МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
ЖИТОМИРСЬКИЙ ДЕРЖАВНИЙ УНІВЕРСИТЕТ ІМЕНІ ІВАНА ФРАНКА

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Physics

Практикум з англійської мови для студентів фізико-математичного факультету спеціальностей: «Фізика та інформатика», «Фізика та математика», «Математика та інформатика», «Інформатика»

Житомир 2012

УДК 53:811.11(07)
ББК 22.3:81.432.1
К 78

Рекомендовано до друку рішенням вченої ради
Житомирського державного університету імені Івана Франка
(протокол № 3 від 22 жовтня 2010 р.)
Гриф МОН від 10 червня 2011р.

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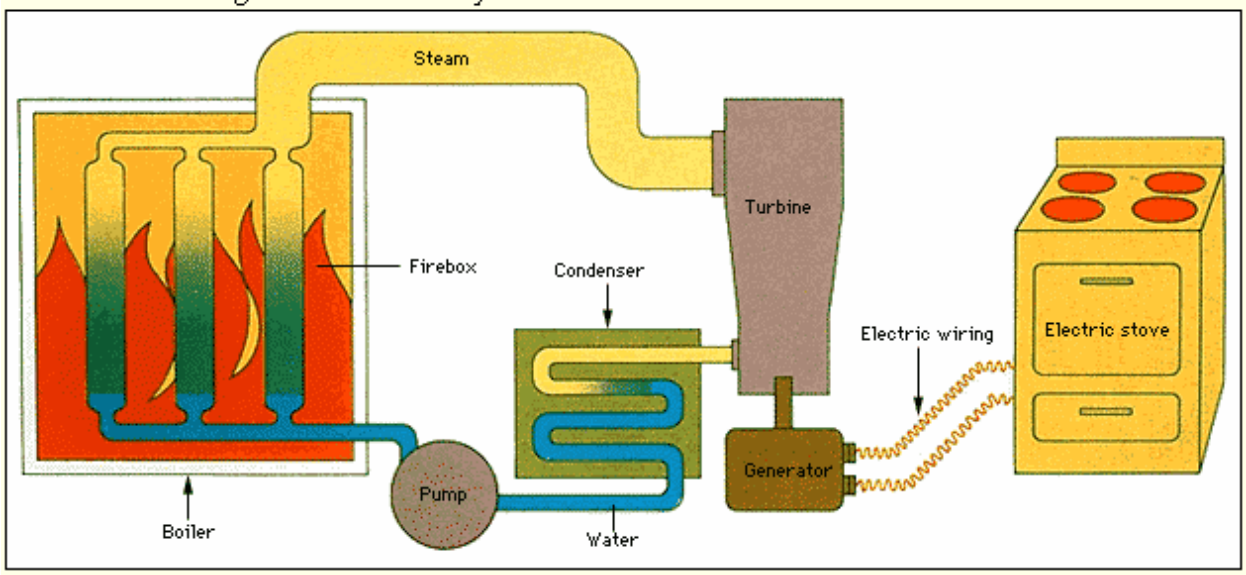
Фізика: практикум з англійської мови для студентів фізико-математичного факультету спеціальностей: «Фізика та інформатика», «Фізика та математика», «Математика та інформатика», «Інформатика»: Навчальний посібник – Житомир: Вид-во ЖДУ ім. І. Франка, 2012. – 84 с.

Практикум складається з 6 розділів, текстів для додаткового читання та додатків. Тексти підібрані з оригінальної науково-технічної літератури та містять необхідну термінологію зі спеціальності. Кожен розділ включає текст, лексичний мінімум, систему прав комунікативного та лексико-граматичного характеру. Вправи та тести побудовано на мовному матеріалі, який використовується в текстах розділів. Додається підсумковий тест для перевірки знань всього курсу.

Зміст

How heat is changed into electricity



Introduction

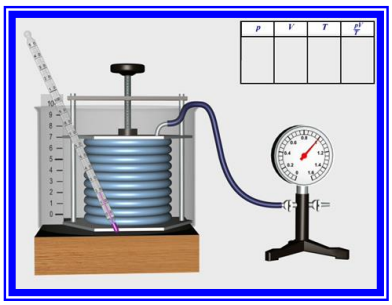
Вступ

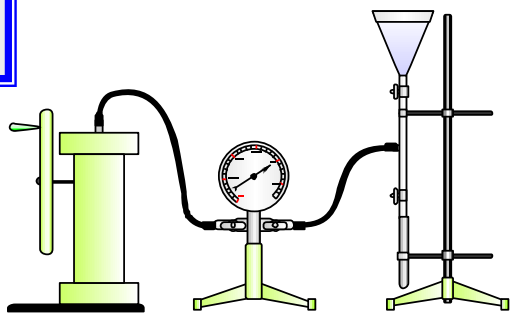
Сучасне суспільство висуває нові вимоги до професійної підготовки фахівця. Автори посібника намагались надати підібраному матеріалу не тільки інформативну, але й професійну спрямованість. Посібник-практикум складений відповідно до вимог Програми з англійської мови для університетів (5-річний курс навчання): Проект.(Київ,2001р.) та рекомендацій Ради Європи щодо вивчення іноземних мов.

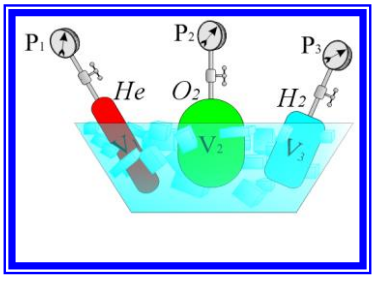
Основна мета посібника - послідовно провести студентів по розділам спеціальної лексики та граматики, на сучасних, професійно-спрямованих текстах ввести інформацію з вивчення фізики та сформувати навички роботи з літературою по спеціальності під час перекладу на українську мову.

Практикум складається з шести розділів та текстів для додаткового читання. Тексти підібрані з оригінальної науково-технічної літератури та містять необхідну термінологію за спеціальністю. Кожний розділ включає набір лексико-граматичних та комунікативних вправ. Вправи та тести побудовано на мовному матеріалі, який використовується в текстах розділів. Підсумковий тест може бути використаний як для самоконтролю, так і для контрольної роботи.

Практикум призначений для студентів неспеціальних факультетів денної, заочної та дистанційної форми навчання, які вивчають фізику, а також для всіх тих, хто бажає поглибити свої знання з англійської мови.







Unit 1

Task 1. Think over such questions:

1. Do you consider physics to be a difficult science? Give your reasons.
2. What fields of physics do you know? Which one do you suggest being the most complicated? Give your motives.

Task 2. Look at the pictures and identify the objects, then say how this equipment can be used in studying physics. Use expressions like: *so that, as you see, as I understand*…etc.

1

2

3

4

5

6

Task 3. Read the phonetic transcription. Practise your pronunciation:

['fɪzɪks] ['fɪzɪsɪst] ['fɪzɪkəl] ['nætʃrəl] ['saɪəns] ['mætə] ['enədʒɪ] [mɪ'kænɪks] [mɪ'kænɪkəl] [ək,selə'reɪʃən] [ɪlek'trɔnɪks] [ɪlek'trɪsɪtɪ] [dɪ'zaɪn] [tʃɑ:dʒ] [flu:ɪd] ['sɪstɪm] [spi:d] [ə'ku:stɪks] [hi:t] ['stætɪk] [daɪ'næmɪk] ['ɵə:məudaɪ'næmɪks] [flu:ɪd] ['fju:ʒən] ['fɪʃən] ['plæzmə] ['prəutɔn] ['pa:tɪkl] [ɪ'lektrɔn] ['nju:trɔn] [rɪ'zɪstəns] ['nju:klɪaɪ] ['nju:klɪəs] [tek'nɔlədʒɪ] ['sɪmbəl] ['ʌltrəsɔnɪk]

Task 4. Practise saying the following words. Pay attention to the pronunciation:
physics, physicists, natural things, mechanics, electromagnetic, acceleration, proton, neutron, electron, subatomic particle, nucleus, nuclei, plasmas, acoustics, fluid mechanics, electrical resistance, superconductors, fusion energy, fission, positively and negatively charged particles, astronomy, biology, chemistry, geology, technology, ultrasonics, thermodynamics.

Task 5. Read the following international words and guess their meaning:
department, manner, university, physics, mechanics, laboratory, minute, examination, period, basic, combination, special, group, system, result, electronic, electric, position, symbol, actually, natural, unique, general, element, discussion, summarize.

Task 6. Read the text and try to understand its central idea without consulting the dictionary.

Physics

Physics is the science devoted to the study of matter and energy. The word physics comes from a Greek word meaning natural things. Knowledge obtained from the study of physics is important in other sciences, including astronomy, biology, chemistry, and geology. There is also a close connection between physics and practical developments in engineering, medicine, and technology.

What physicists study

Physicists try to answer basic questions about the world, how it is put together, and how it changes. The subjects studied by physicists consist of two broad categories, classical physics and modern physics. These two categories differ primarily in emphasis. Classical physics deals with questions regarding motion and energy. It is composed of five basic areas: (1) mechanics, (2) heat, (3) sound, (4) electricity and magnetism, and (5) light. Modern physics concentrates on scientific beliefs about the basic structure of the material world. Its major fields include (1) atomic, molecular, and electron physics; (2) nuclear physics; (3) particle physics; (4) solid-state physics; and (5) fluid and plasma physics.

Mechanics is the study of the effects of forces on bodies at rest or in motion. For example, it describes how force acts upon an object to produce acceleration. The mechanics of bodies that undergo a change in motion because of forces acting upon them is called dynamics. The mechanics of bodies at rest or in motion at a constant speed and in a constant direction is called statics. One branch of mechanics, known as fluid mechanics, deals with the behavior of liquids and gases. Principles of mechanics are used in describing such types of motion as planetary orbits and the paths of other moving objects

Heat. The study of heat is called thermodynamics. It involves investigating how heat is produced, how it is transmitted from one place to another, how it changes matter, and how it is stored. Heat energy can be transformed into other kinds of energy, and other kinds of energy can be transformed into heat energy. For example, when coal is burned, the chemical energy that binds its molecules is partially transformed into heat. Thermodynamics also includes cryogenics, the study of material at very low temperatures. Principles of thermodynamics are essential for understanding all types of heat engines, as well as refrigerators and freezers.

Sound. The study of sound is called acoustics. Sound consists of vibrations that are produced by an object and which travel through a medium, such as air, water, or the walls of a building. The study of sound also includes ultrasonics, which deals with vibrations that have frequencies too high for human beings to hear.

Electricity and magnetism are so closely related that scientists often refer to the two of them together as electromagnetism. The motion of electric charges can produce magnetic effects, and magnetic forces can produce electrical effects. Knowledge of this relationship has led to the development of huge electric generators and such electronic devices as radios, televisions, and computers.

Light. The study of light is called optics. Optics has two major branches, physical optics and geometrical optics. In physical optics, physicists study the nature of light and the physical processes by which it is emitted (given off) from bodies and transmitted from place to place. Geometrical optics is the study of how light travels, and how the direction of travel is affected by different materials. It is important in understanding the lenses and mirrors which are used in telescopes, microscopes, and eyeglasses.

Atomic, molecular, and electron physics are concerned with understanding the structures of molecules and atoms. In particular, they concentrate on the behavior, arrangement, motion, and energy states of the electrons that orbit atomic nuclei. Studies in atomic, molecular, and electron physics have revealed much about the structure of matter. For example, scientists have determined that substances differ from one another in the arrangement of the atoms of their molecules. Because of this difference, the way that each substance absorbs and emits electromagnetic energy is unique. As a result, scientists are able to identify a substance on the basis of its electromagnetic activity alone. This method of identification has important applications in medicine and in certain industrial situations where minute amounts of a material are involved.

Nuclear physics involves the study of the structure and properties of the atomic nucleus. It focuses on radioactivity, fission, and fusion. Radioactivity is the process by which certain nuclei spontaneously give off high-energy particles or rays. Radioactive materials are used to treat cancer and diagnose illnesses, and to trace chemical and physical processes. Fission is the

process in which an atomic nucleus splits into two nearly equal parts, releasing a huge amount of energy. It provides the energy for atomic bombs and nuclear reactors. Fusion is the process in which the nuclei of two atoms join together to form the nucleus of a heavier element. It occurs primarily with hydrogen and other light elements. Fusion, which releases even more energy than does fission, produces the energy of the hydrogen bomb.

Particle physics. Physicists have discovered that the protons and neutrons within atomic nuclei are formed of still more elementary particles. Particle physicists conduct research by using devices called particle accelerators. These devices can raise subatomic particles to very high speeds. When these particles have reached speeds very close to the speed of light, they are allowed to collide with ordinary matter. Physicists then study the fragments that result from the collisions and measure their energy. In this way, they hope to understand how elementary particles are joined together to make protons, neutrons, and other subatomic particles.

Solid-state physics, also called condensed-matter physics. Solids may be classified according to how the electrons and nuclei of the different atoms that make them up interact with each other. Physicists who study solids are interested in how the properties of these materials are affected by such factors as temperature and pressure. For example, at extremely low temperatures, some solids lose all electrical resistance, thereby becoming superconductors. Research on the electronic structure of solids is especially important in understanding the behavior of semiconductors, which serve as the basis of modern electronic devices.

Fluid and plasma physics. The modern physics of fluids is built on the principles of classical fluid mechanics. Understanding the behavior and movement of fluids is important for the design and construction of automobiles, ships, airplanes, and rockets, as well as for the study of weather. Plasma physics concerns the study of gases called plasmas. If enough energy is introduced into a gas, the gas becomes ionized (separated into positively and negatively charged particles). The resulting gas is a plasma. Plasmas are used in neon lights and fluorescent lamps. Physicists are studying how plasmas might be controlled and used to produce fusion energy to generate electricity.

- Read the text again and try to understand it in detail.

Check your pronunciation

Glossary:

matter ['mætə] *n* – матерія
mechanics [mɪ'kænɪks] *n* – механіка
acceleration [ək,selə'reɪʃən] *n* – прискорення
acoustics [ə'ku:stɪks] *n* – акустика
property ['prɔpətɪ] *n* – властивість
resistance [rɪ'zɪstəns] *n* – опір
ray ['reɪ] *n* – промінь
sound ['saund] *n* – звук
light [laɪt] *n* – світло
fusion ['fju:ʒən] *n* - синтез **nuclear physics** ['nju:klɪə'fɪzɪks] *n* – ядерна фізика
solid-state physics *n* – фізика твердих тіл
generate['dʒenəreɪt] *v* – перетворювати
ordinary matter ['ɔdnrɪ 'mætə] *n* – проста матерія
reveal [rɪ'vi:l] *v* – виявляти
emit [ɪ'mɪt] *v* – випромінювати

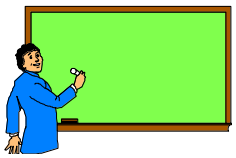
- Write down the new words and learn them.

Exercises

1. Explain the meanings of the following words and expressions from the text. Make sentences with each of them:

- thermodynamics_____
  _____
- optics_____
  _____
- nuclear physics_____
  _____
- plasma physics_____
  _____

2. Find in the text the English equivalents for the following expressions:



- сучасна фізика_____
- фізика твердих тіл_____
- елементарні частинки_____
- властивості атомного ядра_____
- визначати речовину_____
- вивільняти велику кількість енергії_____

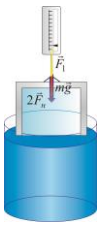
3. Give English equivalents to the following words. Use them in questions to your friend.

Ядерна фізика, тіло, речовина, механіка, енергія, рух, прискорення, атом, нейтрон, протон, властивість, наука, науковці, матерія, сила, синтез, напівпровідник, температура, тиск, водень, термодинаміка, двигун.

_____
_____
_____
_____

4. Read the text and fill in the gaps from below. Render it into Ukrainian. Give it a headline. Discuss with your partner the importance of the main branches of mechanics.

_____



Mechanics can be divided into two branches-statics and dynamics.
Statics studies bodies at rest, or in motion at a constant speed and in a _____ direction.
Solid mechanics is the study of the motions of rigid bodies and deformable solid bodies, and of the forces that cause such motions.
Dynamics is the study of objects that change their speed or the direction of their motion because of forces acting upon them. Sir Isaac Newton expressed the relationship of these forces and changes in motion in his second law of_____. This law states that the force applied to an object is equal to the mass of that object multiplied by its acceleration in the direction of the force.
Statics is one of the two branches of_____, the science that studies the effects of forces on bodies at rest or in motion. Statics deals with a body at_____, or in motion at a constant speed and in a constant direction. Such a body is said to be in equilibrium because the forces acting on it cancel each other out.

rest	**motion**	**mechanics**	**constant**

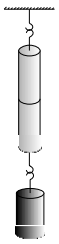
5. Fill in the correct word from the list below.
Use the words only once.

radioactive, low, electronic, light, elementary, electromagnetic, natural, electrical

1. _____things
2. _____temperatures

3. _____ particles
4. _____materials
5. _____devices
6. _____effects
7. _____activity
8. _____elements

6. Choose the correct item:



Physics deals with relation between _____ and energy.
A force **B** matter **C** time **D** atom

Mechanics is the study of the effects of forces on bodies at _____or in motion.
A distance **B** space **C** form **D** rest

Plasma physics concerns the study of _____called plasmas.
A particles **B** electrons **C** gases **D** air

The study of _____is called acoustics.
A matter **B** sound **C** nature **D** solid

All matter is made up of small particles called_____.
A nucleus **B** atom **C** electrons D protons

Work in pairs

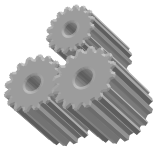
7. Discuss with your partner the following questions. Be ready to agree or disagree with...
Phrases to agreement or disagreement:

My personal opinion…	***На мою думку…***
It would be helpful to know…	***Було б корисно знати, що…***
I must express some disagreement with…	***Я не зовсім згоден …..***

1. What is physics?
2. What language does the word "physics" come from?
3. What does classical physics study?
4. What does modern physics study?
5. What does mechanics study?
6. What does plasma physics concern?

Self Check

8. Complete the sentences. Develop the idea. Give your point of view on the following in 2 or 3 sentences. There is a model at the beginning.



Model: ***Optics has two major branches: physical optics and geometrical optics. Physical optics studies the nature of light. Geometrical optics is the study of how light travels, and how the direction of travel is affected by different materials.***

1. Physics is the science devoted to_____
_____
_____.
2. Classical physics deals with questions regarding_____
_____
_____.
3. Plasma physics concerns the study of _____
_____
_____.

4. Particle physicists conduct research by using devices called _____ _____ _____.
5. Nuclear physics involves the study of the structure and properties _____ _____ _____.
6. Fusion is the process in which the nuclei of two atoms join together to form _____ _____.
7. The study of light is called _____ _____ _____.
8. Modern physics concentrates on scientific beliefs about the basic structure _____ _____ _____.

Check your grammar

1. Fill each gap with a preposition from the box.

to	in	of	from	on	with	by

1. Physics is the science devoted ….. the study….. matter and energy.
2. Physicists who study solids are interested….. how the properties….. these materials are affected ….. temperature and pressure.
3. Plasmas are used….. neon lights and fluorescent lamps.
4. The study ….. light is called optics.
5. Sound consists….. vibrations.
6. It is transmitted….. one place….. another.
7. Classical physics deals…..questions regarding motion and energy.
8. The subjects studied….. physicists consist….. two broad categories.
9. The modern physics ….. fluids is built….. the principles …..classical fluid mechanics.
10. It focuses….. radioactivity, fission, and fusion.
11. The direction of travel is affected….. different materials.

