposes the impressed voltage.
4. The windings are provided with a closed magnetic path. The magnetic path is composed of laminated sheet steel.
5. Afterwards transformers have been assembled and placed in a waterproof tank. The tank is filled with oil to improve insulation and cooling.
6. The flux has to cross the insulation between the laminations at these places. It means that there is a vertical air gap absorbing ampre-turns over and above those required for the iron itself.
7. The load is another new term. It refers to a change in any variable.

8. If there is any difference between the measured variable and the set point, an error is generated. This error enters a controller. The controller in turn adjusts the final control element in order to return the controlled variable to the set point.
9. Each block in Fig.1 represents a functional relationship. The functional relationship exists between the input and output of a particular component.
10. The temperature measuring element senses the bath temperature T and transmits a signal Tm to the controller. The temperature measuring element may exhibit some dynamic lag.

II Replace the underlined relative clauses by the past participle.

Model: ***Gas welding utilizes the heat <u>which is produced</u> by the combustion of either acetylene or hydrogen in a steam of pure oxygen.***

Gas welding utilizes the heat produced by the combustion of either acetylene or hydrogen in a steam of pure oxygen.

1. An extra metal, <u>which is required</u> to fill the space between the parts, is supplied by welding rod of suitable material, <u>which is melted</u> in the gas flame.
2. In the electric-arc process, the heat is supplied by a continuous arc <u>which is drawn</u> between the electrons.
3. The atomic-hydrogen arc-welding process is a recent development <u>which is used</u> to prevent oxidation of the metal.
4. Arc-welding is accomplished by utilizing the heat <u>which has been generated</u> by an electric arc to fuse the metals together.

III Replace the underlined relative clauses by the present participle.

Model: ***Welding is used in industry in a variety of forms and on products <u>which cover</u> a considerable range of size.***

Welding is used in industry in a variety of forms and on products <u>covering</u> a ***considerable range of size.***

1. Metals <u>which have</u> similar composition may be united in one homogeneous piece by fusing together the edges in contact.
2. Spot welding is accomplished by clamping the lapped edges of the work between the electrodes <u>which</u> usually <u>have</u> a small tip area.
3. In atomic-hydrogen welding when dissociated hydrogen recombines to form molecular hydrogen a large amount of heat is generated in a small space, <u>which makes</u> an intense flame.
4. In spot welding the heavy current which is applied for a fraction of a second melts the metal at the interface of the lapped pieces of the work, <u>which results</u> in complete welding of the two pieces under the contact area of the electrodes.

IV There are many relative clauses with the preposition before WHICH in scientific English.

Change the following pairs of sentence into single sentences using PREPOSITION + WHICH making the second sentence a relative clause.

Model: ***The simple and inexpensive controller can be employed. The output of the controller can regulate the physical quantity to the process at only two specific values.***

The simple and inexpensive controller can be employed the output <u>OF WHICH</u> can regulate the physical quantity to the process at only two specific values.

1. There exist very complex control systems. In these systems many components are used.
2. There are some processes requiring a cascade control system. Two controllers and two measuring elements are used in it.
3. A typical response of a stable closed-loop system to an external disturbance is an oscillation. The amplitude of the oscillation is reduced with time.
4. A control system is judged by the rapidity. The transient response is completed with the rapidity.

V Replace the underlined *–ing* or *–ed* forms by corresponding relative clauses.

Model: ***General heating is provided by gilled tube electric heater, <u>mounted</u> in three 5kw batteries.***

General heating is provided by gilled tube electric heater, which is mounted in three 5kw batteries.

1. A 24 hour establishing period is provided before any temperatures are taken, and reading taken every half-hour over a 4 hour period.

2. Refrigeration sheets are made out of two parts, one giving interior and exterior dimensions of the insulated compartment under test.

1. The second sheet gives the actual equipment is tested at temperatures being well above outside ambient at varying humidities covering conditions likely to be found in most parts of the world.

3. Their test report test result, showing the overall heat leakage.

5. A simulation of solar temperature is obtained at the roofs of vehicles to be tested by six 3kw radiant heaters suspended from the ceiling, and fitted on rails and pulleys.

THE PASSIVE

The passive voice is common in scientific writing where the action described is felt to be more important than the actors.

Note that passive sentences always contain some form of the verb TO BE together with the PAST PARTICIPLE.

I Rewrite each of the following sentences in the passive:

Model

(A) We often enclose a large-scale reactor in a steel shell.

A large-scale reactor is often enclosed in a steel shell.

(B) Protective relays may close the trip circuit immediately or after a definite time interval.

The trip circuit may be closed immediately or after a definite time interval BY protective relays.

1. We may locate the various pieces of substation equipment in a substation building.
2. We may classify substations according to their functions.
3. We can find substations of the indoor and outdoor type, depending upon the degree of protection from the weather.
4. We must interconnect central stations electrically so that each one is a potential

source of emergency service to the other.

5. The spare capacity of the load curve need not determine the size of units.
6. We call this type of the relay circuit closing.
7. We should equip a modern steam power station with one or more turbine generator units which change heat energy into electrical energy.
8. Instead of a coal-burning furnace a nuclear power station has a nuclear furnace, i.e.- nuclear fission produces heat in a reactor.
9. We find in present day practice that the majority of the three-phase systems today operate with an earthed neutral earthing.
10. One achieves the earthed neutral earthing either directly or through an impedance.
11. We conduct induced static charges to earth without disturbance.
12. The disconnection of a generator which overspreads may cause dynamic overvoltages.
13. Overvoltages which we have already described rarely exceed three to five times the normal phase to neutral «peak» voltage of the system.
14. Atmospheric discharges such as static charges or lightning strokes produce external overvoltages.
15. A single number cannot represent the strength of a material.
16. One may subject any solid body to external forces.
17. We might define the modules of elasticity as the intensity of stress.
18. We can determine the proportional limit and yield point; we often use the latter terms and call them the elastic limit.
    A simple example will illustrate the method of resolution of stress (the agent).
19. We must pay the greatest attention to choosing materials used in machine design.
20. We cannot handle dynamic problems in such a simple manner.
21. You should do the experiment in such a way.

II Turn these sentences into the PASSIVE FORM, use the agent where necessary.

1. Where do we store important data?
2. The CPU performs the data processing functions.
3. A programmer often has to modify programs.
4. Computer technology has made household appliances smarter and feature richer.

5. We can use transistors for amplification and frequency conversion.
6. Smart devices will perform many ordinary chores in the future.
7. Will machines perform our ordinary chores in the future?
8. We use the decimal system for scientific purposes.
9. Can we control the electron flow in solid materials?
10. Stratumsoft are developing the first virtual assistant, or EVA.
11. If EVAs live up to the developer's claims, they could provide the illusion of personal service without the cost.
1. We can programme each EVA with information such as a product catalogue, answers to frequently asked questions or an online encyclopaedia.
13. If the EVA does not have an answer, it will interrogate the questioner, record the response, and add the answer to its database for further enquiries.
14. Solar cells convert solar energy into electricity.
15. The introduction of the new equipment has increased production.
16. They are constantly reducing the size of solid-state devices.
17. The scanner converts the barcode into electrical pulses.
18. The branch computer searches the stock file for a product matching the barcode.

LANGUAGE SKILLS

1. STRUCTURE OF A TECHNICAL PAPER

A technical paper should be clear and concise. A paper usually consists of the following components:

1. Title- concise and to the point; some publications limit the title to less than ten words.

2. Abstract- is a summary of the paper, including

a) a brief description of the problem

b) the solution

c) conclusions.

References are not cited in the abstract.

3. Keywords- should be selected such that a computerized search will be facilitated.

4. **Introduction**
    a) Contains the background of the problem, why it is important, and what others have done to solve the problem.
    b) All related existing work should be properly described and referenced.
    c) The proposed solution should be briefly described, with explanations of how it is different from, and superior to existing solutions.
    d) The last paragraph should be a summary of what will be described in each subsequent section of the paper.
5. **System model**
    a) The proposed model is described.
    b) Figures are used to help explain the model.
6. **Numerical results**
    a) Based on the model, numerical results will be generated.
    b) They are presented in the form of figures or tables.
    c) All results should be interpreted.
7. **Conclusions**
    a) This summarizes what has been done and concluded based on the results.
    b) A description of future research should also be included.
8. **References - a** list of books and papers referred to in the paper.
9. **Appendix**
    a) Those materials which are deemed inessential to the understanding of the paper, but included for the sake of completeness.
    b) Sometimes, detailed mathematical proofs are put in the appendix to make the paper more readable.
10. **Figures**
    a) May be placed immediately after they are referred to in the text, or placed at the end of the paper
    b) Each figure should be readable without relying on the accompanying description in the text.
    c) All symbols should be explained in the figure legend.
    d) Figures and legends should not be made too small.

2. WRITING ABSTRACTS

Summaries are common in all kinds of writing, usually appearing at the end of a chapter or article, highlighting the major point of the piece and outlining the significant detail. However, writers use many other forms of summary too. In business writing, for example, reports often *begin* with a summary, called an ***executive summary***, allowing the reader a chance to see if the report (or some section of the report) is relevant to him/her before reading much of it. In academic writing, essays, articles, and reviews often begin with a summary too, called an ***abstract.*** Abstracts are very common in academic writing, and they have a fairly standard form. In essence, abstracts inform the reader of six bits of information about the piece of writing being summarized:

1. **purpose**
   - What is the author's reason for writing?
   - What is the author's main idea?

   scope
   - What is the author's focus in this piece?
   - Where does the author concentrate his/her attention?

   method
   - What kinds of evidence does the author provide?
   - How does the author try to convince the reader of the validity of his/her main idea?

   results
   - What are the consequences of the problem or issue that the author is discussing?

   recommendations
   - What solutions does the author present to the reader to resolve the problem of issue in the piece?
   - Does the author recommend action or change in his/her piece?

   conclusions
   - Does the author describe a 'cause and effect' relationship or explain the origins of this issue or problem?
   - What conclusions does the author draw from his/her study of the issue or problem?

Abstracts are not long. If each point above, for example, got its own sentence, then the abstract would be six sentences long. Many writers find that they can combine several of the sentences of the abstract when the ideas are closely related. At the beginning of an essay, abstracts allow you to introduce your subject to your readers before you go into your analysis in detail. Abstracts are important because they give a first impression of the document that follows, letting readers decide whether to continue reading and showing them what to look for if they do. Though some abstracts only list the contents of the document, the most useful abstracts tell the reader more. An abstract should represent as much as possible of the quantitative and qualitative information in the document, and also reflect its reasoning. Typically, an **informative abstract answers these questions in about 100-250 words**:

a) Why did you do this study or project?
b) What did you do, and how?
c) What did you find?
d) What do your findings mean?

Here are some other points to keep in mind about abstracts:
a) An abstract will nearly always be read along with the title, so do not repeat or rephrase the title. It will likely be read without the rest of the document, however, so make it complete enough to stand on its own.
b) Your readers expect you to summarize your conclusions as well as your purpose, methods, and main findings. Emphasize the different points in proportion to the emphasis they receive in the body of the document.
c) Do not refer in the abstract to information that is not in the document.
d) Avoid using I or we, but choose active verbs instead of passive when possible (*the study tested* rather than *it was tested by the study*).
e) Avoid if possible avoid trade names, acronyms, abbreviations, or symbols. You would need to explain them, and that takes too much room.
f) Use key words from the document. (For published work, the abstract is "mined" for the words used to index the material--thus making it more likely someone will cite your article.)

Some useful guidelines for writing

a) Integers less than ten are spelled out. It is correct to write 'six cells' and not '6 cells'.
Integers larger than ten and fractional numbers are written in Arabic digits, i.e. 12, 5.6 etc.
b) The first time a symbol is used, for example ISDN, it should be explained what it stands for and subsequently the symbol is only used.
c) Abbreviated forms like 'don't' should not be used. They should be spelled out.

d) The words 'figure', 'table', 'theorem' may be used as proper or common nouns. Proper nouns must be capitalized. They are proper nouns when a number or some other attribute follows them. For example, we say

'Figure 1 illustrates....'

'In this figure, we illustrate....'

e) A sentence should not be started with 'also'. Words such as *'Besides', 'Moreover', 'In addition'* should be used instead.

f) Repeated usage should be avoided. It is better to write

'the storage required in the first case is greater than that in the second case.' than

'the storage required in the first case is greater than the storage required in the second case'.

g) English and American spelling is sometimes different. It is very important to be consistent throughout the text.

Questionnaire 2: Criteria for evaluating abstracts

Format

1. *Did the abstract provide a brief (max. 100-200 words) outline of what the presentation was about?*
2. *Was the submitted Word file professional in appearance?*

Grammar

1. *Were the words spelled correctly? Were informal words and phrases avoided?*
2. *Was the punctuation correct? Were clauses appropriately joined with commas and hyphens?*
3. *Were there grammatical mistakes present (wrong verbal tenses, omitted articles, wrong use of prepositions, relative pronouns, syntactically awkward structures)?*