2. Read and memorize the plural of the following nouns:

Singular		Plural
datum	дана величина	data
quantum	квант	quanta
spectrum	спектр	spectra
momentum	момент	momenta
phenomenon	явище	phenomena
radius	радіус	radii
formula	формула	formulas, formulae

3. Put the verb into the correct form. Use Simple Tenses (Active):

1. Physics (to be) _____ the science devoted to the study of matter and energy, (not to be)_____.
2. Maxwell (to show)_____ that waves in combined electric and magnetic fields, called electromagnetic waves, travel at the speed of light.
3. Modern physics (to concentrate)_____ on scientific beliefs about the basic structure of the material world.

4. Mechanics (to describe)_____ how force (to act)_____ upon an object to produce acceleration.
5. Copernicus (to propose) _____ that the earth was one of the planets, all of which (to orbit) the sun.
6. Optics (to have) _____ two major branches, physical optics and geometrical optics, (not to have) _____.
7. Electricity (to make) _____these and many other useful things possible.
8. Electricity (to determine) _____ the structure of every object that exists.
9. Electric ranges, microwave ovens, and food processors (to help) _____ us prepare meals quickly and easily.
10. In 1880, Curie and his brother Jacques (to publish) _____ a paper about their discovery of the piezoelectric properties of crystals.

4. Put the verb into the correct form. Use Simple Tenses (Passive):

1. Transistors (to use) _____ to amplify electric signals, act as oscillators.
2. The study of heat (to call) _____thermodynamics.
3. The dream of explaining all physical phenomena with one small set of basic laws (not to realize) _____.
4. Thermodynamics (to base) chiefly on two laws (principles) _____.
5. These devices (to form) _____ by making certain regions in a semiconductor either p- or n-type.
6. Much of the Greek written tradition in science (to preserve) _____ during the early Middle Ages by people in the Middle East.
7. The paper (to send) _____ later to the Library of Congress in Washington, D.C.

5. Synonyms and antonyms

We often use prefixes to form the opposite of an adjective. The most common prefixes are *un-*, *in-*, *im-*. Complete the columns. Write one opposite adjective using a prefix, and another opposite adjective which is a different word from the box.

sad out of date wrong cheap wrong boring negative stupid artificial arrogant cruel strange casual

Adjective	**Opposite** (Adj. + prefix)	**Opposite** (different word)
happy	unhappy	sad
natural	_____	
positive	_____	
interesting	_____	
correct	_____	
attractive	_____	
fashionable	_____	
intelligent	_____	
usual	_____	
kind	_____	
formal	_____	
modest	_____	

6. Transform the following adjectives into adverbs:

Model: quick – quickly; hot – hot

easy –_____

cold –_____

warm –_____
heavy –_____
clean –_____
opposite –_____
natural –_____
electrical –_____
accurate –_____

7. Change the following statements to questions beginning with the question words given:

1. Physics is the science studying various phenomena in nature. (what?)

_____

2. The physical properties of molecules depend on the forces acting between them and the distance between them. (what?)

_____

3. In physics laws are usually expressed as mathematical formulas. (how?)

_____

4. Matter can exist in four states: solid, gas, liquid and plasma. (how?)

_____

5. The elements are all different from one another. (what?)

_____

6. Chemistry deals with the composition of matter and reactions between various forms of matter. (what?)

_____

7. Plasma physics concerns the study of gases called plasmas. (what?)

_____

8. The mechanics of bodies at rest or in motion at a constant speed and in a constant direction is called statics. (how?)

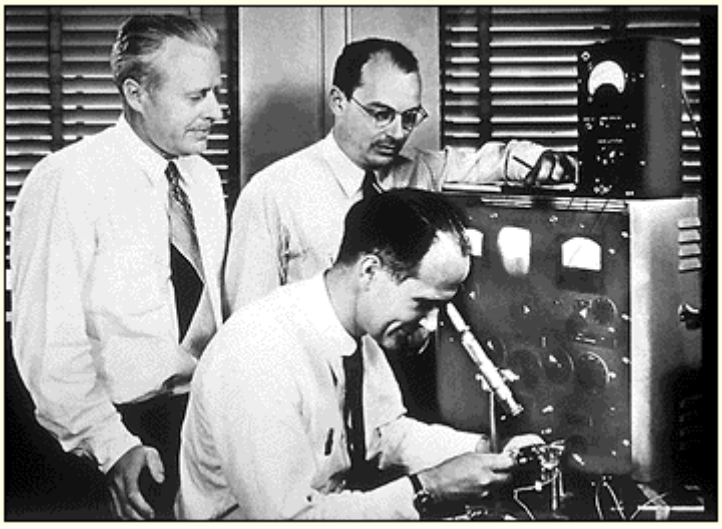
_____

9. Physicists study the fragments that result from the collisions and measure their energy. (who?)

_____

Speaking Task

Look at the picture and guess the profession the people present.
Describe the picture. Is it modern enough? Why? Give your own ideas.



Talking Points

Task 1

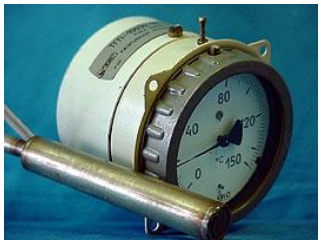
Read the text "Physics" again and make notes under the following headings.

⇨ Mechanics ⇨ Heat ⇨ Sound⇨ Electricity and magnetism ⇨ Light
⇨ Atomic, molecular, and electron physics ⇨ Nuclear physics ⇨ Particle physics
⇨ Solid-state physics ⇨ Fluid and plasma physics

Then, talk about physics as a science.

Task 2. Look at the devices and ask each other questions about it.



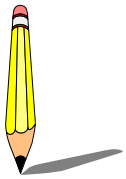
Words you may need: device, to demonstrate, to measure, radiation, possible, force, physical, objects, to determine.

Project Work

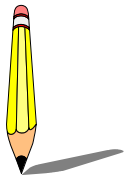
Imagine that you are a scientist. What qualities do you need to be a scientist? Consider, which directions can be interesting for you and why? Prove their scientific importance.

You may begin like this:

- Physics continues to be one of the most active and important sciences. Physicists predict….



Notes on the topic studied:



Notes on the topic studied:

Unit 2

Task 1. Think over such questions:

1. Does the term "electricity" sound familiar to you? What are the fields of its application?
2. People use numerous electrically powered devices every day. Recollect some interesting (horror) situations from your own life when you had to deal with electricity or electric devices. Describe them.

Task 2. Read the phonetic transcription. Practise your pronunciation:

[ɪlek'trɪsɪtɪ] [ɪ'lektrɪkəl] [ɪ'lektrɪk] [tʃɑ:dʒ] ['ju:nɪvə:s] [dɪ'tə:mɪn] ['waɪə] ['spa:k] [ə'trækt] [rɪ'pel] ['kwa:k] ['ju:nɪt] ['faɪbə] ['ɔptɪkəl] ['ɔpəzɪt]['strʌktʃə] [ɔb'dʒekt] ['nju:trəl] ['daɪəgnəuz] [ɪn'vɪzəbl] [ɪn'fluəns] ['pauə] ['pa:tɪkl] [ɪlek'trɔnɪks] ['maɪkrəskəup] ['ætəm] ['mɔlɪkju:l] ['prəuses] [mæg'nətɪc]

Task 3. Practise saying the following words and word-combinations. Pay attention to the pronunciation:

electricity, universe, electrically powered devices, particles, to process, quarks, neutron, negative charge, electrically neutral, opposite charges, to diagnose, invisible, X-ray machines, imagers, unit, optical fibers, invisible, to repel, electron microscopes, to relay information, structure of every object, electrically powered devices, magnetic fields, electromagnetism.

Task 4. Read these international words and guess their meaning:

situation, standard, vertical, double, alternative, popular, production, real, text, segment, result, method, problem, axiom, reflexive, equality, symmetric, false, correct, essential, concept, vertical, fundamental, object, distance, fix, symbolize.

Task 5. Read the text and find some information about the usage of electricity in medicine:

Electricity

Electricity is a basic feature of the matter that makes up everything in the universe. When most people hear the word electricity, they think of lights, television, microwave ovens, computers, air conditioners, and other electrically powered devices. Electricity makes these and many other useful things possible. But electricity is much more important than that. Electricity and magnetism together make up a force called electromagnetism, one of the fundamental forces of the universe. Electrical force is responsible for holding together the atoms and molecules from which matter is composed. In this way, electricity determines the structure of every object that exists.

Electricity is also associated with many biological processes. In the human body, electrical signals travel along nerves, carrying information to and from the brain. Electrical signals tell the brain what the eyes see, what the ears hear, and what the fingers feel. Electrical signals from the brain tell muscles to move. Electrical signals even tell the heart when to beat.

One of the most important properties of electricity is electric energy.

Many aspects of our daily lives depend on electric energy. People use numerous electrically powered devices every day. One of the most important is the computer, which uses electric energy to process information.

In homes. Electric appliances, such as dishwashers, toasters, vacuum cleaners, and washing machines, save hours of labor. Electric ranges, microwave ovens, and food processors help us prepare meals quickly and easily. Refrigerators and freezers preserve food. Air conditioners and electric fans cool our homes, while electric heaters provide warmth and hot water. Television,

radio, video games, compact disc players, and videocassette recorders furnish entertainment. Electric lights let us make use of the nighttime hours.
In industry. Modern industry would be impossible without electric energy. Factories produce many products on assembly lines using electrically operated conveyor belts and equipment. Manufacturers use electric instruments to ensure correct product sizes and quality. Drills, saws, and many other small tools run on electric energy. Electric motors run elevators, cranes, and most other large machinery.
In communication. Electric energy powers almost every device people use to communicate. Telephones, TV's, radios, fax machines, and computer modems all run on electric energy. Communications satellites use electric energy from devices called solar cells to relay information around the world. TV and radio signals are partly electrical, as are telephone, computer, and fax signals that travel along wires or thin strands of glass called optical fibers.
In transportation. Electric energy supplies power to subways, trolleys, and trains that carry millions of people to and from work. Most cars use electric sparks to ignite the gasoline that powers the engine. Electric devices help reduce fuel consumption and air pollution in gasoline engines. Many controls in airplanes and ships are electrically powered.
In medicine and science. Health care workers use numerous electric instruments to examine patients and perform medical tests. For example, X-ray machines and magnetic resonance imagers enable doctors to see inside our bodies. Electrocardiograph machines record tiny electrical signals from the heart, helping doctors to diagnose heart disease.
Scientists from every field use electric devices to conduct research. Microbiologists, for example, use powerful instruments called scanning electron microscopes to learn the secrets of living cells. Physicists use electrically operated particle accelerators to probe the interiors of atoms. Huge telescopes with electric motors help astronomers study planets, stars, and galaxies.

Electric charge

All matter in the universe, from the human body to the distant stars, is made from two kinds of tiny particles called electrons and quarks. Quarks, in turn, make up larger particles known as protons and neutrons. Electrons and quarks have a property called electric charge. Electrons have one kind of charge, called negative. Quarks have either negative charge or the opposite kind of charge, called positive. Protons have a positive charge the same size as an electron's negative charge because each proton contains two quarks with 2/3 unit of positive charge each and one quark with 1/3 unit of negative charge. Neutrons, in contrast, contain two quarks with 1/3 unit of negative charge each and one quark with 2/3 unit of positive charge. The charges cancel each other out, leaving the neutron electrically neutral, meaning it has no overall electric charge.
Opposite charges, also called unlike charges-negative and positive-attract one another. Like charges-positive and positive, or negative and negative-repel (push away) one another. The power to attract and repel other charges is caused by invisible influences called electric fields that surround each charged particle. Because of the fields, particles attract or repel one another even when they are not touching.

Check your pronunciation

Glossary:

universe ['ju:nıvə:s] *n* – всесвіт
determine [dı'tə:mın] *v* – визначати
electric charge [ı'lektrık tʃa:dʒ] *n* – електричний заряд
wire ['waıə] *n* – провід
electric spark [ı'lektrık 'spa:k] *n* – електрична іскра
invisible influence [ın'vızəbl ın'fluəns] *n* – невидимий вплив
attract [ə'trækt] *v* – притягати
optical fibers ['ɔptıkəl 'faıbəz] – оптичні волокна
repel [rı'pel] *v* – відштовхувати
quark ['kwa:k] *n* – кварк (фундаментальна частинка)
molecule ['mɔlıkju:l] *n* – молекула

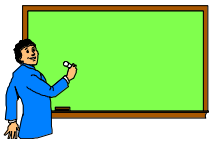
- Write down the new words and learn them.

_____
_____
_____

Exercises

1. Explain the meanings of the following words and expressions from the text. Make sentences with each of them:

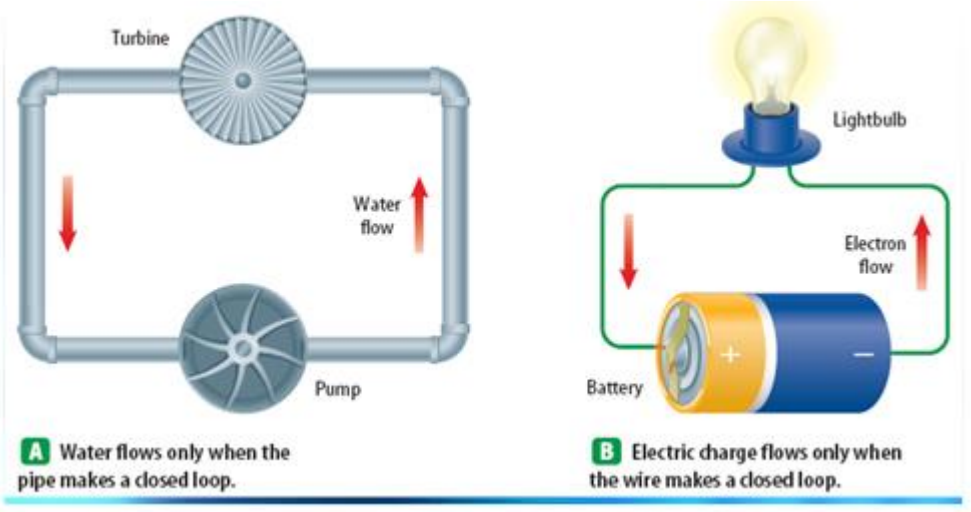
- fundamental forces of the universe_____
_____
- electrical signals_____
_____
- electrons and quarks_____
_____
- electric fields_____
_____



2. Find in the text the English equivalents for the following expressions:

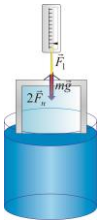
- обробка інформації_____
- найбільш важливі властивості_____
- записувати надзвичайно маленькі електричні сигнали_____
_____
- оточувати заряджені частинки_____
- оптичні волокна_____.

3. Do you know? Work in groups and describe similarities between the flow of water in a pipe and the flow of electric current through a circuit.



4. Read the text and fill in the gaps from below. Render it into Ukrainian. Give it a headline. Discuss with your partner a fundamental force called electromagnetism.

_____



Magnetism and _____are actually closely related. Just as an electric field surrounds an electric charge and produces a force that affects other charges, so a magnetic field surrounds a _____and produces forces that act on other magnets. Like an electric charge, a magnet will attract or repel another magnet.
Together, magnetism and electricity make a fundamental force of the universe called

electromagnetism. Electromagnetism is based on the fact that the _____of electric charges can produce magnetic fields, and changing magnetic fields can produce electric currents. Passing an electric current through a coil of wire makes the coil a temporary magnet called an electromagnet.
The electric current creates a _____around the coiled wire. As long as the current flows, the coil will be a magnet.

magnetic field	**magnet**	**electricity**	**motion**

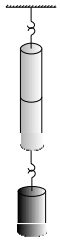
5. Give English equivalents to the following words. Use them in questions to your friend.
Електрична енергія, електрика, всесвіт, магнітне поле, електричний струм, невидимий, позитивний заряд, негативний заряд, теплота, зображення, проводити досліди, протилежні заряди, властивість, промисловість, виробники, електромагнетизм.

_____
_____
_____
_____

6. Fill in the correct word from the list below.
Use the words only once.
electric, magnetic, positive, electrical, negative, charged, electrically, medical

1. _____ charge
2. _____ tests
3. _____ particle
4. _____ signals
5. _____ neutral
6. _____ current
7. _____ fields
8. _____ charge

7. Choose the correct item:
The electric current creates a magnetic_____ around the coiled wire.
A charge **B** particle **C** field **D** signal



The charges cancel each other out, leaving the neutron _____neutral.
A electrically **B** positively **C** negatively **D** currently

A magnet will attract or repel another _____.
A atom **B** electron **C** magnet **D** charge

Telephones, TV's, radios, fax machines, and computer modems all run on electric_____.
A current **B** power **C** force **D** energy

Electric energy supplies_____ to subways, trolleys, and trains.
A energy **B** force **C** charge **D** power

People use numerous electrically powered _____every day.
A telephones **B** books **C** radios **D** devices

Work in pairs

8. Discuss with your partner the following questions. Be ready to agree or disagree with... Phrases to agreement or disagreement:

My personal opinion…	***На мою думку…***
It would be helpful to know…	***Було б корисно знати, що…***
I must express some disagreement with…	***Я не зовсім згоден …..***

1. If an atom has more protons than electrons, what kind of charge will the atom have?
2. How are insulators important to electrical safety?
3. How are electricity and magnetism related?
4. What familiar office machine uses static electricity?
5. How has electric energy changed the way people live?

_____
_____
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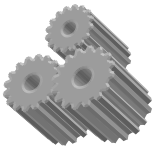
Self Check

9. Complete the sentences. Develop the idea. Give your point of view on the following in 2 or 3 sentences. There is a model at the beginning.

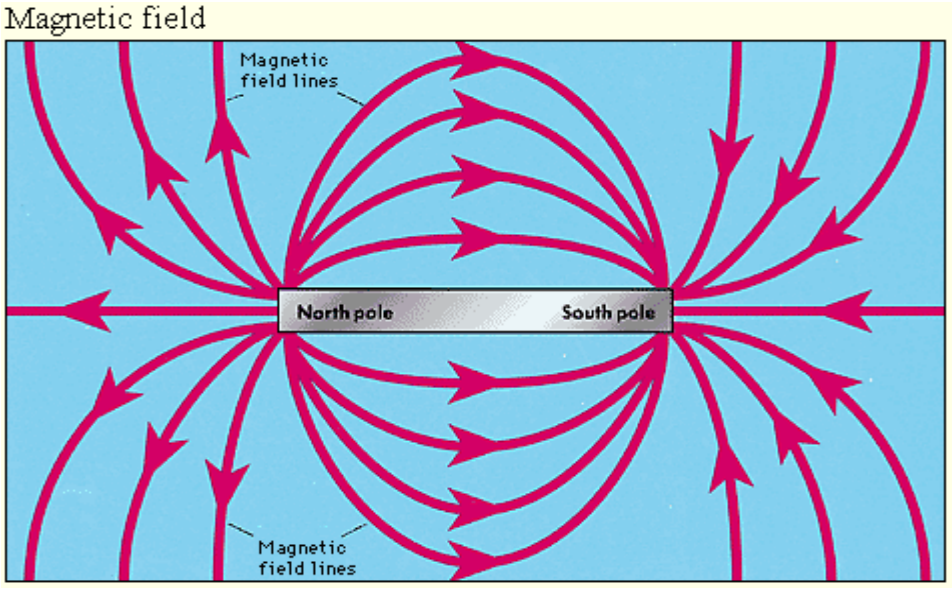


Model: ***Electrical signals tell the brain what the eyes see, what the ears hear, and what the fingers feel. Electrical signals from the brain tell muscles to move. Electrical signals even tell the heart when to beat.***

1. Electrical force is responsible for holding together the atoms and
_____
_____
_____.
2. Electrons and quarks have a property called
_____
_____
_____.
3. Many aspects of our daily lives depend on
_____
_____
_____.
4. Electricity and magnetism together make up a force called
_____
_____
_____.
5. Electric energy supplies power to
_____
_____
_____.
6. Modern industry would be impossible without
_____
_____
_____.

Speaking Task

Look at the picture. Do you know what it means? Describe it with your partner.



Words you may need: property, magnets, magnetite, to produce magnetic forces, magnetic field lines, poles, to attract, to repel.

Talking Points

Read the text "Electricity" again and make notes under the following headings.

⇨ Electrical force ⇨ Electric energy ⇨ Electric charge

Then, looking at your notes, describe one of the most important properties of electricity.

Do you know this:

How is Electrical POWER calculated?

Electrical Power is the product of the current (I) and the voltage (v)

The unit for electrical power is the same as that for mechanical power - the walt (W)

$$\text{power} = \text{current} \times \text{voltage difference}$$

$$P(\text{watts}) = I(\text{amperes}) \times V(\text{volts})$$

Example Problem: How much power is used in a circuit which is 110 volts and has a current of 1,36 amps?

P = I V

POWER = (1,36 amps) (110 V) = 150 W

Compose similar problem and ask your partner to solve it.

Check your grammar

1. Form adverbs from the following adjectives and translate them into Ukrainian.
Example:
careful - carefully
(notice that the final **l** is doubled)
positive, negative, separate, constant, obvious, graphic, near, practical, distinct.

2. Put in a suitable pronoun from the box:

something	**anyone**	**somewhere**	**everybody**	**nobody**	**everything**

1. _____ knows that this problem is very difficult.
2. Did you find the same result _____?
3. _____ could perform that operation.
4. _____ must be done in time.
5. Have you got _____ important to say?
6. She was going to ask _____ to help her.

3. Use the correct form of the verb *to be* in Present Simple:

1. Principles of thermodynamics (to be) _____ essential for understanding all types of heat engines, as well as refrigerators and freezers.
2. It (to be) _____ important in understanding the lenses and mirrors which are used in telescopes, microscopes, and eyeglasses.
3. One of the most important properties of electricity (to be) _____ electric energy, (not to be) _____.
4. However, the diameter of a plutonium atom (to be) _____ only about 3 times that of a hydrogen atom.
5. The three basic types of particles (to be) _____protons, neutrons, and electrons**.**
6. Electrons with the least energy (to be) in inner shells, and those with more energy (to be) in outer shells.
7. This value (to be) _____ an average for the two isotopes chlorine 35 (atomic weight 34.96885) and chlorine 37 (atomic weight 36.96590) in their natural proportions.
8. The current in household wiring (to be) _____ alternating current.
9. Batteries (to be) _____ a common power source.
10. Most chips (to be) _____no larger than a fingernail.

4. Translate the following adjectives:
старий, старший, найскладніший, найгірший, веселіший, новий, найважчий, простіший, гірший, більший, простий, довший, найтемніший, найвищий, дорогий, холодніший, найкращий, важчий

_____
_____
_____

5. Translate the following sentences using the appropriate *modal verbs:*

1. Він повинен виконати це завдання.
2. Ви можете здійснювати відповіді обчислення за допомогою калькулятора.
3. Йому необхідно вивчити розділ фізики «Механіка».
4. Можна мені провести цей дослід?
5. Ви не повинні користуватися конспектом.
6. Він ніколи не міг зрозуміти цього фізичного явища?
7. Мені дуже прикро, але я не можу надати вам необхідну допомогу.
8. Вам прийдеться знайти відповідь на дане питання.

6. Complete the following questions:

- Electronics has changed the way people live.

What…_____

- The flow of electrons in one direction at a time forms an electric current.

What…_____

- Most chips are no larger than a fingernail.

Most…_____

- Electrons flow from the negative voltage end of a circuit to the positive voltage end.

How…_____

- A calculator, like most electronic devices, has two kinds of electronic circuits.

How many…_____

Project Work

Speaking Task

Be ready to answer the following questions. Try to argue your answers.

1. Why does metal conduct electric current better than wood?
2. How can you make a balloon stick to your shirt? Why does it stick?
3. What should you do if you are caught outdoors during a lightning storm?

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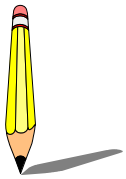
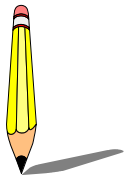


Notes on the topic studied:



Notes on the topic studied:

Unit 3

Task 1. Discuss the following questions in groups:

1. Have you ever seen an atom? What does it look like? What can you compare it with? What do you know about its size?
2. What objects are made up of atoms? Is it also true when we speak about human body?

Task 2. Read the phonetic transcription. Practise your pronunciation:

['ætəm] ['prəutɔn] ['nju:trɔn] [ɪ'lektrɔn] ['aɪsəuba:] ['aɪsəutəup] ['piərɪ'ɔdɪk teɪbl] ['haɪdrɪdʒən] ['ɔksɪdʒən] [ə'kə] ['pa:tɪkl] ['ɪnə ʃel] ['autə ʃel] ['nætʃrəl] ['nætʃrəlɪ] ['arən] ['kemɪkəl] ['kemɪstrɪ] [sʌbə't'ɔmɪk] [pa:tɪkl] [sʌbə't'ɔmɪk pa:tɪkl] [ju'reɪnjəm] [plu:'təunjəm] [dɪs'tɪŋgwɪʃ] [daɪ'æmɪtə] [ə't'ɔmɪk weɪ] ['piərɪ'ɔdɪk teɪbl]

Task 3. Practise saying the following words and word-combinations. Pay attention to the pronunciation:

atomic mass, natural proportions, chemical properties, naturally, protons and neutrons, hydrogen isotopes, oxygen, iron, lead, complex substances, atomic weight, uranium, plutonium, to distinguish, natural elements, to occur, isobars, the periodic table, subatomic particles, diameter, similar chemical properties, ordinary particles in a small fraction of a second.

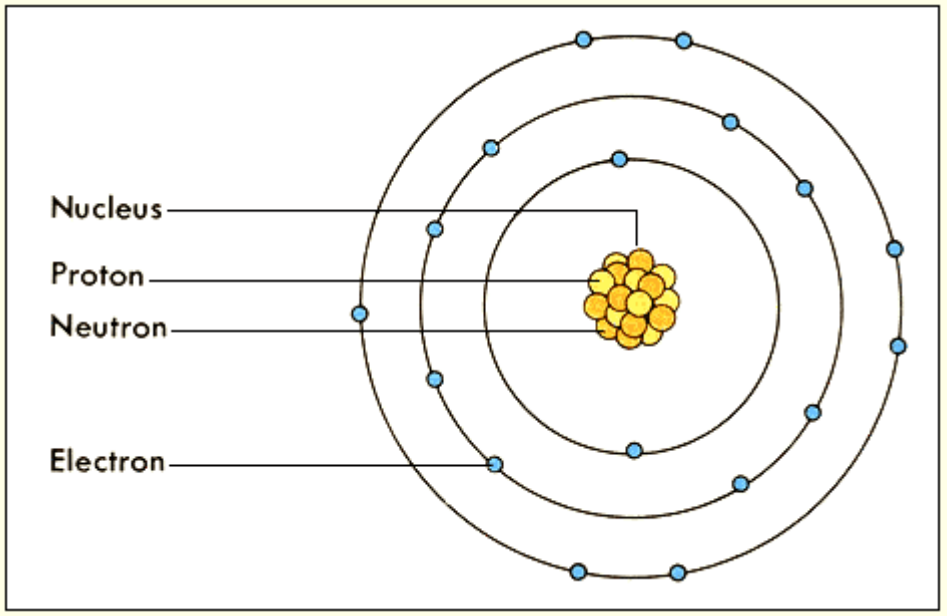
Task 4. Read these international words and guess their meaning:

total, condition, start, theory, collection, communicative, normal, material, complex, periodic, gravitation, acceleration, radiation, potential, model, pyramid, constantly, general, microscope, energy, region, matter, diameter, negative, positive.

Task 5. Read the text and say if the following statements are true (T) or false (F):

- Atoms vary greatly in size.
- Hydrogen is the heaviest element in nature.
- The weight of some atoms is about 1 gr.
- Protons and electrons are crowded into the nucleus of an atom.

Atom

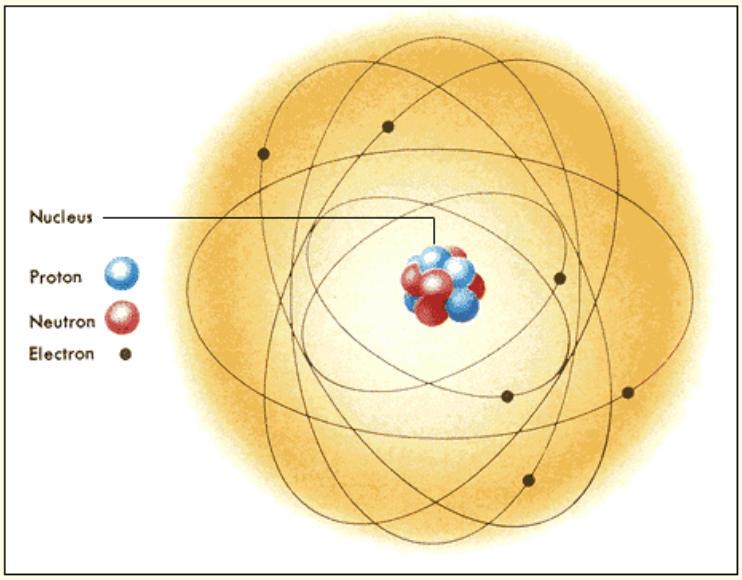


Atom is one of the basic units of matter. Everything around us is made up of atoms. An atom is incredibly tiny - more than a million times smaller than the thickness of a human hair. The smallest speck that can be seen under an ordinary microscope contains more than 10 billion atoms. The diameter of an atom ranges from about 0.1 to 0.5 nanometer. A nanometer is a billionth of a meter, or about 1/25,000,000 inch.

Atoms form the building blocks of the simplest substances, the chemical elements. Familiar elements include hydrogen, oxygen, iron, and lead. Each element consists of one basic kind of atom. Compounds are more complex substances made of two or more kinds of atoms linked in units called molecules. Water, for example, is a compound in which each molecule consists of two atoms of hydrogen linked to one atom of oxygen.

Atoms vary greatly in weight, but they are all about the same size. For example, an atom of plutonium, the heaviest element found in nature, weighs more than 200 times as much as an atom of hydrogen, the lightest known element. However, the diameter of a plutonium atom is only about 3 times that of a hydrogen atom.

The parts of an atom



Tiny as atoms are, they consist of even more minute particles. The three basic types are **protons, neutrons, and electrons.** Each atom has a definite number of these subatomic particles. The protons and neutrons are crowded into the nucleus, an exceedingly tiny region at the center of the atom. If a hydrogen atom were about 4 miles (6.4 kilometers) in diameter, its nucleus would be no bigger than a tennis ball. The rest of an atom outside the nucleus is mostly empty space. The electrons whirl through this space, completing billions of trips around the nucleus each millionth of a second. The fantastic speed of the electrons makes atoms behave as if they were solid, much as the fast-moving blades of a fan prevent a pencil from being pushed through them.

Atoms are often compared to the solar system, with the nucleus corresponding to the sun and the electrons corresponding to the planets that orbit the sun. This comparison is not completely accurate, however. Unlike the planets, the electrons do not follow regular, orderly paths. In addition, the protons and neutrons constantly move about at random inside the nucleus.

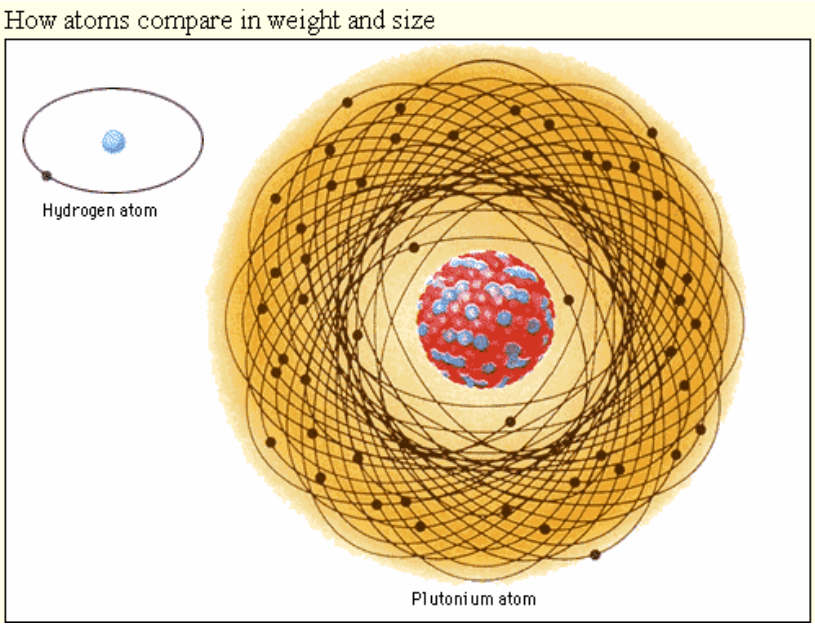
The nucleus makes up nearly all the mass of an atom. Mass is the quantity of matter in an atom. Each proton has a mass roughly equal to that of 1,836 electrons. It would take 1,839 electrons to equal a neutron's mass. Each proton carries one unit of positive electric charge. Each electron carries one unit of negative charge. Neutrons have no charge. Under most conditions, an atom has the same number of protons and electrons, and so the atom is electrically neutral.

Protons and neutrons are about 100,000 times smaller than atoms, but they are in turn made up of even smaller particles called quarks. Each proton and neutron consists of three quarks. In the laboratory, scientists can cause quarks to combine and form other kinds of subatomic particles besides protons and neutrons. All these other particles break down and change into ordinary particles in a small fraction of a second. Thus, none of them is found in ordinary atoms.

The electrons, unlike the protons and neutrons, do not seem to have smaller parts. Electrons have very little mass. The mass of an electron in grams may be written with a decimal point followed by 27 zeros and a 9.

Opposite electric charges attract. The positively charged nucleus therefore exerts a force on the negatively charged electrons that keeps them within the atom. However, each electron has energy and so is able to resist the attraction of the nucleus. The more energy an electron has, the farther from the nucleus it will be. Thus, electrons are arranged in shells at various distances from the nucleus according to how much energy they have. Electrons with the least energy are in inner shells, and those with more energy are in outer shells.

The properties of atoms



The atomic number tells how many protons an atom has. All atoms of the same element have the same number of protons. For example, every hydrogen atom has a single proton, and so the atomic number of hydrogen is 1. The atomic numbers for other natural elements range successively up to 92 for uranium, which has 92 protons in each atom. Tiny amounts of plutonium, which has an atomic number of 94, also occur naturally. Elements whose atoms have more than 92 protons can be created in the laboratory.

The atomic number determines an element's place in the periodic table. This table organizes the elements into groups with similar chemical properties.

The mass number is the sum of the protons and neutrons in an atom. Although all atoms of an element have the same number of protons, they may have different numbers of neutrons. Atoms that have the same number of protons but different numbers of neutrons are called isotopes.

Most of the elements in nature have more than one isotope. Hydrogen, for example, has three. In the most common hydrogen isotope, the nucleus consists only of a proton. In the two other hydrogen isotopes, the nucleus consists of one or two neutrons in addition to the proton. Scientists use the mass number to distinguish the three isotopes as hydrogen 1, hydrogen 2, and hydrogen 3. They also refer to hydrogen 1 as protium, to hydrogen 2 as deuterium, and to hydrogen 3 as tritium.

Atoms that have the same mass number but different atomic numbers are called isobars. Thus, isobars are atoms of different elements. For example, the isobars argon and calcium have a mass number of 40, but argon's atomic number is 18 and calcium's is 20.

Atomic weight is the weight of an atom expressed in atomic mass units (amu). One amu, also called a dalton, equals 1/12 the weight of an atom of carbon 12. For most atoms, the weight in amu is extremely close to the mass number. Atomic mass units are very small. There are 602 billion trillion amu in a gram.

Scientists determine the atomic weight of an element with more than one isotope by averaging the weights of all the isotopes in the proportions in which they occur in nature. For example, the atomic weight of chlorine is 35.453 amu. This value is an average for the two isotopes chlorine 35 (atomic weight 34.96885) and chlorine 37 (atomic weight 36.96590) in their natural proportions.

Check your pronunciation

Glossary:

atom ['ætəm] *n* – атом
proton ['prəutɔn] *n* – протон
neutron ['nju:trɔn] *n* – нейтрон
electron [ɪ'lektrɔn] *n* – електрон
isobar ['aɪsəuba:] *n* – ізобар
inner shell ['ɪnə ʃel] *n* – внутрішня оболонка
outer shell ['autə ʃel] *n* – зовнішня оболонка
atomic weight [ə'tɔmɪk weɪ] *n* – атомна вага
iron ['arən] *n* – залізо(елемент)
element ['elɪmənt] – елемент **isotope** ['aɪsəutəup] *n* – ізотоп
periodic table ['pɪərɪ'ɔdɪk teɪbl] *n* – періодична таблиця
hydrogen ['haɪdrɪdʒən] *n* – водень
oxygen ['ɔksɪdʒən] *n* – кисень
uranium [ju'reɪnjəm] *n* – уран
plutonium [plu:'təunjəm] *n* – плутоній
occur [ə'kə] *v* – виникати, мати місце
subatomic particle [sʌbə't'ɔmɪk pa:tɪkl] *n* – субатомна частинка

- Write down the new words and learn them.

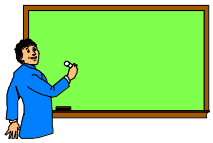
_____
_____
_____
_____
_____

Exercises

1. Explain the meanings of the following words and expressions from the text. Make sentences with each of them:

- protons, neutrons, and electrons_____
_____
- periodic table_____
_____
- isobar_____
_____
- atomic number_____
_____

2. Find in the text the English equivalents for the following expressions:



- внутрішня оболонка_____
- різна кількість нейтронів_____
- подібні хімічні властивості_____
- сонячна система_____

3. Give Ukrainian equivalents to:

a) stable (unstable, heavy, excited, light, complex) nucleus;
b) even-charge nucleus, even-mass nucleus , even-odd nucleus, odd-odd nucleus, artificially radioactive nucleus, parent nucleus.

_____
_____
_____
_____
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_____

4. Give English equivalents to the following words. Use them in questions to your friend.
Хімічні властивості, атомна вага, кисень, водень, атомна маса, успіх, визначати, ядро, матерія, періодична таблиця, нейтрон, протон, ізотоп, природний, вираз, частинка, число, кількість, успішно.