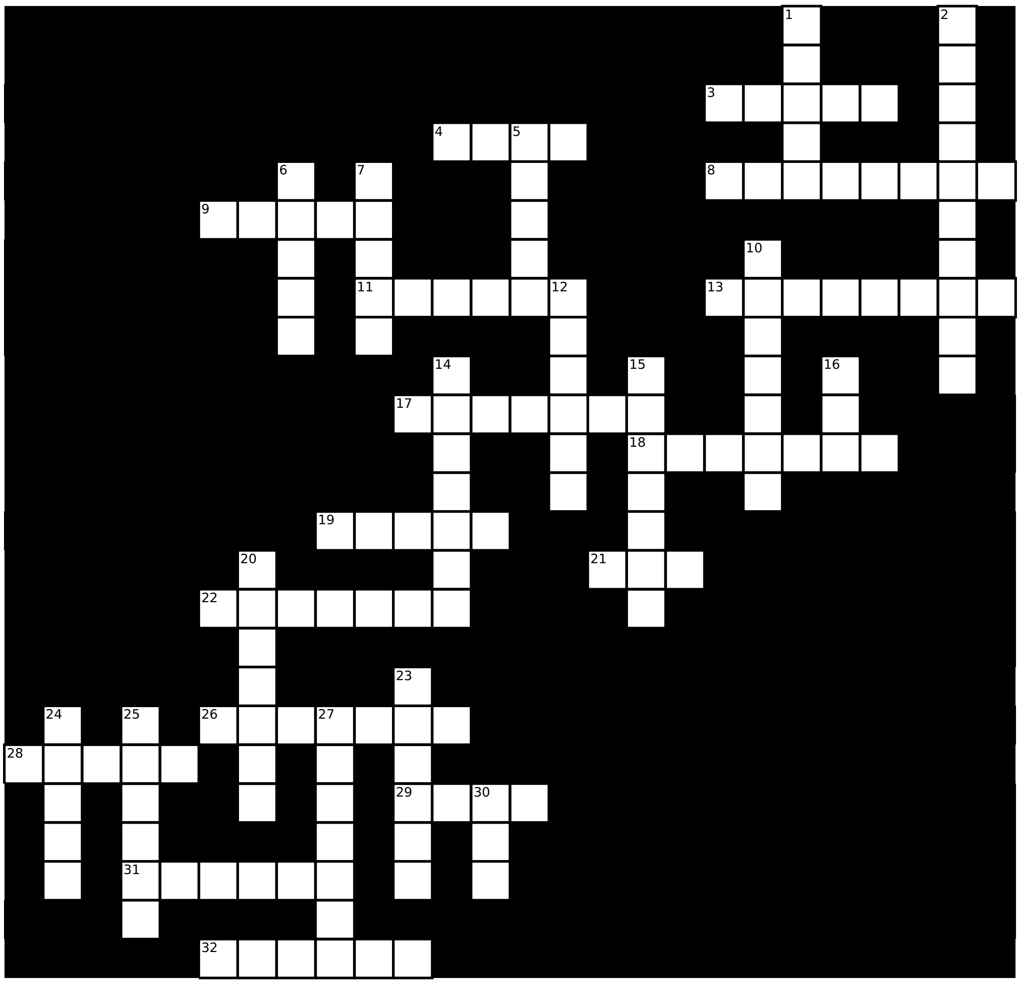
Content

1. *Did it follow the chronology of the presentation and the paper?*
2. *Did the abstract begin with a one-sentence summary of the main point of the presentation and did it introduce the problem being discussed?*
3. *Were all keynotes present in the abstract?*
4. *Were the ideas organized in a logical fashion?*

Science writing aspects

1. *Was the passive voice used?*
2. *Was the scientific vocabulary used and not the general vocabulary?*

Units
English



Across

3 unit of frequency equal to one cycle per second
4 unit of power equal to one joule per second
8 unit of x-radiation or gamma radiation
9 unit of work done by force of one newton over distance of one meter
11 unit of plane angular measurement, approximately 57.3 degrees
13 unit of the quantized magnetic moment of a particle
17 unit of measurement of power of lens or eye
18 unit of electrical charge of one ampere over period of one second
19 unit of magnetic flux equal to 100 million maxwells
21 unit of noise intensity equal to ten decibels
22 unit of brightness of light
26 unit of magnetic field strength
28 unit measuring electrical capacitance
29 unit of electrical potential difference and electromotive force
31 unit for measuring amount of electrical current
32 unit of strength of radio wave emission

Down

1 unit of radioactive decay and intensity
2 unit of radioactive decay equal to 1 million disintegrations per second
5 unit of magnetic flux density equal to one weber per square meter
6 unit of luminous flux
7 unit of electrical inductance
10 unit of luminous intensity
12 unit of force that accelerates 1 kilogram to 1 meter / second / second
14 unit of magnetomotive force
15 unit for measuring sound intensity
16 unit of electrical resistance of circuits
20 unit of magnetic flux
23 unit of temperature based on absolute zero, equal to 1 degree Celsius
24 unit of magnetic flux density equal to 1/10000 tesla
25 unit of pressure equal to one newton per square meter
27 unit of electrical conductance equivalent to one ampere per volt
30 unit of illumination equal to one lumen per square meter

PART FOUR

Energy

Fill the gaps with the following words: potential energy, battery, velocity, pendulum, projectile, physics, magnesium, matter, heat, work, light, kinetic energy, interconvertible.

Energy is capacity of ________[1] matter to perform _______[2] work as the result of its motion or its position in relation to forces acting on it. Energy associated with motion is known as ________[3] kinetic energy, and energy related to position is called _________[4] potential energy. Thus, a swinging ________[5] 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 ___________[6] 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, inasmuch as it can perform work in the process of falling. An electric ________[7] battery has potential energy in chemical form. A piece of _________[8] magnesium has potential energy stored in chemical form that is expended in the form of _________[9] heat and ________[10] light if the magnesium is ignited. If a gun is fired, the potential energy of the ________[11] gunpowder is transformed into the kinetic energy of the moving ________[12] 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 ________[13] velocity of light. At higher velocities close to that of light, as in nuclear reactions, energy and matter are interconvertible. In modern _________[14] physics the two concepts, the conservation of energy and of mass, are thus unified.

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

Geothermal Energy

Read the following paragraphs and provide the correct form of the verbs in parentheses:

I. INTRODUCTION

Geothermal Energy is energy _______[1] (contain) in intense heat that continually ______[2] (flow) outward from deep within Earth. This heat originates primarily in the core. Some heat

________[3] (generate) in the crust, the planet's outer layer, by the decay of radioactive elements that are in all rocks. The crust, which is about 5 to 75 km (about 3 to 47 mi) thick, _______ [4] (insulate) the surface from the hot interior, which at the core may reach temperatures from 4000° to 7000° C (7200° to 12,600° F). Where the heat is concentrated near the surface, it can be used as a source of energy.

II. GEOTHERMAL GEOLOGY

The distance from Earth's surface to its center is about 6,500 km (about 4,000 mi). From Earth's surface down through the crust, the normal temperature gradient (the increase of temperature with increase of depth) is 10° to 30° C per km (29° to 87°F per mi). ________[5] (underlie) the crust is the mantle, which ______[6] (make) of partially molten rock. Temperatures in the mantle may reach 3700° C (6700° F).