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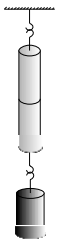
5. Choose the correct item:



a) Atoms of uranium, radium, and all other elements heavier than bismuth are _____.
A active **B** radioactive **C** neutral **D** heavy

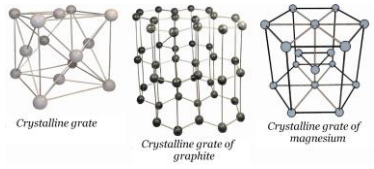
b) Most of the elements in nature have more than one_____.
A atom **B** proton **C** isotope **D** nucleus

Atomic mass units are very_____.
A heavy **B** changeable **C** large **D** small

c) Atoms that have the same number of protons but different numbers of neutrons are called _____.
A protons **B** gamma rays **C** isotopes **D** neutrons

d) Atoms that have the same mass number but different atomic numbers are called_____.
A isotopes **B** isobars **C** complex substances **D** ordinary atoms

6. Translate into Ukrainian:



1. Nuclei consist of protons and neutrons collectively called nucleons. 2. The number of protons in nuclei of the same element is equal to the atomic number Z. 3. The number of neutrons varies. 4. Most naturally occurring atoms have stable nuclei. 5. Artificial nuclei are produced by bombarding stable nuclei with high energy charged particles such as protons, deutorons. 6. Elementary particles are classified by a set of quantum numbers describing their intrinsic properties: spin, charge, parity, strangeness. 7. Particles can be divided into groups according to the kinds of interactions they participate in. 8. The proton takes parting neither strong nor weak interactions.

_____
_____
_____
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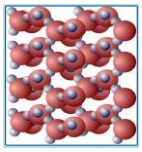
_____
_____

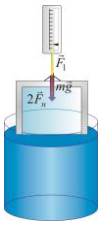
7. Fill in the correct word from the list below.
Use the words only once.
electric, complex, mass, single, periodic,
chemical, hydrogen, human, atomic.

1. _____ isotope
2. _____ number
3. _____ table
4. _____ substances
5. _____ charges
6. _____ properties
7. _____ proton
8. _____ hair
9. _____ weight



8. Read the text and fill in the gaps from below. Render it into Ukrainian. Give it a headline. Discuss with your partner such phenomena as radiation.

_____



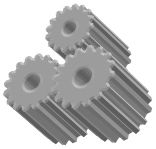
In some atoms, the nucleus can change naturally. Such an atom is called radioactive. The change in the nucleus may be only in the arrangement of the protons and neutrons. Or the actual number of protons and neutrons may change. When a nucleus changes, it gives off radiation. This radiation consists of alpha or _____particles or gamma rays. Atoms of uranium, _____, and all other elements heavier than bismuth are_____. Some isotopes of lighter elements are also radioactive

The type of radiation given off by a radioactive nucleus depends on the way the nucleus changes. Gamma rays are given off if only the arrangement of the protons and neutrons in the nucleus changes. But alpha or beta radiation is given off if the number of protons and _____in the nucleus changes. The atom then becomes an atom of a different element. This process is called_____ or radioactive decay.

transmutation	**radioactive**	**beta**	**radium**	**neutrons**

Self Check

9. Complete the sentences. Develop the idea. There is a model at the beginning.



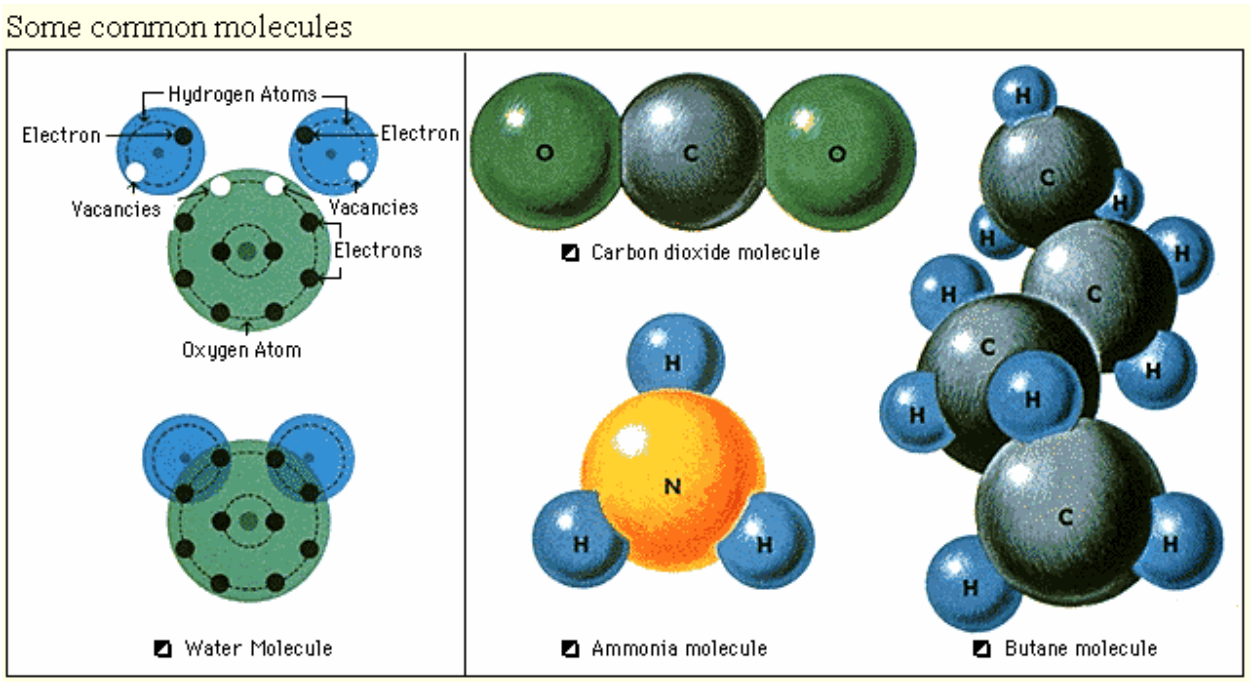
Model: ***Most of the elements in nature have more than one isotope. Hydrogen, for example, has three. In the most common hydrogen isotope, the nucleus consists only of a proton.***

1. The atomic number determines an element's place in _____
_____
_____
_____.
2. The mass number is _____
_____
_____.
3. The atomic number tells _____
_____
_____
_____.
4. Atoms that have the same number of protons but different numbers of neutrons are called
_____
_____
_____.

5. Opposite electric charges _____
_____
_____
_____.
6. Each proton carries one unit of _____
_____
_____
_____.
7. Each element consists of one basic kind of _____
_____
_____
_____
8. Atoms vary greatly in weight, but they are all about _____
_____
_____
_____

Speaking Task

Task 1. Compare and contrast molecules in the pictures. Which of these molecules are familiar for you? Name them. Discuss it. Use such words as: both, as well, too, but, despite, however.



Work in pairs

Task 2. Discuss with your partner the following questions. Be ready to agree or disagree with. Phrases to agreement or disagreement:

My personal opinion…	***На мою думку…***
It would be helpful to know…	***Було б корисно знати, що…***
I disagree with the statement that…	***Я не згоден з твердженням …***

1. What is the difference between an atom's mass number and its atomic number?
2. What three basic types of particles make up an atom?
3. Why does a heavy nucleus have more neutrons than protons?
4. What determines the chemical behavior of an atom?
5. When did the idea of atoms originate?
6. How does the size of a proton compare with that of an atom?

Check your grammar

1. Form nouns from the following verbs. Use appropriate noun suffixes:
-ance, -ence
-ment
-ion, -tion, -sion

Example:
to develop - development
to detect, to ionize, to penetrate, to deduce, to omit, to interact, to predict, to classify, to conserve, to differ, to collect, to achieve, to explore, to calculate, to radiate, to emit, to connect.

_____
_____
_____
_____
_____
_____
_____

2. Read and remember the following pairs of words. Translate them into Ukrainian:

a) stable - unstable, like – unlike, known – unknown, charged – uncharged, equal – unequal, developed – undeveloped, divided – undivided;
b) complete – incomplete, definite – indefinite, dependent – independent, accurate – inaccurate.

3. Make the nouns plural. Translate them into Ukrainian.
Mind that there are two kinds of nouns: countable and uncountable.

atom – _____
matter – _____
energy – _____
science – _____
electron – _____
device – _____
gas – _____
molecule – _____
electricity – _____
weight – _____
battery – _____
circuit – _____
resistance – _____

4. Make the following infinitives passive:

1. Classical physics (to compose) _____ of five basic areas: mechanics, heat, sound, electricity and magnetism, and light.
2. Principles of mechanics (to use) _____ in describing such types of motion as planetary orbits and the paths of other moving objects.
3. The study of light (to call) _____ optics.
4. The modern physics of fluids (to build) _____ on the principles of classical fluid mechanics.
5. Electricity also (to associate) _____with many biological processes.
6. Compounds are more complex substances made of two or more kinds of atoms which (to link) _____in units.
7. The protons and neutrons (to crowd) _____ into the nucleus.

8. Electrons (to arrange) _____ in shells at various distances from the nucleus according to how much energy they have.
9. When the switch is on, the conductors (to connect) _____, and current flows.
10. If too many electric devices (to plug) _____ into an outlet, a fuse or circuit breaker will shut off the current.

5. Change the following statements to questions beginning with the question words given:

1. Physicists use electrically operated particle accelerators to probe the interiors of atoms. (who?)

_____
_____

2. Like an electric charge, a magnet will attract or repel another magnet. (what?)

_____
_____

3. Electric energy supplies power to subways, trolleys, and trains. (what?)

_____
_____

4. Electricity and magnetism together make up a force called electromagnetism. (what?)

_____
_____

5. Physicists use electrically operated particle accelerators to probe the interiors of atoms. (why?)

_____
_____

6. Electric devices help reduce fuel consumption and air pollution in gasoline engines. (what?)

_____
_____

7. Atoms vary greatly in weight, but they are all about the same size. (what?)

_____
_____

6. Put the verbs in brackets in the correct tense:

1. In this chapter you (to deal) with electronics.
2. We (to solve) this problem yesterday.
3. A battery (to produce) direct current.
4. The given principle (to be) valid for all such cases.
5. He (to find) the whole system relatively simple.
6. The book (to contain) interesting information.
7. She (to leave) her book in the classroom.

Talking Points

Read the text "Atom" again and make notes under the following headings.

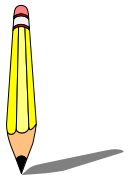
⟹ The parts of an atom ⟹ The properties of atoms

Then, looking at your notes, describe the parts of an atom and its properties.

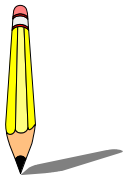
Project Work

Discuss the following questions in groups:

1. On what did Ernest Rutherford base his theory of atomic structure?
2. How do scientists study the energies of electrons?
3. How do physicists create radioactive isotopes in a laboratory?



Notes on the topic studied:



Notes on the topic studied:

Unit 4

Task 1. Think and answer such questions:
- Do you know anything about electric current from your physics lessons at school? Recollect some situations.
- Have you ever light the bulb during your labs in physics? Describe that process. Did you imagine yourself a great scientist?

Task 2. Read the phonetic transcription. Practise your pronunciation:

[ɪ'lekrɪk tʃɑ:dʒ] [ɪ'lekrɪk 'kʌrənt] [dɪ'rekt] [ɔ:ltəneɪtɪŋ 'kʌrənt] [kən'dʌktə] [,semɪkən'dʌktə] [sel] ['fɪləmənt] [fju:z] [ɪ'lekrəulaɪt] [,a:tɪ'fɪʃəl 'sætəlaɪt] ['plʌg] [pa:ɵ] [hi:t] [kə'nekʃ(ə)n] [kə'nektə] ['bætərɪ] ['sə:kɪt] ['daɪəud] ['dʒenəreɪt] ['sə:kɪt 'breɪkə] [kə'pæsɪtə]

Task 3. Practise saying the following words and word-combinations. Pay attention to the pronunciation:
direct and alternating current, parallel circuit, integrated circuit, transistor, diode, capacitor, inductors, mechanical energy, circuit breaker, fuse, resistance, electric conductors, generator, light bulb, negative terminal, sunlight, heat, chemical action, electrolyte, path, artificial satellites.

Task 4. Read these international words and guess their meaning:
opposite, electrode, electrolyte, result, action, reactions, battery, separate, terminal, computer, active, parallel, transistors, diodes, individual, signals, business, generator, electrostatic, industry, machine.

Task 5. Read the text and explain the difference between direct and alternative current:

Electric current

A flow of electric charge through a conductor is called electric current. Energy is associated with the flow of current. As current flows through electric devices, this energy may be converted to useful forms. For example, electric energy is converted into heat by an electric range and into light by a light bulb.

Direct and alternating current. Current that flows steadily in one direction is called direct current (DC). A battery produces direct current. Sometimes current flows back and forth, changing direction rapidly. It is then called alternating current (AC). The current in household wiring is alternating current

Sources of current. By itself, a conductor does not have electric current flowing in it. But if a positive charge is applied to one end of the conductor, and a negative charge to the other end, then electric charge will flow through the conductor. Because positive and negative charges attract, some type of energy must be supplied to separate the charges and keep them at opposite ends of the conductor. The energy may come from chemical action, motion, sunlight, or heat.

Batteries produce electric energy by means of chemical action. A battery has two structures called electrodes, each made from a different chemically active material. Between the electrodes, the battery contains a liquid or paste called an electrolyte, which conducts electric current. The electrolyte helps promote chemical reactions at each electrode. As a result of the chemical reactions, a positive charge builds up at one electrode and a negative charge builds up at the other. Electric current will then flow from the positive electrode, through a conductor, to the negative electrode.

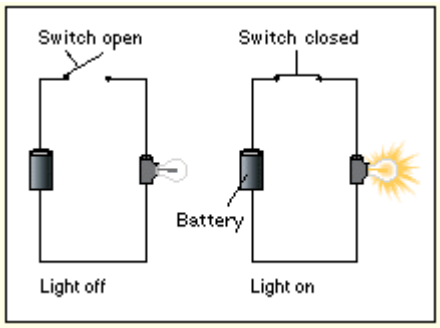
In a flashlight battery, the flat end is the negative electrode. The end with a bump connects to the positive electrode. When a wire links the electrodes, a current flows. The electric energy is

converted to light if it passes through a flashlight bulb. Chemical reactions in the electrolyte keep the electrodes oppositely charged and so keep the current flowing.

Generators change mechanical energy into electric energy. In a generator, a source of mechanical energy spins coils of wire near a magnet to produce electric current. A generator works because moving a conductor near a magnet produces a current in the conductor. Most generators produce alternating current.

Solar cells, also called photovoltaic cells, convert sunlight into electric energy. Solar cells power most artificial satellites and other spacecraft as well as many handheld calculators. Photovoltaic cells are made from semiconducting materials, usually specially treated silicon. Energy from the sun forces negative and positive charges in the semiconductor to separate. The charges will then flow through a conductor.

Electric circuits



To use electric energy, an electric device must be connected to an energy source. A complete path must be provided for electric current to flow from the energy source to the device and back again. Such a path is called an electric circuit.

A simple circuit. Suppose you want to make a battery-powered light bulb shine. Electric current will only flow if there is a complete circuit that leads from the battery to the bulb and back to the battery. To make the circuit, connect a wire from the positive terminal of the battery to the light bulb. Then, connect another wire from the bulb back to the negative terminal. Electric current will then flow from the battery's positive terminal, through the light bulb, to the battery's negative terminal.

Inside the bulb is a thin wire called a filament. The filament is made from a material with greater resistance than the wires linking the battery and bulb. The moving electrons that make up the current collide with atoms in the filament and give up most of their energy. The released energy heats the filament, which glows and gives off light.

Series and parallel circuits. A single battery or generator often powers more than one electric device. In such cases, circuit designs called series circuits and parallel circuits are necessary.

A series circuit has only one path. The same current flows through all parts of the path and all electric devices connected to it. Flashlights, some Christmas tree lights, and other simple devices use series circuits. In a parallel circuit, the current splits to flow through two or more paths. Parallel circuits enable a single energy source to provide current to more electric devices than a series circuit could. Household lights and appliances are connected in parallel circuits.

Many circuits include some parts that are series and some that are parallel. An extremely complex circuit, like that in a computer or TV, has millions of parts connected in various series and parallel combinations.

Electric and magnetic fields. When most people think of an electric current, they think of moving electrons carrying charges through a wire. Actually, most of the energy flows in electric and magnetic fields surrounding the wire. Energy from the fields enters the wires and replaces energy the electrons lose through resistance. The battery, generator, or other energy source continually restores energy lost from the fields.

In DC circuits, electrons flow from one battery terminal, through the circuit, to the other terminal. But the energy of the electric and magnetic fields flows at the same time from both terminals to the electric device. In AC circuits, individual electrons move back and forth in the wires and do not travel the entire circuit. Nevertheless, electric energy flows from the energy source to the device in the form of the fields.

Controlling electric current. The simplest way to stop a current flowing through a circuit is with a switch. A basic switch consists of two electric conductors that can be moved apart to create a gap in a circuit. When the switch is off, the gap is open, and no current flows. When the switch is on, the conductors are connected, and current flows.

Wires and electric devices become dangerously hot if too much current flows through them. Switches called fuses and circuit breakers protect the wiring in most buildings. If too many electric devices are plugged into an outlet, a fuse or circuit breaker will shut off the current. Many individual electric devices also contain fuses.

Electrically powered devices are said to be electronic if they carry electrical signals that can be varied in some way to represent information. Electronic devices include transistors, diodes, capacitors, inductors, and integrated circuits. Signals may represent sounds, pictures, numbers, letters, computer instructions, or other information. In the amplifier of a compact disc player, for example, transistors provide a continuous range of currents that strengthen electrical signals representing the sounds being played.

Check your pronunciation

Glossary:

electric charge [[ɪ'lekrɪk tʃɑ:dʒ] *n* – електричний заряд

electric current [ɪ'lekrɪk 'kʌrənt] *n* – електричний струм

direct [dɪ'rekt] *v* – управляти, керувати, направляти; *adj* – прямий, безпосередній

direct current [dɪ'rekt'kʌrənt] *n* – постійний струм

alternating current [ɔ:ltəneɪtɪŋ 'kʌrənt] *n* – змінний струм

capacitor [kə'pæsɪtə] *n* – конденсатор

conductor [kən'dʌktə] *n* – провідник

semiconductor [,semɪkən'dʌktə] *n* – напівпровідник

cell [sel] *n* – елемент

filament ['fɪləmənt] *n* – нитка розжарювання

fuse [fju:z] *n* – плавкий запобіжник

electrolyte [ɪ'lekrəulaɪt] *n* – електроліт

artificial satellite [,a:tɪ'fɪʃəl 'sætəlaɪt] *n* – штучний супутник

plug ['plʌg] *n* – штепсельна вилка

path [pa:θ] *n* – траєкторія

heat [hi:t] *n* – теплота

generate ['dʒenəreɪt] *v* – генерувати, породжувати

diode ['daɪəud] *n* – діод

- Write down the new words and learn them.

_____

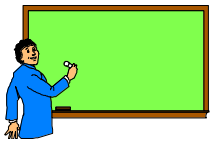
_____

_____

_____

Exercises

1. Explain the meanings of the following words and expressions from the text. Make sentences with each of them:



- electric current_____

_____

- direct current_____

_____

- alternating current_____

_____

- electric circuit_____

_____

- series circuits and parallel circuits_____

_____

- electronic devices_____

_____

2. Give English equivalents to the following words. Use them in questions to your friend.

Електричний заряд, провідник, запобіжник, змінний струм, постійний струм, опір, елемент, напівпровідник, конденсатор, електронний пристрій, небезпечний, генератор, електричне коло, магнітне поле, паралельне з'єднання, напрямок, вимикач.

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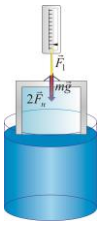
_____
_____

3. Read the text and fill in the gaps from below. Render it into Ukrainian. Give it a headline. Discuss with your partner the importance of static electricity.

_____



Sometimes, a large number of atoms in an object gain or lose _____. When such a gain or loss happens, the entire object takes on an electric charge. The term static electricity describes situations where objects carry_____.

Static electricity occurs, for example, when you rub a balloon on your shirt. The friction between the cloth and the balloon causes electrons to transfer from your shirt to the balloon. The shirt then has an overall positive charge because it has more protons than electrons. The balloon takes on a negative charge because it has extra electrons. The balloon will then stick to the shirt or to another surface, such as a wall.

Similarly, when you walk across a rug on a dry day, friction between your shoes and the rug transfers electrons from your body to the rug, giving your body a positive charge. If you touch a doorknob or other metal object, electrons may jump from the object to your body. You may see a spark and feel a slight shock.

Lightning results from static electricity. Scientists believe that raindrops tossed in the winds of thunderclouds build up electric charge. Parts of the cloud become positively charged, while other parts become_____. Charge may jump between different parts of the cloud, or from the cloud to the ground. The result is the huge electric spark we call_____.

Static electricity has many uses in homes, businesses, and industries. For example, the copying machines found in most offices are electrostatic copiers. They make duplicates of printed or written material by attracting negatively charged particles of toner (powdered ink) to positively charged paper. Static electricity is also used in air cleaners called electrostatic precipitators. These _____ put a positive electric charge on particles of dust, smoke, bacteria, or pollen in the air. Negatively charged collector plates attract the positive particles out of the air.

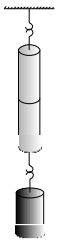
negatively charged	**lightning**	**devices**	**electric charge**	**electrons**

4. Fill in the correct word from the list below.
Use the words only once.

negative, light, charged, electric, magnetic, circuit, parallel, extra, complete

1. _____ electrode
2. _____ electrons
3. _____ particles
4. _____ breaker
5. _____ path
6. _____ spark
7. _____ fields
8. _____ bulb
9. _____ circuits

5. Choose the correct item:



The term static electricity describes situations where objects carry_____.
A electric spark **B** conductor **C** positive particles **D** electric charge

The battery, generator, or other energy source continually _____energy lost from the fields.
A changes **B** stores **C** restores **D** describes

A single battery or generator often _____ more than one electric device.
A stores **B** powers **C** attracts **D** grounds

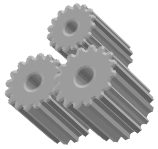
Solar cells convert sunlight into_____.
A positive particles **B** electric charge **C** lightning **D** electric energy

A basic switch consists of two _____that can be moved apart to create a gap in a circuit.
A generators **B** energy sources **C** electric conductors **D** batteries

The electric energy is converted to _____if it passes through a flashlight bulb.
A sunlight **B** moonlight **C** light **D** electric spark

Self Check

6. Complete the sentences. Develop the idea. There is a model at the beginning.



Model: ***The electrolyte helps promote chemical reactions at each electrode. As a result of the chemical reactions, a positive charge builds up at one electrode and a negative charge builds up at the other.***

1. A flow of electric charge through a conductor is called _____
_____
_____
_____.

2. The energy may come from _____
_____
_____
_____.

3. Generators change mechanical energy into _____
_____
_____
_____.

4. Wires and electric devices become dangerously hot if _____
_____
_____
_____.

5. Household lights and appliances are connected in _____
_____
_____
_____.

6. To use electric energy, an electric device must be connected to _____
_____
_____
_____.

7. A generator works because moving a conductor near a magnet produces _____
_____
_____
_____.

8. Switches called fuses and circuit breakers protect _____
_____
_____
_____.

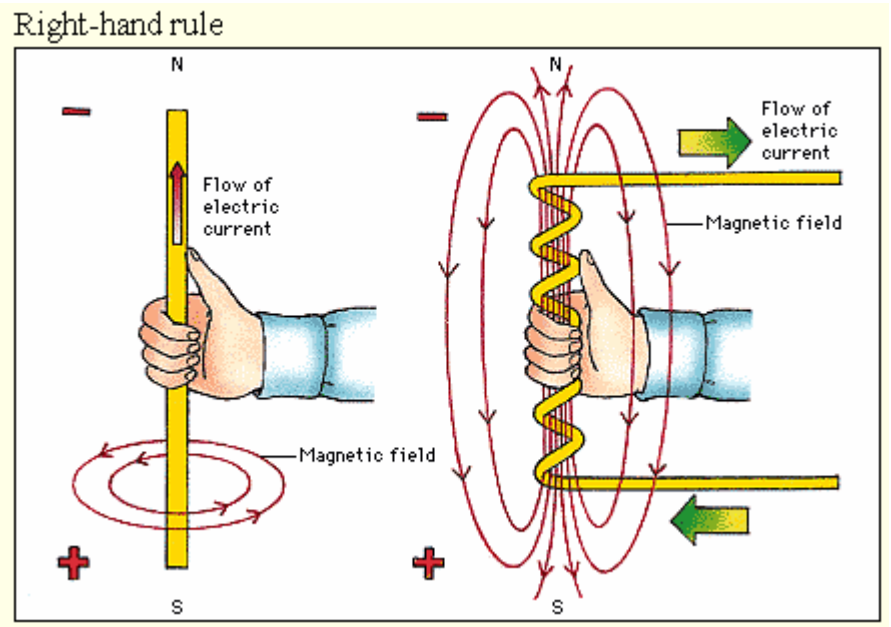
Speaking Task

1. Electricity and Magnetism – how are they related?

When an electric current passes through a wire a magnetic field is formed. When electric current flows through a wire, a magnetic field forms around the wire. The direction of the magnetic field depends on the direction of the current in the wire.

Look at the picture and describe it. When describing this physical law you should give examples.

Use words such as: ***generally speaking it seems to me, it is naturally, in this case, as a result of, I consider that, thus, therefore, hence, that is why.***



2. Speak on the topic:

"What is the difference between static and current electricity?"

Work in pairs

Discuss with your partner the following questions. Be ready to agree or disagree with...

Phrases to agreement or disagreement:

I agree that…	***Я згоден, що…***
It would be helpful to know…	***Було б корисно знати, що…***
I must express some disagreement with…	***Я не зовсім згоден …..***

1. What is energy associated with?
2. What do electronic devices include?
3. What does a basic switch consist of?
4. What does generator restore?

Check your grammar

1. Complete the following sentences choosing correct prepositions from the brackets:

- There is also a close connection *(in, through, between)* _____ physics and practical developments in engineering, medicine, and technology.

- The subjects studied (*with, by*) _____ physicists consist (*with, of*) _____ two broad categories, classical physics and modern physics.
- Modern physics concentrates (*under, on*) _____ scientific beliefs about the basic structure of the material world.
- Mechanics is the study of the effects of forces (*by, on)* _____ bodies (*in, at*) _____ rest or (*in, at*) _____ motion.
- Heat energy can be transformed (*through, into*) _____ other kinds of energy.
- This method of identification has important applications (*with, by, in*) _____ medicine.
- It provides the energy *(of, for, with*) _____atomic bombs and nuclear reactors.
- Electricity is a basic feature of the matter that makes (*on, up*) _____ everything (*in, on*) _____ the universe.
- Electrical force is responsible (*with, to, for*) _____holding together the atoms and molecules.
- Electricity is also associated (*to, by, with*) _____many biological processes.

2. Make the following infinitives passive:

1. A flow of electric charge through a conductor (to call) _____ electric current.
2. Energy (to associate) _____ with the flow of current.
3. Static electricity (to use) _____ in air cleaners.
4. Household lights and appliances (to connect) _____ in parallel circuits.
5. Photovoltaic cells (to make) _____ from semiconducting materials.
6. Electronic computers (to use) _____ in business, schools, government, industry, scientific laboratories, and the home.

3. Put the verb into the correct form:

1. Physicists (to study)_____ how plasmas might be controlled.
2. Because of the fields, particles attract or repel one another even when they not (to touch) _____.
3. Electric current only (to flow) _____ if there is a complete circuit that leads from the battery to the bulb and back to the battery.
4. The battery, generator, or other energy source continually (to restore) _____ energy lost from the fields.
5. Signals (to represent) _____ sounds, pictures, numbers, letters, computer instructions, or other information.
6. The value of such devices (to lie) _____ in their ability to manipulate signals extremely fast.
7. A television viewer can watch events on another continent as they (to take) _____ place.
8. Many digital circuits (to process) information much faster than analog circuits.
9. Researchers also (to test) _____ supergravity theories, which will include the fourth fundamental force, gravitation.
10. Many of these advanced courses (to include) _____ intensive laboratory work.

4. Put questions to the underlined words:

/ Researchers in West Germany discovered an important elementary particle, the gluon, <u>in 1979</u>.

_____

/ This movement of electrons creates <u>an electric current</u>.

_____

/ The study of light is called optics.

_____

/ Energy is associated with the flow of current.

_____

/ A battery produces direct current.

_____

/ Generators change mechanical energy into electric energy.

_____

/ Energy from the sun forces negative and positive charges in the semiconductor to separate.

_____

Talking Points

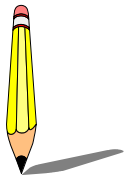
Read the text "Electric current" again and make notes under the following headings.

⟹ Direct current ⟹ Alternating current ⟹ Sources of current

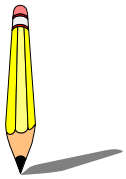
Then, looking at your notes, describe the difference between direct and alternating current.

Project Work

1. Make a report about sources of electric current.
2. Prepare a multimedia project on the topic studied.



Notes on the topic studied:



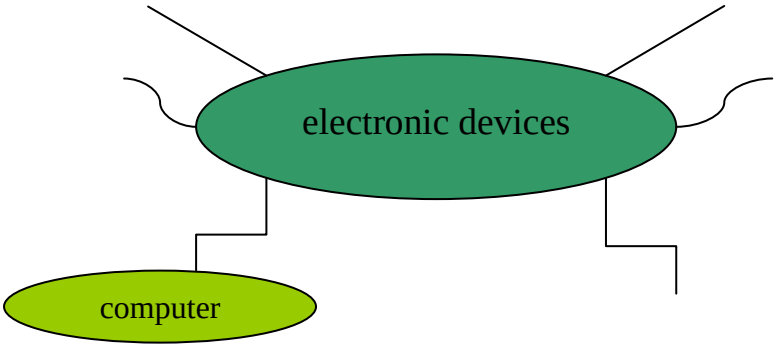
Notes on the topic studied:

Unit 5

Task 1. Discuss the following questions in groups:

? Do you know the difference between two terms: electronics and electricity? Which notion is supposed to be wider?

? Electronics has changed the way people live. What electronic devices do you know?



Task 2. Read the phonetic transcription. Practise your pronunciation:

[ɪlek'trɔnɪks] [ɪlek'trɔnɪk] [dɪ'rekʃən] ['dɪdʒɪt] ['dɪdʒɪtl] ['sə:kɪt] ['dɪdʒɪtl 'sə:kɪt] ['baɪnərɪ] [tʃɑ:dʒ] ['ækses] [kən'dʌktə] [vɔlt] [ˌmaɪkrəu'prəsesə] ['meməri] [kəm'pəunənt] [kəm'pju:tə] ['deɪtə] [ˌɪnfə'meɪʃən] [ˌsemɪkən'dʌktə] ['vəultɪdʒ] [ɪ'lekrɪk 'vəultɪdʒ] [ɪ'lekrɪk 'kʌrənt]

Task 3. Practise saying the following words and word-combinations. Pay attention to the pronunciation:

electronics, purpose, light and heat, current and voltage, binary number, binary digit, on-line services, digital circuits, semiconductor material, pressure, subcircuits, essential part, input data, analog signals, memory circuits, microprocessor, bits, byte, extremely, highly specialized components, power source, insulators, essential part of the circuit.

Task 4. Read the following international words and guess their meaning:

component, radio, information, industry, electronics, telephones, element, system, signal, optical, standard, diagram, vertical, visible, code, universal, symbol, sensor, minute, unique, term, general, position, laboratory, instrument

Task 5. Read the text and find some information about work of an electronic circuit:

Electronics

Electronics is a branch of physics and engineering that involves controlling the flow of electric charges in certain devices for a useful purpose. Electronic components (parts) are used in a broad range of products, including radios, television sets, computers, videocassette players, hearing aids, medical instruments, and many other products. Today, people rely so heavily on electronic products that the age we live in is often called the electronic age.

Electronics is part of the broad field of electricity. Electricity includes two important elements: (1) electric current and (2) electric voltage. Electric current is the flow of electric charges. Electric voltage is a type of "pressure" or force that causes the charges to move in the same direction. Familiar uses of electricity include the furnishing of energy in homes and businesses to provide light and heat, and to drive motors.

Electronics deals chiefly with the use of current and voltage to carry electric signals. An electric signal is an electric current or voltage modified in some way to represent information. A signal

may represent sound, pictures, numbers, letters, computer instructions, or other information. Signals can also be used to count objects, to measure time or temperature, or to detect chemicals or radioactive materials.

Electronics depends on certain highly specialized components, such as transistors and integrated circuits, that serve as part of almost all electronic equipment. The value of such devices lies in their ability to manipulate signals extremely fast. Some components can respond to signals billions of times per second.

The field of microelectronics is concerned with the design and production of miniature components, chiefly integrated circuits, and of electronic equipment that uses such components.

Electronics has changed the way people live. Electronic communication systems link people throughout the world. Radio can transmit a voice around the world in a fraction of a second. People in different countries communicate almost instantly through telephones and computers. A television viewer can watch events on another continent as they are taking place. Cellular telephones enable a person to call another person while riding in a car or walking down the street. Fax machines send and receive copies of documents over telephone lines in minutes.

Electronic computers are used in business, schools, government, industry, scientific laboratories, and the home. On-line services provide computer users instant access to a wide variety of information and features through telephone lines.

Electronic circuits

In any electronic device, a circuit provides a pathway for the electric current that operates the device. A calculator has a complex circuit. Many of the parts of this complex circuit are actually smaller subcircuits that perform particular jobs. Not all of the circuits necessarily work at the same time. Certain components act as electronic "switches," turning circuits "on" and "off" as needed. When a switch allows current to pass through a circuit, the circuit is on. When a switch blocks current, the circuit is off.

How a circuit works. To understand how an electronic circuit works, one must know something about atoms. Circuit operation is based on the attraction between charges.

The flow of electrons in one direction at a time forms an electric current. Voltage, also known as electromotive force, is the "pressure" or force that drives the electrons. In circuits, voltage is the electrical attraction caused by the difference in the charges between two points in the circuit. A power source provides voltage. One side of the power source supplies a negative voltage, and the other end supplies a positive voltage. Batteries are a common power source. Systems that plug into an electric outlet receive power from a commercial power plant.

Electrons flow from the negative voltage end of a circuit to the positive voltage end. This movement of electrons creates an electric current.

Wires and certain other parts of circuits are made of materials called conductors, which can carry an electric current. In conductors, which include metals, each atom has one or more electrons that can move from atom to atom. These electrons are called free electrons or charge carriers. Circuits also contain insulators, materials that block current because they have no mobile charge carriers.

As electrons move through a conductor, they collide with the atoms of the material. Each collision hinders the flow of electrons and causes them to lose some energy as heat. Opposition to electric current, which changes electric energy into heat, is known as resistance.

A build-up of heat can damage a circuit. A calculator uses so little current that there is no danger of overheating. However, some computers generate so much heat that their circuits must be continually cooled. The whirring noise a desktop personal computer makes comes from a small fan that cools the system.

Types of electronic circuits. Manufacturers make two types of electronic circuits: (1) conventional and (2) integrated. A calculator, like most electronic devices, has both kinds.

Conventional circuits consist of separate electronic components connected by wires and fastened to a base.

Integrated circuits have components and connectors formed on and within a chip-a tiny piece of semiconductor material, usually silicon. A semiconductor is a substance that conducts electric

current better than an insulator, but not as well as a conductor. The chip serves not only as the base but also as an essential part of the circuit. Most chips are no larger than a fingernail. Integrated circuits often serve as components of conventional circuits.
A type of integrated circuit called a microprocessor can perform all of the mathematical functions and some of the memory functions of a large computer.

Electronic circuits work with two basic types of signals: (1) digital and (2) analog. Digital signals represent all information with a limited number of voltage signals. Each signal has a distinct value. Analog signals vary continuously in voltage or current, corresponding to the input information. A fluctuating voltage can stand for changes in light, sound, temperature, pressure, or even the position of an object.
Digital circuits process information by counting or comparing signals. Many digital circuits can process information much faster than analog circuits. The majority of processing is done by digital circuits.
In digital processing, all input data-words, numbers, and other information - are translated into binary numbers, which are groups of 1's and 0's. The code is called binary (consisting of two) because only two digits are used. Any binary number can be represented by a combination of circuits or devices that are in one of two states. For example, a circuit can be on or off. One state corresponds to a binary 1 and the other to a 0. Each 1 or 0 is called a bit, a contraction of binary digit. Many systems work with bits in groups called words. A word that consists of 8 bits is called a byte.
Digital processing requires three basic elements: (1) memory circuits, which store data; (2) logic circuits, which change data; and (3) control circuits, which direct the operations of the system. Wire channels called buses link the elements to each other as well as to the entire system. A microprocessor combines these elements on one chip.
Memory circuits store bits permanently or temporarily. A common type of memory circuit contains thousands of capacitors arranged in rows. The capacitors hold bits as an electric charge or the absence of a charge. A metal conductor connects each capacitor to the system. Transistors or diodes act as switches between the capacitors and conductors. When a signal opens a switch, bits can travel along the conductor. Other circuits then restore the bits by recharging the capacitors with the same sequence of charges.

Check your pronunciation

Glossary:

electronics [ɪlek'trɔnɪks] *n* – електроніка
electronic [ɪlek'trɔnɪk] *adj* – електронний
direction [dɪ'rekʃən] *n* – напрямок
equipment – обладнання
digital ['dɪdʒɪtl] *adj* – цифровий
circuit ['sə:kɪt] *n* – коло, схема
digital circuit ['dɪdʒɪtl 'sə:kɪt] *n* – цифрова схема
bit [bɪt] *n* – мінімальна одиниця кількості інформації
byte [baɪt] *n* – одиниця виміру пам'яті, одиниця інформації = 8 біт
resistance [rɪ'zɪstəns] *n* – опір
data ['deɪtə] *n* – дані, інформація
semiconductor [ˌsemɪkən'dʌktə] *n* – напівпровідник
binary ['baɪnərɪ] *adj* – двійковий, бінарний
digit ['dɪdʒɪt] *n* – цифра, однозначне число
binary digit ['baɪnərɪ'dɪdʒɪt] *n* – двійкова цифра
charge [tʃɑ:dʒ] *n* – заряд
sequence of charges – послідовність зарядів
access ['ækses] *n* - доступ
conductor [kən'dʌktə] *n* – провідник
insulator ['ɪnsjuleɪtə] *n* – ізолятор, непровідник
voltage ['vəultɪdʒ] *n* – напруга
volt [vɔlt] *n* – вольт (одиниця виміру ел. напруги)

 **- Write down the new words and learn them.**

_____
_____
_____

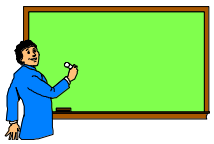
Exercises

1. Explain the meanings of the following words and expressions from the text. Make sentences with each of them:

- electronic products_____
_____
- digital circuits_____
_____
- binary number_____
_____
- memory circuit_____
_____
- electric voltage _____
_____

2. Find in the text the English equivalents for the following expressions:

- електронне обладнання_____
- двійкова цифра_____
- металевий провідник_____
- обмежена кількість_____
- функція пам'яті_____

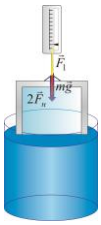


3. Give Ukrainian equivalents to the following words. Use them in questions to your friend:
digital circuits, input data, conductors, electric energy, insulators, light, sound, temperature, pressure, electronic components, pictures, numbers, letters, computer instructions, positive voltage.