The convective (circulating) motion of this mantle rock drives plate tectonics—the 'drift' of Earth's crustal plates that _______ [7] (occur) at a rate of 1 to 5 cm (0.4 to 2 in) per year. Where plates spread apart, molten rock (magma) rises up into the rift (opening), _______ (solidify) to form new crust. Where plates collide, one plate is generally forced (subducted) beneath the other. As the subducted plate slides slowly downward into the mantle's ever-increasing heat, it melts, ________[9] (form) new magma. Plumes of this magma can rise and intrude into the crust, bringing vast quantities of heat relatively close to the surface. If the magma ______ [10] (reach) the surface it forms volcanoes, but most of the molten rock stays underground, creating huge subterranean regions of hot rock.

III. GEOTHERMAL RESERVOIRS

In certain areas, water ______[11] (seep) down through cracks and fissures in the crust comes in contact with this hot rock and ______ [12] (heat) is heated to high temperatures. Some of this heated water circulates back to the surface and ______[13] (appear) as hot springs and geysers. However, the rising hot water may remain underground in areas of permeable hot rock, forming geothermal reservoirs. Geothermal reservoirs, which may reach temperatures of more than 350° C (700° F), can provide a powerful source of energy.

IV. GEOTHERMAL POWER PLANTS

Fill the gaps with the most appropriate word: natural, produced, drilling, output, capacity, wells, largest, needs.

Geothermal reservoirs within about 5 km (about 3 mi) of Earth's surface can be reached by a ________ [1] well. The hot water or steam from ______[2] can be used to turn turbine generators to produce electricity. A power plant that uses this _______ [3] source of hot water or steam is called a geothermal power plant.

At the beginning of the 21st century, there were some 380 geothermal power plants in 22 countries around the world with a combined installed _______[4] of about 8,000 megawatts. Geothermal energy provided 1.6 percent of the world's total electricity, serving the electricity

_______[5] of about 60 million people, mostly in developing countries. About 2.5 percent of the electricity ________[6] in the United States came from geothermal power plants. The electricity produced from geothermal power in the United States represented about 37 percent of the world's ______[7] of electricity from geothermal power. The United States, the Philippines, Italy, Mexico, Indonesia, Japan, New Zealand, and Iceland are the _______ [8] producers of geothermal energy.

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Induction (electricity)

I. INTRODUCTION

Induction (electricity), in electricity, the creation of an electric current in a conductor moving across a magnetic field (hence the full name, electromagnetic induction). The effect was discovered by the British physicist Michael Faraday and led directly to the development of the rotary electric generator, which converts mechanical motion into electric energy.

II. ELECTRIC GENERATOR

When a conductor, such as a wire, moves through the gap between the poles of a magnet, the negatively charged electrons in the wire will experience a force along the length of the wire and will accumulate at one end of it, leaving positively charged atomic nuclei, partially stripped of electrons, at the other end. This creates a potential difference, or voltage, between the ends of the wire. If the ends of the wire are connected by a conductor, a current will flow around the circuit. This is the principle behind the rotary electric power generator, in which a loop of wire is spun through a magnetic field so as to produce a voltage and generate a current in a closed circuit.

III. ELECTRIC TRANSFORMER

Induction occurs only if the wire moves at right angles to the direction of the magnetic field. This motion is necessary for induction to occur, but it is a relative motion between the wire and the magnetic field. Thus, an expanding or collapsing magnetic field can induce a current in a stationary wire. Such a moving magnetic field can be created by a surge of current through a wire or electromagnet. As the current in the electromagnet rises and falls, its magnetic field grows and collapses (the lines of force move outward, then inward). The moving field can induce a current in a nearby stationary wire. Such induction without mechanical motion is the basis of the electric transformer.

A transformer usually consists of two adjacent coils of wire wound around a single core of magnetic material. It is used to couple two or more a-c circuits by employing the induction between the coils.

IV. SELF-INDUCTION

When the current in a conductor varies, the resulting changing magnetic field cuts across the conductor itself and induces a voltage in it. This self-induced voltage is opposite to the applied voltage and tends to limit or reverse the original current. Electric self-induction is thus analogous to mechanical inertia. An inductance coil, or choke, tends to smooth out a varying current, as a flywheel smoothes out the rotation of an engine. The amount of self-induction of a coil, its inductance, is measured by the electrical unit called the henry, named after the American physicist Joseph Henry, who discovered the effect. The inductance is independent of current or voltage; it is determined only by the geometry of the coil and the magnetic properties of its core.

"Induction (electricity)," Microsoft® Encarta® Online Encyclopedia 2009 http://encarta.msn.com

Match the expressions in the left-hand column to their definitions:

1. induction
2. rotary electric
   generator
3. voltage
4. inductance coil
5. inductance

a) choke
b) the amount of self-induction of a coil
c) the creation of an electric current in a conductor
   moving across a magnetic field
d) a potential difference
e) device converting mechanical motion into electric energy

INVENTIONS

Engine

Automobile engines get their power from burning fuel such as gasoline, diesel, or alcohol. The combustion, electrical, lubricating, and cooling systems need to work together to make the engine run smoothly and deliver power efficiently to the vehicle. The basic functions and interactions of these engine systems are shown in this series of slides. Many modern engines have a fuel injection system instead of a carburetor.

Engine, machine for converting energy into motion or mechanical work. The energy is usually supplied in the form of a chemical fuel, such as oil or gasoline, steam, or electricity, and the mechanical work is most commonly delivered in the form of rotary motion of a shaft.

Engines are usually classified according to the form of energy they utilize, such as steam, compressed air, diesel, and gasoline; the type of motion of their principal parts, such as reciprocating and rotary; the place where the exchange from chemical to heat energy takes place, such as internal combustion and external combustion; the method by which the engine is cooled, such as air-cooled or water-cooled; the position of the cylinders of the engine, such as V, in-line, and radial; the number of strokes of the piston for a complete cycle, such as two-stroke and four-stroke; the type of cycle, such as Otto (in ordinary gasoline engines) and diesel; and the use for which the engine is intended, such as automobile and airplane engines.

Engines are often called motors, although the term *motor* is sometimes restricted to engines that transform electrical energy into mechanical energy. Other specialized engines are the windmill, gas turbine, steam turbine, and rocket and jet engines.

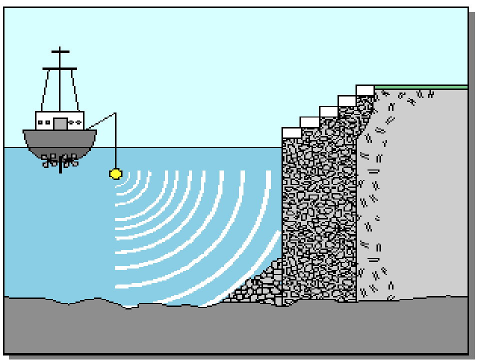
"Engine," Microsoft® Encarta® Online Encyclopedia 2009

Answer the following questions:

1. What is the engine?
2. What is the difference between the engine and the motor?
3. What fuels are used in order to supply energy to the engine?
4. What is the chemical energy of fuel transformed into in engines?
5. What criteria are used for the classification of engines?