_____
_____
_____
_____
_____

4. Read the text and fill in the gaps from below. Render it into Ukrainian. Give it a head-line. Discuss with your partner the two basic kinds of memory circuits.

_____



There are two basic kinds of memory circuits-random-access memory (RAM) and read-only memory (ROM). The information in RAM can be erased or added to. RAM circuits store_____ only as long as the power is on. When the power is turned off, all the stored charges are wiped out. RAM circuits are used in such devices as computers and certain calculators, which need to store large amounts of information for brief periods.

A ROM circuit permanently stores information installed at the time of manufacture. This information can be neither erased nor added to. ROM generally contains instructions, or programs, for operating the system.

Not all memory is stored in circuits. For example, computers also use external _____devices, such as magnetic disks and magnetic tapes. Users input such memory into the system. Another type of memory device is a_____, also called a CD, which

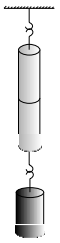
stores information on a plastic platter. A CD-ROM can store data, pictures, and sound as well as programs.
Logic circuits, also called_____, manipulate data according to instructions. In a processor, the bits go through a sequence of switches that change them in some way. For example, a group of switches may add two numbers together. Such a group is called an adder. An adder may involve hundreds of switches. During processing, bits are stored temporarily in areas called_____, awaiting the next instruction.

processors	**data**	**registers**	**compact disc**	**memory**

5. Fill in the correct word from the list below.
Use the words only once.
read-only, binary, magnetic, on-line, compact, power, positive

1. _____ tapes
2. _____ voltage
3. _____ digit
4. _____ memory
5. _____ services
6. _____ disc
7. _____ source

6. Choose the correct item:
A word that consists of 8 bits is called a_____.
A number **B** digit **C** byte **D** bit



The flow of electrons in one_____ at a time forms an electric current.
A route **B** direction **C** way **D** disk

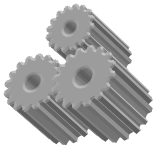
Batteries are a common _____ source.
A digital **B** magnetic **C** electrical **D** power

Opposition to electric current, which changes electric energy into heat, is known as_____.
A voltage **B** resistance **C** microprocessor **D** conductor

Transistors or diodes act as _____between the capacitors and conductors.
A semiconductors **B** circuits **C** disks **D** switches

Self Check

7. Complete the sentences. Develop the idea. There is a model at the beginning.



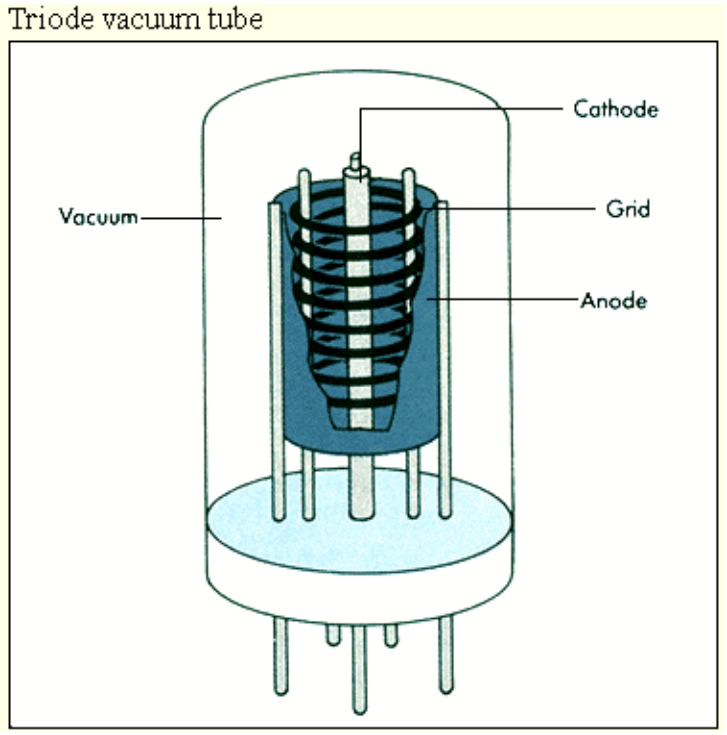
Model: ***Any binary number can be represented by a combination of circuits or devices that are in one of two states. For example, a circuit can be on or off. One state corresponds to a binary 1 and the other to a 0.***

1. Electronics is a branch of
   _____
   _____
   _____.
2. Electricity includes two important elements:
   _____
   _____
   _____.

3. Electrons flow from the negative voltage end of a circuit to
_____
_____
_____.
4. Digital circuits process information by
_____
_____
_____.
5. A type of integrated circuit called
_____
_____
_____.
6. Digital processing requires three basic elements:
_____
_____
_____.

Speaking Task

Task 1. Discuss the picture. Where do we use the triode vacuum tube? What for? Give your opinion.



<u>Work in pairs</u>

Task 2. Discuss the following questions. Be ready to agree or disagree with.
Phrases to agreement or disagreement:

I agree entirely with…	***Я повністю згоден, що…***
It would be helpful to know…	***Було б корисно знати, що…***
I must express some disagreement with…	***Я не зовсім згоден …..***

1. What is electronics?
2. How do electronics and the science of electricity differ in their use of electric current?
3. In what ways do conventional circuits differ from integrated circuits?
4. What is the difference between analog signals and digital signals?
5. What are the three main elements that digital circuits need to process information?

Check your grammar

1. Suggest antonyms of the following words:

positive – _____
repel – _____
protons – _____
hot – _____
easy – _____
small – _____
same – _____
direct current – _____

2. Use the correct form of Present Perfect:

1. Knowledge of this relationship (to lead) _____ to the development of huge electric generators and such electronic devices as radios, televisions, and computers.
2. Studies in atomic, molecular, and electron physics (to reveal) _____ much about the structure of matter.
3. Scientists (to determine) _____that substances differ from one another in the arrangement of the atoms.
4. Physicists (to discover) _____that the protons and neutrons within atomic nuclei are formed of still more elementary particles.
5. This table (to organize) _____the elements into groups with similar chemical properties.
6. People (to rely) _____so heavily on electronic products that the age we live in is often called the electronic age.
7. Electronics (to change) _____ the way people live.
8. Electronic communication systems (to link) _____ people throughout the world.
9. Ongoing research into the nature of matter (to lead) _____ to important discoveries.
10. Such theories illustrate how physicists again (to begin) _____ to express the hope that a few basic laws will unify all our knowledge about how the world works.

3. Use the correct form of Past Simple or Past Perfect:

1. In 1915, Einstein (to announce) that he (to develop) a general theory of relativity based on his special theory.
2. In 1900, the German physicist Max K. E. L. Planck (to propose) that the radiation of light occurred in packets of energy, called quanta.
3. Some astronomers before Ptolemy (to suggest) that the earth did in fact move.
4. In Copernicus's time, most astronomers (to accept) the theory the Greek astronomer Ptolemy (to formulate) nearly 1,400 years earlier.
5. Ptolemy (to say) that the earth was at the center of the universe and was motionless.
6. He also (to stat) that all the observed motions of the heavenly bodies were real and that those bodies (to move) in complicated patterns around the earth.

4. Read these sentences and state the functions of the *–ing-forms:*

1. It is no use performing this operation now.
2. The entire situation is being slightly changed.
3. We know of their having succeeded in finding an appropriate explanation.
4. We have defined these sets as being equal.
5. When working with these signs one must be very careful.

5. Make up questions to the following statements:

1. Memory circuits store bits permanently or temporarily.

_____

2. Opposition to electric current, which changes electric energy into heat, is known as resistance.

_____

3. The chip serves not only as the base but also as an essential part of the circuit.

_____

4. Electronics deals chiefly with the use of current and voltage to carry electric signals.

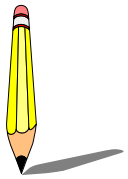
_____

5. Electric current is the flow of electric charges.

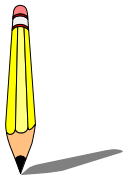
_____

6. Electronics depends on certain highly specialized components, such as transistors and integrated circuits.

_____



Notes on the topic studied:



Notes on the topic studied:

Unit 6

Task 1. Think over such questions:

☺ There is no doubt that physics is an important science. Complete the following sentence:

! The importance of physics lies in… _____

☺ In a year you will get bachelor's degree in physics. What are your plans for the future? Will your job be somehow connected with physics?

Task 2. Read the phonetic transcription. Practise your pronunciation:

['fɪzɪks] ['fɪzɪsɪst] ['fɪzɪkəl] ['enədʒɪ] [mɪ'kænɪks] [mɪ'kænɪkəl] [ək,selə'reɪtə] [tek'nɔlədʒɪ] ['sɪstɪm] [dɪ'zaɪn] [ɪm'plɔɪ] [,kɔntrɪ'bju:ʃən] [,grævɪ'teɪʃən] [dɪs'kʌvərɪ] ['nju:klɪəwepən] [prɪ'dɪkt] [rɪ'sə:tʃ] ['deɪndʒə] ['nju:klɪəpla:nt] ['neɪtʃə] ['saɪəns] ['saɪəntɪst] ['mætə] ['enədʒɪ]

Task 3. Practise saying the following words and word-combinations. Pay attention to the pronunciation:

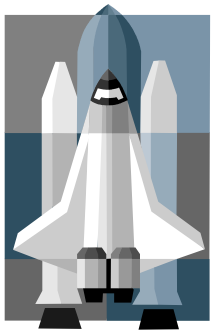
physicists, high-energy particle accelerators, researchers, important discoveries, higher mathematics, chemistry, facilities, nuclear energy, environment, superconductivity, doctor's degrees, nuclear power plant, danger, medical imaging systems, highly specialized, physics laboratories.

Task 4. Read the following international words and guess their meaning:

project, social, kinetic, nation, faculty, crisis, substance, transmission, hemisphere, transform, qualification, compact, motive, diagnose, component, agent, absolute, contrast, isolate, attack, report, primitive, priority.

Task 5. Read the text and find information about physics contributions to technology:

Physics today



Physics continues to be one of the most active and important sciences. Ongoing research into the nature of matter has led to important discoveries. For example, researchers in West Germany discovered an important elementary particle, the gluon, in 1979. Gluons, which are a type of boson, carry the powerful strong force. This force, also called the strong interaction, binds the atomic nucleus together. In 1983, a research team led by Carlo Rubbia of Italy discovered two more subatomic particles- the W particle and the Z particle. Physicists predict that these particles are a source of the weak force, also called the weak interaction. This force controls the disintegration of atomic nuclei – the process at work in radioactivity.

Physicists believe that there may be an underlying unity among three of the basic forces of the universe: the strong force, the weak force, and the electromagnetic force that holds electrons to the nucleus. Theories that attempt to establish this underlying unity are referred to as grand unified theories. Researchers are also testing supergravity theories, which would include the fourth fundamental force, gravitation. Such theories illustrate how physicists have again begun to express the hope that a few basic laws will unify all our knowledge about how the world works.

Physics also continues to make important contributions to technology. For example, advances in electronics resulted in the development of extremely sophisticated computers. Lasers and optical fibers (glass or plastic filaments that carry light) led to improvements in communication systems and medical technology. Physicists began developing ceramiclike materials that can act as superconductors at much higher temperatures than the superconductors of the past. Advances in

superconductivity could one day lead to such applications as efficient and economical power generators, high-speed trains that float on magnetic fields, and improved medical imaging systems.
A person who plans to pursue physics as a career should take science and mathematics courses in high school. The formal training of physicists begins in college. Physics students must learn calculus, modern algebra, and other forms of higher mathematics. They also take basic courses in chemistry. After a year or two of introductory course work, physics majors begin to specialize, taking more advanced courses in the various subfields of physics. Many of these advanced courses include intensive laboratory work.
Most physics majors continue their education beyond the bachelor's degree. A majority pursue doctor's degrees. A key part of a physicist's training includes learning to ask questions that suggest new approaches to understanding how the world works.
More than half the physicists in Ukraine are engaged in research and development activities. Many industries employ physicists in their research departments. These people often work in applied physics, which generally involves improving manufacturing processes or products. Many physicists are employed by colleges and universities. They generally divide their time between teaching classes and performing research.
Today, physics research often requires the use of highly specialized and expensive instruments and equipment, such as high-energy particle accelerators. In Europe, the nations that belong to the European Organization for Nuclear Research built the CERN physics laboratories in Geneva, Switzerland.

Check your pronunciation

Glossary:

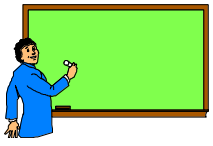
physicist ['fɪzɪsɪst] *n* – фізик	**predict** [prɪ'dɪkt] *v* - пророкувати
universe ['ju:nɪvə:s] *n* – всесвіт	**nuclear weapon** ['nju:klɪəwepən] *n* – ядерна зброя
employ [ɪm'plɔɪ] *v* – надавати роботу, наймати	**discovery** [dɪs'kʌvərɪ] *n* – відкриття
sophisticated computers – вдосконалені комп'ютери	**gravitation** [,grævɪ'teɪʃən] *n* – гравітація, тяжіння, сила тяжіння
contribution [,kɔntrɪ'bju:ʃən] *n* – внесок	**research** [rɪ'sə:tʃ] *n* – (наукове) дослідження, дослідницька робота

- Write down the new words and learn them.

_____
_____
_____
_____

Exercises

1. Explain the meanings of the following words and expressions from the text. Make sentences with each of them:



- radioactivity _____
  _____
  _____
- research_____
  _____
- important contributions
  _____
  _____
- highly specialized and expensive instruments and equipment
  _____
  _____
  _____

- development activities

_____

_____

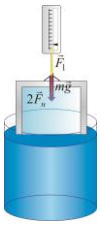
- subfields of physics

_____

_____

2. Read the text and fill in the gaps from below. Render it into Ukrainian. Give it a headline. Discuss with your partner the main sources of heat.

_____



Anything that gives off heat is a source of heat. The heat that we use or that affects life and events on the earth comes from six main sources. They are (1) _____, (2) the earth, (3) chemical reactions, (4) nuclear energy, (5) friction, and (6) electricity. We control some of these sources, and others we do not. We use the sources we control, such as electricity and nuclear energy, to heat buildings and do other work. But the sources we do not control also benefit us. For example, the sun provides the heat and light that make life possible. All sources of heat, even those that we normally control, can do great damage if they get out of control. For example, fires, which are chemical reactions, destroy much property every year.

The sun is our most important_____. If the sun should ever cool, the earth would become cold and lifeless. Only a tiny fraction of the heat produced in the sun strikes the earth. Yet it is enough to keep us and all other organisms on the earth alive.

The sun's heat is absorbed by the seas, the ground, plants, and the_____. Large amounts of heat can be collected by using such devices as large solar furnaces. These furnaces have mirrors that reflect the sun's light from a wide area onto one spot. Some solar furnaces can generate enough heat to melt steel. Smaller ones can gather enough heat to cook food.

The _____ itself contains much heat deep inside. When a _____ erupts, some of this heat escapes to the surface. The lava from a volcano is rock melted by the heat deep within the earth. Some of the earth's heat also escapes in geysers. These springs shoot forth boiling water that has been heated by hot rocks within the earth. People have begun to use the earth's heat to generate electricity, heat houses, and do other work.

Chemical reactions can produce heat in a number of ways. A chemical reaction in which a substance combines with oxygen is called oxidation. Rapid oxidation produces heat fast enough to cause a flame. When coal, wood, natural gas, or any other fuel burns, substances in the fuel combine with oxygen in the air to form other compounds. This chemical reaction, which is known as_____, produces heat and fire.

volcano	**combustion**	**earth**	**source of heat**	**the sun**	**atmosphere**

3. Give English equivalents to the following words. Use them in questions to your friend.

Атмосфера, всесвіт, наукові дослідження, фізик, ядерна фізика, ядерна електростанція, ядерна зброя, загроза, довкілля, поверхня, радіація, тертя, хімічні реакції, радіоактивність, взаємодія, сила тяжіння.

_____

_____

_____

_____

4. Fill in the correct word from the list below.
Use the words only once.

bachelor's, nuclear, electromagnetic, supergravity, basic, laboratory, chemical

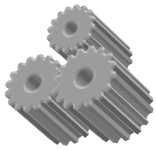
1._____ degree

2._____ reactions

3._____ laws
4._____ force
5._____ energy
6._____ theories
7._____ work

Self Check

5. Complete the sentences. Develop the idea. Give your point of view in 2-3 sentences. There is a model at the beginning.



Model: ***Physics also continues to make important contributions to technology. For example, advances in electronics resulted in the development of extremely sophisticated computers.***

1. Physics students must learn
   _____
   _____
   _____.
2. Physics research often requires
   _____
   _____
   _____.
3. A key part of a physicist's training includes
   _____
   _____
   _____.
4. A person who plans to pursue physics as a career should
   _____
   _____
   _____.

Speaking Task

Look at the picture. Discuss the good and bad points of the nuclear energy. Do you think that our planet is in danger? What problems does our planet face? Express your opinion.
Use words such as: ***nuclear physics, nuclear power plant, nuclear weapon, nuclear energy, danger, environment.***

Nuclear power plant

Check your grammar

1. Put the verb into the correct form (use Perfect Tenses):

1. They (to change) _____ the whole system.
2. By around 3000 B.C., the Sumerians (to develop)_____ a number system, and they used algebraic formulas for following and predicting movements of the stars, sun, moon, and planets.
3. Our group (to determine)_____ to agree to this plan.
4. They (to choose) _____ the conventional method.
5. People (to begin) _____ to use the earth's heat to generate electricity, heat houses, and do other work.
6. Such materials (to make) _____possible modern computers and other important electronic devices.
7. Scientists before Einstein (to discover) _____ that a bright beam of light striking a metal caused the metal to release electrons, which could form an electric current.
8. Electronics (to change) _____ the way people live.
9. The Industrial Revolution, which (to deign) _____ in Great Britain in the 1700's, led to the production of scientific instruments that were extremely accurate for their time and which enabled scientists to perform more complicated experiments.
10. They already (to choose) the conventional method.

2. Translate these sentences. Note the use of the Gerund.

1. Having performed the first step made it possible to take the following steps.

_____

2. On obtaining the results the scientists went on working.

_____

3. He knew nothing of our having realized the program.

_____

4. The two statements being internally consistent is evident.

_____

5. The two scientists doing research independently made it possible to create two different ways of solving the same problem.

_____

_____

3. Put all types of questions to the following sentences:

- Circuit operation is based on the attraction between charges.

_____

_____

_____

- Physics continues to be one of the most active and important sciences.

_____

_____

_____

- Electric current will flow if there is a complete circuit.

_____

_____

_____

- In 1983, a research team led by Carlo Rubbia of Italy discovered two more subatomic particles.

_____

_____

_____

- Copernicus proposed that the earth was one of the planets, all of which orbited the sun.
- Many industries employ physicists in their research departments.

_____
_____
_____

- All nuclei have the same extremely high density.

_____
_____
_____

- Scientists have developed special techniques to obtain pure crystals of semiconductor materials.

_____
_____
_____
_____

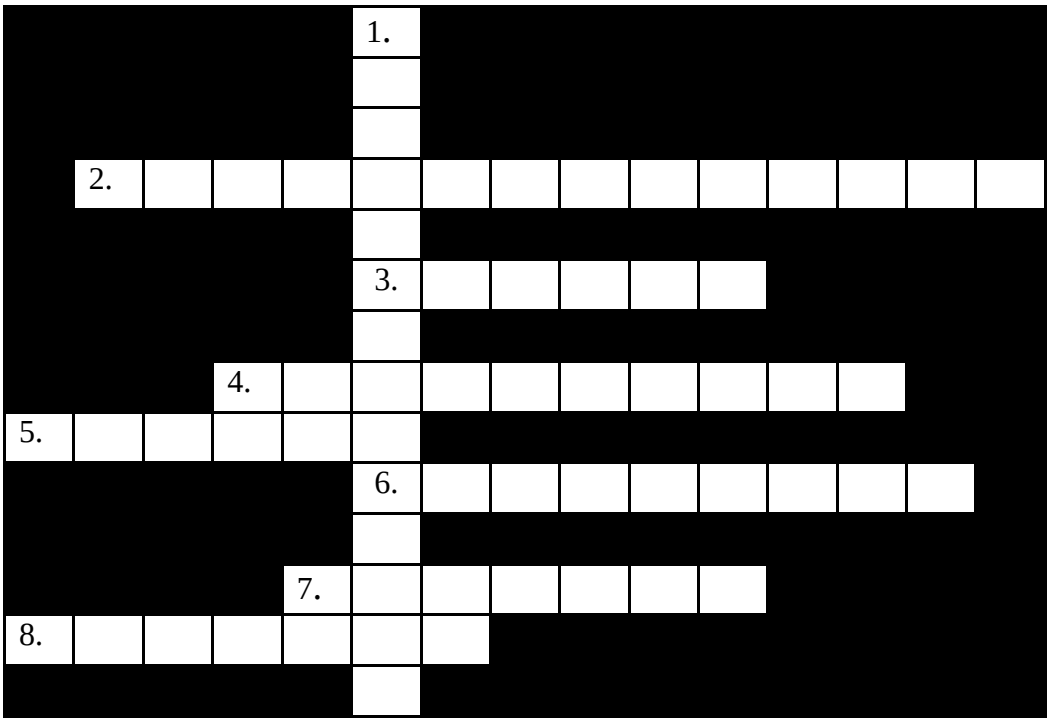
- Try the crossword!

Down:

1. The study of heat.

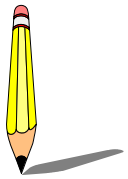
Across:

2. Solid that loose all electrical resistance at extremely low temperatures.
3. The study of light.
4. The study of material at very low temperatures.
5. The process in which the nuclei of two atoms join together to form the nucleus of a heavier element.
6. The study of sound.
7. The process in which an atomic nucleus splits into two nearly equal parts.
8. The mechanics of bodies at rest or in motion at a constant speed and in a constant direction.

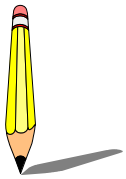


Project Work

1. *Make a report about one of the great physicists.*
2. *Write an essay "My future career".*
3. *Prepare a multimedia project on the topic studied.*



Notes on the topic studied:



Notes on the topic studied:

It is interesting to read. Useful information.

Text 1

History

The beginnings of physics date back to prehistoric times. Stonehenge and the other huge rock structures prehistoric people built indicate that they had some knowledge of mechanics. Such knowledge would have been necessary for them to transport these rocks and to place them on top of one another. In addition, there is some evidence that prehistoric people may have used these rock structures to mark significant moments in the seasonal cycle of the sun and moon.

The first people to leave written records of their discoveries and inventions were the Sumerians, Babylonians, and Egyptians. By around 3000 B.C., the Sumerians had developed a number system, and they used algebraic formulas for following and predicting movements of the stars, sun, moon, and planets. Similar developments occurred in Egypt and Babylonia. The Egyptians also developed practical geometric techniques for use in construction and land surveying.

The Greeks appear to have been the first people to develop general theoretical systems of mathematics and natural science. Beginning about 600 B.C., they developed a general understanding of the principles of geometry. The Greek mathematician Euclid organized these principles into a unified system about 300 B.C.

The Greeks were keen observers of the physical world. In the 300's B.C., the philosopher Aristotle provided proofs, based on physical evidence, of the spherical shape of the earth. In the 200's B.C., the astronomer Eratosthenes calculated the circumference of the earth, and Aristarchus, another astronomer, estimated the relative distances to the moon and sun. Also during the 200's B.C., the mathematician and inventor Archimedes discovered several basic scientific principles and developed ways of calculating areas and volumes.

In the A.D. 100's, Ptolemy, an astronomer in Egypt, developed a model for predicting the positions of the sun, moon, stars, and planets. Like Aristotle and other Greek philosophers, Ptolemy viewed the earth as the center of the universe. Ptolemy's system served as a guide for predicting the motion of the heavenly bodies for nearly 1,500 years.

The Middle Ages began in about the 400's with the fall of the Roman Empire. At that time, records of Greek scientific discoveries were lost to western Europe. From about 400 to 1000, western Europeans had little interest in scientific learning. Most educated people felt that religion, rather than scientific investigation, should provide the answers to questions about the universe.

Much of the Greek written tradition in science was preserved during the early Middle Ages by people in the Middle East. These people translated many of the Greek works into Arabic. Arabic scholars wrote commentaries on these texts, made astronomical observations to correct Ptolemy's system of astronomy, and performed experiments in optics and mechanics.

During the 1100's and 1200's, there was also increasing interest in scientific observation and experiments. For example, various writings, including those of the English scholars Robert Grosseteste and Roger Bacon, proposed effective methods for scientific research.

Practical inventions in agriculture and other fields also sparked scientific inquiry in Europe during the Middle Ages. In China and other Asian countries, scientific activity and invention flourished during this period. However, unlike in the West, science and technology had little influence on each other.

The Renaissance is the name given to the period in Europe that extended from about the early 1300's to about 1600. It was a time of social, economic, political, and intellectual excitement that produced many new approaches in both the arts and the sciences.

In the 1300's, at Oxford University and the University of Paris, such scholars as Richard Swineshead and Nicole Oresme investigated the problem of the description of motion. During the 1400's and 1500's, the famous Italian painter and inventor Leonardo da Vinci also conducted studies of motion and hydraulics.

In 1543, the Polish astronomer Nicolaus Copernicus published a revolutionary astronomical system in which he placed the sun--instead of the earth--at the center of the universe. Copernicus proposed that the earth was one of the planets, all of which orbited the sun. At the time, almost no one accepted his point of view. Catholic and Protestant leaders alike felt that his system was in conflict with their religious beliefs. There were also serious scientific objections to the system. Acceptance of the Copernican system required a complete rethinking of the whole basis of physical science. Such a rethinking did in fact occur over the next 150 years, primarily through the work of such major figures as Galileo, Johannes Kepler, and Rene Descartes.

Beginning in 1609, the Italian astronomer and physicist Galileo built a number of telescopes for observing the heavens. While none of Galileo's observations with his telescopes proved the Copernican system, they did call traditional views into question. Galileo also perfected the idea of the laboratory experiment in his study of the motion of falling bodies. He showed that a person could gain an understanding of the way objects fall toward the earth by assuming that, in the absence of disturbing influences, all the objects accelerate at the same constant rate.

In the early 1600's, the German astronomer and mathematician Johannes Kepler used the observations of others to construct a new and accurate model of the solar system. In the mid-1600's, Rene Descartes, a French philosopher and mathematician, challenged the long-standing assumption that an absence of motion was the natural state of all objects. Instead, he proposed that objects have inertia--that is, they maintain whatever their state of motion unless otherwise disturbed.

The work of Galileo, Kepler, and Descartes reflects a change in attitude that occurred during the Renaissance. People had begun to believe that the physical world was governed by natural laws, and that it was possible to discover those laws. The path to such discovery was now seen to begin with careful measurements carried out, if possible, under controlled laboratory conditions.

Developments in the 1800's. The Industrial Revolution, which had begun in Great Britain in the 1700's, led to the production of scientific instruments that were extremely accurate for their time and which enabled scientists to perform more complicated experiments. As scientific research grew more complex, people began specializing in more narrowly defined areas of study. Three areas of particular interest in the 1800's were heat and energy, light, and electricity and magnetism.

The beginning of modern physics. Near the end of the 1800's, many physicists were convinced that the work of physics was nearly over. They believed that almost all the laws governing the physical universe had been discovered. Some of them believed that all physical laws would one day be expressed in a few simple equations.

The dream of explaining all physical phenomena with one small set of basic laws was not realized. Instead, various discoveries began to reveal that such phenomena were more complex than scientists had thought. In 1895, for example, Wilhelm Roentgen of Germany discovered X rays. In 1896, the French physicist Antoine Henri Becquerel discovered natural radioactivity, the spontaneous emission of radiation from atoms. In 1897, the English physicist Joseph J. Thomson discovered the first subatomic particle, later called the electron. In 1898, French physicists Marie Curie and her husband, Pierre, isolated the radioactive element radium. Such developments signaled that, rather than being nearly over, the work of physics had only begun.

Quantum theory. The early 1900's brought revolutionary developments in physics. Scientists looked for inconsistencies in the classical physics of Newton and others, and discovered new interpretations of observed events.

In 1900, the German physicist Max Planck published his quantum theory of energy transfer to explain the spectrum of light emitted by certain heated objects. He stated that energy is not given off continuously, but in the form of individual units called quanta. In 1905, Albert Einstein, the German-born American physicist, proposed a new particle, later called the photon, as the carrier of electromagnetic energy. Einstein said that light, in spite of its wave nature, must be composed of these energy particles.

Text 2 

Thermodynamics

Thermodynamics is the study of the relationship between heat and other forms of energy. It is based on three laws (principles).

The first law of thermodynamics is the law of conservation of energy. It states that energy is never created or destroyed. Energy may change form-for example, from internal energy to mechanical motion--but the total quantity of energy in any system (group of things) remains the same.

According to the second law, all spontaneous (natural) events act to increase the entropy within a system. Until a system reaches its maximum entropy, it can do useful work. But as a system does work, its entropy increases until the system can no longer perform work.

The third law of thermodynamics concerns absolute zero. It states that it is impossible to reduce the temperature of any system to absolute zero.

Thermodynamics is the study of various forms of energy, such as heat and work, and of the conversion of energy from one form into another. Engineers, chemists, and physicists use the principles of thermodynamics in understanding events in nature and in such activities as designing machines and calculating the loss or gain of energy in chemical reactions.

Thermodynamics is based chiefly on two laws (principles). The first law states that energy in a system, which may be anything from a simple object to a complex machine, cannot be created or destroyed. Instead, energy is either converted from one form into another or transferred from one system to another. For example, a heat engine, such as a gas turbine or a nuclear reactor, changes energy from fuel into heat energy. It then converts the heat energy into mechanical energy that can be used to do work. The total amount of energy always remains the same. In addition, all systems have internal energy that undergoes certain changes but is never created or destroyed. Scientists study changes in this internal energy by measuring the differences in such properties as the volume, temperature, and pressure of the system.

The second law of thermodynamics deals with the natural direction of energy processes. For example, according to this law, heat will, of its own accord, flow only from a hotter object to a colder object. The second law of thermodynamics accounts for the fact that a heat engine can never be completely efficient--that is, it cannot convert all the heat energy from its fuel into mechanical energy. Instead, the engine transfers some of its heat energy to colder objects in the surroundings.

Text 3 

Nuclear physics

Nuclear physics is the branch of physics that deals with the properties, structure, and reactions of atomic nuclei. Nuclear physics began around 1900 with the discovery of radioactivity and the nucleus. The development of increasingly powerful and precise tools has enabled physicists to study nuclei in ever greater detail.

The nucleus contains more than 99.9 percent of an atom's mass. It consists of two kinds of particles, neutrons and protons, with nearly identical masses. Protons have a positive electrical charge, and neutrons have none. The number of protons in a nucleus determines what chemical element the atom belongs to. The neutron number determines what isotope of that element it represents.

A powerful force called the strong nuclear force or strong interaction binds the neutrons and protons in the nucleus and packs them together. All nuclei have the same extremely high density. If the earth were compressed until it had the density of an atomic nucleus, its diameter would be only about 1/3 mile (0.5 kilometer).

Nuclei with different numbers of protons and neutrons can have remarkably different properties. Some nuclei are shaped like spheres, while others are slightly elongated like footballs or slightly flattened like jelly doughnuts. Some nuclei are rigid, while others are somewhat flexible. Some are stable, while others are radioactive and spontaneously release radiation called alpha particles, beta particles, and gamma rays in order to take a more stable form. Physicists explain these properties using sophisticated theories that allow them to predict the behavior of new kinds of nucei.

Much of the information about atomic nuclei comes from studies of nuclear reactions. Typically, a particle accelerator is used to create tiny, high-velocity beams of protons, electrons, or other particles. A nuclear reaction occurs when one of these particles strikes a nucleus. Physicists then use high-precision tools to analyze the radiations emitted during the reaction.

Nuclear reactions are used in both nuclear weapons and devices developed for peaceful purposes. The fission (splitting) of very heavy nuclei and the fusion (combining) of two very light nuclei both release large amounts of energy. Usually, this energy is released in a slow, controlled way. Fission energy is used to generate electricity and to power ships, and researchers are working on devices to turn fusion energy into electricity. In nuclear weapons, very different conditions force a large number of fission or fusion reactions to occur nearly simultaneously, producing an atomic bomb or hydrogen bomb explosion.

Research in nuclear physics has led to new techniques for diagnosing and treating disease, sterilizing and preserving food, and exploring for oil. Often, these techniques make use of radioactive nuclei called radioisotopes. Nuclear research is also useful in other branches of physics and in such fields as astrophysics, biochemistry, and chemistry.

Text 4 

Semiconductor

Semiconductor is a material that conducts electric current better than insulators like glass, but not as well as conductors like copper. Such materials have made possible modern computers and other important electronic devices. The transistors used in tiny pocket radios are semiconductor devices. So are the solar cells that provide electric power in artificial satellites.

Silicon is the most widely used semiconductor material. Other important semiconductor materials include cuprous oxide, germanium, gallium arsenide, gallium phosphide, indium arsenide, lead sulfide, selenium, and silicon carbide.

Electronic devices made of semiconductor materials can perform many functions, including those of vacuum and gas-filled tubes. However, semiconductor devices have a number of advantages over these tubes. Semi-conductor devices use much less power than tubes, they last longer, and they can be built much smaller. One example of a tiny semiconductor device is the silicon chip used in computers and calculators.

Like tubes, semiconductor devices can rectify (change alternating current to direct current). They can also amplify weak electric signals. In addition, these devices can oscillate (make alternating current or radio waves) at frequencies from a few hertz to over 100,000 megahertz. Radios, television sets, and other electronic devices depend on rectifiers, amplifiers, and oscillators. Some semiconductor devices can make light, and others can detect light. Most television camera tubes are semiconductor devices.

Basic principles. In ordinary copper wire, the copper atoms have electrons that are free to move from atom to atom. Such a flow of electrons makes up an electric current. In an ideal state, semiconductor materials would be insulators because they would have no free electrons. But if very small amounts of certain impurities such as antimony, arsenic, or phosphorus are present, a few free electrons are produced that can move and form an electric current. These semiconductors are known as n-type semiconductors.

Another type of semiconductor, called p-type, is formed by adding small quantities of other impurities such as aluminum, boron, or gallium. These impurities take electrons away from a few atoms of the semiconductor. This lack of an electron in an atom is called a hole. A hole can pass from one atom to another. A flow of such holes passing from atom to atom also forms an electric current.

The abbreviation n means negative, referring to the negative charge of the electrons in n-type materials. Similarly, p means positive, referring to the positive charge associated with holes in p-type materials.

Semiconductor materials must be exceptionally pure to work properly. Scientists have developed special techniques to obtain pure crystals of semiconductor materials and to add the right amounts of impurities.

Semiconductor devices include semiconductor diodes, semiconductor lamps, semiconductor lasers, semiconductor radiation detectors, solar cells, and transistors. These devices are formed by making certain regions in a semiconductor either p- or n-type.

Semiconductor diodes allow current to flow in only one direction and are used as rectifiers. They have a piece of gallium arsenide, germanium, or silicon with an n-type region and a p-type region. The area where the two regions touch is called a p-n junction. When the p-type region has a positive charge and the n-type region has a negative charge, the p-type attracts electrons from the n-type, and the n-type attracts holes from the p-type. Thus, electric current flows across the p-n junction. If the p-type region is made negative and the n-type region is positive, almost no current will flow across the junction. The p-type then repels electrons in the n-type, and the n-type repels holes in the p-type.

Semiconductor lamps include tiny gallium phosphide diodes that produce light with little electric power. These lamps are used in some telephone sets.

Semiconductor lasers produce narrow beams of intense light. They are efficient lasers, but their light covers a wider frequency range than light from other lasers.

Semiconductor radiation detectors indicate the presence and intensity of gamma rays and X rays. These devices are widely used in scientific research.

Solar cells change sunlight into electric power. They are made of slabs of silicon with a p-n junction near the surface. Light knocks electrons out of the atoms, producing electrons and holes that flow to make an electric current.

Transistors are used to amplify electric signals, act as oscillators, or make circuits that perform arithmetic and logic operations. Some transistors have more than one p-n junction.

Famous Physicists :

Archimedes

Archimedes, pronounced ahr kuh MEE deez (287?-212 B.C.), was the most original and profound mathematician of ancient times. Archimedes, a Greek, was also a physicist and a mechanical engineer. In the ancient world, he was best known as an inventor. His surviving writings rank among the masterpieces of scientific literature, especially On the Sphere and Cylinder.

Archimedes was born in Syracuse, the largest Greek settlement in Sicily. He probably went to study in Alexandria, Egypt, then the chief center of Greek learning. There, Archimedes studied with disciples of Euclid, a famous Greek mathematician. Archimedes spent the rest of his life in Syracuse. When the Romans captured Syracuse, the Roman commander Marcellus ordered that citizens of Syracuse be left unharmed. However, according to one story, Archimedes was killed by a soldier while working on a geometry problem.

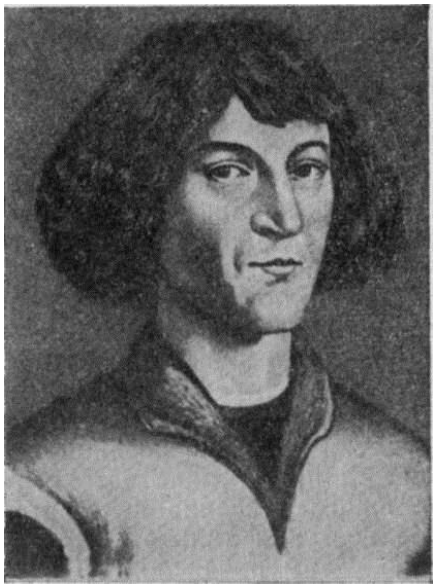
Archimedes proved the law of the lever and invented the compound pulley. With these machines, it is possible to move a great weight with a small force. Archimedes reportedly once boasted to Hiero, king of Syracuse: "Give me a place to stand on, and I will move the entire earth." He was referring to the way levers and pulleys can help people move objects many times their own size. The king challenged him to prove his boast. Archimedes is said to have used a system of pulleys to move a ship fully loaded with passengers and freight In his investigations of force and motion, Archimedes also discovered that every object has a center of gravity. This is a single point at which the force of gravity appears to act on the object.

Archimedes did much of his work for King Hiero. In one famous story, the king suspected that a goldsmith had not made a new crown of pure gold, but had mixed in some less costly silver. The king asked Archimedes to find out if the goldsmith had cheated.