Sonar

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



Sonar, acronym for *SO*und *N*avigation *A*nd *R*anging, a detection system based on the reflection of underwater sound waves[1], just as radar is based on the reflection of radio waves in the air. A typical sonar system emits ultrasonic pulses by using a submerged radiating device[2]; it listens with a sensitive microphone, or hydrophone, for reflected pulses from potential obstacles or submarines. The term was later applied by the U.S. Navy to all types of underwater sound devices[3], including those used for the detection of enemy vessels by the sound of their engines and for the measurement of water depths.

Modern submarines[4] rely on sonar for detecting the presence of enemy vessels. The most advanced system, called a towed array, uses a long cable to which hydrophones are attached. At sea, the submarine deploys this cable so that it trails far behind. Airplanes are used to deploy a different type of sonar[5]. This system uses a device called a sonobuoy, consisting of a hydrophone mounted in a floating buoy[6]. It is designed so that when a sound, such as that of a submarine engine, is picked up, the detector operates a small radio transmitter that sends out a signal that can be received by patrolling antisubmarine planes.

Spinoffs from the development of sonar technology include acoustic oceanography, the study of ocean properties using a variety of acoustic means[7], and acoustic tomography, an imaging or remote-sensing technique using computer analysis to study the data collected when acoustic signals are passed through an object. Acoustic tomography[8] is used in oceanic and medical research and in medical diagnosis.

Contributed by:
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"Sonar," Microsoft® Encarta® Online Encyclopedia 2009 http://encarta.msn.com

Servomechanism

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

Servomechanism, in engineering, is a device or combination of devices that automatically controls a mechanism or a source of power or energy. Servomechanisms automatically compare the controlled output of a mechanism to the controlling input[1]. The difference between the settings or positions of the output and the input is called the error signal, which regulates the output to a desired value[2]. Servomechanisms may be mechanical, electrical, hydraulic, or optical. The process of sending the error signal back for comparison with the input is called feedback[3], and the whole process of the input, output, error signal, and feedback is called a closed loop[4].

An example of a servomechanism is the automatic control system[5] by which a thermostat in a house controls the heat output of the heating furnace[6]. Other examples include automatic pilots used on ships, aircraft, and space vehicles[7], in which the direction of motion of the vehicle is controlled by a compass setting. Unmanned spacecraft are automatically turned to point their cameras, radio antennas, and solar panels in the desired directions by servomechanisms[8]. The input in that case is the sensing of the direction of the sun and stars, and the output is the control of small jets that turn and orient the spacecraft.

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

GRAMMAR REVIEW

DISCOURSE MARKERS

I Complete the following sentences using the words and phrases below:

because of (x2), caused, consequently, due to, owing to, result in, result of.

1) Bird strike can ______________ damage to aircraft.
2) Bird strikes were a potential problem for the train, ______________ /______________/______________ its speed.
3) During the test, the train was severely damaged as a ______________ the impact.
4) The damage occurred ______________ a problem relating to temperature.
5) The impact of the chicken ______________ it to enter the train.
6) The engineers thought the gun was so faulty, so ______________ they called their colleagues.

II Read the following engineering urban legends and complete the descriptions of causes and effects using the correct form of the words and phrases from the previous exercise. Sometimes more than one word or phrase is possible.

1 Apparently, the biggest challenge in space exploration was developing a pen for astronauts to use in orbit as ordinary ballpoint pens don't work in space, ________________/________________/_______________ the fact that there's no gravity. So ______________ this problem, there were teams of researchers working for years, trying to find a solution. Eventually, someone came up with the idea using a pencil.

2 When they designed the foundations of the library on the university campus, they forgot to allow for the weight of the books on the shelves, which ______________ the building to start sinking. So ______________, half of the floors have had to be left empty, without books, to keep the weight down.

3 Did you hear about the Olympic-sized swimming pool that was built? They got the length wrong, ______________, the tiles. They forgot to take into account the thickness, which ______________ the pool measuring a few millimetres too short. So ______________, it can't be used for swimming competitions.

III Complete the gaps in this summary of the text on operating systems using these linking words and phrases:

although, because, but, in addition, such as (x2), therefore.

The user is aware of the effects of different applications programs ________ operating systems are invisible to most users. They lie between applications programs, ________ wordprocessing, and the hardware. The supervisor program is the most important. It remains in memory, ________ it is referred to as resident. Others are called non-resident ________ they are loaded into memory only when needed. Operating systems manage the computer's resources, ________ the central processing unit. ________, they establish a user interface, and execute and provide services for applications software. ________input and output operations are invoked by applications programs, they are carried out by the operating systems.

VERBS

I *up*- and *–up* verbs

Complete the gaps with the appropriate form of the correct verb from this list:

back up	***keep up***	***update***
build up	***set up***	***upgrade***
catch up free up	***start up***	***upload***

1) To avoid losing data, you should ________ your files regularly.
2) You can ________ your PC by adding a new motherboard.
3) Delete some files to ________ space on your hard disk.
4) Data is ________ from regional PCs to the company's mainframe each night.
5) The operating system boots when you ________ your computer.
6) She's taking a course to ________ her knowledge of computing.
7) The computer checks the memory when it ________.
8) He ________ a website to advertise his travel company.

9) If you miss a class, you can study the hand-outs to ________.
10) You can ________ with developments by reading PC magazines.
11) The image in a digital camera is ________ from a red, green and blue image.

II Complete each blank with the appropriate phrasal verb in the correct form. Sometimes more than one answer is possible.

break into	***grow up***	***throw away***
get into	***phone up***	***log on***
find out	***hack into***	***hand over***
go about	***keep ahead***	***track down***
set about		

1) Hackers try to __________ passwords so they can penetrate a system.
2) Don't __________ your password to anyone who asks for it.
3) The police __________ Ralph __________by talking to his friends and acquaintances.
4) Some hackers __________ systems to get commercially valuable information.
5) When you __________ to a network, you have to provide an ID.
6) How do you __________ hacking into a system?
7) Hackers may __________, pretending to be from the company, and ask for your password.
8) Never __________ your credit card receipts where someone can find them.
9) Ralph was a hacker as a teenager but he's __________ now and become more responsible.
10) __________ a system is strictly illegal nowadays.
11) It's a constant race to __________ of the hackers.

III Replace the verb in italics with one of the following verbs of similar meaning:

check out	***set about***	***work out***
throw away	***note down***	***hand over***
shut down	***grow up***	***run up***
hack into		

1) Don't *discard* your credit card receipts; they could help fraudsters.

2) Trying to *penetrate* computer systems is against the law.
3) The typical hacker is s young person who has not *matured* yet.
4) The best way to *begin* hacking into a system is to try to get hold of a password.
5) If someone telephones you and asks for your password, don't *provide* it.
6) Hackers *closed* Hotmail for five hours.
7) Hackers *accumulated* a telephone bill of a million pounds for Scotland Yard.
8) The difficult thing was to *determine* how the website would look.
9) So you won't forget, *record* the ID number the support technician gives you.
10) *Examine* the manufacturer's websites before you phone for help.