Archimedes found the answer to this problem while taking a bath. His solution rested on volume (the amount of space occupied by an object). Archimedes noticed that water spilled out of the bath as he placed his body into it. By measuring the amount of water his body displaced, he could measure its volume. Archimedes was so excited when he found the answer that he ran into the street without dressing, shouting "Eureka!" (I have found it!) . Archimedes compared the amount of water displaced by the crown to the amount of water displaced by an equal weight of pure gold. The crown displaced more water, and so it was not pure gold. The goldsmith had cheated.

Archimedes discovered other basic laws of hydrostatics, the branch of physics that deals with liquids at rest. One of the major laws, called Archimedes' principle, describes buoyancy. Buoyancy is the loss in weight an object seems to undergo when placed in a liquid, as compared to its weight in air. Archimedes' principle states that an object fully or partly immersed in a liquid is buoyed upward by a force equal to the weight of the liquid displaced by that object. From this principle, he concluded that a floating object displaces an amount of liquid equal to its own weight.

Copernicus



Copernicus, pronounced koh PUR nuh kuhs, Nicolaus, pronounced nihk uh LAY uhs (1473-1543), was a Polish astronomer who developed the theory that the earth is a moving planet. He is considered the founder of modern astronomy.

In Copernicus's time, most astronomers accepted the theory the Greek astronomer Ptolemy had formulated nearly 1,400 years earlier. Ptolemy had said that the earth was at the center of the universe and was motionless. He had also stated that all the observed motions of the heavenly bodies were real and that those bodies moved in complicated patterns around the earth.

Some astronomers before Ptolemy had suggested that the earth did in fact move. The Greek astronomer Aristarchus had even suggested that the earth and all the other planets moved around the sun. By Ptolemy's time, however, these theories had been rejected. Copernicus knew about some of these early theories. He also believed that Ptolemy's theory was too complicated. He decided that the simplest and most systematic explanation of heavenly motion required that every planet, including the earth, revolve around the sun. The earth also had to spin around its axis once every day. The earth's motion affects what people see in the heavens, so real motions must be separated from apparent ones. Copernicus skillfully applied this idea in his masterpiece, On the Revolutions of the Heavenly Spheres (1543). In this book, he demonstrated how the earth's motion could be used to explain the movements of other heavenly bodies. Copernicus could not prove his theory, but his explanation of heavenly motion was mathematically strong and was less complicated than Ptolemy's theory. By the early 1600's, such astronomers as Galileo in Italy and Johannes Kepler in Germany began to develop the physics that would prove Copernicus' theory correct.

Copernicus was born in Thorn (now Torun, Poland). He attended the University of Krakow. Through the influence of his uncle, he was appointed a canon (church official) of the cathedral chapter of Frauenburg (now Frombork, Poland). He used the income from this position to study law and medicine at the universities of Bologna, Padua, and Ferrara in Italy from 1496 to 1506. When he returned to Poland in 1506, he served as canon.

Faraday

Faraday, pronounced FAIR uh day, Michael (1791-1867), one of the greatest English chemists and physicists, discovered the principle of electromagnetic induction in 1831). He found that moving a magnet through a coil of copper wire caused an electric current to flow in the wire. The electric generator and the electric motor are based on this principle. Joseph Henry, an American physicist, discovered induction shortly before Faraday, but failed to publish his findings.

Faraday's work in electrochemistry led him to discover a mathematical relationship between electricity and the valence (combining power) of a chemical element. Faraday's law states this relationship. It gave the first clue to the existence of electrons. Faraday introduced ideas that would become the basis of field theory in physics. He maintained that magnetic, electric, and gravitational forces are passed from one body to another through lines of force or strains in the area between the two bodies.

Faraday was born near London. He was first apprenticed to a bookbinder. He became Sir Humphry Davy's assistant at the Royal Institution in London in 1813, and remained there for 54 years. Faraday was a popular lecturer. He gave scientific lectures for children every Christmas. The most famous of these lectures is called "The Chemical History of a Candle."

Maxwell

Maxwell, James Clerk (1831-1879), a Scottish scientist, was one of the greatest mathematicians and physicists of the 1800's. He is best known for his research on electricity and magnetism and for his kinetic theory of gases. This theory explains the properties of a gas in terms of the behavior of its molecules. Maxwell also investigated color vision, elasticity, optics, Saturn's rings, and thermodynamics, a branch of physics that deals with heat and work.

Maxwell based his work on electricity and magnetism on the discoveries of the English physicist Michael Faraday. In 1864, Maxwell combined his ideas with those of Faraday and certain other scientists and formed a mathematical theory that describes the relationship between electric and magnetic fields. Both these fields exert forces on electrically charged objects. Maxwell showed that waves in combined electric and magnetic fields, called electromagnetic waves, travel at the speed of light. In fact, Maxwell argued that light itself consists of electromagnetic waves. In the late 1880's, the German physicist Heinrich R. Hertz conducted experiments that confirmed Maxwell's theory.

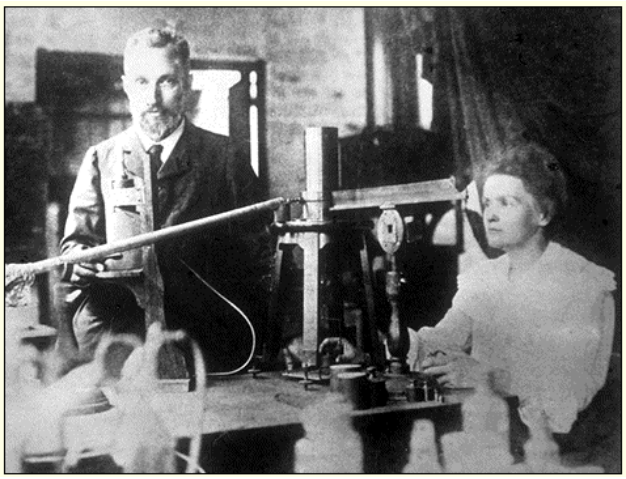
In his research on the kinetic theory of gases, Maxwell developed a statistical law that gives the distribution of velocities among molecules of a gas. He was the first scientist to use such a law to show how molecular behavior determines pressure, temperature, and other properties of a gas.

Maxwell was born in Edinburgh, Scotland, and studied at the University of Edinburgh. He graduated from Cambridge University in 1854 and taught there until 1856. He then became a professor of physics at Marischal College in Aberdeen, Scotland.

From 1860 to 1865, Maxwell taught physics at King's College in London. In 1865, he retired to his family estate and devoted his time to scientific writing. In 1871, Maxwell became the first professor of experimental physics at Cambridge and director of the newly established Cavendish Laboratory there.

Maxwell edited many research papers by the English physicist Henry Cavendish. These papers described Cavendish's discoveries about electricity. Maxwell's most famous work was Treatise on Electricity and Magnetism (1873). The key ideas of this work are often considered the basis of such developments in modern physics as the theory of relativity and the quantum theory.

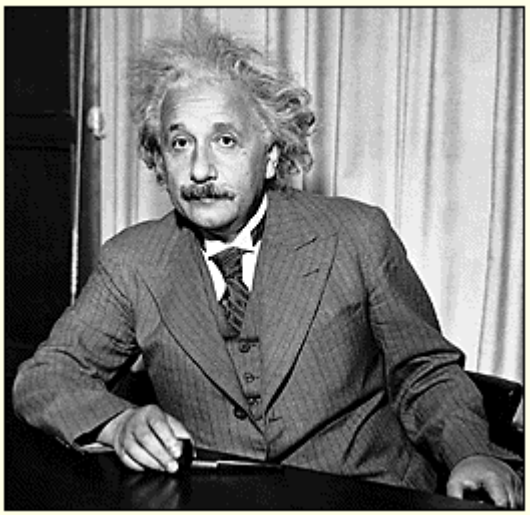
Curie



Curie, pronounced KYOO ree, Pierre, pronounced pyair (1859-1906), was a French physicist known for his work in radioactivity. He and his wife, Marie, shared the 1903 Nobel Prize in physics with another French physicist, Antoine Henri Becquerel, for research on the radioactivity of uranium. The Curies, while studying uranium, discovered two highly radioactive chemical elements, radium and polonium. A co-worker, Gustave Bemont, helped in the work with radium.

Curie was born in Paris and studied and taught physics at the University of Paris. His early work involved research on the magnetic properties of metals. The temperature at which such properties suddenly change became known as the Curie point. In 1880, Curie and his brother Jacques published a paper about their discovery of the piezoelectric properties of crystals.

Einstein



Einstein, Albert (1879-1955), was one of the greatest scientists of all time. He is best known for his theory of relativity, which he first advanced when he was only 26. He also made many other contributions to science.

Einstein's relativity theory revolutionized scientific thought with new conceptions of time, space, mass, motion, and gravitation. He treated matter and energy as exchangeable, not distinct. In so doing, he laid the basis for controlling the release of energy from the atom.

Thus, Einstein was one of the fathers of the nuclear age. Einstein's famous equation, E equals m times c-squared (energy equals mass times the velocity of light squared), became a foundation stone in the development of nuclear energy. Einstein developed his theory through deep philosophical thought and through complex mathematical reasoning. The great scientist was once reported to have said that only a dozen people in the world could understand his theory. However, Einstein always denied this report.

On Aug. 2, 1939, Einstein wrote a letter to President Franklin D. Roosevelt, explaining that it might be possible to build an atomic bomb. Einstein urged the President to provide governmental help for the study of the release of nuclear energy. Einstein also warned the President that Nazi Germany might already be trying to build an atomic bomb. His letter helped set the United States on the long, difficult, and costly path that finally led to the production of an atomic bomb in 1945.

Einstein was born on March 14, 1879, in Ulm, Wurttemberg, Germany. When Einstein was five years old, his father showed him a pocket compass. The little boy was deeply impressed by the mysterious behavior of the compass needle, which kept pointing in the same direction no matter which way the compass was turned. He later said he felt then that "something deeply hidden had to be behind things."

After attending elementary and secondary schools in Munich and in Aarau, Switzerland, Einstein studied mathematics and physics at the Swiss Polytechnic Institute in Zurich. He graduated in 1900. From 1902 to 1909, Einstein worked as an examiner at the Swiss Patent Office in Bern. This job as patent examiner allowed him much free time, which he spent in scientific investigations. Einstein became a Swiss citizen in 1905.

The papers of 1905. During this time, Einstein made three of his greatest contributions to scientific knowledge. The year 1905 was an epoch-making one in the history of physical science, because Einstein contributed three papers to Annalen der Physik (Annals of Physics), a German scientific periodical. Each of them became the basis of a new branch of physics.

In one of the papers, Einstein suggested that light could be thought of as a stream of tiny particles. This idea forms an important part of the quantum theory. In 1900, the German physicist Max K. E. L. Planck had proposed that the radiation of light occurred in packets of energy, called quanta. Einstein extended this idea by arguing that light itself consisted of quanta, which were later called photons.

Scientists before Einstein had discovered that a bright beam of light striking a metal caused the metal to release electrons, which could form an electric current. They called this phenomenon the photoelectric effect. But scientists could not explain the phenomenon as long as they assumed that light traveled only in waves. Using his theory of quanta, Einstein explained the photoelectric effect. He showed that when quanta of light energy strike atoms in a metal, the quanta force the atoms to release electrons.

Einstein's paper established the theoretical basis for the photoelectric cell, or "electric eye." This device made possible sound motion pictures, television, and many other inventions. Einstein received the 1921 **Nobel Prize** in physics for this paper on quanta.

In a second paper, titled "The Electrodynamics of Moving Bodies," Einstein presented the special theory of relativity. In this paper, he showed how the theory demonstrated the relativity of time, a previously unimaginable idea. Einstein's name is most widely known for this theory. In 1944, a manuscript copy of Einstein's famous electrodynamics paper brought a pledge to invest $61/2 million in war bonds at an auction in Kansas City. The paper was later sent to the Library of Congress in Washington, D.C. In a study published in 1905, Einstein showed the equivalence of mass and energy, expressed in the famous equation E equals m times c-squared.

The third major paper of 1905 concerned Brownian motion, an irregular motion of microscopic particles suspended in a liquid or gas. It confirmed the atomic theory of matter.

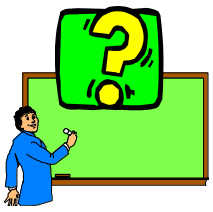
Einstein accomplished all this before he held any academic position. But in 1909, he became professor of theoretical physics at the University of Zurich in Switzerland. In 1911 and 1912, he occupied the same position at the German University in Prague. He returned in 1912 to a similar post at the Federal Institute of Technology in Zurich.

Einstein was elected to the Prussian Academy of Sciences in Berlin in 1913. When he accepted the professorship of physics at the University of Berlin in 1914, he once more assumed German citizenship. The same year, he became director of the Kaiser Wilhelm Physical Institute in Berlin.

In 1915, Einstein announced that he had developed a general theory of relativity based on his special theory. In his general theory, he attempted to express all laws of physics by covariant equations, or equations that have the same mathematical form regardless of the system of reference to which they are applied. The general theory was published in 1916.

Einstein's general theory of relativity did not completely satisfy him because it did not include electromagnetism. Beginning in the late 1920's, he tried to combine electromagnetic and gravitational phenomena in a single theory, called a unified field theory. Einstein failed to establish a unified field theory, though he spent the last 25 years of his life working on it. Toward the end of his life, he remarked that it would be worthwhile to show that such a theory did not exist. He worried that if he neither produced a theory nor showed that one was impossible, perhaps no one ever would.

Appendix I



Final Test

1. Physics is the science devoted to the study of…

a) electricity;
b) electrons;
c) matter and energy.

2. The subjects studied by physicists consist of two broad categories…

a) classical and practical physics;
b) theoretical and practical physics;
c) classical and modern physics;

3. The study of sound is called…

a) thermodynamics;
b) acoustics;
c) optics.

4. The process in which an atomic nucleus splits into two nearly equal parts is called…

a) fusion;
b) fission;
c) fluid physics.

5. Opposite charges, also called unlike charges-negative and positive-… one another.

a) attract;
b) repel;
c) push away.

6. Everything around us is made up of…

a) electrons;
b) protons;
c) atoms.

7. The heaviest element found in nature is…

a) hydrogen;
b) plutonium;
c) oxygen.

8. The … are crowded into the nucleus, an exceedingly tiny region at the center of the atom.

a) protons and electrons;
b) protons and neutrons;
c) neutrons and electrons.

9. … have no charge.

a) electrons;
b) protons;
c) neutrons.

10. The atomic number tells how many … an atom has.

a) protons;
b) electrons;
c) neutrons.

11. The atomic number of hydrogen is …

a) 1;
b) 2;
c) 3.

12. Electrons that can move from atom to atom are called …

a) charge carriers;
b) free electrons;
c) “blind” electrons.

13. Nuclei consist of protons and neutrons collectively called ...

a) atoms;
b) nucleons ;
c) electrons;

14. Magnetism and electricity make a fundamental force of the universe called electromagnetism.

a) electricity;
b) electromagnetism;
c) classical physics;

15. Each atom has a …number of subatomic particles.

a) great;
b) definite;
c) positive;

16. When a nucleus changes, it gives off ...

a) radiation;
b) atoms;
c) magnetism;

17. Current that flows steadily in one direction is called …current

a) alternative;
b) positive;
c) direct;

18. Electrical force is responsible for holding together the …from which matter is a) a) a)

a) composed.
b) atoms and molecules;
c) electrons and protons;
d) neutrons and electrons;

Appendix II

List of Standard Symbols

length - **l**
mass - **m**
time - **t**
area - **A**
volume - **V**
velocity - **v**
acceleration - **a**
density - **p**
force - **t**
moment - **m**
pressure - **p**
work - **w**
power - **p**
stress - **σ**
electric potential - **V**
electric current - **I**
electrical resistance - **R**
temperature - **t**
heat – **Q**
specific heat - **c**
latent heat - **I**

Appendix III

Irregular Verbs

Infinitive	Past Indefinite	Past Participle	
be	was,were	been	бути
bear	bore	borne	нести, переносити
become	became	become	ставати, робитися
begin	began	begun	починати
bind	bound	bound	зв'язувати
break	broke	broken	ламати
bring	brought	brought	приносити
broadcast	broadcast	broadcast	поширювати,
	broadcasted	broadcasted	передавати по радіо
build	built	built	будувати
burn	burnt	burnt	горіти
buy	bought	bought	купувати
catch	caught	caught	ловити
choose	chose	chosen	вибирати, обирати
come	came	come	приходити
cost	cost	cost	коштувати
cut	cut	cut	різати
deal	dealt	dealt	розглядати питання (with)
do	did	done	робити, виконувати
draw	drew	drawn	креслити,малювати, добувати (інформ.)
dream	dreamt	dreamed	мріяти, уявляти
drink	drank	drunk	пити
fall	fell	fallen	падати, спускатися
feed	fed	fed	годувати, постачати
feel	felt	felt	почувати, відчувати, вважати
fight	fought	fought	битися, боротися
find	found	found	знаходити, вважати
forbid	forbade	forbidden	забороняти, не дозволяти
forget	forgot	forgotten	забувати
forgive	forgave	forgiven	прощати
freeze	froze	frozen	заморожувати
get	got	got	одержувати, діставати
give	gave	given	давати, віддавати
go	went	gone	йти, ходити, рухатися
grow	grew	grown	рости, збільшуватися
have	had	had	мати, володіти
hear	heard	heard	чути, слухати
hide	hid	hid	ховати, приховувати
		hidden	
hold	held	held	тримати, мати, володіти
keep	kept	kept	зберігати, берегти
know	knew	known	знати, уміти
lay	laid	laid	класти, покласти
lead	led	led	вести, керувати
learn	learnt	learnt	учитися, учити, навчатися
	learned	learned	

leave	left	left	залишати, покидати
let	let	let	дозволяти
lie	lay	lain	лежати, бути розташованим
light	lit	lit	запалювати, світити
	lighted	lighted	
lose	lost	lost	утрачати (властивість, якість), втратити
make	made	made	робити, виробляти, створювати
mean	meant	meant	мати намір, означати, значити
meet	met	met	зустрічати
pay	paid	paid	платити
put	put	put	класти, ставити
read	read	read	читати
ring	rang	rung	дзвонити
rise	rose	risen	піднімати
run	ran	run	бігти
say	said	said	сказати
see	saw	seen	бачити
seek	sought	sought	шукати
sell	sold	sold	продавати
send	sent	sent	посилати
set	set	set	ставити
shoot	shot	shot	стріляти
show	showed	shown	показувати
shut	shut	shut	закривати
sing	sang	sung	співати
sit	sat	sat	сидіти
sleep	slept	slept	спати
speak	spoke	spoken	говорити
speed	sped	sped	поспішати
spell	spelt	spelt	писати або вимовляти по літерах
	spelled	spelled	
spend	spent	spent	витрачати, проводити (час)
spoil	spoilt	spoilt	псувати
	spoiled	spoiled	
spread	spread	spread	розгортати, поширювати
stand	stood	stood	стояти, ставити
strike	struck	struck	ударяти, бити
swim	swam	swum	плавати
take	took	taken	брати
teach	taught	taught	учити, навчати, викладати
tell	told	told	говорити, повідомляти
think	thought	thought	думати, вважати
understand	understood	understood	розуміти, мати на увазі
wake	woke	woken	будити, прокидатися
	waked	waked	
win	won	won	виграти, перемогти
write	wrote	written	писати

For personal notes:

For personal notes:

For personal notes:

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Посібник-практикум

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Physics

Надруковано з готового оригінал-макета

Підписано до друку 07.02.2011 р. Формат 60х84/8.
Умовн. друк. арк. 10.5. Обл.-вид. арк. 8.5. Наклад 300.

Видавництво Житомирського державного університету імені Івана Франка
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