IV Verb + object + infinitive

Verb + object + *to* – infinitive

Complete the gaps with the correct form of the verb in brackets. For example:

A graphical users interface lets you *use* a computer without knowing any operating system commands.

A graphical users interface *allows you to use* a computer without knowing any operating system commands.

1) The Help facility enables users __________ (get) advice on most problems.
2) Adding more memory lets your computer __________ (work) faster.
3) Windows allows you _________ (display) two different folders at the same time.
4) The Shift key allows you __________ (type) in upper case.
5) The Mousekeys feature enables you __________ (use) the numeric keypad to move the mouse pointer.
6) ALT + TAB allows you __________ (switch) between programs.
7) The StickyKeys feature helps disabled people __________ (operate) two keys simultaneously.
8) ALT + PRINT SCREEN lets you __________(copy) an image on an active window to the Clipboard.

V Put the verbs in brackets in the correct form in this description of how the smart cards work.

Smart cards prevent unauthorised users __________ (access) systems and permit authorised users __________ (have) access to a wide range of facilities. Some computers have smart card readers __________ (allow) you buy things on the Web easily and safely with digital cash. A smart card can also send data to a reader via an antenna __________ (coil) inside the card. When the card comes within range, the reader's radio signal __________ (create) a slight current in the antenna___________ (cause) the card __________ (broadcast) information to the reader which __________ (allow) the user, for example, __________ (withdraw) money from an ATM or __________ (get) access to a system.

GERUND

I Rewrite each of the following sentences like this:

An important function of the operating system is to manage the computer's resources.

Managing the computer's resources is an important function of the operating system.

1) One task of the supervisor program is to load into memory non-resident programs as required.
2) The role of the operating system is to communicate directly with the hardware.
3) One of the key functions of the operating system is to establish a user interface.
4) An additional role is to provide services for applications software.
5) Part of the work of mainframe operating systems is to support multiple programs and users.
6) The task in most cases is to facilitate interaction between a single user and a PC.
7) One of the most important functions of the computer is to process large amounts of data quickly.
8) The main reason for installing more memory is to allow the computer to process the data faster.

II infinitive or *–ing* form

Complete the following sentences with the correct form of the verb.

1) Don't switch off without (close down) your PC.
2) I want to (upgrade) my computer.
3) He can't get used to (log on) with a password.
4) You can find information on the Internet by (use) a search engine.
5) He objected to (pay) expensive telephone calls for Internet access.
6) He tried to (hack into) the system without (know) the password.
7) You needn't learn how to (program) in HTML before (design) webpages.

8) I look forward to (input) data by voice instead of a (use) a keyboard.

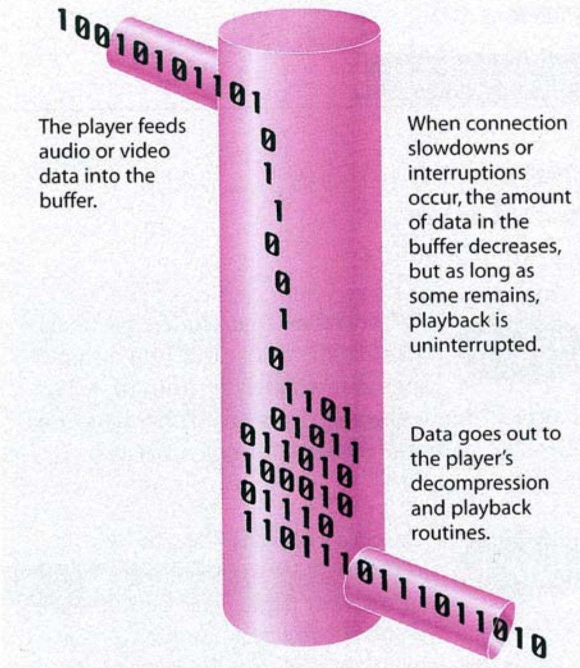
TIME CLAUSES

Time clauses are used to show how actions are linked in time. The most common time links between two sentences are *when, until, before, as, once, after.* Comma is used after the time clause when it comes first in a sentence.

I Link each pair of sentences using a time clause.

1) a You use a search engine.
   b It provides a set of links related to your search.
2) a With POP3, email is stored on the server.
   b You check your email account.
3) a You have clicked on a hyperlink.
   b You have to wait for the webpage to be copied to your computer.
4) a You listen to the first part of a streamed audio file.
   b The next part is downloading.
5) a The graphics can be displayed gradually.
   b The webpage is downloaded.
6) a You receive an email message.
   b You can forward it to another address.
7) a You click on a hyperlink.
   b The browser checks to see if the linked webpage is stored in the cache.
8) a You can bookmark a webpage to make it easier to find in the future.
   b You find a webpage you like.
9) a You type in a Web address.
   b You should press the Enter key.
10) a You click on the Home button.
   b The browser displays your starting webpage.

II Fill in the gaps in this description of buffering, a way of ensuring that Web video runs smoothly.



Streaming is a way of dealing with bandwidth problems ....[1] you download video from the Internet. One key to successful streaming is the process of buffering. ....[2] you download a movie, the video player stores part of the movie in memory ....[3] playing it. Imagine the buffer as a container filled from the top as shown in Fig 3. ....[4] the container is full, the player sends data on for playback from the bottom. Data keeps coming in ....[5] a clip plays. The user can view the beginning of the movie ....[6] the rest of the clip downloads. ....[7] connection slowdowns or interruptions occur, the amount of data in the buffer decreases but as long as some remains, playback is uninterrupted. Playback continues at a steady rate ....[8] the buffer is empty.

LINKING WORDS: REASON AND RESULT

I Rewrite each sentence so that it has a similar meaning and contains the word in bold.

1) He had an accident and couldn't attend the conference on IT in Vienna.

   so

2) We didn't use that piece of string, because it was to short.

   enough

3) The question was so difficult that I had to ask for help.

   such

4) Plastics are used widely in engineering. They are cheap.

   because

5) We need to complete the experiment. Another week will be needed.

   In order to

6) The tests cannot be done. The test chamber has not been available for days.

   since

7) They haven't got enough time to do all the work.

   too

8) We couldn't do anything. They hadn't brought necessary equipment.
as

LANGUAGE SKILLS

1. WRITING A CV

A CV should be concise, accurate, and informative. It should be updated on a regular basis, at least annually or more frequently if you have education, training, accomplishments, or publications to add.

A consistent style and format with both headings and sub-headings should be used. When describing accomplishments, using the past tense of active verbs is quite powerful, for example, "invented," "formulated," "collaborated," "interacted," or "synthesized."

Preparation

These four areas are very important:

2. experience
3. interests
4. skills
5. personal qualities

1. Experience should include:

1. education
2. any professional training
3. periods of employment – include part-time jobs and those which didn't last very long, as well as 'proper' jobs
4. other extended periods in which your life focused on a particular activity (for example, periods of foreign travel)
5. any voluntary work you have done

2. Interests: They are one of the ways in which personality can be defined; and your personality is very relevant indeed to a job application.

3. Skills: Your notes on your experience should provide you with useful prompts when it comes to listing your skills. Make sure that you include not only skills related to your trade or profession, but also personal skills, for example:

organizing events
interviewing
chairing meetings
supervising
meeting the public
training staff
giving advice
making presentations

4. Personal qualities: It is sometimes difficult to begin such a list, so here are some qualities to start you off.

accurate
adaptable
astute
can work under pressure
careful
committed
competent
cooperative
courteous
decisive
dedicated
energetic
extrovert
flexible
friendly
get on well with other people
good communicator
good sense of humour
good time-keeper
hardworking
imaginative
independent worker
lively
logical
loyal
methodical
meticulous
orderly
organized
positive
practical
receptive
relaxed
reliable
self-confident
self-motivated
sensitive
thorough
thoughtful
vigilant
works well with others

Write down any which you think apply to you, and then add others of your own. For each one you choose, make sure that you can think of incidents in your own life and work experience that bear them out

Turning your notes into a CV

The next stage is to decide how you want to order your CV. This can be done in one of two ways:

- chronologically
- functionally

A **chronological** CV presents your education and work experience either in the order in which they happened, or in reverse order, with your most recent experience first. Since recent experience is probably of most interest to an employer, this latter method is now widely used. The advantages of a chronological CV are that it emphasizes the companies or organizations you have worked for (and the periods of time involved) and your continuity of employment. The disadvantage is that if your career has had ups and downs, especially if it includes periods of unemployment, these show up very clearly. The employer who is looking for a steady and reliable employee will probably favour this approach.

A **functional** CV is organized by skills and qualities. If, for example, your experience is in motor-parts sales, both as a representative and in head office, the functions you could use as headings might be:

a) presenting the product range
b) customer care
c) information technology

Under each one you can provide further details of specific experience. The advantage of this approach is that you can focus on you strengths without having to spell out relative inexperience or periods of unemployment. The disadvantage is that it may not make clear important periods of employment with impressive employers. The employer who is looking for applicants with particular skills and capabilities will find the functional CV more helpful than the chronological.

Electrical Engineer Sample Resume

Example 1:

Ann Node
00 Sapphire Street
Motherlode Nebraska00000
000-000-0000
000-000-0000
ann@example.com

Summary of Qualifications:

Chartered Engineer 2007
BSc Electrical Engineer 2005

Experience:

16 July 2008 to present, Assistant Electrical Engineer Selective Electrics Motherlode. This position includes multiple roles.

Responsibilities

Systems maintenance (contracts) Testing and repair of industrial electrical systems for clients, including turbines, pumps, cranes, and assembly lines. Power supply maintenance and installation for industrial assembly lines.

Planning (Construction) Responsible for drawing up installation plans for commercial property power supplies using CAD systems. Supervision of staff engaged in installations. Preparation of reports at planning and installation stages.

2 January 2006 to 30 June 2008 Junior electrical tradesperson, HiVolt Electrical Contractors. Installation of residential electrical systems for construction projects. Installation of hot water systems. Maintenance of project electrical systems. (The work was graded from trainee level to trade standard in the course of this employment.)

References:

Available upon request.

Exercise: Write your own CV. These key words and phrases might help you.

Key Word & Phrase

...amounting to a total savings of...	Handled...
...on an ongoing/regular basis...	Honored as...
...to ensure maximum/optimum...	Implemented...
Accomplished...	Improved...
Acted as liaison for/between...	In charge of...
Acted/Functioned as...	Initially employed...
Adept at...	Initiated...
Administered...	Innovation resulted in...
Advised...	Installed...

Analyzed/Assessed...	Instructed...
Arranged...	Instrumental in...
Assigned territory consisting of...	Interaction with...
Assigned to...	Investigated...
Assisted with...	Knowledge of/experienced as...
Budgeted...	Maintained...
Conducted...	Managed...
Consulted...	More than [ ] years experience...
Contracted/Subcontracted...	Negotiated...
Coordinated...	Organized...
Counseled...	Performed...
Delegated...	Planned...
Delivered...	Presented...
Demonstrated...	Proficient/competent at...
Developed...	Promoted to/from...
Direct/Indirect control...	Proven track record in...
Directed...	Provided technical assistance...
Drafted...	Recipient of...
Edited...	Recommendations accepted...
Engineered…	Recommended...
Established...	Remained as...
Evaluated...	Reported directly to...
Experience involved/included...	Resulted in...
Experienced in all facets/phases...	Sales quota accountability...
Expertise skills...	Served/Operated as...
Extensive training/involvement...	Specialize in...
Familiar with...	Successful in/at...
Formulated...	Temporarily assigned to...
Gathered...	Worked closely with...

2. HOW TO WRITE A JOB APPLICATION

1. Introductory paragraph

a) State your **purpose/reason** for writing:

"I should like to apply . . ."

b) State the **post/position** for which you want to apply:

" . . .for the position of Research Technician . . ."

c) Cite the **source** and the **date/issue** from which you learned about the job:

"which was advertised recently in the October 10th issue of the New Scientist . .."

2. Body of the letter

a) Introduce yourself with any relevant **<u>personal data</u>** (e.g. age, marital status, nationality):
"I am 23 years old, single and am willing to relocate abroad."

b) Briefly include your **<u>current job, length of employment and any duties and responsibilities</u>** which might be relevant to the job:
"I am presently employed as a . . . and have held this position for the last three years."

c) Point out your highest **<u>academic qualification</u>**
"As you will note from my CV, I hold a master's degree in . . . from the University of Turku, where I specialised in . . ."

d) Mention any earlier **<u>experience</u>** (e.g traineeships) or special **<u>skills</u>** which could be valuble to the employer:
”I have also had experience in…while working as a trainee in a work study programme at…”
". . . and am familiar with . . . /have much experience in using . . ."

e) Emphasise the **<u>benefits</u>** to the employer of hiring you, and mention any reasons why the job would be beneficial to you (this shows that your motivation is not purely financial!):
"*I believe that my knowledge of . . . would be of great value/benefit to this position . . ."*
"I feel that this position would give me the opportunity to further develop my skills in the field of . . ."

<u>3. Closing paragraph</u>

a) Mention the **<u>documents</u>** (e.g. CV) which accompany your covering letter:
"Please find enclosed my curriculum vitae . . ."

b) Mention your willingness or ability to come for an **<u>interview</u>** or to give more **<u>information</u>**:
"I should be pleased to attend an interview at any time which is convenient to you. I can be contacted at the telephone number given at any time /during office hours / after 5 p.m."
"I would be most happy to provide any further details you may require."

c) If the advertisement specifies that **<u>further information</u>** concerning conditions of employment, job description, or salary can be obtained by writing:
"*I should be grateful for further details concerning . . ."*

d) Finally, indicate your interest in getting a **<u>reply</u>** even if it isn't what you'd hoped for:
"I look forward to hearing from you (soon)."

The standard opening for formal correspondence is Dear.

• Dear Sir

• Dear Madam

• Dear Sir or Madam
• Dear Sirs
• Dear Mr.
• Dear Mrs.
• Dear Ms.

Useful phrases:

• Thank you for your letter of [date] concerning
• Thank you for sending me a [catalogue, quotation]
• Thank you for your enquiry of [date]
• I refer to your letter of [date] concerning
• I am writing to confirm our telephone conversation of [date]
• I would be grateful if you could forward me a [price list, catalogue]
• I am contacting you regarding
• I am writing to complain
• I apologise for the delay in replying
• As stated in your letter/fax of [date]
• I wish to draw your attention to the
• I wish to inform you that
• I am writing to inform you that
• I am writing to express my dissatisfaction with
• Please note that
• Please find enclosed

Closures:
• I look forward to hearing from you
• I look forward to hearing your response
• I would be most grateful if you would look into this matter as soon as possible
• Please let me know as soon as possible what action you propose to take
• I trust that you will give this matter your urgent attention
• I hope you can settle this matter to my satisfaction
• Please do not hesitate to contact me should you require further information
• Please contact me if you require further details

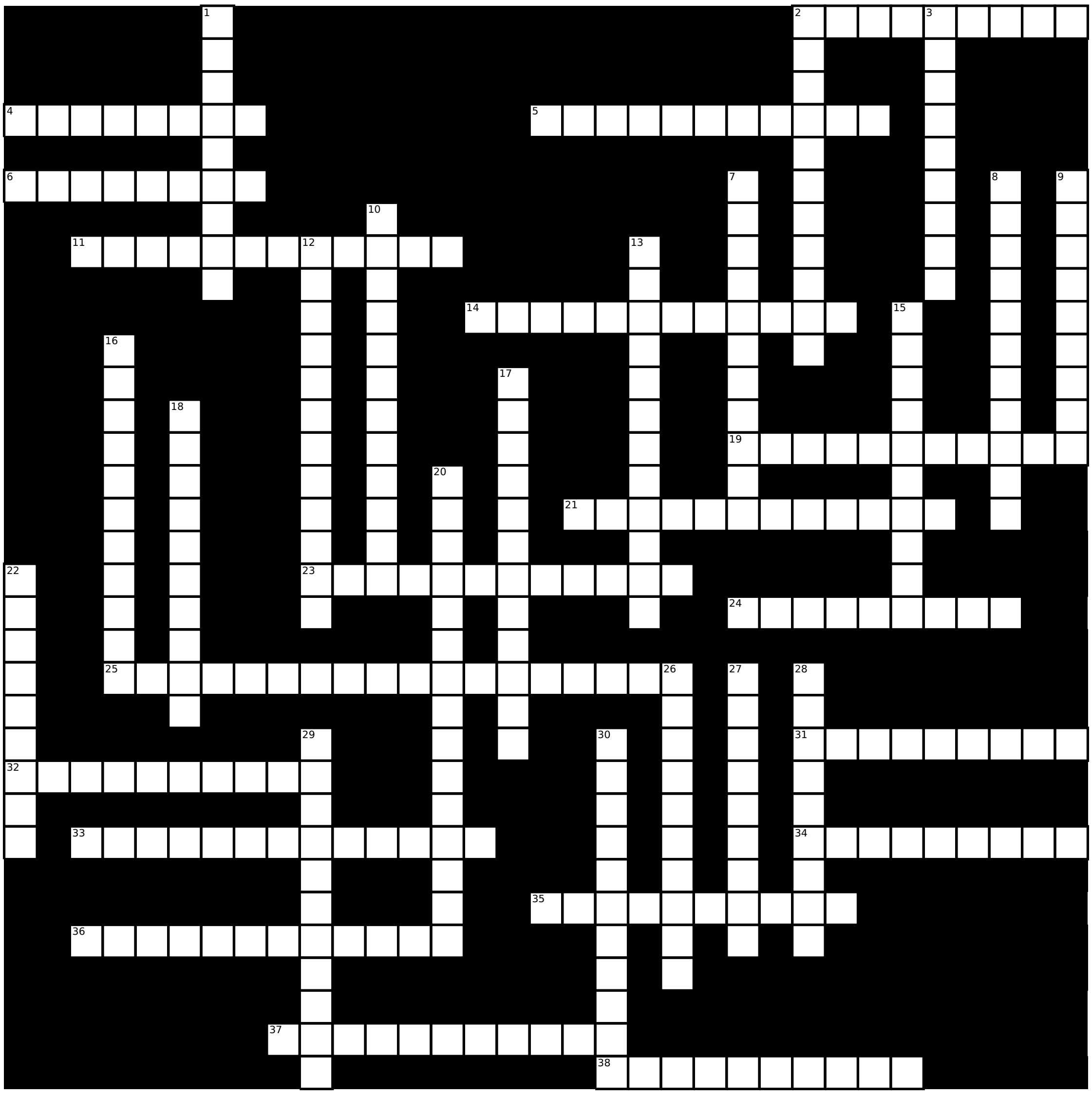
If you know the person's name, use:

• Yours sincerely

If you don't know the person's name, use:

• Yours faithfully

Instruments
English



Across

2 instrument for measuring dose of radiation
4 instrument for measuring illumination
5 instrument for recording earthquakes
6 instrument for measuring electrical resistance
11 instrument for recording measurements of magnetic fields
14 instrument for recording alternating current wave forms
19 instrument for measuring temperature
21 instrument measuring wavelengths of light of a spectrum
23 instrument for measuring electrical potential
24 instrument measuring change in wave formations of electricity
25 instrument for measuring electrical current
31 instrument for measuring light intensity
32 instrument for recording speed of rotation
33 instrument for measuring electromotive forces
34 instrument for measuring work performed
35 instrument for measuring sound levels
36 instrument for measuring electric charge
37 instrument for detecting earthquakes
38 instrument for viewing objects using X-rays

Down

1 instrument for measuring wavelengths
2 instrument for recording mechanical forces
3 instrument for measuring pressure of a liquid or gas
7 instrument for measuring absorbed or evolved heat
8 instrument for measuring velocity
9 instrument for measuring electrical potential
10 instrument for detecting presence and direction of electric current
12 instrument for measuring electrical current
13 instrument for recording very small electrical currents
15 instrument for measuring electrical conductivity
16 instrument for detecting sounds produced by the body
17 instrument for detecting electrical charges in the body
18 instrument for measuring light intensity
20 instrument for measuring the speed of light
22 instrument for measuring electrical power
26 instrument for detecting radar signals
27 instrument for measuring air pressure
28 instrument for measuring radiant energy or infrared light
29 instrument for measuring time
30 instrument for measuring velocity

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